

## **Water and Sanitary Services Assessment**



### **WATER SUPPLY**

Adopted by Council 13 October 2005



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# 1. Executive Summary

This assessment of water supply has been undertaken as required under Part 7 Section 125 of the Local Government Act 2002. The following paragraphs are the summary of the Council's Water Supply Assessment (Statement of Proposal) be used as part of the Councils Assessment of Water and Sanitary Services.

## 1.1 How Drinking Water is Obtained

For the purpose of making this assessment the city has been divided into two separate communities; the urban community, and the urban fringe community. The urban community includes the Christchurch City Council reticulated supply and several hospitals and schools which have independent supplies within the urban area. The urban fringe community includes supplies on the outskirts of the city. This is mostly made up of school supplies and also includes the Christchurch City Council Kainga and Brooklands supply.

All of the water supplies identified in the assessments source their water from wells into the aquifers which extend under the city and the Canterbury Plains. It is estimated that 1,300 properties or a population of 3,500 are not provided with a reticulated supply within the CCC boundaries. It is assumed that these properties all source their drinking water from private domestic wells.

## 1.2 Risk Assessment

The potential risks to each of the supplies are similar as the sources and methods of abstraction are similar. Contamination can occur at any point in the water supply system, being the source, treatment, storage or reticulation. The supplies provide different levels of treatment or mitigation of these risks resulting in differing probabilities of a contamination event occurring. The main risks identified are summarised below:

- Unsecured well heads or access hatches leading to contamination of the source or stored water
- No residual treatment provided (except for Paparua Prison) leading to increased risk of contamination of water in storage or reticulation
- Salt water intrusion into aquifers that discharge into the sea
- Loss of service due to lack of storage or backup electricity
- Insufficient backflow protection leading to backflow of contaminants into reticulation

These risks can all be treated in order to reduce the probability of a contamination event occurring. Christchurch City Council has a Public Health Risk Management Plan in place. Operators of other supplies have some preventative measures in place.

Two areas have been identified where contamination risk may present a higher potential threat to the community. There are two school supplies located in an area that is not serviced by a reticulated wastewater system and the soils are not free draining. There is therefore a higher risk of

contamination of the water supplies from septic tanks in the area. Additional care needs to be taken in the location and operation of these bores to ensure contamination does not occur.

The second higher risk area is where surface or climatic effects have an influence over the characteristics of the groundwater (non-secure groundwater). The Paparua Prison supply and some pump stations in Christchurch's North-West pressure zone are areas where this may be the case. Additional water quality testing may be necessary to monitor against any public health risks resulting from this.

### **1.3 Quality and Adequacy of Drinking Water**

All of the water suppliers have sufficient water to meet their current demand. The Council currently abstracts just over 50 million cubic metres of water a year for its reticulated supply. This represents approximately half of the water taken annually within the city boundaries. The policies and rules set out in Chapter 4 and 5 of Environment Canterbury's proposed NRRP have been developed to achieve (amongst other things) no significant long-term decline in groundwater levels as a result of abstraction, no significant long-term-decline in water quality as a result of land use activities particularly the source water to the Christchurch aquifers and, in artesian aquifers, no contamination of groundwater as a result of abstraction. These rules will ensure that the long-term sustainability of the aquifers as a water source is protected. Provided these rules and policies are adhered to, there will be sufficient quantity of high quality water to meet future demands

Christchurch is well known for the high quality of its drinking water. Because of its naturally high quality, the water does not need to be treated to meet current drinking water standards. Paparua Prison, in the Urban Fringe community is the only supply which treats its water with a chlorine solution to provide residual treatment. There is no infection incidence data suggesting that any of the sources of drinking water in either the Urban or Urban Fringe Communities have been a cause of water borne diseases.

The Christchurch City Council supply is operated by adequately trained staff available to ensure compliance with the New Zealand Drinking Water Standards 2000. The training and qualifications of the operators of non-council operated supplies have not been established. Supplies to schools are generally operated by school caretakers with only a rudimentary understanding of their supply systems. It is believed that preventative maintenance is generally not practised on school supplies. The hospital, airport and prison supplies appear to be operated by personnel knowledgeable in the operation and maintenance of water supply systems and have preventative maintenance systems in place.

### **1.4 Current and Estimated Future Demands**

The current total annual consumption from the Christchurch City Water Supply is around 50 million cubic metres per year. The Council has consented approvals with ECan to draw in the vicinity of 75 million cubic metres per annum from the aquifers serving the City. The peak demand for the whole City is around 21,000 cubic metres per hour. Accurate consumption figures are not available for the non-Council operated supplies.

Future demand for the Council operated supplies are assessed in detail in the Water Supply Asset Management Plan. The population served by the Christchurch City Water Supply is expected to increase by approximately seven percent in the next ten years. A large proportion of the peak water demands in Christchurch is for domestic irrigation. For new developments the peak demand will increase proportional to the number of households. Infill housing decreases the irrigable land area and therefore does not increase the peak demands. Only a small increase in the total annual consumption is expected because of the demand management methods that are already in place. (Page 94-98 Water Supply AMP aim to reduce consumption from 420 litres/person/day (2001) to 380 litres/person/day in 2026.)

Future demands are not expected to increase for the non-council urban suppliers. Of the urban fringe community only the Christchurch Airport and Paparua Prison are predicting an increase in demand. The increase is expected to be in the order of 10-15 percent.

The Health (Drinking Water) Amendment Bill proposes greater responsibilities with regard to the quality of water supplied. This may become too onerous for many non-council suppliers and therefore increased demand for the council provided supply may result. If all non-Council water users were to be supplied from the Council system this would increase the aquifer drawoff by approximately 1.1 million m<sup>3</sup> per annum.

### **1.5 Options to Meet the Demands**

Demand resulting from population growth can be met in the following ways:

- Construction of additional pumping stations, wells and other infrastructure to increase capacity to help meet peak demands up to agreed maximum take levels as stipulated in ECan consents.
- Implementation of demand management programmes including public education to encourage efficient water use, water loss reduction programmes, water supply modelling to identify operational changes to increase system efficiencies

Options to meet demand related to non-secure groundwater sources can be met by:

- Additional water quality testing.
- Introduction of treatment.
- Connection to Council reticulated supply (for non council supplies).
- Drilling new wells into secure sources.

Options to meet demand related to wells in areas with septic tanks and insufficient drainage

- Further investigation to establish if there is a public health risk

- Ensure well heads are secure and operated correctly
- Abandon existing supply and connect to Council reticulated supply

Options to meet demand related to the Health (Drinking Water) Amendment Bill and the greater responsibilities with regard to the quality of water supplied:

- Continue to manage own supply ensuring staff adequately trained and risk management procedures are in place.
- Employing external qualified staff to operate and maintain supply and manage risks.
- Abandon existing supply and connect to Council reticulated supply.

### **1.6 Christchurch City Council's Role in Meeting the Demands**

Most of the responsibility for ensuring water supplies are appropriate rests with the local Medical Officer of Health (Community Public Health Unit of Christchurch District Health Board) which is charged with this responsibility through the Health Act and via administration arrangements with the Ministry of Health.

The Council's role will be to ensure its own public water supply system is managed in an appropriate manner to meet compliance and community needs.

It is expected that any new infrastructure for growth will be ultimately funded by developers and Council may assist in setting up cost share areas to recover funds from future developments. The Council may also consider assistance with funding of the service where there are significant public health issues. This would be assessed on a case by case basis.

The Council may also have a future role to liaise with schemes owners and other agencies, such as Ecan, and Community Public Health to ensure appropriate water supply arrangements are in place to meet the total communities reasonable needs. This would be assessed on a case by case basis.

### **1.7 Proposals for Meeting the Demands**

Pending legislation, the Health (Drinking Water) Amendment Act is likely to require water supply owners to construct manage and monitor the supplies in a manner that will ensure acceptable levels of risk are achieved.

The Christchurch City Council, for its own supply, is already implementing plans to meet the future demands. This includes:

- Capital works programmes to provide additional infrastructure for growth.
- Demand management programmes to reduce per capita consumption.
- development of a Public Health Risk Management Plan.

- a projected increase in the operating budget to cover likely additional water testing and compliance requirements.

The Council will accept applications to connect to the supply from non council operated supplies within the reticulated area although there may be restrictions on the size of connection that can be made. Non council supplies outside the city reticulated area may also apply but permission to connect will be made on a case by case basis. Assistance with funding to connect, where there are public health issues, will also be assessed on a case by case basis.

#### **1.8 Consultation with Medical Officer of Health**

The Medical Officer of Health has been consulted in the process of making the assessment. Meetings were held with relevant staff and a draft copy of the assessment was provided for review. Comments received on the first draft have been incorporated into the assessment.

#### **1.9 Assessment of Options**

Various options to meet the demands are detailed in the draft assessment. The preferred options for addressing the issues identified have been considered as part of the Special Consultative Procedure.

## 2. Introduction

### 2.1 Purpose and Scope

This document is the water supply Sanitary Services Assessment for the Christchurch City district prepared in accordance with LGA2002 requirements. The document assesses all drinking-water supplies in the geographical area under the jurisdiction of the Christchurch City Council, including those provided by the Council as well as those water supplies provided independently. Independent supplies include the International Airport, Christchurch Public Hospital, The Princess Margaret Hospital, Paparua Prison (the men's and women's prisons), Ruapuna Park Raceway, The Groynes and a number of schools throughout the city area.

The Local Government Act 2002 requires all territorial authorities throughout New Zealand to prepare assessments of water and sanitary services, with the primary purpose to safeguard public health. The first such assessment must be completed by 30 June 2005.

The term "water and sanitary services" includes:

- Water supply (drinking water).
- Sewerage works and works for the disposal of sewage (including collection and disposal of nightsoil).
- Stormwater.
- Cemeteries.
- Crematoria.
- Public toilets.
- Waste disposal.

Part 1 of this assessment considers water supply only and Part 2 considers sewerage. These are the first two categories listed above. The remaining categories are covered by separate documents.

### 2.2 Methods

In undertaking this assessment, reference has been made to a number of other documents, Council plans and reports. Where this has been done, endnotes are provided referencing these. These documents may be referred to for a deeper understanding of this assessment.

For the purpose of this assessment, two communities have been identified and are defined in Table 1:

■ **Table 1: Definition of Communities**

Community	Location
Urban	<ul style="list-style-type: none"> <li>■ Christchurch City</li> <li>■ Christchurch Hospital</li> <li>■ Hillmorton Centre</li> <li>■ Princess Margaret Hospital</li> <li>■ Canterbury Christian College</li> <li>■ Christs College</li> </ul>

Urban Fringe	<ul style="list-style-type: none"> <li>▪ Hammersley Park School</li> <li>▪ Linwood Avenue School</li> <li>▪ Mairehau School</li> <li>▪ Richmond School</li> <li>▪ Shirley School</li> <li>▪ South Hornby School</li> <li>▪ Wainoni School</li> <li>▪ West Spreydon School</li> <li>▪ Wharenui School</li> <li>▪ Kainga and Brooklands</li> <li>▪ Christchurch International Airport</li> <li>▪ The Groynes</li> <li>▪ Halswell School</li> <li>▪ Marshland School</li> <li>▪ Ouruhia Model School</li> <li>▪ Yaldhurst School</li> <li>▪ Paparua Prison</li> <li>▪ Ruapuna Park Raceway</li> </ul>
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Small individual supplies and those supplies to communities of less than 100 people have not been included in this assessment except for Ouruhia Model School that provides water to 90 people<sup>1</sup>.

The Botanical Gardens also has a well supply providing water for irrigation, toilets and drinking fountains. The permanent population of the Gardens is approximately 25 though 1.2 million people visit the Gardens each year. The Council plans to connect all drinking water fountains at the Gardens to the City reticulation network within 2 – 3 years. No further assessment of this supply is provided in this document.

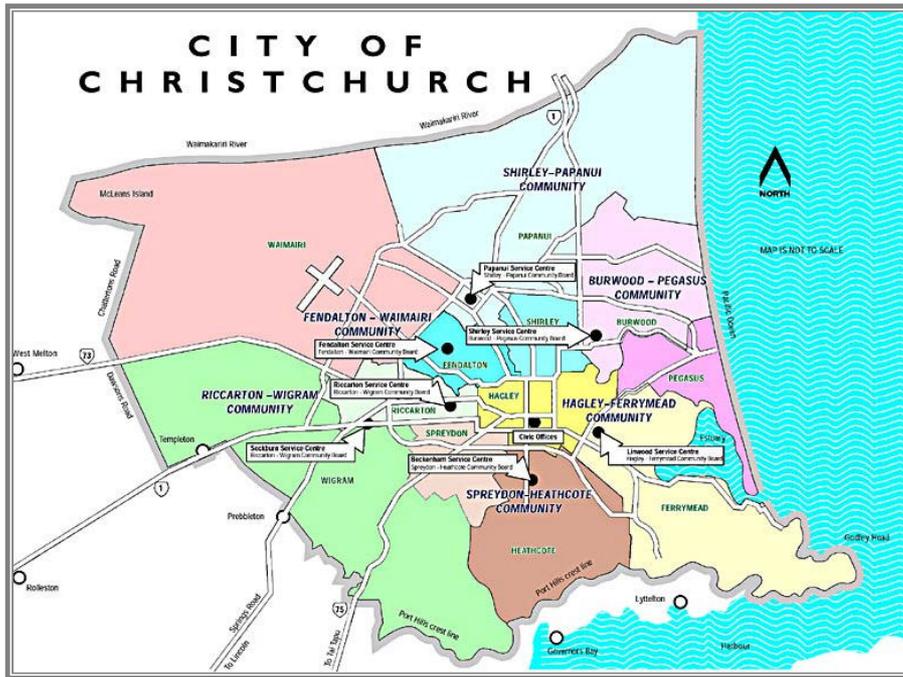
### **2.3 Outcomes**

In undertaking this assessment, the Council wants to provide its customers with an opportunity to comment on the findings and proposals forming the assessment. The Local Government Act 2002 provides for the Council to undertake a Special Consultative Procedure that will give customers that opportunity through making a submission on the assessment. A public notice will provide details of how and when a submission can be made.

### **2.4 Territorial Authority Area**

The Christchurch territorial authority area is bounded to the east by the Pacific Ocean and the estuary of the Avon and Heathcote rivers, to the south and southeast by the Port Hills and in the north by the Waimakariri River. The area is shown in Figure 1.

■ **Figure 1: Territorial Authority Area**



**2.5 Timeframe Considered**

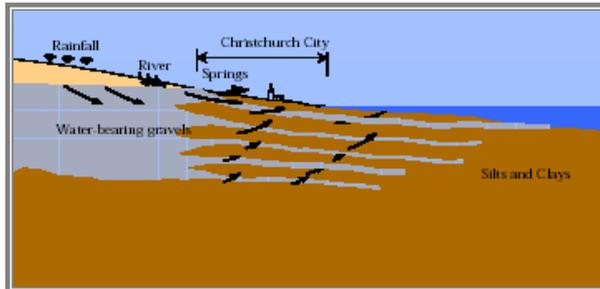
The next ten year period has been considered in the preparation of these assessments. Forecasting information has been obtained from Statistics New Zealand population growth forecasts, areas zoned or indicated for development, current demand trends and existing reports.

### 3. Description of Water Services

#### 3.1 Water Sources

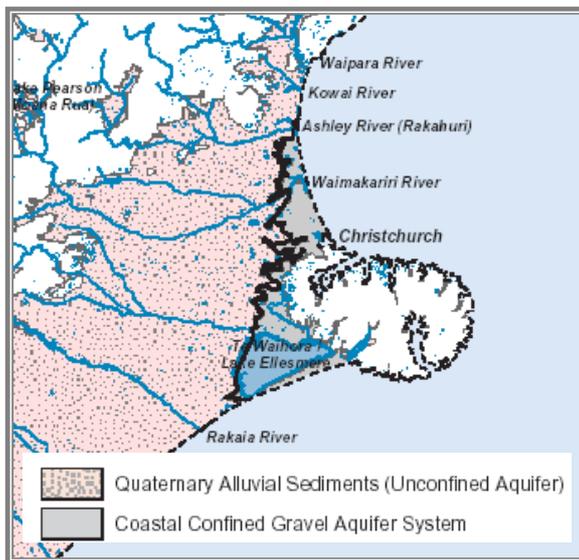
The communities identified in this assessment source water from bores drilled into a series of aquifers that underlie the city and the Canterbury Plains. Figure 2 indicates in pictorial form the location of these aquifers and the source of the water within them.

##### ■ Figure 2: Christchurch's Aquifers



(Source: Christchurch City Council: Water Supply Asset Management Plan 2002)

- *The aquifers receive water from rainfall and rivers. The water passes through gravel beds and sands that were deposited during the formation of the Canterbury Plains by glaciers and rivers.*



(Source: Environment Canterbury: Proposed Natural Resources Regional Plan)

#### 3.2 Overall Adequacy of Supply

An adequate water supply is one that provides water on demand whenever required at sufficient pressure.

Environment Canterbury (ECan) states, in its proposed Natural Resources Regional Plan (NRRP)<sup>2</sup>, that groundwater development can cause loss in surface water flow either through direct stream depletion effect, or by wide-scale lowering of aquifer water levels / pressures that then deplete

spring flows. Where aquifers flow to the sea, abstraction can also result in salt-water contamination if the source is not managed well. For the Christchurch-West Melton groundwater system, if groundwater levels in the aquifer system are maintained high enough to sustain adequate minimum flows in the Avon / Ōtakaro and Heathcote rivers, then widespread pressure reversal and associated lateral salt-water intrusion are unlikely to arise. However, there is still a risk of localised downward contamination by seawater as a result of excessive pumping in areas adjacent to the coast.

Environment Canterbury is responsible for the allocation of water from the aquifers. A resource consent is required from ECan in order to take water from the aquifers (except for individuals taking water permitted under the regional rules).

Issues relating to the protection, use and development of the region's water resources are addressed in Chapter 4: Water Quality and Chapter 5: Water Quantity of Environment Canterbury's proposed Natural Resources Regional Plan (NRRP). The policies and rules set out in Chapter 4 and 5 of Environment Canterbury's proposed NRRP have been developed to achieve (amongst other things) no significant long-term decline in groundwater levels as a result of abstraction, no significant long-term decline in water quality as a result of land use activities particularly the source water to the Christchurch aquifers and, in artesian aquifers, no contamination of groundwater as a result of abstraction. These rules will ensure that the long-term sustainability of the aquifers as a water source is protected. Provided these rules and policies are adhered to, there will be sufficient quantity of high quality water to meet future demands.

### 3.3 Urban Water Services

#### 3.3.1 Sources and Demand

##### Christchurch City

The source of the Christchurch City Council reticulated water supply is the aquifers as described above. The individual sources of supply are detailed in Table 2.

■ **Table 2: Sources – Urban (Christchurch City)**

Component	Code	Name
	CHR001	Christchurch
		Local Authority: Christchurch City Council
<b>Zone:</b>	<b>CHR001CE</b>	<b>Central Christchurch</b>
Plant:	TP00179	Central Christchurch
Source:	G00118	Central CHCH, Aquifer 1
Source:	G00119	Central CHCH, Aquifer 2
Source:	G00120	Central CHCH, Aquifer 3
Source:	G00121	Central CHCH, Aquifer 4
<b>Zone:</b>	<b>CHR001NW</b>	<b>North-West Christchurch</b>
Plant:	TP00180	NW CHCH, Treated
Source:	G00122	NW CHCH, Aquifer 1
Plant:	TP00181	NW CHCH, Untreated
Source:	G00123	NW CHCH, Aquifer 2
Source:	G00124	NW CHCH, Aquifer 3
Source:	G00125	NW CHCH, Aquifer 5

<b>Component</b>	<b>Code</b>	<b>Name</b>
	<b>CHR001</b>	<b>Christchurch</b>
Plant:	TP00182	Parklands
Source:	G00126	<i>Parklands, Aquifer 2</i>
Source:	G00127	<i>Parklands, Aquifer 4</i>
<b>Zone:</b>	<b>CHR001PA</b>	<b>Parklands</b>
Plant:	TP00182	Parklands
Source:	G00126	<i>Parklands, Aquifer 2</i>
Source:	G00127	<i>Parklands, Aquifer 4</i>
<b>Zone:</b>	<b>CHR001RI</b>	<b>Riccarton</b>
Plant:	TP00185	Riccarton
Source:	G00130	<i>Riccarton, Aquifer 1</i>
Source:	G00131	<i>Riccarton, Aquifer 2</i>
Source:	G00132	<i>Riccarton, Aquifer 3</i>
<b>Zone:</b>	<b>CHR001RP</b>	<b>Rocky Point</b>
Plant:	TP00184	Rocky Point
Source:	G00129	<i>Rocky Point, Aquifer 1</i>
<b>Zone:</b>	<b>CHR001WE</b>	<b>West Christchurch</b>
Plant:	TP00183	West Christchurch
Source:	G00128	<i>West CHCH, Aquifer 2</i>

(Source: Water Information New Zealand on the Web, as extracted from the National WINZ database)

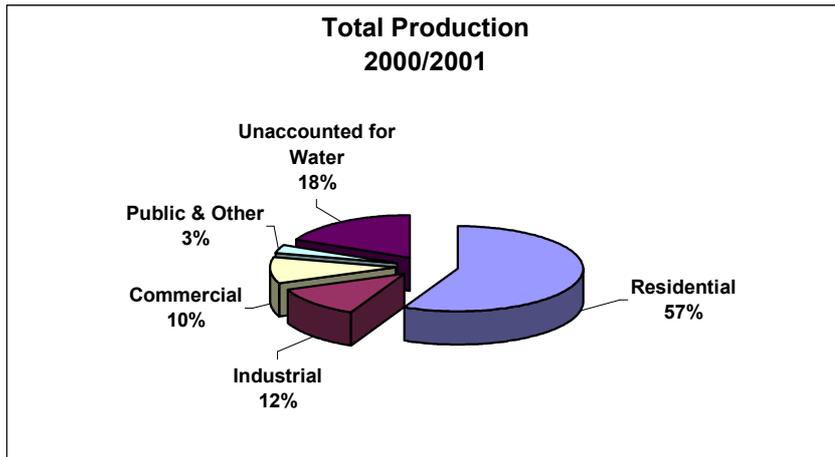
The population served by the reticulated supply in the 2003 / 2004 year in the Urban Community was approximately 328,000. The number of people estimated to be not supplied by a reticulated water supply is 3,500. This is based on 1,300 rural rated properties averaging 2.5 people per household.

The City Council has designed its supply to meet the demand of the community it supplies, with storage capacity provided primarily for hill areas. Storage is provided in reservoirs and tanks at 32 sites totalling 124,000 m<sup>3</sup> (124 million litres). This storage represents 18 hours' supply of average daily usage or 5.5 hours' supply at peak hour usage. The aquifers also provide storage capacity.

The average daily demand per person for water during 2000 / 2001 was approximately 490 litres. Comparing the demand per person during the winter period with the peak daily demand per person gives a clear indication of the large variation in demand. The winter period demand was approximately 295 litres per person while the peak demand was approximately 1,100 litres per person. Much of this difference can be attributed to Christchurch's climate during summer when a considerable proportion of the water is used for irrigation.

The annual demand for water during 2000/01 totalled approximately 50,000 million litres representing about half of the water used in the Christchurch District. The breakdown of this demand is shown in Figure 3.

■ **Figure 3: Water Allocation**



Future demand for water is determined by a number of factors including population, household composition, urban density, urban development, industrial and commercial development, public attitudes and education programmes, pricing, garden irrigation practices, types of water fittings used and types of appliances / facilities used by water users (eg. dishwashers, pools, etc).

The projected population increase between 2001 and 2016 is approximately 8% for Christchurch for medium population growth<sup>3</sup>. The population in 2015 based on this would be about 352,000.

The number of households in Christchurch is projected to increase much faster than population because of the trend to fewer persons per household. There is also a trend in the Christchurch urban area toward infill housing thus reducing the amount of irrigable land. Christchurch City Council has therefore assumed that infill housing will not increase total peak water requirements. New greenfields development will, on the other hand, increase peak water requirements<sup>4</sup>.

It is expected that the combined effect of smaller households and reduced average lot sizes will, however, result in a small increase in the annual water requirements per person.

The projected increase in new dwelling units in Christchurch between 2001 and 2026 is approximately 24,800. This is made up 13,300 in greenfields and 11,500 in infill. This growth is expected to be mainly in the northeast and southwest<sup>4</sup>.

Christchurch City Council has assumed that commercial growth will be in proportion to the population increase. With education of the population, changing attitudes about water use and trends to using appliances that use less water, Christchurch City Council expects that the increased demand for water will be relatively small over the next 10 years. It expects that the existing abstraction from the Christchurch West Melton Aquifer System can be maintained at present levels of approximately 50 million cubic metres annually<sup>4</sup> within this period.

To help minimise increases in demand for water, Christchurch City Council has adopted a demand management strategy. Strategies currently practised by the Council include public education on water conservation and efficiency, applying restrictions on water use, providing incentives to reduce water use (eg. pricing) and leak detection. Other, less cost-effective strategies include retrofitting of water fittings, water and wastewater audits, home leak detection and repairs, rainwater reuse and effluent reuse. These may be adopted as necessary.

To provide for the projected growth in the Christchurch City Council territorial authority area, the Council expects to increase infrastructure as summarised in Table 3.

■ **Table 3: Proposed Infrastructure Development**

Year	Increase in capacity	Pump stations and reservoirs	Reticulation
2005	Increase well and pumping capacity		New water mains as required (2005 – 2015)
2006	Increase well and pumping capacity		
2007		New pump station and reservoir system for growth in hill area	
2008	Increase well and pumping capacity		
2010	New pump station		
2012	Increase well and pumping capacity	New pump station and reservoir system for growth in hill area	
2015	New pump station		

The Council's customer research suggests that customers are prepared to accept quite frequent restrictions for the purposes of protecting the environment<sup>5</sup>. However, it was noted that the restrictions referred to did not reduce consumption greatly when they were applied in 1998. More severe restrictions to achieve greater reductions in consumption of the order of 10% – 30% would probably be less popular<sup>5</sup>.

The Council has assumed that rules that will be adopted in the proposed NRRP will allow continued takes from the aquifers at current demand with a reliability of one year in 20 (ie. restrictions would not occur more frequently than once in 20 years). Demand for growth will be met by new wells outside the constraint areas defined in the proposed NRRP<sup>5</sup>. The proposed NRRP also indicates that the annual consented amount for the Council's water take from the aquifers will be approximately 75,000 million litres.

#### Other Suppliers

The sources and populations served by the other water suppliers in the Urban Community are shown in Table 4 and Table 5.

■ **Table 4: Sources & Populations Served – Urban (Hospitals)**

Water supplier (code)	Sources			Population served
	Component	Code	Name	
<b>Christchurch Hospital (CHR005)</b>	<b>Zone:</b>	<b>CHR005CH</b>	<b>Christchurch Hospital</b>	<b>1,200</b>
	Plant:	TP01952	Christchurch Hospital	
	Source:	G01139	Christchurch Hospital Bore	

Water supplier (code)	Sources			Population served
	Component	Code	Name	
	Plant:	TP02045	Pathology Building	400
	Source:	G01223	<i>Pathology Building Bore</i>	
	Zone:	<b>CHR005PA</b>	<b>Pathology Building</b>	
	Plant:	TP01952	Christchurch Hospital	
	Source:	G01139	<i>Christchurch Hospital Bore</i>	
	Source:	G01223	<i>Pathology Building Bore</i>	
<b>Hillmorton Centre (HIL002)</b>	Zone:	<b>HIL002HI</b>	<b>Hillmorton Centre</b>	<500
	Plant:	TP01783	Hillmorton Centre	
	Source:	G01024	<i>Hillmorton Centre Bore</i>	
<b>The Princess Margaret Hospital (PRI001)</b>	Zone:	<b>PRI001PM</b>	<b>Princess Margaret Hospital</b>	600
	Plant:	TP01949	Princess Margaret Hospital	
	Source:	G01135	<i>Princess Margaret Hospital Bore</i>	

(Source: [www.drinkingwater.org.nz/supplies/SupplyCysForLA.asp](http://www.drinkingwater.org.nz/supplies/SupplyCysForLA.asp). Population figures supplied by hospitals)

The following should be noted with respect to these water suppliers:

- Christchurch Hospital also takes its water from the City reticulation network.
- The Princess Margaret Hospital has a connection to the City reticulation network for fire sprinklers.
- Hillmorton Centre currently takes water from the bore source but advises that the supply source will be transferred to the City reticulation network in the near future.

■ **Table 5: Sources & Populations Served – Urban (Schools)**

Water supplier (code)	Sources			Population served
	Component	Code	Name	
<b>Canterbury Christian College (CAN004)</b>	Zone:	<b>CAN004CA</b>	<b>Canterbury Christian College</b>	163
	Plant:	TP01006	Canterbury Christian College	
	Source:	G00613	<i>Canterbury Christian College Well</i>	
<b>Christs College (CHR006)</b>	Zone:	<b>CHR006CH</b>	<b>Christs College</b>	350
	Plant:	TP02311	Christs College	
	Source:	G01398	<i>Christs College Well</i>	
<b>Hammersley Park School (HAM005)</b>	Zone:	<b>HAM005SC</b>	<b>Hammersley Park Primary School</b>	156
	Plant:	TP00990	Hammersley Park Primary School	
	Source:	G00602	<i>Hammersley Park Primary School Well</i>	
<b>Linwood Avenue School (LIN005)</b>	Zone:	<b>LIN005SC</b>	<b>Linwood Ave Primary School</b>	360
	Plant:	TP00979	Linwood Ave Primary School	

Water supplier (code)	Sources			Population served
	Component	Code	Name	
	Source:	G00591	Linwood Ave Primary School Well	
<b>Mairehau School (MAI001)</b>	<b>Zone:</b>	<b>MAI001SC</b>	<b>Mairehau Primary School</b>	<b>400</b>
	Plant:	TP01010	Mairehau Primary School	
	Source:	G00617	Mairehau Primary School Well	
<b>Richmond School (RIC003)</b>	<b>Zone:</b>	<b>RIC003SC</b>	<b>Richmond Primary School</b>	<b>130</b>
	Plant:	TP00987	Richmond Primary School	
	Source:	G00599	Richmond Primary School Well	
<b>Shirley School (SHI002)</b>	<b>Zone:</b>	<b>SHI002SC</b>	<b>Shirley Primary School</b>	<b>260</b>
	Plant:	TP00989	Shirley Primary School	
	Source:	G00601	Shirley Primary School Well	
<b>South Hornby School (SOU003)</b>	<b>Zone:</b>	<b>SOU003SC</b>	<b>South Hornby Primary School</b>	<b>320</b>
	Plant:	TP00981	South Hornby Primary School	
	Source:	G00593	South Hornby Primary School Well	
<b>Wainoni School (WAI060)</b>	<b>Zone:</b>	<b>WAI060SC</b>	<b>Wainoni Primary School</b>	<b>160</b>
	Plant:	TP00993	Wainoni Primary School	
	Source:	G00605	Wainoni Primary School Well	
<b>West Spreydon School (WES006)</b>	<b>Zone:</b>	<b>WES006SC</b>	<b>West Spreydon Primary School</b>	<b>300</b>
	Plant:	TP00984	West Spreydon Primary School	
	Source:	G00596	West Spreydon Prim. School Well	
<b>Wharenui School (WHA044)</b>	<b>Zone:</b>	<b>WHA044SC</b>	<b>Wharenui Primary School</b>	<b>200</b>
	Plant:	TP02192	Wharenui Primary School	
	Source:	G01317	Wharenui Primary School Bore	

(Source: [www.drinkingwater.org.nz/supplies/SupplyCysForLA.asp](http://www.drinkingwater.org.nz/supplies/SupplyCysForLA.asp). Population figures supplied by schools)

A number of these schools also have connections to the City reticulated water supply network. The details of these are provided below:

- Canterbury Christian College has a well-sourced supply to one building only and the remainder of the school takes water from the City reticulation network. The school advises that the well supply will be abandoned in the very near future.
- Christs College takes water from 3 wells. Two wells are used for domestic water supply while the third well is used for the swimming pool and for irrigation. A connection to the City reticulation network is available as a backup if required.

- Hammersley Park School has indicated that its supply is from the city reticulation network and not from a well.
- Linwood Avenue School takes water from both a well and the City reticulation network. The City reticulation supplies water for 2 taps and the administration block only.
- Mairehau School takes water from the City reticulation network for fire fighting purposes but uses a well supply for all other purposes.
- Water for Shirley Primary School is taken from a well with a separate supply from the City reticulation network for fire fighting purposes.
- At South Hornby School the principal supply is from a well but one block and 2 separate buildings are supplied with water from the City reticulated supply.
- Wainoni School takes water from the City reticulation network for fire fighting purposes but uses a well supply for all other purposes.
- West Spreydon Primary School has indicated that it sources its water from the City reticulation network, not from a well.
- Wharenui School takes water from the City reticulation network and from its own well. The City reticulation network provides water for fire fighting as well as for other general purposes. The well supply is used in the two school blocks and the hall kitchen.

The hospitals and schools within the Urban Community are currently able to meet the demand for water that they face from their own aquifer sources. The schools do not have as great a demand for water as do the hospitals, as they are required only to provide for their needs during the normal school period. This would include drinking water, water for toilet blocks and for irrigation. Some schools may also need to provide for swimming pools. In contrast, hospitals are required to meet the demands associated with people who are working 24 hours a day and for people who are resident.

A summary of the storage provided by each water supplier and the supplier's assessment of its adequacy is provided in Table 6.

■ **Table 6: Storage and Adequacy – Urban**

Supplier	Storage provided	Adequacy
Christchurch Hospital	Secure fibreglass and stainless steel tanks	Adequate
Hillmorton Centre	Secure concrete water tower	Adequate
The Princess Margaret Hospital	Secure concrete water tower	Adequate
Canterbury Christian College	Concrete water tower	15,000 L. 2- 3 days' supply
Christ's College	Secure PVC header tank	Inadequate storage. Reticulated supply for backup
Hammersley Park School	School advises that well source is not used for drinking water	
Linwood Avenue School	Covered plastic storage tanks	Adequate
Mairehau School	One small storage tank above staff toilets	Inadequate
Richmond School	Plastic storage tank	Inadequate
Shirley School	Two concrete tanks	Just adequate
South Hornby School	Two secure concrete storage tanks	7,200 L. Adequate
Wainoni School	Covered concrete storage tank	Inadequate

Supplier	Storage provided	Adequacy
West Spreydon School	School advises that well source is not used for drinking water	
Wharenui School	Two covered, secured storage tanks	Adequate

(Sources: Water suppliers)

Future demand for water is not expected to increase for these users. The arguments for this have been presented in Section 3.3.1. Should demand increase, the users have the option of connecting to the City reticulated water supply network or developing new wells of their own. The Health (Drinking Water) Amendment Bill proposes greater responsibilities with regard to the quality of water supplied for those users who supply their own water. It is therefore likely that connecting to the City reticulation will be the preferred option.

### 3.3.2 Abstraction, Treatment and Reticulation

#### Abstraction

Abstraction of water from the aquifer sources differs slightly for the various water suppliers. Table 7 summarises how water is abstracted prior to treatment and / or delivery into the reticulation pipework. Note that the term

■ **Table 7: Abstraction Methods – Urban Community**

Water suppliers	Abstraction from own sources
Christchurch City	Pumped from wells into pipe network or to storage reservoirs. Wells made safe from tampering.
Christchurch Hospital	Pumped from wells to fibreglass and stainless tanks. Facilities made safe from tampering.
Hillmorton Centre	Pumped from well to concrete water tower. Facilities made safe from tampering.
The Princess Margaret Hospital	Pumped from well to concrete water tower. Facilities made safe from tampering.
Canterbury Christian College	Pumped from well to concrete water tower. Well made safe from tampering.
Christ's College	Pumped from wells to PVC header tank. Facilities made safe from tampering.
Hammersley Park School	<i>School advises that well source is not used for drinking water</i>
Linwood Avenue School	Pumped from well to covered plastic storage tanks. Well made safe from tampering.
Mairehau School	Pumped from well directly into water supply pipework. One small storage tank. Well made safe from tampering.
Richmond School	Gravity supply from well to plastic storage tank.
Shirley School	Gravity supply from unsecured well to 2 concrete tanks.
South Hornby School	Pumped from well to 2 concrete storage tanks. Facilities made safe from tampering.
Wainoni School	Gravity supply from well to covered concrete storage tank. Well made safe from tampering
West Spreydon School	<i>School advises that well source is not used for drinking water</i>
Wharenui School	Gravity supply from well to 2 covered storage tanks made safe from tampering.

(Sources: Water suppliers)

### Treatment

The aquifer supply source is of high quality. This is discussed further in Section 3.3.3. As it is of a high quality, little if any treatment is required. Some water suppliers do provide some treatment. The treatment provided by Council and independent suppliers is summarised in Table 8.

■ **Table 8: Treatment – Urban Community**

Water supplier	Treatment of water from own sources
Christchurch City	Adjustment to pH with undertaken at Farrington and Burnside pumping stations
Christchurch Hospital	Filters (not considered by MoH to offer any value in way of treatment)
Hillmorton Centre	Disinfected with chlorine as required
The Princess Margaret Hospital	None
Canterbury Christian College	None
Christ's College	Sand filter holding tank
Hammersley Park School	School advises that well source is not used for drinking water
Linwood Avenue School	None
Mairehau School	None
Richmond School	None
Shirley School	None
South Hornby School	None
Wainoni School	None
West Spreydon School	School advises that well source is not used for drinking water
Wharenui School	Filtered

(Sources: Water suppliers)

Christchurch City Council treats the water for prevention of corrosion to the reticulation and to meet the Drinking Water Standards for New Zealand, 2000 (DWSNZ: 2000). The Farrington and Burnside stations, where this treatment is carried out, supply water to between 20% and 30% of the northwest zone of the reticulation system. The northwest zone represents approximately 20% of the total reticulated water supply.

### Reticulation

#### *Christchurch City*<sup>6</sup>

Christchurch City Council operates 53 primary pumping stations used to extract water from 166 wells drilled in to the 5 aquifers. After extraction from the wells, the water is delivered into a vast network of pipes. The total length of this network of pipes is 2,993km. Some of these pipes feed water to a total of 51 storage reservoirs providing a capacity of 104,000 m<sup>3</sup>. In some places the pressure of water in the pipelines is boosted to provide a satisfactory water pressure at the customers' points of supply. This pressure boosting is carried out at 27 secondary pumping stations. The pumps take water from a total of 24 suction tanks providing a storage capacity of 20,000 m<sup>3</sup>. Standby plant fuelled by diesel is installed to operate the system in the event of power failure.

The Council owns the pipe network to the boundary of properties from which point the property owners take their water supply. The Council's pipework ends at an isolating valve usually installed on the property side of a water meter on the property boundary.

The main pipe network is made from cast iron, fibrolite or plastic. Approximately 95% of the cast iron pipe is unlined the remainder being lined with cement mortar. The pipes that connect the main pipelines to domestic consumers are generally 15mm diameter, but may vary so that the same flow is available for each connection irrespective of the size of the main pipe and the local supply pressure. Domestic connections to the Council's pipework are designed to make sure that water cannot flow back into the Council's pipe system as this could result in the water becoming contaminated. Valves are installed in the network of pipes so that when a section of pipe has to be isolated for replacement or repairs, the number of properties affected by stopped water supply is small.

Fire hydrants are installed on the water mains to provide water for fire fighting.

The water supply network is controlled from a central room. As the pressure in the system falls and rises around the district, pumps are switched on and off by a combination of automatic and manual controls.

### Other Suppliers

Other suppliers have a variety of reticulation pipework delivering water from their sources. This is summarised in Table 9.

■ **Table 9: Reticulation – Urban Community**

Water supplier	Pipe material	Year of installation
Christchurch Hospital	Copper	1974 and later
Hillmorton Centre	Asbestos cement	1935
The Princess Margaret Hospital	Asbestos cement	1958
Canterbury Christian College	Steel	pre 1984
Christ's College	Clay to sand holding tank	circa 1910
Hammersley Park School	<i>School advises that well source has been abandoned and is not used for drinking water</i>	
Linwood Avenue School	Galvanised steel	circa 1928
Mairehau School	Galvanised steel and plastic	circa 1954
Richmond School	Unknown	Unknown
Shirley School	Galvanised steel	circa 1916
South Hornby School	Steel and plastic	1962
Wainoni School	Steel	pre 1964
West Spreydon School	<i>School advises that well source is not used for drinking water</i>	
Wharenui School	Polyethylene	pre 1950

(Sources: Water suppliers)

### 3.3.3 Water Quality and Ministry of Health Grading

The Ministry of Health assesses the quality of water supplied for drinking water purposes and grades all major water supplies "to provide a public statement of the extent to which a community water supply achieves and can ensure a consistently safe and wholesome product"<sup>7</sup>. This grading considers where the water comes from, how it is treated, the condition of the pipe network, its management and the quality of water in the network. The grading relates to compliance with the DWSNZ: 2000.

Except for Christchurch Hospital, the Ministry of Health has not verified Council and non-Council water supplies sourced from the aquifers as secure. The Christchurch Hospital source has been graded as secure. Because of the status afforded these supplies by the Ministry of Health, there may be some pressure on the Council to supply water in the future. Forthcoming changes to legislation and the requirement to provide Public Health Risk Management Plans may also have a similar effect. However, it is noted that many supplies have been recognised by the Ministry of Health as non-verified “secure” groundwater and that there is probably little intention of users of these supplies of having the supplies verified as secure.

Information on all supplies has been sourced from the supply operators. The accuracy of information provided by the non-Council supply operators has not been verified by site visits. Non-Council supplies to schools are simple and are generally operated by caretakers. The qualifications of these operators have not been established but it is believed that they only have a rudimentary understanding of their supply systems. It is also believed that preventative maintenance is generally not practised. In contrast, the hospital, airport and prison supplies appear to be operated by personnel knowledgeable in the operation and maintenance of water supply systems. These larger systems also appear to have preventative maintenance practices underway.

The quality of the water supplies in the Urban Community, based on gradings and assessments by the Ministry of Health, are detailed below.

### Christchurch City

The water supplied by Christchurch City Council passes through aquifers containing gravels and sands. These gravels and sands filter the water. In addition to this, the condition of the aquifers does not allow microbiological organisms to exist and therefore water that comes from these aquifers is of very high microbiological quality.

The water supply provided by the Council is one of 46 supplies in New Zealand that is untreated and sourced from groundwater that are not verified by the Ministry of Health as secure. The Ministry of Health has, however, granted a temporary “secure” status to the source.

For the year to June 2004 the Council sourced its water from all 5 aquifers in the following proportions:

Aquifer	Proportion
1st	33%
2nd	23%
3rd	6%
4th	31%
5th	7%
	100%

The Council is currently working through the criteria for demonstrating the security of the groundwater sources. To date it has been demonstrated that *E.coli* is absent from the groundwater sources and the well heads are secure. Further work is underway to demonstrate that the groundwater is not directly affected by surface or climate influences. Investigations to date

indicate that there may be some pump stations in the North-West Pressure Zone that draw from unconfined aquifers. Options to address this will be developed as necessary.

The Council believes that the quality of water is excellent for supply to consumers and takes cognisance of the wishes of its community that, in a survey undertaken in 2000, indicated a strong preference for unchlorinated water<sup>8</sup>. Chlorination is the most common method used to disinfect drinking water in New Zealand (67 percent of population are served by chlorinated supplies)<sup>6</sup>.

Chlorine disinfection leaves a trace of chlorine in the water for further disinfection if contamination enters the water system after the treatment point. This trace level of chlorine is considered by many people to be unpleasant and is not preferred over the taste of the untreated water from the Christchurch aquifers. The Council has carefully assessed the option of introducing chlorine as a disinfectant to the water supply and has concluded that there is no need to do so. The Ministry of Health also believes that chlorination of a groundwater source is not necessary provided the groundwater source is secure. The Ministry, however, considers such a source, without disinfection, as presenting a higher risk to consumers than one that is disinfected.

The Ministry of Health in its annual review of the microbiological and chemical quality of drinking water in New Zealand for 2002 concluded that microbiological compliance of secure groundwater supplies compared favourably with other forms of treatment<sup>9</sup>. This review also showed that the 2 supplies from secure groundwater, serving populations of 100,000 or more, fully complied with treatment requirements<sup>10</sup>. One of these supplies is the artesian aquifer source in the Hutt Valley and the other is the Christchurch source.

The Ministry of Health grading for Christchurch City Council's supply is currently Ba. This is the highest grading that the supply can obtain. Higher gradings require the use of chlorine to disinfect the system. The first letter indicates the grading for the water source and the treatment that the water receives before it enters the pipe network. The second letter grades the water quality and the systems in place to minimise risk to the consumer of unsafe water. This grading level for drinking water supplied by the Council, is acceptable to the Ministry of Health.

### **Non-Council Supplies**

#### ***Christchurch Hospital***

Christchurch Hospital takes its water from 2 bores, each supplying both the hospital and the pathology building. The Ministry of Health has graded these supplies as secure under the DWSNZ: 2000<sup>11</sup>. The Canterbury District Health Board (DHB) audited its records in 2002 and determined that the distribution zone complied with the bacteriological requirements of the DWSNZ: 2000<sup>12</sup>.

#### ***Hillmorton Centre***

One bore supplies drinking water to this centre. The Ministry of Health has also not graded this supply though it does recognise the bore as a non-verified "secure" groundwater supply<sup>14</sup>. The Canterbury DHB audited its records in 2002 and determined that the distribution zone complied with the bacteriological requirements of the DWSNZ: 2000<sup>12</sup>.

***The Princess Margaret Hospital***

One bore supplies drinking water to this hospital. The Ministry of Health has also not graded this supply though it does recognise the bore as a non-verified “secure” groundwater supply<sup>14</sup>. The Canterbury DHB is currently seeking a “secure” status for this source. The DHB did not undertake surveillance of this water supply during 2002. During 2002 the distribution zone did not comply with the DWSNZ: 2000 as it was not monitored on sufficient days of the week and there was inadequate monitoring for the presence of lead<sup>13</sup>.

***Canterbury Christian College***

This college takes water from a well for one building that has not been graded by the Ministry of Health though it does recognise the source as a non-verified “secure” groundwater supply<sup>14</sup>. Three separate classrooms are connected to the City reticulation system.

The Canterbury DHB did not undertake monitoring of the well-sourced water supply during 2002 and the Ministry of Health records that during 2002 the distribution zone did not comply with the DWSNZ: 2000 as it was not monitored on sufficient days of the week and the maximum interval between successive monitoring samples was too long<sup>12</sup>.

The school advises that it will abandon the well source in the near future.

***Christs College***

This college takes water from 3 wells that have not been graded by the Ministry of Health. Two wells are used for domestic water supply while the third well is used for the swimming pool and for irrigation. A connection to the City reticulation system is available as a backup if required.

The Canterbury DHB did not undertake monitoring of the water supply during 2002 and the Ministry of Health records that during 2002 the distribution zone did not comply with the DWSNZ: 2000 as it was not monitored on sufficient days of the week and the maximum interval between successive monitoring samples was too long<sup>12</sup>.

***Hammersley Park School***

The Ministry of Health *Register of Community Drinking-Water Supplies in New Zealand 2003 Edition* records that this primary school takes water from a well that has not been graded by them though it does recognise the source as a non-verified “secure” groundwater supply<sup>14</sup>. The school has advised that its supply is from the City reticulation system and not from a well.

The Ministry of Health records that during 2002, water sourced from the well in the distribution zone was not monitored for *E.coli*<sup>12</sup>.

***Linwood Avenue School***

This primary school takes water from both a well and the City reticulation system. The Ministry of Health has not graded the well-sourced water supply. The Ministry has recorded that the source is a non-verified “secure” groundwater supply<sup>14</sup>. For the 2002 year, the Ministry of Health records that the distribution zone complied with the requirements of the DWSNZ: 2000 but that the maximum interval between successive monitoring samples was too long<sup>12</sup>.

**Mairehau School**

This primary school takes water from the City reticulation system for fire fighting purposes but uses a well supply for all other purposes. The Ministry of Health has not graded the well-sourced supply but does record that the source is a non-verified “secure” groundwater supply<sup>14</sup>.

During 2002 the distribution zone fully complied with the requirements of the DWSNZ: 2000<sup>12</sup>.

**Richmond School**

Richmond Primary School takes water from a well that has not been graded by the Ministry of Health but it does record that the source is a non-verified “secure” groundwater supply<sup>14</sup>. The Ministry of Health has also recorded that during 2002, water from the distribution zone was not monitored for *E.coli*<sup>12</sup>. The school has advised that it is planning to change its supply source to the City reticulation network.

**Shirley School**

Water for this primary school is taken from a well with a separate supply from the City reticulation system for fire fighting purposes. The Ministry of Health has not graded the well-sourced water supply that serves this primary school but does recognise the source as a non-verified “secure” groundwater supply<sup>14</sup>. For the 2002 year, the Ministry of Health records that the distribution zone complied with the requirements of the DWSNZ: 2000 but that the maximum interval between successive monitoring samples was too long<sup>12</sup>.

**South Hornby School**

This primary school takes water for its principal supply from a well that has not been graded by the Ministry of Health. The Ministry has recorded that the source is a non-verified “secure” groundwater supply<sup>14</sup>. The Canterbury DHB did not undertake monitoring of the water supply during 2002 and the Ministry of Health records that during 2002 the distribution zone did not comply with the DWSNZ: 2000 as it was not monitored on sufficient days of the week and the maximum interval between successive monitoring samples was too long<sup>12</sup>.

One block and 2 separate buildings within the school are supplied with water from the City reticulated supply.

**Wainoni School**

This primary school takes water from the City reticulation system for fire fighting purposes but uses a well supply for all other purposes. The Ministry of Health has not graded the well-sourced supply but does record that the source is a non-verified “secure” groundwater supply<sup>14</sup>.

The Ministry of Health has also recorded that during 2002, water from the distribution zone was not monitored for the bacterium *E.coli*<sup>12</sup>.

**West Spreydon School**

West Spreydon Primary School has indicated that it sources its water from the City reticulation system though the Ministry of Health records that water is taken from a well. The Ministry of

Health has not graded this well source but it recognises the source as a non-verified “secure” groundwater supply<sup>14</sup>.

The Ministry of Health has recorded that during 2002, water from the distribution zone was not monitored for *E.coli*<sup>12</sup>.

#### **Wharenui School**

This primary school takes water from the City reticulation system and from its own well. The Ministry of Health has not graded the well source.

The Ministry of Health has recorded that during 2002 there was inadequate sampling from the distribution zone for it to comply with the DWSNZ: 2000<sup>12</sup>. An inadequate number of samples was taken and the maximum interval between successive monitoring samples was too long

#### **3.3.4 Disease Incidence**

Medical practitioners are currently required to report to the Ministry of Health all incidences of notifiable diseases. These include diseases and illnesses that can be transmitted through water supplies such as campylobacteriosis, cryptosporidiosis, verotoxigenic *Escherichia coli* (VTEC) infection, giardiasis, hepatitis A, cholera, typhoid and typhus.

Not all cases are reported. The reason for this is that not all people infected would seek advice of a doctor and in these cases, no report would be lodged with the Ministry of Health.

These illnesses cannot directly be related to the water supply within the community where the ill person may live. Some of these illnesses can be passed from person to person or as a result of eating contaminated food, and they can be contracted outside the area of residence. Statistics of notifiable diseases therefore do not directly reflect the quality of a water supply. However, a concentration of one type of water-borne disease in an area of a particular water supply may indicate that that water supply is the source of the infection.

There is no infection incidence data suggesting that any of the sources of drinking water in the Urban Community have been a cause of infection.

### **3.4 Urban Fringe Water Services**

#### **3.4.1 Sources and Populations Served**

##### **Christchurch City**

Christchurch City Council operates the Brooklands and Kainga water supply. Water is supplied from bores to a population of 2,200 (2000 / 01 figures). The individual sources of supply are detailed in Table 10.

■ **Table 10: Sources – Urban Fringe (Christchurch City)**

<b>Component</b>	<b>Code</b>	<b>Name</b>
	BRO012	Brooklands / Kainga
		Local Authority: Christchurch City Council
<b>Zone:</b>	<b>BRO012BR</b>	<b>Brooklands / Kainga</b>

Component	Code	Name
	BRO012	Brooklands / Kainga
Plant:	TP00965	Brooklands
Source:	G00582	Brooklands Bore
Plant:	TP00964	Kainga
Source:	G00581	Kainga Bore

(Source: Water Information New Zealand on the Web, as extracted from the National WINZ database)

During 2000 / 01 the average daily demand per person for water was 425 litres. The winter period demand was 227 litres per person while the peak demand was 1,166 litres per person. These are similar demands to the average figures across the other consumers supplied from the City reticulated supply.

### Non-Council Suppliers

The sources of water and populations served by other water suppliers in the Urban Fringe Community are shown in Table 11.

■ **Table 11: Sources & Populations Served – Urban Fringe (Other Supplies)**

Water supplier (code)	Sources			Population served
	Component	Code	Name	
<b>Christchurch International Airport (CHR002)</b>	<b>Zone:</b>	<b>CHR002CI</b>	<b>Christchurch International Airport</b>	<b>4,500</b>
	Plant:	TP00228	Christchurch International Airport	
	Source:	G00168	Christchurch Int. Airport Wells	
<b>The Groynes (THE006)</b>	<b>Zone:</b>	<b>THE006TG</b>	<b>The Groynes</b>	<b>150</b>
	Plant:	TP01951	The Groynes	
	Source:	G01138	The Groynes Bore	
<b>Halswell School (HAL005)</b>	<b>Zone:</b>	<b>HAL005SC</b>	<b>Halswell Primary School</b>	<b>516</b>
	Plant:	TP02046	Halswell Primary School	
	Source:	G01224	Halswell Primary School Bore	
<b>Marshland School (MAR008)</b>	<b>Zone:</b>	<b>MAR008SC</b>	<b>Marshland Primary School</b>	<b>225</b>
	Plant:	TP00988	Marshland Primary School	
	Source:	G00600	Marshland Primary School Well	
<b>Ouruhia Model School (OUR001)</b>	<b>Zone:</b>	<b>OUR001SC</b>	<b>Ouruhia Primary School</b>	<b>90</b>
	Plant:	TP00985	Ouruhia Primary School	
	Source:	G00597	Ouruhia Primary School Well	
<b>Yaldhurst School (YAL001)</b>	<b>Zone:</b>	<b>YAL001SC</b>	<b>Yaldhurst Primary School</b>	<b>350</b>
	Plant:	TP00975	Yaldhurst Primary School	
	Source:	G00587	Yaldhurst Primary School Well	
<b>Paparua Prison (PAP009)</b>	<b>Zone:</b>	<b>PAP009ME</b>	<b>Paparua Men's Prison</b>	<b>1,100</b>
	Plant:	TP02025	Paparua Men's Prison	
	Source:	G01210	Men's Prison Well	
	Plant:	TP02027	Paparua Prison Drive	
	Source:	G01214	Prison Drive Well	
	Plant:	TP02026	Paparua Women's Prison	
	Source:	G01211	Women's Prison Well	
<b>Zone:</b>	<b>PAP009WO</b>	<b>Paparua Women's Prison</b>	<b>100</b>	

Water supplier (code)	Sources			Population served
	Component	Code	Name	
	Plant:	TP02025	Paparua Men's Prison	
	Source:	G01210	Men's Prison Well	
	Plant:	TP02027	Paparua Prison Drive	
	Source:	G01214	Prison Drive Well	
	Plant:	TP02026	Paparua Women's Prison	
	Source:	G01211	Women's Prison Well	
<b>Ruapuna Park Raceway</b>	<b>Zone:</b>	<b>RUA011RU</b>	<b>Ruapuna Park Raceway</b>	<b>300</b>
	Plant:	TP02297	Ruapuna Park Raceway	
	Source:	G01384	Ruapuna Park Well	

(Source: [www.drinkingwater.org.nz/supplies/SupplyCysForLA.asp](http://www.drinkingwater.org.nz/supplies/SupplyCysForLA.asp). Population figures supplied by water suppliers)

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Note that Halswell School takes water from a well for 11 of its 24 classrooms. The remainder of the school takes water from the City reticulation system. These water suppliers in the Urban Fringe Community currently have sufficient water to meet their current demand. Halswell School has indicated that its storage is inadequate but because it has alternative means of supply from the City reticulation system, it is not totally reliant on the aquifer supply and water storage. Paparua Prison has indicated that the adequacy of the storage for both the men's and women's prisons is only marginal, representing 17 – 18 hours of supply if tanks are full. The storage at the men's prison is 227,000 L and there is 180,000 L of storage at the women's prison. Those suppliers without storage are reliant on continued supply by gravity or pumping from the aquifer.

■ **Table 12: Storage and Adequacy – Urban Fringe**

Supplier	Storage provided	Adequacy
Christchurch International Airport	None	N/A
The Groynes	None	N/A
Halswell School	Secured concrete tank	Inadequate storage. Reticulated supply for fire hoses
Marshland School	None	N/A
Ouruhia Model School	Elevated concrete tank	11,000 L. Adequate
Yaldhurst School	Elevated concrete tank	½ day's supply (marginal adequacy)
Paparua Prison	Secure concrete water towers (2)	407,000 L. 17-18 hours' supply (marginal adequacy)
Ruapuna Park Raceway	Secure, covered concrete and plastic tanks	Adequate

(Sources: Water suppliers)

As discussed in Section 3.3.1, future demand for water for the schools is not expected to increase. Over the next 5 years the estimated increase in demand at the airport is projected to be 10% and at the prison it is projected to be 10-15%.

Most suppliers have the option of connecting to the City reticulated water supply network or developing new wells of their own. The prison is situated further from the City reticulated supply and therefore this option may not be the most economical option to meet demand projections. The Health (Drinking Water) Amendment Bill proposes greater responsibilities with regard to the quality of water supplied for those users who supply their own water. It is therefore likely that

connecting to the City reticulation will be the preferred option for many. With respect to the prison, should its population increase substantially there would be a need for further building development. New water supply sources would be considered at that time.

The suitability and vulnerability of these supplies through potential subdivision development and changes to land use are addressed in Regional Plans and the City Planning process.

### 3.4.2 Abstraction, Treatment and Reticulation

#### Abstraction

The different methods of abstraction of water from the aquifer sources for the water suppliers in the Urban Fringe Community are summarised in Table 13. Note that this is prior to treatment and / or delivery into the reticulation pipework.

■ **Table 13: Abstraction Methods – Urban Fringe Community**

Water supplier	Abstraction method from own sources
Christchurch International Airport	Pumped from wells into pipe network. Wells made safe from tampering.
The Groynes	Pumped from well into pipe network
Halswell School	Pumped from well to concrete tank. Facilities made safe from tampering.
Marshland School	Pumped from well into water supply pipework. Well made safe from tampering.
Ouruhia Model School	Pumped from well into elevated concrete tank. Well made safe from tampering.
Yaldhurst School	Pumped from well into elevated concrete tank. Well made safe from tampering.
Paparua Prison	Pumped from wells into 2 concrete water towers. Facilities made safe from tampering.
Ruapuna Park Raceway	Pumped from well into concrete plastic storage tanks. Facilities made safe from tampering.

(Sources: Water suppliers)

#### Treatment

The aquifer supply source is of a high quality. The water suppliers in this community do not provide water treatment with the exception of the prison. This is summarised in Table 14.

■ **Table 14: Treatment – Urban Fringe Community**

Water supplier	Treatment of water from own sources
Christchurch International Airport	None
The Groynes	None
Halswell School	None
Marshland School	None
Ouruhia Model School	None
Yaldhurst School	None
Paparua Prison	Disinfection at well heads with sodium hypochlorite
Ruapuna Park Raceway	None

(Sources: Water suppliers)

## Reticulation

Water suppliers have a variety of reticulation pipework delivering water from their sources. This is summarised in Table 15.

■ **Table 15: Reticulation – Urban Fringe Community**

Water supplier	Pipe material	Year of installation
Christchurch International Airport	Steel, PVC and asbestos cement	1940
The Groynes	Cast iron	Unknown
Halswell School	Galvanised steel and alkathene	Unknown
Marshland School	Plastic	Unknown
Ouruhia Model School	Unknown	1974 and later
Yaldhurst School	Unknown	Unknown
Paparua Prison	Steel, PVC and asbestos cement	pre 1964 and later
Ruapuna Park Raceway	Unknown	pre 1989

(Sources: Water suppliers)

### 3.4.3 Water Quality and Ministry of Health Grading

As referred to in Section 3.3.3, the Ministry of Health assesses the quality of water supplied for drinking water purposes and grades them. These gradings were last undertaken in the mid 1990s. The quality of the water supplies in the Urban Fringe Community, based on gradings and assessments by the Ministry of Health, are detailed below.

#### Christchurch International Airport

The airport receives its water from private wells owned and operated by Christchurch International Airport Limited. These wells source their water from the Christchurch aquifers. The water is sourced from groundwater supplies, though the Ministry of Health reports that the security of the source has not been verified but is a potential secure groundwater<sup>14</sup>. The Ministry of Health has graded the water supply as Bb. The grading of B for the water source is the highest that can be obtained for a secure ground water supply without disinfection with chlorine. The other grading of b means that the reticulation condition, management and water quality is satisfactory with a very low level of risk to the consumers. In order to obtain this grading for the water supply, Christchurch International Airport Limited is required to, and does, monitor the quality of the water.

#### The Groynes

Water for the Groynes is sourced from a well that has not been graded by the Ministry of Health but has been recognised by the Ministry of Health as a non-verified “secure” groundwater source<sup>14</sup>. The Ministry of Health has recorded that during 2002 there was inadequate sampling from the distribution zone for it to comply with the DWSNZ: 2000<sup>12</sup>. Samples were not taken on sufficient days of the week and the maximum interval between successive monitoring samples was too large.

#### Halswell School

Halswell Primary School takes water from a well that has not been graded by the Ministry of Health. This source supplies 11 of its 24 classrooms. The remainder of the school takes water

from the city reticulation system. The Ministry of Health records that during 2002, water from the distribution zone was not monitored for the bacterium *E.coli*<sup>12</sup>.

#### **Marshland School**

Marshland Primary School sources water from a well that has not been graded by the Ministry of Health but it does recognise the source as a non-verified “secure” groundwater supply<sup>14</sup>. During 2002 the distribution zone fully complied with the requirements of the DWSNZ: 2000<sup>12</sup>.

#### **Ouruhia Model School**

The well-sourced water supply for this school has not been graded by the Ministry of Health but it does recognise the source as a non-verified “secure” groundwater supply<sup>14</sup>. The Ministry of Health records that during 2002, water from the distribution zone was not monitored for the bacterium *E.coli*<sup>12</sup>.

#### **Yaldhurst School**

The Ministry of Health has not graded the well-sourced water supply that serves this primary school but does recognise the source as a non-verified “secure” groundwater supply<sup>14</sup>.

The Ministry of Health has recorded that during 2002 there was inadequate sampling from the distribution zone for it to comply with the DWSNZ: 2000<sup>12</sup>. An inadequate number of samples was taken and the maximum interval between successive monitoring samples was too large.

#### **Paparua Prison**

The Department of Corrections takes water from 3 wells, each supplying both the women’s and men’s prisons. All 3 wells are recognised by the Ministry of Health as non-verified “secure” groundwater supplies<sup>14</sup> but are ungraded. The Canterbury DHB audited the Department of Corrections records in 2002 and determined that the distribution zone complied with the bacteriological requirements of the DWSNZ: 2000 but for chemical compliance, the men’s prison water supply was inadequately monitored for nitrate ( $\text{NO}_3^-$ )<sup>13</sup>. Variation in nitrate concentration is monitored by the Ministry of Health to assess whether the groundwater is affected by surface or climate influences. Surface or climate influences would indicate that the groundwater is not secure<sup>15</sup>.

#### **Ruapuna Park Raceway**

Ruapuna Park Raceway takes water from a well that has not been graded by the Ministry of Health nor recognised as a non-verified “secure” groundwater supply. The Canterbury DHB did not undertake monitoring of the water supply during 2002 and the Ministry of Health records that water from the distribution zone was not monitored for the bacterium *E.coli* during 2002<sup>12</sup>. The presence of this bacterium will almost certainly indicate that the water is contaminated with faecal matter. If monitoring for *E.coli* is not undertaken, then there is no check for contamination.

#### **3.4.4 Disease Incidence**

A general discussion on water-borne disease is included in Section 3.3.4. No infection incidence data indicates that any of the sources of drinking water in the Urban Fringe Community have been a cause of infection.

Both Marshland School and Ouruhia Model School are located in an area that is not serviced by a sewage reticulation system and where septic tanks are used. The area is also not free draining. Under these conditions, care needs to be taken in the location and operation of water supply bores to ensure that contamination of the water supply does not occur.

## 4. Assessment of Public Health Risks

### 4.1 Risk Assessment Methodology

The risks pertaining to public health and environmental effects for those communities within the Christchurch City Council area that are not connected to the municipal water and sewage reticulation systems have been assessed. The assessment is a high level preliminary risk assessment and was carried out on a qualitative basis. The methodology, assessment and evaluation criteria used are described in the following sections.

The risks from the reticulated water supply and sewerage system operated by the Council have previously been assessed by other projects. The level of risk previously identified is contained in the following reports published by the Council:

- Wastewater Management Plan, 2004, Part 2 Asset Management Overview.
- Water Quality Public Health Risk Management Plan, Draft 2003.

No comment is provided in this report as to the appropriateness of the methodology used to determine the level of risk for each of the hazards and failure events assessed in the reports prepared by others.

The assessment in this report is a preliminary risk assessment based on the experience of the authors and was carried out on a qualitative basis using the descriptor scales and evaluation criteria as set out in Section 4.2. This assessment is the first stage of a risk management process. Should risks be evaluated as being unacceptably high, then it is recommended that further analysis is undertaken to confirm the level of risk and to assess mitigation measures to reduce the level of risk.

The methodology followed in conducting this qualitative risk assessment is based on the guidance provided in AS/NZS 4360:1999 Risk Management Standard and its associated guideline documents. The assessment has focussed on only two areas of risk pertaining to the operation and use of non-reticulated water and sewage systems. These are the risk to public health and to the environment. This includes both normal operations and failure modes associated with these activities.

Key definitions used throughout the assessment are set out below:

**Hazard** is a source of potential harm or a structure with a potential to cause loss.

**Event** is an occurrence that can have an adverse impact on the environment or on public health. An event releases the intrinsic potential of a hazard

**Consequence** is the outcome of an event expressed in the assessment qualitatively, being illness, injury, loss of biological community, or environmental damage.

**Risk** is the combination of the likelihood and the consequence of a specified hazard being realised.

**Environmental risk** recognises that activities of an organisation can cause some form of environmental change as the result of an event.

The following steps in the risk assessment process were followed:

- Establish context of the risk assessment.
- Identify hazards associated with non reticulated water supply and sewage disposal.
- Determine for each hazard the fault / failure modes that could result in an event which could impact on public health or the environment.
- Describe the event as a result of the fault / failure.
- Describe the potential effect as a consequence of the event.
- Analyse the level of risk using the evaluation criteria (likelihood and consequence sections) as set out in the report.
- Evaluate whether the level of risk is acceptable or not using risk matrix.

The initial identification of hazards, fault / failure modes and the establishment of credible events was undertaken by a team of SKM consultants with expertise in water supply, wastewater treatment and reticulation, public health and environmental effects.

#### 4.2 Evaluation Criteria

Evaluation criteria (descriptors) used to assign probabilities (likelihood / frequency) of an event occurring and the consequence of that event were developed using a combination of data from AS/NZS 4360<sup>16</sup> and HB203<sup>17</sup>, plus some expansion and enhancements based on knowledge derived from previous qualitative risk assessments, experience and common sense.

The risk matrix used to assign four levels of risk to an event is based on the matrix published in AS/NZS 4360.

The evaluation criteria (look-up tables) for frequency and consequence and the risk matrix are presented in Tables 16, 17 and 18.

##### ■ Table 16: Frequency Descriptors and Scales

Level	Descriptor	Alternative Descriptor	Description	Value	Frequency
A	Almost Certain	Frequent	Expected to occur at least once per year	1	1/year
B	Likely	Probable	Expected to occur several times during life of asset	0.1	1/10 years
C	Possible	Occasional	Might occur at some time during life of asset	0.01	1/100 years
D	Unlikely	Remote	Could occur at some time; very unlikely in life of asset	0.001	1/1,000 years
E	Rare	Very Unlikely	Improbable; event has happened but not anticipated; could occur in exceptional circumstances	0.0001	1/10,000 years

■ **Table 17: Consequence Descriptors and Scales**

Level	Descriptor	Effects		
		Social (health & safety)	Environment	Fiscal
1	Insignificant	No injuries or minor health effects	Incidental on-site effect. No ecological consequences	Low financial loss. <\$10,000
2	Minor	First aid treatment. Incidental injury or health effects to persons exposed (vomiting etc but self medicated). Minor nuisance	Minor release immediately contained. Reduction in abundance / biomass of flora / fauna in affected area. No changes to biodiversity	Medium financial loss. \$10 -100 k.
3	Moderate	Injuries or health effects to persons, requiring medical treatment. Significant sustained nuisance.	Off-site release contained with outside assistance. Reduction in biomass in local area without significant loss of pre-impact ecological functioning.	High financial loss. \$100 –1,000k
4	Major	Extensive injuries or health effects to persons. Illness requiring hospitalisation of one or two persons.	Off-site release with significant impact to biodiversity and ecological functioning with eventual recovery (maybe not to pre-impact conditions).	Major financial loss. \$1-10 million
5	Catastrophic	Single public fatality or severe permanent disabilities to more than one person. Multiple persons (>2)being hospitalised	Toxic release with off-site detrimental effect. Irreversible changes to abundance of biomass in affected environment. Loss of ecological functioning with little prospect of full recovery.	Huge financial loss. >\$10 million

The descriptors / criteria adopted for the consequence have been developed to reflect society's tolerance and acceptance of risk pertaining to illness and fatalities associated with water and sewage. Society tends to set its level of tolerance based on the level of voluntary or non-voluntary exposure to a risk. For non-voluntary type risk exposures, the levels of tolerance by society are generally lower. For activities over which the public has limited voluntary control (such as water supply, or a chemical factory located nearby), the level of risk that could result in a fatality to the member of public is usually valued at a higher consequence level than an activity where there is some degree of voluntary acceptance of the level of risk (eg driving a car). Society is more tolerant of road accidents or industrial worker fatalities, than a person dying from meningitis.

A fatality from a water-borne illness in New Zealand or a contagious disease such as meningitis is generally regarded as being unacceptable, and for this reason a fatality of a member of the public has been set as the highest level of consequence.

The scale of the descriptors set in terms of public fatality (single) is conservative. This approach will for some events potentially over-estimate the level of risk. However, given that this risk assessment is a preliminary assessment and is based on limited data, those risks identified as being extreme or high can be subject to further scrutiny once more detailed data has been collected that allows the level of risk to be better qualified.

The level of risk was determined for each hazard, and the fault / failures and events pertaining to that hazard, based on the scales assigned by the qualitative frequency and consequence descriptors using a risk matrix, as described by NZS 4360:1999.

■ **Table 18: Risk Matrix**

Consequence vs Likelihood	1 (Insignificant)	2 (Minor)	3 (Moderate)	4 (Major)	5 (Catastrophic)
<b>A</b> (Almost Certain)	H	H	E	E	E
<b>B</b> (Likely)	M	H	H	E	E
<b>C</b> (Possible)	L	M	H	E	E
<b>D</b> (Unlikely)	L	L	M	H	E
<b>E</b> (Rare)	L	L	M	H	H

Based on AS/NZS 4360:1999

Risk is assigned one of four levels, being:

<b>L</b>	LOW	Low risk; managed by routine procedures
<b>M</b>	MODERATE	Moderate risk; required above normal attention
<b>H</b>	HIGH	High risk; ALARP must be applied
<b>E</b>	EXTREME	Extreme risk; not acceptable and must be reduced

The principle of ALARP (As Low As Reasonably Practicable) means that while the risk is in the tolerable band, measures (mitigation) must still be applied to reduce it further. Risk levels of High (H) and Moderate (M) both fall into the tolerable region and must be addressed.

However, the level of attention applied to a High (H) risk (compared to a Moderate Risk) is much greater and it is possible the actual cost of those risk reduction measures may outweigh the financial (equivalent) benefits gained. When the risk level is Moderate, risk reduction measures can always be applied but are mandatory if they result in a positive cost / benefit outcome.

The results of the risk analysis are summarised for each community in the following sections. Detailed analysis of the risks for each supplier in the two communities identified in this assessment, and the mitigation measures recommended to reduce the risk, is included in Appendix A and Appendix A.

#### 4.3 Water Supply Risk Factors

The potential risks to each of the supplies are generally similar, as the sources in all cases are the Christchurch confined aquifers, and contamination risk scenarios beyond abstraction are also

similar in each case. Contamination of the supply can occur at any part of the water system, being the source, treatment, storage or reticulation.

Continuity of supply is dependent on the availability of water at the source and the ability of the delivery system to continue to deliver water to users. A summary of each supplier's ability to ensure continuity of supply in the two communities is provided in Tables 20 and 23. Note that the information detailed in these tables is as provided by the individual suppliers and site visits were not undertaken to verify the accuracy of the information.

With respect to security from contamination, most suppliers provide no form of water treatment or disinfection. Without this, the suppliers rely on a secure source and all other facilities from the source to the consumer being made secure from unauthorised entry of contaminants or tampering. Those suppliers providing treatment of some form are listed in Tables 8 and 14. The security of the facilities from unauthorised entry is summarised for each supplier in Tables 19 and 22. Again, no site visits were undertaken to verify the accuracy of the information provided by the individual suppliers.

Considering each element of the water system, the common risks include:

### **Supply**

These risks are summarised as follows:

- Salt-water intrusion – Water from the top aquifer discharges into the sea. The lower aquifers are apparently “blind” and do not discharge into the sea. This is indicated schematically in Figure 2. If excessive water is extracted from the top aquifer the risk exists that the pressure in the aquifer may drop to a level where seawater could enter the aquifer. As salt water is heavier than drinking water, this salt water would remain in the aquifer. If the pressure in the aquifer continued to drop then the salt water would intrude further into the aquifer.

Monitoring the pressure in the aquifer will indicate when the pressure drops to critical levels. Abstraction from the aquifer would be reduced when these critical pressure levels were approached.

- Contamination via seepage from contamination at points of abstraction – It is possible for the source to become contaminated by lower pressures in the area of abstraction permitting contaminated groundwater to enter the well through the well screen, or by contaminated matter being able to enter down the wellhead if it is not secured, by breach of the confining layer, or by mixing of water between aquifers.

Designing and constructing wells in accordance with strict standards, monitoring the pressure in the aquifer at points of abstraction, ensuring that no contaminated discharges occur onto land in the area of the abstraction points and securing wellheads are methods of mitigating these potential means of contamination. Environment Canterbury has developed policies and methods, including rules in the Proposed Natural Resources Regional Plan to ensure that bores are constructed and maintained to meet current industry standards, and to ensure that activities occurring within a community drinking water supply zone do not pose a significant risk to the drinking water supply. Applications must be lodged with ECan for discharges that are not permitted under the Regional Rules.

- Contamination from the groundwater recharge zone to the north west of the city. This could happen through the increasing pressure to develop land in this area. Changes in land use may increase the risk of groundwater contamination and a decline in groundwater quality. Supplies drawing from this groundwater may need to add treatment or find alternative sources of potable water
- Excessive abstraction resulting in drop in artesian pressures leading to the possibility of cross contamination between aquifers if one of the aquifers becomes contaminated downward migration of contaminants or contaminated water from the land surface.

**Treatment**

The risks associated with treatment include:

- Insufficient treatment.
- Over-treatment.

Both of these will result in contaminated water entering storage and / or reticulation.

Careful control of water treatment operations, sampling and monitoring of the treated water, and suitably trained and qualified staff will help mitigate the risks associated with treatment.

**Storage**

Contamination of stored water can occur for the following reasons:

- Long retention time for water.
- Entry of contaminants through access hatches or seepage (including sabotage and structural failure of the reservoir).
- Poor procedures for cleaning of storage tanks.

Mitigation of these can be provided by sizing storage volumes to ensure circulation of the stored water, securing and monitoring of access points, sealing of other possible points of ingress, ensuring good operation and maintenance practices are followed, employing suitably trained and qualified staff and providing a disinfection residual within the stored water. Disinfection of water leaving storage can also be utilised.

**Reticulation**

Water within the reticulation system can be contaminated from such events as:

- Ingress of contaminated water from surrounding ground.
- Contamination during pipe repair works.
- Backflow from other users' connections, including fire hydrants.
- Biofilm or sediment build-up in the pipework.

Means of mitigation include maintaining sufficient water pressure within the pipework to prevent ingress of contaminants from the surrounding ground, maintaining good operation and maintenance practices (including employing suitably trained and qualified staff), installing backflow preventers at connections to other users and regularly inspecting these devices, and regular flushing and / or disinfection of the pipework.

In addition there are risks associated with monitoring of the water supply. These risks relate to the appropriateness of the test being undertaken, the frequency of the tests and the analysis of samples taken. Following good procedures and ensuring compliance with the latest standards published in the DWSNZ, will help mitigate these risks.

#### 4.4 Urban Community Risk Assessment

Details of risks specific to each supplier are considered in this section of the report.

Christchurch City Council has undertaken a thorough risk assessment of its water supply system and this has been included in the Christchurch City Public Health Risk Management Plan 2004 prepared by the Council<sup>18</sup>. The Council is committed to risk management and is proactively addressing the areas of improvement identified in this risk management plan.

The Council has prepared a “Priority Risk List” for its water supply network. Any risk event that could cause a serious health impact on a small number of people or a minor impact on a large number of people, has been included in that list irrespective of the likelihood of its occurrence. This indicates the Council’s commitment to deal with risks to its water supply.

With respect to backflow prevention, the Council has a Backflow Prevention Policy and Programme in place. The main goal of this policy and programme is to protect the public drinking water from chemical or microbial contamination that can be caused by backflow. The magnitude of the task means implementation is a progressive task with priority being given to highest risk connections. New connections are fitted with appropriate devices as a condition of supply. Clarification in the Building Act and the proposed drinking water legislation will assist in ensuring that backflow is prevented.

The following assessment is for the other suppliers in the urban community only. Tables 19 and 20 provide a summary of the security provided to the water supply facilities and to the provision of a water supply itself, respectively.

##### ■ Table 19: Security of Facilities – Urban

Supplier	Security provided
Christchurch Hospital	Source recognised as secure by MoH. Wells secure from unauthorised entry.
Hillmorton Centre	All facilities secure
The Princess Margaret Hospital	Applied for recognition from MoH as secure source All facilities secure
Canterbury Christian College	All facilities protected from tampering
Christ's College	All facilities protected from tampering
Hammersley Park School	City reticulated supply
Linwood Avenue School	All facilities covered
Mairehau School	Wellheads enclosed
Richmond School	Unknown
Shirley School	Facilities not secure
South Hornby School	All facilities protected from tampering
Wainoni School	Wellhead protected from tampering and storage tank enclosed

Supplier	Security provided
West Spreydon School	City reticulated supply
Wharenui School	All facilities protected from tampering

Source: Water suppliers

■ **Table 20: Continuity of Supply – Urban**

Supplier	Security provided
Christchurch Hospital	Standby power; connection to City reticulated supply
Hillmorton Centre	Standby power; connection to City reticulated supply imminent
The Princess Margaret Hospital	Standby power; connection to City reticulated supply for fire sprinklers
Canterbury Christian College	City reticulated supply for 3 classrooms; full connection to City supply imminent
Christ's College	Connection to City reticulated supply available
Hammersley Park School	City reticulated supply
Linwood Avenue School	Standby power; connection to City reticulated supply
Mairehau School	None. Connection to City reticulated supply for fire hoses
Richmond School	None. Connection to City reticulated supply is planned
Shirley School	None. Connection to City reticulated supply for fire hoses
South Hornby School	City reticulated supply for 1 block and 2 separate buildings
Wainoni School	None. Connection to City reticulated supply for fire hoses
West Spreydon School	City reticulated supply
Wharenui School	City reticulated supply to part of school

Source: Water suppliers

Some security of supply is provided by provision of water storage on site. Table 6 summarises the storage provided by each supplier.

Risks associated with each element of the water supply system are set out below.

#### 4.4.1 Supply Risks

Security of the sources for each supplier is summarised in Table 19. Some of the suppliers have indicated that their source of water is not secure from possible contamination.

#### 4.4.2 Treatment Risks

Table 8 provides a summary of treatment provided and indicates that disinfection is provided for the water supply to the Hillmorton Centre only. Three suppliers provide filtration of some form, these being Christchurch Hospital, Christ's College and Wharenui School. The Ministry of Health considers that the filters used by Christchurch Hospital offer no value in the way of water treatment. All suppliers must mitigate the possibility of contaminants entering the water supply, especially those that do not provide any form of treatment.

#### 4.4.3 Storage Risks

Storage provided by each supplier and the security assessment of the storage is summarised in Table 6. Christ's College, Mairehau School, Richmond School and Wainoni School recognise that their water storage volume is inadequate. Shirley School believes its storage is just adequate. However, Christ's College has an alternative supply available from the City reticulation and

Richmond School plans to connect its supply to that system. Storage is particularly important for fire fighting purposes and Table 20 indicates which suppliers have alternative means of water supply for this.

#### **4.4.4 Reticulation Risks**

The risks associated with reticulation pipework relate to contamination and discontinuity of supply. Contamination of drinking water can occur as a result of the following factors:

- Leaking pipework allowing ingress of groundwater at times of low operating pressure.
- Backflow from connection to a potential contaminating source, including fire hydrants.
- Biofilm or sediment build-up in pipework.

Failure of pipework nearing the end of its life will result in discontinuation of supply for periods until the pipework can be repaired or replaced.

Table 9 summarises the age and materials of pipework used by suppliers in the Urban Community.

#### **4.4.5 Monitoring Risks**

The Ministry of Health, in its annual review of the microbiological and chemical quality of drinking water in New Zealand for 2002, has recorded the degree of monitoring of the water supply that has been carried out by the various suppliers in the Urban Community. These results have been summarised for each supplier in Section 3.3.3. A number of suppliers are not monitoring the quality of the water sufficiently and therefore run the risk of supplying contaminated water.

#### **4.4.6 Urban Community Risk Summary**

The risk assessment for the Urban Community has been undertaken and is presented in detail in Appendix A.

As stated above, the level of risk is broken down into four categories: Extreme (E), High (H), Moderate (M) and Low (L). The assessment establishes the risk prior to mitigation. A number of the suppliers are undertaking varying degrees of mitigation and consequently the level of risk to their consumers is less.

The events that give risk levels of extreme and high, prior to mitigation, are summarised in Table 21.

■ **Table 21: Events for Extreme & High Levels of Risk – Urban**

	Events	Hospitals	Schools	Comment
<b>Extreme</b>	Unsecured wellhead	✓	✓	Contamination of source
	Unsecured access hatches	✓	✓	Only applicable where storage provided
	Incorrect water treatment	✓		Vulnerable community with reduced immunity
<b>High</b>	Seepage from contaminated site	✓	✓	Contamination of source
	Incorrect water treatment		✓	Children more susceptible to sickness
	Biofilm / sediment build-up in reticulation pipework	✓		Vulnerable community with reduced immunity
	Low / negative pressures in reticulation pipework	✓	✓	Contamination of pipework
	Backflow from cross-connections / fire hydrants	✓		Contamination of pipework supplying vulnerable community
	Old bores / wells not sealed	✓	✓	Contamination of source
	Contamination during storage maintenance	✓		Only applicable where storage provided
	Contamination during pipe repair	✓	✓	Contamination of pipework
	Failure of electricity	✓	✓	No supply where storage insufficient

#### 4.5 Urban Fringe Community Risk Assessment

Tables 22 and 23 provide a summary of the security provided to the water supply facilities and to the provision of a water supply itself, respectively.

■ **Table 22: Security of Facilities – Urban Fringe**

Supplier	Security provided
Christchurch International Airport	MoH grading Bb. Secured wellheads and locked well chambers
The Groynes	Pump chambers secure
Halswell School	All facilities protected from tampering
Marshland School	All facilities protected from tampering
Ouruhia Model School	Well and pump chamber protected from tampering
Yaldhurst School	All facilities protected from tampering
Paparua Prison	All facilities protected from tampering
Ruapuna Park Raceway	All facilities protected from tampering

Source: Water suppliers

■ **Table 23: Continuity of Supply – Urban Fringe**

Supplier	Security provided
Christchurch International Airport	Standby power
The Groynes	None
Halswell School	None. Connection to City reticulated supply for fire hoses
Ouruhia Model School	None

Supplier	Security provided
Marshland School	Standby power
Yaldhurst School	None
Paparua Prison	None
Ruapuna Park Raceway	None

Source: Water suppliers

Some security of supply is provided by provision of water storage on site. Table 12 summarises the storage provided by each supplier.

Identical risks to those detailed in Section 4.4 for the Urban Community apply to the Urban Fringe Community. These are detailed below:

#### 4.5.1 Supply Risks

Security of the sources for each supplier is summarised in Table 22.

#### 4.5.2 Treatment Risks

Table 14 provides a summary of treatment provided and indicates that disinfection is provided for the water supply to Christchurch men's and women's prisons only. All suppliers must mitigate the possibility of contaminants entering the water supply, especially those that do not provide any form of treatment.

#### 4.5.3 Storage Risks

Storage provided by each supplier and its security is summarised in Table 12. Halswell School recognises that its water storage volume is inadequate and Paparua Prison rates its storage as marginal. However, Halswell School has a connection to the City reticulated system for fire fighting.

#### 4.5.4 Reticulation Risks

The risks associated with reticulation pipework are contamination and discontinuity of supply. Contamination of drinking water can occur as a result of the following factors:

- Leaking pipework allowing ingress of groundwater at times of low operating pressure.
- Backflow from connection to a potential contaminating source, including fire hydrants.
- Biofilm or sediment build-up in pipework.

Failure of pipework nearing the end of its life will result in discontinuation of supply for periods until the pipework can be repaired or replaced.

Table 15 summarises the age and materials of pipework used by suppliers in the Urban Fringe Community.

#### 4.5.5 Monitoring Risks

The results of the Ministry of Health annual review of the microbiological and chemical quality of drinking water in New Zealand for 2002 has been summarised in Section 3.4.3. This review has recorded the degree of monitoring of the water supply that has been carried out by the various

suppliers in the Urban Fringe Community. A number of suppliers are not monitoring the quality of the water sufficiently and therefore run the risk of supplying contaminated water.

#### 4.5.6 Urban Fringe Risk Assessment

The risk assessment for the Urban Fringe Community has been undertaken and is presented in Appendix A.

The events that give risk levels of extreme and high, prior to mitigation, are summarised in Table 24.

■ **Table 24: Events for Extreme & High Levels of Risk – Urban Fringe**

	Events	Schools	Airport	Prisons	Ruapuna Park	Comment
<b>Extreme</b>	Unsecured wellhead	✓	✓	✓	✓	Contamination of source
	Unsecured access hatches	✓				Only applicable where storage provided
<b>High</b>	Seepage from contaminated site	✓	✓	✓	✓	Contamination of source
	Incorrect water treatment	✓				Children more susceptible to sickness
	Low / negative pressures in reticulation pipework	✓	✓	✓	✓	Contamination of pipework
	Old bores / wells not sealed	✓	✓	✓	✓	Contamination of source
	Contamination during pipe repair	✓	✓	✓	✓	Contamination of pipework
	Failure of electricity	✓	✓	✓	✓	No supply where storage insufficient

## 5. Options to Meet Demands

### 5.1 Existing Plans

The Council is committed to and actively pursuing policies and programmes to protect the people in its territorial area from risks associated with drinking water supply. The Council's Mission Statement with regard to water supply as published in the Public Health Risk Management Plan, 2004 states:

*"The health and safety of our customers is our priority, and the provision of pure, safe and natural drinking water is a responsibility the Council takes very seriously.*

*The Council is, and will remain, proactive in minimising the risks to public health from our drinking water supply, and will continue to employ a robust risk management programme to deliver improvements, where necessary."*

The policies and programmes the Council is pursuing include the completion of an Asset Management Plan, a Public Health Risk Management Plan (PHRMP), adoption of a Backflow Policy and Programme, area/growth planning, active involvement in the review of the Drinking Water Standards for New Zealand, and commitment to additional operational expenditure for testing of drinking water.

In addition to these actions the Council has prepared a "Priority Risk List" for its water supply network. Any risk event that could cause a serious health impact on a small number of people or a minor impact on a large number of people, has been included in that list irrespective of the likelihood of its occurrence.

The introduction to the summary of the PHRMP<sup>18</sup> states that it is a document that provides the basis for deciding what aspects of a water supply present a risk to public health within the Council's community and defines what can actually be done about it. The overall purpose of the PHRMP is to assist the Council in doing everything it possibly can to prevent putting people's health at risk from drinking water. Specifically the PHRMP:

- Identifies the potential sources of drinking water contamination.
- Awards a grading, according to the severity and probability of such contamination occurring.
- Defines what systems and procedures can be put in place to reduce the probability or severity of a contamination event.
- Provides a report to the Council's customers and the Ministry of Health of the intentions of the Council to be aware of and respond to risks associated with the drinking water supply.

The main goal of the Council's Backflow Prevention Policy and Programme is to protect the public drinking water from chemical or microbial contamination that can be caused by backflow. The Council is gradually implementing this with priority being given to highest risk connections. A condition of supply is that all new connections must be fitted with appropriate backflow devices.

The Proposed Natural Resources Regional Plan contains objectives, policies and methods to maintain groundwater levels and artesian pressures in the Christchurch West Melton aquifer, and to

protect the existing high quality groundwater in the confined aquifer system. The Plan establishes a special zone – Christchurch Groundwater Recharge Zone - over the land to the west of the Christchurch that is the source of groundwater recharge to the City's aquifers. Land uses and discharges in this Zone will be managed to ensure that the risk of groundwater contamination is minimised. The Regional plan will complement the provisions of the PHRMP and give practical effect to managing potential sources of groundwater contamination .

The Ministries of the Environment and Health are both presently working on the introduction of legislation and regulations focused on a risk-based approach to reducing risk of incidence of water borne disease in the drinking water supply. The Council has anticipated this legislation and the likely regulations in the programmes it has implemented to deliver potable water to the community. It is also clear that the larger water suppliers such as the International Airport, hospitals and prisons have also taken the legislation and regulations into account in the development, operation and maintenance of their supplies.

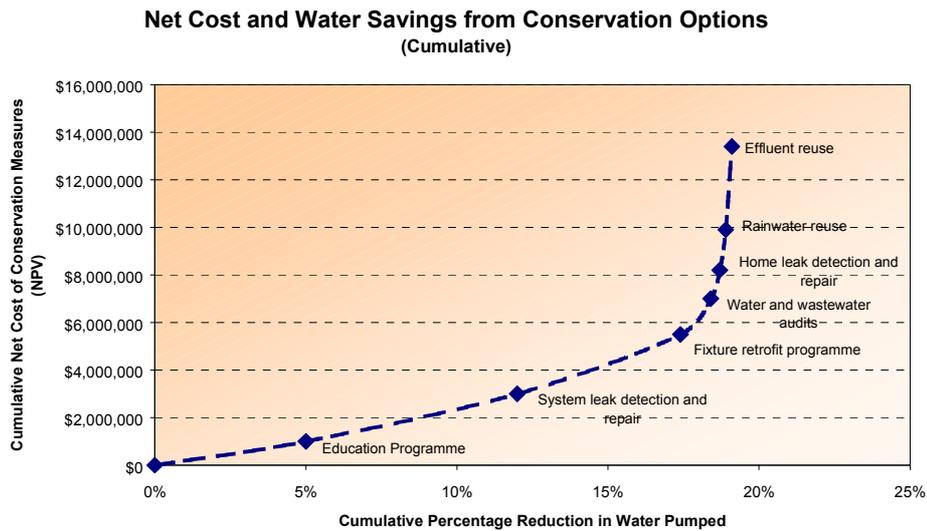
## **5.2 Options to Meet the Demands**

### **5.2.1 Demand resulting from population growth**

Demand resulting from population growth can be met in the following ways

- Construction of additional pumping stations, wells and other infrastructure to increase capacity to help meet peak demands
- Implementation of demand management programmes including public education to encourage efficient water use, water loss reduction programmes, water supply modelling to identify operational changes to increase system efficiencies
- Use of grey, rain or reuse water for non potable supplies to reduce demand on high quality potable resources from the aquifers

The cumulative effect of various demand management approaches, from a Water Conservation Cost Benefit Analysis study carried out for Christchurch City Council in 1996, is shown in the graph below.



The cumulative net cost takes into account the cost of implementing the conservation measure minus the benefits of reduction in capital and operating costs. The most cost-effective measures are those where the curve is flatter, such as Education and System Leak Detection, a greater reduction in water use is achieved for the amount of money spent. Less cost-effective measures lie at the top of the curve, such as Rainwater and Effluent Re-Use.

Because of the low unit cost of water supply in Christchurch and high cost of water conservation measures there are no economic incentives to reduce demand. If grey water and stormwater re-use technologies were to advance sufficiently then these options may become economic.

### 5.2.2 Demand Related to Non-Secure Groundwater

Options to meet demand related to non-secure groundwater sources can be met by

- Additional water quality testing
- Introduction of treatment
- Connection to Council reticulated supply (for non council supplies)
- Drilling new wells into secure sources

### 5.2.3 Demand Related to Public Health Issues

Options to meet demand related to wells in areas with septic tanks and insufficient drainage

- Further investigation to establish if there is a public health risk
- Ensure well heads are secure and operated correctly

- Abandon existing supply and connect to Council reticulated supply

#### **5.2.4 Health (Drinking Water) Amendment Bill**

Options to meet demand related to the Health (Drinking Water) Amendment Bill and the greater responsibilities with regard to the quality of water supplied

- Continue to manage own supply ensuring staff adequately trained and risk management procedures are in place.
- Employing external qualified staff to operate and maintain supply and manage risks.
- Abandon existing supply and connect to Council reticulated supply

### **5.3 Proposed Action Plan**

The Council will:

- Continue to develop and review its policies and plans to ensure that pure, safe and natural drinking water is provided to its customers.
- Remain, proactive in minimising the risks to public health from the Council's drinking water supply.
- Continue to employ a robust risk management programme to deliver improvements, where necessary.
- Continue to renew and strengthen the existing asset to provide a continuous water supply.
- Implement a demand management programme to promote efficient use of the water resource.
- Continue to provide input into city plan variations and regional plans and build the asset for development and growth projections.
- Monitor feedback from the Special Consultative Procedure and other consultations and incorporate inputs into Asset Management Plans and future assessments.
- Seek clarification on the responsibility of the Council to assess the operation and management of non-Council water supplies.

## **Appendix A Risk Assessment – Urban Community**

## **Appendix B Risk Assessment – Urban Fringe Community**

## References

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- <sup>1</sup> This assessment has restricted the community size to 100 people or more based on a recommendation from the “Small Water Group”, formed to advise on the revision to the Drinking Water Standards for New Zealand, that the current 25 – 500 population category be replaced by two categories: 25 – 100 and 101 – 500. It has been considered that populations of less than 100 need not be included in this initial assessment.
- <sup>2</sup> Proposed Natural Resources Regional Plan, July 2004, Environment Canterbury. Chapter 5, clauses 5.4.3.1 and 5.4.3.2.
- <sup>3</sup> Population Projections, Christchurch City Area Units, Statistics New Zealand, 2004
- <sup>4</sup> Water Supply Asset Management Plan, 2003, Christchurch City Council. Clause 4.3
- <sup>5</sup> Water Supply Asset Management Plan, 2003, Christchurch City Council. Clause 4.2.4
- <sup>6</sup> A Summary of the Christchurch City Council Water Supply Asset Management Plan 2002
- <sup>7</sup> Public Health Grading of Community Drinking-Water Supplies 2003, Ministry of Health.
- <sup>8</sup> Opinions Market Research Limited: Water Services Evaluation 2000, Residential Sector, October 2000 – 84% of respondents disagreed with the statement “*I wouldn't mind if Christchurch's water supply was chlorinated*”.
- <sup>9</sup> Annual Review of the Microbiological and Chemical Quality of Drinking-Water in New Zealand 2002, Ministry of Health. Page 59.
- <sup>10</sup> Annual Review of the Microbiological and Chemical Quality of Drinking-Water in New Zealand 2002, Ministry of Health. Table 11.6.
- <sup>11</sup> Letter to SKM of 10 January 2005, Canterbury District Health Board.
- <sup>12</sup> Annual Review of the Microbiological and Chemical Quality of Drinking-Water in New Zealand 2002, Ministry of Health. Appendix 4a.
- <sup>13</sup> Annual Review of the Microbiological and Chemical Quality of Drinking-Water in New Zealand 2002, Ministry of Health. Appendices 4a & 4b.
- <sup>14</sup> Annual Review of the Microbiological and Chemical Quality of Drinking-Water in New Zealand 2002, Ministry of Health. Appendices 11 & 12.
- <sup>15</sup> Drinking Water Standards for New Zealand 2000, Ministry of Health. Clause 3.2.4.
- <sup>16</sup> Standards Australia/Standards New Zealand, AS/NZS 4360: 1999 Risk Management
- <sup>17</sup> Standards Australia/Standards New Zealand, HB203:2000, Environmental risk management – Principles and process
- <sup>18</sup> Christchurch City Public Health Risk Management Plan 2004, Christchurch City Council