WAIMAKARIRI DISTRICT

2008 WAIMAKARIRI IRRIGATION SCHEME
Monitoring report on the impacts on the district of the introduction of irrigation on the upper Waimakariri - Ashley Plain in 1999/2000
WAIMAKARIRI IRRIGATION SCHEME

MONITORING REPORT ON THE IMPACTS ON THE DISTRICT OF THE INTRODUCTION OF IRRIGATION ON THE UPPER WAIMAKARIRI-ASHLEY PLAIN IN 1999/2000

JULY 2008
INDEX

PREFACE .......................................................................................................................... i

EXECUTIVE SUMMARY ...................................................................................................ii

1 INTRODUCTION........................................................................................................ 1
  1.1 Purpose of this Study .....................................................................................1
  1.2 The statutory framework .................................................................................1
  1.3 Scope of report ...............................................................................................3
  1.4 The research methods ....................................................................................3

2 INTRODUCTION TO IRRIGATION............................................................................ 5
  2.1 Early evidence of the value of irrigation..........................................................5
  2.2 20th Century developments in the District .......................................................6
      2.2.1 Individual initiatives in the mid 20th Century........................................6
      2.2.2 Collective initiatives in the mid 20th Century........................................6
  2.3 Waimakariri Irrigation Scheme .......................................................................7
      2.3.1 The establishment of Waimakariri Irrigation Limited ...........................7
      2.3.2 The Company .....................................................................................8
      2.3.3 Consents and the command area.......................................................9

3 ECONOMIC DEVELOPMENT ................................................................................. 12
  3.1 Community outcome.....................................................................................12
  3.2 Economic activity associated with the Waimakariri Irrigation Scheme .........12
      3.2.1 Overview ...........................................................................................12
      3.2.2 Ownership changes ..........................................................................13
      3.2.3 Off-farm development .......................................................................14
      3.2.4 On-farm development .......................................................................19
  3.3 Measuring changes in farming .....................................................................20
      3.3.1 1994 and 2006 Agricultural Production Censuses............................20
      3.3.2 Livestock numbers ............................................................................20
      3.3.3 Properties with dairy cattle ...............................................................22
      3.3.4 Sizes of properties with dairy cattle ..................................................22
      3.3.5 Numbers of dairy cattle on properties with dairy cattle .....................23
  3.4 Dairying in the Waimakariri District ...............................................................23
      3.4.1 Changes in the performance of dairying in the District 1998/9 – 2005/6 ..................................................23
      3.4.2 Comparative performance for dairying in the District 2005/6............24
      3.4.3 Income from dairying in the Waimakariri irrigation scheme command area.................................................................................................26
  3.5 Horticulture/Cropping....................................................................................26
  3.6 Employment opportunities ............................................................................27
      3.6.1 Introduction .......................................................................................27
      3.6.2 Employment trends in agriculture 1996 - 2006 ...................................28
      3.6.3 Services to Agriculture 2000 – 2006 ....................................................30
      3.6.4 Work opportunities for young people .................................................31
  3.7 Economic impact of irrigation .......................................................................31
      3.7.1 On farm production ...........................................................................31
      3.7.2 Impact on employment .......................................................................32
      3.7.3 Increased value of land ....................................................................32
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.7.4</td>
<td>District wide impacts</td>
<td>33</td>
</tr>
<tr>
<td>3.7.5</td>
<td>Relative economic impact</td>
<td>33</td>
</tr>
<tr>
<td>4</td>
<td>WATER</td>
<td>35</td>
</tr>
<tr>
<td>4.1</td>
<td>Community Outcome</td>
<td>35</td>
</tr>
<tr>
<td>4.2</td>
<td>Water quantity</td>
<td>35</td>
</tr>
<tr>
<td>4.2.1</td>
<td>Impact on groundwater</td>
<td>35</td>
</tr>
<tr>
<td>4.2.2</td>
<td>Impact on groundwater levels in Clarkville</td>
<td>39</td>
</tr>
<tr>
<td>4.2.3</td>
<td>Augmentation</td>
<td>41</td>
</tr>
<tr>
<td>4.3</td>
<td>Groundwater quality</td>
<td>42</td>
</tr>
<tr>
<td>4.3.1</td>
<td>Nitrate risk</td>
<td>42</td>
</tr>
<tr>
<td>4.3.2</td>
<td>Nitrate test results</td>
<td>42</td>
</tr>
<tr>
<td>4.4</td>
<td>Microbiological contamination</td>
<td>44</td>
</tr>
<tr>
<td>4.4.1</td>
<td>Methods of testing</td>
<td>44</td>
</tr>
<tr>
<td>4.4.2</td>
<td>Sources of contamination</td>
<td>45</td>
</tr>
<tr>
<td>4.4.3</td>
<td>Waimakariri-Ashley plain testing</td>
<td>45</td>
</tr>
<tr>
<td>4.4.4</td>
<td>E.coli detected</td>
<td>45</td>
</tr>
<tr>
<td>4.4.5</td>
<td>Impact of irrigation</td>
<td>47</td>
</tr>
<tr>
<td>4.5</td>
<td>Surface Water Quality</td>
<td>48</td>
</tr>
<tr>
<td>5</td>
<td>LAND AND LANDSCAPE</td>
<td>49</td>
</tr>
<tr>
<td>5.1</td>
<td>Community Outcomes</td>
<td>49</td>
</tr>
<tr>
<td>5.2</td>
<td>Soil Structure</td>
<td>49</td>
</tr>
<tr>
<td>5.3</td>
<td>Rural character</td>
<td>50</td>
</tr>
<tr>
<td>5.3.1</td>
<td>District Plan provisions</td>
<td>50</td>
</tr>
<tr>
<td>5.3.2</td>
<td>Impact of the irrigation scheme on rural character</td>
<td>51</td>
</tr>
<tr>
<td>6</td>
<td>INDIGENOUS VEGETATION</td>
<td>55</td>
</tr>
<tr>
<td>6.1</td>
<td>Community Outcome</td>
<td>55</td>
</tr>
<tr>
<td>6.2</td>
<td>District Plan provisions</td>
<td>55</td>
</tr>
<tr>
<td>6.3</td>
<td>Sites in the Waimakariri irrigation scheme command area</td>
<td>56</td>
</tr>
<tr>
<td>6.3.1</td>
<td>Sites deleted</td>
<td>56</td>
</tr>
<tr>
<td>6.3.2</td>
<td>Site destroyed and replaced in mitigation</td>
<td>56</td>
</tr>
<tr>
<td>6.3.3</td>
<td>State of sites</td>
<td>57</td>
</tr>
<tr>
<td>7</td>
<td>ROADING</td>
<td>61</td>
</tr>
<tr>
<td>7.1</td>
<td>Community Outcome</td>
<td>61</td>
</tr>
<tr>
<td>7.2</td>
<td>Patterns of road use in the command area</td>
<td>61</td>
</tr>
<tr>
<td>7.3</td>
<td>Effect on roads</td>
<td>63</td>
</tr>
<tr>
<td>8</td>
<td>CORE UTILITY SERVICES</td>
<td>64</td>
</tr>
<tr>
<td>8.1</td>
<td>Community Outcome</td>
<td>64</td>
</tr>
<tr>
<td>8.2</td>
<td>Electricity</td>
<td>64</td>
</tr>
<tr>
<td>8.3</td>
<td>Telecommunications</td>
<td>65</td>
</tr>
<tr>
<td>9</td>
<td>CONCLUSION</td>
<td>66</td>
</tr>
<tr>
<td>9.1</td>
<td>Overview</td>
<td>66</td>
</tr>
<tr>
<td>9.2</td>
<td>Further changes and challenges</td>
<td>68</td>
</tr>
</tbody>
</table>
**INDEX OF TABLES**

Table 3:1  Waimakariri District: Livestock numbers 1994 and 2002 ................. 21
Table 3:2  Waimakariri District: Dairy herd performance 1998/9 and 2006/7 ....... 24
Table 3:3  Waimakariri District: Comparative dairy herd 2006/7 .................... 25
Table 3:4  Waimakariri District: 1996, 2001, and 2006 People working on farms and people working in agricultural services (workplace workforce) .............. 28
Table 3:5  West of District: 1996, 2001, and 2006 People working on farms and people working in agricultural services (workplace workforce) ................... 28
Table 3:6  Waimakariri District - People employed on dairy farms by area 1996, 2001, and 2006 (workplace workforce) ................................................. 29
Table 3:7  Waimakariri District: Businesses providing services to agriculture and number of employees 2000 and 2006 ................................................. 30
Table 4:1  Nitrate monitoring of key wells on the Waimakariri-Ashley plain ........ 43
Table 7.1  West of District: Usually resident population and occupied dwellings . 62
PREFACE

I welcome the publication of this report which assesses the impact thus far of the introduction of irrigation to the upper Waimakairi-Ashley plain with the commencement of the Waimakariri irrigation scheme in the summer of 1999/2000. This was a very significant development for the District and for the people who joined the scheme. It is also one that the Council has been pleased to support.

My Council is also very conscious of its responsibilities under the Resource Management Act to monitor the state of the environment, and under the Local Government Act to report regularly on progress towards Community Outcomes. This report does both, but only in so far as it focuses on the impact of the irrigation scheme. This means that when reviewing such critical issues as those associated with ground water, it is only seeking to identify changes that have occurred during the period since 2000 where these are known and measurable and assess the extent to which these could be attributable to the introduction of the scheme.

In this context, I am also pleased to advise that this report is the first of a series of papers that the Council will be preparing during 2008 dealing with the state of various aspects of the environment as well as focusing on the key issues for the District identified in the Community Outcome Statement in the Council’s 2006 – 16 Long Term Council Community Plan.

On behalf of the members of the Council's Policy and Strategy Unit who prepared this report, I would also like to acknowledge the assistance they received from all those approached for information.

Ron Keating
Mayor
EXECUTIVE SUMMARY

1 Introduction

The study provides an assessment of the impact of the Waimakariri irrigation scheme, which began operation in the summer of 1999-2000 in the Waimakariri District.

The scheme was a farmer led initiative supported by the Waimakariri District Council, in response to the economic restructuring of the 1980s and the droughts of the 1980s and 1990s.

The scheme takes water from the Waimakariri River, and is based on the stock water race system developed in the late 1890s and early 1900s. It serves an area of approximately 40,000 hectares on the upper Waimakariri–Ashley plain, and provides water to irrigate about 18,000 hectares or approximately 45 percent of the total command area.

The study was undertaken by the Council’s Policy and Strategy Unit to fulfil the Council’s monitoring obligations under the Resource Management Act 1991, and to monitor progress towards Community Outcomes required by the Local Government Act 2002.

The report focuses on the scheme’s effect on economic activity in the District, groundwater quality and quantity on the Waimakariri-Ashley plain, land and landscape, significant Kanuka sites protected in the District Plan, and the demand for and use of public infrastructure.

This study does not address issues associated with resource consent compliance by either Waimakariri Irrigation Ltd. (WIL) or the farms that take water from the irrigation scheme. Neither does it provide an assessment of the effectiveness of the Waimakariri River Regional Plan, the resource management plan that controls the taking of water from the Waimakariri River.

2 The scheme

The initial feasibility study for the scheme was completed in 1991, and in 1993 further investigations were done to confirm the value of supplementing the Cust River and the Ashley River/Rakahuri, and the groundwater through the Eyre gravels.

The co-operative company, Waimakariri Irrigation Ltd (WIL) was formed in 1998 to run the scheme. The initial establishment costs were just under $7.3 million, which was funded from the sale of shares and loans. The Waimakariri District Council provided an interest free loan to cover the cost of the resource consent applications, and guaranteed construction loans for at least the first five years.

By April 2005 the Company had 269 shareholders, with a majority of shareholders having fewer than 50 shares. In 2007 the ten largest shareholders held 35 percent of the total number of shares allocated, and the two largest shareholders Landcorp Farming Ltd. and Ngai Tahu Forest Estates Ltd held 12 percent of the shares.

The Company initially held a resource consent to take 5.5 cumecs of water from the Waimakariri River for irrigation and this has been progressively increased to 10.5
cumecs, which includes 1.5 cumecs initially allocated to the Company for the trialling of augmentation of the Eyre River. Also in 2007 it purchased a farm close to the scheme’s headworks to allow the development of storage capacity to supplement the water available from the Waimakariri River.

The Company operates the District’s stock water scheme on behalf of the Waimakariri District Council.

3. **Economic activity**

3.1 **Establishment**

Increased economic activity associated with the Waimakariri irrigation scheme can be divided into the establishment phase and the ongoing farming activity based on irrigation.

The change of ownership of land in conjunction with the establishment of an irrigation scheme has been seen in a number of areas in Canterbury and North Otago, and this also occurred in the Waimakariri District. A number of the District’s larger farms in the command area changed hands in the late 1990s and early 2000s.

The irrigation company was responsible for the development of the scheme’s headworks, including the intake, the raceway to the top of the terrace, and the enlargement of the stockwater races to form the headrace and other main races.

The total on-farm expenditure was significantly greater than that by WIL. An example is provided of the conversion of one farm for dairying that was estimated to have cost approximately $9 million including the cost of the land, buildings, re-fencing, establishment of new pastures, and purchase of livestock.

Locally based contractors undertook much of the work involved with the establishment of the scheme. Other work, including the construction of a number of the new dairy sheds, was undertaken by contractors from out of the district.

3.2 **Increased production**

Most of the information concerning the increased production resulting from the introduction of the irrigation scheme concerns the new dairy farms.

While the information available deals with all the District’s dairy farms the changes recorded are mainly attributable to the introduction of the irrigation scheme, as some of the smaller farms to the east of the District have been replaced by larger farms within the command area.

A comparison of the District’s livestock as recorded by the 1994 and 2002 Agricultural Censuses prior to and three years after scheme introduction show an increase of 27,172 (133.3%) in the number of dairy cattle, and a decrease of 152,210 (26.0%) in the number of sheep. The number of farms reporting having dairy cattle also increased from 174 in 1994 to 220 in 2002. There was also a significant increase in the number of farms of 100 hectares or more with dairy cattle in 2002 compared with 1994.

The herd data provided by the Livestock Improvement Co-operative (LIC) also provides evidence of the magnitude of the increase in production on the District’s dairy farms, largely attributable to the introduction of the irrigation scheme. A
comparison of the LIC records for the District for 1998/9 and 2006/7 show a decrease in the number of dairy herds of 3, from 70 to 67. Despite this there has been an increase of 89 percent in the total number of cows and an increase of 98 percent in average herd size. The average size of dairy farms has increased by 64 hectares or 70 percent, while the milkfat yield per hectare is up by 60 percent, and the average milkfat per cow is 58 percent higher in 2006/7 than in 1998/9.

Information about the increases in production on farms utilising water from the irrigation scheme not involved with dairying is limited, but at least one example is given in the report of the changes that have been made by one of the District's established farming families involving with sheep and cropping.

Information about the increases in employment on farms or in providing services to agriculture in the District is also limited. Data from the 1996, 2001 and 2006 Census of Population and Dwellings show the number of people involved in dairy farming in the west of the District has increased from 51 people in 1996 to 147 people in 2006. The number of people working in business providing services to agriculture in the District as recorded at Census time has increased over the period, but the numbers involved in 2006 still remain relatively small at 186 people.

The information available from Statistic New Zealand's Business Demographic series which deals with businesses enrolled with the Inland Revenue Department for GST shows more significant growth in services to agriculture for District based businesses. Between 2000 and 2006 there was an increase or 33 percent (64) in the number of businesses, and an increase of 55 percent (100) in the employee count. In addition there was an increase of 41 percent (65) in the number of businesses without employees providing services to agriculture, and most of these are likely to involve independent contractors.

The value of farm land in the command area for the irrigation scheme has increased significantly, and a premium is being paid for land when the purchaser is also able to obtain shares in WIL.

The precise economic impact of the irrigation scheme on the District is not easy to assess because of data limitations coupled with the District's proximity to Christchurch City, and the extent of ownership of many of the District's new dairy farms by interests based outside of the District.

4 Water

4.1 Water Quantity

Environment Canterbury undertakes water quantity monitoring across the Waimakariri-Ashley plain. This monitoring would appear to indicate that the introduction of the Waimakariri irrigation scheme has had a positive impact on groundwater levels in the centre of the plain. In the relatively dry summer of 2007/8 wells at Bennetts and Swannanoa recorded constant groundwater levels, when in previous dry years they have shown significant reductions in groundwater levels.

When the irrigation scheme was proposed there was considerable concern among residents in the Clarkville area about the possibility that they would encounter additional drainage problems because of the water applied to the upper plain. A review of the readings from monitor wells in the Clarkville area indicate that there has been no increase in ground water levels since the commencement of the irrigation scheme in 1999/2000.
The apparent support being provided by the irrigation scheme for groundwater levels in the central Waimakariri-Ashley plain is also likely to be providing support for the confined aquifer that is beneath Kaiapoi.

4.2 Water Quality

The possibility of increased levels of nitrates in the groundwater of the Waimakariri-Ashley plain was one of the main risks associated with the introduction of the irrigation scheme. Elevated nitrate levels in groundwater would pose a threat to health, especially for the rural households on the Waimakariri-Ashley plain that draw household water from private wells.

Nitrate contamination comes from the cultivation of farmland, animal excreta and fertilizers. Such contamination is more likely to occur on light shingle based land, such as that to the west of the Waimakariri-Ashley plain as on the heavier clay or peat based soils to the east of the plain.

Monitoring to date by Environment Canterbury has shown no increase in the nitrate levels in the monitor wells in the command area, or to the east of this area. A key well to the east of the command area at Ohoka has shown a decrease in nitrate readings since the introduction of the irrigation scheme. While it is relatively early to draw firm conclusions about the impact of the irrigation scheme on groundwater quality, the improvement in the nitrate readings from the Ohoka well is encouraging.

A review of the tests for microbiological contamination that have been undertaken by Environment Canterbury at varying intervals from 14 wells in the command area and to the east of that area in the unconfined aquifer indicate that there has been little change in the level of E.coli present in these test. For two of three wells that have recorded E.coli in four or more tests since 2000, the source of contamination is considered by Environment Canterbury to be most likely to be from older style on-site sewage and wastewater disposal systems (septic tanks).

5 Land and landscape

5.1 Land

No monitoring of soils being irrigated with water from the scheme has been undertaken, but it can be reasonably confidently assumed that there is little likelihood of the quality of the soils being adversely affected by the introduction of irrigation.

5.2 Landscape

Farming under irrigation has resulted in significant changes in the landscape. The introduction of the irrigation scheme, however, can be assessed as having contributed to the maintenance of rural character in the command area. The District Plan identified key characteristics of rural character as including the dominant effect of paddocks, trees, natural features and agricultural pastoral or horticultural activities, and a sense of openness.

A major change in the landscape that has accompanied the establishment of many of the major dairy farms has been the removal or severe topping of shelter belts to allow for the operation of centre pivot irrigators. This can be seen as having enhanced the sense of openness in parts of the command area as vistas have opened up that were previously closed by belts of shelter trees.
6 Indigenous vegetation

In Eyrewell, to the south of the command area, there are a number of areas of significant indigenous vegetation and habitats for indigenous fauna that are protected in the District Plan under S 6 (c) of the Resource Management Act 1991.

The majority of indigenous vegetation sites in the command area for the irrigation scheme are kanuka sites. Kanuka is considered an iconic dryland species on the Canterbury plains.

During the establishment of the irrigation scheme, which co-incided with the notification of the Proposed Waimakariri District Plan some difficulties were encountered with the stands of Kanuka identified as potential sites for listing in the District Plan. For example, one site was destroyed by its owners, without any consultation with the Council, and this lead to formal enforcement action by the Council. This case was resolved when the owner offered another Kanuka site for protection. The inclusion of a further site was challenged under a reference to the Environment Court in 2001, and this case was also resolved by the inclusion of another site on the same property being included in the District Plan. It was estimated at the time that approximately 10 percent of the 94 hectares of protected Kanuka was lost during the adaptation of farms for irrigation in 1999-2001.

In 2006 the Waimakariri District Council monitored all the vegetation sites protected in the District Plan. This monitoring showed that 11 of the 20 sites in the command area were in good health, 5 were in moderate health, and 2 were in a degraded state. The other two sites were not evaluated, and one of these is a site that now has a QEII Trust covenant. The other is the pomaderris site on the northern boundary of the Eyrewell Forest.

7 Roading and infrastructure

The introduction of the irrigation scheme on the upper Waimakariri-Ashley plain resulted in a significant increase in the volumes of traffic on roads in the area, particularly heavy traffic associated with the new dairy farms. In 2001 there were 10 milk tankers leaving the west of the District taking milk to Temuka, and by 2007 a total of 34 milk tankers were leaving the District as a whole with 26 or 27 of these servicing the dairy farms to the west of Cust at the height of the season.

Estimates of the increase in traffic in the command area by the Waimakariri District Council's Technical Services Unit show that the estimated number of kilometers travelled increased from approximately 84,300 in 2000 to 121,500 in 2007. The greatest percentage increases were estimated to have occurred were 9.7 percent between 2001 and 2002, 11.0 percent between 2002 and 2003, and 12.3 percent between 2003 and 2004. After 2004 the rate of increase in the estimated kilometers travelled in the command area has been minimal.

While a significant proportion of this increase can be attributed to the introduction of the irrigation scheme, it is also important to recognize that there was significant growth in the number of people living in the area between 2001 and 2006. The 2006 Census indicates that the areas to the west of the Waimakariri District recorded a increase of 1017 (23.0 percent) in the number of people and a increase of 390 (24.3 percent) in the number of dwellings in the area between 2001 and 2006.
The commencement of the irrigation scheme in 1999-2000 also resulted in a significant increase in the demand for electricity in the command area. MainPower New Zealand Ltd., the District’s electricity lines company, reports that the supply of electricity to the command area has increased from 25 megawatts per annum in 2000 to 39 megawatts in 2007. The company estimates that approximately 8 megawatts of this 9 megawatt increase is attributable to the introduction of irrigation.

In order to meet the increased demand MainPower has upgraded substations at Oxford and Cust, and in 2008 is contributing a new substation at Swannanoa. It has also upgraded a number of the main power lines into the command area, such as the line along Tram Road.

Telecommunications in the District, including the command area for the irrigation scheme are constrained by the inability of Telecom NZ Ltd to provide broadband internet services via phone line. The irrigation company uses its website to advise farmers of interruptions in supply because of low flows in the Waimakariri River, and the areas receiving water when the supply is reduced. Many of the farmers on the scheme, therefore, have to rely on a much slower dial-up service, or install more costly wireless or satellite services.
1 INTRODUCTION

1.1 Purpose of this Study

This study provides an assessment of the impact of the Waimakariri irrigation scheme on the Waimakariri District. In the summer of 1999-2000 Waimakariri Irrigation Limited (WIL) began to deliver irrigation water to farms lying to the west of the Waimakariri District between the Waimakariri River and the Ashley River/Rakahuri. The scheme was initiated by the District’s farmers in response to the severe droughts experienced during the 1980s, with support from the Waimakariri District Council.

This “run of the river” community irrigation scheme, takes water from the Waimakariri River close to the Waimakariri Gorge Bridge, and sends it across a command area of approximately 40,000 hectares via a system of races based on a network of stock water races, that date from the 1890s. The scheme involved adapting approximately 250 kilometres of the 800 kilometres of water races to provide a combined stock water and irrigation scheme. Although the command area for this scheme is approximately 40,000 hectares only about 18,000 hectares of this area is irrigated.

When the Waimakariri Irrigation Scheme commenced in 1999-2000 the community had high hopes that it would rejuvenate farming in the area, which had been hard hit by droughts and the economic restructuring during the previous 15 – 20 years. From the outset the Waimakariri District Council recognised the importance of monitoring the impact of the scheme on the District, and this report is the first attempt to review the effects of the introduction of irrigation to a previously drought prone area.

1.2 The statutory framework

This study has been undertaken to meet Council’s monitoring obligations under the Resource Management Act (RMA) 1991 and Local Government Act (LGA) 2002. These statutes require the Council to undertake state of the environment monitoring and to monitor progress toward the District’s Community Outcomes respectively.

The RMA S.31 requires that:

(1) Every territorial authority shall have the following functions for the purpose of giving effect to this Act in its district:

(a) The establishment, implementation, and review of objectives, policies, and methods to achieve integrated management of the effects of the use, development, or protection of land and associated natural and physical resources of the district.

While RMA S.35 requires that:

(1) Every local authority shall gather such information, and undertake or commission such research, as is necessary to carry out effectively its functions under this Act.

(2) Every local authority shall monitor—
(a) The state of the whole or any part of the environment of its region or district to the extent that is appropriate to enable the local authority to effectively carry out its functions under this Act; and

(3) Every local authority shall keep reasonably available at its principal office, information which is relevant to the administration of policy statements and plans, the monitoring of resource consents, and current issues relating to the environment of the area, to enable the public—

(a) To be better informed of their duties and of the functions, powers, and duties of the local authority; and

(b) To participate effectively under this Act.

The LGA 2002 introduced major changes in the planning framework for councils, which included a requirement for councils to consult with their communities to establish their priorities. The results of these consultations are carried through into Long Term Council Community Plans, as statements of Community Outcomes. The Waimakariri District’s Community Outcomes are, therefore, a statement of general aspirations dealing with a wide range of matters, some well beyond the scope of the Council’s own activities. Despite this, the Council has a responsibility to report progress towards the achievement of Community Outcomes at least every three years.

The relevant provision of the LGA 2002 with regard to monitoring is set out in S.92(1):

A local authority must monitor and, not less than once every three years, report on the progress made by the community of its district or region in achieving the community outcomes of the district or region.

The Waimakariri District Council has decided that, as far as possible, it will integrate its monitoring responsibilities under the LGA 2002 with its obligations under the RMA 1991. This approach is considered appropriate, because there is significant overlap between the District’s 2006-12 Community Outcomes and the environmental monitoring required under the RMA 1991.

The main 2006 - 2016 Waimakariri District Community Outcomes relevant to this study of the impact of irrigation on the Waimakariri District are:

- Businesses in the District are diverse, adaptable and growing
- There is sufficient clean water to meet the needs of communities and ecosystems
- There are areas of significant indigenous vegetation and habitats for indigenous fauna
- Core utility services are provided in a timely, sustainable and affordable manner
- Transport is accessible, convenient, reliable, affordable and sustainable
1.3 Scope of report

This report focuses on the following themes:

- The increase in economic activity and the growth of employment attributable to the scheme
- The results of water quality and quantity monitoring since the commencement of the scheme
- The impact on land and landscape
- The effect that the introduction of irrigation has had on areas of significant indigenous vegetation, in particular the areas afforded protection under the District Plan
- The changes provision of infrastructure and the impact on the roading network to the west of the District attributable to the introduction of the scheme

This report does not consider the controls on the taking of water from the Waimakariri River for irrigation in the Waimakariri River Regional Plan (WRRP) from a plan effectiveness monitoring perspective. The WRRP is the resource management plan administered by Canterbury Regional Council, Environment Canterbury that controls the taking of water from the Waimakariri River for irrigation and other purposes. Also, the report does not review matters associated with resource consent compliance, either by Waimakariri Irrigation Ltd. itself or by those managing properties that take water from the scheme. Both these are matters for which Environment Canterbury has primary responsibility.

1.4 The research methods

This report is based on information obtained from a range of sources, including:

- Interviews with people associated with Waimakariri Irrigation Limited, and others in a position to provide information about the impact of irrigation on their farming practices and/or the wider community
- Telephone conversations and e-mail communications with individuals and organisations able to provide information about the changes that had occurred since the commencement of the irrigation scheme in 1999/2000
- Official statistics from recent National Censuses, the Business Demographic Series and Agricultural Production Censuses conducted by Statistics New Zealand

While official data provides some useful information about the changes that have occurred in the District's agricultural sector in recent years, there are limitations associated with this data. For example, Agricultural Production Census statistics for 1994 and 2002 are only available at District level, rather than the area serviced by the scheme, referred to as the command area, specifically. The results from the 2007 Agricultural Production Census were not available at the time that this report was finalised. More detailed data about employment is available from the National Census of Population and Dwellings. The National Census, however, only gives a “snapshot” of the situation every five years, and details about secondary employment are not collected. Information is collected annually for the Business Demographic Series, but this statistical series only included businesses that provide services to
agriculture and does not collect information about what is happening on farms. In addition the employee counts reported in this series capture only people who are paid via the PAYE taxation system, and does not enable people who are working full-time to be distinguished from those working part-time. Independent contractors registered for GST and paying tax via the provisional system are only captured as businesses without employees by the Business Demographic Series.
2 INTRODUCTION TO IRRIGATION

2.1 Early evidence of the value of irrigation

During early European settlement, the Canterbury Association saw North Canterbury as an area for agricultural settlement. Hawkins in *Beyond the Waimakariri: A Regional History* describes farming in the 19th Century in part of the area now served by the Waimakariri Irrigation Scheme.

"The first thirty years in the development of farm technique made little impact on the upper Eyre country, where, with the exception of a few good pockets, the land was still supporting a low sheep population. In 1890 there were still thousands of acres of manuka on Eyrewell, Worlingham and Burnt Hill, and on land so light and shingly as to be almost useless. This was part of a poor strip which extended across the upper plains into South Canterbury, but Reed of Westerfield and Cameron of Springfield had proved as early as the 1870’s that it responded well to water. A few water races had been dug as a small private venture at View Hill, and these had been taken over by the Oxford Road Board during the early ‘eighties. The Eyre settlers above Swannanoa were frequently plagued with droughts, and on these occasions their wells dried up and they often had to travel several miles by dray, on horseback, or on foot to get water in drums and buckets. In October 1890 Philip Threlkeld presented the Eyreton Road Board a petition signed by fifty ratepayers asking that they be provided with a water-race system. A Water-race Board was set up, but Marmaduke Dixon, the greatest single occupant of this poor land, decided to experiment on his own.

Hawkins continues to explain Dixon’s early experiments:

Assisted by the younger Marmaduke, with four two-horse teams he dig [sic] an eleven-foot wide cutting through the banks of the Waimakariri and out onto Eyrewell, and with the aid of local artisans fitted it with a controlling sluice gate. On 28 December 1891 he showed the results to a large gathering of farmers – a once useless 250-acre block already covered with a vigorous growth of grass. To confound the sceptics he exhibited the shingly water-race floor sealed with silt. He also showed Doyne’s original contour map, from which he had done all his levelling and which showed plenty of fall. He estimated that the original outlay of under two hundred pounds would be recouped in two seasons. He also claimed that by digging a second channel higher up, and utilising flood water, the land served by the two cuttings would gain 10,000 yards of silt after one flood.

This account of Dixon’s early experiments indicates that farmers had clear evidence of the results that could be achieved from irrigation on the light land in the District, as early as the late 19th Century. Hawkins then explained the events associated with the setting up of the Water-Supply Board, and the origins of the District’s stock water race system.

In the meantime the Oxford system had been extended almost to The Warren and it was Dixon’s idea to link this system with his own and to continue it down through the Eyre country. His own success aroused temporary enthusiasm, but a new Water-Supply Board which appeared in 1892 was elected in a most perfunctory manner. Unfortunately Dixon and the Board could not agree on an intake site. After the Board had turned down Dixon’s offer to dig a channel from Brown’s Rock to the Warren for £4,000 because it was thought that such a scheme would benefit only Dixon on Eyrewell, it countered with a scheme based on intakes at Rockford and Woodstock. It is not necessary to go into the squabble into which this matter degenerated, but it is
sufficient to say that the position was regularised by an Act of Parliament which in 1894 constituted the Waimakariri-Ashley Water-Supply Board, a body which was composed of representatives of the Oxford, Eyreton, West Eyreton, Cust, and Rangiora and Mandeville districts. By 1900 the Board, which had its headquarters in Oxford, had spent $25,000 on the supply of water to thousands of acres of poor land, and had five hundred miles of water-races throughout the district.” (pp.319-320)

This account raises the issue of what would have happened if the members of the new Board had agreed with Dixon. It prompts speculation about whether the District would have had a large-scale irrigation scheme using water from the Waimakariri River about a hundred years earlier, if a few key people had held different views. That the Waimakariri-Ashley Water-Supply Board, nevertheless, established five hundred miles of water-race system over a 6 year period with the technology of the times, illustrates the magnitude of its initiative. It was one that was ultimately to provide the foundation for the Waimakariri irrigation scheme a century later.

2.2 20th Century developments in the District

2.2.1 Individual initiatives in the mid 20th Century

During the 1970’s and 80’s, irrigation became well established in a number of areas within the District, using ground water from wells or surface takes from the District’s rivers. The majority of the wells that were yielding sufficient water for irrigation were to the east of the present command area for the Waimakariri Irrigation Scheme in the Eyreton, Ohoka and Clarkville areas, or to the east of Rangiora in the Waikuku/Woodend area. Some water was being taken from the Waimakariri River for irrigation in the Eyreton area. There was also some run of the river takes for irrigation from the Ashley River/Rakahuri, and from wells adjacent to this river.

Some of the wells to the east of the command area, particularly to the west of Ohoka, were subject to significant fluctuations in ground water level and a number regularly failed in dry seasons. Other farmers in this area spent considerable sums of money unsuccessfully drilling for irrigation water. During mid-late 1990s a few deep wells were drilled to the west of the District. Most notable of these wells was one drilled at “Lythem” on the South Eyre Road near Oxford, which yielded significant quantities of high quality water.

2.2.2 Collective initiatives in the mid 20th Century

A number of large-scale irrigation schemes were developed with substantial government funding in the mid-20th Century. These included schemes in South Canterbury and North Otago. A scheme was also developed during the 1980s in the Amuri area of Hurunui District the use of water from the Waiau River. Those farming on the Waimakariri-Ashley plain also showed some interest in irrigation during this period.

In the mid 1970’s, following a severe drought, a group from the Oxford Branch of Federated Farmers met with the North Canterbury Catchment Board and the Oxford County Council, to discuss the potential for irrigation. Farmers found themselves opposed by jet boat users and fishermen. Two meetings were held but nothing eventuated.
In 1983 a further attempt was made to plan an irrigation scheme for around 12,000 hectares to the west of the District, which would have involved taking water from the Waimakariri River via an intake from under the Gorge Bridge. By that time, however, the government was no longer funding irrigation schemes. This initiative also lapsed because of lack of finance.

A common feature of these proposals for a scheme to irrigate land to the west of the District was that the existing stock water race system was not considered as part of the concept. This has been attributed to the fact that the stock water races spanned the Oxford and Eyre County and Rangiora District Council areas. Those involved suggest that it was only when these local bodies came together with the creation of the Waimakariri District in 1989, that this option was recognised.

2.3 Waimakariri Irrigation Scheme

2.3.1 The establishment of Waimakariri Irrigation Limited

After a further drought in the summer of 1988-1989, farmers living in the west of the District become even more acutely aware of the value of irrigation, but the ground water in the area was insufficient to provide a reliable source for irrigation. Momentum gathered and a feasibility study was undertaken, which resulted in a proposal for a scheme based on the development of the existing stock water races into irrigation channels.

In early 1989 a committee, the Waimakariri Ashley Water Management Scheme Committee, was formed to oversee the investigation of the feasibility of using the stock water race system as the basis for an irrigation scheme. A preliminary investigation was completed in 1990, and in September that year the Irrigation Committee called a public meeting at Cust to discuss the potential of a combined irrigation and stock water scheme. This meeting, which was attended by approximately 250 people, almost unanimously agreed that a full feasibility study should be undertaken.

The full feasibility report was completed in mid 1991, which confirmed the benefits that would eventuate from the development of the proposed scheme. In 1993 further investigations were done which confirmed the value of supplementation of the Cust River and Ashley River/Rakahuri, and the augmentation of groundwater through the Eyre gravels.

Trevor Inch, the Waimakariri District Mayor from 1989 to 1995, and before that the Chairman of the Rangiora District Council, was the Chairman of the Scheme Committee. He was also instrumental in seeing that the Waimakariri District Council played a significant role during the planning stages. The Waimakariri District Council support for the scheme included providing an interest free loan to cover the cost of the resource consent application, and guaranteeing construction loans for the first five years.

In 1998, the Scheme Committee handed over the development and subsequent management of the scheme to a co-operative company, Waimakariri Irrigation Limited. The original directors appointed by shareholders were Donald Young (Chairman), Robert Spark and Roscoe Taggart (both members of the previous Committee), Gerald Clemens and Richard Allison. At that stage, the Council had two directors, Messrs Trevor Minchington (the Council's then Drainage Asset Manager)
and Leicester Steven. Mr. Steven retired as a Director in 1999, and Gareth James (the Council’s then Services Manager) was appointed to take his place. In 2007 the directors were Gerald Clemens (Chairman) Richard Allison, Andrew Mehrtens, Graeme Sutton with David Viles, the Council’s appointee.

The extent to which the irrigation scheme was seen, at the outset, as a community scheme is reflected in the closing comments in the Chairman’s report, in the company’s 2001 Annual Report.

“Finally, to all of the farmers and others in the District, shareholders and non-shareholders alike, I would like again to commend the very strongly supportive attitude that has prevailed right through the construction period, our first two years of operations, and continues today.

Without this support we would not have an effective scheme which is now poised, this year, to bring significant financial and employment benefits of between $80 million and $120 million to many of our shareholders and the District, provided that the flows in the Waimakariri River allow our irrigators to garner the full benefits of the water they require. That remains a fervent hope.”

2.3.2 The Company

The initial cost of the scheme was just under $7.3 million. In addition, to the initial seed funding provided by the Council, the scheme was funded by fixed rate loans of $3.3 million and by capital from 250 shareholders of $4.04 million. Since the opening of the scheme in 1999, the company has doubled in size.

Shares were issued over a period with:

- 11,000 A class shares issued at $364 each on 7 August 1999.
- 3,000 B class shares issued at $400 dollars each on 1 December 2000.
- 4,000 C class shares issued at $510 each during 2002.

The number of shares that a farmer can hold is determined by the area of land owned within the area covered by the scheme. Farmers can hold fewer shares than the number to which they could be entitled, given the area of land they own within the command area. Shareholding in the company is necessary for a farmer to have access to water from the scheme.

With each share offering the system was upgraded, which included the construction of larger culverts. Today, a number of the races are larger than presently required to service existing shareholders, to allow for some change in the distribution of shareholding, and thus the delivery of water, across the command area in the future.

Shares can be traded with the company’s permission. When requests to transfer shares are received, it needs to ensure that when shares are transferred they can be serviced, i.e. that appropriate irrigation infrastructure, is available in that part of the scheme to deliver water in the amounts represented by the shareholding.

It costs each landowner $500 a year to maintain the race system (over and above the cost of shares) and this charge is payable irrespective of whether water is used in that year. The introduction of this charge is understood to have prompted some early sales of WIL shares by landowners not using the water from the scheme to which they would have been entitled.
Landowners who bought shares when first offered were able to buy these at lower prices compared with those who bought shares in the subsequent issues. Recent reports indicate that WIL shares are now changing hands for in excess of $1000.00 per share.

In April 2005 the Companies Office records showed that WIL had 269 shareholders, with a relatively high percentage having fewer than 20 shares. At that time, the distribution in terms of the numbers of shares held was:

<table>
<thead>
<tr>
<th>Shares Range</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fewer than 20 shares</td>
<td>128</td>
<td>(47.5%)</td>
</tr>
<tr>
<td>20 – 49 shares</td>
<td>62</td>
<td>(23.1%)</td>
</tr>
<tr>
<td>50 – 99 shares</td>
<td>26</td>
<td>(9.7%)</td>
</tr>
<tr>
<td>100 – 149 shares</td>
<td>24</td>
<td>(8.9%)</td>
</tr>
<tr>
<td>150 – 199 shares</td>
<td>6</td>
<td>(2.2%)</td>
</tr>
<tr>
<td>200 – 299 shares</td>
<td>8</td>
<td>(3.0%)</td>
</tr>
<tr>
<td>300 – 499 shares</td>
<td>11</td>
<td>(4.1%)</td>
</tr>
<tr>
<td>500 or more shares</td>
<td>4</td>
<td>(1.5%)</td>
</tr>
</tbody>
</table>

Many of the people with small shareholdings purchased shares during the first issue, and some could well have seen their share purchases at that stage as support for the fledgling company, rather than as a serious indication of an intention to farm under irrigation.

By 2006 there were very few shares unallocated, and there had been some minor changes in shareholding since April 2005.

The largest shareholders in the Company in late 2007 were:

- Landcorp Farming Ltd 1,200 shares
- Ngai Tahu Forest Estate Ltd 1,036 shares
- Malbon Dairy Farms Ltd 755 shares
- Schouten Farms Ltd 685 shares
- Netherland Holdings Ltd 563 shares
- Tamara Farms Ltd 465 shares
- Taggart Family 407 shares
- Evans and Mulholland 375 shares
- Macaulay Family 365 shares
- Inch Family 362 shares

It should be noted that by April 2007 Netherland Holdings had increased its shareholding from 423 shares to 563, thus increasing the number of shareholders with 500 or more shares to five. At that stage approximately 35 percent of the shares were held by the ten largest shareholders, and 12 percent by the two largest shareholders.

### 2.3.3 Consents and the command area

The command area for the Waimakariri irrigation scheme, shown in the map below, is an area north of the Waimakariri River, east of Oxford, south of the Ashley River/Rakahuri, and covering much of the farmland to the west of Rangiora.
The command area covers approximately 40,000 hectares, although the amount of water available means that only about 18,000 hectares is being irrigated with water from the scheme.

The taking of water from the Waimakariri River is regulated under the Waimakariri River Regional Plan (WRRP). This Plan establishes a system of priority takes. Stock water and water for community water schemes has priority over irrigation takes, and the irrigation takes are divided between A and B takes, with the 22 cumecs allocated to A takes having priority over the B takes.

The WRRP requires the taking of water by A permit holders to cease when the flow in the river reaches 41 cumecs, as measured at the Old Main North Road Bridge. When the WRRP was made operative in 2004 Environment Canterbury was able to introduce a sharing regime, which means that the amount of water that can be taken by A permit holders declines in proportion to the decline in the river level as the river level falls below 63 cumecs to its minimum level for abstraction for A permit holders of 41 cumecs.

The original stock water race scheme continues to provide water to properties not involved with the irrigation scheme, and the Company operates this scheme on behalf of the Waimakariri District Council under separate consent conditions.

The resource consent CRC000585 initially allowed the Company to take A permit water from the river “for irrigation water supply, augmentation of groundwater surrounding the Eyre River and augmentation of surface water flows in the Cust River, Cust Main Drain and Ashley River.”

Originally, this consent was for 5.5 cumecs, but in 2001 the take was increased to 7 cumecs, and in 2004 it was increased again to 9 cumecs. In 2007 further changes were made to the total and the conditions of consent. It now states that: “up to 10.5 cubic metres of water may be taken for irrigation, including up to 1.5 cubic metres of water for augmentation of ground water surrounding the Eyre River.” The “filling of water storage reservoirs” is also a purpose to which this water can now be put.
Consent CRC00585, however, provides that it “shall not be operated concurrently with the notified use NCY720289 held by Waimakariri District Council to take 1.5 cubic metres per second for stockwater from the Waimakariri River at Browns Rock.” Under the changes to conditions made in March 2007, therefore, the authorisation to take stock water when the taking of irrigation water ceases reverts to the consent NCY720289 held by the Waimakariri District Council, even though the irrigation company is responsible for administering this scheme together with the irrigation scheme.

In 2007, Ngai Tahu Property Limited was granted access to the remaining A take authorised under the Waimakariri River Regional Plan, although this allocation was withdrawn as the result of a High Court decision in early 2008. In its 2007 Annual Report the Company indicated that Ngai Tahu, already the Company’s second largest share holder, had in 2007 advised that it wished to have access to irrigation water no later than the beginning of the 2010 season. The Company’s Report also indicated that Ngai Tahu Properties had already commenced clearing trees from the area that it intended to convert to farming, and that it intended to establish at least three farms during the 2007/08 year.

Controls on the taking of water from the river during periods of low flow mean that there are periods during which the Company is unable to deliver the volumes of water to match shareholders entitlements because of the need for water sharing. The introduction of the sharing regime under with the WRRP has increased the number of days that the Company is unable to supply all shareholders. This has meant that for significant periods in late 2007 and early 2008, for example, the Company has had to rotate the areas supplied across the command area, to spread the available water equitably.

The increased uncertainty of supply has persuaded the Company that there is a need to create water storage capacity, to increase the reliability of supply to its existing shareholders. In January 2007 a property was purchased as a potential water storage facility, and in September 2007 shareholders were presented with the results of the research that the Company had commissioned on the establishment of a storage facility. The Company’s website also carries an analysis of the long-term records for the Waimakariri River and shows how the reliability of supply would be improved with storage.
3 ECONOMIC DEVELOPMENT

3.1 Community outcome

The 2006 – 2016 Waimakariri District Community Outcome that addresses economic development is one of 6 out of 16 ‘priority’ Outcomes. It states:

*Businesses in the District are Diverse, Adaptable and Growing*

- There are growing numbers of business and employment opportunities in our District
- There are sufficient and appropriate places where new businesses are able to set up in our District
- There are opportunities for our young people to enter employment and gain skills in our District

This Outcome statement reflects the community’s concern about the relatively few employment opportunities available in the District, which means that many people travel into Christchurch for work. It also identifies the creation of training and employment opportunities available for young people in the Waimakariri District as a priority. This was seen as a priority, because many young people who have grown up in the District are moving away when they leave school, or shortly afterwards for education and/or employment.

3.2 Economic activity associated with the Waimakariri Irrigation Scheme

3.2.1 Overview

The introduction of irrigation to the upper Wa imakariri Ashley plain was expected to bring significant changes in land use, which would increase farm production and create more job opportunities.

There are essentially two phases of economic activity associated with the commencement of an irrigation scheme:

- The activity associated with the development of the scheme; and
- The activity associated with farming under irrigation as opposed to the farming activity replaced.

While the activity associated with starting up a scheme is relatively short lived, the economic rewards associated with farming under irrigation can be expected to build momentum over a number of years. This is particularly the case where changes are from dryland grazing of sheep to dairying under irrigation, as it takes some time for new pastures to establish and fertility levels to build up.

Activity associated with establishing the Waimakariri irrigation scheme can be divided into two:

- The development of the headworks and the modification of the stock water races to take the additional water for the irrigation scheme; and
• The on-farm developments, particularly the dairy conversions, which often involves changing farm layout and the construction of additional buildings, such as a dairy shed and farm workers’ accommodation.

Changes of ownership of farmland have been a feature of the introduction of irrigation schemes elsewhere in Canterbury and North Otago. The Waimakariri scheme followed this pattern with a number of relatively large properties changing hands also occurred just before or during the start-up phase in the late 1990s and early 2000s.

### 3.2.2 Ownership changes

The ownership changes in the command area have been associated mainly with the establishment of the larger dairy farms. Among the more notable initial changes of ownership was the purchase of 755 hectares on Thongcaster Road by Malbon Dairy Farms Ltd, a company associated with the prominent South Canterbury businessman Allan Hubbard.

Botany Farms Ltd was another new dairy farm established by outside interests that purchased land in the command area in 2001. This company now has access to 491 hectares, of which 298 hectares is the milking platform, and its shareholding in late 2007 was divided among 4 major groupings, each based in the North Island.

Oxford Dairy Farms Ltd. registered in April 2003, is another example of a corporate dairy farm. This company has shareholders based in the District as well as in the North Island.

Schouten Farms and Netherlands Dairy Ltd, involving 428 hectares and 343 hectares respectively, are two other large dairy farms established by people from outside of the District who purchased land in the command area in the late 1990s. The owners of both these properties live on, and are involved with, the day-to-day management of these farming operations.

A few of the District’s farming families already involved with dairying on land to the east of the District, purchased land in the command area and established new farms. These included the Stokes family, based at Waikuku, that established Bunnings Farm Ltd on a 143 hectare property on Boundary Road in the early 2000s near Fernside, and purchased an interest in another 120 hectares in the vicinity, in 2004. The Sparks family also has dairy farming interest in the east of the District. Members of this farming family purchased another 217 hectares property on Boundary Road in 2000 and established Mairangi Dairies Ltd. Mairangi Dairies Ltd purchased a further 140 hectares on the corner of Two Chain and Main Drain Roads, adjacent to the Boundary Road property in 2003.

The Timperley family is a major landowner in the Waimakariri District, as well as at Coutts Island to the south of the Waimakariri River. Prior to the introduction of irrigation, this family was involved with the rearing of pigs in the command area at Bennetts. Since the introduction of irrigation a Timperley family company, Motu Lodge Stud Farm, has also established a dairy farm on a 113 hectare property in this area.

Other established farming families living to the west of the District have also changed to dairy farming as the irrigation water has become available. These included members of the Mehrtens family, on a 261 hectare property on McJarrows Road, and
the Thompson family and others, farming as Stoneleigh Park Ltd, on a 292 hectare property on Carlton Road.

The Larundel Dairy Partnership is a further example of an established farming family that has become involved with dairy farming, in this instance, through an equity partnership in association with Graeme Sutton from Nelson. Prior to forming a partnership with the Fultons, Mr. Sutton had been involved with setting up dairy farms in other areas when irrigation was introduced, including on the Waiau irrigation scheme in the Hurunui District. Mr. Sutton’s interests in irrigation now include a directorship of Waimakariri Irrigation Ltd, and the presidency of Irrigation New Zealand.

Also, Tamara Farms Ltd has a property of 204 hectares, and is one of the ten largest shareholders in the irrigation company. This company has its registered office in Rangiora and its shareholders are based in the United States of America. The same principals are shareholders in Rebecca Acres Ltd., also with its registered office in Rangiora, and which owns an adjacent property of 136 hectares.

The state owned farming enterprise Landcorp Farming Ltd. has also changed part of its operation in the command area to dairy farming. In 2002 it undertook a dairy conversion on part of the approximately 1,000 hectares owned by the Government in the command area, and this development is “on going”.

More recently, outside interests have purchased large properties to the west of the command area. These purchasers include Rakaia Island Dairies, which has taken over Woodstock. Rakaia Island Dairies is based in Mid-Canterbury, and is among the largest shareholders in Fonterra, the New Zealand dairy co-operative.

### 3.2.3 Off-farm development

The main off farm development for the irrigation scheme was undertaken in the late 1990s. The most significant challenges faced by the Company at the outset were the designing of the intake, and the construction of a race capable of carrying water to the top of the terrace that borders the Waimakariri River at the point selected for the intake. A further consideration during construction was to maintain the supply of water to the stock water race scheme.

Intakes for a “run of the river” irrigation scheme present particular difficulties for designers, because the equipment is prone to be damaged when the river is in high flood. The intake developed for the irrigation scheme involves a retractable “boat” that can be lifted out when the river is in flood. The following photograph shows the commissioning of this “boat” in November 1999.
The point selected for the intake for the Waimakariri irrigation scheme was beside the stock water race intake. The following photograph shows this new intake in August 1999 and beside it is the old stock water race intake.

The biggest engineering challenge encountered was to upgrade the water race from the intake to the top of the terrace. The original intention was to widen and deepen the existing water race, along the seven-kilometre section of the race to the top of the terrace. However, soon after starting construction, it became obvious that the gravels on the side of the terrace could not support a race designed to carry the amount of water required for the scheme. As a consequence, a major buttress had to be constructed along the side of the terrace and a whole new race built within it. This new structure was designed to withstand a Richter Force 8 earthquake.

The following photographs show machinery working on the buttress, while maintaining the flow of water to the stock water race system.
The Waimakariri River water carries very fine silt even when not in flood, and the intake system was also designed to take account of this. As a result dual settling channels were constructed, so that silt can be cleared from one channel while water continues to be supplied via the alternative channel. The following photograph shows the dual settling channels.
The main headrace stretches across the west of the command area, and feeder races run down the plain from the headrace. Some of these smaller races carry substantial volumes of water to farms on the irrigation scheme, while others carry smaller amounts to supply the farms on the stock water race scheme only.

The following photograph shows work being undertaken to widen the main headrace in December 1998.

In some instances, major realignment of the existing stock water race was needed, and the extent of this work is illustrated in the following photograph.
The enlarged races created the need for bridges where they had not previously been required, and a number of culverts also had to be replaced with larger ones.

The following photographs show the main headrace viewed from South Eyre Road looking firstly to the south, and then to the north in February 2008.
3.2.4 On-farm development

The introduction of irrigation brings with it changes in farming patterns. In recent years the main change that has occurred with the introduction of irrigation in Canterbury has been a change from sheep farming or mixed sheep and cropping farming to dairying. In the Waimakariri District prior to the introduction of the Waimakariri irrigation scheme there were a significant number of dairy farms of varying sizes, many originally town supply farms on which cows were milked all year round, located on the heavy land to the east of the District. Many of these farms had irrigation, either using groundwater or water drawn from lowland streams.

The changes in land use occurred reasonably rapidly after the commencement of the scheme. In 2000-01 season 120 of the 250 shareholders took water from the scheme. Prior to 2000 there were 6 dairy farms in the area, and the WIL 2001 Annual Report notes that in the 2000-01 season 9 new dairy conversions were taking water from the scheme, and a further 8 conversions were expected in 2001-02. In 2000-01 it was estimated that 23 percent of the scheme’s water was used for dairying, and in the 2001-02 season this was likely to increase to 43 percent.

The cost to the company of getting the scheme underway was significant, but in some instances less than the cost of on-farm work, where dairy conversions were concerned. In mid-2001 Graeme Sutton gave an account of the activities associated with the conversion of a property towards the east of the command area at Swannanoa with which he was concerned. This dairy conversion took place on a farm of approximately 360 hectares that had previously been farmed under irrigation from groundwater. Prior to the conversion, there were 3 irrigation wells on the property, and the partnership sunk a further well to provide a back-up supply for the times when water from the irrigation scheme was not available.

The development of this property also included the construction of a 70-bale rotary cowshed at the centre of the farm, and the installation of 3 central pivot irrigators, the longest of which is 700 metres. A considerable amount of work was involved in realigning fences, taking out most of the trees except those around the periphery and some through the middle of the farm. The entire farm was cultivated and new grasses suitable for dairying were sown. In addition, 3 new houses were built on the farm, one of which is now occupied by the manager of the enterprise, who is also an equity partner. The 1500 cows for this new dairy farm came from Otago, the Oamaru area and the North Island. It was estimated that the cost of the establishment of this dairy farm in 2001, including the purchase of the land and dairy company shares, was in the vicinity of $9 million.

A further indication of the extent of on-farm development is provided by the building consents issued by the Waimakariri District Council for the 10 largest shareholding properties on the irrigation scheme. These included:

- 19 new dwellings
- 8 new urea/grain silos
- 8 new barns or hay sheds
- 6 new implement sheds
- 6 new dairy sheds
- 5 new farm sheds for calf-rearing
- 2 woolsheds
- 2 new cattle or sheep yards constructed
- 1 deer shed
• 1 stock underpass

The following photographs show examples of the new dwellings constructed on new dairy farms in the District.

Some of the construction work, particularly the new dairy sheds was undertaken by contractors from outside of the District, mainly based in Mid or South Canterbury. A good deal of the fencing and other on-farm work needed to adapt properties for irrigation, however, was done by contractors based in the Waimakariri District.

Although the change to dairying has attracted most of the attention relating to the scheme’s introduction, the building consent list also highlights the fact that the introduction of irrigation has increased the numbers of sheep, cattle and deer on some farms.

3.3 Measuring changes in farming

3.3.1 1994 and 2006 Agricultural Production Censuses

Establishing the extent of the changes in agricultural production resulting from the introduction of the Waimakariri irrigation scheme presents difficulties because of the limitations of the available data. During the 1990s Statistics New Zealand conducted 2 agricultural censuses, in 1991 and 1994. Since then 2 agricultural censuses have been conducted during the 2000s, in 2002 and 2007. The differences in the patterns of production between 1994 and 2002 reported by Statistics New Zealand give some indication of the impact of the introduction of the Waimakariri Irrigation Scheme, but this data is only available at District level. This means that it is only at a general level that this data can be viewed as providing base line information for assessing the impact of this scheme on livestock farming in the District. The data from the 2007 Agricultural Census was not available at District level when this report was finalised.

3.3.2 Livestock numbers

The following table sets out the changes in livestock numbers between 1994 and 2002. It provides some indication of the impact of the irrigation scheme on the patterns of farm production in the District, given that without irrigation much of the District would not be able to sustain dairying.
Table 3:1  Waimakariri District: Livestock numbers 1994 and 2002

<table>
<thead>
<tr>
<th>Livestock</th>
<th>1994</th>
<th>2002</th>
<th>Change</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Sheep</td>
<td>584,680</td>
<td>432,470</td>
<td>- 152,210</td>
<td>- 26.0</td>
<td></td>
</tr>
<tr>
<td>Total Dairy Cattle</td>
<td>20,648</td>
<td>47,820</td>
<td>+ 27,172</td>
<td>+ 133.3</td>
<td></td>
</tr>
<tr>
<td>Total Beef Cattle</td>
<td>34,862</td>
<td>41,547</td>
<td>+ 6,685</td>
<td>+ 19.2</td>
<td></td>
</tr>
<tr>
<td>Total Deer</td>
<td>27,930</td>
<td>42,682</td>
<td>+ 14,753</td>
<td>+ 52.9</td>
<td></td>
</tr>
</tbody>
</table>

This table shows that by 2002 there were 27,172 more dairy cattle in the District in 2002 than in 1994, or an increase of 133.3 percent. This can be largely attributed to the introduction of irrigation on the upper Waimakariri/Ashley plain. The decline in the number of sheep and the increases in beef cattle and deer, however, are more likely to have been a response to the market, as returns for beef and venison were significantly better than those for lamb and wool, during the period.

The impact of irrigation on the changes in production patterns for other livestock is more difficult to assess. Overall, however, there was a decline in the number of properties of 100-199ha reporting running sheep between 1994 and 2002 from 114 to 80, or 34 properties (30 percent). There was also a decrease in the number of properties of 200 hectares or more with sheep between 1994 and 2002 from 149 to 115 or 34 properties (23 percent).

Despite the increase in the number of beef cattle recorded in 2002 compared with 1994, there was a decline in the numbers of larger properties running beef cattle in the District, as recorded by the Agricultural Production Censuses. In 1994 there were 95 properties of 100-199ha with beef cattle, and by 2002 this number had declined to 50. In 1994 there were 113 properties of 200ha or more with beef cattle and in 2002 there were 105 properties in this size range recorded as running beef cattle. While some of these properties will have been carrying both sheep and cattle, this data suggests that the introduction of the Waimakariri irrigation scheme played a part in the decline in the number of sheep in the District between 1994 and 2002, as it allowed dairying on land previously best suited to sheep farming.

The Council holds the data concerning land used for cropping from the 1991 Agricultural Production Census, but not from the 1994 Census. A comparison between the areas in arable production recorded in the 1991 and 2002 Censuses show that during this period there was a decline of approximately 1000 hectares in the area being used for cropping, with the sharpest decline in both absolute and
percentage term for bread wheat, followed by oats. Some of the land used for cropping in 1991 will have been within the command area for the irrigation scheme, and by 2002 would have been being converted to dairying.

3.3.3 Properties with dairy cattle

In 1994 there were 103 dairy farms recorded by farm type and in 2002 there were 110 dairy farms, recorded by farm type, in the Waimakariri District. There was, nevertheless, a substantially greater change in the spread of dairy cattle across the District. In 1994 there were 174 farms that reported carrying dairy cattle as at 30 June, with 165 of these properties having milking or in calf cows or heifers. In 2002 the number of farms that reported carrying dairy cattle at the end of the financial year was 220 with 160 of these having milking or in calf cows or heifers.

The increase in the number of farms reporting carrying dairy cattle in 2002 highlights an important feature of the impact of the dairy industry on farming in an area. In addition to the farm on which cows are milked, there are likely to be a significant number of other properties involved in the industry as “dairy support farms”. Some of these will provide winter grazing and these will be able to be identified in an agricultural census, which records information about the livestock on properties at 30 June, others will not. These farms will be ones that provide additional feed, usually in the form of grass for silage, or hay.

3.3.4 Sizes of properties with dairy cattle

There had also been a significant change in the numbers and sizes of the properties that reported having dairy cattle as at 30 June 2002 compared with 30 June 1994. The following chart shows these changes.

This graph shows that the number of properties in the District of over 100 ha with dairy cattle increased from 66 to 104 between 1994 and 2002. There was also an increase in the number of properties of under 49 ha with dairy cattle during the period, and some of this increase at least may be properties being used to support the larger dairy farms by providing winter grazing for dairy cows or all year round grazing for young animals. Some of these support farms will be within the command area for the irrigation scheme, but some are likely to be outside of that area.
3.3.5 Numbers of dairy cattle on properties with dairy cattle

The changes in the numbers and sizes of properties with dairy cattle in the District between 1994 and 2002 also translate into changes in the numbers of dairy animals on properties of different sizes in the District, which are shown in the following graph.

![Graph showing numbers of dairy cattle by size of property as at 30 June 1994 and 2002]

This graph highlights the change in the scale of dairy farming in the District, which can be attributed mainly to the introduction of irrigation to the upper Waimakariri/Ashley plain. In 1994 less than 8,000 of the District's dairy cattle were on farms of 200 hectares or greater, and in 2002 there were almost 26,000 dairy cattle on farms in this size range.

3.4 Dairying in the Waimakariri District

3.4.1 Changes in the performance of dairying in the District 1998/9 – 2005/6

More comprehensive dairy herd data is published annually by the New Zealand Genetics and Livestock Improvement Corporation Ltd (LIC), an organisation involved with improving the performance of dairy animals, including providing artificial insemination services.
The table 3:2 compares data for the District’s dairy farms for the 1998/9 and 2006/7 milking seasons.

| Waimakariri District: Dairy herd performance 1998/9 and 2006/7 |
|--------------|--------|--------|--------|
|               | 1998/9 | 2006/7 | Change |
| Number of farms/herds* | 70     | 67     | - 3    |
| Total Cows**     | 17,018 | 32,209 | + 15,191 (89%) |
| Average size of herd | 243   | 481   | + 238 (98%) |
| Average size of farms (effective hectares) | 91     | 155   | + 64ha (70%) |
| Average cows per hectare | 2.7    | 3.0   | + 0.3 (11%) |
| Average milkfat per hectare | 413kg  | 659kg | + 246kg (60%) |
| Average milkfat per cow | 142kg  | 224kg | + 82 (58%) |

* The LIC statistics for 1998/9 reported the number of farms, and 2006/7 reported the number of herds
** The number of cows reported in this table deals with the number of cows being milked

This table shows that there was a decrease of three in the number of farms/herds in the District. This means that while a significant number of new dairy farms have been established within the command area for the Waimakariri irrigation scheme small dairy farms, mainly in the east of the District, have gone out of business. These smaller farms are likely to have become uneconomic to operate as dairy farms, and have either changed to other activities including dairy support operations, or possibly been subdivided.

The percentage increase in the number of cows is slightly lower than the average herd size between 1998/9 and 2006/7, and this would be anticipated in view of the decrease of three in the number of farms/herds in the District during the period. The increase in the average size of farm (effective hectares) at 70 percent was slightly lower than the increase in the percentages for total cows and average size of herd and this is reflected in a slight increase in the number of cows per hectare.

The increases in the average butterfat per hectare and average butterfat per cow between 1998/9 and 2006/7 also show a substantial increase of 60 percent and 58 percent respectively. Performance per animal is one of the key indicators of financially successful farming, as many farm costs are generated on a per animal basis. It should also be noted that while the new dairy farms are likely to have made a substantial contribution to improved performance, these improvements in key performance indicators also suggest an improvement in the performance of the District’s dairy farms in operation in 2006/7 that were established in 1998/9 prior to the commencement of the irrigation scheme.

3.4.2 Comparative performance for dairying in the District 2005/6

The overall improvement in performance of the dairy farms in the Waimakariri District over the period since the commencement of the Waimakariri irrigation scheme has been gradual. The following graph shows the average kilograms of milkfat per effective hectare recorded between 1998/9 and 2006/7.
The steady increase, particularly since 2000/1, can be seen as attributable to both the replacement of the smaller dairy farms by the larger dairy farms in the command area, and the steady increase in the productivity of these new dairy farms. Farms converted from dryland sheep or sheep and cropping farming, to dairying under irrigation, would not have reach full production from the outset. It takes a number of seasons under irrigation for fertility levels and soil structure to build-up, and for farms to reach their full productive potential.

After up to 6 seasons under irrigation, however, the new dairy farms would be likely to be approaching their full potential. The LIC statistics set out in table 3:3 show that by 2006/7 the dairy farms in the Waimakariri District compared very favourably with those from the South Island and New Zealand as a whole.

Table 3:3  Waimakariri District: Comparative dairy herd 2006/7

<table>
<thead>
<tr>
<th></th>
<th>Waimakariri District</th>
<th>South Island</th>
<th>New Zealand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average milkfat per</td>
<td>659kg</td>
<td>591kg</td>
<td>534kg</td>
</tr>
<tr>
<td>hectare</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average milkfat per</td>
<td>224kg</td>
<td>211kg</td>
<td>189kg</td>
</tr>
<tr>
<td>cow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average milksolids per</td>
<td>1178kg</td>
<td>1046kg</td>
<td>934kg</td>
</tr>
<tr>
<td>hectare</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average milksolids per</td>
<td>400kg</td>
<td>373kg</td>
<td>330kg</td>
</tr>
<tr>
<td>cow</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This table shows that on each measure, the dairy farms in the Waimakariri District during the 2006/7 season, performed better than both the South Island and New Zealand as a whole. This pattern has persisted for some time. For example, the LIC Regional Dairy Statistics report for 2005/6 also highlighted the fact that the Waimakariri District recorded the highest production per cow for milksolids. In addition, the Waimakariri District matched the Hurunui District for the average milkfat per cow, and these were the highest recorded for any district in New Zealand for the 2005/6 season.

While table 3:3 shows the averages per hectare were also well above the South Island and New Zealand averages, these were not as high as those recorded for the Canterbury districts to the south of the Waimakariri River. For example, the Selwyn
District recorded 1207kgs and Ashburton recorded 1263kgs for average milksolids per hectare. Despite this, the 2006/7 per cow average production of milksolids for Selwyn and Ashburton dairy farms at 385kgs and 376kgs respectively were lower than the 400kg average recorded for the Waimakariri District for that season.

3.4.3 Income from dairying in the Waimakariri irrigation scheme command area

Assessing the probable returns from the new dairy farms established in the command area for the Waimakariri irrigation scheme presents some difficulties because of the absence of data specifically related to these farms. Some information about the dairy farms in an area that approximates the command area, however, has been obtained from Fonterra.

Fonterra advised, in November 2006, that in the area between the Ashley River/Rakahuri and Waimakariri River, and between Oxford and Rangiora, it had 21 suppliers. All of these suppliers except 3 had started to supply the co-operative since the beginning of the 1996/7 season, and 10 had begun to supply the company since 1 January 2001. Collectively these suppliers produced over 6 million kilograms of milksolids in the 2005/06 season, which resulted in a total payment to these suppliers of over $25 million. (Shane Lodge, Fonterra, email received November 2006) The returns from a similar volume of milksolids based on the payout forecast for the 2007/8 season of $6.40 per kilogram would total $38.4 million.

3.5 Horticulture/Cropping

Information about the production on farms taking water from the Waimakariri irrigation scheme not involved directly or indirectly with dairying is limited. A survey of land use changes during the first year of operation undertaken by a director of Waimakariri Irrigation Ltd. gives some indication of the shifts in production, in addition to a change to dairying. Examples included:

- A farm in the Fernside area changed from running sheep and goats to growing vegetable seed crops on contract for an exporter. It was reported that the additional employment resulting from this change included the addition of 4 casual employees.
- A cropping farm in the Oxford area reported an increase in wheat and barley production of between 75 and 100 percent when compared with levels being achieved without irrigation.
- A relatively small holding of 20 hectares in the Cust area increased the number of cattle carried and enjoyed an increase in income from the larger number of animals.
- A 1000ha sheep and beef farm in the Oxford area increased the number of stock units carried from 4000 to 11,800, and transferred 80 ha to wheat and barley, which resulted in a 40 percent increase in profitability.

A further indication of changes to farming patterns not involving dairying that have occurred because of the introduction of the irrigation scheme, is provided by Murray and Gina Taggart. The Taggarts' farming operation received considerable publicity when they were announced as the 2006 Tasman District regional finalist for the FMG Rural Excellence Award.
Murray and Gina Taggart bought 193 hectares from the Taggart family and established a family farming partnership in 1990s within the command area. In the early 2000s, they purchased an additional 88 hectares, and then leased a further 125 hectares from other family members. This means that this family partnership now farms a total of over 400 hectares under irrigation.

Apart from having achieved increased sheep numbers and better stock performance since commencing irrigation, the Taggarts have changed the breed of sheep carried. They previously ran corriedale sheep, a breed well suited to the harsh conditions often encountered when dryland farming in the area. Now they run a crossbreed of sheep similar to the coopworth, which is a breed better suited to the more lush feed available when farming under irrigation. The range of crops grown on this property since the introduction of irrigation has increased, and these now include milling wheat, winter and spring barley, ryegrass for seed, Asian radishes and a hybrid canola.

The following photograph shows new silos constructed since the commencement of the irrigation scheme on a farm undertaking cropping under irrigation.

![New Silos](image)

3.6 Employment opportunities

3.6.1 Introduction

Limited data is available about employment in the agricultural sector. The five yearly National Census of Population and Dwellings collects information about occupation and place of work, and provides a detailed breakdown of the types of farming with which those working in the sector are involved.

The Statistics New Zealand Business Demographic Series collects information about businesses, including businesses that provide services to agriculture that are registered for Goods and Service Tax (GST), but not farms. Through a link with the Inland Revenue Departments Pay As You Earn (PAYE) database the Business Demographic Series provides a count of the number of people employed in mid-February each year. This is termed the employee count.

The position with respect to identifying people working on farms is further complicated by the availability of part-time and seasonal work, which is not necessarily captured at Census time, or by the Business Demographic Series. In addition, in an area where work away from farms is relatively readily available, either in Christchurch or elsewhere in the District, some family farms are now run on a part
time basis with one or both partners working full-time or part-time off farm. Some of these people, at least, are likely to give their off farm occupation as their main job when answering questions about their occupation and the industry with which they are involved at Census time.

### 3.6.2 Employment trends in agriculture 1996 - 2006

Table 3:4 sets out the numbers recorded at the last three Censuses for people who gave either working in agriculture, or working in a business providing services to agriculture for the whole of the District.

<table>
<thead>
<tr>
<th>Year</th>
<th>Working on farms</th>
<th>Working in businesses providing services to agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Change</td>
</tr>
<tr>
<td>1996</td>
<td>1449</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>1331</td>
<td>- 118</td>
</tr>
<tr>
<td>2006</td>
<td>1167</td>
<td>- 164</td>
</tr>
</tbody>
</table>

(Source: Statistics NZ Censuses)

This table shows that the numbers of people recorded as working on farms in the Waimakariri District at the most recent Census has declined, while the number of people working in District based businesses that provide services to agriculture has increased, albeit from a very low base number in 1996.

Table 3:5 shows the numbers recorded at the last three Censuses, for the people who indicated that they were working on a farm or working in a business servicing agriculture as their main job in the area to the west of the District that approximately coincides with the command area for the irrigation scheme.

<table>
<thead>
<tr>
<th>Year</th>
<th>Working on farms</th>
<th>Working in businesses providing services to agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Change</td>
</tr>
<tr>
<td>1996</td>
<td>549</td>
<td>- 39</td>
</tr>
<tr>
<td>2001</td>
<td>510</td>
<td>- 39</td>
</tr>
<tr>
<td>2006</td>
<td>534</td>
<td>- 24</td>
</tr>
</tbody>
</table>

(Source: Statistics NZ Censuses)

This table indicates that while the number of people working on farms increased between 2001 and 2006, it was still slightly lower in 2006 than in 1996. At the same time there has been a significantly greater percentage increase in the number of people working in businesses servicing this area.

Dairying stands out in terms of changes in the patterns of employment by type of farm across the District as a whole. The numbers recorded at the last three Censuses for people working on dairy farms for the east and west of the District, and the area to the north of the Ashley River/Rakahuri are set out in Table 3:6.
Table 3:6 shows clearly the change in patterns of dairying in the District during the period under review, with the number recorded as working on dairy farms in the east of the District declining by 78 or 41 percent, and the number working on dairy farms in the area that approximately coincides with the command area for the Waimakariri irrigation scheme increasing by 96 or 189 percent. Despite these changes the overall number recorded as working on a dairy farm in the District as their main job changed little between 1996 and 2006.

While the official statistics suggest that there has not been a significant increase in employment as the result of the introduction of the Waimakariri irrigation scheme, other factors should be taken into account when assessing the impact of the irrigation scheme on employment. The introduction of large-scale corporate farming in the District has lead to the creation of on-farm management opportunities in the area, which were not available previously. An advertisement in the New Zealand Farmers Weekly of 1 December 2007 by Botany Farms Ltd. for an “operations manager” illustrates the type of management employment opportunities that are now available. It stated:

“Our ideal applicant will have: -

- A proud record of staff management and leadership
- Excellent written and verbal communication
- Exceptional pasture management and utilisation skills
- Quality stock management ability
- Irrigation and machinery experience

This is a hands-on role converting ‘grass to profit’. The successful applicant will be supported by absentee Owners, Consultants and other relevant professionals and will be offered a competitive remuneration package that includes a modern four-bedroom dwelling.”

The advertisement also indicated that this position would become available from 1st June 2008, and explained that the successful applicant would replace the current manager who has held the position for 6 years.

Some of the District’s dairy farms advertise more regularly for staff than others. This would appear to indicate that these dairy farms are finding it difficult to obtain suitable employees and/or to retain staff.

Reports from the Oxford area indicate that the shortage of rental accommodation in that area has become acute. Those trying to find housing for people with limited incomes who want to live in that area attributed the problem, at least in part, to the increased demand for rental accommodation by people coming into that area to work on the new dairy farms. It is also possible that the reverse may be the case, in some
instances, as far as the recruitment of farm labour is concerned. If employees are unable to find suitable rental accommodation in the District, this may represent a barrier to employment in the District’s dairy industry for some people.

3.6.3 Services to Agriculture 2000 – 2006

The Statistics New Zealand Business Demographics Series shows that there has been a significant increase in the number of businesses providing services to agriculture and people employed by these businesses in the Waimakariri District between 2000 and 2006. Table 3.7 sets out these changes.

<table>
<thead>
<tr>
<th>Table 3.7</th>
<th>Waimakariri District: Businesses providing services to agriculture and number of employees 2000 and 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of employees</td>
<td>2000</td>
</tr>
<tr>
<td>Businesses</td>
<td>Employee count*</td>
</tr>
<tr>
<td>No employees</td>
<td>160</td>
</tr>
<tr>
<td>1 – 5 employees</td>
<td>26</td>
</tr>
<tr>
<td>6 – 9 employees</td>
<td>3</td>
</tr>
<tr>
<td>10 – 19 employees</td>
<td>4</td>
</tr>
<tr>
<td>20 – 49 employees</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>195</td>
</tr>
</tbody>
</table>

* The employee count is a count of the people who appear on the PAYE schedule returned by employers in February each year

Source: Statistics New Zealand Business Demographics Series

This table shows an increase of 64 or 32.9 percent in the number of businesses servicing agriculture, fishing and forestry in the Waimakariri District between 2000 and 2006, and an increase in the employee count of 100 or 55.5 percent. The employee count, however, does not distinguish between people who were working full-time and part-time, nor does it provide a basis for calculating “full-time equivalents”. Despite this, it is a better basis for capturing information at industry level about the numbers of people doing more than one paid job than the Census, which only identifies the industry and occupation for a persons’ main job.

The growth in the number of people employed in each of the sizes of business employing fewer than 20 people is significant.

The increases for during the period under review were:

35  (58.5%)  for businesses with 1 – 5 employees
35  (175.0%) for businesses with 6 – 9 employees
20  (36.4%)  for businesses with 10 – 19 employees

Businesses without employees are also important when assessing the extent of growth in the level of business activity for those enterprises providing services to agriculture, fishing and forestry. The businesses without employees are the ones that are registered for GST, but do not pay wages. This means that the people operating these businesses are not included in the employee count. In the agricultural sector most of these businesses are likely to involve people working as contractors, usually as individuals or in partnerships, and pay tax via the provisional taxation system. Between 2000 and 2006 there was an increase of 45 or 28.2 percent in the number of these business units in the Waimakariri District.
While the Census statistics do not signal a significant increase in the level of on-farm employment, the Business Demographic Series indicate that there has been a significant increase in the number of people involved with businesses servicing agriculture, fishing and forestry during the early years of the operation of the Waimakariri irrigation scheme. While some of this increase may be attributable to changes not linked with the scheme, it is reasonable to assume that a significant proportion of the increased activity recorded annually by the Business Demographic Series is attributable to the higher levels of agricultural production generated because of the changes in farming attributable to the scheme.

3.6.4 Work opportunities for young people

The change to dairy farming as the result of the introduction of the Waimakariri irrigation scheme has created employment opportunities for young people who live in the west of the District. This includes opportunities for part-time work for school-aged children from the Oxford township. In a town with limited employment opportunities, being able to work before and/or after school, in the weekends and/or during school holidays on dairy farms is seen as important for young people. This work is also relatively well paid when compared with alternative work available locally.

There is, nevertheless, some community concern about the impact of the availability of work on dairy farms on the education for the secondary school students involved with this work. It is feared that, in some instances, schoolwork is being neglected in favour of farm work and the money that can be earned.

On balance, however, the casual work on the new dairy farms available for young people living in the Oxford area is a positive aspect of the introduction of irrigation. In particular, it has the potential to open up career opportunities for young people without farming backgrounds that they might not have previously contemplated. The introduction of large-scale dairy farms offers a career structure in agriculture not previously available in the District, with opportunities for promotion to well-paid jobs such as herd managers. To achieve such positions it is not necessary to have a financial investment in the industry of the kind associated with share milking, hitherto the dairy industry's traditional entry path for those with out access to substantial amount of capital at the outset.

3.7 Economic impact of irrigation

3.7.1 On farm production

From a production perspective the performance of the District's dairy farms indicates that the introduction of irrigation on the upper Waimakariri-Ashley plain has been a success. The overall profitability of dairy farming, however, is dependent on the international prices for dairy products. The sharp increase in the dairy pay-out in the 2006-07 season means that dairy farming in the district is clearly more profitable than in previous seasons, but future profitability will depend on at least the maintenance of the present level of returns.

The increased profitability associated with dairy farming on land that was previously used for dryland farming, principally sheep and/or cropping, can be seen as representing a significant economic gain. When assessing the net advantage from the introduction of irrigation, however, it is somewhat misleading to assume that there
would have been no change in the farming patterns on the land now under irrigation. If irrigation had not been introduced, some of the land, now being farmed under irrigation, may well have been converted to other higher value uses than the uses before the introduction of irrigation.

3.7.2 Impact on employment

The flow-on effect of the economic activity associated with the establishment of these new dairy farms on employment would appear to be more limited than anticipated. In an Economic Profile of the District commissioned by the Waimakariri District Council in 2000 Agriculture New Zealand (A Wrightson Business) indicated that an additional 150 full time equivalent on-farm jobs were likely to be created in agriculture between 2000 and 2005.

At the same time, it was anticipated that growth in agriculture would be likely to contribute to a further agriculture dependent 264 off-farm jobs in the District. These jobs were mainly expected to come from dairying, and were linked with the commencement of the irrigation scheme and the relatively positive overall international outlook for agricultural production.

A comparison of the results of either the 1996 or 2001, and 2006 Censuses for the agricultural workforce shows that the increase in on-farm employment considered likely by Agriculture New Zealand has not been realised. The number of people indicating that their main job was in agriculture has declined overall, and the increase in people employed in dairying has been modest.

Employment in services to agriculture as measured by Statistics New Zealand’s Business Demographic Series between 2000 and 2006 has shown an increased employee count of 100, but this does not necessarily represent full time equivalent jobs. The increase of 50 in the number of businesses providing services to agriculture without employees, however, may be seen as further indication of the increase in off-farm jobs as some at least of these business units are likely to be owner operated contractors or similar.

3.7.3 Increased value of land

A Real Estate agent familiar with the District indicated that land sales prices in the command area attract a premium for properties that are reticulated for irrigation. Availability of shares was seen as a separate issue, as shares are traded independently of land ownership. However, the ability to negotiate the transfer of shares along with the purchase of land is understood to bring with it a substantial price advantage for a vendor.

The situation with respect to the premium for land reticulated for irrigation and with access to water from the Waimakariri irrigation scheme is consistent with the position across New Zealand. For instance, the LIC website shows inflation adjusted average prices per hectare for sales of dairy farms across New Zealand generally increasing, with some fluctuation, from 1986 to 2005. For instance, in 1992 the inflation adjusted as (per the Consumers Price Index for the end of the June quarter), average sale price per hectare for dairy farms in New Zealand was $9,288. In 1998 this had risen to $12,753 and by 2005 it had increased to $21,085.
3.7.4 District wide impacts

There are significant difficulties associated with assessing the District wide impacts of the introduction of the Waimakariri irrigation scheme. The major problems when attempting such an assessment are:

- The proximity of the District to Christchurch City as an alternative source of supplies for the District’s farms and a place where the income generated can be spent; and
- The diversity of ownership, particularly of the major dairy farms, means that the beneficiaries of the incomes from the introduction of irrigation do not necessarily live in the District.

Both these factors mean that it is probably inappropriate to suggest that the District's economy has enjoyed a significant multiplier effect from the additional income generated as the result of the introduction of the Waimakariri irrigation scheme.

It should also be noted that not all the additional employment opportunities associated with the establishment of the District’s the new dairy farms are District based. Milk from the Waimakariri District is processed in South Canterbury, as is the tanker fleet that collects milk from the District’s dairy farms. This means that the dairy tankers that serve the District are based at Temuka, and the people who drive these tankers as well as the people responsible for the maintenance of the vehicles live in South Canterbury. The fact that a number of the builders involved with the construction of the District’s new dairy sheds were based in Mid- or South Canterbury has already been noted.

3.7.5 Relative economic impact

In its 2000 report Agriculture New Zealand identified the District’s three main economic drivers as farming, forestry, and commuting households. A review of the information available about employment in agriculture for 2001 and 2006 suggests that the extent of the increase in this sector is not as great as that projected by Agriculture New Zealand.

The report’s analysis of forestry, which paid particular attention to the age of trees in the Waimakariri District, suggested that although a significant proportion of the District’s trees were approaching maturity this was unlikely to contribute to increased employment in the District. It was considered more likely that the availability of more trees locally would result in a change in the procurement patterns for the Sefton Medium Density Fibre Board mill, than to see the establishment of a new processing plant in the District.

Agriculture New Zealand saw the commuting households as the economic driver likely to make the greatest contribution to economic activity in the Waimakariri District in the short term. The report states:

“The most immediate boost to economic activity of commuting households arises from the construction of new housing and associated infrastructure. However, there is also an ongoing level of activity generated by household expenditure within the District.”
While the “leak of spend” to Christchurch has been an on-going concern for District based businesses, the Agriculture New Zealand report suggests that in 2000 the level of retail spending in the District by District households may have increased to about 85 percent, or 15 percent leakage, from the 1996 estimate by Davie Lovell Smith of 25 percent leakage. The steady increase in the number of businesses and people employed in the retail and service industries in the Waimakariri District since 2000 appears to indicate that most of the growth in economic activity in the District, at least in terms of employment, has come in the form of household consumption by the District's rapidly increasing population.
4 WATER

4.1 Community Outcome

The 2006 – 2016 Waimakariri District Community Outcome concerning water was also one of the six ‘priority’ outcomes. It states:

There is Sufficient Clean Water to Meet the Needs of Communities and Ecosystems

- The demand for water is kept to a sustainable level
- Harm to the environment from the spread of contaminants into ground and surface water is minimised.

The community outcome concerning water expresses the values both of managing the demand for demand for water, and also of ensuring that harm to the environment from the spread of contaminants into ground and surface water is minimised.

4.2 Water quantity

4.2.1 Impact on groundwater

Much of the Waimakariri/Ashley plain to the west of Swannanoa is described by Environment Canterbury as being characterised by low permeability sediments that were restricting groundwater development. In this area the groundwater flows through a network of high permeability channels. The area to the east of Two Chain Road and No 10 Road is classified as a spring discharge zone, which provides protection for the main recharge area for the coastal confined zone.

Prior to the introduction of irrigation the groundwater recharge in these areas came from entirely from rain in the foothills falling in the Eyre and Cust River catchments, and rain falling on the plains. This meant that the static groundwater level was closely related to the amount of rain in any given season, with the levels to the west of the spring discharge zone significantly higher in seasons with high rainfall than in dry seasons.

The following map shows the hydrogeological zones for the Waimakariri-Ashley plain. The command area for the irrigation scheme is located on the Eyrewell, Eyre River, Cust and Cust Sub-Zones. As water moves down the plain, changes in the patterns of water recharge across the command area can also be expected to influence groundwater patterns in the area to the east in the Spring Discharge Zone, in particular.
WAIMAKARIRI- ASHLEY PLAIN
Hydrogeological Zones

080617018544
POL-07-03
Impact of Waimakariri Irrigation Scheme
Waimakariri District Council
Ground water monitoring by Environment Canterbury indicate that the introduction of irrigation would appear to have resulted in a reduction in the extent of the fluctuations in the centre of the Waimakariri-Ashley Plain.

The following map shows the location of wells monitored by Environment Canterbury for groundwater levels on the Waimakariri-Ashley Plain.

The following graphs show the ground water envelope for well 35/4757, which is located at Bennetts Corner, in the command area.
This graph shows that in the summer of 2007/08 the ground water level increased between October and March. This is significant as very little rain fell during this period, but the groundwater readings for this well did not decline as indicated by the minimum recorded and the average –1 standard deviations plotted on the graph, which represent typical ground water levels for a dry season. The pattern of recharge during the summer shown in 2007/08, however, is consistent with the situation for areas elsewhere on the Canterbury plains under irrigation, where the pattern of recharge has also changed.

The following graph shows the ground water record for well M35/0143, which is located close to Tram and Northwood Roads west of Swannanoa, also within the command area.

![Groundwater envelope plot for well M35/0143](image)

This graph also shows a slight increase in the ground water level during the 2007/8 summer, when given the lack of rainfall this would have been unlikely, prior to the commencement of the irrigation scheme.

![Full record for well M35/0143](image)

The full record for this well, which is towards the east of the command area, also suggests that the ground water in this area has been sustained to some extent by the commencement of the irrigation scheme in 2000. Although there was very little rain
in late 2007 and early 2008 the full record does not show a decline similar to that in the summer of 1998, at the beginning of the last extended period with low rainfall.

The records from these two wells suggest that the introduction of irrigation to the west of the Waimakariri-Ashley plain has had a positive impact on groundwater levels in the Eyre zone and the Cust sub-zone as defined by Environment Canterbury in 1997. This increase in groundwater levels is of value to those using groundwater for irrigation to the east of the command area, and those within the command area using groundwater to supplement the water available from the irrigation scheme. In addition these two zones feed the spring discharge zone, which provides a buffer for the confined aquifer under Kaiapoi.

4.2.2 Impact on groundwater levels in Clarkville

When the scheme was proposed, there was considerable community concern that the additional water being applied to the west of the plain would exacerbate drainage problems in the Clarkville area. A review of the ground water records for the monitor wells in the Clarkville area suggests that these fears were unfounded.

The following graph shows the full ground water record for well M35/0637, which is located close to Tram and Jeffs Drain Roads in Clarkville.

Records for this well date back to the late 1970s. The highest levels recorded during the 1980s were higher than those recorded during the 1990s, and there has not been a significant change since 2000.
The groundwater envelope for well M35/0637 also shows that, in contrast to the wells at Bennetts and to the west of Swannanoa, the level in this well declined during the summer of 2007/8.

The following graph shows the groundwater envelope for a monitor well M35/5436 locate at Baynons Road, Clarkville.

The readings for the current season, and the overall envelope for this well differ significantly from the well in the vicinity of Tram and Jeffs Drain Roads, and also gives no indication that the groundwater levels in the Clarkville area have increased as the result of the introduction of the Waimakariri irrigation scheme.
The following graph shows the full record for the Baynons Road monitor well M35/5436.

Instead of showing any increase in the groundwater levels since the introduction of the Waimakariri irrigation scheme in 2000, this well has if anything shown a decline during the period. A review of Environment Canterbury’s classification of the groundwater zones for the Waimakariri-Ashley plain, however, shows that this well is in the Waimakariri River recharge zone, not in the Eyre River zone or the spring discharge zone, which covers the Ohoka-Mandeville and Eyreton areas. This raises the issue of whether the decline in groundwater levels in the Baynons Road monitor well can be attributed to groundwater irrigation takes in the vicinity of this well, or to a change in the patterns of flow in the Waimakariri River.

4.2.3 Augmentation

During the planning stage in the mid-1990s the supplementation of groundwater resources, especially the Eyre aquifer, was identified as one of the scheme’s “key concepts”. The opportunity to enhance groundwater levels in the areas surrounding the Eyre River was seen by many of those interested in the establishment of the irrigation scheme, as one of the major advantages it offered.

It was also recognised that the advantages of augmentation offered could well extend eastward from the command area for the irrigation scheme. People living to the west of Ohoka, had over the years observed a relationship between surface flows in the Eyre River and increases in ground water levels. In dry years, for example, a significant increase in the level in wells in this area occurred about 6 weeks after the Eyre River had begun to flow at the Poyntz Road Bridge.

The initial consents held by Waimakariri Irrigation Limited included an allocation of 1.5 cumecs for augmentation trials for the Eyre River. These trials could only be undertaken, however, when the ground water level in the area was relatively low. Suitable conditions for conducting these trials did not occur until September 2005. When water was released into the Eyre Riverbed, the impact on key monitor wells close to the river and below the release point was immediate.
The release of water into the Eyre River was accompanied by extensive monitoring of ground water levels in the vicinity. The trial was conducted by WIL and funded by the company. The 2006 Annual Report indicates that the cost of the trial was approximately $23,000.00.

Following these trials, the company's consent was changed and the amount of water initially allocated to augmentation was included in the total amount that WIL is able to take for irrigation. Augmentation of groundwater surrounding the Eyre River, nevertheless, was retained as a use to which water taken by WIL could be put.

4.3 Groundwater quality

4.3.1 Nitrate risk

Irrigation can pose a threat to ground water quality because there is a risk that nitrates will be washed through into the ground water. The main sources of nitrates from farming are from cultivation of soil, animal excreta and fertilisers. The risk of nitrates entering groundwater is greater when light shingle soils are irrigated, as opposed to the heavier rich clay soils. Much of the land irrigated in the command area is relatively light and, therefore, there is considerable potential for nitrate build-up in the groundwater within this area, and/or further east, as groundwater moves down the plain.

There are a significant number of households on the Waimakariri-Ashley plain that draw their water from private wells. The members of these households would be adversely affected if the nitrate levels in groundwater increased because of the introduction of the irrigation scheme. High levels of nitrates in drinking water pose a problem for human health, because they enter the bloodstream and inhibit the transportation of oxygen around the body. Drinking water with high nitrate concentrations is of particular concern for the health of pregnant women and babies.

The World Health Organisation has set the maximum allowable value (MAV) is nitrate nitrogen 11.3mg/L, and those responsible for community water supplies have to report readings above 50 percent of MAV to Community and Public Health, a division of the District Health Board. It is generally recognised that nitrate readings are likely to be highest towards the end of the winter or in early spring. There are areas on the Waimakariri-Ashley plain where high nitrate levels have been recorded over the years, most notably in the Ohoka/Mandelea and Cust areas.

Water quality monitoring, and particularly the monitoring of nitrates levels, was a consent condition imposed by Environment Canterbury at the outset. WIL is, in fact, required to prepare a monitoring report on water quality for Environment Canterbury each year. Environment Canterbury also conducts water quality monitoring on the Waimakariri-Ashley plain.

4.3.2 Nitrate test results

Environment Canterbury has a number of monitor wells on the Waimakariri-Ashley plain that it tests regularly for water quality. The following map shows the locations of these monitor wells, as well as others that are monitored in the Waimakariri District.
Table 4:1 summarises the results of nitrate testing in wells on the Waimakariri-Ashley plain, indicating the frequency of testing, the years for which data is available, the median and maximum nitrate tests and the trend in nitrate readings, if any.

<table>
<thead>
<tr>
<th>Well No</th>
<th>Depth</th>
<th>Frequency</th>
<th>First date</th>
<th>Last date</th>
<th>Median nitrate N</th>
<th>Max nitrate N</th>
<th>Trend 1997-2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>L35/0349</td>
<td>20.0m</td>
<td>Annually</td>
<td>1992</td>
<td>2006</td>
<td>1.05</td>
<td>2.1</td>
<td>None</td>
</tr>
<tr>
<td>M35/4757</td>
<td>21.7m</td>
<td>Quarterly</td>
<td>1988</td>
<td>2006</td>
<td>7.15</td>
<td>8.7</td>
<td>Decrease</td>
</tr>
<tr>
<td>M35/8567</td>
<td>15.2m</td>
<td>Annually</td>
<td>1999</td>
<td>2006</td>
<td>7.90</td>
<td>12.2</td>
<td>NA*</td>
</tr>
<tr>
<td>M35/5869</td>
<td>20.5m</td>
<td>Annually</td>
<td>1991</td>
<td>2006</td>
<td>6.80</td>
<td>9.8</td>
<td>None</td>
</tr>
<tr>
<td>M35/8479</td>
<td>23.5m</td>
<td>Annually</td>
<td>2000</td>
<td>2006</td>
<td>1.30</td>
<td>2.2</td>
<td>NA*</td>
</tr>
<tr>
<td>M35/6385</td>
<td>15.5m</td>
<td>Quarterly</td>
<td>1997</td>
<td>2006</td>
<td>4.70</td>
<td>6.8</td>
<td>Decrease</td>
</tr>
<tr>
<td>M35/6295</td>
<td>12.2m</td>
<td>Quarterly</td>
<td>1999</td>
<td>2006</td>
<td>10.90</td>
<td>14.9</td>
<td>NA*</td>
</tr>
<tr>
<td>M35/0132</td>
<td>20.4m</td>
<td>Monthly</td>
<td>1986</td>
<td>2007</td>
<td>3.20</td>
<td>6.7</td>
<td>None</td>
</tr>
<tr>
<td>M35/6639</td>
<td>15.5m</td>
<td>Annually</td>
<td>1999</td>
<td>2006</td>
<td>6.35</td>
<td>7.6</td>
<td>NA*</td>
</tr>
<tr>
<td>M35/5440</td>
<td>20.9M</td>
<td>Quarterly</td>
<td>1986</td>
<td>2006</td>
<td>6.10</td>
<td>7.9</td>
<td>None</td>
</tr>
<tr>
<td>M35/4682</td>
<td>15.8M</td>
<td>Annually</td>
<td>1986</td>
<td>2006</td>
<td>4.40</td>
<td>13.0</td>
<td>None</td>
</tr>
<tr>
<td>M35/4795</td>
<td>13.8M</td>
<td>Annually</td>
<td>1985</td>
<td>2006</td>
<td>7.40</td>
<td>9.0</td>
<td>Decrease</td>
</tr>
<tr>
<td>M35/0698</td>
<td>9.9M</td>
<td>Quarterly</td>
<td>1980</td>
<td>2006</td>
<td>4.50</td>
<td>7.0</td>
<td>Decrease</td>
</tr>
<tr>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>For these wells there was insufficient data to allow a trend assessment</td>
</tr>
</tbody>
</table>

Source: Environment Canterbury

Table 4:1 shows that the periods for which data is available vary, with some wells having been tested since the mid-1980s, and others having only been tested since the commencement of the irrigation scheme. Some wells are also tested more frequently than others, and the frequency with which wells N35/4682 and M35/0698 are tested has changed recently. Both these wells, together with well M35/0132 were tested monthly, and now only well M35/0132 located on the corner of Tram and Bradleys Roads is tested monthly.

Of the 6 wells on the Waimakariri-Ashley plain, relevant to the command area, that have been tested since the 1980s the nitrate readings in 3 have been assessed by Environment Canterbury as decreasing, and in 3 there has been no change during
the period. Of the 3 wells relevant to the command area for which testing commenced during the 1990s, and for which there was sufficient data to allow a trend, if any, to be ascertained 2 wells had shown no change, and the nitrate levels in 1 well were assessed as having decreased. There were insufficient test results for the remaining wells to allow an assessment of trends.

The variations between the nitrate levels in the west compared with those in the east could have been anticipated, as groundwater moves down the plain and, in the normal course of events, some nitrate uptake can be expected. Of the wells recently the subject to nitrate testing, well M35/6295 with a median of 10.9 and a maximum quarterly reading of 14.9 between 1999 and 2006, shows the highest nitrate levels for wells in the vicinity of the command area. This well is located east of Cust in the vicinity of Oxford and Kennedys Hill Road. Cust is one of the areas in the District where high nitrate readings in groundwater have been recorded over the years and, therefore, the high readings from this well are not likely to be attributable to the commencement of the irrigation scheme.

Ohoka is another area in the District where high nitrate readings have also been recorded in the past, and nitrates in groundwater in this area were the subject of a 1997 report by Environmental Science and Research Ltd. That report indicated that although the readings were high, there was no evidence that nitrate levels in the groundwater in that area were increasing. The Ohoka well M35/4795 has been tested for nitrate levels since 1985, and the conclusion drawn by Environment Canterbury based on annual readings between 1985 and 2006 is that the levels are decreasing.

4.4 Microbiological contamination

4.4.1 Methods of testing

Environment Canterbury tests 14 wells within the command area, and to the east of this area for microbiological contamination which are in the unconfined aquifer. The frequency with which these wells are tested varies, and changes have been made to this since 2000. Also since 2002 Environment Canterbury has tested for Escherichia coli (E.coli) and total coliforms. Prior to this for a short period it tested for both E.coli and faecal coliforms.

The results of tests for E.coli are the most important when reviewing levels of microbiological contamination on the Waimakariri-Ashley plain, and assessing the likelihood that any changes in the readings could be attributed to the commencement of the Waimakariri irrigation scheme in the summer of 1999/2000.

E. coli is adopted as the indicator of contamination because it is the predominant coliform in faeces, and is the only member of the coliform group that is found exclusively in faeces of animals. (WHO, 2004, OECD/WHO 2003). This means that a test for E. coli is a more reliable indicator of faecal contamination than the test for faecal (thermotolerant) coliforms previously used by Environment Canterbury.

Environment Canterbury also reports the results of tests for total coliforms. Environment Canterbury indicates that “total coliforms do not necessarily indicate the presence of faecal matter, their presence in groundwater does indicate that the groundwater is vulnerable to bacteria contamination from near-surface soil, and that
if a source of faecal material were present in the soil, it could contaminate the groundwater."

A more detailed review of total coliforms recorded in groundwater tests across the District as a whole will be reviewed in a forthcoming monitoring report on water quality and quantity to be prepared later in 2008.

4.4.2 Sources of contamination

Tracing the sources of microbiological contamination which show up in groundwater tests is difficult, because there are a number of ways in which contamination can occur.

The main sources of contamination are from:

a) discharges from onsite sewage and waste water disposal systems, particularly the older style septic tanks
b) animal excrement on land
c) insecure wells
d) lack of hygiene when taking samples

It should also be noted that the level of microbiological contamination in any particular well is likely to fluctuate widely between tests. The variable likely to influence the level of bacteria in groundwater that have been identified by Environment Canterbury include soil moisture conditions and rainfall events.

4.4.3 Waimakariri-Ashley plain testing

Of the 14 wells that are being tested by Environment Canterbury:

The wells tested annually are:

<table>
<thead>
<tr>
<th>L35/0086</th>
<th>L35/0349</th>
<th>M35/8479</th>
</tr>
</thead>
<tbody>
<tr>
<td>M35/5869</td>
<td>M35/4795</td>
<td>M35/7796</td>
</tr>
<tr>
<td>M35/8479</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The wells tested annually from 2000 – 2004, and quarterly from July 2005 are:

<table>
<thead>
<tr>
<th>M35/6385</th>
<th>M35/4757</th>
<th>M35/6295</th>
</tr>
</thead>
<tbody>
<tr>
<td>M35/5440</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Of the remaining wells:

M35/4682 was tested monthly until 2004, seven times in 2005 and once each year in 2006 and 2006.

M35/0698 was tested monthly until 2004, eight times in 2005, and quarterly since 2006.

M35/0132 is tested monthly. (This well was, in fact, tested intermittently between 1986 and 1996, and monthly since 1997.)
### 4.4.4 E. coli detected

Since 2000, no E. coli have been detected in tests taken from seven of these wells:

<table>
<thead>
<tr>
<th>Well Code</th>
<th>Location Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>L35/0086</td>
<td>To the south of the Eyrewell Forest.</td>
</tr>
<tr>
<td>L35/0349</td>
<td>To the west of the Command area.</td>
</tr>
<tr>
<td>M35/4757</td>
<td>At Bennetts.</td>
</tr>
<tr>
<td>M35/5869</td>
<td>At Howsons Road.</td>
</tr>
<tr>
<td>M35/7796</td>
<td>Remaining two are in the Ohoka area.</td>
</tr>
<tr>
<td>M35/8479</td>
<td></td>
</tr>
</tbody>
</table>

Well L35/0086 is to the south of the Eyrewell Forest, well L35/0349 to the west of the Command area, well M35/4757 is at Bennetts and well M35/5869 is at Howsons Road, while the two remaining are in the Ohoka area.

There are tests from four wells in which relatively low E. coli counts have been recorded on fewer than three occasions. These wells are:

- M35/8567 at Cust saw E. coli recorded in tests taken in September 2000 and 2003.
- M35/4682 at Mandeville saw E. coli recorded in tests taken in April and October 2003.
- M35/0698 at Clarkville saw E. coli recorded in a test taken in May 2003.
- M35/5440 at Eyreton saw E. coli recorded in tests taken in January 2006 and April 2008.

There are three wells from which tests have shown significantly higher levels of E. coli. These are well M35/8479 at West Eyreton, well M35/0132 east of Browns Road and close to the Tram Road, and well M35/6295 east of Cust close to the Oxford Road.

The West Eyreton well is immediately down gradient of the cluster of unsewered dwellings, which form the older village area within the West Eyreton Residential 4 Zone. E. coli have been present in all samples from this well apart from those taken in 2000 and 2004. In September 2003, a very high E. coli count of 980 was recorded. This well was retested the following day, and two separate readings of 770 and 980 E. coli were recorded, together with a total coliform count of 1200. A further test approximately six weeks later, in early November 2003 resulted in an E. coli count of 1, and a total coliform count of 10.

Well M35/6295 east of Cust has recorded E. coli readings of 1 or 2 on four occasions since 2000. These occurred in July 2006, January 2007 and January and April 2008. This is a well that has also consistently returned high nitrate readings during the period under review. These have ranged from 9.0 to 23.8 nitrate nitrogen mg/L, with an average of 10.8, which is very close to the Maximum Allowable Value (MAV) of 11.3. A review of the circumstances at this well does not provide any particular reason for these readings.

Well M35/0132, which is tested monthly, has recorded E. coli present in the samples taken from October 2001 to April 2002, October 2002, January 2003, March 2004, April, May, July, August, October and November 2005, January 2006, June and July 2006, December 2006 to February 2007, and in March 2008. This means that E. coli have been present in 23 of the 101 tests since January 2000.

In a technical report “Bacteria contamination in Canterbury groundwater” Report No. R06/31 ISBN 1-86937-615-3 Environment Canterbury provides a case study of well M35/0132. Environment Canterbury provides the following analysis of the potential sources of contamination:
“Given the frequency and magnitude of detections in samples from this well, the septic tanks, one located approximately 30m cross gradient and the other 100m up gradient from the well appear the most likely contamination source. Poor well head security also cannot be ruled out as a cause for the contamination, as surface material can potentially enter the well head. However, it is unlikely that surface material enters the well as frequently as bacteria are detected here. The land use in the areas is predominantly sheep and crop farming.” (p.60)

While there is always some difficulty in interpreting the source of additional bacterial contamination in ground water, it should be noted that in the late 1990s a number of 4 hectare lots were created immediately up gradient of the property on which this well is located. Dwellings, including relocated houses, with on-site sewage and wastewater disposal systems were constructed on these lots between 1999 and 2001.

While the total coliform readings have been higher since 2000 than between 1996 and 1999, there were also a significant number of detections of faecal coliforms prior to 2000 in tests from this well mainly during summer months (December to April or May). This suggested that a localized source may be contributing to the bacterial counts in well M35/0132, rather than any increases in livestock on land to the west of this well being irrigated with water from the Waimakariri irrigation scheme.

4.4.5 Impact of irrigation

Environment Canterbury’s recent groundwater testing of wells on the Waimakariri-Ashley plain does not provide clear evidence that the introduction of irrigation on the upper plain has had an adverse effect on the microbiological contamination of groundwater in the area. Tests from some wells have shown no E.coli is present, while tests from others have shown relatively low and/or sporadic E.coli counts. In at least two of the three wells where high numbers of detections have been recorded, contamination from older on-site sewage and wastewater disposal systems is considered the most probably source of contamination.

Environment Canterbury’s technical report [ibid p.5] reviews the current understanding of the relationship between irrigation and groundwater contamination. It states:

“The greatest risk of more widespread, non-point-source faecal contamination is from grazed paddocks, but this risk is poorly understood (Close et al., 2002). Contamination has been documented beneath grazed paddocks in southern Canterbury where the water table is shallow and the paddocks are irrigated by flood irrigation (Close et al., 2005; Close and Dann, 2004; Close and Savill, 2003). The large quantities of water used for flood irrigation can rapidly transport bacteria through cracks and macropores in the soil, by-passing the filtration capacity of the soil. On the other hand, the risk of contamination is probably very low in areas where groundwater is deep and irrigation rates are low, because there is not enough water available to carry the faecal material through the topsoil and the underlying material. Monitoring of faecal contamination beneath grazed paddocks under spray irrigation in central Canterbury has been inconclusive (Close et al., 2005).”

In this context, it is important to recognise that irrigation with water from the WIL scheme is spray irrigation with relatively small volumes of water being applied regularly, particularly when centre pivot systems are used. This means that the likelihood of the soil absorbing the bacteria is relatively high. It also suggests that the
risk of the Waimakariri irrigation scheme being a significant threat to groundwater quality is relatively low, so long as consent conditions for the disposal of dairy shed effluent are complied with. The issue of consent compliance is the responsibility of Environment Canterbury and beyond the scope of this study.

4.5 Surface Water Quality

The monitoring of surface water quality on the Waimakariri-Ashley plain has been limited, and does not provide the basis for an assessment of the impact of the introduction of irrigation on the upper plain on surface water quality.

The monitoring of water quality in the stock water races, administered by WIL on behalf of the Waimakariri District Council has been limited to testing for turbidity. Concern about the clarity of water in these races is prompted by the potential for disturbance by livestock, particularly cattle and deer. In fact, the company’s recent monitoring reports indicate that reducing livestock activity in the water races is one of the company's priorities.

The only regular monitoring undertaken by Environment Canterbury to date has been for contact water quality in the Cust Main Drain. This monitoring for water quality in the Cust Main Drain does not test for nutrients, the contaminants most likely to be associated with the degradation of surface water as the result of the introduction of irrigation.

Environment Canterbury indicates that it is currently undertaking an extensive series of testing in the lowland streams and the major drains that feed into the Cust Main Drain system, with a view to establishing a baseline for assessing future changes, if any, in the future. This work commenced in 2006 and is due to be finished by 2010.
5 LAND AND LANDSCAPE

5.1 Community Outcomes

The 2006 – 2016 Community Outcome that focuses on the protection of soils in the District states:

*The land is healthy*

- Soils are protected from inappropriate farming practices
- The loss of topsoil by wind erosion is minimised

This Outcome reflects community concerns about how farm practices may impact upon soil quality and, in particular, the risk of the loss of topsoil through wind erosion.

The Community Outcome that addresses issues associated with the look and feel of the District’s rural areas states:

*The distinctive character of our towns, villages and rural areas is maintained*

- Our rural land is mainly used for farming

This Community Outcome reflects the community’s concern about the impact of development on the character of the District’s rural areas.

5.2 Soil Structure

Most of the land in the command area for the irrigation scheme has relatively “light” soils, which do not retain moisture in the same way that the “heavier” clay based soils found in the eastern part of the Waimakariri District. From a number of perspectives, farming lighter land under irrigation has advantages so long as sufficient water is available during periods when rainfall is limited. For dairy farming, it means that cattle are less likely to “pug” soils during periods of wet weather. From a cropping perspective, the risk of a moisture sensitive crop being spoilt by very heavy rain from a thunderstorm following irrigation is less than when such a crop is grown on heavier or less free draining soils.

In general, light or free draining soils improve when farmed under irrigation. With the more intensive land uses made possible by irrigation, organic matter build up in the soil occurs, and this allows more nutrients to be retained in the root zone of grasses. Richer soils with greater grass growth are also less prone to removal of topsoil by wind erosion.

While no formal soil testing has been undertaken for this report, it is reasonable to conclude that in general there is little likelihood of the soils in the command area being degraded as the result of the changes to farming practices associated with the introduction of irrigation.
5.3 Rural character

5.3.1 District Plan provisions

The issues of rural character in the District’s rural area is addressed in the District Plan by way of the objective and policies for the Rural Zone.

Objective 14.1.1 states:

*Maintain and enhance both rural production and the rural character of the Rural Zones, which is characterised by:*

- the dominant effect of paddocks, trees, natural features, and agricultural, pastoral or horticultural activities;
- separation between dwellinghouses to maintain privacy and a sense of openness;
- a dwellinghouse clustered with ancillary buildings and structures on the same site;
- farm buildings and structures close to lot boundaries including roads;
- generally quiet – but with some significant intermittent and/or seasonal noise from farming activities;
- clean air – but with some significant short term and/or seasonal smells associated with farming activities;
- limited or no roadside advertising.

When the Proposed District Plan was notified in June 1998, 4 hectares was established as the minimum subdivision size for the creation of a new lot as a controlled activity and the construction of a dwellinghouse as a permitted activity in the Rural Zone. During the hearings a number of submitters raised doubts about whether the policies and rules relating to the Rural Zone were appropriately aligned and would achieve the desired results with respect to the maintenance of rural character. In addition, there was at least one submission requesting an increase in the minimum lot size in order to protect the command area for the Waimakariri irrigation scheme from proliferation of small-holdings.

In response, the Council’s hearing panel decided that the minimum lot size for subdivision as a controlled activity and a dwellinghouse, as a permitted activity should be 20 hectares. This decision was referenced to the Environment Court by a number of parties wishing to see the minimum returned to 4 hectares. The Council could not achieve agreement from all interested parties to settle these references, and finally in the face of difficulties in defending the 20 hectare threshold, the Council introduced a Variation to re-establish the 4 hectare minimum.

The Council again received submissions both supporting and opposing these Rules, including one requesting a two-zone approach, with higher minimum size for subdivision as a controlled activity and dwellinghouse development as a permitted activity in the area that was then the Oxford Ward. The Council after hearing submitters' arguments confirmed a 4-hectare minimum. The main reason given by the hearing panel for confirming the position adopted in 1998, was that the introduction of the Waimakariri irrigation scheme, and the accompanying on-farm development, made it unnecessary to provide further protection from pressure to create small-holdings, in the west of the District.
A review of the pattern of subdivision in the command area shows that the majority of the new small-holdings have been created in the West Eyrton area, and involve the subdivision of 20 hectare lots into 4 or 5 small holdings. There have been only isolated instances of larger properties in the command area being the subject of wholesale subdivision of the type that has occurred in the Swannanoa and Fernside areas. On a few occasions, small-holdings adjacent to the new dairy farms have been incorporated into the larger property. There has also been at least one instance where a small holding with a dwelling has been purchased by the owners of a new dairy farm to provide staff accommodation, as an alternative to providing this on the main property.

5.3.2 Impact of the irrigation scheme on rural character

When developing the District Plan, the position adopted was that it was possible for a rural landscape to change without the loss of rural character. When reviewing the impact of the irrigation scheme on rural character in the command area it is, therefore, necessary to appreciate that it is possible for a rural landscape to change without the loss of rural character.

One of the more pronounced changes from a landscape perspective has been the replacement of the parched brown/grey or golden tones of dry grass paddocks during summer months with the green of irrigated pastures. This is a change from the look traditionally associated with much of the Canterbury plains during the height of summer, including the upper Waimakariri/Ashley plain, but does not represent a loss of rural character in the terms set out in Objective 14.1.1 in the District Plan.

The cutting down or severe topping of farm shelterbelts to make way for centre pivot irrigators is another significant change in the farmed landscape associated with the introduction of the Waimakariri irrigation scheme. On some farms, trees have been cut down to make way for the realignment of fences. On others trees have been topped and gaps cut to allow the support structures of the pivot irrigators to pass through the shelter belt, while the spray lines pass over the top of what remains of the trees.

During the last 20 to 30 years there had been extensive tree planting for farm shelter and/or farm forestry. The environmental value of these trees for soil and moisture conservation, and as shelter for livestock was widely appreciated. The removal of trees was, therefore, a change associated with irrigation that triggered considerable community concern.

From the perspective of the maintenance of rural character, and the management of trees on farms the environmental effects of the removal of some trees, and the severe topping of others may not be as clear cut as it at first appeared. While trees are identified in Objective 14.1.1 as one of the key components of rural character, so too are paddocks. While this Objective links openness with separation between dwellinghouses, an increased sense of openness can also be created by the removal of farm shelter belts, as this reveals vistas across the countryside that would otherwise not be available when blocked by lines of trees. The following aerial photograph shows the areas being covered by four centre pivot irrigators on one of the largest of the farms converted to dairying.
It should also be recognised that the removal of shelter trees has occurred mainly on the properties that installed centre pivot irrigators, and the majority of these irrigation systems have been introduced to the west and south of the command area. These areas are visible from the District’s main roads such as the Tram Road and the South Eyre Road. In other areas, particularly to the northwest of the command area, other irrigation systems such as big guns or rota-rainers are being used, and many mature trees planted before the commencement of the irrigation scheme remain.

The following photographs show examples of dairying to the north-west of the command area where shelter belts have been retained, and the use of irrigation systems other than centre pivot irrigators.

It should also be appreciated that some of the trees felled to make way for pivot irrigators were relatively old, and coming to the end of their useful life. In other cases the trees had not been well maintained. Some of these trees would probably have
been removed in the near future as part of the routine maintenance of farm shelter. In these instances, the old or poorly maintained trees may have been removed in the near future, irrespective of the introduction of irrigation.

In other instances, the areas where trees were topped initially looked unsightly, they have recovered. The following photos of the same line of trees were taken approximately two and a half years apart, and show clearly indicate the extent of the changes that have occurred.
The first two photographs above were taken in mid-2005 and the third shows the same line of trees in February 2008. These show that, in this instance at least, trees that were severely topped have recovered to produce apparently healthy, albeit, low shelter for animals.

While the removal of shelter trees can be seen as having contributed to the maintenance of rural character by increasing the sense of openness in areas where this has occurred, and the topping of shelterbelts means that some shelter for animals remains, these changes can be seen as having other environmental consequences. Good farm shelter in association with irrigation is widely recognised as valuable from the perspective of efficient water use, as the rate of transpiration resulting from heavy winds is reduced. Also, when cultivation is being undertaken good farm shelter will reduce the extent of wind erosion.
6 INDIGENOUS VEGETATION

6.1 Community Outcome

The 2006 – 2016 Waimakariri District Community Outcome addressing indigenous vegetation that is relevant to the study of the impact of the Waimakariri irrigation scheme states:

There are areas of significant indigenous vegetation and habitats for indigenous fauna

- Conservation of significant areas of vegetation and/or habitats is encouraged

This outcome underlines the importance for the community of areas of significant indigenous vegetation and/or habitats, and also echoes the requirements of RMA S. 6(c) which makes “The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna” a matter of national importance.

6.2 District Plan provisions

In response to the requirements of RMA S.6(c), the Waimakariri District Plan provides for the protection of a number of areas of significant indigenous vegetation and habitats for indigenous fauna. The criteria for the attributes of sites that warrant protection which are set out in the Explanation to Policy 6.1.1.1. are as follows:

a) size and shape of an area;
b) number of indigenous species within the area;
c) percentage cover of indigenous vegetation;
d) level of pest infestation;
e) level of disturbance within the area;
f) number of rare species and species endemic to the District;
g) representativeness of the area in regard to its vegetation, soil type and land form combination;
h) level of rarity and condition of the area compared to others identified under g;
i) extent to which the area makes up part of an ecological corridor; and
j) recognition as wahi taoanga by Ngai Tuahuriri

The Methods proposed in the District Plan to implement Policy 6.1.1.1 include the maintenance of a Council Register (6.1.1.1.3) to record information about the protected sites listed in the Plan’s Appendix 25.1, and also any sites deleted from the Plan. The reason for maintaining information on the Council’s Register about sites deleted from Appendix 25.1 is “to assist in state of environment reporting”.

For this study of the impact of the introduction of the Waimakariri irrigation scheme, the key issue from the perspective of the protection of indigenous vegetation is the health of the protected sites that are located within the scheme’s command area. Attention should also be paid to any changes to the list of sites in the command area made as the result of submissions and/or references during the development of the Proposed Waimakariri District Plan.
6.3 Sites in the Waimakariri irrigation scheme command area

6.3.1 Sites deleted

No changes to the list of site have been made since the District Plan became operative in November 2005. During the Proposed Plan process, however, one significant change to the list of site was made. The landowner requested the deletion of three kanuka sites, these were original sites numbers V110 of 2.0ha, V111 of 2.6ha, and V112 of 3.3ha. The landowner indicated the position of these sites close to the proposed irrigation race through the centre of the property, as the reason for wishing to have the original sites removed from the Plan.

The Council’s decision not to remove these sites from those listed in the Plan was appealed to the Environment Court and the matter was settled with the inclusion of a new site involving 1.0 hectares of kanuka identified as site V158 in the Plan. In a report prepared for the Council by consultant David Given, relating to the sites that were removed, it was noted that as notified the District Plan had a total of kanuka on flat plain sites listed of 94 hectares, ranging in size from 0.8 ha to 18.5 ha, and the area that would be lost with the removal of the sites in question would represent a loss of approximately 8 percent of the area protected by the Plan.

The kanuka in the sites previously identified as V110, V111 and V112 have been removed, and the area is now being irrigated using a centre pivot irrigator with water from the Waimakariri irrigation scheme. The property is currently leased to Mt. Linton Farming, the lease with this group expired in January 2007, and it is understood that it has not been renewed by this company.

The replacement site V158 is located on the southern boundary of the property and is bounded by the Eyrewell Forest. At present one part this site is fenced off from sheep and in another it is fenced off for cattle. It is the owner’s intention to include provision in the revised lease to have the entire site fenced off from all livestock. Despite the limited fencing the site notes from the 2006 monitoring state that the “site is in good health with ground based herbs and shrubs present.”

6.3.2 Site destroyed and replaced in mitigation

In 1999, shortly after the notification of the District Plan, an estimated 22 – 30 percent of a 3.4 ha kanuka site V106 was destroyed as the landowners set up their property for irrigation using centre pivot irrigators. In response to enforcement action for a breach of Proposed District Plan Rule 24.1.1.2 restricting the extent to which a protected site could be reduced, the owners offered another area of Kanuka of 1.2 ha. The 2006 monitoring notes indicate that this new site has not been grazed since 1999 and that:

“Despite its small size there is good forest floor health with kanuka seedlings germinating. Green flowered clematis was seen along with many grass orchids, silver tussock, mingi mingi, native brooms and leucopogon spp.”

This report indicates that although the original area, which was significantly larger than the area offered by the owners in mitigation, the new site V106 is in good health, and that the overall purpose of the District Plan has not been entirely frustrated by the destruction of a site which was described in the original notes as “a good example of lightly grazed kanuka remnant.”
### 6.3.3 State of sites

The following section details the site assessments from the 2006 monitoring undertaken by the Waimakariri District Council, for the 20 indigenous vegetation sites in the command area for the irrigation scheme.

<table>
<thead>
<tr>
<th>Site</th>
<th>Location</th>
<th>Description</th>
<th>Health</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>V105</td>
<td>Thongcaster Road Oxford</td>
<td>Kanuka – Pond Site Lot 2 DP 23886</td>
<td>Kanuka</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Good health. This is a very good kanuka site. There has been no grazing for 30 or more years, and there are some large kanuka trees with a diverse range of herbs and shrubs at ground level. Some gorse and broom growing through the electric fence around the site.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V106</td>
<td>Thongcaster Road Oxford</td>
<td>Kanuka Northern Boundary Strip Lot 2 DP 23886</td>
<td>Kanuka</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Good health. Despite its small size there is good forest floor health with kanuka seedlings germinating. Green flowered clematis was seen along with many grass orchids, silver tussock, mingi mingi, native brooms and leucopogon spp.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V113</td>
<td>Carleton Road Oxford</td>
<td>North West Kanuka Site Pt Lot 5 DP 3020</td>
<td>Kanuka</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate health. The kanuka has increased in height since the site was evaluated for inclusion in the District Plan in 1997. The owner attributed this improvement to increased fertility resulting from stock camping in the kanuka. Ground based herbs and shrubs were present despite reasonably intensive grazing pressure. Heavy winter snow has tipped over or broken quite a few trees.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V115</td>
<td>Carleton Road Oxford</td>
<td>Trig Site Pt Lot 3 DP 3119</td>
<td>Native broom</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moderate health. This site is the only one listed in the District Plan which contains an unidentified native broom. The integrity of the site is being compromised by the spread of gorse and pine trees.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V116</td>
<td>Eyrewell Forest Wolffs Road/ Poyntzs Road</td>
<td>Pomaderris Site Lot 2-3 DP 55823 &amp; Lot 5 DP 55821</td>
<td>Shrubland along forest margin</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not evaluated. At risk with the clearance of the Eyrewell Forest to make way for further dairy development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V117</td>
<td>Main Race Road West Eyreton</td>
<td>Langstone Kanuka Block Lot 3 DP 45557</td>
<td>Kanuka and native grassland</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not evaluated. QEII covenant was established over this site by the owners Land Corp Ltd. The covenant is dated 11 June 2004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site ID</td>
<td>Location</td>
<td>Description</td>
<td>Condition</td>
<td>Size (ha)</td>
</tr>
<tr>
<td>--------</td>
<td>----------</td>
<td>-------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>V118</td>
<td>Main Race Road West Eyreton Kanuka Site Lot 4 DP 57722 Kanuka</td>
<td>Good health. This site is well looked after. It is free of exotic weeds and is in good health. While kanuka is dominant, cyathodes was noted and will continue to increase. Existing kanuka has been incorporated into house and garden plantings.</td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td>V119</td>
<td>Main Race Road West Eyreton Bottom Kanuka Block Lot 2 DP 301596 Kanuka</td>
<td>Moderate health. The site is fenced with good sheep grazing management being carried out.</td>
<td></td>
<td>2.2</td>
</tr>
<tr>
<td>V120</td>
<td>Pesters Road West Eyreton Kanuka House Site Lot 6 DP 50390 Kanuka</td>
<td>Good heath. Native clematis and broom are established. The site is a credit to the owners.</td>
<td></td>
<td>0.8</td>
</tr>
<tr>
<td>V121</td>
<td>Pesters Road West Eyreton Eastern Kanuka Block Lot 7 DP 50390 Kanuka</td>
<td>Good health. This site is in excellent condition. It is the eastern most site of three on this property.</td>
<td></td>
<td>1.6</td>
</tr>
<tr>
<td>V122</td>
<td>Pesters Road West Eyreton Middle Kanuka Block Lot 7 DP 50390 Kanuka</td>
<td>Good health. This is an excellent fenced site. The adjacent land is leased for dairy farming, and the kanuka benefits from the irrigation waters from the adjacent paddock.</td>
<td></td>
<td>1.2</td>
</tr>
<tr>
<td>V123</td>
<td>Pesters Road West Eyreton Western Kanuka Block Lot 7 DP 50390 Kanuka</td>
<td>Good health. The site is fenced and in excellent health. Matagouri bush was also present. Adjacent farmland is leased for dairy farming.</td>
<td></td>
<td>1.2</td>
</tr>
<tr>
<td>V124</td>
<td>Poyntzs Road West Eyreton Western Kanuka Block Lot 5 DP 50390 Kanuka</td>
<td>Degraded health. The land is leased and cattle are being grazed on the land. The lessee did not know that the site was listed in the District Plan. The size of the site has been substantially reduced because of fire. The site would benefit from the protection that could be afforded by an electric fence, as this would allow the sites to begin to regenerate.</td>
<td></td>
<td>1.5</td>
</tr>
</tbody>
</table>
Degraded health. The land is leased and cattle are being grazed on the land. The lessee did not know that the site was listed in the District Plan. The size of the site has been substantially reduced because of fire. The site would benefit from the protection that could be afforded by an electric fence, as this would allow the sites to begin to regenerate.

Good health. This site is now subdivided into two lots each with different owners. The site has extensive areas of broom, which have been sprayed and cut over a wide area. The area has not been grazed in recent years and as a result there is good seedling regeneration of kanuka. Cyathodes was also present along with leptinella. Fantails, quail and kingfisher were seen and heard.

Good health. This is the District’s largest kanuka site. It is in good health with extensive cyathodes in the understorey. Grazing pressure is greatest as expected on the southern side where sheep have entered the kanuka for shade and shelter.

Signs of rabbits were evident. Radiata continue to expand in size but are a low level threat.

Good health. The site was a “wet feet” kanuka site. At this visit it is no longer so wet, possibly because the mainstem of the Waimakariri River is now on the other side of the riverbed. On this basis it should now be regarded as a dryland kanuka site.

The kanuka is taller, there is regeneration in some open areas, some carex spp. were noted. The site is fenced.

Moderate health. This site is across three paddocks. The eastern part is more heavily grazed than the other two. It is quite open. Few herbs and shrubs are present at ground level.

The remainder of the site is more healthy. Cyathodes was seen along with matagouri. There is little gorse and broom present.
This site has very tall, old kanuka. Some clearance has taken place to facilitate stock access. This site would benefit from fencing. If stock, particularly cattle are not excluded, it will degrade.

<table>
<thead>
<tr>
<th>V140</th>
<th>Poyntz Road West Eyreton</th>
<th>Kanuka Site</th>
<th>Lot 2 DP 58799</th>
<th>Kanuka</th>
<th>3</th>
<th>53/63</th>
</tr>
</thead>
<tbody>
<tr>
<td>V158</td>
<td>Carleton Road Oxford</td>
<td>Fenceline Kanuka Site</td>
<td>Pt Lot 4 DP 3020</td>
<td>Kanuka</td>
<td>1</td>
<td>62/52</td>
</tr>
</tbody>
</table>

Moderate health. The site is intersected by a pine hedge and has extensive gorse of which some has been sprayed. Little grazing has taken place. The moderate health rating has been given because of the extensive gorse present. In areas free of gorse there is a good range of ground based plants and regenerating kanuka.

Good health. The site is located on the southern side of the property adjacent to the Eyrewell Forest. It has been fenced off for sheep in one part and cattle in another.

The 2006 monitoring indicated that of the 20 sites within the command area, 11 were in good health, and 5 sites in moderate health, with 2 sites degraded. The two degraded sites were on the same property, which was being managed by a lessee who did not know of their protected status under the District Plan, and had been severely damaged by fire. The monitoring, therefore, indicates that despite the loss of approximately 10 percent of the area of Kanuka initially proposed for protection as sites of significant indigenous vegetation during the District Plan process and the establishment of the irrigation scheme that most of the listed sites are in good to moderate health. Some of these sites, however, would clearly benefit from additional protection, if only by way of a single strand of electric fencing wire.
7 ROADING

7.1 Community Outcome

The 2006 – 20016 Waimakariri District Community Outcome addressing transport including roading that is relevant to the study of the impact of the Waimakariri irrigation scheme states:

Transport is Accessible, Convenient, Reliable, Affordable and Sustainable

- The standard of our District’s roads is keeping pace with increasing traffic numbers

This is one of the top 6 (from 16) priority Outcome statements and reflects the community’s concern about the impact that the increasing numbers of vehicles on the District’s roading network, and the ability of the authorities to ensure that the standard of the District's roads are able to be maintained at an acceptable standard.

7.2 Patterns of road use in the command area

Council records show the increase that has occurred in the use of the District’s roads within the command area since 2000. This change is illustrated in the graph below, both in terms of the estimated kilometres travelled, and the percentage change on a year on year basis for the years 2000 to 2007.

This graph shows that the estimated number of vehicle kilometres travelled increased from 30,767,385 in 2000 to 44,370,379 in 2007, which is a 44% increase. It also shows that the most significant increases on a year by year basis occurred between 2001 and 2004, the years during which irrigation was becoming established.
The change from dryland livestock and cropping farming to dairying produces a significant change in the patterns of vehicle movement, particularly an increase in the amount of heavy vehicle traffic. During a season dryland farms could be expected to generate a limited number of heavy traffic movements involving the transporting of sheep, wool and/or grain off the property, and the transporting of fertiliser and/or equipment onto the property. By contrast, with a substantial proportion of the command area in dairying, tankers are travelling from farm to farm on a daily basis during the milking season. This means that there has been a significant increase in the number of heavy vehicle movements on the roads in the command area since the commencement of the irrigation scheme in 1999/2000.

At the peak of the 2001/2 season, for instance, 10 dairy tankers per day were travelling between the west of the Waimakariri District and one of the company’s main South Island factories at Clandeboye near Temuka, in South Canterbury. The number of tankers leaving the west of the District during the peak of the milking season now has increased to at least 27 per day in 2007/08.

In addition, with dairying there is more extensive use of fertilisers and there will, therefore, be more trips being made by trucks transporting fertiliser and silage to the area’s dairy farms than there would have been prior to the conversion of these farms for dairying.

The increase in trips is also particularly pronounced during period when silage is being made. These occur in the late spring/early summer when grass is being made into silage, and in the autumn when maize silage is being made.

At the same time, it is important to appreciate that not all the increase in the use of the roads in the command area can be attributed to the changes in farming as the result of irrigation. The changes in the number of people and occupied dwellings in the Census Area Units that approximately coincide with the command area for the irrigation scheme are set out in Table 7.1

<table>
<thead>
<tr>
<th>Census Area Unit</th>
<th>Usually Resident Population</th>
<th>Occupied Dwellings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2001</td>
<td>2006</td>
</tr>
<tr>
<td>Cust</td>
<td>399</td>
<td>429</td>
</tr>
<tr>
<td>Mairaki</td>
<td>249</td>
<td>318</td>
</tr>
<tr>
<td>West Eyreton</td>
<td>1146</td>
<td>1722</td>
</tr>
<tr>
<td>Ashley Gorge</td>
<td>1053</td>
<td>1260</td>
</tr>
<tr>
<td>Oxford</td>
<td>1581</td>
<td>1716</td>
</tr>
<tr>
<td>Total</td>
<td>4428</td>
<td>5445</td>
</tr>
</tbody>
</table>

Source: Statistics New Zealand

This table shows that the number of people in these Census Area Units to the west of the District increased by 23.0 percent between 2001 and 2006, and the number of occupied dwellings increased by 24.3 percent over the same period.

That the increase in the estimate of kilometres travelled was highest for the years 2001 – 2004 and has subsequently levelled off, while the number of dwellings in the area has continued to increase suggests that the increase in the use of roads in the command area may be more closely related to the change in farming associated with irrigation than to the increase in the number of dwellings.
7.3 **Effect on roads**

The Waimakariri District Council indicates that, despite concerns expressed by some residents about the increased traffic, the impact of the introduction of irrigation on the roading network has not been very great. Probably of most significance are the occasions on which water from the irrigation races spills onto roads, usually because of blocked culverts.

The movement of cattle across roads has also created some concern because of the manure dropped on roads, and the disruption of traffic that occurs when a large mob of cows are crossing a reasonably busy road. The difficulties created by the regular movement of stock across roads on some dairy farms has lead the Council to develop a policy requiring the construction of a number of stock underpasses to overcome the problem.

The requirement for dairy farms to construct stock underpasses in certain circumstances has been formalised in the Council’s 2008 stock movement bylaw with the addition of a definition of regular stock movement, which states:

**Regular Movement of Stock** means stock being moved from one side of the road to the other more than four times in any seven day period. Regularly has a corresponding meaning and is independent of the individual identity of animals.

The bylaw also provides for the issuing of stock crossing permits, with a requirement for the construction of an underpass. Section 8.5 states:

**Stock Crossing Permits may be issued with conditions requiring the installation of a stock underpass within a reasonable period, as determined by the Council in consultation with the applicant, on roads where traffic volumes or safety issues are likely to result in unacceptable problems to road users.**

The following photograph shows a stock underpass in the command area under construction.
8 CORE UTILITY SERVICES

8.1 Community Outcome

The 2006 – 2016 Community Outcome addressing core utility services states:

Core utility services are provided in a timely, sustainable and affordable manner

- Energy and telecommunications services have sufficient capacity

This Community Outcome highlights the community’s concern that the provision of core utility services keeps pace with the developments that are occurring in the Waimakariri Districts. For many, the adequacy of the provision of core utility services is predominantly an issue associated with urban development.

While the development of the irrigation scheme represents an important addition to the District’s infrastructure, the focus for this section of the study of the impact of irrigation on the District is on the extent to which the core utility services, particularly energy and telecommunications, have been able to meet any additional demands arising from the introduction of the scheme.

8.2 Electricity

The District’s electricity lines company MainPower New Zealand Ltd indicates that the 25 Megawatt supply to the general area served by the scheme in 2000, increased to 34 Megawatts by 2007. The company estimates that about 8 of this 9 Megawatt increase is attributable directly with the irrigation scheme development. The growth in demand is estimated to have been on average about 5 percent a year, with greater percentage increases in demand in the first four years after the introduction of the scheme, from 2000 to 2004. This demand has come mainly from the need for power to run the irrigation pumps and operate the new dairy shed.

MainPower has made substantial improvements to its infrastructure, to meet this increased demand for electricity. These have included the upgrading the substations at Oxford and Cust, and the construction in 2008 of a new substation at Swannanoa. MainPower has also upgraded a number of major supply lines in the District including the line along Tram Road. The following photograph shows the upgraded electric power lines along Tram Road.
8.3 Telecommunications

Issues associated with the development of telecommunications in the Waimakariri District focus mainly on the ability of people to obtain broadband internet services via their telephone lines. In recent years, there have been a significant number of areas in the District, including within the command area for the irrigation scheme where broadband via a telephone line is not available. The other main option for obtaining broadband services is via wireless, and this requires the property to have “line of site” access to the District’s wireless relay station.

Recent surveys conducted by the Council have found considerable dissatisfaction with the speed of both broadband and dial up internet services in many areas within the District, including from respondents living in the command area for the irrigation scheme.

For farms on the irrigation scheme, the shortcomings associated with the District’s telecommunications services are significant as WIL posts its messages concerning the management of the supply of water on its web site. This is particularly important in seasons when the flows in the Waimakariri River fall to levels where the amount of water that the Company is able to take reduces and the available water is shared across the command area. Under these conditions the races receiving water are rotated, and information about which areas will have water are posted on the WIL website.

The Company appears to have adapted its website to ensure easy access for people with a dial-up internet service. The graphics on its home page are minimal, and messages about supply can be accessed directly from this page. The delay for farmers using a dial-up internet service to contact the WIL website are, therefore, very short when compared with accessing many other home pages via dial-up.
9 CONCLUSION

9.1 Overview

The objective of this analysis has been to assess the impact of the introduction of irrigation to the upper Waimakariri-Ashley plain in the summer of 1999/2000. The requirement was to adopt a “triple bottom line” approach, that is, to evaluate the impact from an environmental, economic and social perspective. The information available for this review is not comprehensive, but despite this it is possible to draw some reasonably firm conclusion.

The following table provides an assessment of the impact of the Waimakariri irrigation scheme, since its inception in 1999/2000.

| Environmental impact: |  |
|-----------------------|  |
| **Groundwater quality** | No changes in nitrate levels have been recorded. The monitoring by Environment Canterbury shows that for most monitor wells on the Waimakariri-Ashley plain readings show “no change”, “a decline” or “too few readings” to allow the assessment of a trend. A limited under of relatively high nitrate levels are being recorded, and these come from wells in areas where historically nitrate levels have been elevated. A review of monitoring by Environment Canterbury for microbiological contamination has not shown a limited number of cases of E.coli contamination, and there is no evidence that these can be attributed directly to the increased number of animals being farmed in the command area as the result of the introduction of irrigation. |
| **Groundwater quantity** | The introduction of the irrigation scheme would appear to have been beneficial for the mid-plain and the spring fed streams in the Ohoka area. Also, the enhancement of the groundwater levels in these areas provides an additional buffer to support the confined aquifer beneath Kaiapoi, which is the source of water for Kaiapoi and in the future likely to be a major source of water for Rangiora. There is no indication that the irrigation scheme has resulted in an increase in groundwater levels in the Clarkville area. Residents feared that this would occur, and would create additional drainage problems in an area which normally has high static water levels. |
| **Rural Character** | The introduction of the irrigation scheme has resulted in significant changes in the rural landscape to the west of the Waimakariri District. These changes can be seen as having been advantageous from the perspective of the maintenance of rural character in the area. The large dairy farms, in particular, have enhanced the “openness” of the area, and have to a certain extent offset the creation of new small-holdings particularly in the West Eyreton area. |
### Energy
MainPower indicates that the 25 Megawatt supply to the general area served by the irrigation scheme in 2000 had increased to 34 Megawatts in 2007.

Milk from the District is transported by tanker to Fonterra’s factory at Temuka by road which involves, at peak season, up to 37 round trips each day from the District as a whole. Approximately 27 of these return trips are transporting milk collected from west of Cust.

### Economic impacts
#### Scheme establishment
The establishment of the Waimakariri irrigation scheme involved very substantial capital investment by the irrigation company and in on-farm development. The cost of the development of the headworks and the main races was $7.3 million. The cost of the dairy conversions collectively would have been considerably higher. The total cost of the land, buildings, realignment of fences, and livestock for one property was given in 2001 as approximately $9 million. Much of the construction work was undertaken by contractors based in the Waimakariri District.

#### Dairying
Available data indicates that the introduction of irrigation to the upper Waimakariri-Ashley plain has resulted in a very substantial increase in production on the land converted to dairy farming. Fonterra indicate that at least 75 percent of the increased quantity of milk from the Waimakariri District is being collected from the area west of Cust.

Agricultural statistics from 2002, and other observations indicate that the impact of dairy farming has extended beyond the major farms that provide the “milking platforms”. Other farms provide grazing, either for young dairy animals or grass or crops for silage or other forms of supplementary feed, provide support for the main dairy farms.

The profitability of the new dairy farms depends on the prices being paid for dairy products internationally. The prices being paid in the 2007/8 season mean that the District’s dairy farms are considerably more profitable than they were in earlier years.

The extent to which the profitability of the new dairy farms has impacted on the local economy is difficult to estimate because of the area’s proximity to Christchurch, and the extent of ownership of the major enterprises by interests based outside of the District.

#### Other farming enterprises
The information available about the other changes in production resulting from the introduction of the irrigation scheme is limited. The low prices being paid for sheep and beef in recent years will have limited the profitability of any of the meat and wool farms using water from the irrigation scheme.

There are indications of an increase in the range of crops being grown in the west of the District as the result of the availability of water for irrigation.

#### Employment opportunities
The data available concerning employment on farms is confined to that collected at the 5 yearly Census of population and dwellings. A comparison of the data from the 2001 and 2006 Censuses indicate that there has been modest growth in on-farm employment in the west of the District.
District.

The data available concerning the employment in businesses providing services to agriculture also shows modest growth.

In both instances, the increases are not as great as those projected by Agriculture New Zealand (Wrightsons) in an economic profile prepared for the Waimakariri District Council in 2000.

Social impacts

Land ownership

The ownership of a significant number of larger properties changed shortly before or just after the irrigation scheme commenced operation in the summer of 1999/2000.

Many of the larger dairy farms are operated a limited liability companies, and some or all of the shareholders in these companies live outside of the Waimakariri District.

A few of the families involved with dairy farming in the east of the District have also become involved in the establishment of new dairy farms taking water from the irrigation scheme.

Casual/part-time work opportunities

The introduction of irrigation scheme has created opportunities for part-time work on the new dairy farms for people living in the Oxford area, and for teenagers in particular. These work opportunities are seen as valuable for young people as they are relatively well paid and there are not very many other work opportunities available in the area for these people.

Housing

Additional homes have been built on the large dairy farms to accommodate farm staff. In addition, there has been a demand for rental accommodation in Oxford and the surrounding area, by people moving into the District to work on the new dairy farms. This has exacerbated the position as far as the availability of rental accommodation for others wanting to rent a place to live in the area, particularly those seeking low cost accommodation.

9.2 Further changes and challenges

This review shows that many of the expectations associated with the introduction of the irrigation scheme from a farming perspective have been realized, although the extent to which dairying would become established in the command area may not have been anticipated. At the outset the availability of irrigation may have been seen as an insurance against drought by some who bought shares in WIL, but for most the capital investment involved has meant a completely new way of farming.

To remain viable, these farms need reliable access to irrigation water. Experience since the sharing regime was introduced when the River Plan became operative has meant that the amount of water that can be taken by the irrigation company is more limited. The company has already purchased land close to the headworks, and is working on the development of a storage lake. This will increase the reliability of the water supply, but the scheme will remain primarily a “run of the river” scheme dependent upon the fluctuations in the amount of water in the Waimakariri River.
Some farmers on the scheme have also developed on farm storage, and the following photographs show examples of storage lakes in a variety of locations within the command area.

Some of the dairy farms are turning to ground water to increase the reliability of supply. Since the commencement of the irrigation scheme a number of the major dairy farms have sought consents to take groundwater. The depths of these wells vary significantly, with one for which consent was given in 2005 adjacent to Pesters Road at 125 metres. This well is consented to take water at a rate not exceeding 100 litres per second “with a volume not exceeding 25,920 cubic metres in any period of three consecutive days”. Included among the conditions of consent for this well is that water can only be taken “at times when any supply from the Waimakariri Ashley Irrigation Scheme is on partial or full restriction due to low flows in the Waimakariri River...” Also “PROVIDED THAT: When the Waimakariri Ashley Irrigation Scheme is on partial restriction, the consent holder shall, as far as practicable, only exercise the consent to the extent necessary to supplement any shortfall in available supply from the Waimakariri Ashley Irrigation Scheme.”

In 2004 another consent for deep new wells in the command area close to Downs Road was issued to a major shareholder in the irrigation scheme. This consent involved two wells, one at 149 metres and the other at 191 metres. Together these two wells are consented for a take of 68 litres per second with the volume not exceeding 5,821 cubic metres per day. The use of groundwater in this instance is not linked to the taking of water from the irrigation scheme. A consent was granted in 2005 to another of the major dairy farms on the irrigation scheme at a depth of 29 metres, and a rate of take not exceeding 26 litres.
The introduction of large-scale dairy farming in the command area has also been accompanied by the purchasing of large properties to the west of the command area by parties with dairy farming interests. The most significant of these cases has been the purchase of a total of approximately 1,850 hectares by Woodstock Farms Ltd, a Rakaia Island Dairies Ltd., one of the largest shareholder in Fonterra. In addition, a property of approximately 575 hectares in the Woodstock area is currently being leased by one of the major dairy farming shareholders in Waimakariri Irrigation Ltd. The full implications of these developments for the District and WIL are not yet apparent, but it is clear that the company is committed to maintaining is current focus and also taking advantage of any opportunities that arise to enhance its operations.

On 7 June 2007 the directors unanimously confirmed the irrigation company’s status as a co-operative under the Co-operative Companies Act 1996. In doing so they “reaffirmed the value of the co-operative company as a measure of facilitating its shareholders carrying on business on a mutual basis”. The Company is proud of its status as a leader in the irrigation industry. In recognition of this, the National Institute of Water and Atmospheric (NIWA) approached WIL, in 2007, with a proposal to form an alliance to focus on “best practice” research. The collaboration with NIWA is an example of the importance that the company places on continuing to improve its performance, to ensure the future for irrigation in an environment in which overall sustainability is seen as being increasingly important.
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