Water Race Management Plan

(Document 1 of 2)

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Selwyn District Council

Water Race Management Plan
30 July 2013

(Document 1 of 2)

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DOCUMENT CONTROL SHEET

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DOCUMENT	Water Race Management Plan
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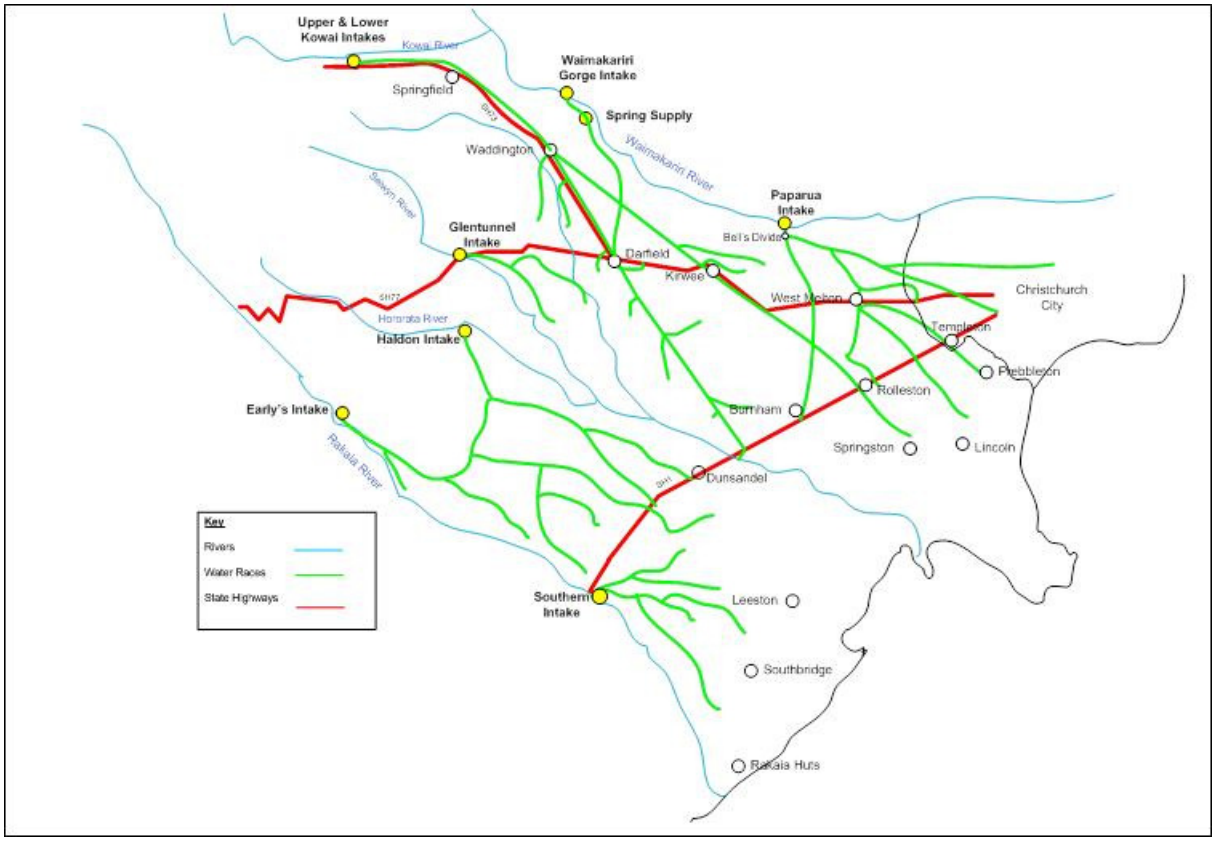
This document comprises a total of 288 pages (excluding cover)

REVISIONS

Number	Issue date	Description
Version 1	31 May 2007	Final
Version 2	April 2009	Incorporating updates from Malvern consent conditions
Version 3	May 2009	Minor typographical amendments Forms updated within the appendices
Version 4	12 October 2009	Table of Contents – updated
		Amendments Record – updated
		New Section 7.3 relating to private water race cleaning incorporated into plan as a result of Policy W103 being updated
		Appendix B – Policy W103 - updated
		Appendix E – Notice to Repair, Maintain or Clean Water Race - updated
		Appendix W – Outage Procedure – new addition
		Appendix AB – Water Race Brochure – new addition
Version 5	1 April 2010	Plan aligned with April 2010 maintenance contract variations
		Table of Contents - updated
		Minor wording changes throughout plan to align with contract variation
		1.6.2 Maintenance Contract Details added
		Table 5-2 revised

		Section 8.1 Response times revised
		Appendix D - Enforcement procedure modified
		Appendix AC - Protocol for Didymo Decontamination
		Standard Operating Procedures numbering added
		Appendix V – removed
		Section 3.0 Ellesmere – updated Glenroy information
Version 6	30 July 2013	Table 1.2 updated
		Table 2.1 updated
		Section 2.6 – Reticulation - udated
		Table 2.8 Demand Mangement Strategies, Opertion and Reporting - revised
		Section 2.9 Water Quality - revised
		Section 2.16 Scada - updated
		Section 2.17 After Hours Alarms - revised
		Section 3.0 Ellesmere Water Race Scheme Description & Operation – Irrigator Users paragraph added.
		Section 3.6 Monitoring Points - updated
		Section 4.3.1 Waimakariri Intake – Flow Monitoring Gauge information added
		Section 4.3.6 Flow Recorder Sites - deleted
		Section 5.4 Irrigation - updated
		Section 7.11 Traffic Management Plan - revised
		Section 11.0 Health and Safety - revised
		Appendix U Contacts Personel - updated
		Appendix W Watering Bay Schematic – new addition
		Appendix CC CRC 084966 Global Spraying Resource Consent – new addition

SCHEMATIC OF WATER RACES



Note: The Selwyn intake was closed in 2008 and no longer used

1.0 MANAGEMENT PLAN OVERVIEW

1.1 Purpose

The purpose of the Plan is to set out the key principles to be followed in managing the water race network. The Plan gives a specific statement of intent for the network, details key objectives/outcomes and outlines best practice guidelines to be followed in managing and operating the network.

1.2 Activity Goal

The Council's goal of providing a Stock Water Race System is:

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

This statement provides a clear indication to water users and other resource users of Selwyn District Council's (SDC's) primary objective in operating and managing the network. The above statement includes reference to customer needs, efficiency, and environmental objectives. An overall plan guiding the operation and management of the network to meet these objectives and outcomes is specified in this plan.

1.3 Background

1.3.1 Background

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

The water race systems must be able to function and co–exist alongside other resource users. Management and operation of the network has now recognised and reflects the values of other resource users. This required a more structured and effective management process which is outlined in this Water Race Management Plan. Details of the three schemes are detailed below.

Description		Quantity
Number of Schemes		Three
Properties Served		2785
Area Served	Ellesmere -	41,847ha
	Malvern	43,690ha
	Paparua	22,744ha
	Christchurch City	2,965ha
	Total	111,246ha
Physical Statistics	Intakes	10
	- Fish screens	2
	Tunnels	4 (1,745m)

Description		Quantity
	Reticulation Length (km)	
	- Major races	362Km
	- Minor races	173Km
	Viaducts	4 (169m)
	Culverts	
	- Major	35 (4,177m)
	- Minor	Unknown
	Divides	
	- Major	30
	- Minor	Unknown
Water Usage	Ellesmere	62.6 million m^3 (annual average)
	Malvern	36.2 million m^3 (annual average)
	Paparua	41.3 million m^3 (annual average)

1.4 Principal Objectives

The maintenance and operational strategies that are current or in the future will be instigated by the Asset Management Service Delivery Unit to ensure that the Councils goal is achieved. This will be achieved by the use of the following principal objectives:

Number	Principal Objective
1	Achieve the water race service potential through efficient operation
2	Achieve customer levels of service
3	Ensure sustainability (efficiency of water use and demand management)
4	Achieve health and safety standards
5	Reduce Council's exposure to risk due to failure of assets

An overall plan guiding the operation and management of the network is required to meet these objectives. The objectives above include other stakeholders (i.e. race users, the community and other river users) values and expectations. Understanding the expectations and outcomes sought by other stakeholders is the first step in more effective management of the race network.

1.4.1 Management Plan Outcomes

The key outcomes sought from the Water Race Management Plan are summarised in Table 1. The main reason for developing and implementing the Management Plan is to achieve or come close to achieving the desired outcomes. Every action, procedure or planned improvement described in the Plan is intended to achieve one of the outcomes below. Some of the outcomes may conflict at times but the aim of the Plan is to allow SDC to avoid or "manage" potential and actual conflicts between stakeholder interests.

Table 1.1: Stakeholder Outcomes

Stakeholder	Key Outcome (s)
Water Race Customers	Reliable supply of water for stock that is economically viable
Selwyn District Council	Maximise social and economic benefits of race network to the District and City
Christchurch City Council	
Department of Conservation	Enhance conservation value of natural waterways (i.e. rivers/streams)
Fish and Game	Enhance ***rivers*** as sport fishery
Te Taumutu Runga, Ngai Tuahuriri /Ngai Tahu	Enhance waterways for Mahinga kai, cultural/spiritual values
Royal Forest and Bird	Enhance wildlife/conservation value of waterways
Irrigators	Provide consistent water at the right time and at sufficient quantities/duration to meet reasonable demands of crop and pastoral needs
Wider Community	Enhance landscape and aesthetic values of farmland and Plains

1.5 Levels of Service

The following details the levels of service as detailed in the 5Waters Activity Management Plan (AMP).

Table 1.2: Customer Levels of Service

Level Of Service Number	Customer Levels of Service
WR2	Provide a well-managed water race system with a high level of responsiveness to the customer

The reporting requirements for the Levels of Service are detailed in the 5Waters AMP.

1.6 Water Race Management

The water race network is owned and administered by Selwyn District Council (SDC). SDC has overall responsibility for water delivery including formulation and implementation of management systems, policies and rules governing operation of the water race network. Some of these responsibilities are delegated to SDC's Water Race Subcommittee. The terms of reference for the Water Race Subcommittee, as established by SDC in 2001, are given in Appendix A.

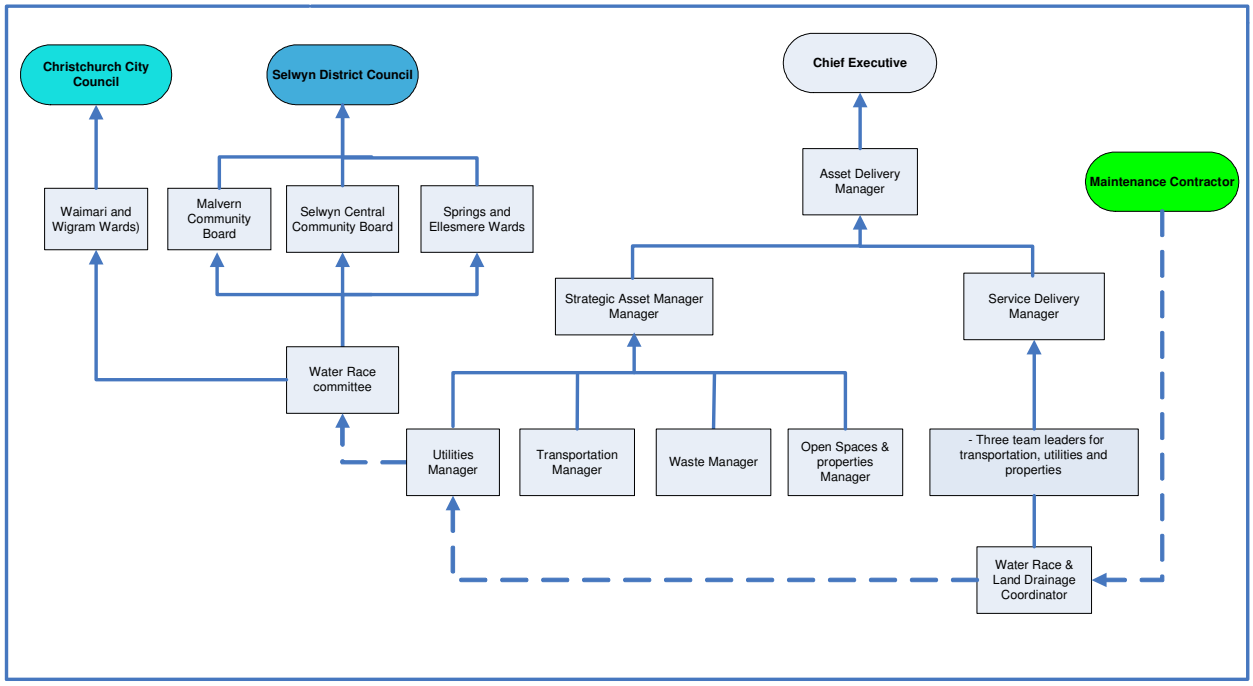
SDC's service delivery staff are involved in the day to day management of the network and report on a 3 monthly basis to the Water Race Subcommittee. SDC's overall responsibility for the network is to:

- Ensure water is available to farmers/water users and is delivered in a manner as equitable as possible
- Develop and implement systems, procedures and processes to ensure effective and efficient management of the network
- Make available copies of water race policies and the Bylaw to farmers/water users and ensure these policies are followed and complied with
- Inform water users of appropriate water management and conservation practices, to be followed in managing the networks
- Inform water users of their obligations in respect of receiving water from the water race network

SDC will use the Water Race Management Plan, 5Water Activity Management Plan, Water Race Policies and Bylaw, Water Race Maintenance Contract (detailing requirements for operating and maintaining the network) and an Irrigation Agreement to carry out the above responsibilities.

The management and operational structure for the water races is detailed below.

Table 1.3: Management and Operational Structure



1.6.1 Water Race Policies and Rules

A copy of SDC's policies (as at September 2009) and Bylaw is included in Appendix B.

1.6.2 Water Race Maintenance Contract

The Council has a Maintenance Contract for the operation and maintenance of all the water race schemes. As of July 2010 this contract will be a lump sum with some dayworks. This enables the contractor to operate the water races using their own judgement but ensuring that specific Council Key Performance Indicators are achieved. The Water Race Contract Values are:

- Ensure customer satisfaction through the delivery of adequate water requirements.
- Operation of the water races enhances the value of the natural environment for future generations
- Accurate and Useful Monitoring of the asset that increases confidence in decision making
- Quality Standards are maintained to enable the life of the asset to be achieved
- Works are completed on time and thoroughly to ensure the continued operation of the races
- Customers complaints are formally managed to improve the customers confidence in Council
- Contract relations are positive and conducted with pride and in close partnership
- The safety of workers and the public is ensured

For details of the contract see "Contract No 849 – Utilities Maintenance April 2010 but the details of the requirements of the response times are detailed in Section 7.0.

1.6.3 Irrigation Agreement

An Irrigation Agreement is used as the means for ensuring the 56 (as at 1 May 2009) individual irrigation water users in the Paparua scheme carry out their obligations and responsibilities. The agreement covers individual water allocations, monitoring responsibilities and details recommended water management practices. The agreement is legally binding between Council and water users. Details of the agreement are shown in Appendix M.

1.7 Stakeholder Consultation and Reporting

SDC will meet annually with stakeholders to discuss management of the network. Information on feedback from users, complaints and improvements made to the network and planned improvements will be documented and forwarded to stakeholders (see Table 1.1 for list of stakeholders).

1.8 Management Plan Update

The Plan will be updated on a two yearly basis by the SDU to incorporate improvements and revisions. The Plan will be a living document to allow for fine-tuning aspects of the Plan that need development, amendment or additions. Updating of the Plan will include input from race users, Maintenance Contractors and stakeholders.

2.0 OVERALL OPERATION AND MANAGEMENT APPROACH

2.1 General

This section describes the general operation of the three water race schemes (Ellesmere, Malvern and Paparua).

2.2 Intake Structure and River Works

2.2.1 Intake Structure -Issues

Stock water intakes require part of the river flow to be directed toward intake structures to provide sufficient head for water abstraction. There is potential for fish to enter the stock water network at these intakes.

Management Approach
All practical measures shall be undertaken to prevent fish entering the intake on the Waimakariri River, Rakaia River, Kowai River and Selwyn River. A fish screen has been installed and operated and maintained to prevent fish from entering the Paparua Water Race Network at the Waimakariri River (Intake Road).

2.2.2 River Works – Issues

River works will be required from time to time. Construction of temporary river works (i.e. gravel diversion banks) can affect amenity and recreational opportunities, bank erosion, disrupt fish passage, and may cause fine sediments to be released into flowing water. The area where river works will be carried out is shown in**:**

- Paparua Resource Consent (Appendix J)
- Malvern Resource Consent – does not include specific plans of area but requires procedures to be followed (Appendix J CRC012002, conditions 2-17)
- Ellesmere Resource Consent – does not include specific plans of area bur requires procedures to be followed Appendix J CRC011993, conditions 2-17)

Paparua

Temporary river works will be required from time to time to divert river water towards the intake structure on the southern bank of the Waimakariri River and clearing of fallen willow trees upstream of the intake.

Malvern

Upper and Lower Kowai

- Temporary river works will be required from time to time to divert river water towards the intake structures on the southern bank
- Excavation of swales on a temporary basis during very low river levels to intercept water flowing close to the surface
- Blacks Creek, etc cleaning of race on a regular (yearly) basis

Waimakariri Gorge

- Temporary river works will be required from time to time to divert river water towards the intake structures on the southern bank

Selwyn River

- Repair of damming of a section of the river (to raise water levels) is required on an infrequent basis

Ellesmere

Te Pirita Intake

- Temporary river works will be required from time to time to divert river works towards the intake on the northern bank

Haldon Intake

- Temporary river works will be required from time to time to:
- dam river
- clearing of fallen willows upstream of intake

Southern Intake

- Temporary river works will be required from time to time to divert river works towards the intake on the northern bank

Management Approach

Gravel diversion banks are formed by bulldozing gravel into banks. The banks range from 10 to 200 metres in length and are generally between 0.25 to 2.0 metres high. The gravel banks are constructed to allow for overtopping during flood events and collapse during freshes. This minimises the taking of excess water volumes during high river flows.

Note: the individual intakes have different requirements associated with their resource consent; the resource consents are shown in Appendix J.

Quantity of Water Diverted

SDC only diverts the flow required (rather than all the available river flow) to operate the intakes in accordance with volumes approved in the consent **(see Section 2.5).** In practice, the volume diverted will be greater than that abstracted due to; losses back to other braids, losses to ground, and to allow fish passage back to a major braid. The volume of water diverted will vary depending on river flows and climatic conditions. The quantity of water diverted is estimated by the Maintenance Contractor who operates the race network.

The Maintenance Contractor uses experience and water depths at control points along the stable parts of the channel to determine the approximate flow in the diversion channel. The water directed into the diversion channels maintains the flow of water past the intake structure and weirs thereby allowing for passage for returning fish to an active channel.

Diversion Structures

Diversion banks are constructed using a bulldozer pushing river material into a mound.

Material will be generally sourced from the upstream side of the river works to minimise disruption to the downstream riverbed natural armouring.

Diversion banks will be constructed with a ***"weak section"*** so this section can be "overtopped" or "fail" in floods. This approach avoids the need to reconstruct the entire diversion bank after flooding.

2.2.3 Operation During Floods

To prevent silt, gravel and sediment–laden water entering the race system, the intake gates will be closed to allow only minimal flow during major flood events. This minimises the build-up of excessive deposits of

gravel and sand in the upper sections of the water race. Large freshes and floods will normally breach the gravel diversion banks, allowing the bulk of the flood flow to continue down the main river channel.

2.2.4 Flood Warnings

Maintenance Contractors are required to have procedures and systems to understand how local weather patterns and river flows impact on the operation of the water race network and the associated mitigation measures.

2.3 Works in River Beds

2.3.1 Management Approach

The operation of the water race network requires physical works in riverbeds on an intermittent but ongoing basis. Works in riverbed include:

- Moving naturally deposited river bed material to form new channels
- Maintaining existing river protection works adjacent to intake structures
- Modifying river bed to enhance intake flows
- Moving naturally deposited river material to reform/form dams

Works in riverbeds have the potential to effect property, riverbank erosion, recreational opportunities, amenity values, cultural values, fisheries and wildlife values. Procedures and conditions are detailed to minimise the effect of works in riverbeds.

2.3.2 Works in River Bed Procedures

Procedures for working in all rivers are as follows but the maintenance operator is also required to be familiar with details of the resource consent for the individual intakes. Major river works will be undertaken after consultation with Environment Canterbury.

- Works can only be undertaken in accordance with Resource Consents conditions (Appendix J)
- Works shall only be those necessary for forming new channels, widening, deepening and generally reinstating existing channels to activate flow in those channels, constructing temporary weirs to reactivate flow in those channels, constructing channels to redirect floodwaters back to a main channel, maintaining the weir and intake structure and intake channel area, and installing and maintaining erosion protection works
- Depth of excavation shall not exceed 0.5 metres below adjacent bed level
- Width of any diversion channels shall not exceed 40 metres
- Length of the diversion weirs shall not exceed 200 metres
- Height of the diversion weirs shall not exceed two metres above adjacent bed level
- Width of excavation shall not exceed 75 metres
- Maintenance operator shall notify the Canterbury Regional Council as soon as the operator has decided to undertake such works. Notification as detailed in the ***River works notification form (Appendix G)***
- Works shall not cause erosion of the bed or banks of the River
- Works shall not cause damage to the banks of the river or any flood protection works
- The contractor shall repair and/or reinstate any erosion control works or access tracks in or alongside the riverbed which are accidentally damaged or destroyed as a result of the exercise of this consent

- The diversion works shall not prevent the passage of fish over the entire length of the diversion and discharge channels, and particular regard shall be given to avoiding the stranding of fish in pools or channels
- All practicable measures shall be undertaken to minimise the adverse effects on property, amenity values, wildlife, vegetation and ecological values
- As far as practicable, no works shall occur within 100 metres of sites where birds are breeding or nesting on the bed of the river
- Vehicles and machinery shall, as far as is practicable, not enter river channels containing flowing water
- As far as practicable, works shall not occur between April and August of any given year
- The exercise of this consent shall not increase the suspended solids concentration of the water in the Waimakariri River by more than 20 percent at any point further than 200 metres downstream from where the work is occurring
- For all instream river works in the Malvern scheme where machinery is used, the Biosecurity New Zealand Didymo protocols must be followed. The most current version of these can be found at www.biosecurity.govt.nz and **in Appendix BB.**

2.4 Operations During Drought

2.4.1 Issues

An appropriate water supply needs to be provided to race users during low river flows. Under drought conditions on the Canterbury Plains the larger "main divide" rivers like the Waimakariri River are often well sustained by snowmelt and headwater (nor-west) rainfall. These larger rivers are likely to have substantial flows in November, December and January.

In some years dry conditions in late summer and autumn will produce low flows on these main divide rivers. During low river flows other river users (fisheries, wildlife and recreation) may also be under pressure. All river users, including water race users, will need to take some actions to reduce demand during low river flows.

2.4.2 Management Approach

Water race users will make their contribution to conserve water during summer low flows by Council introducing temporary restrictions on water takes. This will be achieved by closing off some distribution water races, where practicable, thus requiring property owners to move stock to paddocks that have access to flowing races.

2.5 Seasonal Operations

2.5.1 Issues

Seasonal operation of the water race network allows the water takes to be reduced in winter and spring. These are periods when the water demand and evaporative losses are decreased. Leaving more water in the rivers may be beneficial for in-stream habitat values, fisheries and recreational use of water.

2.5.2 Management Approach

The water race takes will be varied depending on the water available in that particular river. This will help minimise environmental effects of race operations, particularly when river flows drop to low flow levels.

Table 2.1: Reducing Water Takes

Scheme	Intake	Base Minimum Flow (Lts/sec)	Maximum Take (Lts/sec)	Flood Take (Lts/sec)
Malvern	Kowai - Upper	435	See note 1	1,100
	Kowai - Lower	Nil	See note 1	630
	Waimakariri River Gorge	630	700	800
	Waimakariri River spring	60	60	60
	Glentunnel	250	250	280
	Total	**1,375**	**2,210**	**2,870**
Paparua	Intake Rd – Stock water	1231	1331	1700
	Intake Rd - Irrigation	800	800	800
	Total	**2,031**	**2,131**	**2,500**
Ellesmere	Early's – Stock	732	732	
	Early's – Irrigation	1751	1751	-
	Haldon (Hororata River)	341	500	600
	Main South Rd (Lower Rakia)	466	500	600
	Total	**3,290**	**3,483**	

Note 1: From January 2012 the maximum rates of take are specified in consent CRC012003 condition 3 (Appendix J).

2.5.3 Rates of Abstraction – Malvern, Ellesmere and ~~Selwyn~~ Paparua Schemes

Table 2.2 identifies the 'flood', 'maximum', and 'low flows' in the rivers where stock water abstraction is proposed. These flow rates are the 'trigger levels' for the various rates of abstraction applied for in the original consent application. The key date is summarised below:

Table 2.2: Identification of Flows

				Flow (m^3/sec)		
Scheme	Intake(s)	River	Gauging Point	Low*1	Max*2	Flood*3
Malvern	Upper and Lower	Kowai	Limeworks	0.6	2.4	7.2
	Gorge and Springs	Waimakariri	Old Highway Bridge	41.5	124	370
	Glentunnel	Selwyn	Whitecliffs	0.73	3.36	10
Ellesmere	Haldon	Hororata	Below Haldon	0.128	2.1	6.3
	Main South Road	Rakaia	Fighting Hill	88	221	660
Paparua	Paparua	Waimakariri	Old Highway Bridge			

*1 7 day Mean Annual Low Flow

*2 Mean Annual Flow

*3 Equal to 3 times the Mean Annual Flow

2.6 Reticulation

2.6.1 Overview

The reticulation comprises of water races, tunnels, culverts, divides, soak holes and emergency discharge points. The locations of these are all detailed on the Councils GIS system. The Council is only responsible for water races that are defined as Council races. There is a significant kilometre of farm races that Council is not responsible for but are required to have a working knowledge of as they play a significant part in the overall structure and operation of the schemes.

Details	Quantity
Reticulation Length (km)	
- Major races	362Km
- Minor races	173Km
- Non Council races	1613 Km
Viaducts	4 (169m)
Tunnels	4 (1,745m)
Culverts	
- Major	35 (4,177m)
- Minor	Unknown
Divides	
- Major	30
- Minor	Unknown
Soak holes	196
Emergency discharge points	10

2.6.2 Soakholes

Discharge to soakholes is a standard practice for all schemes. **Maximum discharge** to a soakhole is 10 litres per second. Discharge occurs in the following of situations:

- Disposal of water at the end of a race
- Overflow from a main race due to changing weather or river conditions

Where practical the flow in the race prior to the soakhole shall be minimal so to minimise the flow to the soakhole.

Note - Resource consent CRC012001 (Ellesmere scheme) condition 11, shows the following:

If it is necessary to relocate soakholes, the consent holder shall ensure that the discharge at the new location:

- avoids surface flooding of land surrounding soakholes
- is not within 100 metres of any well used to supply potable water
- is not on Ngai Tahu sites of significance

2.6.3 Leakage Control

Leakage from the water race is control via the following:

- Using a mixture of clay and bentonite in the area of leakage or sink holes
- Installing pipe of area of porous ground

2.6.4 Emergency Discharge Points

There are discharge points at strategic sites on key intakes to divert water back into rivers during flood situations in the river. There are used in an emergency, or act as a buffer or when work is required on a section of race, and can be dewatered using the emergency discharge point.

An emergency is when water has flooded into the race system from heavy rain causing flooding due to run-off from roads and farm land into the races. This water is required to be removed quickly to prevent flooding at downstream culverts or overtopping and affecting downstream roads, property, crops or buildings.

2.6.5 Shut Down Procedures

Shut down procedures for the closure of races for maintenance of races are required to be used and are detailed in Appendix W.

2.6.6 Fire Fighting

The Councils main races are used by the Rural Fire Brigades as a major source of water for filling fire tanks and monsoon buckets during major fires. The normal procedure is sandbagging of a race by the fire brigade to construct a pond thus facilitating sufficient water for pumping to tanker etc.

2.6.7 Environmental

Council supports where practical the ongoing preservation of mudfish and trout within the water race schemes. There are also wider ecological values in sections of the raceways.

Mudfish

The Canterbury Mudfish (*Neochanna burrowsius*) are a galaxiid and one of five species found in New Zealand. They spawn in late winter to early spring and not territorial and therefore can occur in high densities. The Canterbury Mudfish are named as a taoga (treasured) species in the Ngai Tahu Deed of Settlement 1997 and the Department of Conservation currently classifying them as "nationally endangered".

The Council supports the on going preservation of mud fish by providing water to enable habitat to be installed. Mud fish habitat is shown in the photo – Kimberly Rd, Mudfish area is wide water area on right with main race to far left. The water flow is controlled by a gate at the upstream point of the "fish" area.

Trout

Juvenile brown trout are prevalent through out the race Malvern and Paparua schemes. There are areas within the race systems where spawning has occurred. Fish transfer from the

race system in the Malvern and Paparua areas (to lakes in the Canterbury high country) has occurred by individuals associated with the North Canterbury Fish and Game Council.
Fish and Game will carry out trout removal where race closure is to occur. A minimum of two days notice is required.

Kowai River

There is an agreement in place between SDC and North Canterbury Fish and Game Council for the Kowai River (Appendix ZZ). The agreement requires that when the Kowai River has dropped to a level where fish may become trapped in isolated pools or channels between the stockwater intake/s and the confluence of the Kowai River and the Rubicon River that a visual inspection be undertaken (condition 2.1) and any live fish be salvaged and liberated (condition 2.2). Records are to be kept of all fish salvaged and the records supplied to Fish and Game every August (condition 3). In order for the salvage and transfer to occur, Fish and Game have granted authorisation under the Freshwater Fisheries Regulations 1983.

Ecological investigations

In 2011 SDC investigated a study on the ecological and biodiversity value of the water races in the Malvern and Ellesmere schemes. 68 sites were surveyed (41 in Malvern and 27 in Ellesmere plus four Mud fish sites. The study resulted in the following:

Malvern scheme -11 were classed as high, seven moderate and 23 with lower ecological value
Ellesmere scheme – 12 were classed as high, seven moderate and 12 with lower ecological value

The study indicated several management actions to preserve the ecological values of the water races within the Selwyn District and highlighted what portions o the schemes to retain from an ecological point of view. These actions will be considered in the proposed SDC Waterrace Strategy.

Property Frontage Maintenance

To encourage property owners to consider the water race on their property frontage as more than a drain Council promotes the beautification of races. SDC have developed a Planting Table to advise property owners of the correct plants and planting for water races. See Appendix CC.

2.7 Criticality

Criticality is determined by considering if an asset is in a situation where:

- The consequences of the asset failing is very high i.e. intake failing thereby putting an entire scheme out of water

Details of the Water Race Criticality Criteria are detailed in the report "5Waters Renewal strategy and Policy" April 2010. The criticality of individual assets within the water race system have been assessed are shown in the asset register.

Additional operations and maintenance requirements are necessary for all critical assets

Facility or Race	Location	Reason
Ellesmere Scheme		
Early's Intake	Steele's Road	Regulates flow to race system
Terrace Race	Steele's Road	Main race supplying the upper Ellesmere scheme
Lower Rakaia Intake	Headworks Road	Regulates flow to race system
Lower Rakaia Supply Race	Headworks Road	Main race supplying the lower Ellesmere scheme
Haldon Intake	Haldon Road	Intake is supplementary to Early's Intake flow

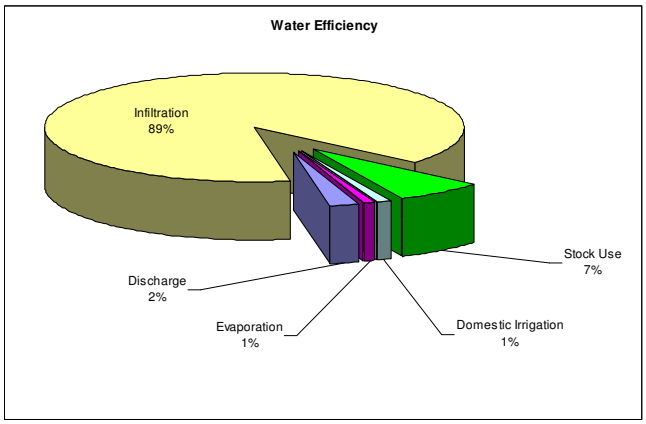
Facility or Race	Location	Reason
		to the upper and lower Dunsandel area. If inactive due to low flows in the Hororata River, some parts of the scheme cannot be supplied
Hororata Dunsandel Road Race	Hororata Dunsandel Road	Main race that contains water from the Early's and Haldon Intake
Malvern Scheme		
Kowai Intakes	At intake	Regulates flow to race system
Kowai Intake Tunnel	Down stream of intakes	Supplies the Malvern scheme for the majority of the year Shingle can fill the tunnel restricting access
Kowai Tunnel		
Kowai Aqueduct		
Waimakariri Intake	At intake	Regulates flow to race system
Waimakariri Tunnel	At intake	Supplies the lower Malvern scheme in summer
Waimakariri Terrace Race	Waimakariri Terrace	Main race supplying the lower Malvern scheme in summer Possible scouring of the main race during high winds and rainfall. Significant portions have been piped. The race is protected in some areas from the above hillside with wooden covers however the hillside above is unstable and in flooding or environmental conditions could cause debris to make access to the water race marginal
Waimakariri Terrace Race overflow structures	Waimakariri Terrace	Stop scouring of steep terrace area if water race overflows or blocks
Kimberly Tunnel/culvert	Adjacent to Waimakariri Terrace	Supplies the lower Malvern scheme in summer
Hawkins Siphon on Deans Rd	Located under Hawkins River	Supplies the southern Malvern area
Selwyn Intake	At intake	Regulates flow to race system
Waireka Fluming	Fluming over Waireka Stream	Supplies the southern Malvern area
Upper Kowai Spill Point	1km downstream of the Upper Kowai Intake	If the rain is very heavy and large amounts of run off water from the surrounding hills enter the main race there is an emergency discharge spill point located 1 km downstream of the intake. It is opened to prevent major flooding downstream in the Springfield Township. The water from this spill point discharges back into the Kowai River
Odges Divide Bishops Creek Spill Point	Located 3km on SH73 below Springfield township.	There is the potential of flooding from Bishops Creek through Springfield Township from run off in heavy rain on the foothills southwest of Springfield. This water is discharged through Bishops Creek back into the Hawkins River. It is also used during a buffer spill period during October to November
Hewitt Spill Point	Hewitt property off Tramway/Boultons Roads into a large pond then flood irrigation (been in place since 1970).	This point is only utilized when the Waimakariri is running high and after heavy rainfall, water needs to be discharged from the main race system to stop flooding downstream at Kirwee Township at SH73/Kirwee. This is the main flood discharge point that is present in this 35 kilometres section of main race, which extends from the Waimakariri intake down Tramway Road
Water Race Access Tracks	One access track is located off Minchins Road, and the other is located off the Old West Coast Road	The Water Race Contractor uses these tracks on a daily basis to gain access to the stock water race known as the Waimakariri Terrace race.

Facility or Race	Location	Reason
Paparua Scheme		
Paparua Intake	At intake	Regulates flow to race system
Bells Divide	Bells Rd area	Regulates flow to majority of race system

2.8 Demand Management

2.8.1 Issues

Reducing water usage and maximising the benefits from what is used



Limited surface water in rivers and streams during summer drought places added stress on other water uses/values such as fishing, recreation, ecological and cultural values. Extraction of water for SDC's water race system has potential to place additional pressures on river systems and uses.

The demand management considers various strategies for optimising demand, conservation, reducing risk of insufficient capacity, quantifying and reducing water lost through infiltration and overflows.

The demand management strategies that are presently in use and the additional strategies that are being implemented by Selwyn District Council are outlined in Table 2.3 below. These strategies are based on the water balance and the ability to obtain the most effectiveness from these strategies .i.e. infiltration accounts for 89% of water used therefore the majority of effort should be directed into this area.

Table 2.3: Demand Management Strategy

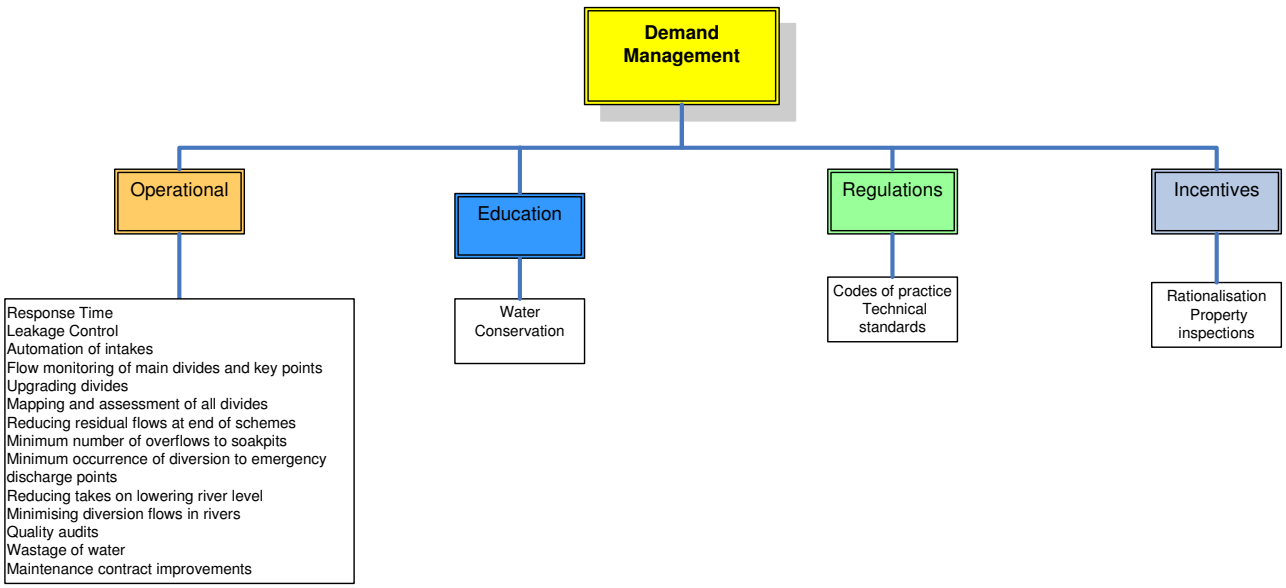


Table 2.4: Demand Management Strategies, Operation and Reporting

	Strategy	Description	What's Being Done	Comment
Operational	Response Time	Prompt response and rectification of reported flooding, blockages or bank damage will reduce wastage	The reporting from AMS commenced July 2011.	
		High reliance on users reporting problems and therefore users must be aware of the importance of the race system and who to call if they wish to report a concern etc	Ongoing education of users by biannual publication and SDC workshops	
	Leakage Control	Continue the development of a leakage measurement system and use it to obtain more accurate data about infiltration losses	Ongoing investigations into leakage measurement methodology	
		Completion of the mapping of all races with known high leakage rates and ongoing reporting	Completion of the mapping in 2009/2010	
		In areas of races that are prone to losses instigate remedies – piping, clay or bentonite lining	Reporting from maintenance contractor	
	Automation of intakes	Enable continuous control of intake to permit the correct take to occur Level measuring devices will allow "live" access to the monitoring of the intake flows to ensure Resource Consent conditions are adhered to	To be instigated at all other intakes once resource consents obtained	This will eliminate the requirement of an operator to manually adjust the intakes gates and improve water race efficiency at the intake in the event of flooding or low flows
	Upgrading divides	Installation of lockable steel divides to replace timber structures or the "rocks and waratahs" systems that are still being used		This has greatly increase control of water and therefore reduce wastage
	Mapping and assessment of all divides	Location, type and condition is being mapped and show on GIS	Increased knowledge of system will assist in renewals programme for divides	Reporting from AMS will be on a ongoing basis
	Reducing residual flows at end of schemes	Ascertaining flows and reporting of these to ensure minimum flows are obtained	Reporting from maintenance contractor on a ongoing basis and auditing to ensure compliance	Reporting from AMS will be on a ongoing basis
	Minimum number of overflows to soak pits	Ascertaining flows and reporting of these to ensure minimum flows are obtained (Paparua resource consent allows 10lts/sec to soak pits)	If Maintenance Contractor suspect discharges are regularly exceeding 10 litres/second then action will be taken to reduce wastage. Action may include adjustment of water take at source and/or inspection of race network to observe why surpluses exist. Ongoing auditing to ensure compliance	Reporting from AMS will be on a ongoing basis Some operational spills are unavoidable, such as occurs after heavy rain or when several irrigators shut off irrigation at one time
	Minimum number of diversions to emergency discharge points	Ascertaining flows and reporting of these to ensure minimum occurrence (Paparua resource consent allows up to 100 Lts/sec)	Ongoing auditing to ensure compliance	Reporting from AMS will be on a ongoing basis
	Reducing water takes on lowering river levels	Reducing water takes from rivers tied to river flow constraints. This creates additional maintenance of the scheme to enable all users to get sufficient water		
	Minimising diversion flows in rivers	Work in river bed for diversion structures in rivers to minimising flows to intakes	Detailed requirements are shown in the management plan and ongoing auditing to ensure compliance	

	Strategy	Description	What's Being Done	Comment
	Wastage of water	Wasting of water is not permitted. If a user is found to be wasting water, the matter will be discussed immediately with the Maintenance Contractor and user and an Action Plan worked out to avoid future unnecessary waste	Communication with landowners and water race committee	Reporting from AMS will be on a ongoing basis
	Maintenance Contract improvements	Change from fix and repair contract to a integrated management between the maintenance contractor and SDC	Under consideration	
		Maintenance Contractors are required to observe and give advice to reduce water wastage as part of their normal day-to-day operations		
		Training of scheme operators in the overall objectives		
Education	Water Conservation / Public Education	Encouraging the understanding of the issues concerning the water system through public education and advertising campaigns	Undertaken in early 2007 Bylaw updated 2008 Education pamphlet developed 2007/2008	
Incentives	Property inspections	Encourage property owners to comply with Councils Bylaws	Encouraging the understanding of the issues via public education and advertising campaigns	
	Rationalisation of water race system (closure of races)	Council policy #W107 is: *The race network may be rationalised from the extremities of the Water Race Scheme on a race by race basis, in consultation with property owners, and in light of any other decisions pertaining to enhanced use of the scheme for irrigation and/or aquifer recharge for water supply and stream augmentation*	Reviewing on a scheme by scheme basis all sections of races	
Regulations	Codes of Practice	Enforcement of appropriate Engineering Codes of Practice to ensure all maintenance, renewal and capital works are carried out to the relevant standards	Preliminary work has commenced on the Codes of Practice. Completed 2009/2010	
	Technical Standards	Enforcement of appropriate Technical Standards to ensure all maintenance, renewal and capital works are carried out to the relevant standards and ensuring new assets are constructed to the correct standards and tested appropriately before being commissioned	Defined standards for new race construction to be enacted	

2.9 Water Quality

2.9.1 Issues

Water quality in races is largely affected by runoff and stock activity in races. Runoff containing fertiliser and organic nutrients is difficult to manage. Stock activity (especially cattle, horses and deer) can affect water quality by increasing sedimentation from bank erosion and disturbance of bottom of race channel. Direct defecation can also add to inflated faecal coliform levels. Improved management of the water race network will need to address stock movement in races.

Maintenance Contractors and users need to be aware of the effect of operation and maintenance of activities on water race quality.

2.9.2 Management Approach

The Council uses the following:

- Watering bays are being promoted for water races that serve all stock farming properties (excluding sheep). This will allow limited and controlled access to races for stock drinking purposes. The remaining length of races to be fenced off/hot wired so that animals only have access to the race for drinking purposes only. This is "Best Practise" for managing stock access to races (Appendix V details schematic of watering bay)
- The Council will provide guidance to race users on design/layout of watering bays
- Maintenance Contractors will ensure that subcontractors use clean and sound machinery when working in riverbeds
- Maintenance Contractors will be required to monitor and minimise discharge of surplus water from the race network

2.9.3 Planned Improvements

The Council will

- Continue the water quality-monitoring programme for Ellesmere. This incorporates sampling, recording and reporting of water quality in races and discharges to groundwater and surface water that was instigated for the Paparua scheme
- Look to continual improvement and instigation of "Best Practice" to improve race water quality

2.9.4 Monitoring

The Malvern consents (CRC012004 condition 7) required that between January 2008 and January 2010 twelve water quality samples need to be taken at least a month apart from at least 2 sites on the Selwyn and Hawkins Rivers and one drain.

2.10 Recording and Reporting Water Use

Measurement and recording of water used through out the schemes will:

- Accurately document the amount of water taken from rivers/streams
- Justify the amount of water required to maintain SDC's water race network
- Assess the effects of water abstraction and water race network on the environment
- Determine compliance with conditions of approval as set out in resource consents

2.10.1 Management Approach

The management approach will be as per the demand management requirements as detailed in Section 2.8 above.

2.11 Maintenance

2.11.1 Issues

Maintenance of water races is necessary to ensure efficient use of water and to obtain the longest life and most beneficial use of water.

Regular maintenance, a programme of systematic improvement and replacement forms part of the water race maintenance programme. The maintenance plan includes preventative, recurring and routine activities that arise on an on going basis. These include:

- Channel and weed control
- Intake structures – cleaning

- Bank erosion and water loss through banks and bottoms
- Inspections of culverts, flumes, etc
- Contingency plans
- Procedures for closure of water races when carrying out major works

2.11.2 Management Approach

Selwyn District Council has prepared a 5Waters Asset management Plan (2012). The Plan will help to achieve the above objective.

The Plan covers:

- Issues
- Levels of service – target level of services
- Demand forecasts – predicted population growth
- Asset Management practices – processes, systems and data
- Asset Management tactics – operations and maintenance tactics and standards
- Financial summary - (financial forecast, funding strategies and asset valuation)
- Asset Management Plan – monitoring and review

2.12 Water Race Cleaning - Weed Control, Vegetation Management and Silt Removal

2.12.1 Issues

The efficient movement of water in the race system requires an effective programme of control of aquatic and race bank weeds and silt removal. Aquatic weeds and silt build up contribute to inefficient water use by restricting water movement in races thereby increasing water losses through evaporation and seepage, by clogging flumes, siphons. However, stronger attention needs to be given to vegetation management, which includes balancing beneficial aspects of race vegetation (i.e. minimise bank erosion, enhance amenity and provide habitat for fish /invertebrate and wildlife) with potential negative affects discussed above.

2.12.2 Management Approach

Race Cleaning

The Council will:

- Use race cleaning equipment and methods to minimise the effects of race cleaning on fisheries and aquatic habitats
- Use contractors that have staff with proven skills and experience or can demonstrate that they have the skills and suitable machinery for race cleaning to ensure minimum effect on waterways
- Ensure that all persons are aware of the Didymo protocol in response to the outbreak of *Didymosphenia geminata* (didymo) in the South Island. This protocol is designed to minimise the risk of unintentional transfer of didymo as a result of the operation and maintenance of the Selwyn District stockwater and land drainage schemes. It applies to all activities where there is a risk of transferring Didymo (Appendix AA).
- Continue to develop and improve race cleaning methods /approaches in consultation with stakeholders. It is recognised that this will take time and the Council is committed to improving race-cleaning activities
- Ask stakeholders to provide information on those parts of the race network, which are known to have significant ecological/fisheries values
- Continue to refine protocols for race cleaning.

Vegetation Management

Some vegetation growth (e.g., perennial grasses) is desirable on race banks at the waterline and above waterline to minimise establishment of land weeds and preventing race bank wind and water erosion.
The Council will:

- Investigate opportunities for enhancing race planting
- Promote awareness of race planting to private property owners via brochures and workshops
- Continue consultation with stakeholders on race weed spraying activities
- Continue to develop the SDC Weed Spraying Contract for improving environmental performance of weed spraying activities
- Appendix BB details the resource consent requirements (CRC3084966). SDC will continue to develop and incorporate "Best Practice" weed spraying protocols

2.13 Water Race Relocation

Landowners either as a result of subdivision or change in farming practice often require the relocation of water races. Historically this has occurred without SDC approval or knowledge and brought to Councils attention when the new race fails i.e. leaks so badly that downstream users are significantly affected.

The Council will:

- Promote awareness of water race relocation issues via brochures and workshops
- Document and refine procedures and policies for race relocations

Before diverting a section of race a check needs to be carried out against Environment Canterbury resource consent rules; Generally, Environment Canterbury will grant a non-enforcement decision if the:

- relocation returns to the same race i.e. no mixing of waters
- relocation occurs within the same property boundary
- the section to be diverted is not known as habitat for Canterbury Mudfish
- the section diverted shall not be a significant spawning habitat for trout or salmon.
- the section diverted shall not be identified as having significant natural values.

2.14 Irrigation Use

2.14.1 Issues

Irrigation for crop, arable and pastoral production is a significant use of water and accounts for about one third of the total water used in the Paparua water race scheme. Management practices are applied via the irrigation agreement to irrigation uses to ensure race water is used wisely and efficiently. Irrigation from the Malvern and Ellesmere water race scheme is not allowed.

2.14.2 Management Approach

- The right to use race water for irrigation is through an Agreement between each irrigator and SDC– See Appendix M1
- Irrigators will incorporate "prudent farming practices" water use into their farming operations
- SDC in conjunction with the irrigators have developed a system for reducing irrigation takes when low flows in the Waimakariri River fall below 63m^3/second – detailed in Appendix M2. All irrigation ceases when Waimakariri River flows reach 41m^3/second as measured at the Old Highway Bridge

2.15 Emergency Plan

An Emergency Response Plan will be developed to allow continuation or re-establishment of the water race network after a major unexpected event such as earthquake or major flood. Failure or malfunction of the parts of the race network (e.g. excessive rainfall, flood routing, blockage or malfunction of intakes control structures) could contribute to:

- Danger to human life
- Substantial property damage
- Loss of livestock/production
- Disruption to other essential services (e.g. major roading network such as State Highways)

The emergency plan should include:

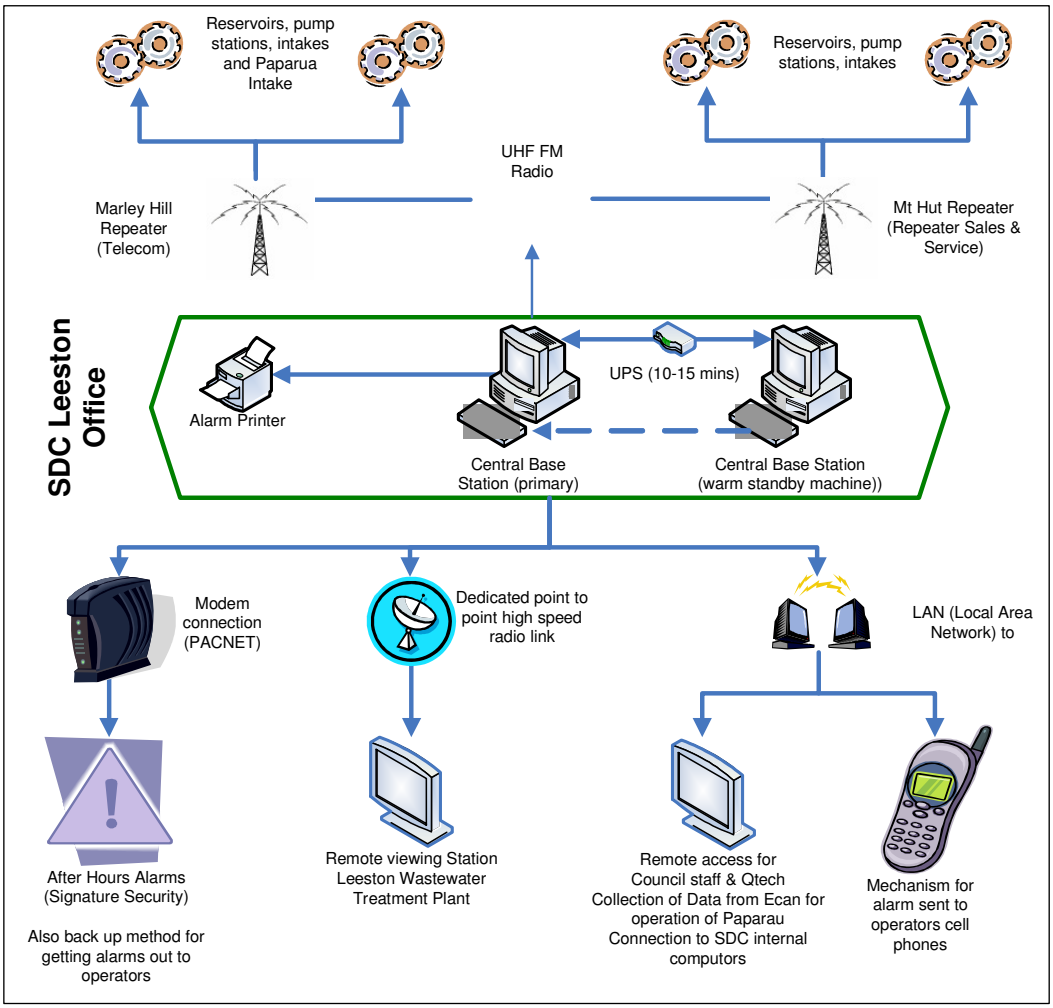
- Action to be taken to minimise damage or risk.
- Action to minimise danger to life or property
- Internal reporting procedures
- External communication and notification processes
- Liaison requirement with Civil Defence agencies (Environment Canterbury and Police)
- Contact details for key SDC personnel and race Operators

2.16 SCADA

Council has operated a "Datran" SCADA (Supervisory Control and Data Acquisition software) since 1993. SCADA is used to control the functions of plant items and pump stations along with alarm monitoring for a majority of the utilities facilities within the district (22 water supplies, 1 Water Race intake, 10 wastewater treatment plants/pump stations and 1 stock effluent dump site).
Table 2.5 details the over view of the Councils SCADA system.

Water level recorders have been installed in the water races near the point of intake on the Kowai, Waimakariri and Selwyn Rivers as part of the Malvern consent conditions (CRC012003 condition 7). One of the options is to install and operate SCADA.

Table 2.5: SCADA Overview



2.17 After Hours Alarms

The afterhours emergency response service is a critical process due to the requirement of a 24/7 service to the community. The Council uses ANSATEL (emergency response service provided to council by Palmerston North City Council) for its afterhours service. ANSATEL provides Council with a 24 hour service outside normal business hours that monitor all SCADA alarms, screens messages and patches calls for action through to the appropriate maintenance contractor or council duty officer.

2.18 Communication Plan

More efficient use of the water race networks requires improved management from SDC, Maintenance Contractor and water race users. Implementation of this Management Plan has provided a platform for improved management by SDC and its Maintenance Contractor. Water users also have a key role to play in the improved management of the race network.

In 2006 the Selwyn District Council in conjunction with Research First developed a mail survey for those in the Paparua and Malvern water race schemes. The aim of the mail survey was to provide the Council with direct input from the community to assist it to determine what standards of service ratepayers in the Selwyn District want in regard to water races and to measure the level of compliance with to of the water race levels of service. This survey will be carried out on a biannual basis for Ellesmere, Malvern and Paparua to allow Council to ascertain the levels of service compliance and provide additional information for the strategic planning of the water race schemes. The conclusions achieve from the 2006 survey is that reliability and maintenance are the two main issues that require improvement.

The Council is reviewing how it communicates with water race users to try and promote improved management by water users. The Council will continue to:

- Look at opportunities for improving flow of information and communicating with race users
- Look at ways of improving user's awareness and opportunities for improved management of race water
- Encourage race users to develop their own ideas and promote these among users

The Council will:

- Notify all water users that a Water Race Management Plan has been prepared and is available for perusal at service centres
- Produce a summary of the Race Management Plan and distribute to all water users
- Promote ideas and ways of improving water use

Water race users receive information about improved management of the race network on a regular basis via the "Council Call". Users will also be asked for suggestions to improve the efficiency of water use.

2.19 Vandalism

The increase in the extent of assets within the water race area (fish screens and flow monitoring equipment etc) and the location of these items in public areas has resulted in a significant increase in vandalism. Policies and associated procedures (see Appendix R) have been instigated to ensure that the maintenance contractor clearly understands their requirements and consideration given to methods to mitigate vandalism.

2.20 Ponds

A pond is an area of water being used for purposes other than a watering place for stock and are permitted to be installed subject to the obtaining permission from the Council. Ponds must comply with the conditions as detailed in the Water Race Policies and Engineering conditions and practices.

2.21 Procedures

Water race procedures are an established or correct method of doing work associated with the Water race schemes. The following details the procedures that are in place for the operation and administration of the Water race schemes:

- Enforcement - define the responsibilities for maintenance and costs of water races by the property owners
- River works – for any work carried out in rivers
- Contamination of water races
- Irrigation inspections
- Vandalism
- Management - approving relocations, ponds, new races and garden use/shelter belt use connections.

2.22 Resource Consent Condition, Monitoring and Reporting

Consent reporting within SDC for Water and Wastewater is the responsibility of the Strategic Asset Manager – Utilities. Information for Water Race consenting is to be provided by SDU on a monthly basis for the monthly environmental report to Environment Canterbury. Reporting on the Water supplies and Water

Race resource consents has not occurred as historically information has not been required from Environment Canterbury. This altered with the new Paparua and Malvern consents that include requirements for volume recording, water clarity, fish exclusion from intakes and stilling basins, and effects of in river works, such as disturbance and re-suspension of silts.

The Council now has a Resource Consent Management System within AMS to achieve the following outcomes:

- Demonstrate environmental compliance, with confidence
- Allow ease of reporting to Regional Council
- Introduce transparency in the actions required to be undertaken to achieve compliance

This Resource Consent Management System has the ability to:

- Report on a monthly and yearly basis
- Report on individual non compliance
- Report on any mitigation carried out

3.0 ELLESMERE WATER RACE SCHEME DESCRIPTION AND OPERATION

3.1 General

The Ellesmere scheme serves the plains area between the Rakaia and Hororata Rivers from Te Pirita and Haldon in the west to Rakaia Huts and Southbridge in the East and the Dunsandel Road from Leeston to Dunsandel in the north making a total of 37,000 hectares.

3.2 Source

The sources of water for the Ellesmere Water Race are the Rakaia River and Hororata River.

3.3 Races – General Layout

From the Glenroy Community Irrigation Company Limited (Glenroy) intake the main race traverses the main Rakaia Terrace in a sliding cut to gain access to the central plains area near the top end of Sharlands Road about 4kms east of Te Pirita Road. From this point the main race divides into two races, the main flow turns due east and follows Sharlands Road down to the S.H.1. Main Highway. It has a number of laterals leading off it in a north and south direction distributing water across the plain. Below the Main Highway it also has a number of laterals leading off it in an east west direction and eventually joins into the upper half the Lower Rakaia intake race system mid way between the Rakaia River Bridge and Dunsandel Township.

The other race known as the Cross Race, heads in a north direction across the plain on a very flat grade generally following the contour towards the Hororata River. This cross race has lateral races leading down the plain in a west -east direction supplying the area below the cross race. It is also used to transport a flow of 80 to 100l/second from Early's Intake main race from the vicinity of Sharlands Road to the Haldon scheme race system at Mitchells Road. This water is used to supplement the Haldon intake and the scheme in times of low flows within the Hororata River.

3.4 Intakes

3.4.1 Glenroy Community Irrigation Company Limited

As at 21 December 2005 the Council Early's intake structure was decommissioned. Early's intake was failing and it was accepted that the fish screen either required major repairs or full replacement. An agreement was made between the Glenroy Community Irrigation Company Limited (Glenroy) and the Council for the use of the Glenroy Scheme and irrigation pond to convey both stock water and irrigation water.

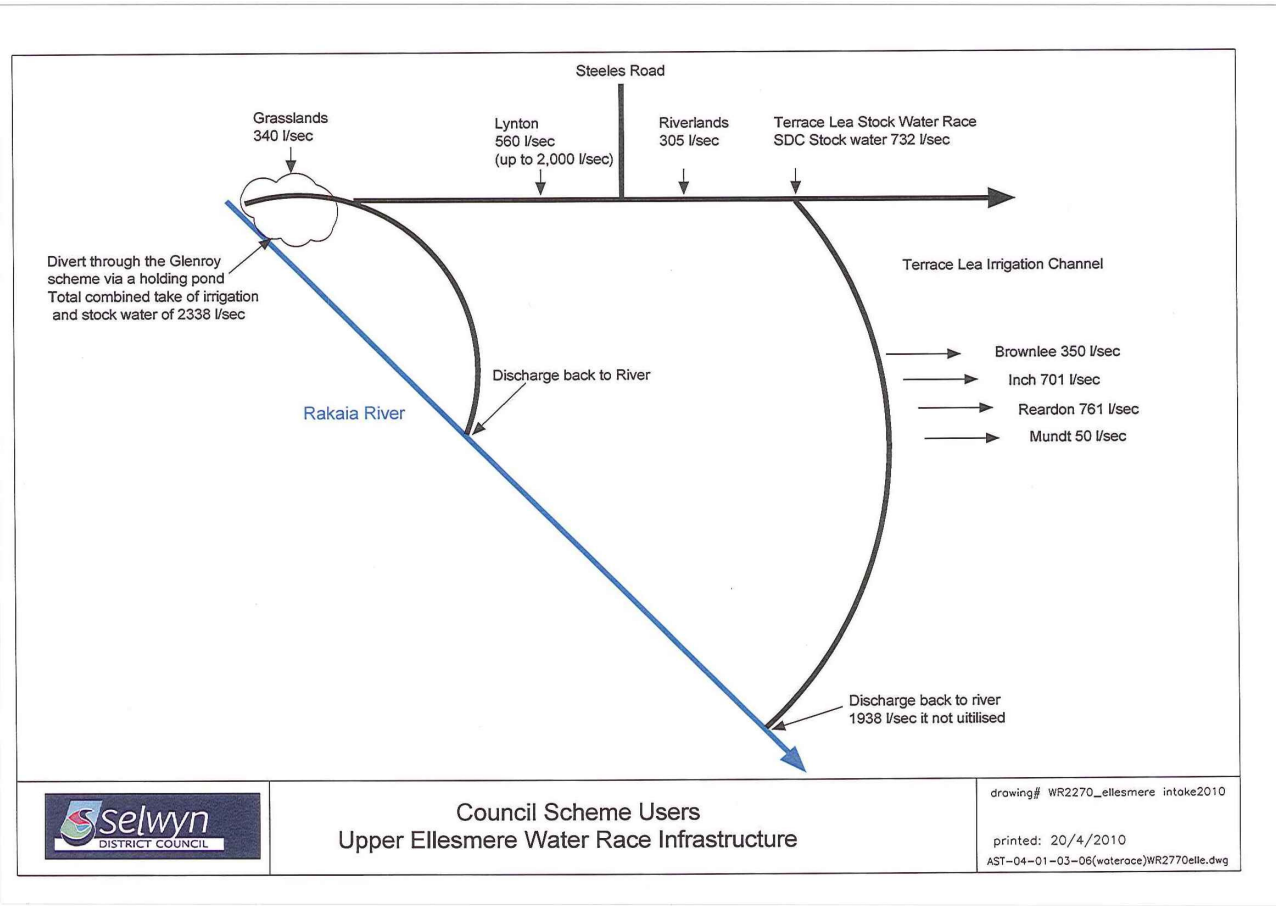
The Glenroy intake consists of a temporary dozed channel currently about 3km in length on the floodplain of the river leading to a protected silt pond where water is diverted into the water race scheme.

The Glenroy irrigation pond is sited on the property of Canterbury Grasslands Limited and consists of a large holding pond with a fish screen and fish bypass. The fish bypass structure incorporates the use of the existing water intake race. This site and assets are operated and owned by the Glenroy Irrigation Scheme. Telemetry (SCADA) is utilised and water race flow data is provided to Council via a web page to allow

Council to view continuous monitoring of the site. The operation of the irrigation pond by the Council has reduced the silt build up that occurred regularly within the Terrace race.

The utilisation of the irrigation pond has proved to be beneficial to both parties by way of ensuring that the stock water race users are supplied with 732 l/second of stock water for 375 days per year (except for unplanned outages). It must be noted that the irrigation is dependent upon the season and restrictions that could be in place.

Table 3.1: Flow Requirements for Early's Intake



Access

Road access to the Glenroy Intake, which is sited on the north bank of the Upper Rakaia River, is by Rakaia Terrace Road, down Steeles Road, to the riverbed (see Ellesmere plan Section 16).

River Channel

Glenroy's channel in the river bed leads to a protected side channel (about 3 to 4 kilometres in length) along the northern river bank to the Glenroy intake structure where water is diverted into the scheme. Water can be diverted into this channel at several points depending on where the main river channel is situated after flooding in river. This requires an inspection and decision on where the best place is to divert water into the channel. Best practice is generally to have two small diversions rather than one large diversion into the channel.

A minimum inspection of once per day of the intake is required, seven days per week. This is carried out by personnel at Canterbury Grasslands Limited (part of Glenroy). River flows and weather conditions will dictate how many inspections are required over any 24-hour period. Adjustment of the intake gates at the Glenroy site is required when rain in the greater Rakaia River Catchment area causes high river flows. This increases the head on the intake gates forcing more water into the main race. Lowering the intake gate will correct the flow into the main race and this is managed by an automated process. Total closure of these gates is generally not required during river flooding because they are well protected from flooding and from river material entering the intake.

The intake is monitored via remote system with data being transmitted back to the Glenroy Irrigation Water Monitoring Consultant, Environmental Consultancy Services Ltd (ESC), and data is accessible via the web page www.ecs-limited.co.nz. The user name and password is held by and the Asset Utilities Team Leader and Asset Utilities Water Supply Supervisor.

Maximum flows as measured on the flow gauge site 5 meters downstream of the fish screen must not exceed the flow rate in the Resource Consent.

The irrigation race divide is located about 10 kilometres below Glenroy's intake. Access to this Stockwater / Irrigation is off the Rakaia Terrace Road through the adjacent property by their main service road leading down to the housing area. At this point access is via the main stockwater race where you turn west and travel along side the race for a further 1 kilometre you will come to the control gates and divide of the Stockwater / Irrigation races. At this point the flow is split into two flows depending on each scheme demand. These gates are operated by the Council's nominated contractor in conjunction with the Glenroy. Flows to these irrigators are regulated by consents held by these irrigators and are controlled by the flows in the Rakaia river. When the Rakaia River reaches a low level flow these irrigators are required to stop all irrigation.

Irrigation Users

As at 31 May 2010, there are seven irrigators who use the Stockwater network from the intake to carry consented irrigation water to their properties, as detailed below. Please note that this table also includes the stock water take of 732 l/second.

Council Scheme User	Take l/second	Take Consent	Take Location	Diversion at Supply Point (l/sec)	Diversion Consent at Supply Point
Grasslands*	200 140	CRC051415.1 CRC990980.2	Glenroy Scheme	Not applicable as take is above Supply Point	Not applicable as take is above Supply Point
Lynton**	560 to 2,000	CRC051802 CRC084036	Above Steeles Road	795 l/second	CRC052056 Maximum of 1,938 l/second
SDC Stockwater	732	CRC970987	At Supply Point	1143 l/second	
Riverlands*	113 192	CRC990979 CRC042529	Below Steeles Road		
Reardon*	38 38	CRC990901 CRC050198	Below Steeles Road		
Inch*	30 40	CRC980976.2 CRC051231.1	Below Steeles Road		
Brownlee	350	CRC990832.4	Below Steeles Road	400 l/second	CRC0990831.1
Mundt	50	CRC083834	Below Steeles Road		
Total	1,751			2338 l/second	

**Irrigator holds two consents*

*** While this irrigator can take up to 2,000 litres per second, this take is restricted to the lesser of; the diversion consent of 795 litres per second, or the combined Band 4 take consent of 560 litres per second and the amount of the Fereday Irrigation Group's 2,000 litre per second Band 2 take consent that is unutilised. On this basis this take cannot exceed 795 lps and will mostly operate at 560 lps."*

3.4.2 Haldon Intake

Access

The Haldon intake is accessed off the Hororata Dunsandel Road some 1.70 kilometres below the intersection of Derretts Road and the Hororata Dunsandel Road.

Intake Structure

The intake structure is sited on the south bank of the Hororata River and consists of:

- A sluice gate on the upstream end of a pipe culvert fed through a short excavated channel from the river
- Gratings and control gates and is run in conjunction with Early's Intake.

The structure is constructed of concrete walls and floor with a single sluice gate and grill bedded into the surrounding ground. The intake is set back 5 metres from the river bank. From the back of the intake structure a 600mm pipe leads away from the back of the structure for some 200 metres. This is to stop the water getting into the race in a flood, which overtops the banks above the intake and flows across paddocks over this pipe section back into the river.

This intake supplies water to the north side of the Ellesmere scheme in a series of races running from the main Haldon Intake to below Dunsandel.

Dam

The water level and diversion for this intake is controlled by a dam across the river bed. In most floods this dam is overtopped but remains intact.
The water is diverted into this intake by the dam and it consists of large boulders and gravels, which are bulldozed up along with surrounding gravel to form this dam.

Whenever the river floods this dam is designed to collapse, stopping overtopping of intake structure. When the river flooding has receded to a level where machinery can work in the river, the dam is reconstructed. This dam is constructed with a "weak section" so this section can be "over topped" or fail in floods. This approach avoids the need to reconstruct the entire dam after flooding.

The height of the dam is 1.3m, the width is 7m and the length is 20m. There is a requirement for a five metre section where a natural flow occurs and allows for fish passage.

River Flows

The flows through this intake are not consistent all year round. This intake is sited on the Hororata River and has only a small catchment basin area. This river varies greatly in flow from winter to summer and any prolonged periods of low rainfall and hot dry weather affects the river levels considerably. There is also a spring present in the Haldon Intake area located in a swamp area around Derretts Road, which runs back into the Hororata River at the intake. It is used as a source of water for this scheme especially at times of low flows in the river however this can also dry up in a dry season.

The flows can drop to such a level at the Haldon Intake that some races in the middle to lower parts of the scheme cannot be served. The Cross Race that supplies the northern section of the Ellesmere scheme is incapable of supplying all the flow requirements when the Haldon Intake gets to low flows.

Low Flows into Intake

This was overcome in previous years to some extent by pumping water from irrigation wells into the race system in these lower parts to increase the flow for downstream users but this is not always viable and there are now constraints on the use of water from irrigation wells that are not consented for other uses.

It is to be noted that there are areas within the Haldon scheme where there are losses in some races because of light soils, sinkholes, and lack of silt from the Hororata River to seal races.

Intake Operation

The Haldon Intake needs some care in its operation, as it is prone to flooding and over toping it banks above the intake. A 40 metre long pipe leads from behind the control gate. This is subject to filling with river material if the gate is not closed before flooding. This gate is closed completely in a flood and only opened again when river levels drop to a point where the culvert will not be subject to filling with gravels.

Intake Gate Setting

The intake gate is generally set at 250 mm opening at all times as river flows are medium to low. In flooding this gate is closed.

Emergency Flood Discharge	Flow Monitoring Gauge
 In very high floods the river can flow into the main race. This water is then diverted back into the river at the Emergency Flood Discharge Point beside the Flow Monitoring Gauge site. This is operated by removing stop logs from a small structure on the race bank and putting stop logs across the main race.	The flow-monitoring gauge is sited some 900 metres downstream of the intake. 

Inspections

Generally a minimum inspection of once per day of the intake is required, seven days per week. At this time also flows into the scheme are recorded and logged each day. The intake gate controls the required flow into the main stockwater race. This gate is adjusted to keep race flows up to the required scheme demand. High river flows and winds cause rubbish to be introduced into the river, which catches on and blocks the intake grill. This rubbish has to be removed from the grill as soon as possible to enable an unobstructed flow through the intake gates.

3.4.3 Lower Rakaia Intake

General

This intake is sited on the Rakaia River about 3kms downstream of the SH1 Rakaia Bridge. Road access to the intake gates is off the Main Rakaia Road onto Headworks Road. The intake consists of two concrete box structures and the control gates are sited at the end of this road on the northern bank of the Rakaia River.

The intake is situated near a protected side channel of the river. This intake consists is feed from a riverside channel, grating, a concrete structure and control gate feeding into the main race. There is one wooden sluice control gate in this structure to regulate the flow into the stockwater race system. This gate is generally set at 200mm opening for all river flows and left at this setting throughout the summer months and lowered for a lower flow in winter months.

There are a number of irrigation schemes within this area (operate under the title - Lower Rakaia Diversion Group) and they operate the main race leading from the Rakaia River and all associated river diversion works. This group operates a "limited Company" for all work associated with the main race and river works. All users then pay a proportion of the cost to operate the main race, river works and resource consent issues.
The maintenance to divert water back into this channel after flooding is carried out by the Group during the months of October through to March and during all other months by the Ellesmere Stockwater Scheme.

Inspections

Generally a minimum inspection of once per day of the intake is required, seven days per week. The intake gate controls the required flow into the main stockwater race. The flows through this intake do not vary greatly from summer to winter as with other schemes. This is because there are generally heavier soils on this scheme, which cause less leakage from the race system.

High river flows and winds cause rubbish to be introduced into the river which catches on and also can block the intake gate screens. This rubbish has to be removed from the screens as required to enable an unobstructed flow through the intake gates. River flows and weather conditions will dictate how many inspections are required over any 24-hour period. Adjustment of the intake gates is required when rain in the greater Rakaia River catchment area will cause high river flows. This increases the head on the intake gates forcing more water into the main race. Lowering the intake gate will correct the flow into the main race. Total closure of these gates is generally not required during river flooding because they are well protected from flooding and from silt entering the intake.

Emergency Flood Discharge

There is no emergency discharge on this Lower Scheme.

3.5 Ellesmere Control Structures

Major divides are on the main races below the main intake control gates. The divides are a mixture of newer metal gates and boulder control gates sited where the main race flow requires splitting into equal or different flows. Each split race then goes in to serve a different part of the scheme. The weirs are required to be set to enable the correct amount of water to be diverted to serve the area required.

Control at these divides is maintained by keeping these boulder weirs at their correct level. Any debris that comes down the race and lodges on these weirs must be removed to enable the correct flow in each direction.

The smaller off-farm divides are required to be checked following a complaint from a property owner with either a lack of water or too much water.

On-farm control divides are generally made up of stones or boulders and are open to tampering by land holders and other persons. Any persistent tampering must be dealt with by using a "notice to the offender".

3.6 Monitoring Points

Monitoring structures are sited below intakes to measure the quantity of water taken from the source and are read on every working day and at a minimum of every second day. Additional readings will be required when the flows from the source are approaching requirements to regulate or restrict the take of water.
These monitoring points are used to measure flows to enable:

- Enable operator to have an understanding of what flows are present
- Compliance with resource consent requirements
- A history of the intake flows and scheme requirements
- Levels of Service to be complied with

Early 2013 Float & Counter Weight Encoder monitoring stations were installed at Steels Rd and Terrace Lea making the original staff monitoring structures obsolete. Monitoring is currently carried out by Boraman Consultants with the data manually downloaded every three months until suitable power supply for telemetry assessed.

Due to the nature of the infrastructure at the Haldon and Lower Rakaia intakes, further investigation has been required. Both sites will have new monitoring stations by end 2013.

Early's Intake has a section of race that has had its cross-sections calibrated by NIWA to enable accurate measurement of the flows. As the monitoring point is not stable, e.g. concrete, the cross-sections have to be recalibrated on a yearly basis. The other two structures are concrete and only need to be recalibrated every three years. The supply to particular end users is required to be monitored by the user and checked by the Council's nominated Contractor.

3.7 Emergency Discharge Points

Emergency discharge points are located at the Early's Intake on the Terrace Lea property and at the Haldon Intake 900 metres downstream of the Intake into the Hororata River. There are no emergency discharge points within the race system.

3.8 Soakholes

Soakholes allow excess water to be taken from the intake to buffer additional usage such as high water use. Maximum flow to each soakhole is 10ℓ/sec.

3.9 Overall Operation

The scheme is operated in two sections, being from Early's & Haldon intake to the Main South Road, and east of the Main South Road.

Personnel from Canterbury Grasslands monitor and manage the Glenroy Scheme to ensure allocated water is available to the Council Scheme (Earlys).

The Council's nominated Contractor carries out an inspection of main divides and race flows from Early's Intake to Haldon Intake and then inspection and cleaning of Haldon Intake and inspection of races in Mitchells Road, Terrace Road, Races from Terrace Road to Main South Road and Sharlands Road.

From the above inspection the Council nominated Contractor can ascertain which races require additional or less water. Adjustments can then be made to major divides as required.

The lower section requires inspection of the main intake at Headworks Road, the river and cleaning of the intake grill and adjusting flows as required followed by checking main divides and races. It also involves discussing and adjusting flows into the lower area with the Lower Rakaia Intake Operator.

Complaints are dealt with after the above inspections.

4.0 MALVERN WATER RACE SCHEME DESCRIPTION AND OPERATION

4.1 General

The Malvern scheme serves the plains areas between the Waimakariri River on the side north and Selwyn River on the south side from Springfield Township and Glentunnel in the west to the western boundary of the Paparua scheme and totals some 43,690 hectares.

This scheme requires diligence by the Council nominated Contractor to maintain a good and adequate supply of water to consumers because of the nature of its main source in the Kowai, Waimakariri, Selwyn Rivers and the extensiveness of the scheme itself. It can be supplied with water from four different intakes on three different rivers and transports this water through a race system starting from above Springfield Township flowing down the plain for over 50 kilometres to the West Melton area in the northeast and below SH1 at Norwood in southeast (Top section of the Paparua Scheme).

4.2 Source

The Malvern Water Race scheme's primary sources of water are the Kowai River, Waimakariri River and Selwyn River with a minor spring supplying the Waimakariri Terrace race.

Rain in the Arthur's Pass, greater Waimakariri River, Upper Selwyn River, upper Kowai River catchments and in the foothills southwest of Springfield and storm run off water on the Malvern Plain Area below Springfield can cause high race flows. Run off from small local creeks can have consequential effects on the four intakes serving this scheme.

Minor sources of water for the Malvern Water Race Scheme are the Waimakariri (Skurrs) spring, Bishops Creek, Springfield Creek, and creeks in the Glentunnel Township Golf Course area. All of the above minor sources enter races at various points around the scheme. After heavy rain these sources are checked for flow rate.

4.2.1 Monitoring Points

Early 2013 Float & Counter Weight Encoder monitoring stations were installed at the Waimakariri Gorge, Selwyn & the Upper Kowai Intakes. A Pressure Transducer monitoring station was installed at the Lower Kowai Intake and a Slip Meter monitoring station installed at the Skurrs Spring Intake, making the original staff monitoring structures obsolete. Monitoring is currently carried out by Boraman Consultants with the data manually downloaded every three months until suitable power supply for telemetry assessed.

Monitoring sites are sited below intakes to measure the quantity of water taken from the river source. The intake flows are measured and are reported upon to comply with resource consent take conditions. Each of these races has a section of race that has had its cross-sections calibrated by NIWA. As the monitoring point is not stable, e.g. concrete, the cross-sections have to be recalibrated on a yearly basis by NIWA.

When the flows within the river drop to a low level and are approaching consent requirements, checks and steps are to be taken to regulate or restrict the source take and ensure compliance with resource consent requirements.

There is no monitoring of the race flows that cross the boundary from the Malvern water race system to the Paparua scheme but generally these are very small flows and should be kept low.

4.3 Intakes

The Malvern Water Race System has four main intakes:

- The Waimakariri River
- The Upper Kowai River
- The Lower Kowai River
- The Selwyn River

4.3.1 Waimakariri Intake

Road access to the intake gates, during normal river flow, is by a gravel road from the south eastern end of the Waimakariri Gorge Bridge on the right hand side. This road leads down to the riverbed and access to the intake is gained by driving up the riverbed under the bridge alongside the south bank to the structure. When the Waimakariri River is in full flood the road/riverbed access is cut off. Access is then gained to the intake structure by a foot track leading away from the southwest end of the Waimakariri Bridge to a steel ladder down the cliff face. The ladder is fenced off top and bottom and is kept locked at all times to keep the general public from accessing this ladder for health and safety reasons.

The intake structure is set back and constructed into the rock face of the south Gorge bank. It is a substantial structure and has been built to withstand floodwaters, which can submerge the whole structure. It is constructed of a concrete box chamber set into a rock terrace face. On the front of this box structure there are two sluice gates set into a wooden frame with a steel grill just in front of these gates. The steel screen grill (to stop rubbish from entering the intake), control gates, inspection chamber behind the gates. From this chamber behind the intake gates there is a tunnel running some 95 metres through and under the river gorge terrace exiting out into a large deep cut channel water race.

The intake requires care in its operation, as it is prone to flooding. A minimum inspection of once per day is required seven days per week. High river flows and winds can cause rubbish to be introduced into the river, which catches and blocks the intake grills. This rubbish has to be removed from the grills to allow an unobstructed flow through the intake gates. River flows and weather conditions will dictate how many inspections are required over any 24-hour period.

The Waimakariri intake consists of a small lead-in channel that extends from the intake control gates up the riverbed for approximately 50 to 60 metres around the bottom of the cliff. The length depends on the location of the river braids. This is followed by a 95-metre section of rock tunnel. A 300-metre length of deep excavated main race leads away from the tunnel outlet. The intake structure is set back into the riverbed rock terrace. On the front of this structure there are two vertical sluice gates set into a wooden frame. The 95-metre rock tunnel leads directly away from the control gates and is subject to filling with river material if the gates are not closed before major flooding.

Operation

These gates are generally each set at a 150mm opening at medium flows in the river. When the river flows are at medium to low flows these gates are opened up wider to keep up the required flow into the stockwater system. In higher river flows number one gate is closed completely and number two is set at less than 150mm so as to stop any gravel from entering the tunnel. In flooding both of these gates are completely closed until flooding recedes to an extent that the gates can be opened safely, generally one to two days.

Major Flooding

Major flooding is defined as over 100 cumecs river flow (as noted at) The Old Main Road Bridge. This occurs when there is over **50mm** of rain in the upper catchment areas of Arthur's Pass and surrounding hills. The gates are closed completely on flows above 100 cumecs and are only reopened when flooding has receded to a point where shingle will not enter the intake. Generally the inside gate is opened first as it is less susceptible to letting gravel enter the intake and some supply can be returned to the scheme. Care and good judgement must be taken with this operation and an inspection of the chamber behind the gates is vital to see whether gravel is entering the intake and tunnel.

As the river flow drop, the intake gates have to be adjusted to keep race flows up to the required scheme demand. The required flow will change from high demand in summer period to nil demand in the winter months when the race is completely closed (closed in the July to September period) and flows to the scheme are from the Kowai intake.

Depending upon the position of the river in front of the intake gates, the channel may need to be changed in direction when the river is located on the northern side. This channel is maintained by an approved contractor as necessary. This channel may require reinstatement after major floods.

Emergency Flood Discharge

There are a number of these over the next six kilometres of main race. Leading from the end of the tunnel to where the race traverses the 100 metre river terrace. These discharge points work automatically in an emergency to stop the race from overtopping on to the terrace section if there was a blockage on any section of the race.

4.3.2 Skurrs Spring

The site is 1.5 km downstream of the intake. It discharges into the main race at a rate of 60 litres per second and this is a constant flow all year round. 10 litres per second is diverted back to the Waimakariri River.

4.3.3 Upper and Lower Kowai Intake

The main source of water for the Malvern scheme in the winter months is the Kowai River. There are two intakes sited on the Kowai River, these intakes serve about 80% of the Malvern scheme during the winter months and early spring months. Glentunnel intake supplies the other 20%.

Road access to both the Upper and Lower Kowai intakes is through a locked gate beside the south end single lane Kowai Bridge on SH73, 5km west of Springfield.

The Kowai River can rise to flooding in a very short time in heavy rainfall because of the nature of the catchment area. In some cases the operator will be required to visit the site in the middle of the night to close intake gates as this cannot be left to the morning. It should be noted that quite often there can be heavy rain in the Springfield/Sheffield/Kowai Catchment area and down at Darfield some 12 km east at Sheffield there can be no indication of rain.

The Lower Kowai race continues through this tunnel for approximately 1km and then meets with the Upper Kowai race and becomes a single race. It then travels down parallel to SH73 and enters Bishops Gully creek. The creek bed is used from this point as a conveyance system for the water race starting from 2km above Springfield over some 8 kilometres to the main divide named Odges sited 3km on SH73 below Springfield Township.

Small gravel dams are constructed in the riverbed at the intake to divert water to ensure the intakes retains sufficient flow into the scheme. In flooding the dam may be breached and washed down. When flooding has receded the dam is reconstructed to ensure the intake has sufficient flow. As river flows drop, the intake gates have to be adjusted to keep race flows up to the required scheme demand. This demand will change from low flows in the summer period when there are generally low flows in the Kowai River and restrictions on the take from the river. In the winter months when there is plenty of water in the Kowai River and it supplies the greater part of the Malvern scheme it changes to a high demand.

Run off from heavy rain on the foothills southwest of Springfield and on the Malvern Plain Area below Springfield can get into the races increasing the flows in the race system. This run off water can cause flooding in Springfield Township and throughout the scheme. Both the Upper and Lower Kowai Intake gates have to be adjusted to compensate this extra water or closed completely and in the case of the small and large tunnel flood gates closed completely.

Access

The Kowai Intakes access is through a locked gate beside the single lane Kowai Bridge on SH73, 5km west of Springfield. From this gate to the Upper intake structure it is approximately 1.5 km via a gravel track running beside the water race.

Intake Inspections

Generally a minimum inspection of once per day is required for both intakes. High river flows and winds can cause rubbish to be introduced into the river, which catches on and blocks the intake screens. This rubbish has to be removed from these screens as soon possible to enable an unobstructed flow through the intake gates. River flows and weather conditions will dictate how many inspections are required over any 24-hour period.

The Kowai River flows drop off in early summer of each year and the Kowai River becomes unable to serve the whole of the Malvern scheme. To overcome this, the Waimakariri Intake is turned on to increase flows to the lower half of the Malvern scheme from Darfield East. This allows flows through the Kowai Intakes in summer to be reduced to keep up some flow in the Kowai riverbed and endeavours to reach the Junction of the Rubicon River. As flows drop further in the river the

Kowai riverbed flow may go subterranean and can retract back to above the Kowai SH73 Bridge near the lower Kowai Intake. In severe drought conditions, the Kowai Intakes need all of the flow within the riverbed to keep some flow up to the upper half of the Malvern scheme. Water from a spring on the northern side of the Kowai River is then taped into.

During the summer months, once a week an inspection is to be made and record kept of the distance river water is flowing downstream from the SH73 Kowai Bridge to the Rubicon river junction.

Dam

With normal river flows the water is diverted into the intake by a small dam across part of the river bed. The dam consists of shingle pushed up by a small dozer (see photo's in Section 18). Under floods the dam is breached and when the river flooding has receded to a level where machinery can work in the river the dam is reconstructed. This minimizes the taking of water volumes during high river flows.

The height of the dam is approximately 1m in height, with a width of 7m and a length of 30m. In dry periods the complete river flow is diverted into this intake. In very low river flow periods that correspond with extended drought periods a cut off drain is installed to catch shallow ground water. The approximate location of these cut off drains is shown on the aerial photographs in Appendix P. The dam is constructed with a "weak section" so this section can be "overtopped" or fail in floods. This approach avoids the need to reconstruct the entire dam after flooding.

Upper Kowai Structure

The Upper Kowai Intake structure is access via a gravel track running approximately 1.5 kilometres west beside the water race from the entrance gate beside the single lane Kowai Bridge on SH73
The intake structure is sited on the southern bank of the Kowai River and constructed into the rock face of the riverbank. The structure is constructed of concrete walls and floor bedded into the rock face a steel grill, two wooden sluice control gates, and 80 metres downstream of the intake a shingle removal structure.
This section of river has a steep grade and a large grill is used to protect the intake from large rocks and gravel which move down the river when in flood.

During normal operation shingle may enter the intake through operational gate. This shingle is small in size and is flushed through the intake into the channel between the intake structure and the shingle removal structure. This shingle is removed from this 80 metre section of channel when the volume of water required is restricted passing through the intake due to the build up of shingle. This operation is carried out by removing stop logs boards from the shingle removal structure. The shingle is then removed by a machine backing up the channel and pushing it out into the riverbed. An excavator machine is used for this work due to the narrowness of the channel.

If the rain is very heavy and large amounts of run off water from the surrounding hill enter the main race there is an emergency discharge spill point located 1 km downstream of the intake. It is open to prevent major flooding downstream in the Springfield Township. The water from this spill point discharges back into the Kowai River.

Lower Kowai Structure

The intake consists of a small dam, gratings, control gates, a section of open race with a concrete river protection floodwall, a small 30 metre tunnel with a floodgate at its entrance. There is a second section of open race leading to a large 950 metre long tunnel fitted with floodgates at the entrance.
A small gravel dam is constructed in the riverbed at the Lower Intake to divert water to ensure the intake retains sufficient flows. See Appendix J for conditions of operating the Lower Kowai intake during low flows.
Directly behind the intake control gate, is a 30 metre long concrete floodwall that leads down the main race from the intake to protect the main race from moderate to high flooding.

This intake is operated with only one gate open and operational, the other gate is closed all year round. This is because of the very steep grade of the riverbed and a constant movement of shingle down the riverbed. Under medium river flows too much shingle would be drawn into the intake if both gates were operational. The intake control gates and a section of the main race are subject to filling with river gravel if the gates are not closed before major flooding. The gates are reopened and adjusted when the flooding has receded to a point where only small amounts of shingle enter the intake.

The Lower Kowai Intake is fed into the Malvern Scheme through two tunnels and joins the upper Kowai race about 1km downstream of the SH73 Bridge becoming one main race.

The intake control gate is set back five metres from the intake grill. Adjustment of the intake gates is required when moderate rainfall in the foothills and in the Upper Kowai River catchment area can cause high river flows. Flooding and high river flows can transport gravel from the river into the intake race. The main intake gate is not closed completely under these conditions, allowing some gravel to travel from the river into the 30m section of race that is between the intake and the small tunnel. The reason for not completely closing the intake gate is that the intake chamber between the grill and gate would fill up with shingle and would be very difficult to remove. It is much easer to remove this shingle by an excavator from the 30m section of race downstream of the intake.

Directly behind the intake control gate, is a 30 metre long concrete floodwall that leads down the main race from the intake to protect the main race from moderate to high flooding. In very high floods the river overtops this wall. At the end of this concrete wall is a small 50-metre tunnel fitted with a floodgate. So it is essential that this floodgate be closed in times of flooding.

As flows in the river drop, the intake gate has to be adjusted to keep race flows up to the required scheme demand. This demand will change from low demand in summer period to high demand in the winter months.

Downstream of the small tunnel is 40 metres section of open race before the entrance to a large 950-metre long tunnel. It is in this section of open race that very fine (3 mm) shingle is removed to stop it from entering the 950-metre long tunnel. The tunnel is also fitted with a set of flood gates which have to be closed during major floods to protect both the tunnel and prevent flood water getting into the main race system which could cause flooding in Springfield.

Downstream 1.4km of the intake is a large aqueduct with a butylene liner that carries water across the gully. This must be inspected daily for debris. The flow monitoring point is also sited at this location and flow must be recorded at this point daily.

4.3.4 Glentunnel Intake

Access to the intake gates is through a locked gate at the northern end of the Glentunnel Camping Ground leading into the Hororata Golf course. The main control intake gate is sited 300 metres downstream from the gate at the top end of the golf course.

The Glentunnel Intake consists of one sluice control gate, and a medium size gravel and boulder dam spanning across the Selwyn riverbed. Some 450 metres downstream from the intake in the main race is a floodgate and spill point channel to divert flood water back to the Selwyn River.

The intake is a simple sluice gate set on the western bank of the Selwyn River. The main race feeds away from the gate through the Hororata Golf Course and on through the Coalgate Township. This intake supplies the area between the Hawkins, Selwyn and Waireka Rivers as well as joining the Kowai system near Bangor to supply the Greendale area of the scheme.

The Glentunnel Intake utilizes a gravel and boulder dam across the Selwyn River, or a portion of it, to divert sufficient water into the intake. In flooding the dam may be breached and washed down. When flooding has receded the dam is reconstructed to ensure the intake has sufficient flow to service the scheme. Adjustment of the intake gates will be required when rain in the Selwyn River catchment areas causes high river flows, increasing the head on the intake gates and forcing more water into the main race. Higher flows and flooding will bring debris from the river into the intake and the gates have to be closed urgently to prevent this and control the flows.

The Glentunnel Intake is accessed from SH77 in the Glentunnel Township through a gate at the northern end of the Glentunnel Camping Ground and along the eastern edge of the Golf Course.

Intake Structure

The intake structure is sited on the western bank of the Selwyn River and constructed into the surrounding ground. The structure is constructed of concrete walls and floor and a single sluice gate. There is no grill in front of this gate. This gate is generally set at 150mm opening at medium to high flows in the river.

Dam

The water is diverted into this intake by a dam across the river bed. It consists of large boulders and gravel, which are bulldozed up along with surrounding gravel to form this dam (see photos in Section 18). Under major floods this dam is designed to collapse. When the river flooding has receded to a level where machinery can work in the river, the dam is reconstructed. This minimizes the taking of water volumes during high-river flows.

The height of the dam is 1.5m, the width is 5m and the length is 50m. A section of the dam is constructed to allow natural flows to occur and allowing for fish passage. The dam is constructed with a "weak section" so this section can be "overtopped" or fail in floods. This approach avoids the need to reconstruct the entire dam after flooding.

Inspections

This intake requires care in its operation and is prone to flooding. Generally a minimum inspection of once per day is required seven days per week. River flows and weather conditions will dictate how many inspections are required over any 24-hour period.

Flood Events and Emergency Flood Discharge

In major flooding the top 400 metres of the main race is subject to filling with floodwater within the Hororata Golf course area. This occurs when the Selwyn River over tops its banks upstream of the Camping ground and flows through the Camping ground into the Golf Course. There are also small natural run off creeks from the surrounding hills that only flow in heavy rain through Glentunnel Township, the Camping Ground and. the golf course.

All this floodwater enters the 400 section of race below the intake in the Hororata Golf Course and can cause flooding in the Coalgate Township and other areas in the Malvern water race scheme.

The surplus floodwater is diverted back into the Selwyn River by an overflow channel. This is achieved by closing a floodgate in the main race sited some 450 metres downstream of the intake.

In very high floods sufficient water cannot be diverted back to the river through this channel. When this occurs, the bank is breached by an excavator further downstream just above the main highway at the Coalgate Township to divert the extra floodwater back to the Selwyn riverbed.

As flows in the river drop, the intake gates have to be adjusted to keep race flows at the required scheme demand. This demand will change from low demand in the winter months to high demand in the summer months.

4.4 Main Race Reticulation System

The main race continues through Coalgate Township where there is a large siphon under Bridge Street and a smaller one 800 metres down on Coaltrack Road. These two siphons require inspection daily and debris removed.

4.4.1 Race System

Waimakariri Terrace Race

This main race starts from the end of the intake tunnel, flows along the toe of the southern edge of the Waimakariri riverbed terrace before traversing the face of the terrace in a sliding cut from Judd's siphon through the Bulls property exiting out at Kimberley road race on the Upper Plain.

Owing to past difficulties, significant portions of the terrace race have been piped. Grills and overflow weirs are located at the start of each piped section of this race. They are required to be checked daily when the race is operational and more often when there are high winds that can deposit rubbish in the race. If this race was to become blocked at these grills and overflow it could scour out the side of the race. This would lead to a loss of supply to the scheme for a considerable period.

A close watch has to be kept on leakage from this section of race along the terrace. This is required to be undertaken on a weekly basis and the Engineer to be advised of any increase in these leaks. Once the race reaches the level of the top of the terrace and onto the plain it then feeds down Kimberley Road to join the main Kowai Race at Tramway Road and then divides. One race continues southeast on into Darfield to join the main SH73 race from the Kowai. The other race carries on east to the Kirwee Township to the Aylesbury Corner divide.

There is a small spring on a Skurrs property about 3.5 km below the intake that feeds into the main Waimakariri race. This spring runs all year around into this race at 60 litres per second. In the wintertime it keeps the Terrace race from drying out and supplies some downstream users with a small amount of water.

The Waimakariri race is usually turned off completely in winter months and the whole scheme is then run using the intakes on the Kowai and Selwyn rivers. The turning on of this race can occur any time but generally from October or as late as mid December. This occurs as soon as the Kowai River flows drop to a level that cannot supply the whole Malvern scheme flow requirements in conjunction with the Glentunnel intake on the Selwyn River. This is the trigger point to turn on the Waimakariri race to boost flows to the lower Malvern scheme area.

From the Kowai

The race then travels parallel to SH73 down into the Sheffield Township where there is a piped section of race outside the Sheffield Fire Station. On this piped section up stream head wall is a grill that controls debris and should be inspected on a daily basis and cleared of rubbish. The race continues through the Sheffield Township for approximately 1 kilometre to a major divide (Waddington Gates) that is located off Tramway Road. At this point the flow is divided in two, one race continues down Tramway Road to Kimberley Road where the Waimakariri race intercepts it. The other race goes to a divide gate located at the intersection of SH73 and Deans Road. From this divide the main race runs parallel to SH73 to the Darfield Township where it meets the Waimakariri race from Kimberley Road.

From the Glentunnel Intake

The first major divide is on the intersection of Beattys Road and Coaltrack Road. This divide supplies an area south of Coaltrack Road to the Selwyn River. The next major divide is 0.5km down Beattys Road and supplies an area between Waianiwaniwa River and the north side of Coaltrack Road down into the Greendale area. The main race continues down to the Waireka River which it crosses a large 100 metre aqueduct structure above the Waianiwaniwa River riverbed. This is followed by a short section of open race and then enters another smaller 30 metre aqueduct crossing a side gully of the Waianiwaniwa River. It then continues across Hacketts Road on to a siphon under Blacks Creek. From Blacks Creek it continues on across Waianiwaniwa Road to the Bangor divide, which serves an area between the Waianiwaniwa Creek north to the Hawkins River.

4.4.2 Control Divide Structures

Divides are on the main races below the main intake control gates. The divides are a mixture of single or multiple control gates of reasonable size and constructed and are sited where the main race flow requires splitting into equal or different flows. Each split race then goes in to serve a different area of the scheme.

Gates are required to be set to enable the correct amount of water to be diverted to the area required. This is carried out by surveying the area below the divide gates and taking note of race flows. If there is insufficient water in one or more of these races then adjustment of main divides and possibly the main river control gates may be required.

Smaller Off Farm Divides

These divide gates are usually a maximum size of 315 mm pipe with a locked control gate attached. Other sizes are 250 mm, 200 mm, 150 mm and 100 mm. These smaller control gates are used to divert flows down smaller lateral races to serve a medium size area, or to supply several properties and can also be only to a single property. These gates are checked following a complaint from a property owner through lack of or too much water.

Control Divides within Farms

These are generally made up of stones or boulders and are open to tampering by landholders and other persons. Any persistent tampering must be dealt with by issuing a "notice to the offender".

Property Supply Points

The supply point to a property is either a race running through a property or a race running along a property boundary, which can supply the property.

A terminating race is a short race leading off a main race usually with some control at the divide and terminating on a property.

A supply point can also be a small diameter pipe, often under a road, with or without a control on it.

4.4.3 Water Race Access Tracks

Two access tracks are located on private property. The Water Race Contractor uses these tracks on a daily basis to gain access to the stock water race known as the Waimakariri Terrace race.

One access track is located off Minchins Road, Sheffield (present landowner Shadbolt) and the other is located off the Old West Coast Road (present owner Bull). Appendix L details location map and agreements associated with the above access tracks.

In agreement with the landowners, these tracks are graded generally once a year by a Contractor but may need to be done more often dependent upon the weather conditions which can degrade tracks rapidly and would require grading more often.

Every 3-5 years the tracks are inspected and ascertain the maintenance requirements to keep the access tracks in good condition. Repairs that may be required include filling large potholes, maintenance metal and compaction of material to the tracks.

4.5 Emergency Discharge and Buffer Discharge Sites

4.5.1 General

Emergency Discharge and Buffer Discharge points on main races, and on some minor races, are required to dump surplus water from the race system. This normally occurs when water from heavy rain has entered the race system causing flooding due to run off from roads and farmland into the races. This water is required to be quickly removed from the system to prevent flooding at downstream flooding. These points are used in times after heavy rain as an emergency for:

- As a buffer to dump water quickly from the race system
- When work is required on a section of race and can be dewatered using these emergency/discharge points

These Emergency Discharge and Buffer Points are located at:

- Upper Kowai Main race 300 metres above SH73 Kowai Bridge
- Odges Divide SH73 into Bishops Creek exiting into the Hawkins River
- Kirwee in Railway Reserve 200 metres below Township into a large soak hole
- Glentunnel below the intake 450 metres at the bottom end of the golf course back into the Selwyn River
- Waiwaniwaniwa River at west end of race fluming that crosses the river discharges into Waianiwaniwa River
- Hewitt Spill Point
- West end of Blacks Creek siphon discharges into Blacks Creek
- Waimakariri terrace race 6 emergency spill weirs back to the Waimakariri River
- Judd's Siphon Waimakariri race back to the Waimakariri River
- Old West Coast Road and Redmond's Road small race on north side of road discharge point into Gully back to Waimakariri River
- Old West Coast Road and Pitt's Road small race on north side of road discharge into Gully back to Waimakariri River
- Old West Coast Road and Cooks Road small race on north side of road discharge into drain back to Waimakariri River

4.5.2 Upper Kowai Spill Point

If the rain is very heavy and large amounts of run off water from the surrounding hills enter the main race there is an emergency discharge spill point located 1 km downstream of the intake. It is opened to prevent major flooding downstream in the Springfield Township. The water from this spill point discharges back into the Kowai River. During these periods the two Kowai Intakes gates are closed along with gates on tunnels (1) and (2).

4.5.3 Odges Divide Bishops Creek Spill Point

Odges Divide is sited 3km on SH73 below Springfield Township. There is the potential of flooding from Bishops Creek through Springfield Township from run off in heavy rain on the foothills southwest of Springfield. This water is discharged through Bishops Creek back into the Hawkins River. It is also used during a buffer spill period during October to November.

4.5.4 Waimakariri Terrace Race

On the terrace section of this race there are over flow weirs used for discharging water from this race. These weirs automatically start if this section of race becomes blocked by a landslip, tree branches, and dead animals or from general rubbish entering the race.

There is also one other discharge point within this section of race. This emergency discharge point is at the low point of Judd's Siphon and is utilized occasionally to tip out water when an inspection is required of the siphon itself.

4.5.5 Hewitt Spill Point

Hewitt property off Tramway/Boultons Roads into a large pond then flood irrigation. The emergency discharge point at the Hewitt's property has been in place since 1970.

This point is only utilized when the Waimakariri is running high and after heavy rainfall, water needs to be discharged from the main race system to stop flooding downstream at Kirwee Township at SH73/Kirwee. The water race operator discharges this water into a pond located on the Hewitt's property via a weir located on Tramway/Boultons Road. This is the main flood discharge point that is present in this 35 kilometres section of main race, which extends from the Waimakariri intake down Tramway Road.

4.5.6 Water Race Discharge into Blacks Creek

The emergency/spring discharge point is located at Blacks Creek. There is an area between Waireka Road, Bangor Road and Blacks Creek in an area just above the main stockwater race where natural springs occur. These springs rise one to two months after heavy rain in the Malvern Hills area. The flow from these springs runs off the paddocks into the water race. Also some of this spring water enters Blacks Creek itself. When this uncontrolled spring water enters the stockwater race the Water Race Operator decreases the flow at the Glentunnel intake to compensate for the springs flow. The operator then closes off the inlet end of the siphon and discharges race water flow above the siphon back into Blacks Creek.

This discharge into Blacks Creek is necessary, as properties west of Blacks Creek siphon still require stockwater. The discharge is at the rate of about 20 litres per second. This amount is required to serve the stockwater race users upstream. These springs can run for several weeks depending on the amount of rain in the Malvern Hills area in the period before the springs start to flow. As flow decreases from the springs the flow is increased in the water race through the siphon to balance the flow to downstream users.

4.5.7 Bishops Creek Flood Control

Bishops Creek is generally a dry creek and has a catchment area in the foothills southwest of Springfield Township. When there is moderate rainfall in this catchment area a small amount of water will flow down the upper section of the creek bed of Bishop's Creek and into the water race at junction No 1.

This is generally only a small amount of water and may not require the adjustment of the Kowai Intakes to compensate for increase in flow.

In times of heavy rain in these foothills, flooding occurs down the creek bed and through Springfield Township and back to SH73 and into Hawkins River.

Both the Kowai Intakes are shut down when this flooding occurs and some of the floodwater is used to run the stockwater scheme in these times. Some of this floodwater is diverted into the scheme at Odges Divide to keep it operational. When flooding has receded in Bishops Creek to a level lower than the scheme requirements. The Kowai Intakes are opened to achieve a balance between the flow from Bishops Creek and the intakes to serve the scheme.

This outlet is located beside SH73 approximately 1.9km west of Pococks Road above Springfield. From this point on the Bishops Creek bed is used to convey the stockwater flow from the Kowai Intakes through the Springfield Township returning in an arc back to the Main Road SH73 over a distance of approximately 8 kms. The discharge point is called Odges divide and is sited 4.5 kilometres below Springfield Township. At this divide the stockwater flow is diverted back into a main race system running parallel to SH73 and heading towards the Sheffield Township.

After several days the flow in Bishops Creek generally stops and the Kowai Intakes are open to fill the normal stockwater flow requirements.

At Odges Divide there is a small low boulder dam, which allows about 10 litres per second to pass through and flow down Bishops Creek back into the Hawkins River. This flow is used for stock that drinks from the creek. A small amount of water is present in this section of Bishops Creek from SH73 to the Hawkins Junction.

4.6 Flooding in Springfield Creek

Springfield Creek is generally a dry creek and has a catchment area in the foothills south west of Springfield Township. When there is moderate rainfall in this catchment area a small amount of water will flow down this creek bed. This flow continues under the Main Highway (SH73) at the south east end of the Township heading in a north easterly direction under Domain Road and onto Bishops Creek, some 1.5 km north east of SH73.

In times of heavy rainfall in these foothills flooding occurs down the creek bed and back into Bishops Creek, which in turn flows into the Hawkins River. The same action is required when Bishop Creek floods in regard to adjusting flows in the Kowai Intakes and race system.

Springfield Creek Water Race Discharges into This Creek

Discharge in question is at a fluming, which crosses over Springfield Creek by SH73 at the south east end of the Township. Stockwater is discharged from the west end of this fluming into the creek bed at the rate of about 20 litres per second. Springfield Creek bed is used to convey this stockwater to a point just above Domain Road. The water is then diverted from the creek bed through a small intake gate back into a water race serving an area of land between Domain Road, SH73 and Keen Road. The small intake gate serving this race may need some adjustment in times of flooding but generally the floodwater continues onto Bishops Creek without any problem.

4.7 Soakholes

Soakholes allow excess water to be taken from the intake to buffer additional usage such as high water use and at the end of races. A maximum of 10ℓ/sec per soak hole is permitted but where possible this should be reduced to as low as possible. There are 63 soakholes in the Malvern scheme.

4.8 Overall Operation

Presently the scheme is operated from two intakes during the winter months being the Upper Kowai River Intake and the Selwyn River Glentunnel Intake. In the spring, summer and autumn months the scheme is operated with up to four intakes, the Waimakariri Gorge, Upper and Lower Kowai and the Glentunnel Intake.

The Malvern Scheme is divided and operated into two sections. There are two operators - Eastern operator who covers the area east and below Darfield bordering the Paparua scheme and the Western operator covers the area west and above Darfield to the foothills.

The Western operator checks the main intake gates, cleans intake grills, records the river flows at the flow monitoring sites, and when required adjusts the intake gates. It may also be necessary to carry out river diversion works to divert the flows to service the scheme. When any works are carried out within the riverbed the operator must notify ECAN and Selwyn District Council using the River Works Notification form.

The Western Operator may contact the Eastern Operator to ascertain flow requirements in the eastern area.

Adjustments can then be made at either the main intake or other major divides located at Odges, Waddington Main Divide Gates, Bulls Race on Waimakariri River Terrace and the grills located at each siphon, piped section and tunnel over this section of race, Tramway Road and the Kimberley Road main divides, Old West Coast Road (Bulls Race) and SH73 Waddington.

The Eastern Operator firstly inspects the main divides at Kirwee and Charing Cross. From information gained from checking these races the operator contacts the Western Operator and requests more or less water for the lower half of the scheme.
PAPARUA WATER RACE SCHEME DESCRIPTION AND OPERATION

4.9 General

The Paparua scheme is made up of a variety of smaller farms and a large number of lifestyle blocks. It consists of an intake on the southern bank of the Waimakariri River at Intake Road feeding into races, which fan out across the plains towards Christchurch in the East and Burnham in the south.

The intake although still within the flood plain of the river is a simple concrete weir with a vertical sluice gate on the protected southern branch of the river. The water is led to this channel as necessary after each major fresh or flood in the river. In a flood the intake is protected by a combination of willow plantings and the mechanism of the river in the active main flood plain area overtopping the low bank of the dozed channel and washing the weak portion downstream.

From the river, water is fed through an intake race for some 500 metres. This race then divides into two races leading to two sedimentation pond areas where most of the sand and silt is allowed to settle out before the water feeds into the scheme.

The scheme from here consists of a series of main and subsidiary races feeding water to properties throughout the scheme area which generally covers the area of the old Paparua County totalling approx. 33,000 hectares with 2,966ha of Christchurch City area served.

4.10 Source

The main source of water for the Paparua Water Race is the Waimakariri River. Minor sources are from the bottom section of the Malvern Water Race system.

4.11 Intake

The access to the main intake is from the end of Intake Road, which runs off the Old West Coast Road.

The Paparua Intake channel extends from the Intake Control gate upstream of the Waimakariri River for several kilometres.

Water can be diverted into this channel at several points depending on where the main river channel is situated after flooding in river. This requires an inspection and decision on where the best place is to divert water into the channel.

4.11.1 Intake Operation

The intake control gates consist of grills, control gate and a large concrete crested weir with an adjustable weir at its southern end. The required flow into the main race is controlled by the intake gate. Large volumes of silt come in from the river when there are flooding in the Waimakariri River. When this occurs, the Intake Control gates do not require complete shut down but are reduced to a level to cut down on the amount of heavy silt laden water entering the system. This reduced flow is usually for a 24 hour period when there are high flood levels in the river.

The intake has a control system located in the control building that is connected to the following:

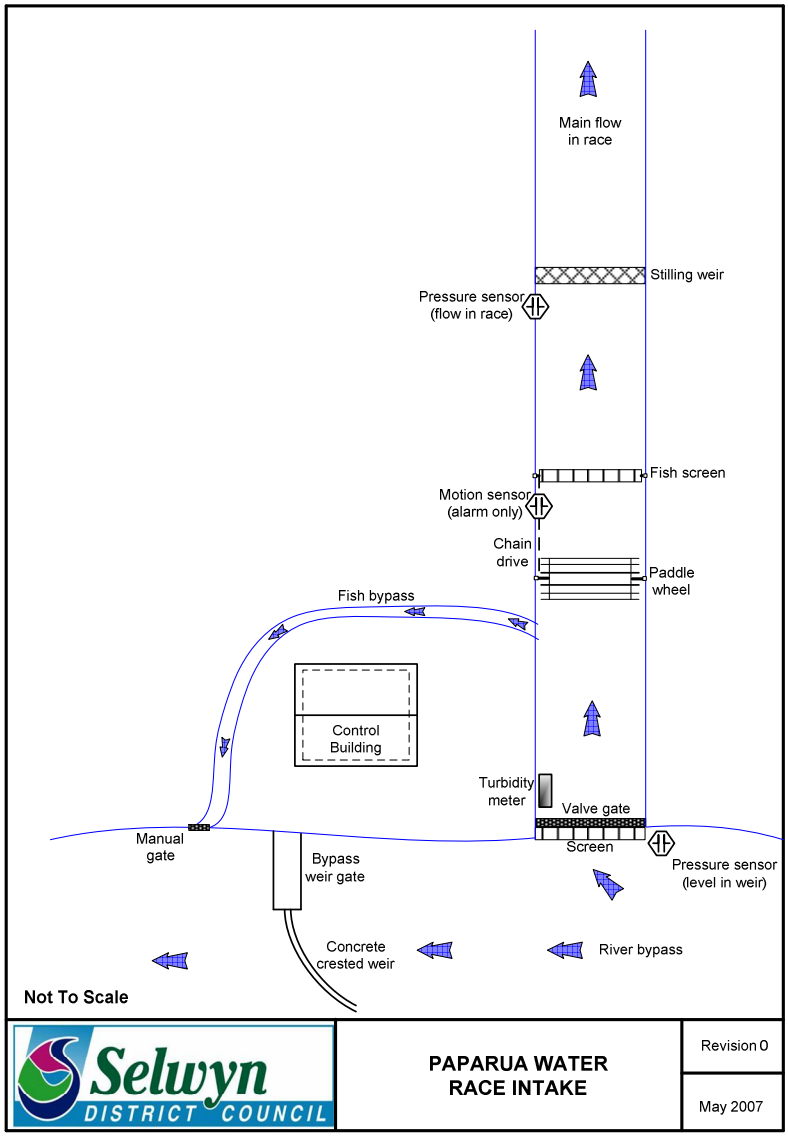
- Main Gate
- Bypass weir gate
- Pressure sensor (flow in race)
- Monition sensor (fish screen)

The control system is connected to the Councils SCADA system and control of the main gate is via the mobile phone system. The use of the mobile phone (text messaging) allows adjustments to main and weir gate to be carried out by the water race operator, give warning of any alarms associated with the intake and allows the operator to ascertain the flows at any given time. Power to operate the hydraulic and SCADA systems are via a solar panel and 10 acid batteries located in the control building.
All flows, gate settings, turbidity and solar panel are recorded on the SCADA system that allows ease of reporting and trending. Manual overrides on the main gate and the bypass weir can be carried out at the control panel. If power stops the hydraulic pump can also be manually operated.

Item	Application
Flow at intake	The flow through the intake is controlled via the flow requirements that uses the pressure sensor in conjunction with the stilling weir (both located downstream of the fish screen). The main gate will go up or down to restrict the flow to the amount that the water race operator has determined.
Fish screen	The fish screen is driven by the paddle wheel. The motion sensor is used to ascertain

	when the chain has stopped i.e. if screen is jammed or problem with the drive chain.
Bypass weir	The bypass weir gate is used for maintaining sufficient depth of water at the intake and to allow scouring of sand/gravel build-up that occurs at the intake. The gate is normally left open in winter and when floods are predicted (allows gravels etc to be washed out of the main weir).
Pressure sensor	The pressure sensor upstream of the main gate only gives a height of water in the river bypass and used to give an indication of the main river flow (rising, falling or stabilised).
Turbidity meter	The turbidity meter is presently not used for the day to day operation but for gathering data on water quality.
Fish bypass gate	Normally locked open to allow any fish to get back into the river

Table 4.1: Intake Schematic



Concrete crested weir with an adjustable bypass weir at its southern end	Hydraulically controlled main intake gate

Outlet of fish screen

Control building

Bulldozer is used to remove debris after flood

Digger is use to remove silt in weir

If the power goes down the gates can be controlled using manual hydraulic pump	The rotating wheel or the chain can be jammed by debris
	
The motion sensor used to indicate jammed screen or broken chain	Control System
	

Table 4.2: Intake Maintenance Requirements

Item	Maintenance Requirements	Responsibility
Drive chain and associated bearings	Grease weekly	Council's nominated Contractor
Turbidity meter	Calibrate on monthly basis	Council's nominated Contractor
Motion sensor	Inspection	Council's nominated Contractor
Weir valve	Inspection	Council's nominated Contractor
Main gate valve	Inspection	Council's nominated Contractor
Level indicator (pressure sensor)	Calibrate on monthly basis	Council's nominated Contractor
Flow recorder (pressure sensor)	Calibrate on monthly basis	Council's nominated Contractor
Fish screen	Inspection	Council's nominated Contractor
Paddle wheel	Inspection	Council's nominated Contractor
Batteries (10 acid type)	Top up as required	Council's nominated Contractor
Hydraulic pump	Check on weekly basis	Council's nominated Contractor
Solar panel	Checked on annual basis for output	SDC via SDU
Control system	Checked on annual basis	SDC via SDU

Silt Ponds

There are two silt ponds, which are used to settle out river silt in times of flood of the Waimakariri River. The ponds are accessed through a locked gate about 100 metres from the river end of Intake Road. These ponds are situated about 1 kilometre below the Main Race Intake Control gates.

The first pond (1.23ha) is situated above the start of the Harewood Race and is the larger of the two ponds. The silt progresses down the main race to a wider channel section just before the pond and silt settles out in the channel. Cleaning is carried out at the wider channel section of the race. The second pond (0.44ha) is smaller in size and the silt is allowed to settle in the pond itself and is cleaned out to bank. Cleaning of these areas is carried out on a yearly basis in August or early September before Northwest rains cause high-river flows in the following months.

Main settling pond	Small settling pond
	

If there is a total outage, or gates are closed completely at the intake and there is no flow into the race system within 24 hours, the upper half of the Paparua Race system drops to a very low flow. There is some storage in pond number one feeding the Harewood Race which after 12 hours drops below to a weir. There is also a second race leading away from this pond known as the Irrigation Race. Supply to this race from this pond lasts longer because the intake from this pond is at a much lower level. This Irrigation Race after the first 12 hours reduces in flow but continues flowing for another 12 – 15 hours.

Pond number two has minimal storage. The race, known as the Sandy Knolls, leads away from this pond and supplies water to the Rolleston and Burnham area.

After 24 hours of outage at the intake the whole upper half of the scheme will be out of water. The lower half of the Paparua scheme starts to be affected by lack of flow into the scheme. It is then imperative that some or all of the required flow be returned to the scheme within 30 or 48 hours at the outer most limits. If this fails to occur within this timeframe the scheme would have serious shortages throughout and stock would be left in many cases without water.

4.11.2 Control Structures

Divides are on the main races below the main intake control gates. The divides are a mixture of single or multiple control gates sited where the main race flow requires splitting into equal or different flows. Each split race then goes on to serve a different area of the scheme.

Gates are required to be set to enable the correct amount of water to be diverted to the area required. This is carried out by surveying the area below the divide gates and taking note of race flows. If there is insufficient water in one or more of these races then adjustment of main divides and the main intake gates may be required.

Smaller on-farm divides are usually required to be checked following a complaint from a property owner through lack of or too much water.

On-farm control divides are generally made up of stones or boulders and are open to tampering by landholders and other persons. Any persistent tampering is dealt with by issuing a "notice to the offender".

4.11.3 Monitoring Points

Monitoring structures are sited below intakes to measure the quantity of water taken from the source and should be read on every working day and at a minimum of every second day. Additional readings will be required when the flows from the source are approaching requirements to regulate or restrict the take of water.

They are used to measure flows to ensure compliance with resource consent requirements and to compile a history of the intake flow.
The only monitoring structures on the Paparua Water Race System are approximately 400 metres downstream of the main intake where there are two control gates that divide the flow into two races.

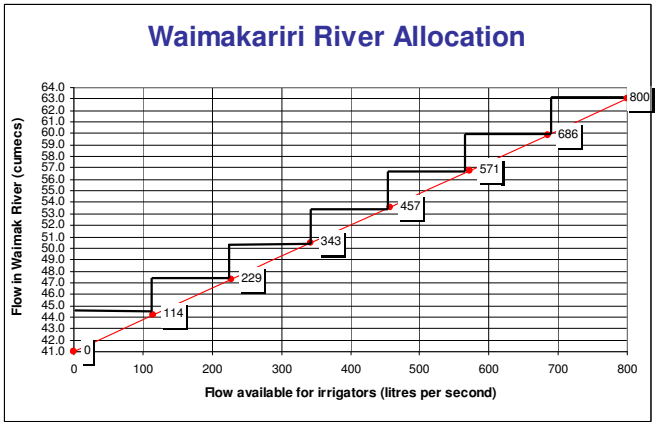
Each of these races has a section of race that has had its cross-sections calibrated by a certified hydrologist to enable measurement of the flows. As the monitoring point is not stable, e.g. concrete, the cross-sections have to be recalibrated on a yearly basis. There is no monitoring of the small race flows that cross the boundary takes from Malvern water race system to the Paparua scheme.

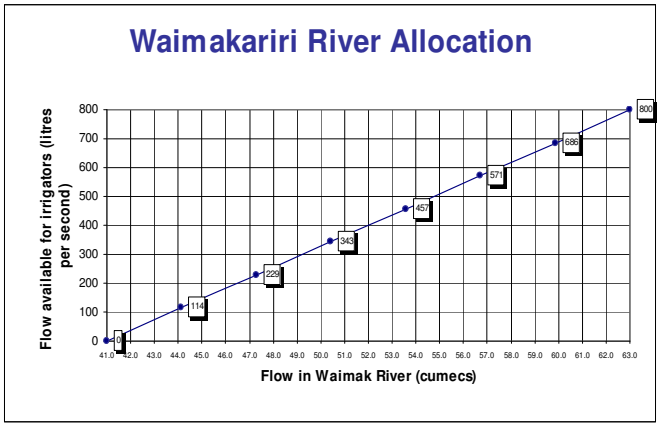
4.12 Irrigation

There are a 55 property owners (as at 1 January 2013) on the Paparua Scheme that have authorisation from the Selwyn District Council for use of water from the water race system for irrigation.

Due to consent conditions, restrictions occur when the flow in the Waimakariri River is less than 63 cubic metres per second. In the event of this occurring rosters are developed to assist irrigation when restrictions are imposed on irrigation. A graph is also sent to the irrigators detailing the steps down in the river and indicating how many litres are available at any one time. When the river reaches 41 cumecs all irrigation ceases. The Council has instigated in conjunction with all irrigators a system that allows irrigators to call Council and receive information on River levels, any restrictions imposed and the appropriate "roster".

The Council's nominated Contractor monitors and liaises with permitted irrigation users during the irrigation period to ensure compliance with their authorised flow and that sufficient water is available for both irrigators and downstream users. Illegal irrigators are reported to Council via the Council's nominated Contractor. These incidences are investigated by SDU who forward a report to Asset Management.
The Waimakariri River allocation graphs are detailed below.





4.13 Emergency Discharge Points

There are discharge points on main races, and on some minor races, to dump surplus water from the race system. These are used in an emergency, or as a buffer or when work is required on a section of race, and can be dewatered using the emergency discharge point.

An emergency is when water has got into the race system from heavy rain causing flooding due to run-off from roads and farmland into the races. This water is required to be quickly removed from the system to prevent flooding at downstream culverts or overtopping and affecting roads, property, crops or buildings. This water can be removed from one discharge point or several, up to 3 to 4, depending on the amount of water to be removed. Also excess water may be taken from the race to buffer additional usage such as high irrigation and sudden shut down of the irrigation systems. Flood discharge points on the race system are sited at:

- Scout Camp on West Coast Road and Buchannan's Road intersection
- Old West Coast Road and Main West Coast Road intersection
- Sandy Knolls Road and Railway Road
- Newton's and West Melton Road intersection

4.14 Soakholes

Soakholes allow excess water to be taken from the intake to buffer additional usage such as high water use. Maximum flow to each soakhole is 10ℓ/sec. The Paparua scheme has 110 soakholes.

4.15 Overall Operation

Presently the scheme is operated in two sections, being the western area, including the intake, and the eastern area. The boundary between the two being the Main South Road along Sandy Knolls Road to Newtons Road and then to the airport area.

The Western Operator checks the main intake gates, river flows, cleans intake grills and when required adjusts intake gates and adjustable weirs. Contact with the Eastern Operator then occurs to ascertain flow requirements in the eastern area. Adjustments then can be made at either the main intake or the other major divides located at Bells Divide, SH73/Sandy Knolls, SH73/Weedons Ross Road, SH73/Langdales Road, SH73/Kirk Road to ensure the correct flow into the eastern area. When there is a total outage of the intake, flows in the upper half of the Paparua race scheme fall away in 6- 8 hours.

5.0 SPRAYING

5.1 Vegetation Management Approach

Some vegetation growth (e.g. perennial grasses) is desirable on race banks at the waterline and above waterline to minimise establishment of land weeds and preventing race bank wind and water erosion. Council carries out significant quantities of spraying to remove noxious weeds adjacent to Council races.
The Council will:

- Investigate opportunities for enhancing race planting
- Promote awareness of race planting to private property owners
- Continue consultation with stakeholders on race weed spraying activities
- Continue to develop the SDC Weed Spraying Contract for improving environmental performance of weed spraying activities that includes "Best Practice" weed spraying protocols

5.2 Objective

The objective for spraying is a weed free area within a four year period. Banks and adjacent beams shall be encouraged to be maintained in a manner that does not encourage weed growth.

The purpose of the water race spraying is to only remove broom, gorse, small willows and other trees, blackberry, rushes, bracken fern, flax, toi tois and other problem weeds identified to the Council's nominated Contractor growing in and on the banks of the race.

5.3 General

The spraying of approximately 60 kilometres of stock water races berms occurs each year within Selwyn District. The extent of the spraying programme may be increased or reduced to reflect extent of infestation and budget constraints.

As at 31 May 2010, the Council is reviewed the weed spraying contract. The previous contract was a long-term contract (three years plus one additional year subject to satisfactory performance) the current contract is yearly with a view to merge all Council spraying into one contract.

All areas that are to be maintained by spraying are to be identified for the schedule used in the spraying contract and the contractor is to ensure that they are all maintained to the appropriate standard on a yearly basis.

The extent of work is four metres either side of the race, or to a fenced property boundary if less or to the outer edge of an adjacent access track or road if greater and there is no fence.

Where spraying has removed desirable plants, a replanting programme to re-establish desirable plants will be required.

5.4 Spraying Conditions

The Council holds a Global Consent to discharge contaminants onto land in circumstances where they may enter into surface water (Appendix CC – Weed Spraying Consent CRC084966). This consent provides for Water Race spraying, road spraying and classified drain spraying (of noxious weeds only).

Consent CRC084966 details the requirements of this activity and must be adhered to at all times.

6.0 CLEANING OF WATER RACES

Note: this section to be updated once ecological survey work for Malvern scheme has been completed.

6.1 Background

The efficient movement of water in the race system requires an effective programme of control of aquatic and race bank weeds and silt removal. Aquatic weeds and silt build up contribute to inefficient water use by restricting water movement in races thereby increasing water losses through evaporation and seepage and by clogging flumes, siphons. However, stronger attention is being given to vegetation management, which includes balancing beneficial aspects of race vegetation (i.e. minimise bank erosion, enhancing amenity and providing habitat for fish /invertebrate and wildlife) with potential negative affects.

6.2 Management Approach to Race Cleaning

The Council cleans approximately 247 km of Council water races per year. Water race cleaning is tendered out on a three yearly basis to contractors with a high level of skills and management to ensure that the cleaning is carried out to the required level.

To ensure water races are maintained to an appropriate level the Council will continue to:

- Use race cleaning equipment and methods to minimise the effects of race cleaning on fisheries and aquatic habitats
- Use contractors that have staff with proven skills and experience or can demonstrate that they have the skills and suitable machinery for race cleaning to ensure minimum effect on waterways
- Continues to develop and improve race cleaning methods/approaches in consultation with stakeholders
- Detail on Councils GIS system those parts of the race network, which are known to have significant ecological/fisheries values
- Refine protocols and procedures for race cleaning

6.3 Water Race Cleaning of Private Water Races

Water races that are on or adjacent to a property and are not Council water races are the responsibility of the landowner to clean. The cleaning of water races is a requirement of landowners under the Water Race Bylaw and should be carried out at least annually.

A copy of SDC's policies (as at October 2011) and Bylaw is included in Appendix B and C.

The Council pamphlet "A Guide to the Management of Water Races in Selwyn District" details the requirements when carrying out cleaning of a water race and is available at all Service Centres and on the Council website and is included in Appendix B.

6.4 Purpose

The purpose of the water race cleaning is to only remove the vegetation growing on the banks of the race that restricts water flow and silt, sand and weed that has been deposited in the bottom of the water race and is reducing the waterway area or slowing water velocity.

6.5 Procedures

The following procedures are required to ensure the management approach is complied with. This includes the following.

- Cutting into the edge of the race bank is not permitted (as shown in the photo)
- The contractor shall excavate only by approved mechanical means that ensures no damage occurs to the existing race bank or invert, other than that required for cleaning purposes
- The contractor shall undertake the work to the standard required by the Water Race Operator and shall take direction on the extent of cleaning required

- The contractor shall ensure that all culverts are inspected to ensure that they are not obstructed. All culverts are required to be clear at the end of the operation and the cleaning of culverts found obstructed and required to be cleaned after the Contractor has left the site may be charged to the Contractor
- The contractor is to advise the Engineer's Representative or the Water Race Operator of any obstructions or leaks encountered for their action.
- The contractor is required to inform all property owners of their intention to encroach onto private property and take all reasonable measures to ensure that these property owners are not detrimentally affected. The contractor shall operate in a courteous and friendly manner and pay particular attention to the shutting of gates to ensure stock is controlled at all times within private property.

6.6 Water Race Cleaning Bucket

The Council requires a specific bucket design, the bucket is to allow water, fish and eels to drain from the weed and silt through the bucket back into the race while retaining the solid material.

The bucket for race cleaning shall have a steel frame with 25mm steel mesh on the back and 50mm steel mesh on the ends.

6.7 Cleaning of Large, Medium and Small Races

Large races are generally main headraces and adjacent to roads. For cleaning large races to bank a larger excavator is required and a greater quantity of sand or silt is to be removed. In some cases, due to the width of the race, the race will require cleaning from both sides.

Medium races and small races are both inside properties and adjacent to roads.

6.8 Cleaning to Truck

Cleaning to truck is required for compliance with New Zealand Transport Agency, safety and aesthetics reason in the following situations:

- Where Council races are within the State Highway road reserve
- Where races are in an urban area
- All Paparua Council races
- Where tailings could/will create a safety issue (this usually associated with vehicle sight distances)
- Where tailings are within 0.5m of the carriageway
- Length of 50m outside properties where the road edge is mowed regularly

Where cleaning to truck, the maximum width of bucket allowed to be used by the Contractor is 1.8m, this reduces the likely hood of spillage of material onto the carriageway.

6.9 Cleaning to Bank

Spoil shall be deposited tidily in a windrow on the bank parallel to the water race. Material shall not be spread over the area adjacent to the water race.

Ellesmere Terrace Race

On the terraced race the cleanings must be deposited over the terrace bank and not on the track adjacent to water race.

6.10 Bank Removal

Bank removal may be undertaken by the Council (and its nominated contractor) where race cleanings have built up over a number of years. Bank removal is carried out in accordance with Policy W104 (3) (Appendix B).

There may be occasions where it is not appropriate to remove the bank either completely or partially from the side of a water race. This can be due to issues such as, but not limited to, where a water race has been "built up" and leakage would result or where the bank stabilises the water race. The removal of the bank could affect the adjacent road reserve and causing flooding problems.

6.11 Traffic Management Plan

The contractor shall be responsible for traffic control for the full duration of the work. All necessary signs, markings, barriers, traffic cones and warning lights etc. shall be erected before work commences and maintained by the Contractor. Traffic management shall be to the Code of practice for temporary traffic management (COPTTM): Part 8 of the Traffic Control Devices manual (TCD Manual) - Published: 01 Nov 2012.

The contractor shall carry out the work in a manner to protect the works and which will permit the safe and convenient passage of traffic over the whole length of road affected by the contract.

6.12 Paparua Pond Race and Pond

Pond Race

The race leading to the Paparua silt ponds requires cleaning on a yearly basis. The optimum time is August prior to the period of northwest winds in spring. The water is then normally clear and allows the machine operator to see the extent of cleaning. The material is used by Sicon in conjunction with their road metals crushing.

Pond Cleaning

Pond cleaning occurs on a five to ten year cycle apart from the entrance to the ponds that require annual silt removal.

7.0 MAINTENANCE CONTRACT

7.1 Response Times

The Council operates a system that will require the Contractor to supply key staff with cell phones with text capability. Alarms indicating failures will ring the Contractor's phones and provide a text message indicating the problem.
The Priority Response times targets for service delivery are as follows:

Priority	RESPONSE	COMPLETION
P1	1 Hour	24 Hours
P2	4 Hours	48 Hours
P3	1 Day	5 Days
P4	5 Days	10 Days

Table 7.1: Response Time Schedule

Description	Priority	Code
Alarm	P1	WRALARM
Blockage	P2	WRBLOCK
Flooding Roads	P1	WR FLOODRD
Flooding Other	P2	WRFLOOD
Flow too high	P2	WRFLO2HI
Flow too low	P2	WRFLO2LO
General Enquiry	P3	WRENQUIR
Illegal Intake	P3	WRILLINT
Maintenance	P4	WRMAINT
Maintenance - Urgent	P1	WRMNTURG

7.2 Inspection Program

The following inspection programme is only an indicator for Council use as the maintenance contractor is responsible for the number and methodology of their inspections.

Table 7.2: Inspection Programme

No	ASSET	ACTIVITY	FREQUENCY	Responsibility	Comment
1	Headworks	Inspection		Mtce Contractor	
	Early's		Daily	Council nominated Canterbury Grasslands	
	Southern		Daily		
	Haldon		Daily		
	Kowai (Upper & Lower)		Daily		
	Glentunnel		Daily		
	Selwyn		Daily		
	Waimakariri		Daily		When operational
	Paparua		Daily		

No	ASSET	ACTIVITY	FREQUENCY	Responsibility	Comment
2	Intake Silt Ponds	Inspection	Weekly		Ensuring compliance of maintenance contract provisions
3	Intake Gates	Inspection	Weekly		
4	Main Gates	Tested	Biannually		
5	Kowai Tunnel Gates	Tested	Biannually		
6	SCADA	Inspection by technician	Annually	Mtce Contractor	
7	Main divides	Inspection		Mtce Contractor	
8	Tunnels	Inspection	Annually	SDU	
9	Manholes	Inspection	Annually	Mtce contractor	
10	Flow recorders	Test	3-5 years	SDU	Engage manufactures representative to test for % error
11	Flow Monitoring points	Test	Annually	SDU	
12	Switchboards	Inspection by Electrician	Annually	Mtce Contractor	Inspection by Electrical contractor

8.0 REPORTING REQUIREMENTS AND RECORD KEEPING

The reporting requirements for the maintenance contractor are detailed in the maintenance contract.

9.0 EMERGENCY PLAN

The Emergency plan requirements are provided for within the documented "Utilities Lifelines Response Plan - effects and intervention for Utilities – March 2010."

10.0 HEALTH AND SAFETY

The health and safety on the Council water race sites is the responsibility of the contractor (Siconferguson Ltd). When Council staff is going to any of these Council water race sites they are required to inform Siconferguson of their intentions.

11.0 AUDITING

The auditing program associated with all the water race schemes are detailed in the maintenance contract No 849 July 2011.

APPENDICES – (LOCATED IN SEPARATE DOCUMENT)

APPENDIX A		TERMS OF REFERENCE FOR SDC WATER RACE SUBCOMMITTEE
APPENDIX B		WATER RACE POLICIES
APPENDIX C		WATER RACE BYLAW
APPENDIX D		ENFORCEMENT PROCEDURES
APPENDIX E		NOTICE TO REPAIR, MAINTAIN OR CLEAN WATER RACE
APPENDIX F		COMMUNICATION PLAN
APPENDIX G		RIVER WORKS NOTIFICATION FORM
APPENDIX H		WATER RACE CONTAMINATION PROCEDURE
APPENDIX I		CONTAMINATION FORM NOTIFICATION
APPENDIX J		CONSENTS
APPENDIX K		HISTORICAL INFORMATION
APPENDIX L		AGREEMENTS FOR ACCESS TRACKS IN MALVERN
APPENDIX M		IRRIGATION AGREEMENT, RESTRICTIONS, REBATE
	M.1	Paparua Irrigation Agreement
	M.2	Paparua Irrigation Restrictions
	M.3	Rebate Procedure
	M.4	Irrigators List
APPENDIX N		IRRIGATION COMPLIANCE CHECK
APPENDIX O		SELWYN DISTRICT AND CHRISTCHURCH AGREEMENT
APPENDIX P		PHOTOS OF INTAKES AND GENERAL
	P.1	Photos of Intakes
	P.2	General Photos
APPENDIX Q		IRRIGATION INSPECTION PROCESS
APPENDIX R		VANDALISM REPORTING PROCESS
APPENDIX S		ENVIRONMENTAL CANTERBURY RIVER LEVEL PROCESS
APPENDIX T		CONTACTS PERSONNEL
APPENDIX U		SHUT DOWN PROCEDURES (OUTAGES)
APPENDIX V		WATERING BAY SCHEMATICS
APPENDIX W		MAPS: SCHEMES
APPENDIX X		MAPS: INDIVIDUAL AREAS
APPENDIX Y		KOWHAI RIVER AGREEMENT WITH FISH AND GAME
APPENDIX z		WATER RACE BROCHURE
APPENDIX AA		PROTOCOL FOR DIDYMO DECONTAMINATION
APPENDIX BB		WEED SPRAYING CONSENT
APPENDIX CC		APPROVED PLANTING TABLE