



**REPORT ON WASTEWATER TREATMENT
OPTIONS TO SERVE CARDRONA VILLAGE**

FOR QUEENSTOWN LAKES DISTRICT COUNCIL

11118

May 2012



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Revision Schedule					
Rev. No.	Date	Description	Prepared by	Reviewed by	Approved
1	7-12-11	Draft Issue to QLDC	BPC	ML	
2	9-12-11	Issued to QLDC	BPC	ML, CO	ML
3	27-04-12	Reissued to QLDC with requested revisions	ML	ML	ML
4	08-05-12	Final amendments	ML	ML	ML
5	29-05-12	Final Council Review	ML	ML	ML

1 EXECUTIVE SUMMARY

The following report provides the results of an investigation of potential options for either a public or community wastewater treatment and effluent dispersal system to serve the Cardrona Village.

The “Cardrona Village” is located on the Crown Range/Cardrona Valley Rd, between Queenstown to the south-west and Wanaka to the north-east. Cardrona Village currently has a small permanent population of approximately 160 residents, but the population is predicted to increase dramatically over the next 20 years as the area is presently experiencing growth, with a number of significant developments having been completed, gained consent or awaiting granting of consents. The peak population occurs, and will continue to occur during the winter period, due to the nearby Cardrona ski fields and other winter activities that are provided in this picturesque location.

Due to the absence of any publicly owned utilities serving the area, developers have been providing their own wastewater systems to serve their individual developments. At present there are three privately owned Wastewater Treatment Plants in the Village, plus a number of septic tank systems serving smaller properties.

As a result of the proposed expansion to this area, Council and the community have identified that either a public or community wastewater system would be preferable to the continuing creation of a number of private systems, and therefore needs to develop a strategy for the community’s wastewater requirements. The purpose of this report is to consider the potential land dispersal locations and to determine the wastewater treatment and dispersal options that may be used effectively for the preferred sites.

This report looks at the projected future flows that are expected to be generated in the Village, based on all existing, consented and future accommodation being fully utilised. Existing wastewater flows have been calculated at a peak of approximately 80m³/day. Existing consented developments that have not yet been built would increase this to a total of approximately 250m³/day. A figure of 420m³/day has been calculated for the future peak total flow that would be generated from the village. Evaluation of a proposal to cater for the flows from the Cardrona Alpine Resort was initially considered but following the draft preparation of this report, this option has been excluded on the basis that the additional cost required would be significant and may preclude some of the options available for the village.

This report includes five potential sites that have been identified as follows:

1. The Benbrae site
2. The Scurr site
3. The Phoenix 47 site
4. The Community Hall site
5. The Pringles Creek site
6. The Mt Cardrona site

The Pringles Creek site and the Community Hall site, although being owned by Council and providing potential cost benefits, are both considered unsuitable for wastewater dispersal due to the orientation of the layers falling towards the public grounds for the Community Hall site, and the limited size of the Pringles Creek site, or floodplain issues if this was extended into neighbouring properties.

The Benbrae site, although currently having an operating treatment plant and a consent for 54m³/day for the associated Benbrae development is also considered unsuitable to serve the future

.1- Information received from the Assessment of Infrastructure Requirements Stage 11 Report by GPF- June 2007

demands of the Village due to the low permeability rates of the silt/clay layers which also fall towards the Village at relatively steep slopes.

Mt Cardrona Station Ltd (MCS) had been planning to install a new Wastewater Treatment Facility and have been granted a "Discharge to Land" Consent for a wastewater discharge of $2164m^3/day$ for flows from both the MCSSZ and from the Cardrona Village. This system was considered to be the preferred option in previous reports prepared for Council, however this development has been delayed indefinitely, and the property has recently been put on the market.

The Scurr site and the Phoenix 47 site are the two options that have been considered as suitable for further investigations and for community consultation, with the Phoenix 47 site being the preferred option primarily due to the lower cost of this option, but environmental, hydrogeological and consent issues would need to be fully examined as part of the next stage of investigations, or at the design stage, to confirm the site's suitability for the proposed wastewater treatment and dispersal options that have been recommended for further investigation on this site.

2 INTRODUCTION

The provision of a Cardrona Village Wastewater System is considered to be an essential part of the development of the Village and to meet the Council's and residents' concerns for the environmental and/or health protection of the community and downstream affected parties.

There are three existing treatment plants and a number of septic tank and dispersal systems which currently serve the existing Village's wastewater discharges.

In addition to the existing development, Consents have also been granted to for a number of further developments which will significantly increase the Village's wastewater flows as follows:

- A 38 bedroom lodge and 49 houses for residential/visitor accommodation.
- A 58 bed backpackers including a shop and café.
- A 28 Lot subdivision North of Soho St.
- An 11 Lot subdivision South of Soho St (which has a current application to be further subdivided into 56 Lots pending a decision on providing a wastewater treatment and dispersal option).

The majority of the Village is located within the Rural Visitor Zone (RVZ) which has no specified density controls, and therefore relatively significant levels of further development could also occur if sufficient demand is generated in the future.

Two reports have been previously prepared for QLDC over the last 5 years for the purpose of evaluating a future Wastewater Scheme to service the village.² The most favourable option in both reports had been to use the future MCS's Wastewater Treatment Facility, located 2.5km north of the village.

These reports were undertaken when construction of the MCS Wastewater Treatment Plant was considered to be imminent and to be undertaken either prior to or concurrently with the development of the MCSSZ and prior to any major development within the Village. Subsequent events have delayed the development of the MCSSZ, and consequently the construction of the Wastewater Treatment Plant. More recently MCS has been put up for sale. Therefore, the timeframe for the construction of the Wastewater Treatment facility is unknown, while development and potential development within the Village is continuing. Owners and purchasers of properties from the Brooklynne Holdings developments and from the Miners Rise at the southern end of the township are currently being delayed from determining whether to install private wastewater systems, or to connect to a public/community scheme.

The provision of a Wastewater Treatment Scheme to serve the Cardrona Village is therefore being considered by QLDC, to meet the demands of the Village, that are being created both by further development, and to meet the environmental concerns of the residents. A further catalyst was the potential proposal from the Cardrona Alpine Resort to connect into a public system located within the Valley but this has since been removed as an option, due to the considerable additional cost and land requirement which could limit options that would serve the Cardrona Village alone.

Council's initial proposal for a wastewater scheme to serve the village was to utilise land already within Council ownership at the Village Hall and within the Cardrona Valley Road Reserve to minimise the cost of the Scheme. These options were both considered to be unsuitable (as determined in Section 5 of this report) and the scope of this report was broadened to include sites not owned by the Council.

The brief for this report includes the following points as noted by Ken Gousmett in an email to Tim Scurr dated 24/8/2011.

1. The report will provide a high level, not detailed, evaluation of options for the Village only and for the combination Village and Cardrona Alpine/Snow Park/Mt Cardrona Station development.
2. The report will include an outline risk assessment of the options
3. The preferred option and costs will be included within Council's Long Term Plan.

² Assessment of Infrastructure Requirements Stage 2 Report by GPF- June 2007
Cardrona New Scheme Options Assessment Report- June 2008

4. The capital and operating costs and impacts on rates are expected to be such that the full cooperation of potential developers as well as the community will be required.
5. Prior to a scheme being committed a ratepayer vote is to be carried out.

Subsequent to the initial Draft Issues of this report, Council has determined that a public wastewater scheme is very unlikely to be able to be provided by Council, and that a community wastewater scheme is a more viable option, at least in the short to medium term.

For the purpose of this report, a public wastewater treatment plant and dispersal scheme is a system that is funded, owned and operated by, or on behalf, of the Council. The Local Government Act allows Council to require landowners to connect into a public reticulation system that discharges into the wastewater treatment plant, even if a consented and legally operating privately owned system is already in operation. Council would generally reimburse their costs by development contributions, levies and increased rates that would cover the capital costs in addition to the operating costs of the system.

A community wastewater scheme is a system that is funded, owned and operated by private ownership but is endorsed, by the Council, and the community, as providing an asset that benefits the community.

The benefits of a community wastewater scheme are considered to be as follows:

- Council is not required to provide the funding for the scheme.
- Council acknowledges that the community scheme is suitable for the wastewater treatment dispersal for the community.
- Council may contribute towards the cost of establishing the scheme.
- Council may elect to manage and operate the system if the private ownerships fail to manage or operate the system in accordance with the Conditions of Consent.
- Landowners who elect to connect to this system have some surety, that if a public scheme is developed in the future, that connection to that scheme, from the community scheme, would be undertaken, and almost certainly at a lower cost than connection from a privately run, non-endorsed scheme.
- The community scheme may potentially be purchased, or taken over, as a public scheme in the future.

However, to be a community scheme, the Council would require:

- The design to be to an acceptable standard to maintain all Resource Consent requirements.
- The design to be acceptable for the scheme to be considered for adoption by Council with minor additional works to bring the assets to Council's standards.
- The design does not result in unsustainable levels of maintenance.

As stated above, since the initial preparation of this report, Council has determined that a public wastewater scheme is unlikely to be provided for Cardrona in the short to medium term. However, this report seeks to identify the sites that could potentially meet the objectives for a community scheme and to determine a preferred site for further investigation and design, subject to obtaining Council's and the community's approval. Due to the significant costs of establishing a privately funded and operated scheme, Council has identified that the scheme will be driven by development levels and that a developer would be the most likely to provide the delivery of the scheme, and this may be in conjunction with the existing landowner(s) and/or consent holders, subject to financial arrangements between these parties.

Individual landowners, and further developments, would not be bound to connect into the community scheme but the benefits and safeguards that would be provided by the scheme, and the efficiencies in cost of a larger scale that could be obtained, should be sufficient incentive for the

greater part of the community to connect to the scheme. Cardrona Water Supply Ltd already operates a similar scheme for water supply within the Village, and charges a connection fee to recoup the capital costs of the infrastructure that has been provided and an annual fee for the operating costs of the system.

This report should therefore be read in the context that the scheme that is most likely to be constructed to serve Cardrona Valley in the short to medium term, would be a community scheme that would be developed, funded, managed and operated by private ownership, but requires the endorsement of the Council and the community to be able to operate in this capacity.

This report has been prepared on behalf of QLDC by Airey Consultants, and assisted by Pattle Delamore Partners (PDP) who has evaluated the proposed sites to determine the best methods of treatment and dispersal as well as assisting with the preliminary cost estimates.

A geotechnical assessment has also been undertaken by Tonkin & Taylor Site Assessment (T & T No. 892431 – Nov '11) on those sites for which no previous existing geotechnical information was available, to determine the sites suitability for wastewater dispersal.

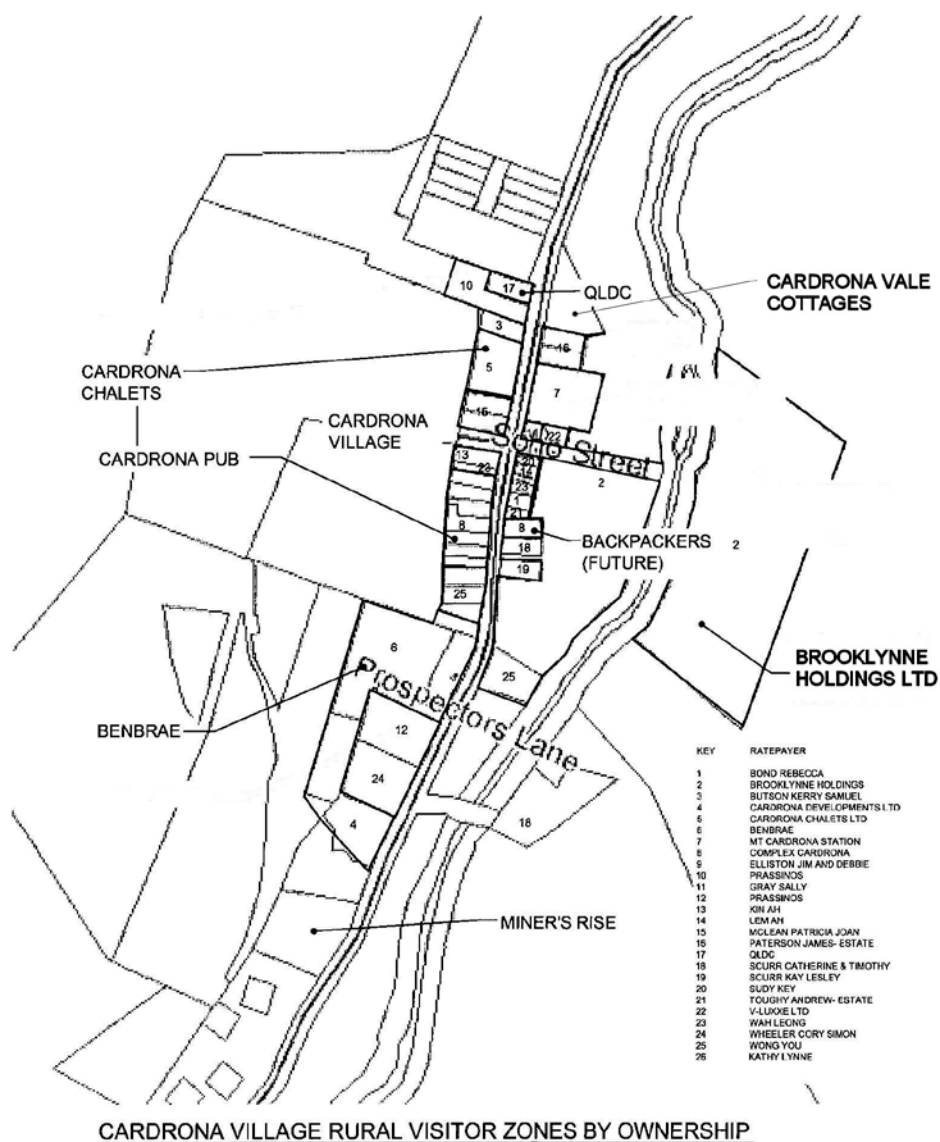
3 POPULATION AND WASTEWATER FLOW PROJECTION

The permanent population in Cardrona is estimated at 60, and expands significantly during the winter months due mainly to the close proximity to the Cardrona Alpine Resort and other winter attractions including Snow Farm and Snow Park. Allowing for full occupation of the Benbrae Resort, the Cardrona Hotel, Cardrona Chalets and all existing houses within Cardrona Village, the existing peak population is estimated to be 350 people.

3.1 CARDRONA VILLAGE OWNERSHIP

Figure 3.1 indicates Cardrona Village ownership details as of 2010. Some of the owners shown on this plan are now known to be out of date.

Figure 3.1- Cardrona Village Ownership



3.2 PREVIOUS STUDIES

The previous study by GPF (June 2007) determined the following potential population and flows for Cardrona Village:

Potential Population	1,380 to 2,461 people
ADWF (using 220L/p/d)	304 to 541 m ³ /day

3.3 METHODOLOGY

For this study the population for the Cardrona Village has been determined using current existing, consented and future proposed development information where available and estimated development densities where no proposed development information is available. The following estimates have been made for development inside the Cardrona Rural Visitor Zone (For Key Numbers refer to Fig 3.1 Cardrona Village Ownership Map).

Note: A development density of thirty 2-bedroom units per Hectare has been allowed for properties where development plans are completely unknown.

Development levels have been determined for:

- the existing level of development
- the consented level of development (not yet built)
- the future estimated level of development

Key	Owner/Development	Existing / Consented and Future Development
4	Cardona Developments Ltd	24 houses (12 houses existing)
12, 10 and 24	Prassinos (recently sold)	46 Units (future)
6	Benbrae Development	70 Units (44 existing and estimated 26 additional) studio, 1, 2 & 3 bedroom
25, 23, 13, 20, 14	Chinese Titles	1 house per lot (future)
8	Cardrona Pub	Bar, Hotel including 20 Units (existing)
15	McLean	4 houses (future)
3 and 5	Cardrona Chalets	6 Units (existing)
17	QLDC	Existing Hall and Toilets
16	Recently sold	6 Units (future)
7	Recently sold	18 Units (future)
11, 18, 19 and 22	Private owners	Existing house per lot
2 and 26	Brooklynne Holdings Ltd	(Consented) backpackers, 11 Lot subdivision, 38 room lodge and 48 Units, proposed 56 Lot subdivision, proposed 28 Lot subdivision and one existing house
1 and 21		1 house per lot (future)

The following developments outside the Cardrona Rural Visitor Zone that could potentially form part of the wastewater catchment area have been included in the calculations.

Owner/Development	(Consented) Development
Miner's Rise	6 Lots
Cardrona Vale Cottages	5 Units

The existing Benbrae development has its own wastewater scheme that may continue to operate independently of the public community scheme approved by both QLDC and ORC and if this occurs then, as per the Benbrae Villas entry on Table 3.4(a), the existing flows would reduce by approximately 35m³/day and the total future flows to be treated would decrease by 70m³/day from 420m³/day to 350m³/day if Benbrae is able to treat and disperse their flows within their own system and land.

Population and Flow Estimates have been made using specific design information based on occupancy and domestic wastewater flow allowances in the Auckland Regional Council's publication TP58 (average dry weather flow of 240l/h/d and number of people per dwelling varies depending on number of rooms). A check on this method using design parameters from NZS4404:2004 with Queenstown Lakes District Council amendments September 2005 (Average dry weather flow of 300l/h/d and number of people per dwelling of 3.5) has also been made.

3.4 RESULTS

The estimated wastewater flows have been calculated for the following stages of development:

DEVELOPMENT STAGE	ESTIMATED TIME FRAME	ADWF (PEAK POPULATION)
Existing development	2012	81
Consented development (not yet built)	2022 – 2032	251
Future total flows	2032 – 2042	422

The calculations are contained within the spreadsheet on Table 3.4a.on the following page of this report.

The estimated time frame for the "Consented development" has been estimated on the basis that the economic climate over the past few years has prevented the development of any of the Consented developments, but this is unlikely to continue. The largest contributor to the "Consented development" flows (as listed in Section 2 of this report)is the 38 room lodge and associated 48 units which provides half (85.6m³ of the consented 170m³) of the additional flows. This development could be constructed at any stage, or potentially not at all if the consent lapses and the consent is not extended. The remaining backpackers and 39 Lots that have been approved for subdivision on Brooklynne's land as well as the buildings within the Miners Rise and Cardrona Vale cottage developments could also occur at any time. The 56 lot subdivision application to divide 11 of the above lots would also be granted if a wastewater solution for the village is determined which would provide an additional 67m³ of the "future" flows to also come on line. The "consented plus existing flow" of 251m³/day is estimated to occur within a ten to twenty year period. Total Future flows are also likely to occur within a shorter time frame if the "resort" aspect of the Village is successful as opposed to growth by traditional means, i.e. dictated by regional growth and percentage of that population that would be attracted to Cardrona. A period of 20-30 years for that time period has been estimated.

The range of estimated future peak population and ADWF associated with this peak population are as determined with the two different methods mentioned in 3.3 above and are summarised below:

<i>Potential Population</i>	1,340 to 1,705 people
<i>ADWF (peak population)</i>	380 to 422m ³ /day

Table 3.4a
ESTIMATED POPULATION AND WASTEWATER FLOWS FROM
EXISTING/CONSENTED/FUTURE DEVELOPMENT FROM
CARDRONA VILLAGE

DATE: 18-Nov-11
CALCS BY: NR/BC

Reference	Existing / Consented/ Future Development	Units	Total Amount	Bedrooms per unit	Occupancy	Peak Population (Residents and Overnight Visitors)	Flow allowance (l/person/day)	Future (Total) ADWF (m ³ /day)	Existing Flow (m ³ /day)	Additional Consented Development Flows (m ³ /day)
Developments within the Rural Visitor Zone										
Cardrona Developments Ltd (#4)	50% Extg, 50% Future	No.	24	2	4	96	240	23.04	12.00	
Prassinos (#24) (0.40 ha) Recently Sold	Future	No.	14	2	4	56	240	13.44		
Prassinos (#12) (0.45 ha) Recently Sold	Future	No.	16	2	4	64	240	15.36		
Benbrae Villas (#6)		No.	-							
Studio	60% Existing	No.	30	1	2	60	240	14.40	7.00	
2 Bedroom Villa	60% Existing	No.	20	2	4	80	240	19.20	12.00	
3 Bedroom Villa	60% Existing	No.	20	3	5	100	240	24.00	16.00	
Bar	Existing	Diners	12				30	0.36	0.36	
Chinese Titles (#25,23,13,20&14)	Future	No.	9	4	6	54	240	12.96		
Cardrona Hotel (#8)			-							
Rooms	Existing	No.	20		2	40	240	9.60	9.60	
Reception Rooms	Existing	No.	1				30	0.03	0.03	
Restaurant	Existing	Diners	100				30	3.00	3.00	
Resident Staff	Existing	No.	4			4	240	0.96	0.96	
#15	Future	No.	4	4	6	12	240	5.76		
Cardrona Chalets (#5 & 3)	Existing	No.	6	2	4	24	240	5.76	5.76	
Prassinos (#10) (0.45 ha) Recently Sold	Future	No.	16	2	4	64	240	15.36		
GLDC (#17)			-							
Hall	Existing	No.	100				30	3.00	3.00	
Public toilet	Existing	No.	100				30	3.00	3.00	
Public Trust (#16)- Recently sold	Future	No.	6	2	4	24	240	2.88		
Mt Cardrona Station (#7)- Recently sold	Future	No.	18	2	4	72	240	17.28		
#11	Existing	No.	1	4	6	6	240	1.44	1.44	
#22	Existing	No.	1	4	6	6	240	1.44	1.44	
Brooklynne Holdings (#2&18)			-							
4 Bedroom Units	Consented	No.	28	4	6	168	240	40.32		40.32
Riverside Lodge			-							
2 Bedroom	Consented	No.	11	2	4	44	240	10.56		10.56
3 Bedroom	Consented	No.	13	3	5	65	240	15.60		15.60
4 Bedroom	Consented	No.	27	4	6	162	240	38.88		38.88
Lodge			-							
Rooms	Consented	No.	38		2	76	240	18.24		18.24
Reception Rooms	Consented	No.	2				30	0.06		0.06
Restaurant	Consented	Diners	50				30	1.50		1.50
Resident Staff	Consented	No.	4			4	240	0.96		0.96
Backpackers			-							
Guests and staff	Consented	beds	58		1	58	240	13.92		13.92
Reception Rooms	Consented	No.	1				30	0.03		0.03
Shop	Consented	No.	1				10	0.01		0.01
Cafe and Bar			-							
Diners	Existing	No.	60				30	1.80		1.80
Cardrona Village South and Soho St	Consented		-							
56 lots	45 Future	No.	56	4	5	280	240	67.20		15.84
#18	Existing	No.	1	4	6	6	240	1.44	1.44	
#1	Future	No.	1	4	6	6	240	1.44		
#19	Existing	No.	1	4	6	6	240	1.44	1.44	
#21	Future	No.	1	4	6	6	240	1.44		
#26	Existing	No.	1	4	6	6	240	1.44	1.44	
Developments outside the Rural Visitor Zone										
Miner's Rise	Consented	No.	6	4	6	36	240	8.64	1.44	7.20
Cardrona Vale Cottages	Consented	No.	5	2	4	20	240	4.80		4.80
			-							
TOTAL			-			1705		421.99	81.35	169.72

In addition to Cardrona Village's projected wastewater flows, consideration had also been given to Cardrona Alpine Resort connection into the Village's wastewater system. The peak flows for each stage of development allowing for Cardrona Alpine Resort are recorded in Table 3.4b as follows:

TABLE 3.4b

<u>Cardrona Village</u>	Peak Daily Flows (m³/day)
Existing development	81
Existing development plus consented development (not yet built)	251
Future total flows	422
<u>Cardrona Alpine Resort</u>	235

Refer to the Appendices for Spreadsheet of the above Cardrona Alpine Resort data (as provided by CPG Ltd)

Due to the Cardrona Alpine Resort providing an additional 55% of flows in addition to those that would be generated within the Village, and occurring concurrently with the Village's peak, it was determined that this could provide a restrictive impact to some of the options that were being considered within this study, in addition to a significant increase in the overall cost.

An existing pond at Cardrona Alpine Resort could potentially provide a buffer but this would provide storage for less than a 20 day period, and was not considered to be significantly sufficient to reduce the required treatment plant or dispersal areas as the peak demands would last longer than this duration during the winter periods.

Treatment and dispersal to the Scurr block may still be a potential option for the Cardrona Alpine Resort flows, but it is noted that there is a considerable distance of piped reticulation that would be required for this option which is likely to be economically unfeasible and is beyond the scope of this report.

4 EXISTING CARDRONA VILLAGE WASTEWATER SYSTEMS

The existing communal wastewater treatment and dispersal systems in the Cardrona Village consist of three different wastewater treatment plants. The largest of these is located at the newly developed Benbrae site, the second at the Cardrona Alpine Valley site (Phoenix 47) and a smaller plant that serves the Cardrona Hotel. A number of stand-alone septic systems for private dwellings are also present. Refer to Figure 4.1 for a plan of the existing Wastewater Treatment locations.

The Benbrae site, located on the western side of the Cardrona Valley Road, has an existing "Innoflow" packaged treatment plant system. This recently (2007) installed system, consisting of a re-circulating textile packed bed reactor (*rtPBR*) has been installed along with a sub-surface "drip irrigation" to disperse treated effluent to land above the Benbrae development. The "Land discharge Consent" (*No.2005:423_V1*) allows for up to $54\text{m}^3/\text{day}$ of treated effluent to be dispersed of here. Owned and operated by a private utilities company Knuckle Peak Services Ltd (KPS) this treatment system currently accepts up to $40\text{m}^3/\text{day}$ from the Benbrae Development, and due to its modular design, this plant could be expanded to accept greater incoming flows.

The Cardrona Alpine Valley Ltd (Phoenix 47) development, located at the southern end of the Village, has a Smith and Loveless "Fast" Reactor Treatment Plant which was installed in 2004. The *aerated fixed-film bioreactor plant* discharges treated effluent into dispersal trenches. The existing dispersal field currently has capacity for $20\text{m}^3/\text{day}$, but the treatment Plant has the capacity to accept in excess of $30\text{m}^3/\text{day}$. The "Land Discharge Consent" (*No.2003.923*) currently allows for dispersal of up to $20\text{m}^3/\text{day}$. The property and the plant is owned and operated by Baxter 2009 Ltd (Grant and Angela Railton). The Smith and Loveless Treatment plant and dispersal field can both be expanded to accept greater incoming flows.

The historic Cardrona Hotel (Complex Cardona Ltd) presently has a "Land Discharge Consent" which allows for up to $12\text{m}^3/\text{day}$. The exact treatment and dispersal details are not fully known,³ but the consent conditions require the system to be a secondary aerobic treatment system (either a reticulating sand filter or a single pass intermittent sand filter). The effluent is then to be pumped into two dispersal trenches (min 31 metres long, 700mm wide and 2.6m deep) under the car-park on the eastern side site of Cardrona Valley Road, opposite the Hotel.

4.1 WASTEWATER TREATMENT PLANTS

Refer to Figure 4.1 for a plan of the existing Wastewater Treatment Plants.

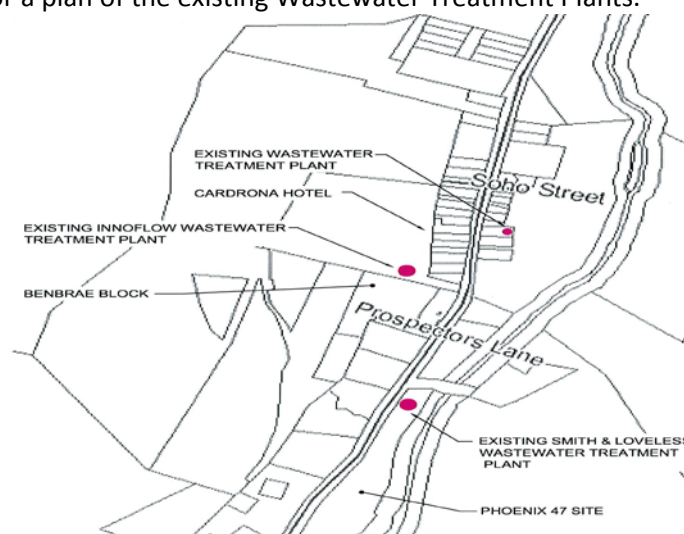


Figure 4.1- Cardrona Village Existing Communal Wastewater Plants

³-Information received from the Cardrona New Scheme Options Assessment Report - June 2008 (Connell Wagner)

5 ASSESSMENT OF PROPOSED LAND DISPERSAL SITES

5.1 POSSIBLE LAND DISPERSAL SITES

Six sites were initially identified as possible sites for the dispersal of wastewater from Cardona Village. The identified sites are as follows:

- The Benbrae site
- The Scurr site
- The Phoenix 47 site
- The Community Hall site
- The Pringle Creek Site
- The Mt Cardrona Station Site

Figure 5.1a below shows the first five land disposal sites by location, including approximate ground levels. Refer over page to Figure 5.1b for the Mt Cardrona Station site location.

A geotechnical investigation was undertaken (by Tonkin Taylor Ltd) for those sites for which no previous existing geotechnical information was available, to determine those sites' suitability for wastewater dispersal, as follows:

- The Phoenix 47 site
- The Community Hall site
- The Pringle Creek site

The Scurr site had previously been investigated also by Tonkin Taylor Ltd, for Brooklynne Holdings Ltd as a potential site in an earlier application which is currently on hold. The Benbrae and Mt Cardrona sites both had investigations completed as part of their wastewater discharge applications.

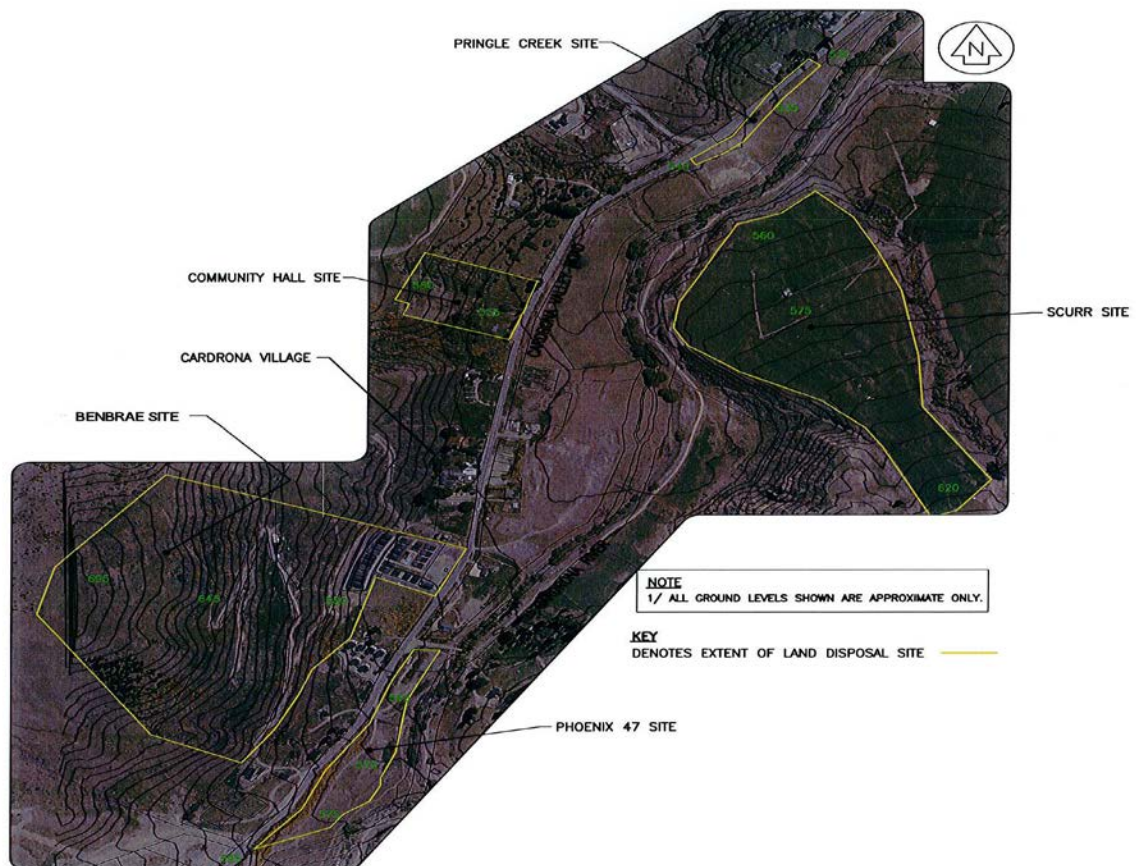


Figure 5.1a- Cardrona Village Dispersal Sites



Figure 5.1b –
Mt Cardrona Dispersal
Site

5.2 THE BENBRAE SITE

This site is owned by Cardrona Ltd and is located on the western side of the Cardrona Valley Road, approximately 100m to the south of the Cardrona Hotel.

As seen from the contours in Fig 5.1a and the photograph in Figure 5.2, the dispersal site is relatively steep. The range of elevation is in the vicinity of approximately 100m from the highest contours on the western boundary falling towards the eastern side of the property. Based on earlier investigation work undertaken for the existing discharge consent, the current dispersal area and the available extension of the field, consists mainly of silt/clay layers, with low permeability, that fall towards the village at relatively steep slopes.



Figure 5.2- Benbrae Site looking east to west

The investigation undertaken for the site and included within the application and the wastewater discharge consent allows for a maximum of 3.6mm/day through drip irrigation as per *ORC Consent No 2005.423V1* (refer to appendices).

The allowable wastewater application rate is considered to be too low for a viable extension of the system to provide for the full development of the Cardrona Village. There is also some negative public perception of this dispersal and treatment site due to its gradient sloping towards the village, and the treatment plant and dispersal field locations adjacent to the community water storage tank, and Benbrae's own water bore. However, given the investment that has been made in this system,

the type of ownership and management of the system, and continuing compliance with the conditions of consent, such that there are no actual environmental concerns, there may be no reason for the Benbrae system, to connect to a community scheme, and the Benbrae system could continue to operate as an independent system. If this occurs, the future total flows required for the community scheme would be reduced from 420m³/day to 350m³/day.

5.3 THE SCURR SITE

This large site is owned by the Scurr Family (Tim and Cathy Scurr) and is located on the eastern side of the Cardrona Valley Road, on the northern outskirts of the Village.

This is an exposed pastured site, with a gentle to moderate slope, elevated 20m-30m above the Cardrona River, and is currently being used for grazing purposes only.



Figure 5.3- Scurr Site

The Scurr Block is currently irrigated with surface water from a small tributary of the Cardrona River, adjacent to the site, for pasture for stock grazing. The geology of the site comprises gravels, sand and silt layers. Following on from an assessment earlier prepared for Brooklynne Holdings Ltd by Tonkin and Taylor, the Long Term Acceptance Rate (LTAR) for this site has been assessed as 10mm/day (T&T No.892431- Nov11). There is approximately 10ha of gross land area available at the Scurr Block, with the potential for further extension if required.

5.4 THE PHOENIX 47 SITE

The Phoenix 47 site is located in the Cardrona Village, on the eastern side of the Cardrona Valley Road at the southern end of the village

The 2 ha flat site is located adjacent to the Cardona River, but is also reasonably exposed to sun and wind. The site assessment undertaken as part of this investigation determines that the ground profile consists of river gravels and sands with silt inclusions.



Figure 5.4- Phoenix 47 Site- L/H from Southern end, R/H from Northern end

Tonkin and Taylor (T&T No.892431- Nov11) have assessed a long term application rate (LTAR) of 35mm/day for the Phoenix 47 site. This is consistent with the existing wastewater dispersal consent for the site (consent number 2003.923, refer to Appendices), which allows for up to 35mm/day to be applied.

5.5 THE COMMUNITY HALL SITE

The Community Hall site is owned by QLDC and is located on the western side of the Cardrona Valley Road, on the outskirts of the northern end of the Village.

This 2 ha site contains moderate to steep terrain, and Tonkin and Taylor's Site Assessment indicates that the ground consists of silty, sandy gravelly layers which slope towards the flat plateau area that contains the hall and the public toilets. Due to the orientation of the layers, and in particular the low permeability silty layers, falling towards the public grounds around the hall and the public toilets, which would result in breakout of the flows over this area, the site is considered to be unsuitable.



Figure 5.5- Community Hall Site

5.6 THE PRINGLES CREEK ROAD SITE

The Pringles Creek Road site, which consists of a section of legal road reserve is owned by the QLDC and is located on the eastern side of the Cardrona Valley Road, approximately 1km north of the village.

This is a small (0.5 ha) site, which according to Tonkin and Taylor's Site Assessment consists of silty, sandy, gravel layers. Extension of this site into the neighbouring property would provide additional area, however most of this additionally available land would be within the floodplain of the Cardrona River as defined on the ORC's flood hazard maps. This site is therefore considered to be unsuitable.



Figure 5.6- Pringle Creek Road site

5.7 THE MT CARDRONA STATION SITE

This site is located approximately 2.5km to the north-east of the Cardrona Valley Township along the Cardrona Valley Road.

The 12 ha site, consisting of a majority of flat topography with some gentle undulations, does however slope sharply down to the valley floor and Cardrona River on the east bank. The site is located in the north facing valley which maximises its sunshine hours. The site is currently vegetated with pasture and grazed by sheep. Following site assessment within the consent application, it was determined that the ground consists of clayey, sandy silts with fine gravels. A maximum loading of $4\ 2164\text{m}^3/\text{day}$ based on a maximum loading rate of 20mm/day with an average of 10mm/day has been approved by the Discharge Permit from Otago Regional Council.



Figure 5.7- The Mt Cardrona Station Site

⁴ As stated in Discharge Consent (2009.221)

6 EVALUATION OF EXISTING CONSENTS

For the purpose of this report, five relevant existing Otago Regional Council “Discharge Permit” Resource Consents and/or applications have been evaluated.

Table 6.1- Current Wastewater Consents			
Property (Consent/ Consent Holder)	Location of Treatment Plant from Cardrona Hotel	Amount m³/day	Expiry Date
Benbrae Development (Knuckle Peak Services)	100m south	54	2020
Phoenix 47 (Grant - Angela Railton)	300m south	20	2019
Scurr Site (Brooklynne Holdings) (Application Only- On hold)	400m north east	130	Not issued
Complex Cardrona Ltd (Cardrona Hotel)	20m east	12	2020
Mount Cardrona Station Ltd (Consent only - not constructed)	2.5km north	2,164	2045

On evaluation of the above consents listed in Table 6.1, some key points and conditions of the consents are listed as follows:

Benbrae Site (ORC Consent No.2005.423V1)

- *Condition 17- “Should a reticulated wastewater system become available in the future, the consent holder shall undertake to connect the on-site wastewater treatment system to the reticulated system within 12 months of any such system becoming available”.*

Mt Cardrona Station (ORC Consent No.2009.348)

- *This Consent allows for up to 2164m³/day of land disposal which allows for both the development of Mt Cardrona Station and Cardrona Village.*
- *An activated sludge treatment is proposed to be used for secondary treatment.*
- *A sub surface dripper system is to be installed at 150mm below the surface for effluent land disposal.*
- *The Land Dispersal will be developed in stages and expanded as demand increases.*
- *The Land Dispersal is proposed to be managed as a “Cut and Carry” system.*

Phoenix 47 Site (ORC Consent No.2003.923)

- *The current dispersal system at the site shall comprise as the minimum an aerated submerged media Wastewater Plant*
- *12 disposal trenches. 0.6m wide and 30m long, spaced 1m apart.*

Copies of the above Consents are found in the Appendices

7 LAND DISPERSAL METHODS AND EFFLUENT QUALITY

7.1 LAND DISPOSAL METHODS

Three dispersal methods are evaluated within this report as options for the sites that have been considered as potentially suitable for a public or community wastewater scheme;

- Slow Rate Irrigation (SRI)
- Rapid Infiltration (RI)
- Pressure Compensated Dripper Irrigation (PCDI).

Slow Rate Irrigation (SRI)

Slow rate irrigation systems are conventional irrigation systems where a crop is grown with options based on either a deficit irrigation regime, or otherwise at a set applied daily amount, based on soil type, the crops grown and the use of the crop.

A Deficit Irrigation Scheme

A deficit irrigation scheme applies treated wastewater only at the rate that the vegetation (grass or trees) can take up the wastewater and the nutrients within the wastewater. In theory, there is no effect on the groundwater levels or quality as all the applied treated wastewater is used by the vegetation. The vegetation takes up the nitrogen components and the soil binds the phosphorous from the applied wastewater. This scheme provides very high environmental results from effluent that does not require a high level of process treatment but requires large land areas for the wastewater dispersal stage of the treatment cycle. A high order investigation indicates that a minimum of 15 ha or more of net irrigable land would be required for SRI (deficit irrigation scheme), to be considered as an option for Cardrona Village. As there is very limited grass growth over the winter season, significant storage would also be required to hold these flows and release them during the months when growth occurs, such that application rates may range from 0-3mm/day.

An Irrigation to Excess Scheme - "Cut and Carry" or non-deficit irrigation

A second option within SRI is that the treated wastewater is applied on an "irrigation to excess" scheme otherwise known as "cut and carry" basis where wastewater is applied to aid pasture growth, but it is often applied with some excess, beyond the plants' capacity for use. This method requires the biomass that is produced on the site to be cut and taken away from the area, thereby removing the nutrients with it, hence "cut and carry".

The wastewater needs to be treated to a higher quality than a deficit irrigation scheme before it is applied to the soil, as the soil treatment will not be as effective as a deficit irrigation scheme. Compared to a deficit irrigation scheme, more wastewater can be applied to the land, or else requires less land for dispersal of the same volume. Application rates at Cardrona may vary from 3-10mm/day.

Rapid Infiltration (RI)

RI is where treated wastewater is applied at a high loading rate to the soil, and it quickly filters through the soil into the groundwater and through to the river. There is less nitrogen uptake or retention in the soils and therefore this system requires a high level of treatment at the treatment plant stage to process and provide the same environmental control levels as the SRI options above. The RI scheme is considered to be a suitable possible option for the Phoenix 47 site due to the site's soil type but would require further specific hydrogeological assessment at the next level of investigation or at the design/consent stage to confirm this method's acceptability for this site. Nitrogen loading would need to be removed at the treatment plant stage to a high level to meet any imposed conditions of the consent. Application rates can be greater than 50mm/day.

Pressure Compensated Dripper Irrigation (PCDI)

The pressure compensated dripper irrigation (PCDI) method uses small diameter piping including pressure compensating emitters, to discharge effluent at a given flow rate. The emitters can be either placed sub surface or above ground, this is dependent on the soil type and terrain and the emitters allow for the same volume of treated effluent to be discharged from each emitter even where the lines are not installed level. The lines are pressured by a pump to achieve the flow required to operate the emitters. High levels of treatment are required for the successful operation of the emitters. Application rates are variable for this method, but for the sites considered at Cardrona, would range from 3mm-35mm/day.

7.2 PREDICTED TREATMENT AND STORAGE

The effluent quality that would be required to be obtained by the treatment plant is determined by the choice of dispersal method. The following median effluent quality has been assumed at this stage based upon PDP's experience but would be subject to further assessment at the next level of investigation and to meet the Regional Council's requirements.

Table 7.2: Effluent Quality

Dispersal Method	BOD	TSS	TN	NH₄-N	TP	E Coli
SRI – Deficit	<70	<70	50	10	10	no limit
SRI – Cut and Carry	<70	<70	20	10	10	<1000
RI	15	15	10	3	10	100
PCDI	15	15	10	3	10	100

Note: all g/m³ except E Coli which is cfu/100mL

As can be seen from the above Table 7.2, a much higher quality of effluent would be required for rapid infiltration dispersal or for PCDI than for the SRI options. These options would most likely utilise a Packed Bed Reactor PBR (recirculating sand filter, recirculating textile filter, single press intermittent filter) such as the existing "Innoflow" system at Benbrae or the "Smith and Loveless" "Fast" reactor system at the Phoenix 47 site. UV treatment could also be required, particularly for an RI system, so that all pathogens are removed prior to ground dispersal.

A sequencing batch reactor (SBR) could also be an option as they are very effective in the reduction of the BOD₅ and nitrogen levels. UV disinfection may also be required with this option to remove bacteria. A SBR is a staged activated sludge treatment plant, with a fill, aerate, settle and decant cycle, which reduces the land requirements for a clarifier or separate nitrogen removal ponds. This option could also be suitable for the SRI "irrigation to excess" option. However, these plants can require higher maintenance than other options, and OLDC has experienced problems with such a system in Wanaka, and has expressed their concern for this type of plant in a more remote location such as Cardrona.

A deficit irrigation scheme would not require such a high quality effluent. It is likely that an activated sludge plant or aerated lagoon would be suitable for the deficit scheme SRI.

The existing on site systems (Smith and Loveless at the Phoenix 47 site or Innoflow system at the Benbrae site) could be suitable and expanded to form part of the new treatment system, for each of the dispersal methods.

7.3 SITE ASSESSMENT FOR TREATMENT AND DISPERSAL

Following Assessment of the above land dispersal methods and land dispersal sites, three sites were considered suitable for possible further evaluation.

The Phoenix 47 Block

This 2 ha site is considered to be potentially suited for a rapid infiltration type system, or a PCDI system, due to the high permeability of the soils. This site may not be suitable for an SRI dispersal

system because the land area is too small and the grass growth rate over winter when the highest loading would be applied is considered to be too low to effectively remove the levels of nitrogen that would be required to operate as an SRI system. Significant storage volumes would also be required as a result of the above factors.

The 35mm/day loading rate and Type 2 soils (in accordance with AS:NZ 1547:2000) as determined by the Tonkin and Taylor report would require an area of 1.3 ha for the PCDI system at the full extent of future development.

Due to the proximity of the river, and the reduced treatment that would occur through the soils at the high loading rates, a high level of treatment is required to avoid causing a nitrogen problem in the river. This system could therefore also be augmented with a “cut and carry” type overlay which would assist nitrogen removal, particularly over the summer months when eutrophication of the stream is more likely. The population will be less over summer and reduced loading rates can be applied so that the system could effectively operate as an SRI system over this time.

An SBR reactor with a filter and UV disinfection unit may however be required as part of the treatment process, in order to reduce the total nitrogen and the faecal coliforms to levels acceptable to ORC.

Further hydrogeological assessment of the proposed area (including piezometer installation and field permeability and infiltration tests and hydrogeological modelling) would be required to confirm the feasibility of each of these options on this site.

The Scurr Block

The Scurr block is not considered to be suitable for a RI system, because a high loading rate is not recommended due to the slope stability of the 20m escarpment below the site. A deficit irrigation scheme is also not considered to be viable as the large area of land required and the costs of the irrigation are considered to be too large to make this a viable option. However, this site is suitable for an irrigation to excess “cut and carry” scheme. Approximately 8 Ha of the 10 ha is available for dispersal, taking into account the required setback distances of the land, from the edge of the embankment surrounding this site, and would be sufficient to operate as an effective SRI system.

Tonkin and Taylor recommends a LTAR for the Scurr site of 10mm/day. This rate takes into consideration the large scale land application of this option, however, further hydrogeological assessment may be required to confirm that this rate is suitable. Storage will also be required within the treatment plant (not necessarily as a stand-alone storage pond) so that the flows can be stored for those periods when the ground is covered in snow and is not suitable for SRI.

The Mt Cardrona Station Site

The Mt Cardrona Station Site Consent states that the treated effluent will be discharged to 12 ha of land by sub-surface irrigation. The drippers will have an average discharge capacity of 2mm/hr. The applicant proposes to divide the area into four irrigation blocks and to irrigate these blocks typically up to 5 hours each day, therefore at an average loading of 10mm/day but at a maximum of up to 20mm/day during peak demand. The land disposal will be developed in stages and expanded as the wastewater volumes increase.

The dispersal method chosen here by the applicant would also utilise the “cut and carry” system. The grass would be grown and regularly harvested (two to four cuts per year) to increase the removal of nutrients, and the extent of nitrogen removal is to be closely monitored by the conditions of consent.

The Applicant has chosen to use an activated sludge system. This system uses air and biological processes to reduce contaminants load in wastewater. The activated sludge system may also be configured as part of a SBR or membrane bioreactor. UV treatment may also be added if required.

7.4 OTAGO REGIONAL COUNCIL CONCERNS

In order to understand the environmental concerns that Otago Regional Council holds with the discharge of effluent in the Cardrona Village area, a discussion has been held with the Director of C:\Users\Saraht\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Outlook\S6MG1I0P\11118-02 QLDC Report (3).Docx - Appendices

Resource Management, Dr Selva Selvarajah. Dr Selvarajah is familiar with the water quality issues in the area and the sensitive environmental nature of the Cardrona River. Dr Selvarajah has advised that the river is nitrogen limited and the river has a very low summer flow which makes it very sensitive to eutrophication if excess nitrogen enters the river. Dr Selvarajah has also advised that phosphorous is not a significant issue for this catchment. As a result, ORC's main concern is around preventing excess nitrogen entering the river and so any wastewater treatment system and dispersal system must be designed accordingly, to significantly remove nitrogen from the effluent.

In line with this, an SRI system which discharges in accordance with a deficit irrigation regime (thereby removing nitrogen from the irrigated land) would therefore be a preferred option, for the Regional Council.

A rapid infiltration (RI) or PCDI system would require a high level of treatment to be provided at the wastewater plant and further investigation and consultation with ORC would need to be undertaken to confirm the final design and consent requirements.

The Mt Cardrona Station Consent already allows for the wastewater loading from the Cardrona Village and therefore any future consent application for the Village alone can allow for the fact that the overall model for nitrogen loading and other nutrients already includes the full Village loading to the Cardrona River.

7.5 OPTIONS REQUIRED

Table 8.3 tabulates the land areas, treatment plant volumes and storage pond volumes that were considered for each of the dispersal methods to the Phoenix 47 and Scurr blocks.

Table 8.3: Requirements for each Land Dispersal method						
	2011 consented developments (250m³/day)			Total Future Development (420m³/day)		
Dispersal Method	Irrigable Land Required (ha)	Treatment Plant Volume (m³)	Storage Volume (m³)	Irrigable Land Required (ha)	Treatment Plant Volume (m³)	Storage Volume (m³)
SRI – Deficit (Scurr)	15	4,000	35,000	30	7,000	60,000
SRI – Irrigation to Excess (Scurr)	8	250	1,000	8	420	1,800
RI (Phoenix 47)	0.25	250	0	0.5	420	0
PCDI (Phoenix 47)	0.75	250	0	1.3	420	0
<i>Note: land areas are net irrigable areas. Gross land requirements would likely be 20% higher.</i>						

8.0 DESIGN OPTIONS- WASTEWATER TREATMENT AND DISPERSAL

8.1 OPTION 1- PHOENIX 47

The Phoenix 47 site has an existing discharge consent for up to 20m³/day. A new consent would be required for the projected winter flows of up to 420m³/day. (Refer to appendices for an overview of the existing plant).

A new wastewater treatment plant would be required for this site to either replace or supplement the existing Smith and Loveless wastewater treatment plant that has capacity for approximately 35m³/day.

A wastewater reticulation system would be required as per all the options, but due to the location of the Phoenix 47 site a relatively small pump station in the Village or otherwise, a pressure sewer system, would be required to deliver wastewater to the treatment site.

Advantages

- A wastewater treatment plant and dispersal system is already located on site.
- Power accessible at site.
- Due to the proximity to town, only a small pumped delivery system is required.
- Potential to expand the existing treatment plant and dispersal system.
- Cheapest cost option.

Disadvantages

- Close proximity to the Cardrona River, which may require higher environmental controls.
- Possible hydrogeological issues which need further investigation, prior to confirmation of the site's suitability for RI.
- Small sized block with limited opportunity for expansion if required.

8.2 OPTION 2- SCURR BLOCK

The Scurr Block is also a suitable option for the Cardrona Village wastewater treatment plant, with the principal benefit being that it has some separation from the Cardrona River and has a large available land area.

An "irrigation to excess" system would be the best use of the site, as it provides a high level of overall treatment, and could specifically be designed to maximize nitrogen removal.

A reticulation system would be required to the site which is located approximately 0.5km from the Village. In addition, the pipe would need to cross under the Cardrona River, and larger pumps and associated running costs would be required for the operation of this system.

Advantages

- Large site available.
- Located on the outskirts of town.
- Opportunity for expansion with more land nearby if necessary.

Disadvantages

- Large area of disposal field required.
- More wastewater reticulation required.
- Pipe required to cross under the Cardrona River.
- More expensive option than Option 1.

8.3 OPTION 3- MT CARDRONA STATION

A third option is the proposed Mt Cardrona Station wastewater treatment plant and disposal facility. This scheme has already obtained consent for up to $2164m^3/day$ of land dispersal. The consented method of land dispersal is the irrigation to excess "cut and carry" system. The dispersal site will be done in stages, and can be expanded as the population increases.

If this was to serve the Cardrona Village, a 2.5km gravity pipeline would be required to access this. Recently MCS was put on the market, and uncertainty stands with this option, with regard to the timing of the development of the MCSSZ and therefore the construction of the treatment plant.

Advantages

- Large site available.
- Already holds discharge to land consent.
- Located out of town.
- Could serve all of the Cardrona development.
- Potential to add in Cardrona Ski Mountain flows at a later date.
- System can expand as village grows.

Disadvantages

- Uncertainty about the viability and/or timing of construction of this scheme.
- Requires significant reticulation and pumping to get the wastewater from the Village to the site for treatment.
- The most expensive option for the Village alone.

9. PROJECT RISKS

The preliminary risk assessment to the three options has been assessed as shown in table 9.1.

Table 9.1- Wastewater Treatment and Dispersal Risks					
Risk	Category	<u>Option 1</u> Phoenix 47	<u>Option 2</u> Scurr Block	<u>Option 3</u> Mt Cardrona Station	Mitigation Measures
Financial risk to QLDC	Financial	Low	Med	High	Due to the larger site at the MCS, this is seen as a bigger financial outlay initially between the QLDC and the developers. The land is presently up for sale.
Land availability	Financial	Med	Med	Med	The MCS land is up for sale. No contact with other owners has been made.
Geotechnical/ Construction	Environmental	Low	Med	Mid	The elevated location of this Scurr site to the Cardrona River is seen as a medium risk. Correct buffering of this would be required if construction took place.
Project Consents	Environmental	Med	Med	Low	If either of the Phoenix 47 or Scurr site went ahead new discharge consent would be required. Appropriate application and consultation would be required prior.
Koiwi/ archaeological finds	Environmental	Low	Low	Low	There are no known sites of any value, so risks are deemed low.
Contamination of Groundwater of uncontrolled discharge	Environmental	Med	Low	Low	During construction of the new reticulation system in the village, some risks would be present with cutting into and connecting to live existing systems.
Visual Impact	Environmental	Low	Med	Med	Both the Scurr and MCS are open sites, therefore some visual impact would be found. This could be mitigated using plant screening of some sort.
Odour	Environmental	Med	Low	Low	Odour would need to be controlled at the Phoenix 47 site. Mitigation measures include ventilation, filtration etc.
Population growth predictions	Technical	Med	Med	Med	The population predictions based in this report has been based on available knowledge on the levels of consented and future of development. The town planning controls in the District Plan are not prescriptive and some variation could occur.

10 CONCLUSIONS AND RECOMMENDATION

The Phoenix 47 site is our recommended site for further investigation to confirm that it would be the preferred wastewater treatment and land dispersal site for the Cardrona Village. Rapid infiltration or pressure compensating dripper irrigation would need to be confirmed as an appropriate dispersal method to meet the necessary environmental controls following further hydrogeological testing and consultation with ORC.

Currently this 2 ha site only has a discharge consent for up to 20m³/day with a Smith and Loveless FAST plant and a new treatment plant dispersal field, and consent would be required for the projected winter flows of up to 420m³/day.

There are a number of advantages with choosing the Phoenix 47 site, and these include the facts that there is already a wastewater treatment plant on site which can be readily expanded, the site is close to the town and it would provide the cheapest option for either a public or community system to serve the Village.

The Scurr Site would be the second favoured site for further investigation, if the Phoenix 47 Site is determined to be unsuitable due to potential setback issues related to its close proximity to the river, or is unable to meet the required environmental levels, particularly for nitrogen loading. The Scurr Site has a much larger area for various options of dispersal, and a greater separation from the Cardrona River, and would be suitable for an SRI system, but would be significantly more expensive than the Phoenix 47 site.

The Mt Cardrona Station Site would be the most expensive option for the Cardrona Village wastewater treatment and dispersal and is currently on the market so its viability is uncertain at this time.

APPENDIX A- DRAWINGS

- Benbrae "Innoflow" Treatment Plant
- Phoenix 47 "Smith & Loveless" Treatment Plant drawing.
- Rapid Infiltration Sketch

APPENDIX B- DATA

- Cardrona Ski Fields Wastewater spreadsheet
- Smith & Loveless "Fast" Modular Treatment Plant Overview Sheet
- Smith & Loveless "Fast" Project Example. *Approx. cost in 2008 for 650m³/day plant= \$2m*
- Phoenix 47 & Scurr Block Geotechnical Information

APPENDIX C- CONSENTS

- Mt Cardrona Station Discharge Consents
- Phoenix 47 Discharge Consent
- Benbrae Discharge Consent