Farm Environmental Management Plan: Otamatapaio Station, Omarama.

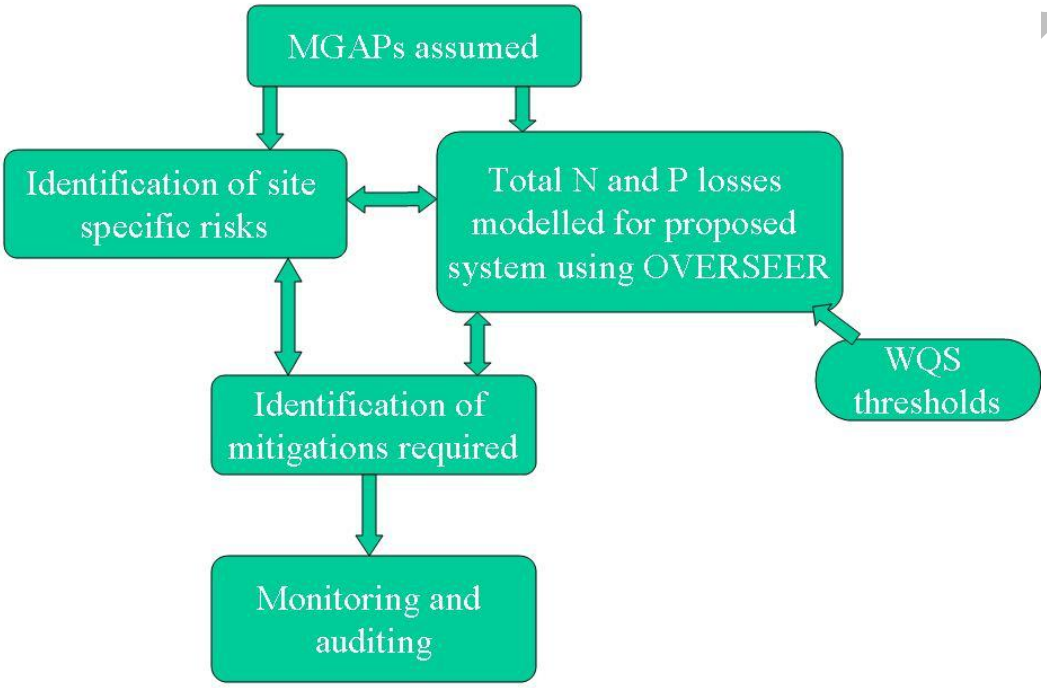
1. Introduction

The Water Quality Study ('WQS') funded by Mackenzie Water Research Limited ('MWRL'), found that the additional irrigation proposed in the catchment could take place without significant adverse effects on the environment providing that nutrient reduction occurred on the farms.

The process that was advocated for ensuring this on-farm nutrient reduction was through Farm Environmental Management Planing. A clear process for building a Farm Environmental Management Plan (FEMP) was laid out in the Water Quality Study and has been followed here. An overview schematic of the process of building a FEMP is shown in Figure 1.

The responsibility of the implementation, monitoring and auditing of the plan lies with the **farmer**.

Figure 1: Overview schematic of the process to build a Farm Environmental Management Plan



MGAP – Mandatory good agricultural practices

2. Farm Description

2.1 General farm description

Otamatapaio (5568 ha's) and Glenburn (1164 ha's) are two freehold properties run in conjunction by the company Otamatapaio Station Ltd.

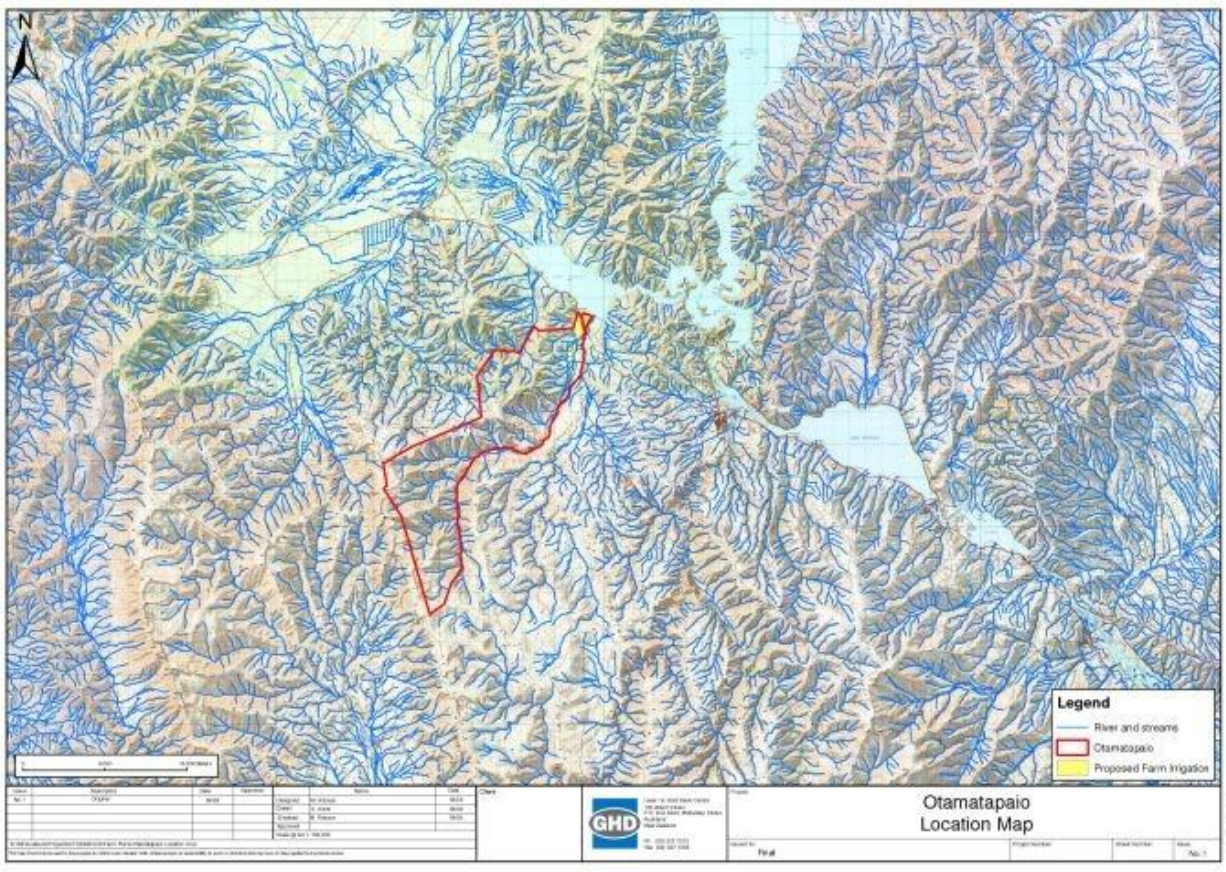
Otamatapaio is positioned 12 km from Omarama, 10 km from Otematata, on State Highway 83, boundarying Lake Benmore Ahuriri arm, which is a popular summer holiday area.

The property is well balanced, from High country extensive grazing area to intensive irrigated pastures, swamp areas and low lying dryland fans. It is well positioned with some of the extensive country receiving southerly rains, most rain generally from the nor-west. Under current management the property is running 12,000 stock units comprising of fine merino sheep and beef cattle.

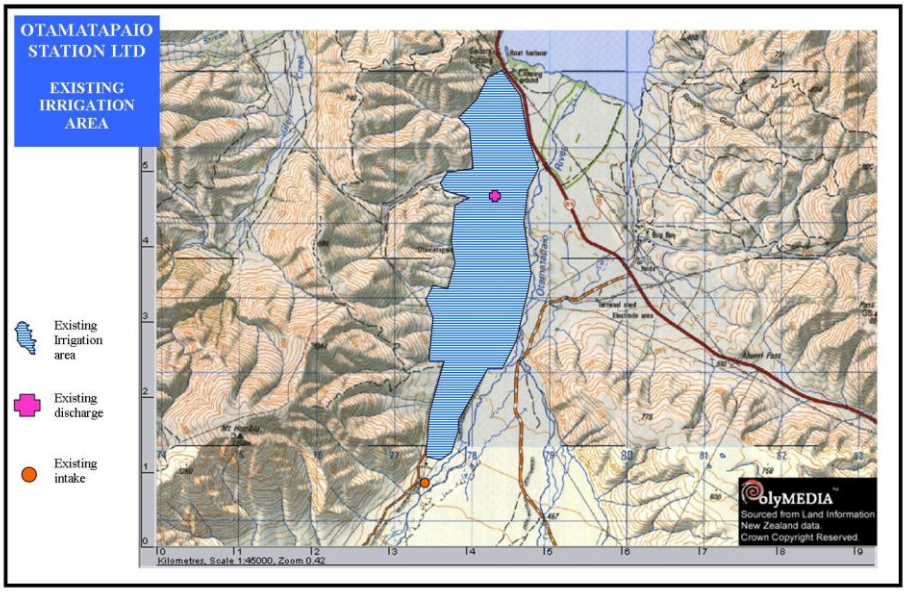
Only the consents related to the Otamatapaio irrigation area are currently in the hearing process, the consent for Glenburn (CRC961829) expires in 2031.

The FEMP relates to both properties as they are run in conjunction.

Otamatapaio has applied for an additional consent to take and use water from Lake Benmore for the irrigation of additional land at both Glenburn and Otamatapaio (CRC021330). The hearing for this consent is currently adjourned. This additional irrigated land area has been modelled in Overseer.



Map A: Location map of Otamatapaio



Map B: Existing irrigation area at Otamatapaio

Table 1: Cover Utilisation by season and stock class for current system:

Cover Utilisation by season and stock class - current				
Class of stock	*Spring*	*Summer*	*Autumn*	*Winter*
Ewes: Mixed aged	Over sown mid Altitude country	Wean Feb: Summer grazing native high altitude country	April mustered off native, mid altitude high country	Supplement fed on lower paddocks, (property has high snow risk)
Older Ewes & 2ths	Lamb on swamp areas & dryland paddocks	Irrigation/swamp: Wean Feb.	Dryland Country	Irrigation
Wethers	Utilised to maintain growth lanes etc, used as management tool	Mid Dec: High Altitude country	Apr/May: Grazing mid altitude	Mid Altitude
Lambs/Hoggets	Irrigation	Weaned February: irrigation, dryland paddocks	Wether hoggets, hill country, ewe hoggets, irrigation/dryland paddocks	Irrigation
R2 Heifers	Calving Irrigation	Irrigation/Hill country	Hill country	Hill country
R2 Steers	Irrigation	Irrigation		
R1 Steers	Cows Calve mid October Hill country	On cows	On Cows	Irrigation

R1 Heifers	Cows Calve mid October Hill country	On cows	On cows	Irrigation
Bulls	Paddocks	Out with cows	Paddocks	Paddocks

Photo A: Existing border dyke irrigation at Otamatapaio

Photo B: Existing border dyke irrigation at Glenburn

2.2 Proposed Farming system with new irrigation areas:

Current irrigated area = approx 150 ha comprising of: 76 ha pivot

20 ha modern borders

40 ha old border system/wild flooding

Proposed redeveloped irrigation area would be 200 ha's, all spray irrigation.

There are currently 280 hectares of border dyke irrigation at Glenburn; with the conversion to spray this would increase to approximately 420 hectares.

Otamatapaio has applied for an additional consent to take and use water from Lake Benmore for the irrigation of an additional 120 hectares at Glenburn and 121 hectares at Otamatapaio.

Table 2. Cover Utilisation by season and stock class for proposed system:

Cover Utilisation by season and stock class - proposed				
Class of stock	*Spring*	*Summer*	*Autumn*	*Winter*
Ewes: Mixed Age	Over sown mid Altitude country	Wean Feb: Summer grazing native high altitude country	April mustered off native, mid altitude high country	Supplement fed on lower paddocks, (property has high snow risk)
Older ewes & 2ths	Lamb on swamp areas & dryland paddocks	Irrigation/swamp: Wean Feb.	Dryland country	Irrigation/Swamp
Wethers	Utilised to maintain growth lanes etc, used as management tool	Mid Dec: High Altitude country	Apr/May: Grazing mid altitude	Mid Altitude
Lambs/Hoggets	Irrigation	Weaned February: irrigation, dryland paddocks	Wether hoggets, hill country, ewe hoggets, irrigation/dryland paddocks	Irrigation
Cows	Calving: Hill country	Spread between irrigation/swamp & hill country	Spread between irrigation/swamp & hill country	Hill country
R2 Heifers	Calving Irrigation	Irrigation/Hill country	Hill country	Hill country
R2 Steers	Irrigation	Irrigation		
R1 Steers	Cows Calve mid October Hill country	On cows	On Cows	Irrigation
R1 Heifers	Cows Calve mid October Hill country	On cows	On cows	Irrigation
Bulls	Paddocks	Out with cows	Paddocks	Paddocks

2.3 Soils

Otamatapaio:

- The flats and fan terraces comprise of Grampian soil, fine sandy loam, medium to high fertility.
- Heavier Swampy flats are Dobson soils

- Lower tussock mid/higher tussock a mix of Waitaki, Omarama Benmore and Puketeraki soils.
- Higher altitude are Kaikouras silt and stony loams

Glenburn:

- Lighter flats Mackenzie shallow stony silt loams
- Swamp Dobson soils, high fertility
- Easy rolling hill country comprising of Grampian soils.

2.4 Topography

Otamatapaio/Glenburn ranges from approx 360 metres, Lake Benmore to 1370 metres at the highest point on the Hawkdun range.

Otamatapaio has a mix of west/east aspect while the flats are not influenced by aspect.

Property varies from extensive high country to rolling lowlands, down to alluvial fans that run into Lake Benmore, which are developed and subdivided into more intensely farmed areas.

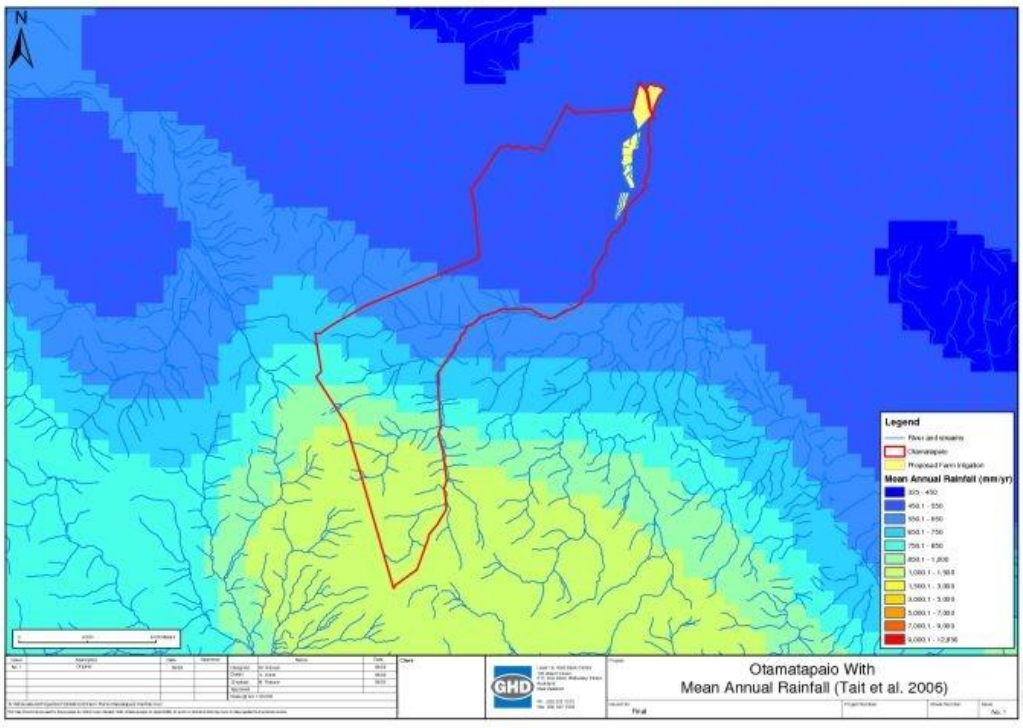
Generally the property has an excellent balance of winter/summer country greatly enhanced by its irrigated flats.

2.5 Climate

Rainfall varies annually from 350 mm/380mm on the front country (Glenburn) with a higher rainfall on the Otamatapaio alpine catchment which varies annually from 450mm to 500mm.

The property is exposed to strong northerly winds which bring hot dry summer conditions, but also brings northerly rains. Otamatapaio is often subjected to cold southerly conditions, which also brings in rain.

Otamatapaio can receive severe snow storms, three to four per annum with a 1 year in five severe snow, which can make the winter very long and cold, with heavy frosts.



Map C: Mean Annual rainfall data at Otamatapaio.

3. Environmental Context

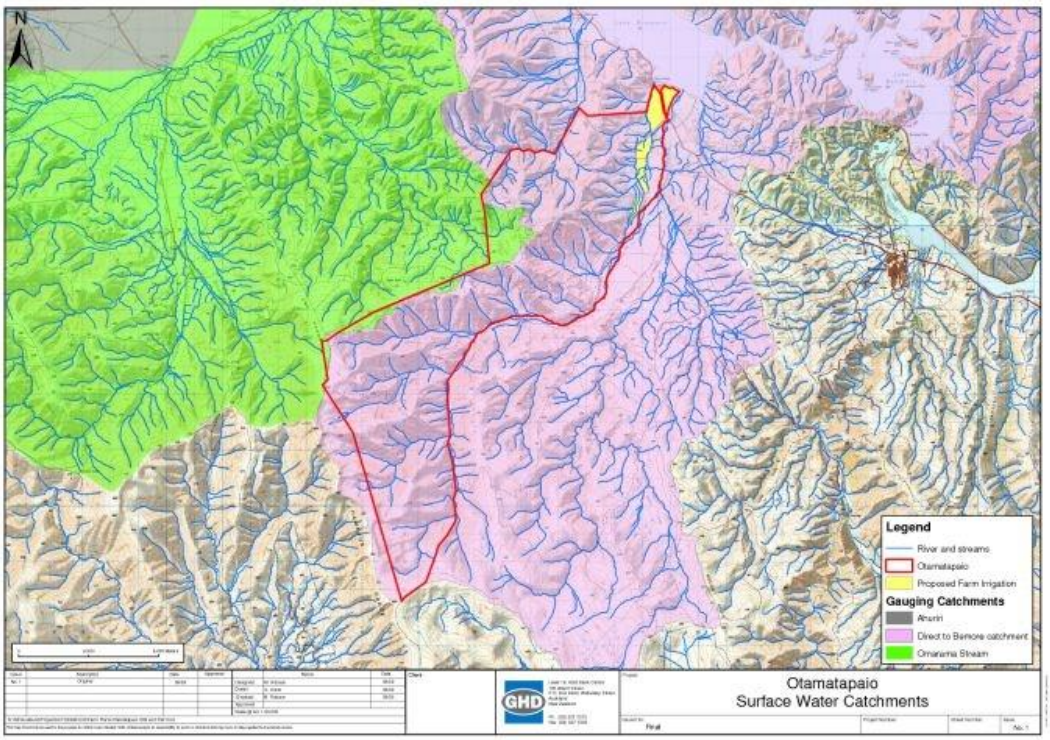
The environmental context of the farm is a reference both to local and wider receiving environments.

3.1 Water Quality Study receiving environments and mitigation requirements

Otamatapaio Station, according to the WQS, lies in the direct to Lake Benmore surface water catchments, with a small area of Omarama Stream surface water catchment.

Table 3 shows the calculated nutrient mitigation requirement of the receiving environments determined in the WQS and the resulting thresholds for N and P for Otamatapaio Station.

For this farm, the Lake Benmore mitigation requirements are the most stringent. These mitigation requirements cap Otamatapaio Station's nutrient discharges at 22466 kg N per annum and 588 kg P per annum.



Map D: Surface Water receiving environment

3.2 Local receiving environments

Otamatapaio Station local catchment is Lake Benmore. The water run off areas is fed to the Lake via a heavy swamp area below the irrigation, through to Clark Creek catchment.

Otamatapaio Station local receiving environments are the Otamatapaio River, Clark Creek, Otamatapaio Swamp and at Glenburn the Glenburn Swamp and Ahuriri River.

Both the swamp area and lower end of the Clark Creek, prior to it discharging into Lake Benmore can be developed in highly sustainable riparian margins to filter water before it enters into Lake Benmore.

The majority of the run-off water will have run via two riparian margins before entering Lake Benmore.

Table 3. Water Quality Study mitigation requirements for Otamatapaio Station

Stream mitigation required for periphyton kg/ha irrigated land		Secondary stream mitigation required for periphyton kg/ha irrigated land		Stream mitigation required for ANZECC kg/ha irrigated land		Secondary stream mitigation required for ANZECC kg/ha irrigated land		GWR mitigation required kg/ha irrigated land		Lake mitigation required kg/ha irrigated land	
N	P	N	P	N	P	N	P	N	P	N	P
										-10.70	-1.1

4. Farm Environmental Management Plan development

4.1 Stage 1 – Mandatory good agricultural practices

The table below shows the mandatory good agricultural practices that will be adopted. These include the base assumptions of OVERSEER and therefore help validate the use of the model on the farm.

Table 4. Mandatory good agricultural practices

Mandatory good agricultural practices	What these practices mean on farm
Fertilisers applied according to code of practice for fertiliser use	The fertiliser users' code of practice aims to ensure that where fertilisers are used that they are used safely, responsibly and effectively and in a way that avoids, remedies or mitigates any adverse environmental effects. The code of practice includes guidance on fertiliser use, application, storage, transport, handling and disposal.
Use a fertiliser recommendation system (nutrient budget) and account for all sources of nutrients including applied effluents and soil reservoirs accounted for	Planning fertiliser applications to all crops, determining crop requirement and accounting for soil nutrients and organic nutrient supplies, all reduce the risks of applying excessive fertiliser above the crop requirement. This maximises the economic return from the use of fertilisers and reduces the risk of causing nutrient pollution of the environment Accounting for all sources of nutrients including imported sources and soil reservoirs is an important management measure in all farming systems and become especially important on farms where manure is produced and applied to the land. The re-application of organic manures to land is often thought of as a disposal of a waste product, and the available nutrients within the organic manures are not accounted for. The use of an integrated nutrient budgeting tool such as OVERSEER automatically accounts for nutrients supplied in organic manures.
Fertiliser application applied evenly	The even application of fertiliser is an assumption of the OVERSEER model as included in the fertiliser code of practice. Fertiliser spreaders should be tested and calibrated in-house at least annually and every 5 years by an independent auditor.
Irrigation and effluent applied evenly	The even application of water and or effluent is an assumption of the OVERSEER model. Irrigators should be tested and calibrated in-house at least annually and then every 5 years in accordance with the code of practice for irrigation evaluation by a qualified irrigation auditor.
Crop, cultivation, nutrient inputs and yield records kept per farm management unit	Maintaining good crop input records is important for: • The calculation of cumulative annual organic fertiliser applications and also their contribution to long term nutrient supply; • The prediction of realistic crop yields that are used to determine crop requirements; • Providing accurate inputs to the OVERSEER nutrient budgeting model that is being used here as a proxy for measuring diffuse nutrient losses.

Good design of irrigation systems	Design will match soil properties and low application amounts on shallower soil to prevent summer drainage.
Robust irrigation scheduling	Good irrigation scheduling to prevent summer drainage.
Supplement and feeding out management	To be addressed in the Farm Environmental Risk Assessment.
Winter grazing management	To be addressed in the Farm Environmental Risk Assessment.

4.2 Stage 2 – OVERSEER and meeting WQS mitigation requirements

The WQS thresholds set for Otamatapaio Station using the most stringent nutrient mitigation requirement are 22466 N/year and 588 kg P/year. The table below shows the output from OVERSEER for the modelled proposed farming system at Otamatapaio Station. As can be seen with the existing borderdykes at Glenburn the modelled outputs exceed the threshold for P set out by the WQS. There are plans for the conversion of these borderdykes to spray which would see an additional 140 hectares of irrigation. This scenario has been modelled in Overseer and as can be seen below the modelled outputs are within the threshold for P and N.

Otamatapaio has applied for an additional consent to take and use water from Lake Benmore for the irrigation of an additional 120 hectares at Glenburn and 121 hectares at Otamatapaio. This additional irrigation area has been modelled in both Overseer files.

The results illustrate that all mitigations measures proposed including the conversion of borderdykes at Glenburn as modelled by OVERSEER are within the thresholds set out by the WQS.

Prior to the conversion of the borderdykes Otamatapaio are committed to reducing there P fertiliser use on the Glenburn borderdykes.

Management or mitigation strategies that have been used to meet this threshold are detailed in Section 5.

Table 5. Total N and P losses modelled by OVERSEER for the proposed farming system on Otamatapaio Station and WQS thresholds

	OVERSEER proposed modelled outputs kg/year with existing Glenburn borderdykes	**OVERSEER proposed modelled outputs kg/year with Glenburn borderdykes converted to spray**	**WQS threshold kg/year**
Total N leaching/runoff	17771	16993	22466
Total P leaching/runoff	891	312	588

4.3 Stage 3 – Identification and mitigation of site specific environmental risks

The Farm Environmental Risk Assessment FERA has been undertaken on the existing farming system at Otamatapaio and Glenburn and has highlighted potential soil, stock, water and track risks. These risks are described below. The full FERA is attached as Appendix A.

The FERA focused on the irrigation areas; existing or proposed and any intensively farmed areas in the farming system. This includes the existing borderdyke irrigation at Glenburn which is not part of the Upper Waitaki hearings.

Otamatapaio has applied for an additional consent to take and use water from Lake Benmore for the irrigation of land at both Glenburn and Otamatapaio. Some of the mitigation options discussed in Section 5 are related to this new development if the consents are granted.

4.3.1 Soil Risk

The risks associated with soil are that although wind erosion wasn't evident there is a potential vulnerability to wind erosion. The continuation of irrigation will ensure that ground cover levels are upheld and will reduce the risks associated with bare ground and wind erosion.

4.3.2 Stock risks

The risks associated with stock are that at present stock are not excluded from watercourse within the irrigation area.

4.3.3 Track risks

The risks associated with tracks are that the main track at Glenburn runs through a watercourse.

4.3.4 Water Risk

The risk associated with water is that stock are not restricted from entering all of the head races of the border dykes at Otamatapaio. Otamatapaio has a proposed conversion plan to convert to spray irrigation whereby the water flow in the headraces will cease to flow.

4.3.5 Site specific management measures and existing mitigation measures in place

1. At Glenburn any runoff from the border dykes is filtered through a large vegetated area prior to being discharged into the Ahuriri River (also see Map E)

Photo F: Showing the vegetated area that acts as a filter system for any run off

2. Fodder crops are grown as part of the pasture renewal process, ensuring that soil organic matter levels are not depleted in a few paddocks. Regrassing after winter grazed fodder crops will be at the earliest opportunity.
3. A contractor or approved handler if required is used to apply chemicals on the farm
4. Cultivation and Trafficking

Direct drilling is the primary method of establishing pasture. Inversion tillage is used if required to break in (cultivate for the first time) any new pastures and occasionally soil can be left bare over winter. Inversion tillage is used at the most appropriate time to reduce the potential effects of wind erosion

Stock are grazed over winter and trafficking of soils when wet does occur. Annual monitoring and identification of soil compaction and documented remedial actions taken will ensure any soil compaction due to stock grazing over winter is identified.

5. Compaction

Soil around water troughs is not compacted nor does pugging occur at present. If compaction does occur then this will be assessed during the annual soil compaction survey and remedial action taken if required.

6. Runoff

There is no evidence of track runoff entering a watercourse. This will be monitored as part of the annual track survey. Annual monitoring and identification of track runoff and documented remedial actions taken will ensure any track runoff entering a watercourse is identified.

7. Erosion

There is no evidence of stock induced bank side erosion in the Otamatapaio River. This will be monitored as part of an annual survey, as outlined in Table 8.

4.3.6 General issues on extensive high country farming systems

In extensive high country farming systems there are a number of issues that on more intensive farming systems would be assessed as being a risk to water quality but on extensive high country farming systems they have not been defined as a risk due to the extensive nature of the farming systems and the lower stocking rate per hectare. Some of these general issues have been identified below:

1. There will be areas within the farming system where tracks will cross waterways; these are tracks that are used irregularly, in extensive areas of the farm.
2. There are also areas within a high country farming system where stock will have unrestricted access to streams for crossings and stock water. This is essential access for stock movement and stock water. On most farms there are a number of small creeks/streams that flow within the hill country and it would be logistically impossible to place stock crossings on all of these. There is also the need for stock to move across streams/creeks within a block (paddock) for grazing access. A reticulated water system would be unsustainable in the hill country as troughs would freeze solid in the winter months, preventing access to fresh drinking water.
3. Swamps/heavy grounds are an integral area in a high country farming system; they provide a water source and good grazing for stock in dry years. In undertaking the FERA it has been identified that all swamps/heavy ground need to be monitored to ensure that bank erosion, compaction and pugging does not occur.
4. Wind erosion is a significant issue in the upper Waitaki Catchment. The sparse vegetation on large areas of land in the Mackenzie Basin gives little protection to the shallow, friable soils which continue to be eroded by frost heave and westerly winds. A mean soil loss of 0.22 mm/year or 2.2 tonnes of soil lost per hectare across a number of sites within the Mackenzie Basin has been reported. While it cannot be assumed from this information that erosion rates will continue at this level in the future, the results do confirm a strong relationship between the percentage of vegetation cover and erosion risk. The problem of bare ground and exposure to wind erosion has been compounded since the early 1990s by the rapid spread of hieracium particularly on the poorest soils. One of the most significant impacts of further irrigation in this area would be a reduction in the amount of bare ground and

corresponding reduction in wind erosion risk. (*Environmental, Economic and social impacts of irrigation in the Mackenzie Basin. Ministry for the Environment, February 2005.)*

5. Monitoring and identification of any problems arising for the above issues has been included in Table 8

5. Farm Environmental Management Plan for Otamatapaio Station

5.1 Mitigation measures and management options adopted on Otamatapaio Station

The table below shows the all the mitigation and management tools that are proposed to be undertaken on Otamatapaio Station. Measures indicated as **FEMP stage 1 are those identified as Mandatory Good Agricultural Practice**, **measures identified as FEMP stage 2 are those changes that have been modelled in OVERSEER to meet the WQS mitigation requirement (if required)**, and those indicated as **FEMP stage 3 are mitigation measures chosen to ameliorate site specific environmental risks on the farm. FEMP Stage 4 mitigation measures are for the new irrigation development if consent CRC961829 is granted.**

Table 6 indicates in brief how the measures are to be monitored and audited.

Table 6. Table of mitigation options, monitoring and auditing for Otamatapaio Station

FEMP stage	Measure	Monitoring	Auditing
1	Fertilisers applied according to code of practice for fertiliser use		Self certification
1	Accounting for all sources of nutrients including applied effluents and soil reservoirs	Soil and effluent testing and cumulative effluent inputs per management unit	Reconciliation of fertiliser, effluent and soil records with nutrient budget for example blocks. Submission of examples soil and effluent tests
1	Even fertiliser application	Calibrate and optimise fertiliser spreaders annually and every 5 years by an external auditor	Submission of testing and calibration
1	Even irrigation and effluent application	Calibrate and optimise irrigators annually in house and every 5 years by an external auditor	Submission of testing and calibration
1	Record crop, cultivation, nutrient inputs and yields per farm management unit	Upkeep of records	Submission of example block records
1	Good design of irrigation systems	Design of irrigation system by a certified professional	Irrigation system audited by a certified auditor every 5 years
1	Robust irrigation scheduling	Calculation of annual % effective water use	Submission of annual % effective water use
2	No winter application of fertiliser on irrigation. Irrigation maintenance always applied early spring Oversown hill country bi annual maintenance often applied late autumn or end of winter.	Field records	Signed field records
2	N fertiliser applications split to under 50 kg N/application	Field records	Signed field records
2	No P fertiliser within three weeks of irrigation	Field records	Signed field records
2	Olsen P of below 30 maintained on	Regular soil testing (every	Submission of soil tests

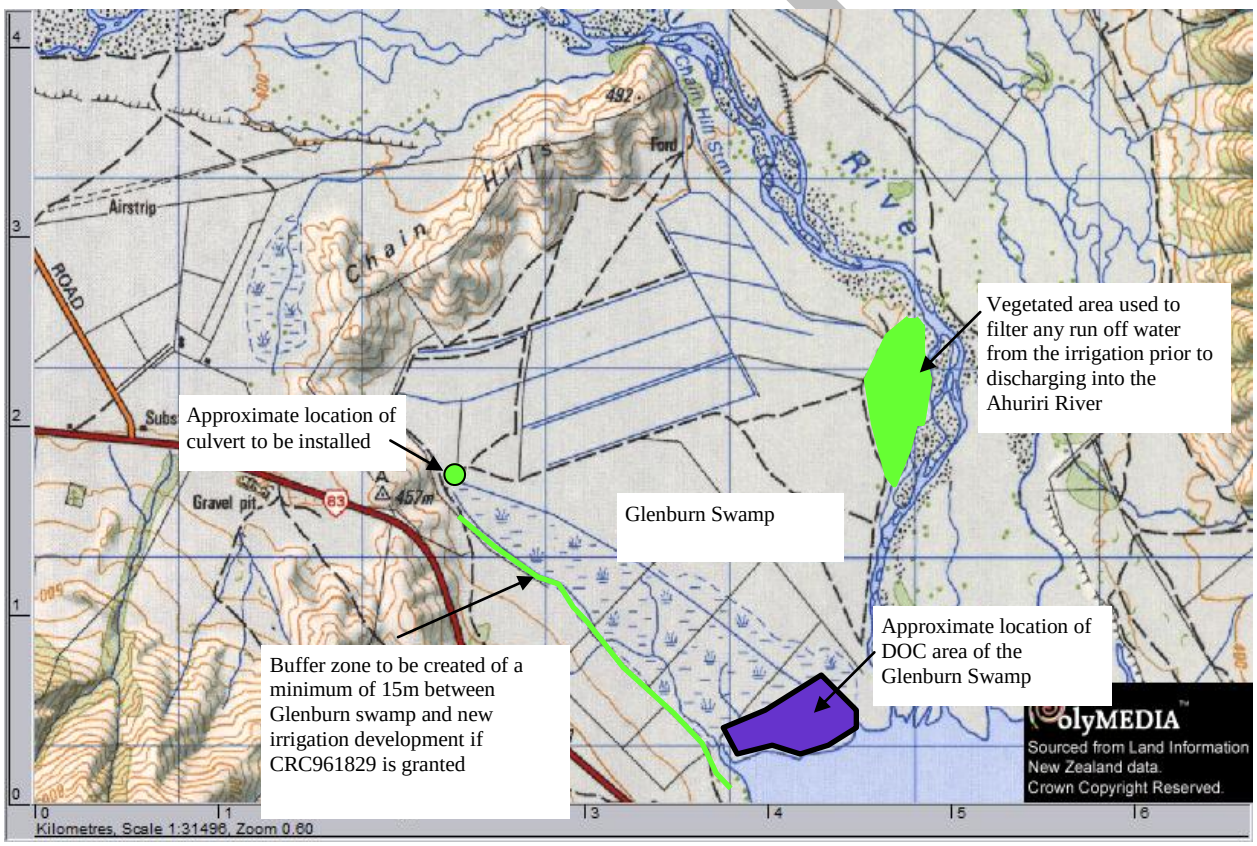
FEMP stage	Measure	Monitoring	Auditing
	applicable areas Some Hill country Olsen P results are naturally higher than 30	3 years)	
3	Redevelopment of existing irrigation, conversion to spray irrigation at Otamatapaio and Glenburn	Photos and location map	Annual audit report until conversion completed
3	Install a culvert in the watercourse at Glenburn where the main track crosses the water course	Photos and location map	Photos in Audit report when work completed
3	Development of settling pond at Clark Creek, just prior to crossing SHWY 8, (see Photo C and Map F)	Water Quality monitoring results	Photos in audit report when work completed and then bi-annually photos
3	20 metre layback from any water way when applying fertliser by land based application e.g. bulk spreader	Field records	Annual Audit report
3	Fencing stock out of permanently flowing waterways namely Clark Creek through riparian fencing within the irrigated area at Otamatapaio	Surface water testing of race/waterway as it enters and exits the property	Annual auditing report for water quality testing. Photos once mitigation completed.
3	Monitor and manage stock access, stock type and stock number from all permanently flowing waterways within other non irrigated intensively farmed areas	Location Plan of waterways and photos	Photos and location plan in first audit report
4	If redevelopment of the irrigation system at Otamatapaio is to occur alongside the banks of the Otamatapaio River then stock should be fenced out of the river and a 25m setback established	Photos	Audit report once redevelopment is completed
4	Minimum of 15m setback from new irrigation development at Glenburn and the Glenburn Swamp.	Photos	Audit Report once consent granted and mitigation completed
4	Fencing 50 metres from Lake Benmore if the proposed new irrigation development occurs at Glenburn and Otamatapaio	Photos and location map	Audit Report once consent granted and mitigation completed

See Photos B and C for location of riparian margins, See Map B for the location of the existing irrigation area and Maps E and F for the approximate locations of mitigation measures.

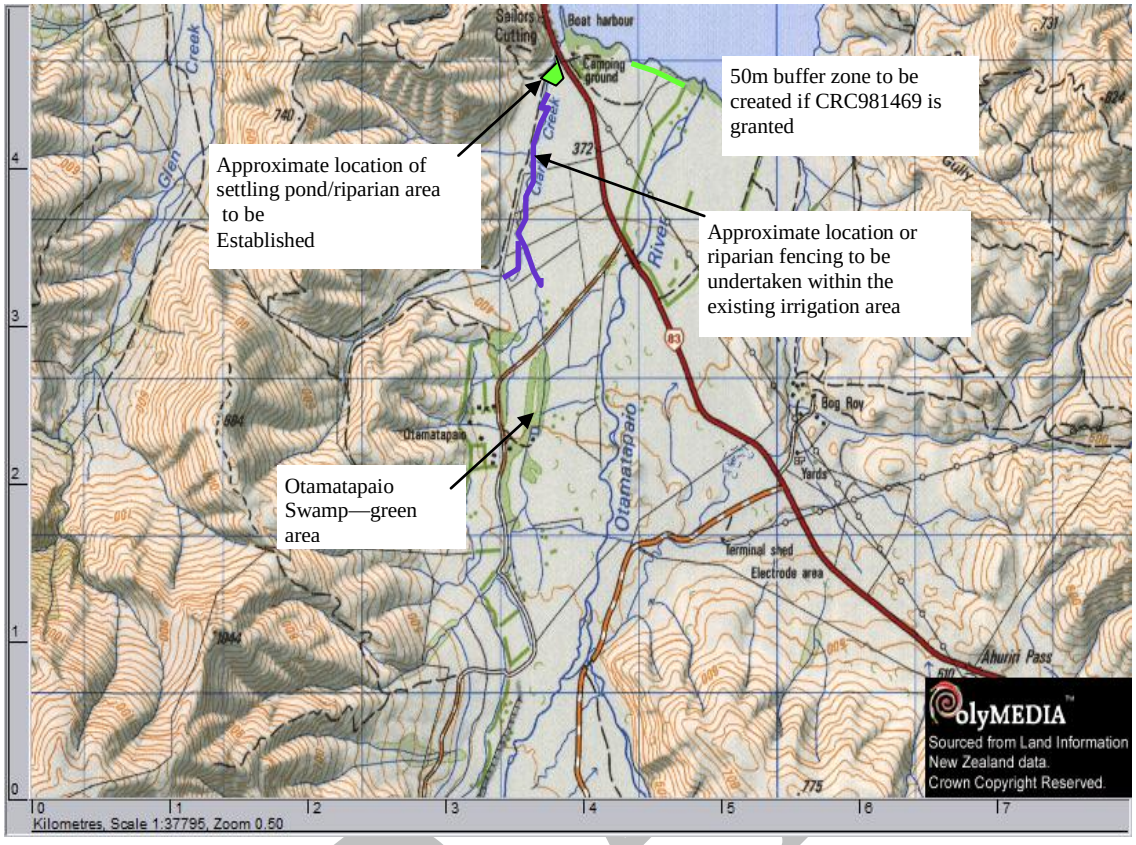
Photo B: Clark Creek: Area on left developed into Riparian Margin

Photo C: Clark Creek running through the irrigation area to be fenced to restrict stock access

Map E: Areas of existing and proposed mitigation at Glenburn



Map F: Areas of existing and proposed mitigation measures at Otamatapaio



5.2 Monitoring and Auditing

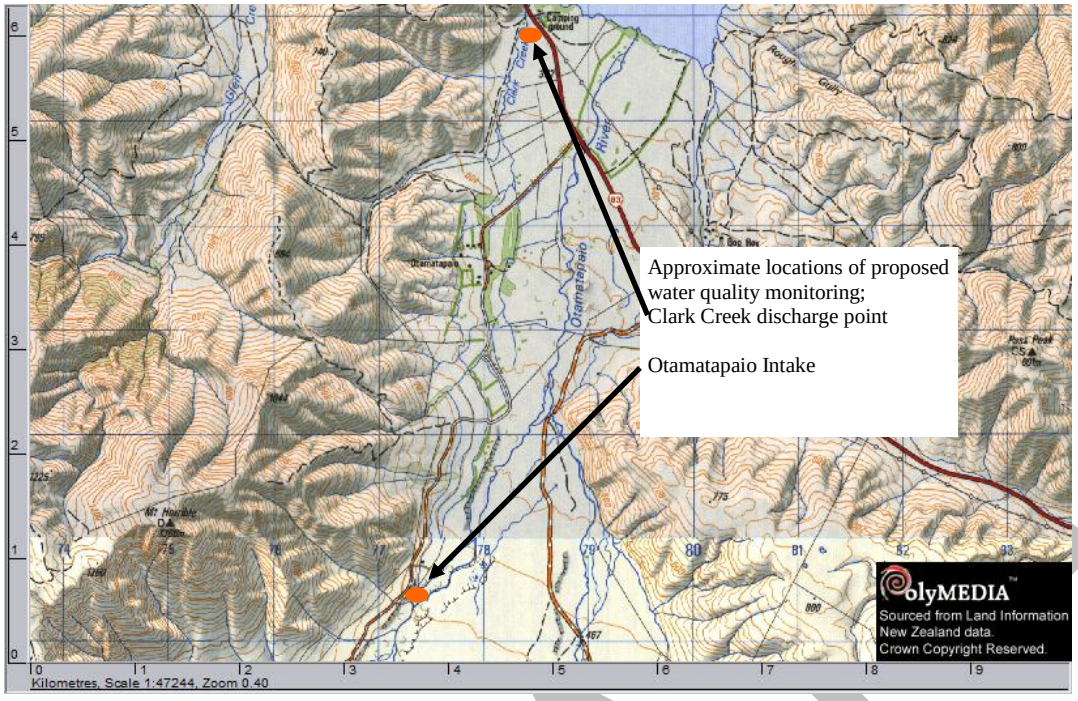
5.2.1 Baseline monitoring

Baseline monitoring is already underway on Otamatapaio Station.

Table 7. Baseline monitoring on Otamatapaio

		Location	Frequency	Measured parameters to include
Soil	Soil nutrient testing	All irrigation paddocks and intensive areas in rotation	1 in 3 years	Standard suite of soil nutrients
Water	Surface water quality	Monitoring points on Map E	Monitoring undertaken in 2007 and 2008	Total Nitrogen, nitrate, ammonia, total Kjeldahl nitrogen, total phosphorus, dissolved reactive phosphorus, suspended solids.
Pasture	Ground cover and species	All blocks	Annually	% Ground cover, species
Weeds and Pest Monitoring		Whole Farm	Annually	Done as part of an annual survey from Ecan

Map E: Monitoring Points for Water Quality Otamatapaio



5.2.2 On-going monitoring

On going monitoring and auditing of FEMP are as important as the plan itself.

Table 7 above shows the current monitoring undertaken on Otamatapaio and Glenburn and Table 8 below shows proposed monitoring plan, frequency, location for the monitoring and parameters for the monitoring along with the triggers and contingency plans if the triggers are exceeded.

Table 8. Example monitoring plan for Otamatapaio Station showing location, frequency and parameters for monitoring

		Location	Frequency	Measured parameters to include	Triggers	Contingency plan if triggers are exceeded
Soil	To include: Soil nutrient testing	All irrigation paddocks and intensive areas in rotation	1 in 3 years for soil nutrient status	Standard suite of soil nutrients	Olsen P >30	Reduce or stop the application of P fertiliser to the area and monitor
Soil	Soil compaction testing	All irrigation blocks in rotation	Annually for soil compaction testing.	Soil compaction	Compaction, surface capping	Remove compaction with the appropriate tool
Soil	Visual assessment	Glenburn and Otamatapaio swamps/heavy ground	Annually	Soil compaction, pugging and bank erosion	Any visual evidence of extensive pugging, bank erosion or compaction if grazed	Exclude stock from the affected area until remedial action can be taken
Runoff	Wet weather survey	All blocks and tracks	Annually	Runoff	Runoff occurring	Introduce runoff removal infrastructure where appropriate.

		Location	Frequency	Measured parameters to include	Triggers	Contingency plan if triggers are exceeded
Water	Surface water quality	Monitoring points on Map E	Quarterly to be consistent with ECAN for the first 5 years and then reviewed	Total Nitrogen, nitrate, ammonia, total Kjeldahl nitrogen, total phosphorus, dissolved reactive phosphorus, suspended solids.	No significant decrease in water quality	If comparative surface water analysis indicates a decrease in surface water quality then the particular contaminant should be identified while a full root cause analysis is undertaken
Water	Irrigation application	Irrigation area	Annually in house and 1 in 5 years by an independent	Application uniformity	>80 %	Optimisation of the irrigator performance will be performed at the time of testing
Tracks that cross waterways	Visual assessment of bank/track erosion	All tracks that cross creek/stream within extensively farmed areas	Annually	Visual assessment of bank/stream erosion caused by vehicle crossing or stock	Any sign of extensive visual erosion	Restrict vehicle and stock access until an assessment of the damage and cause can be made
Fertiliser	Fertiliser application	All Farm	Annually in house and 1 in 5 years by an independent	Application uniformity	>80 %	Optimisation of the spreader performance will be performed at the time of testing
Weed and pest pressures	Weed and pest populations	Relevant blocks	Annually	% or magnitude of infestation	ECAN monitor and communicate if their triggers have been exceeded	Legislative compliance with notice of direction issued by ECAN

See Map E for water quality monitoring points; see Map B for the area of existing irrigation

Where triggers are exceeded, the immediate contingency plans in Table 9 should be implemented while a 'root cause' analysis is carried out. Any further mitigation measures to be adopted as a result of monitoring should be added to Tables 7, 9 and 10.

1) Is the current mitigation option implemented correctly?

No – Implement and monitor

Yes – to 2)

2) Has anything changed in the farm system?

Yes – remodel and monitor

No – to 3)

3) Have there been abnormal conditions at the time of trigger breach?

Yes – continue monitoring to see if trigger breach continues

No – Seek advice if suitably qualified person to investigate root cause and suggest appropriate mitigation.

If emergency conditions occur that risk a pollution event, such as a catastrophic failure of the irrigation system that is resulting in overland flow to a watercourse, seek immediate guidance from you regional council:

Environment Canterbury 0800 76 55 88

5.2.3 Auditing

The auditing process allows both the farm operator to illustrate, and other interested parties to have confidence that the management practices and mitigations planned for the farm are being implemented. In addition, the audit shows that there is a mechanism for the adaptive management of the property should the chosen mitigation or management not perform to expectations.

An annual audit is proposed, and requires both external and in-house input. The annual audit should be completed and submitted to ECan by end of July each year.

Table 9 below shows an example of an annual audit report Otamatapaio Station

Table 9. Table showing proposed contents of an annual audit report for Otamatapaio Station

Mitigation Measure	Audit Measures	Action in case of non compliance
	Annual audit of OVERSEER nutrient budget and report based on previous 3 years. Submission of compliance with thresholds	Should the OVERSEER report show losses exceeding the threshold, further mitigations should be adopted to effect a reduction in nutrient loss to below thresholds.
	Submission and brief interpretation of water quality analysis	Where triggers have been exceeded, immediate contingency plans should have been carried out and a root cause analysis conducted. The results of which should be presented here.
	Submission and brief of annual wet weather survey	Any remedial actions proposed after the annual survey should be undertaken.
	Submission and brief of annual tracks that cross waterways survey	Any remedial actions proposed after the annual survey should be undertaken
	Submission and brief of annual compaction survey of the irrigation area	Any remedial actions proposed after the annual survey should be undertaken
	Annual pest and weed survey undertaken by Ecan should be submitted	Legislative compliance
Even irrigation application	Calibrate and optimise irrigators annually in house and every 5 years by an external auditor	Submission of testing and calibration
Record crop, cultivation, nutrient inputs and yields per farm management unit	Verification of records	If records have not been produced then this should be rectified for next audit
Good design of irrigation systems by a certified professional and audited every 5 years	Irrigation system audited by a certified auditor every 5 years and any changes recommended should be implemented	If changes recommended not implemented then this should be rectified by next audit
Robust irrigation scheduling	Verification of records	If records not received then this should be rectified by next audit
No June/July application of fertiliser on the irrigated area	Field records	If records not received this should be rectified for next audit.
N fertiliser applications split to under 50 kg N/application	Field records	If records not received this should be rectified for next audit
No P fertiliser within three weeks of irrigation	Field records	If records not received this should be rectified for next audit

Olsen P of below 30 maintained	Submission and brief interpretation of soil test results	Where triggers have been exceeded, immediate contingency plans should have been carried out and a root cause analysis conducted. The results of which should be presented here.
Redevelopment of existing irrigation, conversion to spray irrigation at Otamatapaio and Glenburn	Photos and location map	Ensure conversion is completed within the specified timeframe
Install a culvert in the watercourse at Glenburn where the main track crosses the water course	Photo once installed	Timeline for completion required, if not completed prior to indicated timeframe then should be rectified by next audit
Development of settling pond at Clark Creek, just prior to crossing SHWY 8, (see Photo C and Map F)	Check settling pond is present. Photos	Settling ponds should be constructed and in use before next audit
20 metre layback from any water way when applying fertliser by land based application e.g. bulk spreader	Field records and maps	If maps not received with annual audit this should be rectified by the next audit.
Fencing stock out of permanently flowing waterways namely Clark Creek through riparian fencing within the irrigated area at Otamatapaio	Check fenced areas are present. Photos	Areas of fencing damage should be repaired.
If redevelopment of the irrigation system at Otamatapaio is to occur alongside the banks of the Otamatapaio River then stock should be fenced out of the river and a 25m setback established	Check fenced areas are present and where they have indicated they will be. Photos	Areas of fencing damage should be repaired. Areas of less than 25m setback should be extended to ensure the minimum is 25m
Minimum of 15m setback from new irrigation development at Glenburn and the Glenburn Swamp.	Check setback area is present. Photos	Areas of less than 15m setback should be extended to ensure the minimum is 15m.
Fencing 50 metres from Lake Benmore if the proposed new irrigation development occurs at Glenburn and Otamatapaio	Check fenced area is present. Photos	Areas of fencing damage should be repaired.

6. Summary

This FEMP has been written to serve two purposes; to ensure the existing farm system can meet the nutrient mitigation requirements set out by the MWRL Water Quality Study, and to set out the process for identification of farm specific environmental risks that arise from the inherent characteristics of the farm and from the existing farm system and its management.

The WQS thresholds and modelled outputs from OVERSEER detailed in Section 4.2 illustrate that this proposed system meets the WQS thresholds identified.

A full on-farm risk assessment was completed in December 2009 with a commitment to address the risks identified. Section 4.3 sets out the risks identified for this property and those issues common to all high country farming systems, along with existing mitigation measures.

The mitigation and management measures detailed in Table 6 set out the measures that have been adopted to mitigate and manage the risks that were identified in the risk assessment along with mandatory good agricultural practices and those measures that have been modelled in OVERSEER.

Baseline monitoring and any additional monitoring proposed for this property are identified and set out in Section 5.2, Tables 7 and 8 allows the performance of the measures chosen to be monitored and where they are performing sub-optimally, these can be addressed through the root cause analysis process.

The auditing of this plan, addressed in Section 5.2.3, Table 9 ensures that the relevant mitigation measures outlined in Table 6 are audited annually either internally or externally and communicated to ECAN by the end of July each year.

7. References

Ministry for the Environment. 2005. Environmental, Economic and social impacts of irrigation in the Mackenzie Basin.

GHD (2009a). Cumulative Water Quality Effects of Nutrients from Agricultural Intensification in the Upper Waitaki Basin – Mitigation Toolkit.

Webb, T. H. (1992). Soils of the Upper Waitaki Basin, South Island, New Zealand, DSIR.

APPENDIX A: Farm Environmental Risk Assessment

GUIDELINES QUESTIONS FOR THE
COMPLETION OF A FERA November/December 2009

The plan is to focus on those existing/proposed irrigation areas along with any intensive areas surrounding. We also need to keep in mind that this is a whole farm environmental risk assessment and hence other areas of the farm may also be applicable at times. Take notes on wetland areas, swamps, major streams/rivers, location of the yards in relation to watercourses

Some guideline questions for track management and runoff		**Notes/description**
1	Do any regularly used tracks run through streams?	Yes at Glenburn main track that goes past the house. In extensive high country properties there are areas within the farm where tracks will cross streams, these will be tracks that are used irregularly
2	Do any tracks directly runoff to a water course	NO
3	Stock crossings?	In most places culverts are installed. In extensive high country properties there are areas within the farm where stock will cross streams and use streams for stock water.
4	Any evidence of previous runoff, soil wash or erosion?	No but a potential vulnerability to wind erosion on some of the higher altitude country
6	Do you have a silage pit located near a permanent watercourse?	No
Some guideline questions for stock management		
1	Are measures taken to control dietary intakes of N and P? (Intensive beef and dairy)	N/A
2	Are stock restricted from entering watercourses in intensively farmed areas?	No - Clark Creek running through pivot area at Otamatapaio
3	Do you graze stock in paddocks that have a hydraulic connection to a watercourse in winter months?	NO
4	Yards - do you use water? If yes, details (e.g is it collected, discharged, what is it used for…?)	Yes dipping, water does not runoff to any watercourses

Some guideline questions for biodiversity		
1	Are there any special areas or species of interest or conservation on the farm?	Swamp at Glenburn
2	Are there any water or wetland features on the farm?	Swamp at Glenburn
3	Are these features actively protected?	Fenced but grazed by stock
Some guideline questions for chemical usage	*Chemical storage and handling is dealt with under the Hazardous Substances and New Organisms Act*	
1	Are those handling chemicals of 'approved handler status'?	Yes, contractor used for spraying
Some guideline questions for water		
1	Do you use border dyke irrigation?	Yes
2	Do you collect wipeoff losses?	Yes, water is collected and reused up to 3 times
3	Are these wipeoff losses discharged to a watercourse	Yes, Clark Creek and Otamatapaio Swamp - riparian areas to be constructed
4	Is there evidence of bankside erosion in any permanent flowing watercourses?	NO
Some example questions on cropping		
1	Is inversion tillage used? Describe	Yes, discing is used if required otherwise direct drill
2	Are soils left bare over winter?	NO
3	If arable or fodder crops are grown, are measures taken to conserve or build soil organic matter on arable land?	Yes

4	Are remedial measures in place after winter grazed crops?	Yes, grass grown with winter feed crop to utilise early spring growth
5	Is there a possibility of run off from winter grazed areas reaching a water course?	Yes, Clark Creek
6	Other cropping issues or incidences? Please describe	No
Some example questions on soil health		
1	Are there compacted, consolidated or capped soils?	None evident
Some example questions on pest and weed management		
1	Do you undertake any current pest or weed control? E.g rabbits, gorse	Rabbits shot and other weeds sprayed if required