Farm Environmental Management Plan: Riverside (Greenfield Rural Opportunities Ltd)

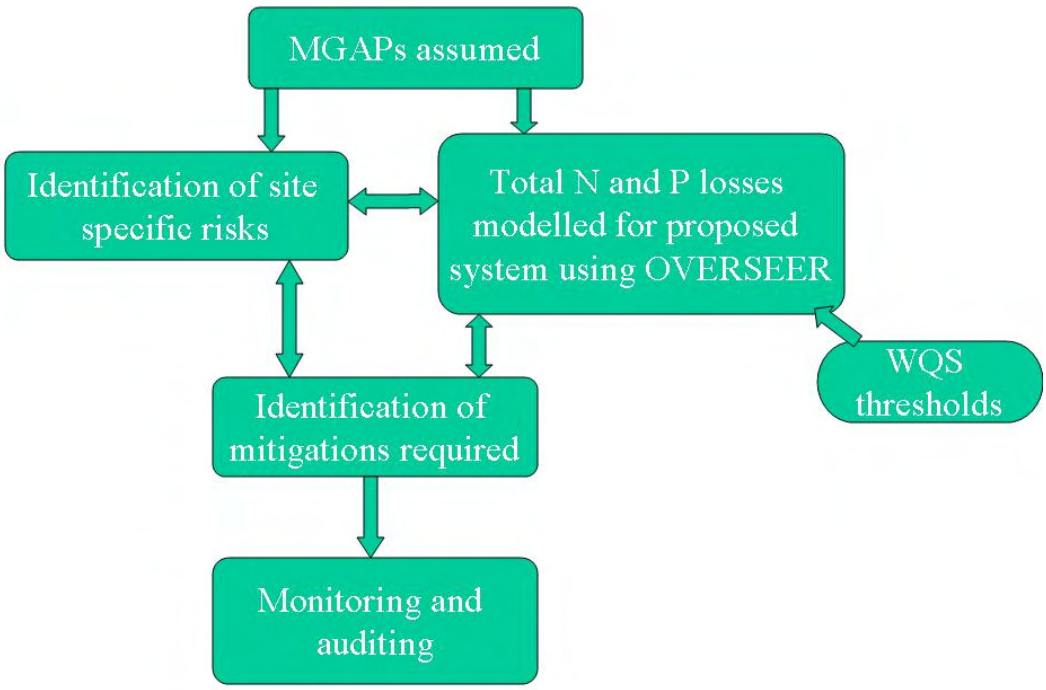
1. Introduction

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

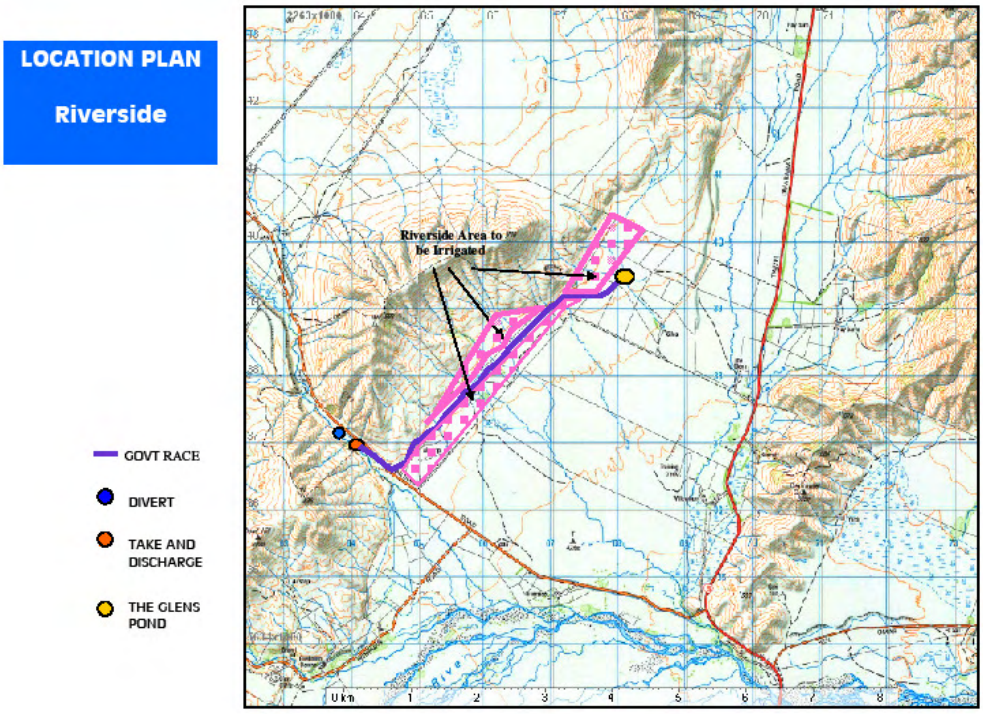


MGAP – Mandatory good agricultural practices

2. General farm description

Situated on the east side of Quailburn Road (no exit), 10 kilometres North West by road from Omarama. This is an established farming location with mainly extensive run properties.

The property is known as Riverside, and is an 1,802ha property located on the western side of Willowburn Station, accessed from Quailburn Road. The property currently runs deer, beef cattle and sheep.



Aerial Photograph of Riverside

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**
Lambs	Grass flats	Grass flats	Grass flats	No stock
Hoggets	Grass flats/ Oversown hill			No stock
Breeding cows			Oversown Hill	No stock
Beef Steers	Grass Flats/ Oversown hill	Grass flats / Oversown hill	Grass flats / Oversown hill	No stock

2.1 Proposed farming system

Riverside runs a farming model of grazing only. The table below represents the "best estimate" of where the stock will be grazed. Significant changes between current and proposed are not foreseen.

The addition of irrigation will allow grazing for a longer period during the shoulder of the season but not necessarily with increased stock numbers

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**
Lambs	Grass flats	Grass flats	Grass flats	No stock
Hoggets	Grass flats/ Oversewn hill			No stock
Breeding cows			Oversewn hill	No stock
Beef Steers	Grass flats/ Oversewn hill	Grass flats/ Oversewn hill	Grass flats/ Oversewn hill	No stock

2.2 Soils

The soils on the property are made up as follows:

- 200 ha Pukaki soils, medium quality silt loam over stony gravels
- 55 ha Tekapo soils, medium quality fine sandy loam
- 507 ha Ohau soils, fair quality silt loam over stony loam
- 1040 ha Tekapo hills soils, medium quality stony loam on greywacke

2.3 Topography

Altitude ranges from 460 to 893 metres above sea level. The aspect comprises some 902 hectares tending north westerly, with 900 hectares tending south easterly

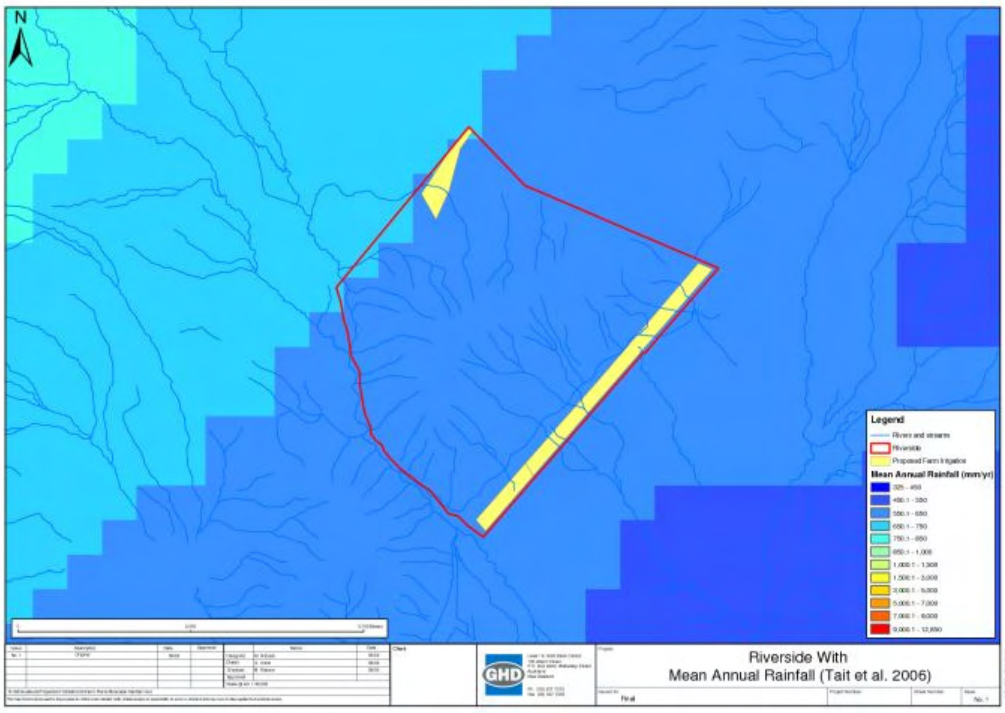
Approximate contour consists:

- 530 ha easy undulating
- 232 ha moderately rolling
- 1040 ha strongly rolling to steep

2.4 Climate

Rainfall averages between 550 and 750 mm per annum with tending cold severe winters and hot dry summers, with low to medium snow risk. Altitude of the farm ranges from 460 to 893 metres above sea level.

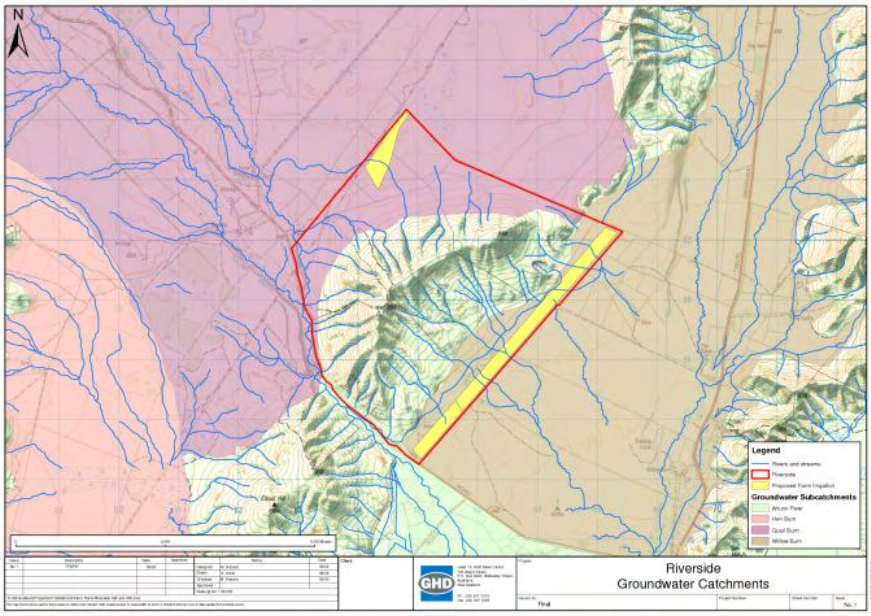
Air temperatures are normal for this region with no topographical feature having any significant effect or causing variation from the “norm”.



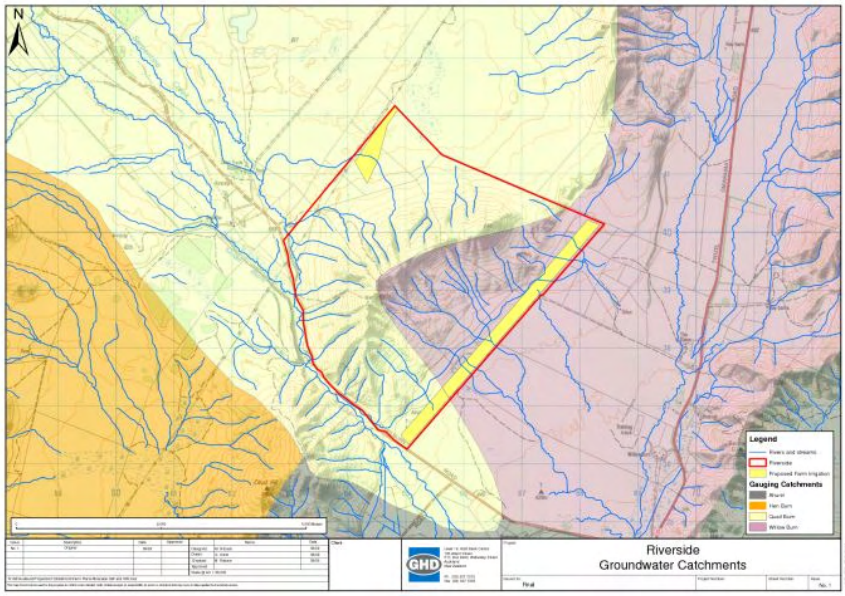
Rainfall Map

3. Environmental Context

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



Groundwater Catchment



Surface Water Catchment

3.1 Water Quality Study receiving environments and mitigation requirements

Riverside, according to the WQS, is in the Willowburn groundwater catchment and Willowburn and Willowburn and Ahuriri Arm surface water catchments, as shown on the above maps. The following table shows the calculated nutrient mitigation requirement of the receiving environments determined in

the WQS and the resulting thresholds for N and P for Riverside. Please note that no groundwater catchment mitigation is required.

Ahuriri Arm Mitigation required kg/ha irrigated land	Secondary stream mitigation required for periphyton kg/ha irrigated land	Stream mitigation required for ANZECC kg/ha irrigated land
N -10.70 P - 1.10	N 1.10 P –0.90	N -0.7 P -0.1

For this farm, the Ahuriri Arm mitigation requirements are the most stringent. These mitigation requirements cap Riverside's nutrient discharges at 5,930 kg N per annum and 137 kg P per annum.

3.2 Local receiving environments

The Quailburn Government Race runs through the property. The race was established by the government and was part of the sale and purchase agreement upon the subdivision of Benmore Station in 1916/17 to returning soldiers. The race was in place by 1921. The race is an open race except for around the steeper slopes of Riverside where it is piped.

The property also drains into the Willowburn. Willowburn Swamp is an extensive area of slow moving streams and an extensive willow area (hence the name). It is predominantly fed by a series of water races.

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 3. 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 Riverside, using the most stringent nutrient mitigation requirement, are 5,930 kg N/year and 137 kg P/year. Table 4 below shows the output from OVERSEER for the modelled proposed farming system at Riverside. The results illustrate that the proposed farm system losses as modelled by OVERSEER are within the thresholds set out by the WQS. Management or mitigation strategies that have been used to meet this threshold are detailed in Section 5.

Table 4. Water Quality Study mitigation requirements for Riverside

	Nitrogen Threshold (kg/farm)	Phosphorous Threshold (kg/farm)
MWRL Water Quality Study Property Thresholds	6436	104
OVERSEER® outputs	5,902	95

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

4.4 Farm Environmental Risk Assessment (FERA)

3.4.1 The tracks on the property are not used all that regularly, but there are a number that are not culverted. There are already a number of tracks that are culverted, and if the proposed irrigation goes ahead then these tracks that are un-culverted will likely be culverted.

3.4.2 There was no evidence that there was any previous runoff or soil wash.

3.4.3 There are no evident regularly used stock tracks that cross through streams, these all tend to be fenced off, admittedly to a small degree in places.

3.4.4 There are no silage pits or buns located on the property. There is currently no bailage on the property either, and bailage is only made when there is ample feed (this being relatively rare), otherwise it is brought in.

3.4.5 Stock do have access to the streams in places for stock water.

3.4.6 The sheep yards on the property (no cattle yards) are located a large distance from any permanent waterways, and if dipping is done (which has been years since it has been) it is contained in the yards and allowed to evaporate over time.

3.4.7 There are no special areas or species of interest on the property. The only major stream on the property is the diversion race from the Quailburn River, and this is not of great significance.

3.4.8 When large areas are being sprayed out contractors are brought in to do the job.

3.4.9 No irrigation is currently used on the property.

3.4.10 No significant bankside erosion is seen on the property. In places there are small areas of erosion, which is from high water flows.

3.4.11 Direct drilling is the preferred method for re-sewing, but in areas where there are new soils the ground may be overturned or fallowed over the winter, to allow for planting.

3.4.12 Over the winter the soils are left bare to some degree.

3.4.13 There is no permanent winter grazing that is undertaken, and there are very few stock numbers on over the winter. The property is mainly used for grazing over the Spring, Summer and Autumn.

3.4.14 If there is winter grazing (very rare and not likely in the future) that has been in place, the soils in these areas will be re-drilled over the spring.

3.4.15 There were no problems evident with compacted or consolidated soils on the property, the soils were relatively silty.

3.4.16 Current pest control measures that are used; shooters are brought in often to keep rabbit numbers down; also if numbers get bad pindone or 1080 (if they get extremely bad) can be used. Spraying contractors are brought in to do any broom, gorse, or briar spraying. Contractors are also employed to do the wilding pines on the property.

3.4.17 Fertilisers used are; last year 655 tonne of lime. Also 140 to 150 tonne of Sulphur Super 30 is applied every year. Last year there was a total of 1385 hectares drilled, with 800 tonne of fert. used. (see above for break down).

3.5 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 an 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 three issues has been included in Table 8.

5. Farm Environmental Management Plan for Riverside

5.1 Mitigation measures and management options adopted on Riverside Station

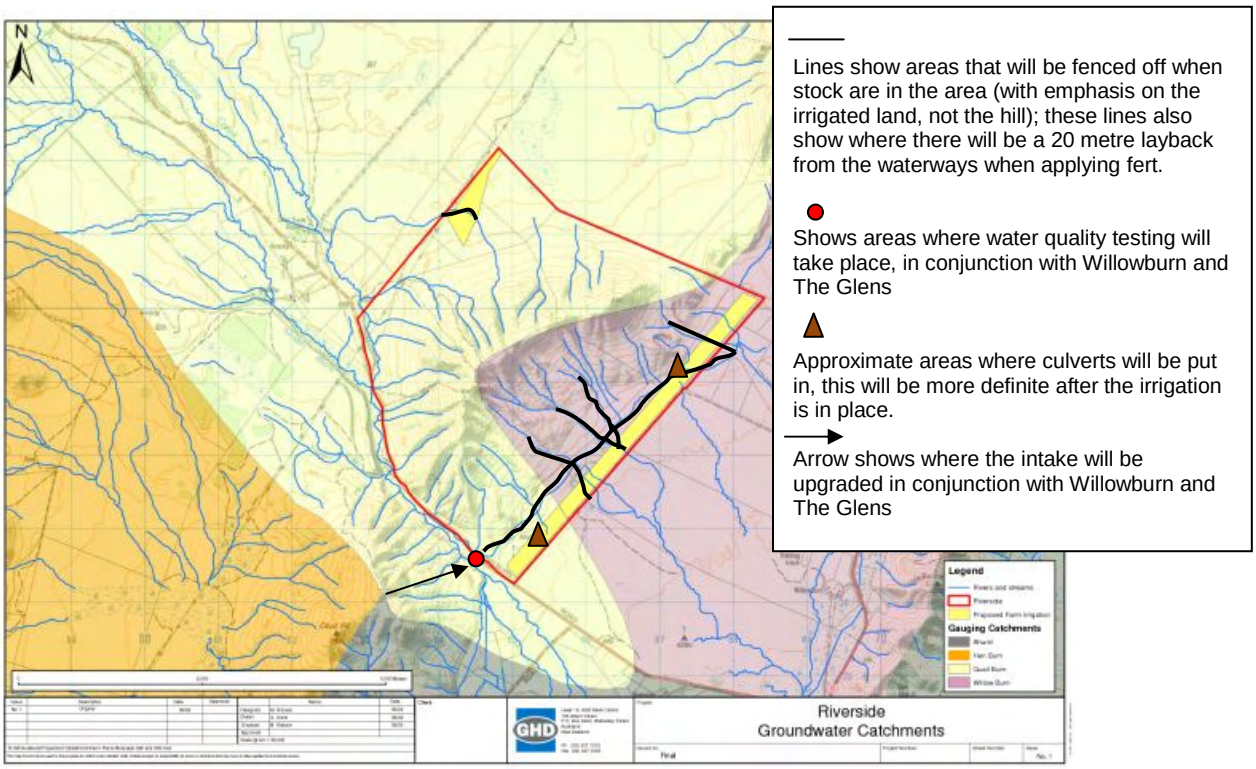
The table below shows the all the mitigation and management tools that are proposed to be undertaken on Riverside. Measures indicated as **FEMP stage 1 are those identified as Mandatory Good Agricultural Practice**, **measures identified as FEMP stage 2 are those changes that have been modelled in OVERSEER 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.** Table 6 indicates in brief how the measures are to be monitored and audited.

Table 5. Table of mitigation options, monitoring and auditing for Station XX

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	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	Regular soil testing (every 3 years)	Submission of soil tests
3	Fence off the diversion from the Quailburn, keep drinking bays for stock	Surface water testing of race/waterway as it enters and exits the property	Annual auditing visit.
3	Place culverts along the tracks that cross the Quailburn diversion (government race)	Photos	Annual audit visits
3	Maintain a 20 metre layback from any waterway when applying land based irrigation	Field Records	Annual audit report

FEMP stage	Measure	Monitoring	Auditing
3	Maintain a 20 metre buffer zone from permanent waterways with the irrigation area	Photos	Annual audit visit
3	Upgrade the take point out of the Quailburn River in conjunction with Ellis Lea Farms and Willowburn Station	Photos and location map	Annual audit visit

The intake from the Quailburn that will be upgraded



Annotated map with key mitigation options and locations on Riverside station

5.2 Monitoring and Auditing

5.2.1 Baseline monitoring

Baseline monitoring is already underway on Riverside.

Table 6. Baseline monitoring on Riverside

		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
Pasture	Growth rates	All blocks	Monthly during growing season	Dry matter production
Soil and Air	Temperatures	2 sites	Monthly	Air and ground temperatures
Rainfall	Quantity	1 site	Weekly	Rainfall quantity observed and recorded

5.2.2 On-going monitoring

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

Table 6 above shows the current monitoring undertaken on Riverside and Table 7 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 7. Example monitoring plan for Riverside 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
Runoff	Wet weather survey	All blocks and tracks	Annually	Runoff	Runoff occurring	Introduce runoff removal infrastructure where appropriate.
Water	Surface water quality	As per consent conditions	As per consent conditions	As per consent conditions	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

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 8 below shows an example of an annual audit report Riverside Station

Table 8. Table showing proposed contents of an annual audit report for Riverside

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.
Fence off the Government race from the Quailburn, keep drinking bays for stock	Check fenced area is present. Photos	Areas of fencing damage should be repaired.
Place culverts along the tracks that cross the Quailburn diversion (government race)	Photo once installed	Timeline for completion required, if not completed prior to indicated timeframe then should be rectified by 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.
Maintain a 20 metre irrigation setback from permanent waterways with the irrigation area	Check setback area is present. Photos	Areas of less than 15m setback should be extended to ensure the minimum is 5m.
Upgrade the take point out of the Quailburn River in conjunction with Ellis Lea Farms and Willowburn Station	Check infrastructure is present. Photos	Infrastructure should be constructed and in use before next audit

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 5 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 6 and 7 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 8 ensures that the relevant mitigation measures outlined in Table 5 are audited annually either internally or externally and communicated to ECAN by the end of July each year.