

# **Farm Environmental Management Plan: Waitangi Station**

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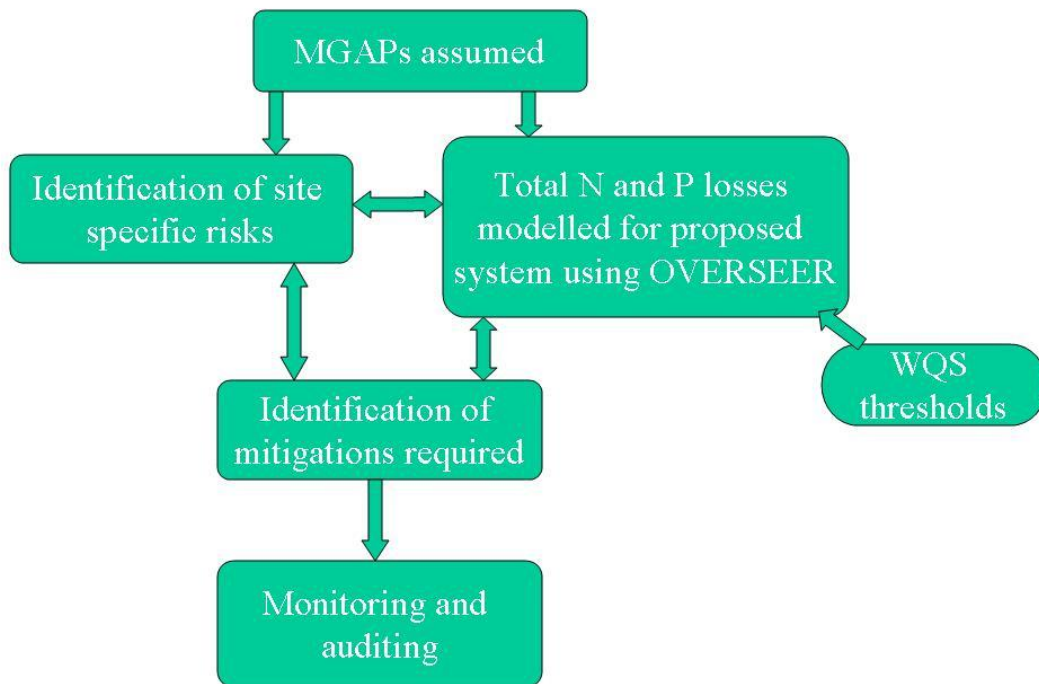
# 1. Introduction

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 Planning. 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 for 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



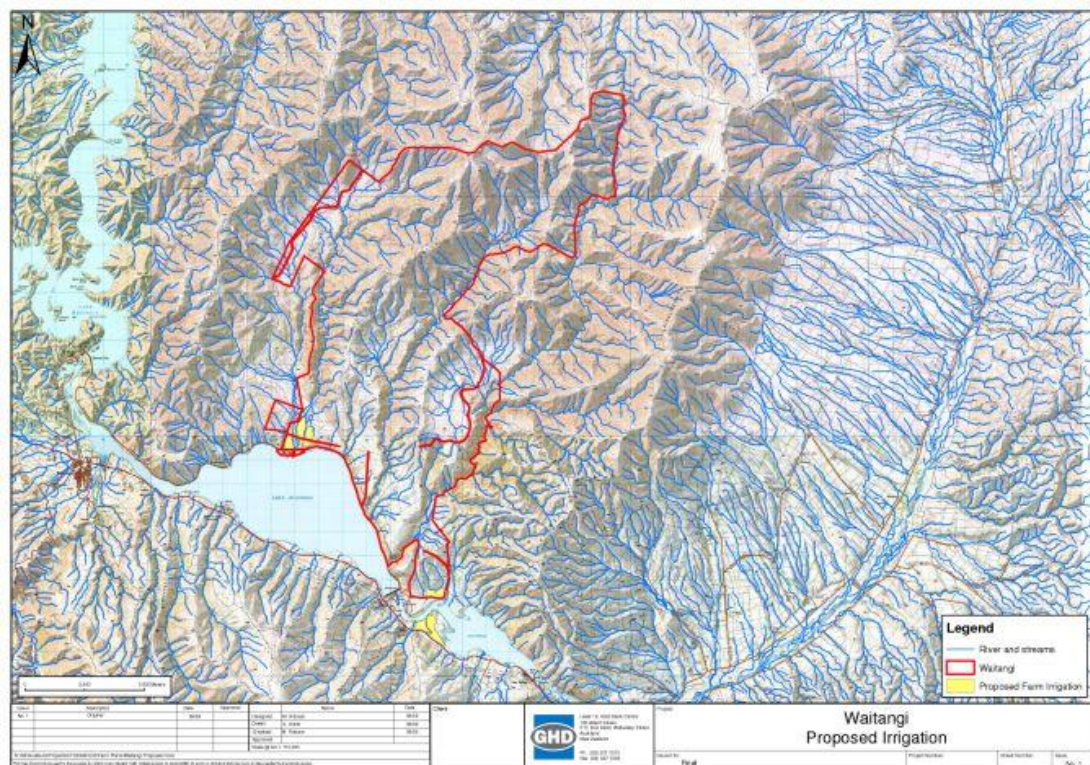
MGAP – Mandatory good agricultural practice

## 2. Farm Description

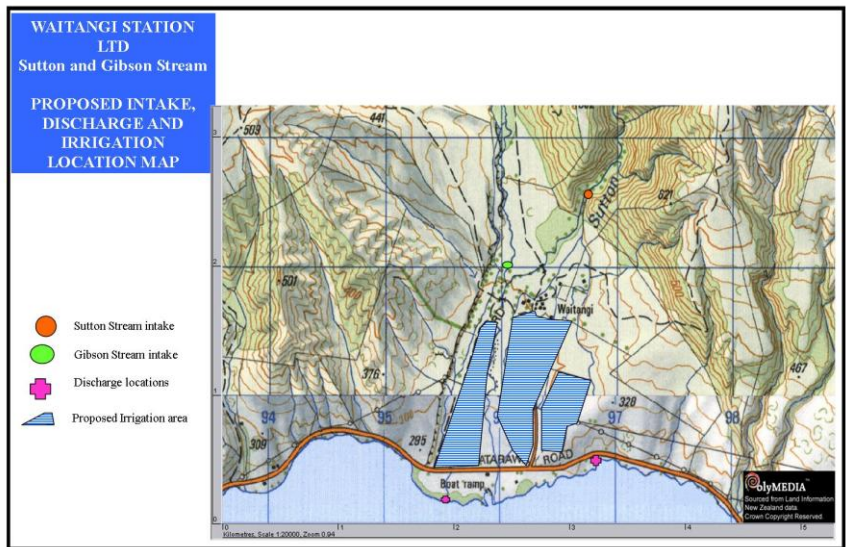
### 2.1 General farm description

Waitangi Station is a high country station which is predominantly hill country with a small amount of flat land, approximately 200 ha. The station currently runs 14,000 merino sheep and 300 cattle. All stock are summered and wintered on the hill country. The hill country comprises a large area of 2500-3500ft mid altitude country of which 5000ha has been oversown and topdressed. The lower areas of rolling hill and flat area of cultivation approximately 140 ha and some oversown and topdressed approximately 400ha.

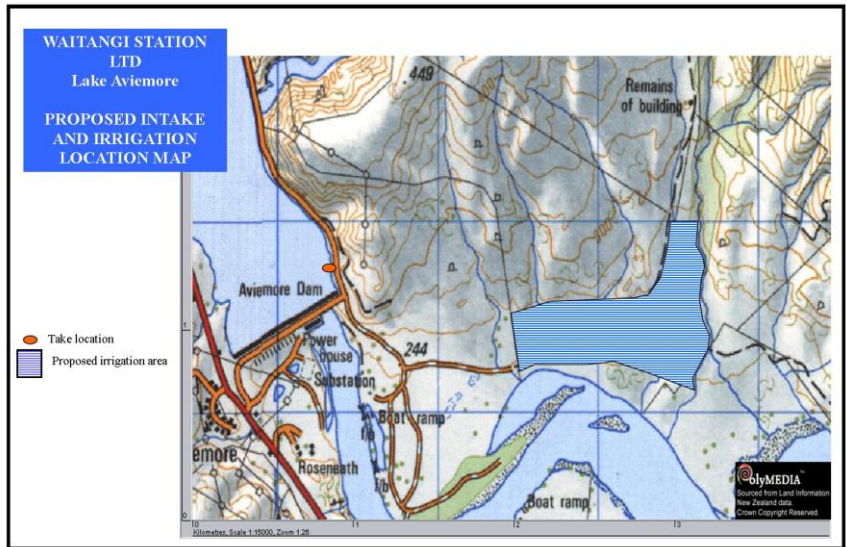
Three catchments form the property giving the property a North-South aspect. Ground cover ranges from grasses (lower altitude) fescue tussock (mid altitude) snow tussock (high altitude) matagouri and other native scrub is spread throughout.



Map A: Location map



Map B: Proposed Irrigation Location map for Gibson/Sutton area



Map C: Proposed Irrigation Location map for Lake Aviemore area

**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	Oversown Hill	Oversown Hill	Oversown Hill	Oversown Hill/Native

<b>Hoggets</b>	Grass flats and oversown hill	Oversown Hill	Oversown Hill	Oversown Hill
<b>Breeding cows</b>	Oversown Hill	Oversown Hill	Oversown Hill	Oversown Hill
<b>Wethers</b>	Oversown Hill/Native	Native	Native	Native



Photo A: Area of land to be irrigated using Sutton Stream Water, shows existing land cover (photo courtesy of Susannah Vesey)



Photo B: Area of land to be irrigated using Sutton Stream Water, shows existing land cover (photo courtesy of Susannah Vesey)



Photo C: Area to be irrigated using Lake Aviemore water. Proposed irrigation area runs along base of hills on left and across to fence line on right. Willows and tussocks along lake create a 'buffer zone'. Photo taken from main highway (photo courtesy of Susannah Vesey)



Photo D: Type of vegetation that forms the buffer zone at the Lake Aviemore proposed irrigation area

## 2.2 Proposed farming system

The proposed irrigation development is at two separate sites; Sutton/Gibson and at Lake Aviemore. 78 hectares is proposed to be developed at the Sutton/Gibson location and 50 hectares at Lake Aviemore.

Irrigation will ensure winter feed supplies as well as cull merino lambs will be fattened in Sept-Oct as opposed to selling store. Cattle will be used strategically on irrigation to be fattened i.e. run on hill till 12-20 months old then finished on irrigation. Strategic saving of autumn grass to feed to twin bearing and 2 tooth ewes before lambing.

**Table 2. Cover utilisation by season and stock class for proposed system**

<b>Cover utilisation by season and stock class - PROPOSED</b>				
<b>Class of stock</b>	<b>Spring</b>	<b>Summer</b>	<b>Autumn</b>	<b>Winter</b>
<b>Ewes</b>	Some ewes grass flats and oversown hill	Oversown hill	Oversown hill	Oversown hill
<b>Hoggets</b>	Grass flats and oversown hill	Oversown hill	Oversown hill	Oversown hill
<b>Breeding cows</b>	Oversown hill	Oversown hill	Oversown hill	Oversown hill
<b>Wethers</b>	Oversown hill/native	Oversown hill/native	Oversown hill/native	Oversown hill/native

Pasture and crop rotation is unknown at this stage but will be as required e.g. cereal-lucerne, or short term crops e.g. Italian ryegrass-permanent pasture

### 2.3 Soils

Soils range from stony flood plain around the Homestead area, to good soils over clay on the downs around the Homestead. Good soils with rocky outcrops in mid altitude country very rocky steep gorges. Steep high altitude country stony soils rising to shingle tops.

The soils in the proposed irrigation development areas are as below:

Sutton/Gibson – Eweburn, Tasman and Becks with PAW of between 40-100mm

Lake Aviemore – Grampians, Dalgety and Eweburn with PAW of between 45-90mm

### 2.4 Topography

Waitangi topography is formed by 3 catchments, Deep Stream, Stony Creek and Sutton Stream. Gorges formed by these streams are very steep right down to Lake Aviemore except for Sutton Stream which opens out onto a flood plain approximately 1.5km from Lake Aviemore. Altitudes range from approximately 260m (Lake Waitaki) to 1880m (Mt Sutton). Approximately ½ the property is mid altitude rolling hill with the back ½ of the property steep hill.

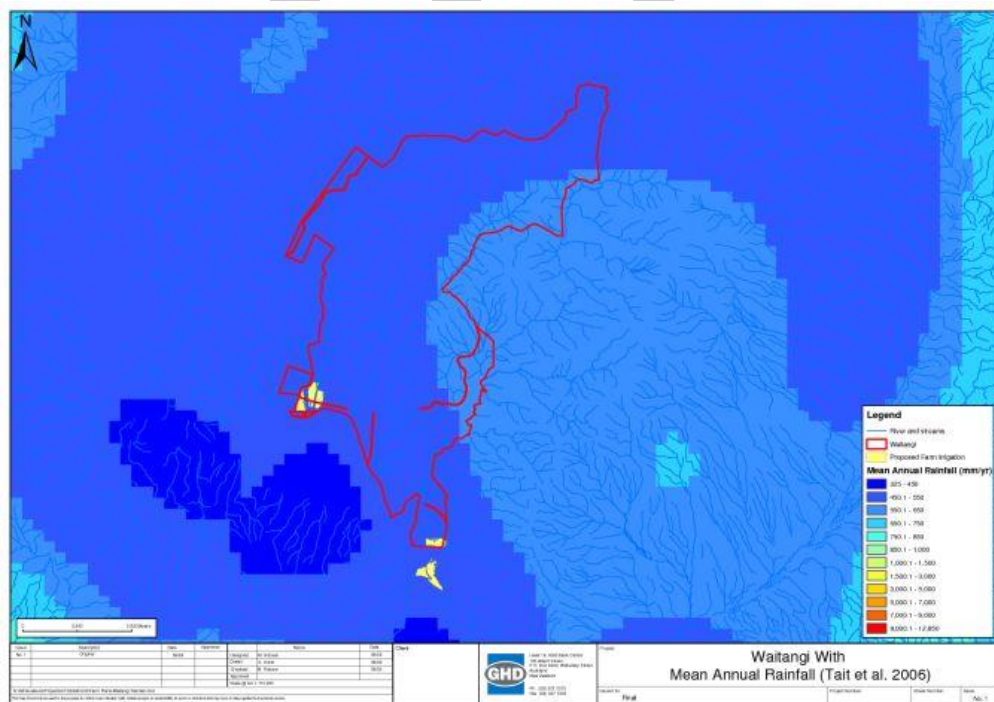
### 2.5 Climate

Rainfall records have been taken at the Waitangi Homestead for approximately 50 years; these put the variation from the last 50 years of between 225mm at the driest to 650mm at the wettest.

Snow: most winters 3000-3500ft snowline, most winters there is snow cover to the lowest point on the farm but shifts reasonably quickly in approximately 1-7 days. Heavy snow every 3-5 years over whole property.

Temperature to -15oC in winter, frost average -5oC and -10oC

Summer temperatures can rise up to 38oC.



Map D: Mean annual rainfall

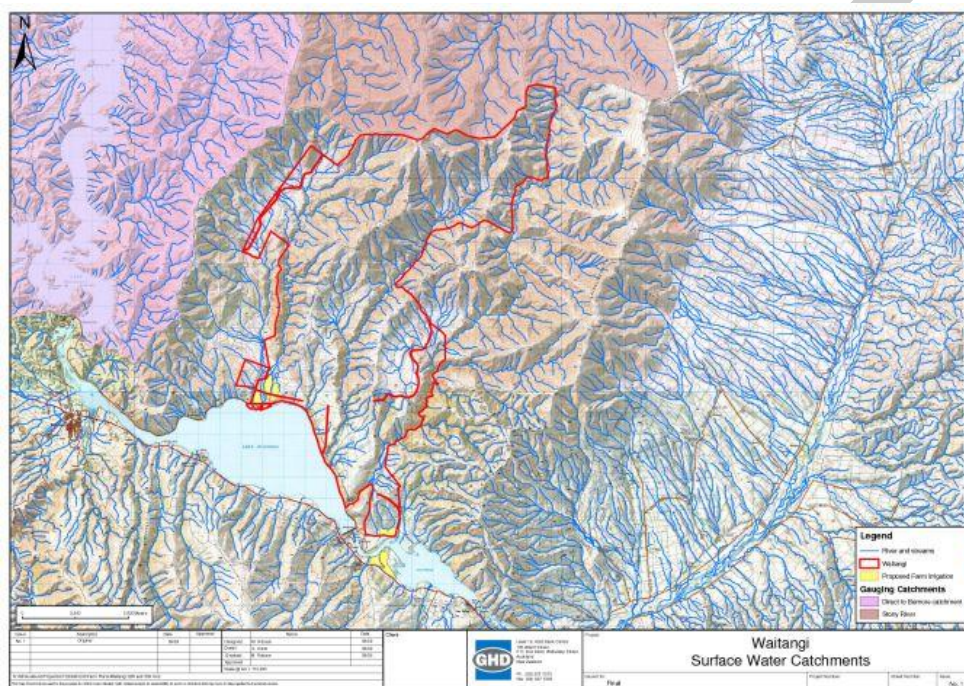
### 3. Environmental Context

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

Waitangi Station, according to the WQS, lies in the Lake Aviemore surface water catchments for the Gibson/Sutton area of proposed irrigation and Lake Waitaki for the Lake Aviemore area of irrigation, as can be seen from the below map.

As can be seen below in Table 3, Waitangi has no specific mitigation requirements from the WQS.



Map E: Surface water receiving environment

#### 3.2 Local receiving environments

Lake Aviemore and Lake Waitaki are the large local receiving environments for Waitangi Station proposed irrigation. Both are artificial lakes, with 95% open water, with steep shorelines. Both provide habitat for waterfowl. Deep Stream, Sutton Stream, Gibson Stream and Stony Stream are all smaller local receiving environments. These streams are all small rocky bottomed streams that flow within the boundaries of Waitangi Station and drain into either Lake Aviemore or Lake Waitaki.

**Table 3. Water Quality Study mitigation requirements for Waitangi 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
Waitangi	N/A	N/A	N/A	N/A	N/A	N/A

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## 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**

<b>Mandatory good agricultural practices</b>	<b>What these practices mean on farm</b>
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	<p>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</p> <p>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.</p>
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	<p>Maintaining good crop input records is important for:</p> <ul style="list-style-type: none"> <li>• The calculation of cumulative annual organic fertiliser applications and also their contribution to long term nutrient supply;</li> <li>• The prediction of realistic crop yields that are used to determine crop requirements;</li> <li>• Providing accurate inputs to the OVERSEER nutrient budgeting model that is being used here as a proxy for</li> </ul>

	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 Waitangi Station, using the most stringent nutrient mitigation requirement, are 56286 kg N/year and 2390 kg P/year. The table below shows the output from OVERSEER for the modelled proposed farming system at Waitangi Station. 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 5. Total N and P losses modelled by OVERSEER for the proposed farming system on Waitangi Station and WQS thresholds**

	OVERSEER modelling proposed outputs kg/year	WQS threshold kg/year
Total N leaching/runoff	46354	56286
Total P leaching/runoff	671	2390

## 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 Waitangi and has highlighted potential soil 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.

### 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 establishment of irrigation will ensure improved ground cover levels which will reduce the risks associated with bare ground and wind erosion.

### 4.3.2 Site specific management measures and mitigation measures in place

1. There are vehicle/stock bridges at Waitangi to cross streams close to the Homestead/woolshed/yards.

Photo E: Wooden stock bridge for stock and vehicles to cross a stream close to the woolshed.



2. There is an approximate 10m drop down to Lake Waitaki where the proposed irrigation development is to occur. This is in addition to the minimum 20m buffer zone between the Lake and the proposed irrigation development (see Figure 2)

Figure 2: Not to scale drawing of the buffer zone created at the Lake Aviemore irrigation area by the 10m bank and the 20m minimum buffer zone

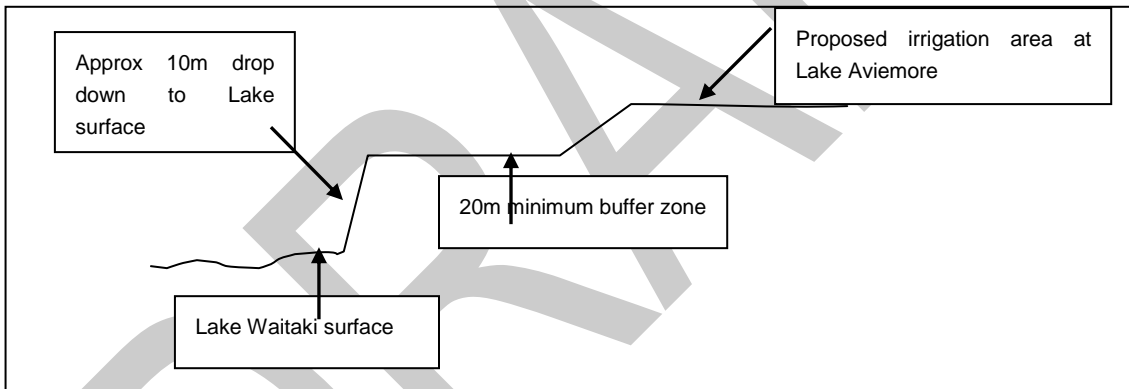


Photo F: Approximate 10m drop down to Lake Waitaki surface from the end of the buffer zone



3. Fodder crops are grown as part of the pasture renewal process, ensuring that organic matter levels are not depleted in only a few paddocks. They are usually grazed over the early spring for twin bearing ewes. Regrassing will be at the earliest opportunity.
4. A contractor or approved handler if required is used to apply chemicals at Waitangi.

#### 5. Cultivations and Trafficking

Direct drilling is the primary method for renewing 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.

Reestablishment of pastures is not expected to involve inversion tillage.

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.

#### 6. 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.

#### 7. 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.

#### 8. Erosion

There is no evidence of stock induced bank side erosion in either the Sutton or Gibson Streams. This will be monitored as part of an annual survey, as outlined in Table 8.

### 4.3.3 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 Waitangi Station

### 5.1 Mitigation measures and management options adopted on Waitangi Station

The table below shows the all the mitigation and management tools that are proposed to be undertaken on Waitangi 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..**

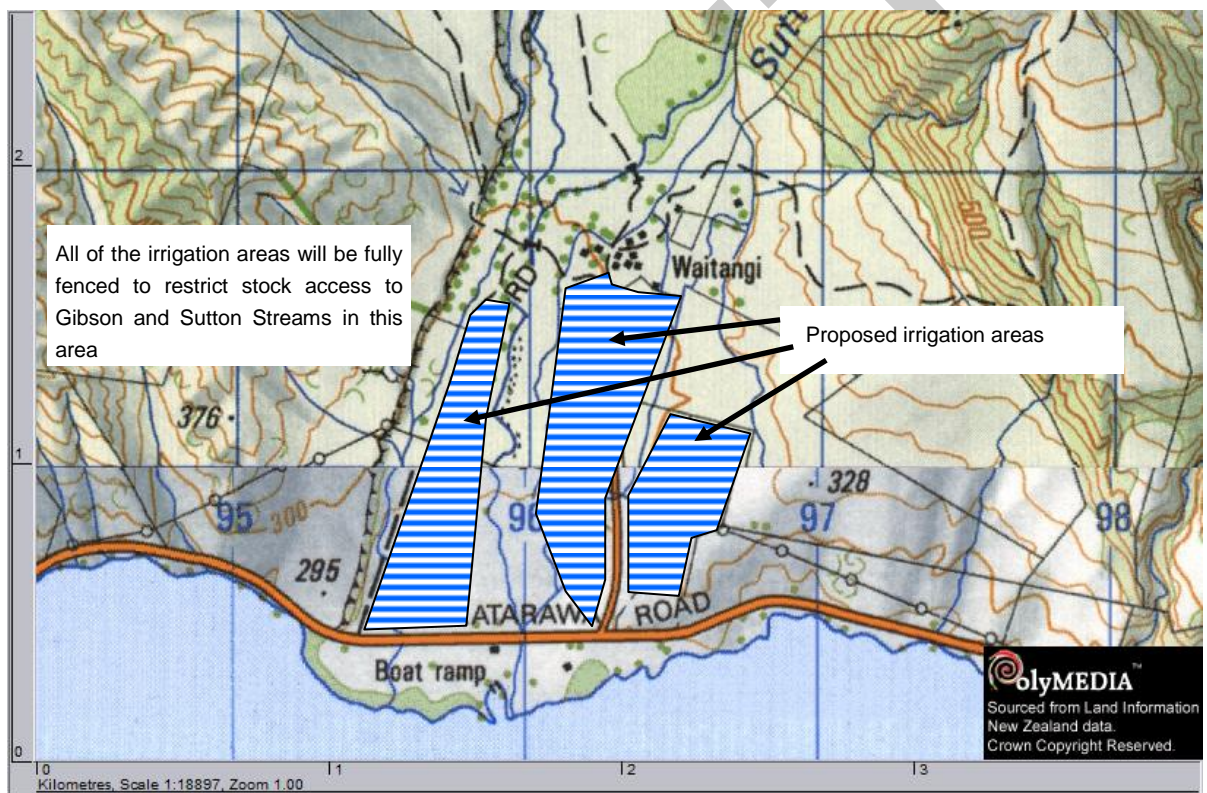
Table 6 indicates in brief how the measures are to be monitored and audited.

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

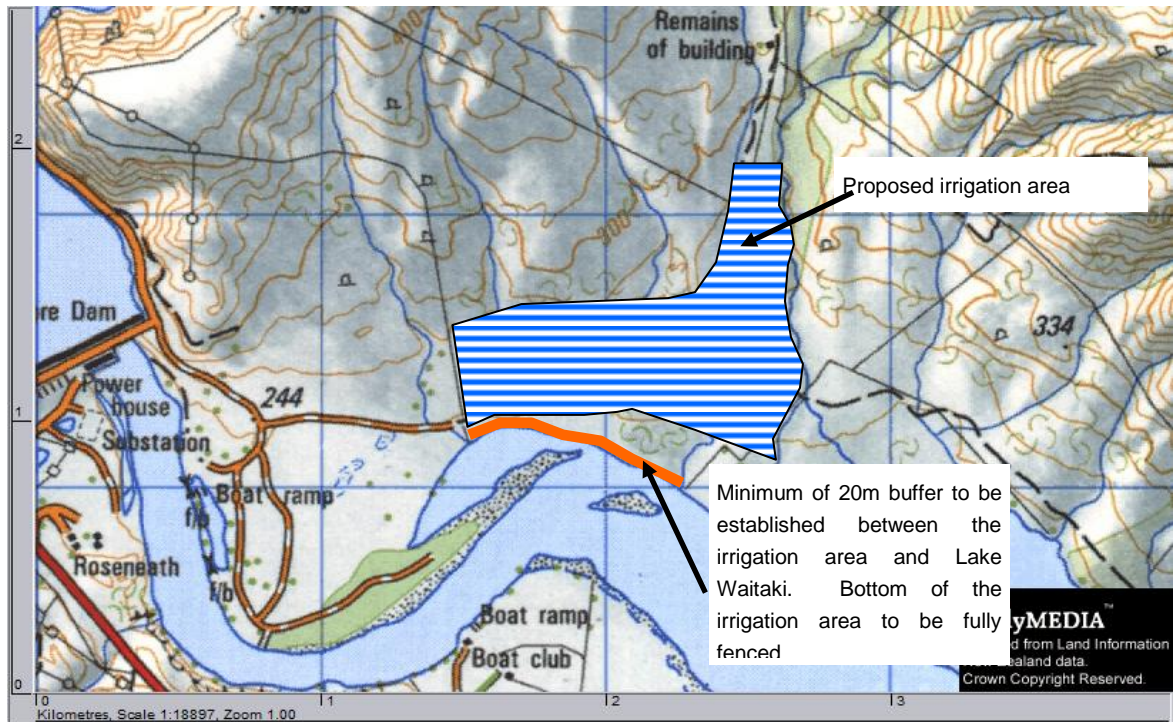
FEMP stage	Measure	Monitoring	Auditing
1	Fertilisers applied according to code of practice for fertiliser use		Self certification
1	Accounting for all sources of nutrients including applied effluents and soil reservoirs	Soil and effluent testing and cumulative effluent inputs per management unit	Reconciliation 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 land. Application of fertiliser on the hill country is often in autumn or late winter and is approximately 60kg/ha	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; only applicable to those areas where the natural P level of the soil is below 30	Regular soil testing (every 3 years)	Submission of soil tests
3	Gibson and Sutton Streams to be fenced within the irrigation area, with irrigation set back from the streams of a minimum of 5m.	Photos and location map	Annual Audit and updates by photos if additional fencing is undertaken

FEMP stage	Measure	Monitoring	Auditing
3	Buffer zone created between the irrigation area and Lake Waitaki; minimum of 20m (see Photo C, Figure 2 and Map C)	Photo and location map	First annual audit and then bi-annual photo
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	Location Plan and photos in first audit report
3	20 metre layback from any water way when applying fertiliser by land based application e.g. bulk spreader	Field records	Annual Audit report

Map F: Mitigation measures at Sutton/Gibson proposed irrigation development area



Map G: Mitigation measures at Lake Aviemore proposed irrigation development area



## 5.2 Monitoring and Auditing

### 5.2.1 Baseline monitoring

Baseline monitoring is already underway on Waitangi Station.

*Water quality monitoring of the Sutton Stream was undertaken by the Upper Waitaki Water Quality Trust for the applicant in April, June and October 2007 and January 2008.*

**Table 7. Baseline monitoring on Waitangi Station**

		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	Sutton Stream exit from property	April, June October 2007 and January 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

		Location	Frequency	Measured parameters to include
Pest	Pest Infestation	Whole Farm	Annually	Done as part of an annual survey from ECan Hot spot locations of pest infestation
Weed	Weed Infestation	Whole farm	Annually	Self monitored for weed infestation

## 5.2.2 On-going monitoring

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

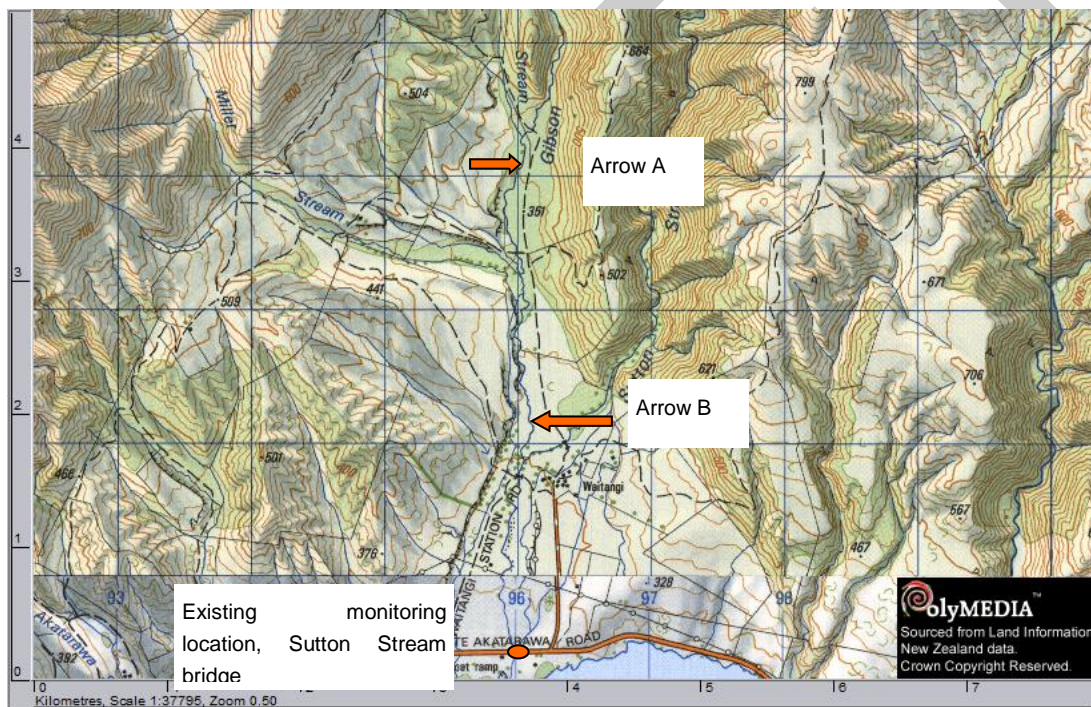
Table 7 above shows the current monitoring undertaken for Waitangi Station and Table 8 below shows the proposed monitoring plan, frequency, location for the monitoring along with the triggers and contingency plans if triggers are exceeded.

**Table 8. Example monitoring plan for Waitangi 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 of 30 in those areas where the Olsen P is naturally less than 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 irrigation blocks	Annually	Runoff	Runoff occurring	Immediately review current runoff mitigation options for tracks. Introduce further runoff removal infrastructure where appropriate.
Water	Surface water quality	The existing Sutton Stream site and another in conjunction with neighbour, yet to be determined	Quarterly for the first 5 years and then reviewed	Total Nitrogen, nitrate, ammonia, total Kjeldahl nitrogen, total phosphorus, dissolved reactive phosphorus, E Coli and suspended solids.	No significant decrease in water quality	If comparative surface water analysis indicates a decrease in surface water quality then the degraded determinant should be identified while a full root cause analysis is undertaken
Water	Irrigation application		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

	Location	Frequency	Measured parameters to include	Triggers	Contingency plan if triggers are exceeded
Fertiliser	Fertiliser application	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
Pest pressures	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
Weed	Weed populations Relevant blocks	Annually	% or magnitude of infestation	Self trigger	Undertaken annually by self monitoring, spray those areas that require

Map H: Existing and proposed locations of water quality monitoring. A water quality monitoring point will be chosen between Arrows A and B after consultation with the neighbouring applicant.



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, 8 and 9

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 your 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.

Those pertaining to FEMP stages 1 and 2 are included here.

Table 9 below shows an example of an annual audit report for Waitangi Station.

**Table 9. Table showing proposed contents of an annual audit report for Waitangi 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	Legislative compliance

	should be submitted	
Fertilisers applied according to code of practice for fertiliser use	Self certification	Any issues should be rectified and identified in next audit
Accounting for all sources of nutrients including applied effluents and soil reservoirs	Reconciliation of fertiliser and soil records with nutrient budget.	Where reconciliation is not verified then this should be rectified at next audit
Even fertiliser application	Calibrate and optimise fertiliser spreaders annually and every 5 years by an external auditor. Signed records for verification	Spreaders not performing shall be recalibrated
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.
Gibson and Sutton Streams to be fenced within the irrigation area, with irrigation set back from the streams of a minimum of 5m.	Check fenced area is present. Photos	Areas of fencing damage should be repaired.
Buffer zone created between the irrigation area and Lake Waitaki; minimum of 20m (see Photo C, Figure 2 and Map C)	Check setback area is present. Photos	Areas of fencing damage should be repaired.
20 metre layback from any water way when applying fertiliser 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.

## 6. Summary

This FEMP has been written to serve two purposes; to ensure the proposed 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 proposed 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.

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## 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

<b>Some guideline questions for track management and runoff</b>		<b>Notes/description</b>
1	Do any regularly used tracks run through streams?	No, culverts or bridges are installed (photos of stock bridges). 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?	Bridges are used for stock crossing (Photos) 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
6	Do you have a silage pit located near a permanent watercourse?	NO
<b>Some guideline questions for stock management</b>		
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?	Yes, fenced areas. The new irrigation development will exclude stock from flowing waterways within the irrigation area, buffers will be created of at least 20m at Lake Aviemore and similar at Sutton and Gibson

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 for dipping, runoff minimal and cannot enter a waterway
<b>Some guideline questions for biodiversity</b>		
1	Are there any special areas or species of interest or conservation on the farm?	NO
2	Are there any water or wetland features on the farm?	NO
3	Are these features actively protected?	
<b>Some guideline questions for chemical usage</b>		
	<i>Chemical storage and handling is dealt with under the Hazardous Substances and New Organisms Act</i>	
1	Are those handling chemicals of 'approved handler status'?	Yes, contractors are used for spraying
<b>Some guideline questions for water</b>		
1	Do you use border dyke irrigation?	NO
2	Do you collect wipeoff losses?	N/A
3	Are these wipeoff losses discharged to a watercourse	N/A
4	Is there evidence of bankside erosion in any permanent flowing watercourses?	No, all of the streams on the property are shallow and stony
<b>Some example questions on cropping</b>		

1	Is inversion tillage used? Describe	Yes, is required to break in new ground, for all pasture renovation direct drilled is used
2	Are soils left bare over winter?	Yes occasionally, they are sprayed and then left (not cultivated)
3	If arable or fodder crops are grown, are measures taken to conserve or build soil organic matter on arable land?	Yes, Italian ryegrass is grown for ewes just prior to lambing, it is not grazed in the winter
4	Are remedial measures in place after winter grazed crops?	N/A
5	Is there a possibility of run off from winter grazed areas reaching a water course?	N/A
6	Other cropping issues or incidences? Please describe	
<b>Some example questions on soil health</b>		
1	Are there compacted, consolidated or capped soils?	None evident
<b>Some example questions on pest and weed management</b>		
1	Do you undertake any current pest or weed control? E.g rabbits, gorse	Few rabbits controlled by shooting