Farm Environmental Management Plan: Bog Roy Station

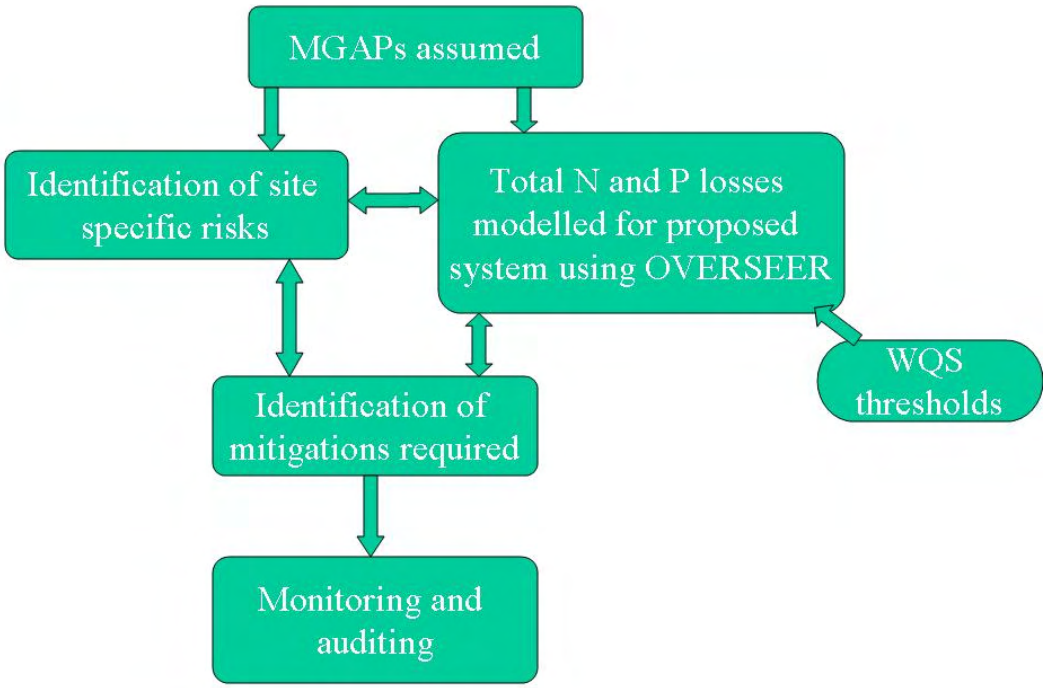
1. Introduction

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



2. Farm Description

2.1 General farm description

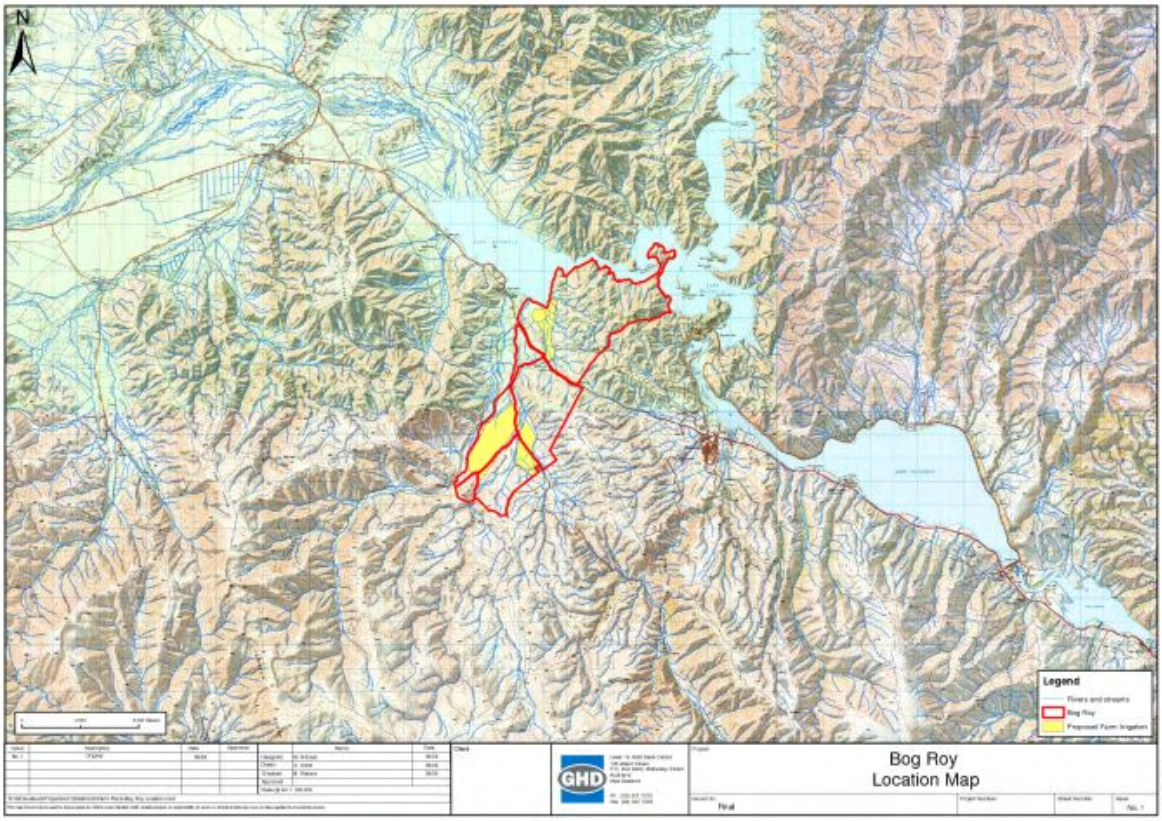
The property currently runs beef cattle and sheep.

The property is 3,000 hectares in total and consists of flatter country (closest to Lake Benmore) and gently rolling country.

30 hectares is currently irrigated with water taken from Corbies Creek, using k-line irrigation. This will be developed to enable up to 60ha to be spray irrigated.

The irrigated land is vital to the economics of the operation allowing the applicant to grow winter feed and finish all the properties young stock.

Irrigation on Bog Roy has occurred since the 1960's, and prior to this, the system was used to supply stockwater. The applicant's grandfather constructed the system and it is thought to have been put in place in the early 1950's. Therefore, it has been in existence for some time.



Location Plan

Aerial Photograph of Bog Roy Station

Table 1. Cover utilisation by season and stock class for current system

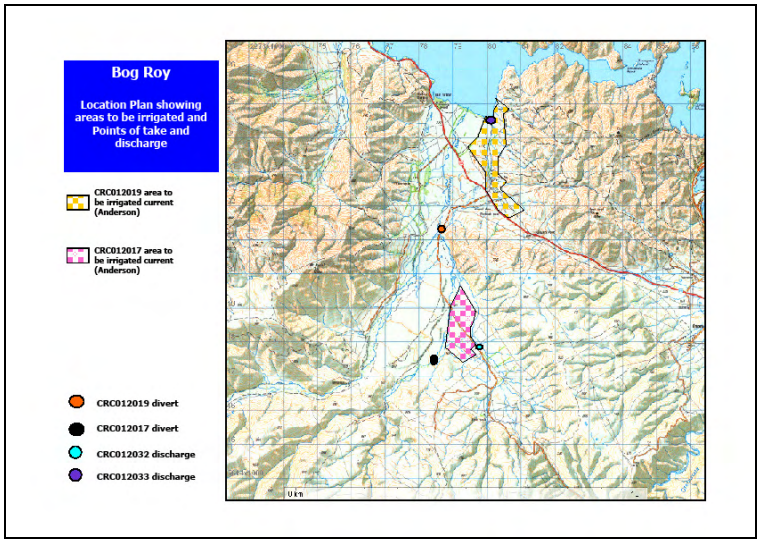
	Cover utilisation by season and stock class - CURRENT			
Class of stock	**Spring**	**Summer**	**Autumn**	**Winter**
Ewes	Oversewn hill	Oversewn hill	Oversewn hill	Oversewn hill
Hoggets	Irrigation/Improved Dryland	Irrigation/Improved Dryland	Irrigation/Improved Dryland	Irrigation/Improved Dryland
Breeding cows	Native	Native	Native	Native
R1 Steers & Heifers	Irrigation/Improved Dryland	Irrigation/Improved Dryland	Irrigation/Improved Dryland	Irrigation/Improved Dryland

2.2 Proposed farming system

The mode of irrigation application will change over the next 5 years (from date of renewal) from a current flood (100ha) and k-line (28ha) system, to entirely spray. However, the actual farming system (stock classes and numbers) will to a large degree remain the same.

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	Oversewn hill	Oversewn hill	Oversewn hill	Oversewn hill
Hoggets	Irrigation/Improved Dryland	Irrigation/Improved Dryland	Irrigation/Improved Dryland	Irrigation/Improved Dryland
Breeding cows	Native	Native	Native	Native
R1 Steers & Heifers	Irrigation/Improved Dryland	Irrigation/Improved Dryland	Irrigation/Improved Dryland	Irrigation/Improved Dryland



Irrigation Area

2.3 Soils

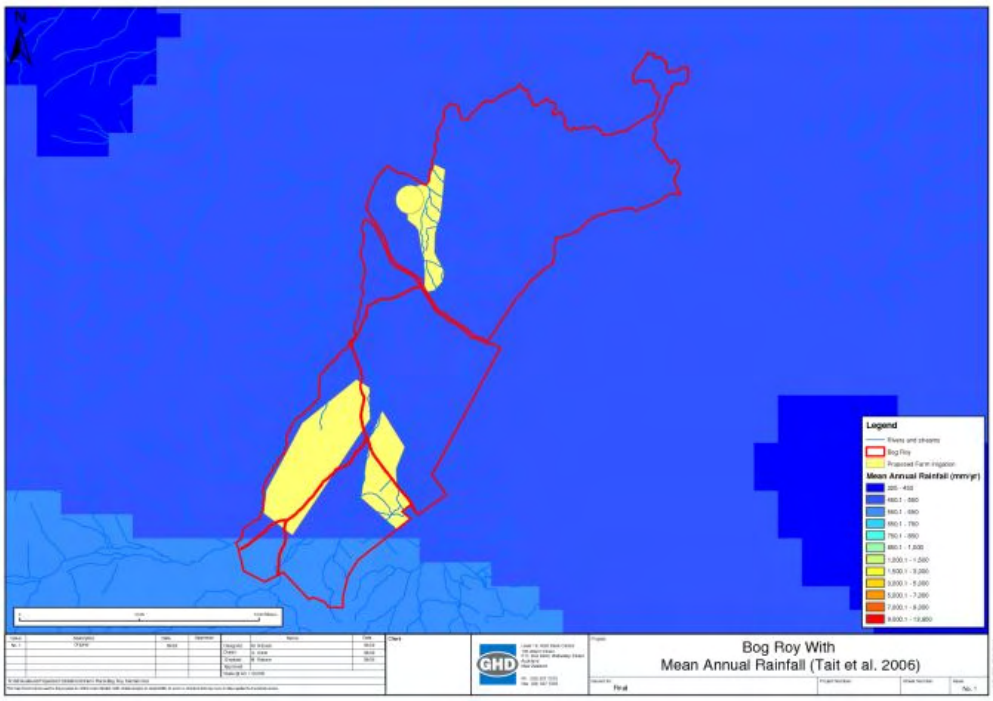
- Eweburn 45mm
- Grampians 90mm
- Streamlands 90mm and 100mm

2.4 Topography

Bog Roy comprises of approximately one third flats, one third improved rolling hill and one third native steeper hill.

2.5 Rainfall

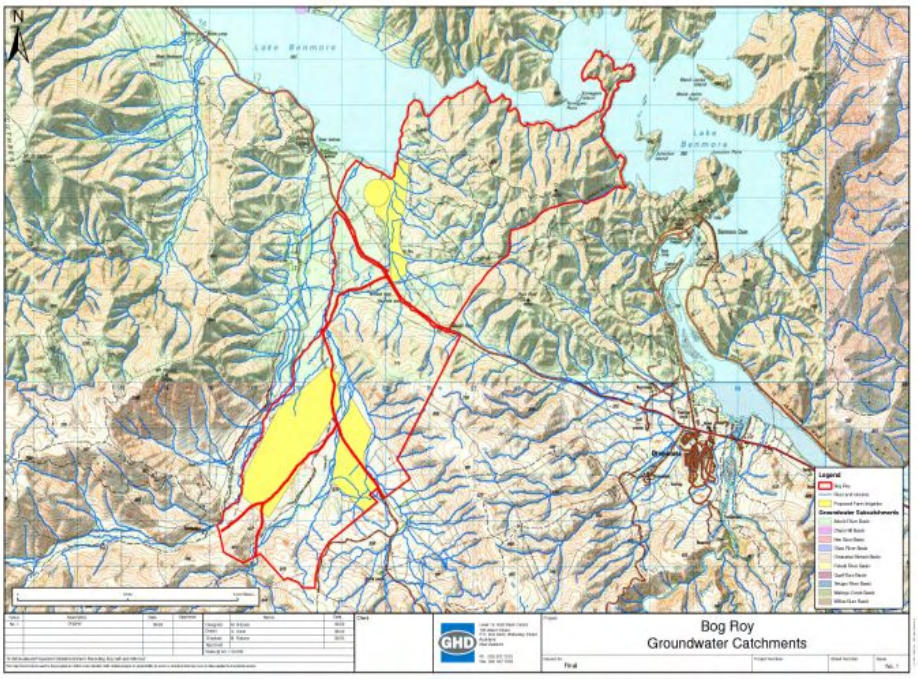
The average annual rainfall measured at the Bog Roy Homestead is 400mm. The WQS indicates that the average annual rainfall for the irrigation area is in the order of 500mm to 600mm.



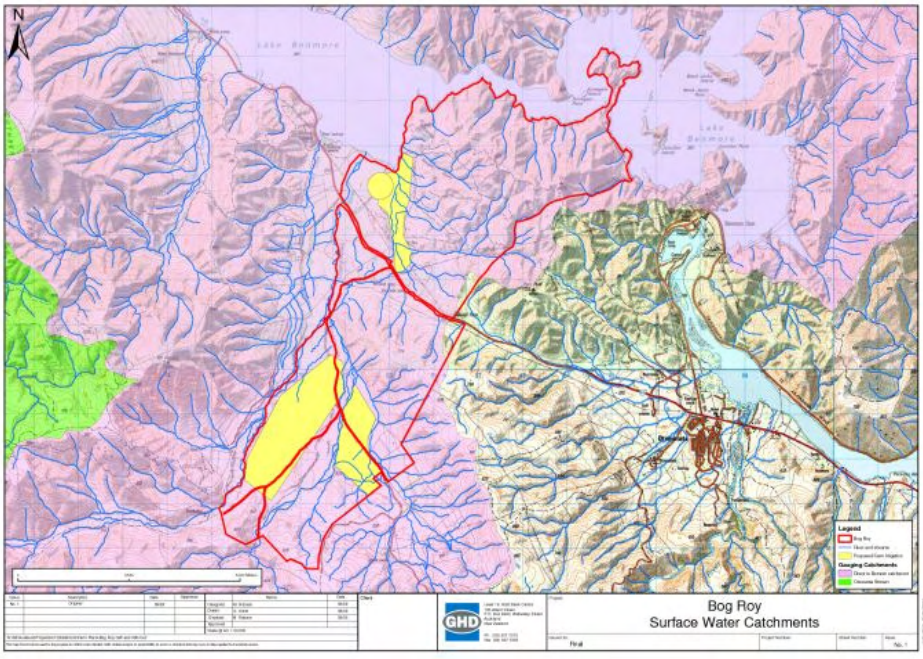
Rainfall Map

3. Environmental Context

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



Groundwater Receiving Environment



Surface Water Receiving Environment

3.1 Water Quality Study receiving environments and mitigation requirements

Bog Roy Station, according to the WQS, has no groundwater catchment, but lies in the “Ahuriri Arm” surface water catchment.

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 Bog Roy Station.

Ahuriri Arm Mitigation required kg/ha irrigated land
N -10.70
P -1.10

For this farm, the Ahuriri Arm mitigation requirements are the most stringent. These mitigation requirements cap Bog Roy Station's nutrient discharges at 8,834 kg N per annum and 237 kg P per annum.

3.2 Local receiving environments

The Otamatapaio River and Lake Benmore are the two local receiving environments.

The Otamatapaio River drains the Hawkdun and St Cutherbert Range, directly into the southern side of the Ahuriri Arm of Lake Benmore at Sailors Cutting. The Otamatapaio River has a catchment area above SH83 of 185km^2. Corbies Creek also contributes to the Otamatapaio catchment.

The catchment altitude ranges from 360m up to 1850m, and the upper catchment has snow on the shady faces for much of the winter months and therefore low flows in the catchment are usually experienced in winter.

There are significant flow losses down the system below the Foot Bridge; however the losses are the greatest approximately 200 metres downstream of the Corbies Creek confluence where often in the summer months the river bed is completely dry.

The Otamatapaio supports fisheries common to high country rivers. These include common and upland bullies, common river galaxies, rainbow and more predominantly brown trout.

Lake Benmore is a hydro lake, and part of Bog Roy Station was inundated with the creation of the lake in the 1950's. Therefore, part of the station now borders the lake.

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 Bog Roy Station, using the most stringent nutrient mitigation requirement, are 8,834kg N/year and 237 kg P/year. Table 5 below shows the output from OVERSEER for the modelled proposed farming system at Bog Roy 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 4: Total N and P losses modelled by OVERSEER for the proposed farming system on Bog Roy Station and WQS thresholds

	Nitrogen Threshold (kg/farm)	Phosphorous Threshold (kg/farm)
MWRL Water Quality Study Property Thresholds needs + buffer	9313	116
OVERSEER® outputs	8505	106

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

4.3 Farm Environmental Risk Assessment

Below are the details of the Risk assessment undertaken in December 2009 which includes management measures and existing mitigation measures.

4.3.1 All the vehicle tracks that get used even rarely are culverted (even up the hill).
4.3.2 No tracks directly runoff into any waterways.
4.3.3 No evidence of soil wash or runoff.
4.3.4 No silage pits used, but there are buns on the property. These are located away from any waterways, and are fenced off.
4.3.5 Stock are not restricted from entering watercourses, and the majority of the stock get their water from streams. This would change if the consent went ahead and pivots were put in. The streams would be fenced and the stock would have troughs.
4.3.6 The only real stream on the place is in the flood irrigated land, this is only a seep when the irrigation is not running.
4.3.7 In the sheep yards water is not often used, but on the odd occasion when lice get back water will be used in the yards. One set of yards is relatively close to a waterway, and the dip would be allowed to drain into this (see photos). Electric eye dips are used so there is not a lot of runoff present. The distance to the stream was approximately 50 metres.
4.3.8 No special species of interest or areas on the farm.
4.3.9 There is one wetland feature on the farm closer to the lake, this zone will likely be retired to DOC with tenure revue.

4.3.10 If any large areas are being sprayed out contractors are brought in to do this job.

4.3.11 There is currently border dyke irrigation on the property (approximately 100 hectares); the majority of this would be converted to spray irrigation (k-line) in the future.

4.3.12 The runoff from the border dykes is collected to some degree in a small (10 to 20 metre riparian zone).

4.3.13 Direct drilling is the ideal form of re-seeding used. With the land being turned over if it needs breaking in.

4.3.14 Soils are not left bare as much as possible over the winter. There is not a lot of grazing over the winter, with the majority of the stock on the hill. If there is grazing done it will be rye corn, this would then be re-drilled over the spring with lucerne.

4.3.15 There may be up to 1000 hoggets on this (near home), this area is not close to any waterways.

4.3.16 No sign of compacted or consolidated soils on the property, even under the border dykes.

4.3.17 Pest control measures in place are; shooters for rabbits, with poisoning done on occasion. 1080 was used two weeks ago (mid November). Very little gorse and broom but spot spraying is used to keep this under control.

4.3.18 Fertilisers used are; 20 units of P. 20-25 units of K, this only gets applied if the paddock has been cut for bailage, and is often every second year. 30 units of S every year. 35-40 units of N in the spring and autumn. 80-85 kg of Urea, this depends on the amount of feed around.

4.3.19 On the improved dry land areas Sulphur Super 20 at 150kg per year, this is applied if there is a good harvest off the lucerne; otherwise it is every second year. On the hill maxi sulphur super is used every second year at 80kg.

4.4 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. 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.)***
2. Monitoring and identification of any problems arising for the above issue has been included in Table 8.

5. Farm Environmental Management Plan for Bog Roy Station

5.1 Mitigation measures and management options adopted on Bog Roy Station

The table below shows the all the mitigation and management tools that are proposed to be undertaken on Bog Roy 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 5. Table of mitigation options, monitoring and auditing for Bog Roy 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 June/July application of fertiliser on the irrigated area	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 streams that are located within a paddock that is used by stock regularly, if he paddock is not used regularly a temporary waratah fence would be acceptable, leave drinking bays for stock water	Surface water testing of race/waterway as it enters and exits the property, photos in the audit report	Annual auditing visit.
3	Redevelopment of existing irrigation to spray	Photos and location map	Photos in audit report until conversion completed

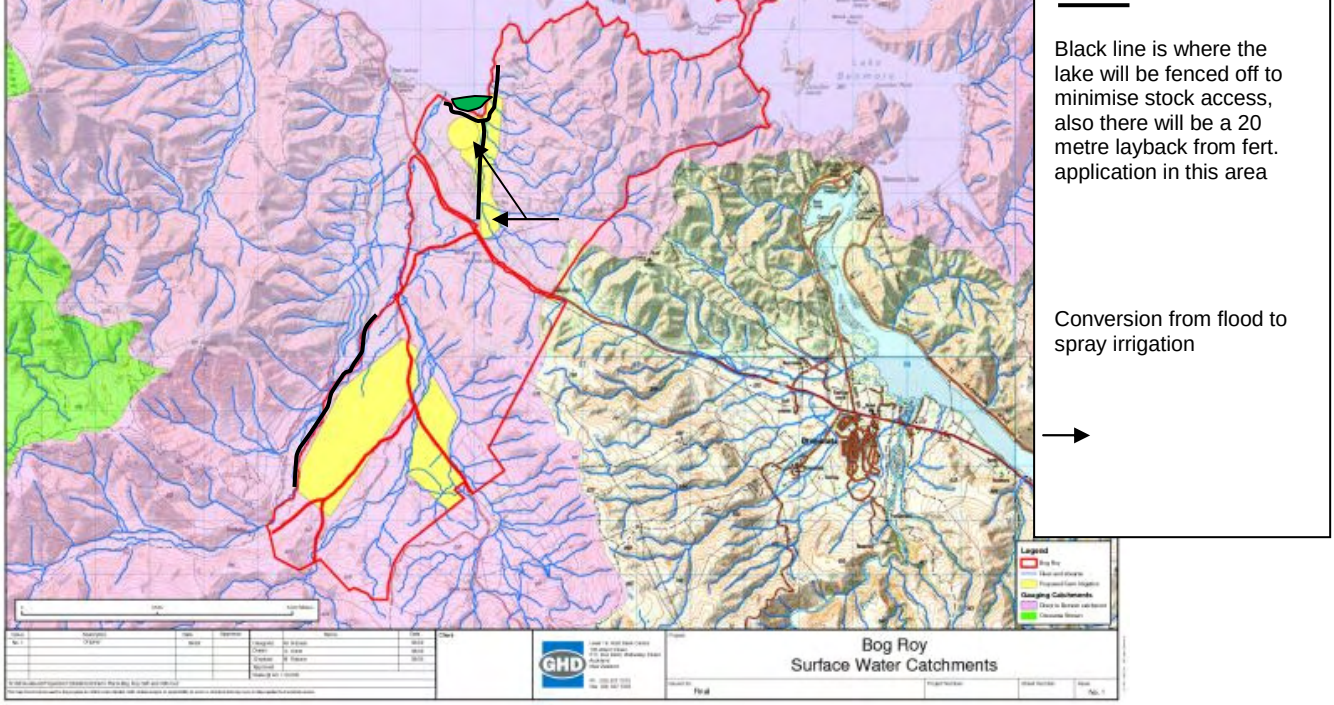
FEMP stage	Measure	Monitoring	Auditing
3	20 metre layback from any permanent waterway while applying fertiliser by land based application	Field records	Annual audit report
3	Fence (permanent or temporary while stock present) a 5-11 metre irrigation buffer zone back from any waterway, (Lake Benmore)	Photos	Annual audit visit, and photos in the report

Photo 1

Photo 2

<u>Photo 1</u> shows the current flood irrigation land, the dark area (sprayed off) is going to likely be converted to spray irrigation with the rest of the flood irrigation land becoming improved dry land.

<u>Photo 2</u> shows the flood irrigation at work and the runoff race located in the middle of the paddock. This race is allowed to enter the lake. It is proposed that within 5 years all irrigation will be converted to spray



5.2 Monitoring and Auditing

5.2.1 Baseline monitoring

Baseline monitoring is already underway on Bog Roy Station.

Table 6. Baseline monitoring on Station Bog Roy Station

		Location	Frequency	Measured parameters to include
Soil	Soil nutrient testing	All blocks in rotation	1 in 2 years	Standard suite of soil nutrients,
Water	Surface water quality	Corbies Stream, Intake at Corbies	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	As needed	% Ground cover, species

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 Bog Roy 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 7. Example monitoring plan for Bog Roy 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
Runoff	Wet weather survey	All blocks	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.

The audit measures and actions in case of non-compliance will be finalised once the FERA is completed. Those pertaining to FEMP stages 1 and 2 are included here.

Table 8 below shows an example of an annual audit report for Bog Roy Station.

Table 8. Table showing proposed contents of an annual audit report for Bog Roy 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
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.
Fence off the streams that are located within a paddock that is used by stock regularly, if he paddock is not used regularly a temporary waratah fence would be acceptable, leave drinking bays for stock water	Check fenced areas are present and where they have indicated they will be. Photos	Areas of fencing damage should be repaired.
20 metre layback from any permanent waterway while applying fertiliser by land based application	Field records and maps	If maps not received with annual audit this should be rectified by the next audit.
Fence (permanent or temporary while stock present) a 5-11 metre irrigation buffer zone back from any waterway, (Lake Benmore)	Check fenced areas are present and where they have indicated they will be. Photos	Areas of fencing damage should be repaired.
Redevelopment of existing irrigation to spray	Conversion plan and map	Ensure conversion is completed within the specified timeframe

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 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.