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Farm Environmental Management Plan

Mary Range Farming

Prepared for Simons Pass Station Ltd

Ryder Consulting

Date November 2009

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Prepared for Simons Pass Station Ltd

by

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Cover photo: Flooding on Mary Range Station with Mary Range in background (Photo by Melissa Robson).

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Table of Contents

1.0 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 WQS and has been followed here. An overview schematic of the process of building a FEMP is shown in Figure 1 below.

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

1.1 Purpose of a Farm Environmental Management Plan

This Farm Environmental Management Plan (FEMP) has been written to serve two purposes, to ensure the proposed farm system can meet the nutrient mitigation requirements set out by the Water Quality Study, and to identify and mitigate other farm specific environmental risks that arise from the inherent characteristics of the farm or from the proposed farm system and its management. These farm specific risks include uncontrolled discharges that are not identified in farm nutrient budget modelling but that may still have an environmental effect.

1.2 Why use a Farm Environmental Management Plan?

Farm management planning and the use of best management practices and mitigation methods are commonly used to reduce diffuse pollution from farms.

Diffuse pollution, as the name suggests, does not come from a single traceable source. In many cases the impacts are both temporally and spatially distanced from the source. This makes measurement from and traceability to an individual property difficult. For this reason, instead of measuring the losses, the emphasis is placed on the implementation of techniques that are known to reduce the contaminant.

1.3 Scope of a Farm Environmental Management Plan

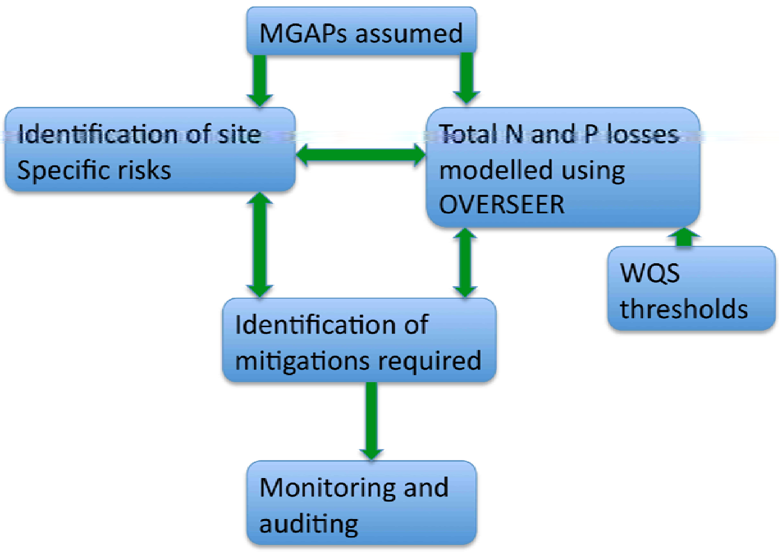
The development of a FEMP is divided into four sections:

- The first section describes Mandatory Good Agricultural Practices (MGAPs) that need to be implemented across the farm, and include the base assumptions of the OVERSEER model[1]. This helps to validate the use of the model on the property;

[1] In the future, should an alternative model be used, the assumptions for that model would need to be specified in this good agricultural practice section.

- The second section involves the construction of a representative farm model in OVERSEER and demonstrating the fulfilment of the nutrient mitigation required by the Water Quality Study; and
- The third section involves the identification and mitigation of site-specific environmental risks.
- The fourth section describes the proposed monitoring and auditing strategy.

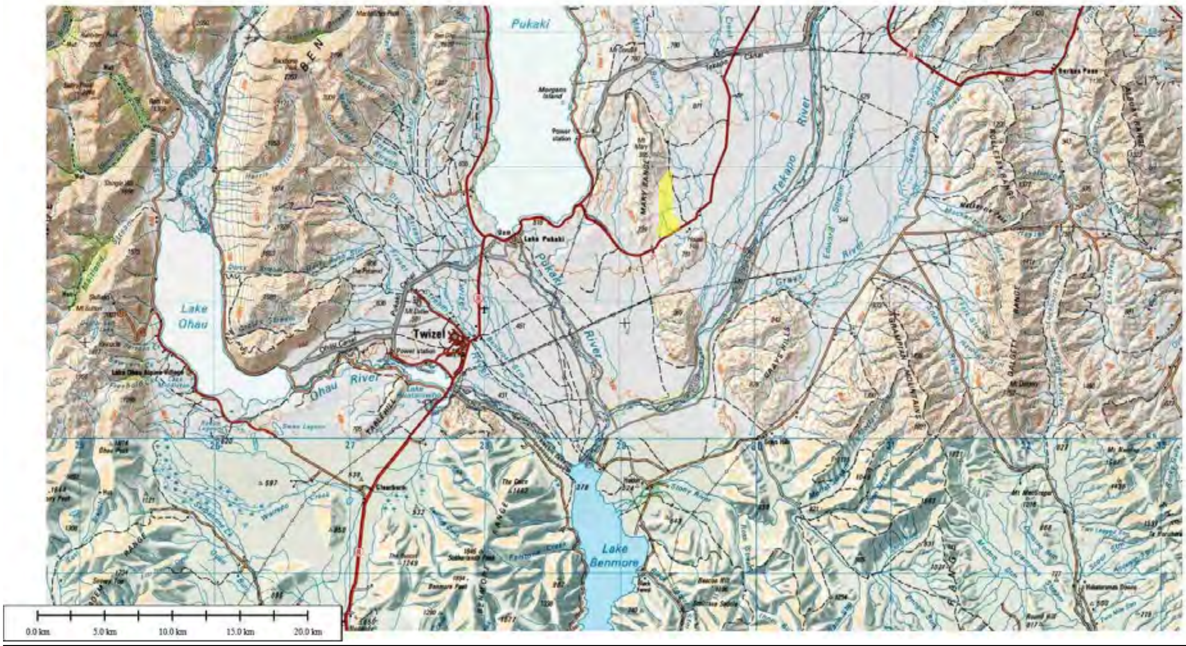
Figure 1 An overview schematic of the process of building a Farm Environmental Management Plan



2.0 Farm Desription

Mary Range Farming is currently a part of Simons Pass Station and is located to the east of Lake Pukaki and the Mary Range (Figure 2). The station consists of 950 ha of predominantly flat country. The flats include a large area of existing border dykes and is currently running beef and sheep.

Figure 2 Location map for Mary Range Station (provided by Water Dynamics)



2.1 Soils

The one main soil series on Mary Range Station is an association of Grampian/Simons/Glenrock.

Grampian/Simons/Glenrock soil series association occurs on easy rolling to rolling piedmont fans which grade into more gently sloping fans and terraces. Where fans coalesce, Grampian soils occur on more gently sloping land. Simons soils will occupy planar old fans with moderately deep silty loess mantle and will also occupy nearly level glacial outwash terraces, with pockets of Glenrock soils occupying associated wind deflation hollows (Webb, 1992).

Soils of the Simons series are well drained soils formed from deep to moderately deep loess deposits and are characterised by 15-25 cm silt loam to fine sandy loam top soils and B horizons with a friable structureless C horizon beginning at around 60 cm. The depth of gravels varies between 45 and 150 cm. These soils have an increased bulk density in the subsoil and in deeper profiles a fragipan can be found below 50 cm.

Soils of the Grampian series are similar to Simons series although with better developed nut structure in the upper horizons and a more pronounced fragipan that can lead to perching of water within 60 cm of the soil surface.

Soils of the Glenrock series are somewhat excessively to well drained soils, mainly shallow and stony, formed on fan detritus on younger fans and are characterised by 8-20 cm of silt loam to fine sandy loan weakly structured top soils with a silt loam to very stony loam B horizon and a structureless C horizon at about 40-50 cm (Webb, 1992). Wide variations of stoniness and texture can occur over short distances (Webb, 1992).

2.2 Climate

The climate in the Mackenzie Basin is characterized by dry summers and cold winters. Average annual rainfall on this station is 589 mm (GHD, 2009), and there is moderate variability in the monthly rainfall. Mean annual temperature is 10.3 degrees C, with a minimum winter temperature of < -2 degrees C (Snow and King, 2008).

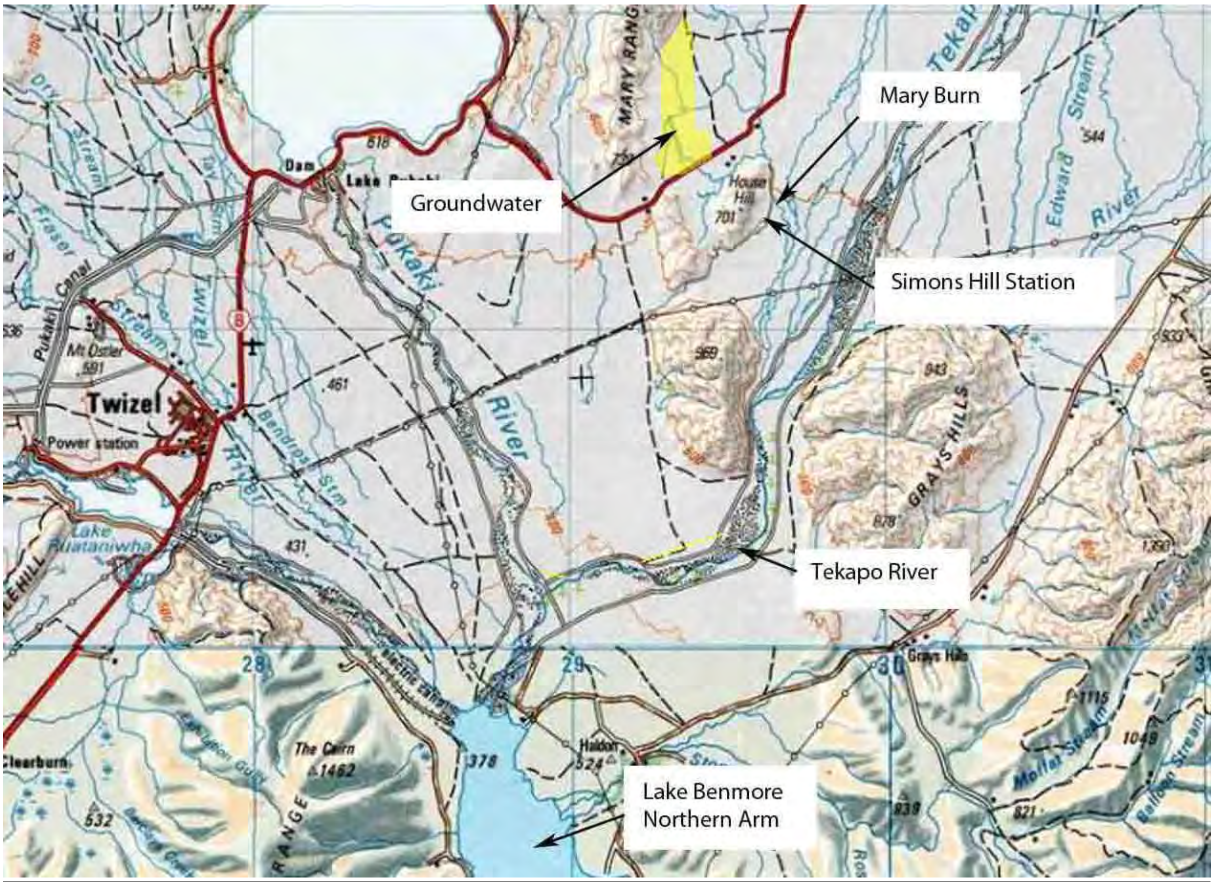
2.3 Topography

The irrigation command area is on flat country sloping slightly to the south east.

3.0 Environmental Context

The environmental context of the farm is a reference to both the local and wider receiving environments. Figure 3 shows the receiving environments of Mary Range Station.

Figure 3 Map showing receiving environments of Mary Range Station



3.1 *Water Quality Study mitigation requirement*

The irrigated area of Mary Range Station, according to the WQS, lies in the Mary Burn surface water sub-catchment and in the Tekapo groundwater sub-catchment (refer to Annexure 1).

Table 1a and Table 1b show the calculated nutrient mitigation requirement for the receiving environments as determined in the WQS and the resulting thresholds for Mary Range Station.

For this farm, the Mary Burn periphyton thresholds are the most restrictive for P and the Tekapo River periphyton thresholds are the most restrictive for N. These mitigation requirements cap Mary Range Station's nutrient discharges at 17,794 kg N and 1,013 kg P per annum.

3.2 *Local receiving environments*

There are no on farm local receiving environments for Mary Range Station, however, off farm, the local receiving environments are the neighbouring station, Simons Hill and the Mary Burn at the base of House Hill. Received water from the Mary Range, surface runoff and border dyke outwash leaves the property and discharges onto the neighbouring station through multiple channels, some of which converge and discharge into the Mary Burn.

Table 1a Water Quality Study mitigation requirements for Mary Range Station . Yellow highlights indicate receiving environment most restrictive mitigation (GHD, 2009)

Farm	Surface water sub-catchment	Secondary surface water sub-catchment	Ground water sub catchment	Lake Sub-catchment	Proposed whole farm N loss from WQS	Proposed whole farm P loss/ha from WQS	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		Groundwater mitigation required kg/ha irrigated land		Lake mitigation required kg/ha irrigated land	
							N	P	N	P	N	P	N	P	N	P	N	P
Mary Range Station	Mary Burn	Tekapo	Tekapo	Northern	18024	1271	0.7	-0.9	-0.8	-0.2								

Table 1b Water Quality Study mitigation requirements for Mary Range Station continued

Stream mitigation required for periphyton kg/farm		Secondary stream mitigation required for periphyton kg/farm		Stream mitigation required for ANZECC kg/farm		Secondary stream mitigation required ANZECC kg/farm		GWR mitigation required kg/farm		Lake mitigation required kg/farm		Stream mitigation threshold for periphyton kg/year		Secondary stream mitigation threshold for periphyton kg/year		Stream mitigation threshold for ANZECC kg/year		Secondary stream mitigation threshold for ANZECC kg/year		Groundwater mitigation required threshold kg/year		Lake mitigation required threshold kg/year		Overall Farm thresholds for WQS mitigation kg/year	
N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P
200.9	-258.3	-229.6	-57.4	0	0	0	0	0	0	0	0	18225	1013	17794	1213	18024	1271	18024	1271	18024	1271	18024	1271	17794	1013

4.0 FEMP Development

4.1 Mandatory good agricultural practice (MGAPs)

Table 2 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 2 Mandatory good agricultural practices

Mandatory good agricultural practices	What these practices mean on farm
Fertilisers applied according to code of practice for fertiliser use (NZFMRA, 2002).	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 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 every 5 years by an independent 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

Mandatory good agricultural practices	What these practices mean on farm
	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	Proper storage of supplements and responsible methods of feeding out that do not result in accumulations of excreta on small proportions of the farm. Where large amounts of supplements are fed out, a feed pad should used.
Winter grazing management	Winter management of stock to prevent pugging and high densities of stock in one area for long times.

4.2 OVERSEER and meeting WQS mitigation requirements

The WQS thresholds set for Mary Range Station, using the most stringent nutrient mitigation requirement, are 17,794 kg N and 1,013 kg P per annum. Table 3 below shows the output from OVERSEER for the modelled proposed farming system at Mary Range Station [2]. The results illustrate that the farm system mitigations proposed meet the N and P thresholds set out in the WQS.

A list of OVERSEER model inputs and outputs have been provided seperately.

Table 3 Total N and P losses modelled by OVERSEER for the proposed farming system on Mary Range Station and WQS thresholds

	OVERSEER modelling outputs kg/year	WQS threshold kg/year
Total N leaching/runoff	5,500	17,794
Total N leaching/runoff using Highly Developed	6,097	17,794
Total P leaching/runoff	187	1,013

Using a highly developed setting, the losses are still within the WQS threshold, therefore no further mitigation would be required should the soils become highly developed.

[2] OVERSEER modelling was conducted by AgResearch

4.3 Identification and mitigation of site specific environmental risks –Intensive sheep and beef with dairy grazing

The farm environmental risk assessment (FERA) has highlighted current or potential stock, effluent/infrastructure, soil, fertiliser and chemical site-specific risks. These risks are described below and are colour coded to indicate the severity of the risk or sensitivity of the environment to that risk[3]. All risks identified will need to be addressed in the FEMP.

Soil risks

The current soil risks arise from the presence of some surface capping and consolidation of soil. The low risk associated with the compaction and capping is due to the infrequency of rainfall conditions that cause runoff to reach a receiving environment. The soil risks associated with the proposed system are the risk of compacted and capped soils from overwintering stock and trafficking soil when wet. These Grampians/Simons/Glenrock association soils are vulnerable to soil capping and subsoil consolidation and commonly have a fragipan occurring around 50 cm, and this can lead to perching of water.

Additional soil risks associated with the proposed farm system are the use of conventional tillage to establish fodder crops and some soils will be left bare over winter after fodder crop has been grazed in situ.

Figure 4 Soil capping on Mary Range Station under Lucerne

[3] **High risk**, **medium risk**, **low risk**

Effluent/Infrastructure risks

The effluent risks associated with the current system are that liquor is not collected and spread, and direct discharges may occur from the silage pits, and yard.

Fertiliser risks

The fertiliser risks associated with the proposed farming system are that P levels may exceed 30 and no suitable storage and filling area has been identified.

Stock nutrient loss risks

The stock nutrient risks associated with the current system are that stock have access to waterways (non natural) on the property. Risks associated with the proposed farming system are that stock are overwintered outside on the property, however, stock numbers are reduced over the winter period. Additional risks are that there are no provisions for dealing with fallen stock and stock may have access to open irrigation races.

Water, runoff and tracks risks

The risks associated with the current system are that border dyke outwash losses could be discharged into the Mary Burn via the neighbouring station, under wet conditions ponded water and surface runoff discharges onto the neighbouring property and ultimately into the Mary Burn, and there are sloping fields adjacent to these waterways that are vulnerable to runoff. The low risk associated is due to the infrequency of rainfall conditions that cause runoff to reach a receiving environment. Additional risks include no reticulated water, and tracks risks associated with the proposed farming system are that stock tracks passing through a waterway may not be culverted and runoff from tracks may discharge to a waterway.

Chemical risks

The chemical risks associated with the proposed farming system are that no provision for the safe storage, handling, using and disposing of chemicals has been made and no back siphoning prevention measures have been made for when water used from an un-isolated supply is used to fill sprayers.

5.0 Proposed farm system with mitigation

The proposed farming system on Mary Range Station is an irrigated intensive beef and sheep farm with dairy grazing. This system makes use of surrounding high country runs, dairy farms and downland farms to source stock that are either grazed under contract or traded for finishing (Ogle, 2009). Stock are wintered outside and winter feed requirements are buffered through feeding silage and fodder crops. Two cuts for silage will be made between early October and mid December to be fed out in winter (Ogle, 2009).

5.1 Soils

The FERA highlighted current soils risks are associated with capped and consolidated soils. Potential additional soils risks arising the use of conventional tillage to establish fodder crops (risk of wind erosion), fodder crops grazed in situ late in autumn before being left bare over winter, overwintering stock and trafficking when wet. The proposed management or mitigation measures are:

Use direct drilling as principal method for establishing fodder crops and pastures. If this is not possible, methods such as light irrigation may be employed post cultivation to reduce the likelihood of wind blow;

Regrass at the earliest opportunity after winter grazed kale crop; and,

No trafficking of the soil when wet and as this is not always possible, the annual monitoring and identification of soil compaction in hydrologically connected areas and documented remedial actions taken. Compaction will need to be identified on an annual basis between late autumn and mid spring, excluding times when land is frozen. Compaction is identified both through visual inspection (of the soil surface and plant stress indicators) and through testing for compaction using a soil penetrometer and digging verification pits. Identified compaction should be removed at the earliest opportunity with an appropriate technique for the depth of compaction

In addition, growing the fodder crops as a part of the pasture renewal process thus not mining soil organic matter levels in a few paddocks, should be practiced.

5.2 Stock

The proposed stock on the station are between 530 and 1060 cows (beef and dairy heifer) and between 721 and 4500 sheep (lambs and hoggets) (Ogle 2009).

The FERA highlighted potential stock risks associated with stock being wintered outside on the property, stock access to open irrigation races and there being no provisions for fallen stock. The proposed management or mitigation measures are:

Frequent movement of stock over winter period;

No stock access to open irrigation channels; and,

All fallen stock will be removed from the property.

5.3 Production

The irrigated area will be under a pasture mix including ryegrass and clover. Pasture production is expected to be approximately 13.7 t dry matter/ha on irrigated and fertilised land. A 70 % pasture utilisation rate has been assumed on irrigated land. Two separate crop rotations are grown, a bi-cropped turnip (7.3 t DM/ha) and annual ryegrass crop followed by kale (12.3 t DM/ha), fed out in situ and re-grassed in spring, and secondly swede (12.2 t DM/ha), drilled in December, grazed over winter and re-grassed in spring. (Ogle, 2009). The annual farm production will be in the form of the 150 heifer grazers, 2,500 merino hoggets finished, 380 bulls finished and 4,500 cross bred lambs finished (Ogle, 2009).

5.3 Silage storage

The FERA highlighted potential effluent risks arising from silage liquor[4] not being collected and spread to land and that direct discharges may be occur from the silage pits and yard. The proposed management measures are:

No direct discharges of contaminated water from yards;

Silage is made and stored on a concrete pad and drains to an effluent collection facility; and,

The silage liquor will be recycled to land.

5.3 Anticipated fertiliser use

Specific fertiliser recommendations will be produced on an annual basis using a recommended system. Plant nutrient supply will be estimated from inorganic fertilisers as well as N fixation and animal return using a nutrient budgeting system. An annual application of approximately 50 kg N is applied across the irrigated areas except the cropping areas. The irrigated areas are maintained at an Olsen P of 25.

The FERA highlighted potential fertiliser risks arising from soil Olsen P increasing above 30 and from no suitable storage and filling area being identified. The proposed mitigation measures are:

Soil Olsen P levels to be maintained at or below 30;

Fertiliser to be stored in a covered area;

The identified filling areas will be at least 50 m from a watercourse, spring or bore and will have no drains that discharge to clean water or that can discharge direct to ground; and,

If liquid fertilisers are used, fertiliser should be stored in a bunded tank and protected from vehicle movements.

In addition, the soils will be regularly tested.

5.4 Water

The FERA highlighted water and runoff risks arising from surface runoff (including border dyke losses) from the property discharging on the a neighbouring property and ultimately into the Mary Burn, sloping fields adjacent to waterways vulnerable to runoff, no reticulated water supply and stock tracks running through waterways. The proposed mitigation measures are:

[4] All facilities containing silage and silage liquor must be of the appropriate specification as the liquor is highly corrosive.

Create a 2 wetland and swale system for attenuating runoff with single outlet point through to neighbouring property. The first wetland is an expansion and protection of the area already identified by willow growth. Outlet from this area will be through an existing open channel and discharged into the swale. The swale (broad, shallow, grassed channel) should be installed running parallel with the state highway, this will pick up any runoff from the property and discharge into created depression/wetland placed at the lowest point on the property. Any outlet from this wetland will cross the road through the existing culvert and discharge on to the neighbouring station through a single channel. The existing race that captures and transports runoff from the west and north of the property should discharge into the swale and the western end;

A wet weather survey should be conducted when possible to review the swale/wetland system;

All water for stock should be provided by a reticulated water supply; and,

Stock tracks running through waterways should be culverted and direct runoff prevented.

5.4 Chemical storage and management

The FERA highlighted that no chemical management strategy was in place. To satisfy the issues raised in the FERA the proposed management measures are:

A contractor or approved handler to be used to supply, handle, and apply chemicals on the farm;

The services of a professional crop adviser or other suitably qualified person to be used to advise on pesticide options, doses and tank mixes; and,

Back siphoning prevention measures will be implemented on the farm when filling sprayers from an un-isolated water supply.

6.0 Farm Environmental Management Plan for Mary Range Station

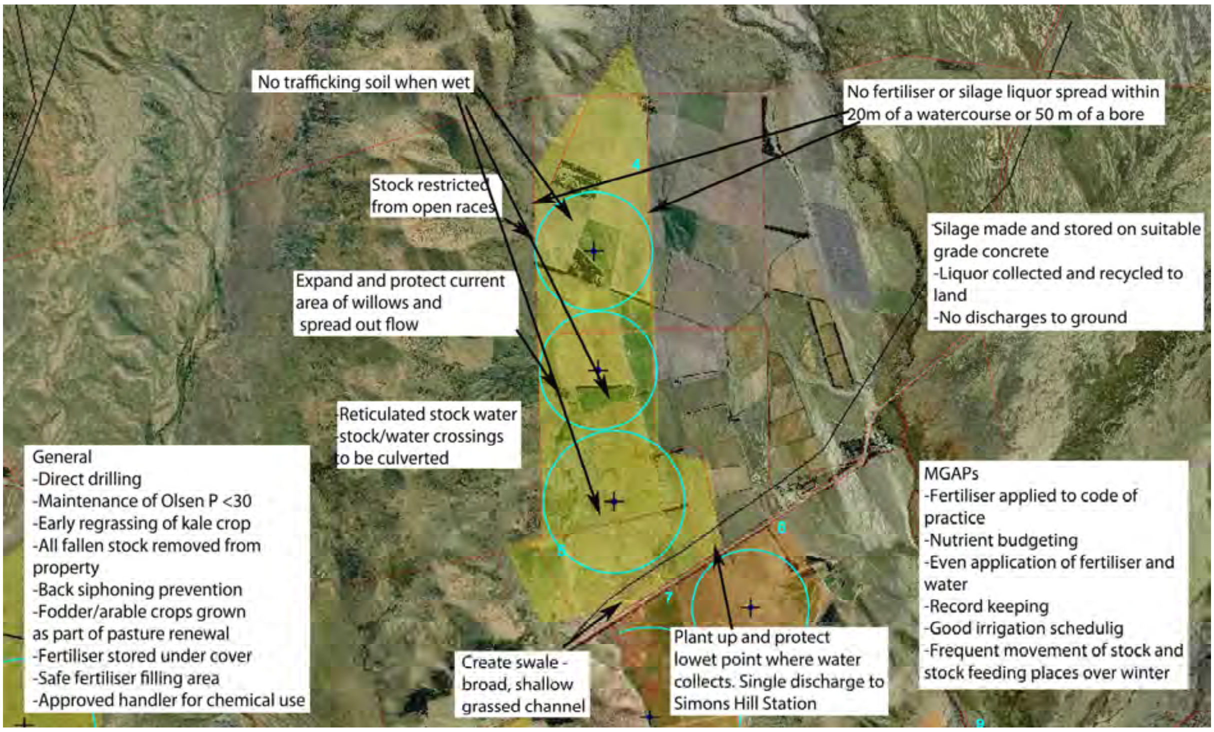
Table 4 below shows the all the mitigation and management tools that are proposed to be undertaken on Mary Range Station. Measures indicated as FEMP stage 1 are those identified as Mandatory Good Agricultural Practice, measures identified as FEMP stage 2 are those changes that have been modelled in OVERSEER to meet the WQS mitigation requirement, and those indicated as FEMP stage 3 are mitigation measures chosen to ameliorate site specific environmental risks on the farm. The table indicates in brief how the measures are to be monitored and audited, and a map showing the locations of the proposed mitigation measures is shown in Figure 5. Table of mitigation options for Mary Range Station

Table 4 Table of mitigation options for Mary Range 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 animal returns and soil reservoirs	Soil testing and use of a nutrient budgeting	Reconciliation of fertiliser and soil records with nutrient budget for example blocks. Submission of example soil 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 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, stock days, 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 after installation and then by a certified auditor every 5 years
1	Robust irrigation scheduling	Use of example pivots for aquaflex soil moisture monitoring	Submission of soil moisture monitoring data
1	Good silage storage and good feeding out management		Annual audit of silage facility
1	Frequent movement of stock over winter to prevent pugging and reduce winter stock losses. Verification of reduced stock numbers over winter	Upkeep of stock movement records	Submission of example stock movement records
2	No stock access to open irrigation races		Annual audit
2	Reduce risk of wind blow following cultivation through use of direct drilling or other methods such as light irrigation on cultivated area.	Upkeep of records	
2	Early regrassing after winter grazed kale	Upkeep of records	OVERSEER nutrient budget
2	Olsen P of below 30 maintained	Regular soil testing (every 3 years)	Submission of soil tests
2	No fertiliser or silage effluent will be applied within 20 m of a watercourse or 50 m of a bore		Self certification
2	Stock tracks running through waterways should be culverted and runoff diverted.		Annual audit
3	All fallen stock will be removed from the property		Submission of details of removers
3	Back siphoning prevention measures when filling chemical sprayers from un-isolated water supplies		Back siphoning prevention measures reported
3	Fodder and arable crops will be grown as part of the pasture renewal process and will therefore	Upkeep of records	Annual audit

	rotate around appropriate parts of the station		
3	Fertiliser to be stored under cover		Photograph of store
3	Fertiliser filling area to be where there are no drains and where a direct discharge to ground in not possible		Photograph of filling area
3	A contractor or approved handler will be used to supply, handle and apply chemicals		Submission of contractor details
3	Professional crop adviser for chemical use, doses and tank mixes.		Submission of consultant details
3	Silage should be made and stored on suitable concrete that drains to an effluent collection facility		Annual audit and submission of design parameters (once only)
3	Silage liquor to be recycled to land		Annual audit
3	No trafficking when wet on Grampian/Simons/Glenrock association soils		Annual audit
3	Expand current area of willows and protect from stock. De channelising flow through this area with single outlet.		Annual audit
3	Create swale (broad and shallow grassed channel parallel with road to receive discharged water from property and feed into created wetland.		Annual audit
3	Plant up and protect lowest point of the farm where water collects naturally. Swale will discharge into this pond/wetland. Single outlet to discharge to Simons Hill Station.		Annual audit
3	Stock water provided by reticulated supply		Annual audit

Figure 5 Annotated map with key mitigation options an locations on Mary Range Station



6.1 Monitoring and Auditing

Monitoring and auditing of the FEMP are as important as the plan itself.

Table 4 shows the monitoring suggested for the mitigation and management options chosen for Mary Range Station. Table 5 shows the frequency and parameters for the environmental monitoring, Figure 6 shows these monitoring points on a map of the property.

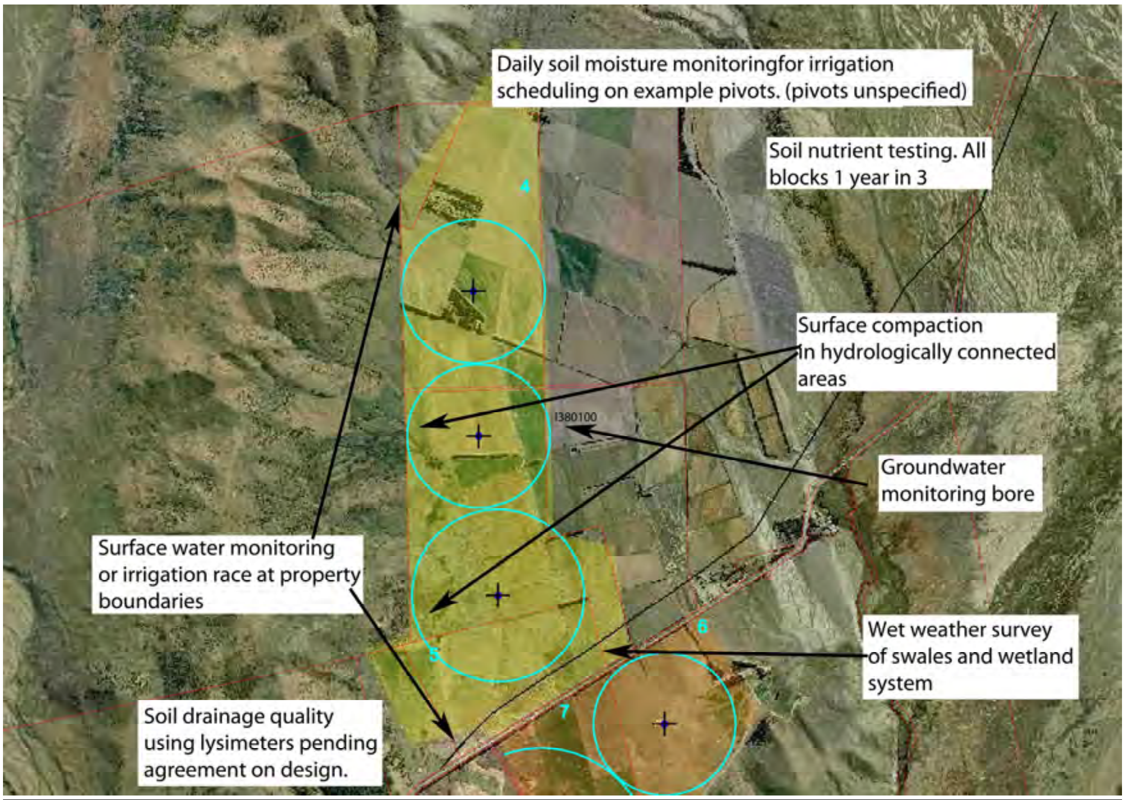
Additional monitoring will be carried out in conjunction with other farmers in the sub-catchments by the Mackenzie Irrigation Company, on the Mary Burn, Tekapo River and Northern Arm of Lake Benmore, and in the Tekapo groundwater sub-catchment.

Table 5 Location, frequency and parameters for environmental monitoring on Mary Range Station

	Location	Frequency	Measured parameters to include	Triggers	Contingency plan if triggers are exceeded
Soil nutrient testing	All pivots in rotation	1 in 3 years	Standard suite of soil nutrients.	Olsen P of 30	Reduce or stop addition of P to area and monitor
Soil drainage quality	TBC	Monthly	Nitrogen species	No trigger - for model verification purposes only	
Groundwater quality	Two existing deep groundwater bores	Annually at mid depth of aquifer	Total Nitrogen, nitrate, ammonia, total phosphorus, dissolved reactive phosphorus.	1 mg/l	Continued exceedences should be investigated and compared with the baseline data of the existing bores. A trend tending towards the 1mg/l trigger is satisfactory. A negative trend would require mitigation such as reducing winter stock numbers.
Surface water quality	Entry and exit of open irrigation/ drainage race on property boundaries	Every 3 months	Total Nitrogen, nitrate, ammonia, total phosphorus, dissolved reactive phosphorus.	Significant increase in monitored parameters	Exceedences should be investigated with specific attention to elevated parameters, as these may indicate the type of contamination.
Irrigation application		Annually in house and 1 in 5 years by an independent	Application uniformity	<80 %	Optimisation of the irrigator performance will take place at the time of testing
Soil moisture	Example pivots	Daily during irrigation system	Soil moisture and deficit	67 % PAW for irrigation scheduling purposes (for PAW 30 and 60 mm soils)	Irrigation
Fertiliser application		Annually in house and 1 in 5 years by an independent	Application uniformity		Optimisation of the irrigator performance will take place at the time of testing
Soil compaction	Hydologically	Annually	Soil compaction	Compaction and	Remove

	connected areas			surface capping	compaction with appropriate tool for depth.
Wet weather survey	Wetland and swale system	Annually if conditions allow	Runoff	Uncaptured runoff occurring.	Review design and amend to capture and attenuate runoff.

Figure 6 Annotated map showing location of monitoring points on on Mary Range Station



Where triggers are exceeded, the immediate contingency plans in Table 5 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 4, 5 and 6.

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[5] at the time of trigger breach?

Yes – continue monitoring to see if trigger breach continues

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

If emergency conditions occur that risk a pollution event, such as severe flooding event that puts the effluent storage system at risk or a catastrophic failure of the effluent system, seek immediate guidance from the Canterbury Regional Council: 0800 76 55 88

[5] Abnormal conditions include extreme weather conditions and catastrophic failure of irrigation/effluent infrastructure

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 Environment Canterbury by end of July each year. Table 6 below shows the proposed contents of an annual audit report for Mary Range Station.

Table 6 Table showing proposed contents of an annual audit report for Mary Range Station

Audit measures	Action in the case of non-compliance if applicable
Additional auditing that must be done externally	
Check the storage of silage for visible signs of discharge and destination of silage liquor	All liquid should drain into effluent storage. Any discharge must be stopped immediately. Temporary barriers such as straw bales may be used to take up any discharges until permanent structures are in place
Check fertiliser storage and filling area.	There should be no possibility of loss of fertiliser to drains or direct discharge to ground. Any drains should be covered, or the filling area moved to where no discharges will occur.
Check integrity of irrigation race fencing	Any gaps in fencing should be blocked temporarily when stock are present until a permanent repair can be made
Review of stock movement records to show winter feeding and stock movement, lower stock numbers over winter and no feeding out on lower terraces.	
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.
Reconciliation of fertiliser and soil records with nutrient budget and fertiliser recommendations	Where reconciliation is not possible and an over application has occurred, this should be rectified in the following year. Following that - non compliance
Review measures recommended by irrigation audit have been implemented	Recommendations not already implemented should be done so prior to next audit.
Review of back siphoning prevention measures	Immediate stop of use of unprotected water supply for filling chemical sprayers while permanent measures are put in place. If measures are not in place for following audit - non compliance.
Review of fallen stock policy - use of a contractor to removed fallen stock	Concerns or absence of policy should be rectified for next audit. Following that - non compliance
Review of chemical management policy - use of contractor or approved handler status, use of a crop adviser	Concerns or absence of policy should be rectified for next audit. Following that - non compliance
Review of no spread zones for fertiliser and silage effluent	Map should be displayed for next audit. Following that - non compliance
Review methods employed for reducing wind blow on cultivated areas	Concerns or absence of methods should be rectified for next audit. Following that - non compliance
Review of crop records to verify rotation of fodder crops and early regrassing after kale crop	Concerns or absence of over rotation should be rectified for next audit. Following that - non compliance
Independent fertiliser spreader and irrigation testing and calibration 1 in 5 years	Spreaders and irrigators not performing should be recalibrated
Additional auditing that can be done either externally or internally	
Submission of silage clamp storage design plans	Once approved, the plans need only to be submitted once
Submission and brief interpretation of soil, water quality, and machinery calibration tests	Where triggers have been exceeded, immediate contingency plans should have been effected and a root cause analysis conducted. The results of which should be presented here. Continual breach - non compliance
Submission of example irrigation schedules and reconciliation with soil moisture monitoring	The restriction of irrigation water to 600 mm/ha is an important driver to efficiency. Other sanctions are unlikely to be necessary to promote water use efficiency.
Annual fertiliser spreader and irrigation testing and calibration	Spreaders and irrigators not performing should be recalibrated
Auditing that must be done internally	

Self certification for application of fertiliser according to code of practice	Any failures in observing the code of practice for applying fertiliser should be rectified and followed up in the next audit

7.0 Summary

This FEMP has been written to serve two purposes, to illustrate that the proposed farm system can meet the nutrient mitigation requirements set out by the Water Quality Study, and to identify and mitigate other farm specific environmental risks that arise from the inherent characteristics of the farm or from the proposed farm system and its management. These farm specific risks include uncontrolled discharges that are not identified in farm nutrient budget modelling but that may still have an environmental effect.

The mitigation and management measures detailed in Table 4, lay out the techniques that have been adopted to fulfil these two objectives. The WQS thresholds and modelling outputs from OVERSEER detailed in Table 3 illustrate that the proposed farming system meets the WQS thresholds and the risk assessment and mitigation measures proposed in Section 5 illustrates how site specific environmental issues, including uncontrolled discharges, have been identified and are mitigated.

The monitoring and auditing of this plan, addressed in Section 6 allow 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.

8.0 References

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

GHD (2009a). Cumulative Water Quality Effects of Nutrients from Agricultural Intensification in the Upper Waitaki Basin – Rivers and Lakes Report.

NZFMRA (2002). Code of Practice for Fertiliser Use. Providing practical and specific guidance for safe, responsible and effective nutrient management.

Olge, G. (2009). Farm system models for land to be irrigated in the Mackenzie basin by Simons Pass Station Limited and Simons Hill Station Limted. Report prepared by Ogle Consulting.

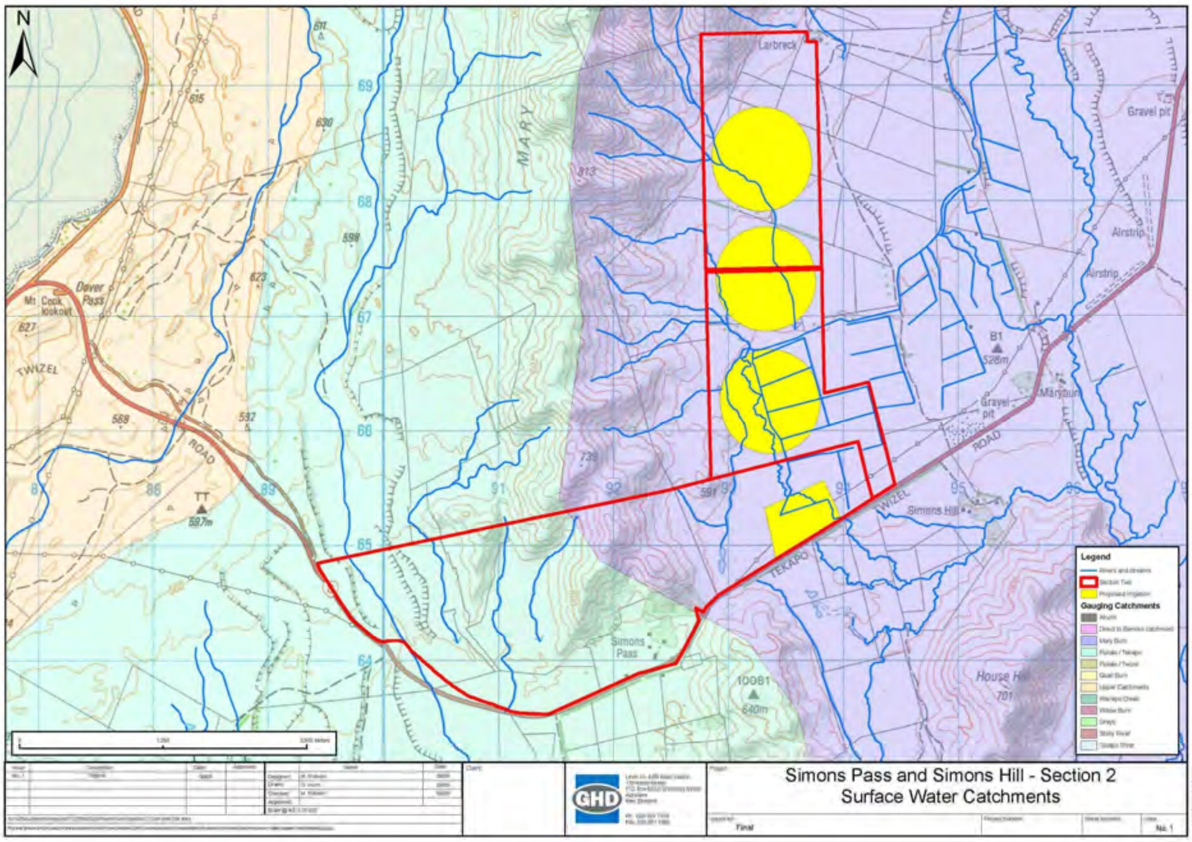
OVESEER v.5.3.4 . AgResearch.

Snow, V., King, W. (2008). Upper Waitaki Farm Systems and Nutrient Assessment. Stage 2: Pasture and Ryecorn Growth Modelling. Report prepared for GHD by AgResearch.

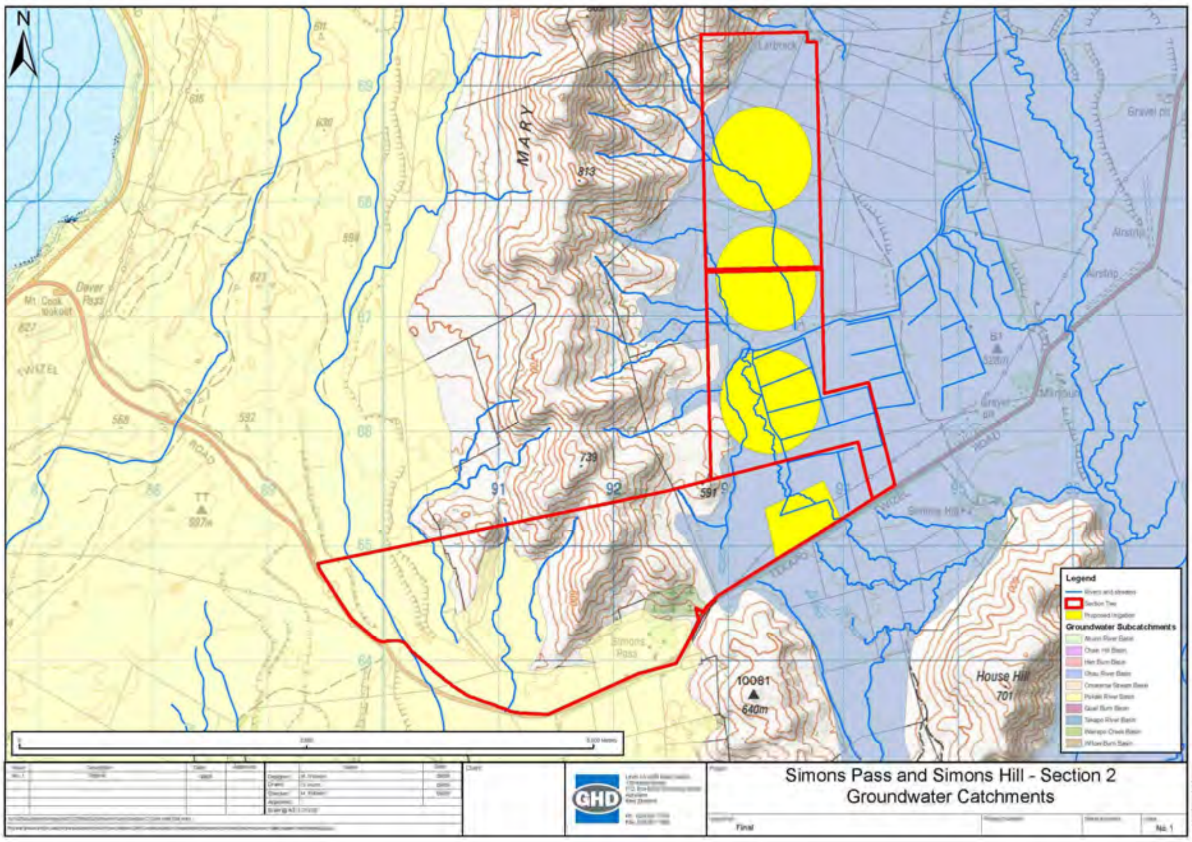
Webb, T. H. (1992). Soils of the Upper Waitaki Basin, South Island, New Zealand, DSIR.

ANNEXURE 1

WQS ground and surface water sub-catchments from Mary Range Station
Maps provided by GHD Ltd to illustrate sub-catchment boundaries only



N
Larbreck
Gravel pit
Airstrip
B1
528m
Gravel pit
Maryburn
ROAD
TEKAPO
TWIZEL
Simons Hill
Simons Pass
10081
640m
House Hill
701
Dover Pass
Mt. Cook lookout
TWIZEL
ROAD
TT
597m
MARY
Legend
Gauging Catchments
Simons Pass and Simons Hill - Section 2
Surface Water Catchments
GHD
Final
No. 1



N
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TWIZEL
ROAD
TT
597m
MARY
Legend
Groundwater Subcatchments
Simons Pass and Simons Hill - Section 2
Groundwater Catchments
GHD
Final
No. 1

ANNEXURE 2

Farm Environmental Risk Assessment

Some guideline questions for track management and runoff	Current	Intensive sheep and beef with dairy grazing
	Mary Range Farming	
Are there tracks in hydrologically connected areas?	No	No
Do any tracks run through streams?	No	No
Do any tracks directly runoff to a water course	No	No
Are devices in place for removing and/or treating contaminated water from tracks?	NA	NA
Are tracks for stock specifically maintained?	No	Not determined,any regularly used new track crossing a waterway will be culverted and runoff diverted on approach to the crossing
Do stock regularly pass through water courses?	No	No,any regularly used new track crssing a waterway will be culverted and runoff diverted on approach to the crossing
Are there any sloping fields adjacent or hydrologically connected to a water course?	Yes. An existing irrigation race received water from the property and from neighbouring properties and the Mary range. Race discharges into multuiple culverts under the road onto Simons Hill Station.	Yes. An existing irrigation race received water from the property and from neighbouring properties and the Mary range. Race discharges into multuiple culverts under the road onto Simons Hill Station.
Any previous runoff or soil wash?	There were clear examples of standing water and overland flow on the station during the site visit. Water discharged from station onto neightbouring station was heavily discoloured. However the site visit was preceded by a very wet period (1 in 10 years) and therefore the discolouration may not arise entirely from surface runoff on the property.	
If arable or fodder crops are grown, are measures taken to conserve or build soil organic matter on arable land?	Organic matter levels are maintained through the pasture phase of the rotation.	Proposed scenario will have two fodder crop rotations at any one time. Rotation 1 is a 2 year pasture break of fodder crops before returning to pasture, and Rotation 2 is a 1 year break. Organic matter levels will be maintained through pasture phase of rotation. However, conventional cultivation to establish both the turnips and kale and the swedes has been modelled. These impacts are reduced by having the turnip crop bicropped with annual ryegrass.
Are remedial measures to prevent runoff in place after winter grazed crops?	No	Winter grazing is reduced by stock numbers reducing over winter. Fodder crops are reinstated into pasture in spring.
Is there a possibility of run off from winter grazed areas reaching a water course?	Yes under wet conditions. During site visit (after a period of wet weather) ponded water was seen on border dykes and surface runoff partialy collected and discharged through culverts to neighbouring property.	Yes under wet conditions. During site visit (after a period of wet weather) ponded water was seen on border dykes and surface runoff partialy collected and discharged through culverts to neighbouring property.A 2 wetland polishing point and a swale system is proposed to attenuate contaminants in runoff.
Some guideline questions for stock nutrient loss		
If stock over wintered outside on the farm, are strategies in place to reduce winter nutrient losses?	Unknown	Yes.Cross bred lambs and merino hoggets are finished and sold before winter thereby reducing stocking over the winter period. However, the dairy heifers and beef stock remain. MGAPs proposed by AgResearch - require the use of a feedpad where large amounts of supplements are fed out. And also that feeding out methods where feedpads are not used, do not result in accumulations of excreta on small proportions of the farm.
Are measures taken to control dietary intakes of N and P?	No	No supplements imported. Extra dry matter conserved on farm and fed out in winter, and

	(Intensive beef and dairy)		fodder crops grown. DM deficit is avoided by reducing numbers over winter.
	Are stock restricted from entering watercourses?	Stock are not restricted from entering irrigation race	Stock will be prevented from entering waterways
	Are feed areas moved during winter in hydrologically connected fields?	Yes	Yes
	Other stock nutrient issues or incidences? Please describe	NA	
Some guideline questions for biodiversity			
	Are there any special areas or species of interest or conservation on the farm?		Ecology Report
	Are there any water or wetland features on the farm?	An irrigation bywash race runs along the western side of the property. A wetland area identified by willow growth is present on farm. Water leaving the farm via the bywash race will discharge into the Mary Burn via Simons Hill Station.	An irrigation bywash race runs along the western side of the property. A wetland area identified by willow growth is present on farm. Water leaving the farm via the bywash race will discharge into the Mary Burn via Simons Hill Station.
	Are these features actively protected?	No	features will be protected
	Are surface water features protected from stock access?	No	features will be protected
	Is there evidence of bankside erosion	No	No
	Other biodiversity issues? Please describe	Ecology report	Ecology report
Some guideline questions for chemical usage			
	Are those handling chemicals of 'approved handler status'?	Currently use a contractor	
Some guideline questions for water			
	Do you use irrigation scheduling?		Yes
	How do you estimate soil moisture deficit?		Yes - aquaflex is proposed in selected pivots to assist scheduling
	Do you use surface irrigation (border dyke, wild flood)	Yes	No
	Do you collect wipeoff losses?	No	NA
	Are these wipeoff losses discharged to a watercourse	These would have eventually discharged to the Mary Burn	NA
	Are your borders laser levelled?		NA
	If you have spray irrigation, do you practice fertigation?	No	Fertigation has not been modelled.
	Is clean water yards collected separately and discharged or used?	NA	Clean water will be collected and used or discharged. No direct discharges of contaminated water will occur off the yard.
	Are back siphoning prevention measures in place when filling sprayers?	NA	Back siphoning measures will be in place
	Other water issues or incidences? Please describe	NA	
Some guideline questions for fertiliser			
	Do you apply more than 50 kg N per application?	No	No
	Do you apply N fertiliser during later autumn and winter?	No	No
	Do you apply P fertiliser within 3 weeks of surface irrigation?	Yes	NA
	Do you regularly soil test?	Yes	Soils will be regularly tested
	Do you have Olsen P levels over 30 ?	No	Soils may reach Olsen P of 30

	Are fertilisers ever applied within 20 m of a watercourse or 50 m from a borehole?		Fertiliser will not be applied with in 20 m of a watercourse or 50 m from a bore.
	Are fertiliser spreaders calibrated regularly?		MGAP - annual calibration
	Are there ‘no-fertiliser’ areas on farm?	No	Yes, riparian and well laybacks and the wetland areas and swales.
	Other fertiliser issues or incidences? Please describe	NA	No suitable storage or filling area
Some example questions on effluent			
	Do you produce effluent?	No	No
	Do you have less than 4 weeks storage of effluent?	NA	NA
	Is your effluent storage facility fully sealed?	NA	NA
	Do you separate clean and dirty water in the yard?	NA	NA
	Do any direct discharges occur off the yard?	NA	Direct discharges will be prevented from occuring from the yard
	Do you spread effluent by a travelling irrigator? If not, how	NA	NA
	What rate do you apply effluent at?	NA	NA
	What depth of effluent do you typically apply?	NA	NA
	Do you use soil moisture deficits to decide on application depth?	NA	NA
	How do you determine application depth?	NA	NA
	Do you apply more than 150 kg N/ha/yr of effluent N?	NA	NA
	If silage is made on farm, is effluent collected and spread to land?	No	Effluent will be collected
	Are there any direct discharges from silage pit?	Unknown. The nature of the lining could not be ascertained.	No direct discharges will occur from the silage pits
	Other effluent issues or incidences? Please describe		
Some example questions on cropping			
	Is inversion tillage used? Describe	No	Conventional tillage will be used to prepare paddocks for fodder crop. (should change to DD)
	Are soils left bare over winter?	No	YES - in winter in rotation. Paddocks are usually under pasture. However, rotation 1 - first fodder crop will have a winter cover from the bi-cropped ryegrass, the second crop will be grazed out in situ in April May and then left fallow until reseeded in spring, so 1 winter in rotation 1. Rotation 2 Swedes fed out over winter and sown back into grass in spring, so 1 winter in rotation 2.
	Are remedial measures in place after winter grazed crops to reduce nutrient loss?	No	The turnip fodder crop is bi-cropped with annual ryegrass to provide feed after the turnips are eaten, however this will also provide a degree of nurient capture.
	Is there a possibility of run off from winter grazed areas reaching a water course?	Yes, During ste visit, standing water and overland flow was evident from grazed areas. (no stock there at the time)	Yes, however a wetland polishing pond is recommended to receive runoff before it discharges from the property.
	Other cropping issues or incidences? Please describe	No	No
Some example questions on soil health			

	Previous incidence of soil erosion or wash? (wind or water)	There were clear examples of standing water and overland flow on the station during the site visit. Water discharged from station onto neightbouring station was heavily discoloured. However the site visit was preceded by a very wet period (1 in 10 years) and therefore the discolouration may not arise entirely from surface runoff on the property.	The irrigation and consequent ground cover will reduce wind erosion losses
	Are there compacted, consolidated or capped soils?	In Lucerne paddock, some surface capping was evident. However, there are no surface water receiving from this paddock.	Soil may become capped and compacted, due to stocking and trafficking. The Simons and Grampians soils in the Grampians-Simons-Glenrock Association have subsoils with relatively high bulk density and moderate permeability, and have incident fragipans. Water movement through the pans is slow and perching occurs. Care should be taken not to compact these soils.
	Is the soil trafficked when wet?	Possibly	Soil may be trafficked when wet, e.g. contractors cutting for silage in poor conditions. This should be avoided as much as possible, however as this is not always possible, compaction and capping should be assessed annually in hydrologically connected areas as a part of soil compaction survey.
	Are remedial measures for soil health in place after winter grazing	No	Winter grazing is reduced by stock being sold off, thereby reducing soil physical damage
	Are stock over wintered outside?	Yes	Partially. Although stock numbers are reduced over the winter period.
	Other soil issues or incidences? Please describe		