CRC011845-B

Farm Environmental Management Plan

Report for

Irishman Creek Station

August 2009

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1. Introduction

In the Water Quality study, that assessed cumulative effects of nutrients on water quality from agricultural intensification in the Upper Waitaki, it was found that the additional irrigation proposed in the catchment could take place without significant adverse effects on the environment providing that nutrient reduction was effected on farm.

The process that was advocated for effecting 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 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.

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.

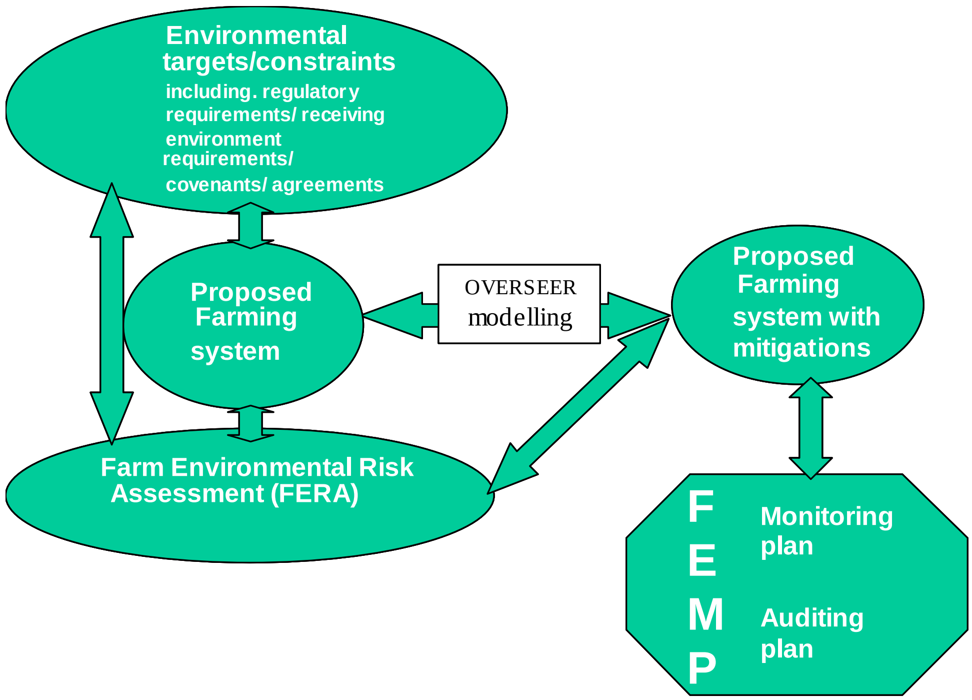
1.3 Scope of a Farm Environmental Management Plan

The development of a FEMP is divided into four sections:

- The first section describes mandatory good agricultural practices that need to be implemented across the farm, and include the base assumptions of the OVERSEER model. This helps to validate the use of the model on the property;
- 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.

1.4 It should be noted that no changes to the current farm system are proposed.

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



2. Farm Description

2.1 Location

Irishman Creek Pastoral lease, parts Run 343 and section 1 SO 15864 Canterbury Registration District, comprises 9802 hectares between the Tekapo River and Lake Pukaki in the mid-Mackenzie Basin (Fig. 1)[1].

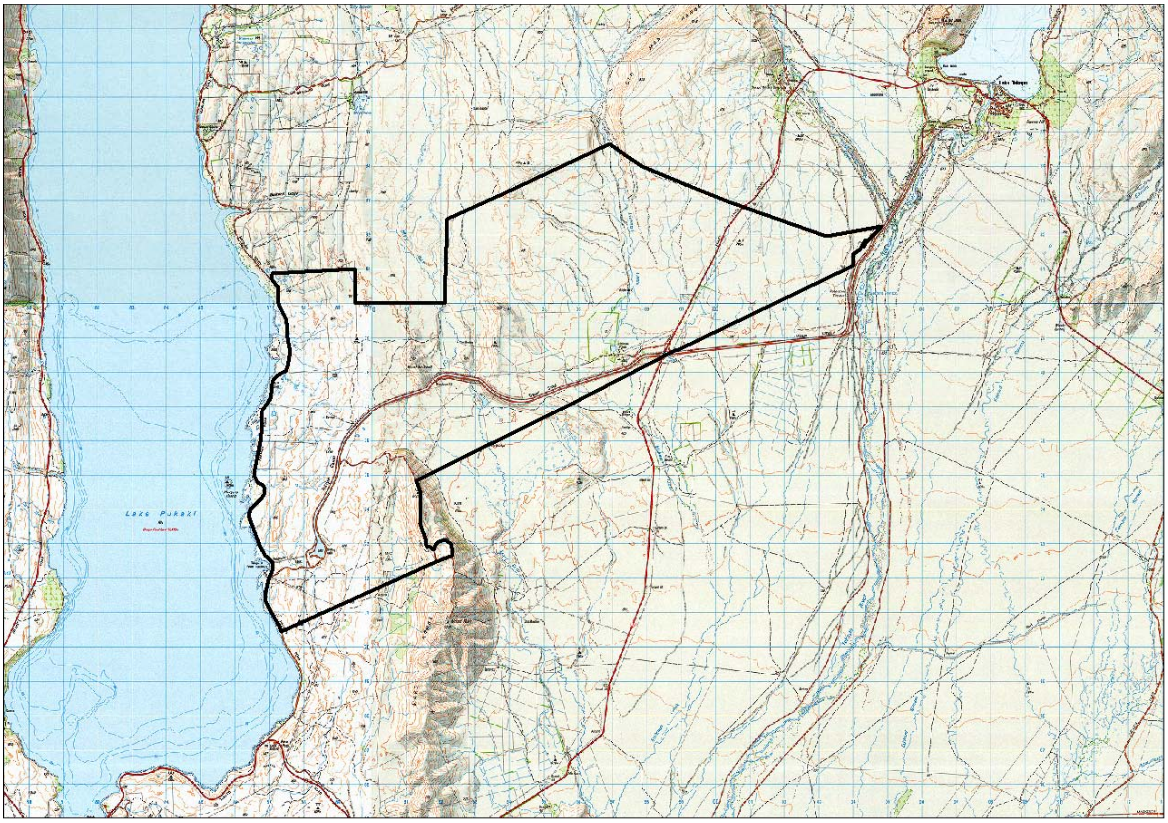


Figure 1. Irishman Creek Station, Mackenzie Basin.

[1] Department of Land Survey and Information, 2003. Canterbury Land District Cadastral Data, cited in Draft Preliminary Proposal 2003, Proposal for Review of Crown Land under part 2 of the Crown pastoral Land Act 1998.

2.2 Geology and landforms

Geological formations on Irishman Creek are comprised of, or derived from, sedimentary Torlesse Group Chlorite subzone 1 sandstones and mudstones (greywacke and argillite)[2]. Three major types of landforms are present[3]:

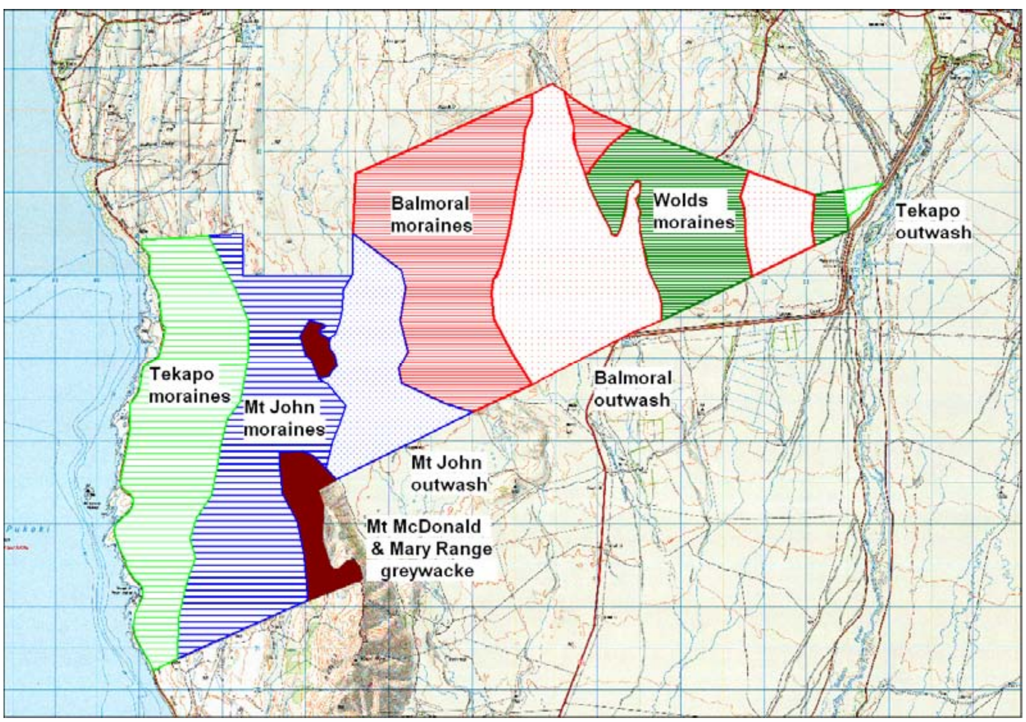
a. Hard rock ranges
b. Glacial moraine
c. Glacial outwash

Landforms have been largely determined by successive Otiran glaciations:

a. The Tekapo advance,	*ca*.	13,000 years Before Present
b. The Mt John advance		17,000 "
c. The Balmoral advance		50,000 "
d. The Wolds advance		203,000. "

The Mary Range and Mt McDonald are low, isolated, outcrops of greywacke that have been extensively glaciated, retaining remnant areas of moraine. A small area of the southern part of the Old Man Range, a range of recent gravels over older weathered Pliocene Glentanner Bed outwash gravels[2], is present on the northern boundary. Moraines and their associated fluvio-glacial outwash surfaces comprise the remaining landforms (Figure 2).

Figure 2. Irishman Creek landform distribution



[2] Gair, H.S. 1967. Geological map of New Zealand, Sheet 20, Mt Cook. Department of Scientific and Industrial Research, New Zealand

[3] Lynn, I. 1993. Land types of the Canterbury Region, *in* The Canterbury Regional Landscape Study, Boffa Miskell and Lucas Associates.

The approximate areas of landform types, including hydro-electric canal areas which are not in Irishman Creek pastoral lease, and not differentiating the moraines on the hard rock ranges, are given in Table 1.

Table 1. Extent of landforms on Irishman Creek

Landform		Area (ha)	%
Hard Rock	Mt McDonald	74	**0.7**
	Mary Range	288	**2.8**
Moraine	Tekapo	1873	**18.0**
	Mt John	2025	**19.4**
	Balmoral	2104	**20.2**
	Wolds	1162	**11.2**
Outwash	Tekapo	33	**0.3**
	Mt John	909	**8.7**
	Balmoral	1949	**18.7**
	TOTAL	10417	100.0

The extent of low-relief topography differentiates Irishman Creek in relation to most surrounding Mackenzie Basin and other South Island high country properties (Figures 3, 4).

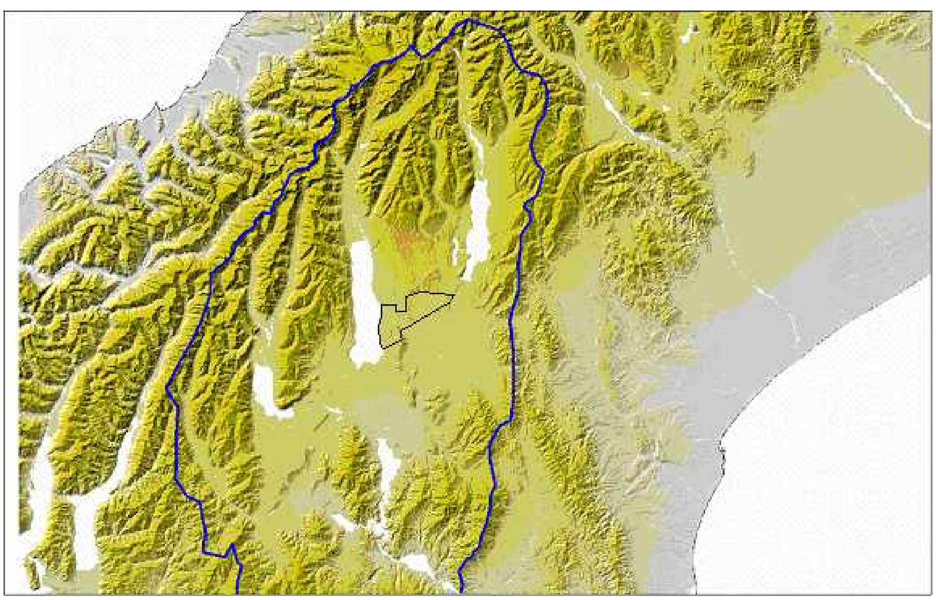


Figure 3. Relief of Irishman Creek in relation to the Mackenzie Ecological Region and surrounding South Island high country.

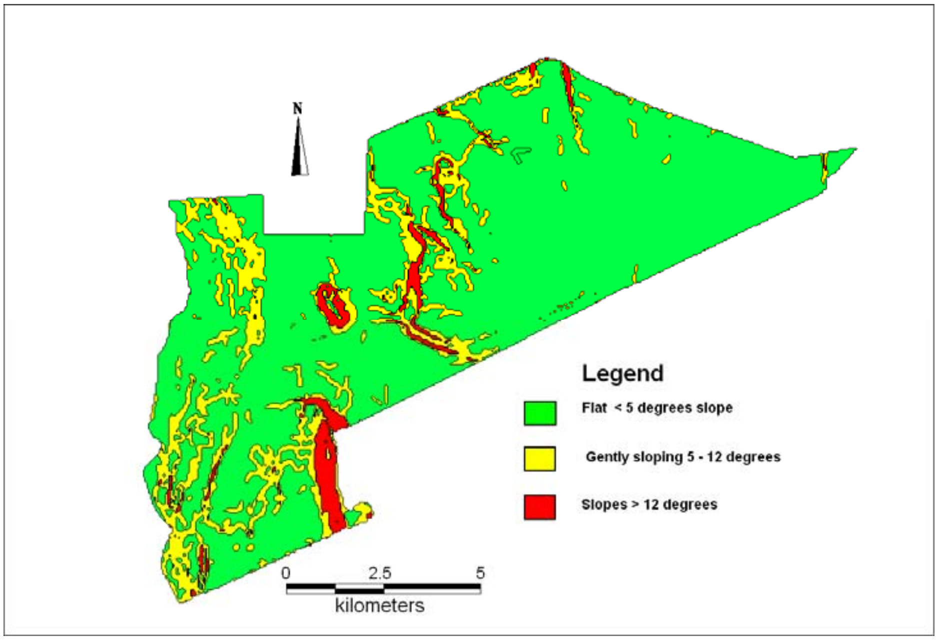


Figure 4. Slope classification of Irishman Creek Station[4].
Ninety six percent of Irishman Creek is flat to moderately sloping, presenting few limitations to agricultural development (Table 2).

Table 2. Area of slope classes on Irishman Creek Station.

Slope Class	Slope Range (degrees)	Total Area (hectares)	%
Flat - gently sloping	0 - 5	8,392	**79**
Gently - moderately sloping	5 - 12	1,897	**18**
Rolling - Steepland	> 12	383	**4**
Total		10,672	**100**

2.3 Soils

Soil distributions are strongly related to the major geomorphic landforms[5] (Fig. 5).

[4] Classes after Webb, T.H. 1992. Soils of the upper Waitaki basin. DSIR Land Resources Scientific Report No 3.

[5] Webb, T.H. 1992. loc. cit. Also the source for the pedological and chemical data presented in following tables.

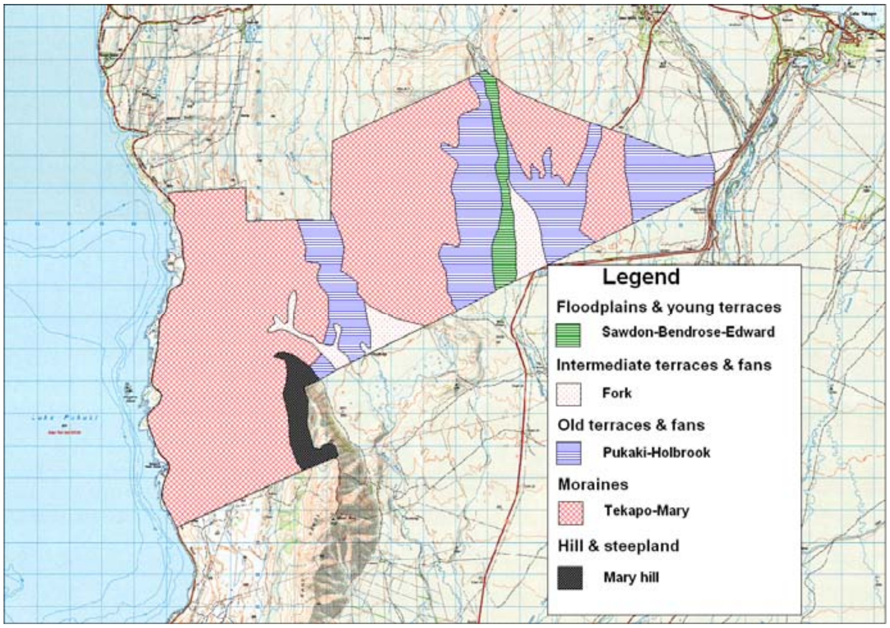


Figure 5. Irishman Creek Soil association distributions.

Steepland soils occur on the slopes of the Mary Range and Mt McDonald.

The **Tekapo-Mary** association mainly occurs on rolling moraines, with lesser areas on easy rolling and hilly moraines. Deep phases of Tekapo soils occur on toe slopes and soil depth thins upslope to shallow phases on crests. Mary soils occur on sites exposed to north westerly winds, and usually occur above toe slopes. Inclusions of imperfectly drained Cox soils may occur in concave sites in this association.

The **Pukaki-Holbrook** association occurs on old terraces associated with moraines. Pukaki soils are formed from deep fine sandy loess deposits and Holbrook soils are predominantly stony soils in wind deflation hollows.

Fork soils occur on intermediate-aged terraces and fans and encompass wide variation in stoniness and depth phases.

Sawdon-Bendrose-Edward association soils are found adjacent to rivers and streams on young terraces and river floodplains. Complex inter-fingering of component soils occurs where younger alluvium has spread onto terrace surfaces or units are dissected by shallow stream channels. Free draining shallow and deep phases of Sawdon soils occur on the older flood plains and Bendrose soils on younger surfaces. Edward soils occur in localized areas of silty alluvium. The approximate planar areas of the soil associations are given in Table 3.

Table 3. Area and topographic distribution of soil associations on Irishman Creek.

Landform	Soil Series	Total Area (ha)	%	Total Area in Slope Class (ha) < 5^0	%	$5-12^0$	%	> 12^0	%
Steepland	Hill & steepland	272	**3**	20	**7**	**75**	**27**	177	**65**
Moraine	Tekapo - Mary	7,083	**66**	5290	**75**	**1515**	**21**	278	**4**
Old terraces & fans	Pukaki - Holbrook	2,336	**22**	2247	**96**	**83**	**4**	6	**0**
Intermediate terraces & fans	Fork	468	**4**	438	**94**	**26**	**6**	4	**1**
Young terraces & floodplains	Sawdon - Bendrose - Edward	285	**3**	277	**97**	**8**	**3**	0	**0**
Other		228	**2**						
	Total	10,672	**100**	8,273	**78**	1,706	**16**	465	**4**

The differentiating characteristics of the soil series are summarized in Table 4.

Table 4. Pedological characteristics of soil series on Irishman Creek[4].

Soil Series	Drainage	Horizons	Stoneless depth **(cm)**	Depth **(cm)**	Texture of fines
Moraine					
Tekapo	well	A, Bw, C	>20	>50	Fine sandy loam or loamy fine sand; <18% clay
Mary	excessive	A, Bw, C	<20	<40	silt loam or fine sandy loam
Old terraces & fans					
Pukaki	well	A, Bw, C	>20	>50	Fine sandy loam or loamy fine sand; <18% clay
Holbrook	excessive	A, Bw, C	<20	<40	sandy loam or loamy sand
Intermediate terraces & fans					
Fork	excessive	A,Bw,Bh,C	variable	>50	sandy loam or loamy sand
Young terraces & floodplains					
Sawdon	well-excessive	A, Bw, C	variable	<40	variable
Bendrose	well-excessive	A, Bw, C	variable	<40	Sandy loam or loamy sand
Edward	moderate-excessive	A, Bw, C	>45	>60	silt loam or fine sandy loam

The topsoil chemical characteristics of soil series are summarized in Table 5.

Table 5. Chemical characteristics of soils on Irishman Creek[4].

	Soil Series	Carbon	C/N	CEC	pH	BS	Al	P-inorg	P-org	P-ret
a)	**Rating**									
Moraine										
	Tekapo	L+M	M	M	M	VL-M	L+M	L-H	M-VH	M
	Mary	L	M-H	M	M	VL-M	L+M	L-H	M-VH	M
Old terraces & fans										
	Pukaki	L+M	M	M	M	VL-M	L+M	L-H	M-VH	M
	Holbrook	L	M-H	M	M	VL-M	L+M	L-H	M-VH	M
Intermediate terraces & fans										
	Fork	L	M	L	M	VL	M	H	M	-
Young terraces & floodplains										
	Sawdon	L	L	M	M	H+VH	VL	M+H	L	L
	Bendrose	L	L	M	M	H+VH	VL	M+H	L	L
	Edward	L	L	M	M	H+VH	VL	M+H	L	L
b)	**Values**	**%**	**ratio**	**me/100g**		**%**	**me/100g**	**me/100g**	**me/100g**	**%**
Moraine										
	Tekapo	2-4	12-16	12-25	5.3-6.5	Low	0.5-2	10-20	10-20	30-60
	Mary	<2	10-12	6-12	5.3-6.5	Low	0.5-2	10-20	10-20	30-60
Old terraces & fans										
	Pukaki	2-4	12-16	12-25	5.3-6.5	Low	0.5-2	10-20	10-20	30-60
	Holbrook	<2	10-12	6-12	5.3-6.5	Low	0.5-2	10-20	10-20	30-60
Intermediate terraces & fans										
	Fork	<2	12-16	6-12	5.3-6.5	V. Low	0.5-2	20-30	30-50	-
Young terraces & floodplains										
	Sawdon	<2	10-12	12-25	5.3-6.5	High	<0.1	30-50	10-20	10-20
	Bendrose	<2	10-12	12-25	5.3-6.5	High	<0.1	30-50	10-20	10-20
	Edward	<2	10-12	12-25	5.3-6.5	High	<0.1	30-50	10-20	10-20

2.4 Climate

The inter-montane basin character gives a sub-continental climate, with dry hot summers and cold winters[6]. Mean annual precipitation is 550-600 mm, fairly evenly spread throughout the year, but with wide seasonal and annual variability. Cold air drainage from surrounding ranges result in a large mean daily range in temperature and low night temperatures may occur at any time of the year. Snow falls between 6-12 days each year, with potential for extreme accumulation in some seasons. Irishman Creek, lying central in the basin, experiences high sunshine hours, averaging between 2000-2300 hours per annum. Frost may occur at any season, averaging 10 frost days per month between April to November and cool temperatures severely limit plant growth between May to September.

Dry north-west winds and the low rainfall result in severe moisture deficits in most years. As most soils have profile water holding capacities of 20-50 mm, mean annual soil water deficits are estimated to be about 440-500 mm. Key climatic parameters are summarized in Table 6.

Table 6. Average climatic parameters for the upper Mackenzie Basin, Lake Tekapo.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Air Temperature (^{o}C)													
	15.3	**15.2**	**13.1**	**9.7**	**5.8**	**2.8**	**1.7**	**3.6**	**7**	**9.6**	**11.5**	**13.7**	9.1
Sunshine hours													
	264	**224**	**203**	**177**	**132**	**98**	**114**	**157**	**186**	**216**	**238**	**256+**	2265
Growing degree days > 5 ^{o}C													
	319	**286**	**251**	**145**	**52**	**12**	**6**	**16**	**72**	**147**	**196**	**270**	1772
Growing degree days > 10 ^{o}C													
	167	**149**	**106**	**38**	**4**	**0**	**0**	**0**	**6**	**37**	**67**	**124**	697
Ground Frost (days)[1]													
	1.6	**1.4**	**4.7**	**11.9**	**18.7**	**23.8**	**26.4**	**23.8**	**17.8**	**10.7**	**11**	**2.5**	154
Daily wind run (km)													
	304	**282**	**246**	**230**	**193**	**180**	**167**	**182**	**232**	**285**	**315**	**315**	244
Rainfall (mm)													
Tara	**51**	**43**	**48**	**53**	**53**	**48**	**53**	**48**	**56**	**51**	**51**	**51**	606
Tekapo	**50**	**41**	**44**	**53**	**57**	**50**	**48**	**51**	**53**	**51**	**48**	**51**	597
Potential Evaporation (mm)													
	156	**117**	**88**	**48**	**21**	**4**	**7**	**232**	**65**	**96**	**127**	**153**	905
Water deficit (@ 25 mm storage)													
	112	**91**	**48**	**16**	**2**	**0**	**0**	**0**	**11**	**54**	**84**	**112**	530
Water deficit (@ 75 mm storage)													
	105	**82**	**48**	**15**	**2**	**0**	**0**	**0**	**0**	**20**	**73**	**100**	445

[6] O'Connor, K. F. 1976. An introduction to the Waitaki. Man & the Biosphere Report No 1, Tussock Grasslands & Mountain Lands Institute, Lincoln College; NZ Meteorological Service Data presented in Table 5.

2.5 Agronomic Productivity

Due to climatic limitations (previous section), the growing season at Irishman Creek is short, from the beginning of September to the end of May, and this is frequently constrained by moisture deficits on many soils. Pasture productivity in the Mackenzie Basin ranges from less than 0.3 tonne dry matter (DM) / hectare/ year on unfertilized soils through to greater than 18 tonnes DM/ha/yr on irrigated and fertilised soils[4].

Irrigation can successfully cancel soil moisture deficits allowing optimal plant growth during late spring to autumn (October- April) in dry years. For example at Tara Hills Research Station, Omarama, the long-term average annual rainfall was 385 mm and the average evaporation 1092 mm, resulting in an average annual water deficit of 707 mm. Irrigation efficiencies varied with soil and application technique but ranged between 70% to 26%[7]. On irrigated shallow free draining soils, ryegrass and white clover pastures began growing in mid September and ceased by mid- May. Production peaked at 70 kg dry matter (DM) ha^{-1} day^{-1} in November with a second, smaller, peak in mid-late December. Un-irrigated dryland hill pastures had similar, though considerably smaller, growth patterns with peaks of 20-25 kg DM ha^{-1} day^{-1} in late October and 10-15 kg DM ha^{-1} day^{-1} in mid-March[8] (Figure 6).

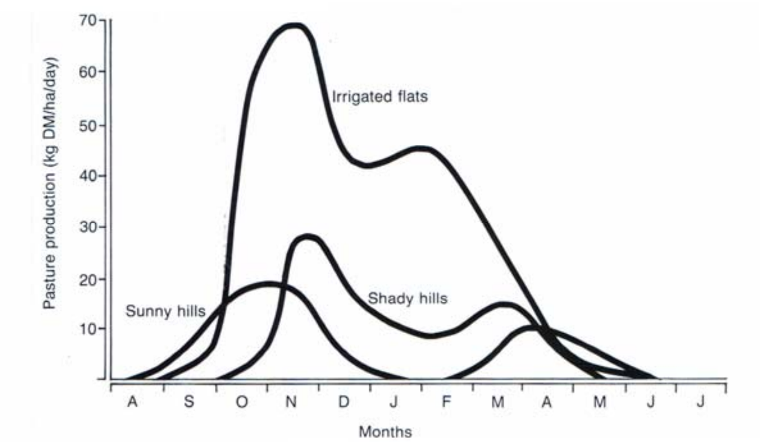


Figure 6. Daily rates of pasture production at Tara Hills, irrigated flat compared with dryland hill pastures.

The yield from irrigation depended on pasture age and composition. Poor quality pasture produced 2.5 – 5.0 t DM $ha^{-1}year^{-1}$ while high producing pastures yielded between 7.5 – 10.0 t DM $ha^{-1}year^{-1}$. In comparison, dryland pastures produced between *ca.* 0.4 – 1 t DM $ha^{-1}year^{-1}$ in dry years to 5 t DM $ha^{-1}year^{-1}$ in wet seasons[9].

Very similar results were obtained from irrigation research near Lake Tekapo, which is directly applicable to Irishman Creek (Figure 7)[10]. As previously mentioned, this lifted total pasture

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7 Greenwood, P. B. 1982. Irrigation research at Tara Hills High Country Research Station 1948 to 1982. Invermay Agricultural Research Centre Technical Report No 13, 201pp.

8 Greenwood, P.B. 1982 (loc cit).

9 Greenwood, P.B. 1982 (loc cit).

10 Scott, D. 1992. Pasture productivity. In Webb, T., Soils of the upper Waitaki Basin, South Island, New Zealand. DSIR Land Resources Report No. 3, pp. 65 – 77.

productivity from less than 0.3 tonne DM per hectare per year without development, to between 15-18 tonnes DM / ha/ yr in fertilised and irrigated pastures.

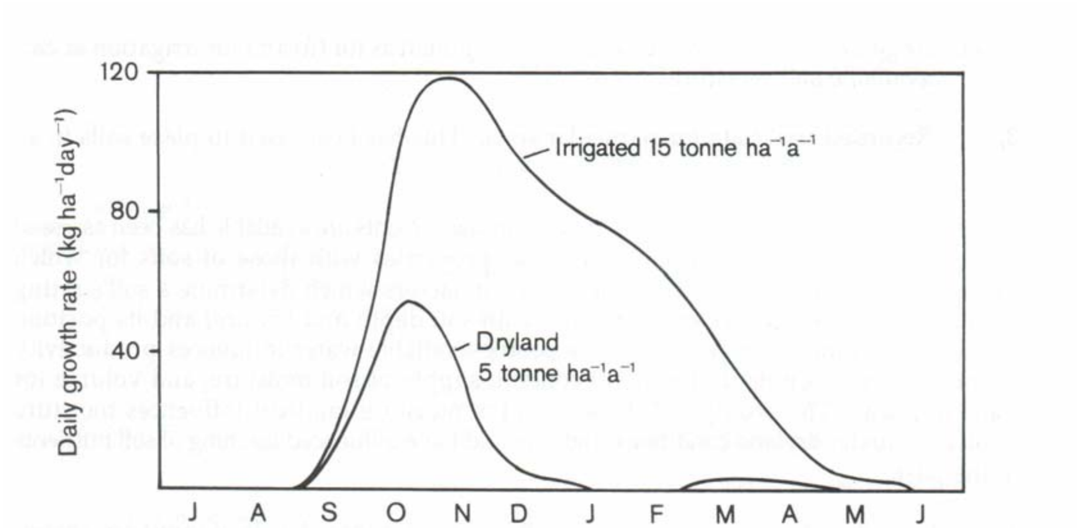


Figure 7. Daily growth rates under irrigation and dryland pastures with high fertilizer inputs, Mt. John, Tekapo, over a five year period.

One of the key benefits to result from irrigation is reduction in the variability of dryland pasture production (Figure 8).

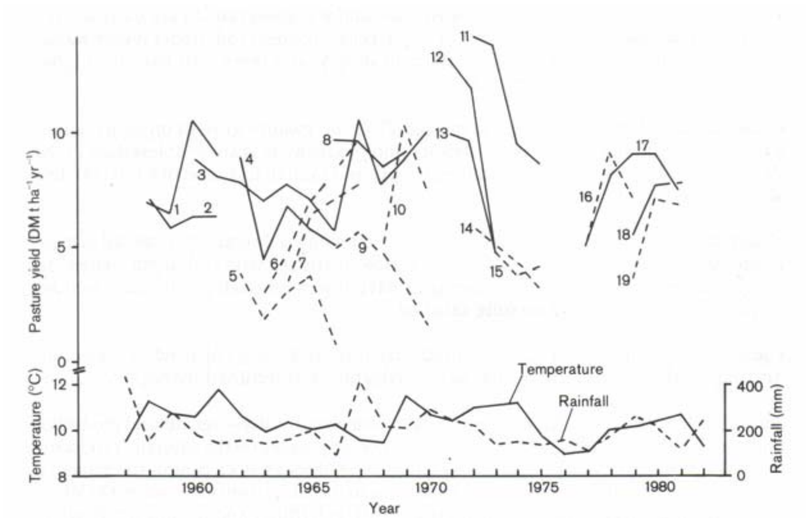


Figure 8. Seasonal variability in pasture yield.

(Scott, D. 1992. Pasture productivity. In Webb, T., Soils of the upper Waitaki Basin, South Island, New Zealand. DSIR Land Resources Report No. 3, pp. 65 – 77.)

[1] Scott, D. 1992. (loc cit.)[1] O'Connor, K. F. 1966a. A scientific basis for potential use of land in the Mackenzie. Proceeding 16th Lincoln

From the initial Tara Hills and subsequent irrigation research, at Mt John, near Irishman Creek[11], irrigation and pastoral development has been established as a technically viable option for

[11] O'Connor, K. F. 1966a. A scientific basis for potential use of land in the Mackenzie. Proceeding 16th Lincoln Farmers Conference. pp77-87; O'Connor, K. F. 1966b. The soils of the MacKenzie Basin interpreted for suitability for irrigation and dryland development for pastural use. In: Water resources of the Mackenzie Basin. MOW Report;

increasing the quantity and quality of forage supply, effectively addressing a critical environmental constraint for pastoral farming.

Pastoral intensification through irrigation is a currently key development strategy for the entire upper Waitaki Basin, particularly with the advent of modern centre-pivot systems capable of precise delivery, maximizing water-use efficiency and mitigating adverse environmental effects[12] [13]. Economic analysis also showed strong economic and social benefits from irrigation. If 40,000 ha were developed in the Mackenzie, annual farm gross incomes are predicted to increase by $62.4 million and net farm incomes by $36.4 million. The estimated flow on impact in the New Zealand economy would be around $249.6 million with creation of 240 jobs[14].

The majority of the soils on Irishman Creek are *"… well suited to irrigation and offer only minor obstacles to irrigation."*[15] .

The soils have been classified as 2st: flat to easy rolling land with even micro topography and few channels, with moderately deep, well drained soils and minimal to slight soil limitations to crop production. They have moderate to high profile water storage capacity. Of the 8, 276 ha on flat to very gently sloping terrain, some 7,815 ha consist of 2st soil types (Table 3). With irrigation and fertiliser these soils will produce between 12-15 tonnes of dry matter (DM) per hectare per year[16].

Scott, D.; Clifford, P. T. P.; Maunsell, L. A.; Archie, W. J. 1975: Some irrigation investigations in the Mackenzie Country. Tussock Grassland and Mountain Lands Institute Review 31: 49-52; Scott, D.; Maunsell, L. A. 1981: Pasture irrigation in the Mackenzie Basin. 1. Species comparison. New Zealand journal of experimental agriculture 9: 279-290; Scott, D.; Maunsell, L. A. 1986: Pasture irrigation in the Mackenzie Basin. 3. Hay mixtures. New Zealand journal of experimental agriculture 14: 25-29; Floate, M. 1992. Guide to tussock grassland farming. AgResearch, Invermay, 120 pp; Scott, D.; Maunsell, L. A.; Keoghan, J. M.; Allan, B. E.; Lowther, W. L.; Cosssens, G. G. 1995: A guide to pastures and pasture species for the New Zealand high country. Palmerston North, New Zealand Grassland Association; Scott, D. 2000a: Sustainability of New Zealand high-country pastures under contrasting development inputs. 3. Sheep carrying capacity. New Zealand Journal of Agricultural Research 43: 175-185; Scott, D. 2000b. Sustainability of New Zealand high-country pastures under contrasting development inputs. 6. Fertiliser efficiency. New Zealand Journal of Agricultural Research 43: 525-532; Scott, D. 2001: Sustainability of New Zealand high-country pastures under contrasting development inputs 7. Environmental gradients, plant species selection, and diversity. New Zealand Journal of Agricultural Research 44: 59-90. Many other similar citations have been omitted for brevity.

[12] Waitaki Catchment Water Allocation Board . 2005. (loc cit).

[13] Webb, T.H. 1992. (loc cit); Waitaki Catchment Water Allocation Board . 2005.

[14] Collier, G. 2003. Economics of Irrigation in the Upper Waitaki. Unpublished report for the Mackenzie Irrigation Group.

[15] Webb, T.H. 1992. (loc cit) pages 85,and 86.

[16] Scott, D. 1992. Pastoral production. In Webb, T.H. 1992 loc. cit., pages 65-77.

3. Environmental Context

The environmental context of the farm is a reference both to local and wider receiving environments. Figure 9 shows the receiving environments of Irishman Creek Station. Due to the permeability of the soils no surface runoff is expected to occur.

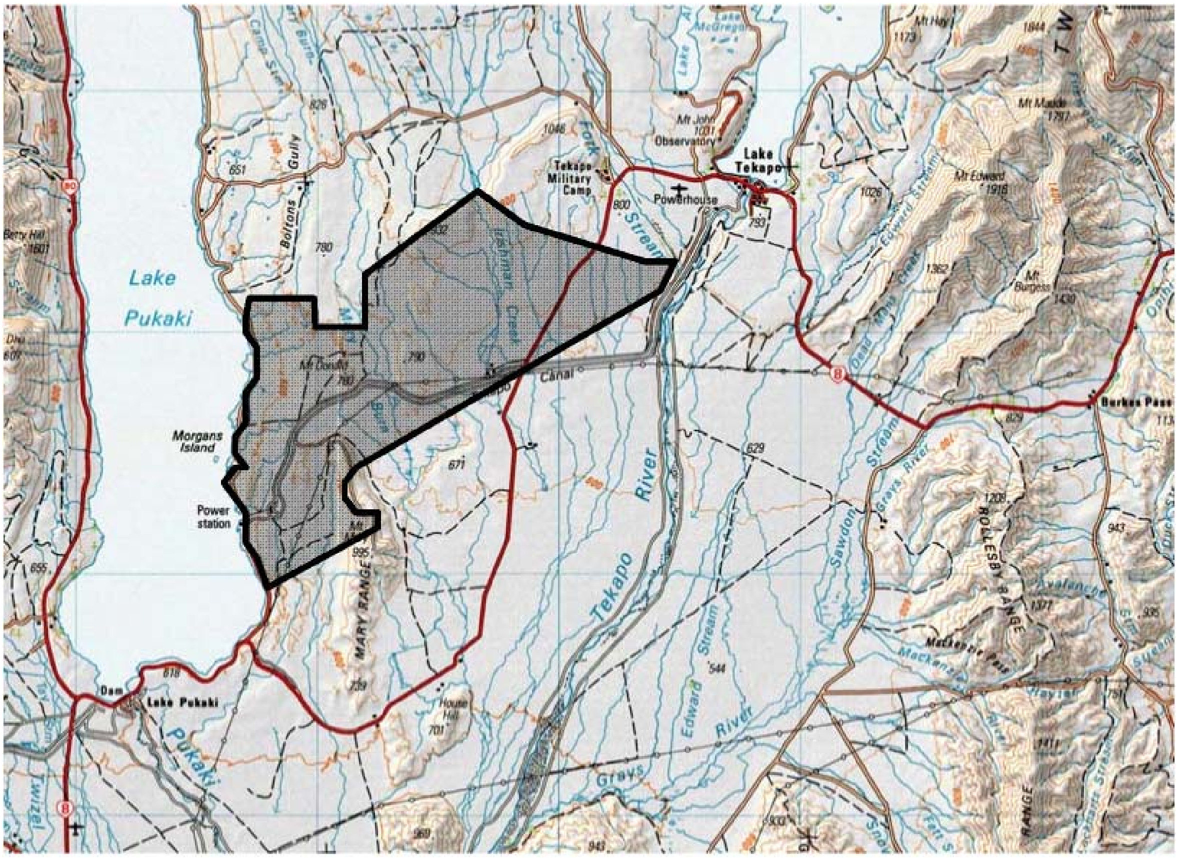


Figure 9. Map showing the receiving environments for Irishman Creek Station.

3.1 Water Quality Study mitigation requirement

Irishman Creek Station, according to the WQS, lies in the Mary Burn surface water catchment and the Tekapo River Basin groundwater catchments. Appendix A. Table 3 shows the required mitigation for the receiving environments referred to in the WQS.

Table 7. Water Quality Study mitigation requirements for Irishman Creek Station

Station Name	Surface water sub-catchment	Stream mitigation Periphyton required		Secondary stream periphyton mitigation		Stream mitigatio n required		Secondary stream mitigation required		GW R mitigation required kg/farm		Lake mitigation required kg/farm	
		N	P	N	P	N	P	N	P	N	P	N	P
Irishman Creek	Mary Burn	29358	2026	29305	2074	29286	2055	29286	2055	29286	2055	29286	2055

The calculated nutrient mitigation requirement of the receiving environments determined in the Water Quality Study for Irishman Creek Station, are 29286 kg N per annum and 2026 kg P per annum.

3.2 Local receiving environments

The local receiving environments within the property are the Mary Burn and the Irishman Creek. Although the property has been assessed within the WQS as being a tributary of the Mary Burn Creek, the connection is rather tenuous as the Irishman Creek disappears into the gravels of the Tekapo basin downstream of SH8. Although surface water re-emerges within the lower reaches of the Irishman Creek prior to its confluence with the Mary Burn, it is likely that a significant portion of that flow is received from general groundwater contained within the Tekapo River flood plain.

4. FEMP development

4.1 Stage 1 – Mandatory good agricultural practices

Table 1 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 1 Mandatory good agricultural practices

Mandatory good agricultural practices
Fertilisers applied according to code of practice for fertiliser use
All sources of nutrients including applied effluents and soil reservoirs accounted for
Fertiliser application applied evenly
Irrigation and effluent applied evenly
Crop, cultivation, nutrient inputs and yield records kept per farm management unit

4.2 Stage 2 – OVERSEER and meeting WQS mitigation requirements

The WQS thresholds set for Irishman Creek station, once the most stringent nutrient mitigation has been achieved, are 29286 kg N/year and 2026 kg P/year. Below shows the output from OVERSEER for the modelled proposed farming system at Irishman Creek station. The OVERSEER outputs illustrate that the modelled farm system achieves both the N and the P thresholds set out in the WQS.

A list of OVERSEER model inputs and outputs are given in Appendices C and D.

Table 4 Total N and P losses modelled by OVERSEER for the proposed farming system on IRISHMAN CREEK station

	WQS Threshold kg/year	OVERSEER output kg/year
Total N leaching	29286	2026
Total P leaching	24061	476

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

The Farm Environmental Risk Assessment (FERA) has highlighted that there are potentially soil, stock and fertiliser site-specific environmental risks on the farm. These risks are described below. The full FERA is attached as Appendix C.

4.3.1 Soil risks

The current soil risks identified are vulnerability to, and evidence of, wind erosion, and poor extent of ground cover for protection.

4.3.2 Effluent risks

There are no effluent risks associated with the current or proposed farming system.

4.3.3 Fertiliser risks

The fertiliser risks associated with the farming system are that fertiliser may be applied unevenly, excessive volumes may be applied in a single application, and that applications are poorly timed resulting in runoff.

4.3.4 Stock risks

The stock risks associated with the proposed farming system are that stock are not to be excluded from the watercourses, and there is no provision to control dietary N and P levels.

4.3.5 Water risks

The water risks associated with the proposed farming system are that stock are not to be excluded from the watercourses.

5. Farm system with mitigations

5.1 Blocks

Block sizes are large, with smaller paddocks and yards near the homestead.

5.2 Soils

The FERA highlights potential soil issues arising from severe climatic conditions and the vulnerable nature of the soils to erosion. The management mitigations are;

Maintenance of adequate ground cover by controlled grazing and, where appropriate, application of fertiliser.

Effective rabbit control.

Avoidance of wildfires.

Cultivation restricted to appropriate techniques, periods and situations.

Burning restricted to appropriate periods and seasons.

5.3 Stock

The stocking rates on Irishman Creek Station are extremely low, approximately 1 SU per ha.

Due to the absence of natural water courses most of the blocks and more intensive areas carry stock water troughs, many of which are gravity fed from the Tekapo/Pukaki canal.

Whilst it is not practical to exclude stock from all water courses on Irishman Creek, the low density of stock results in minimal contamination, and stocking policy will continue to reflect this.

5.4 Production

Irishman Creek Station produces super fine Merino wool from a closed flock of specially bred Merino sheep. Surplus stock and those culled for age are sold, mainly at Tekapo sales.

The Station also runs a herd of Angus/Hereford cattle, which are used as a pasture management tool behind the sheep. Surplus calves and cows culled for age/dryness are sold, mainly at Temuka sales.

The Station grows hay and crops for winter feed. The present stock totals approximately 10,000 SUs of which 90% are sheep, 10% cattle.

5.5 Anticipated fertiliser use

Specific fertiliser recommendations are produced on an annual basis using a recommended system. Plant nutrient supply is estimated from both organic and inorganic fertilisers as well as N fixation using a nutrient budgeting system.

The management or mitigation options are:

No N fertiliser to be applied in autumn and winter.

No phosphorus to be applied within three week of irrigation.

No stock on border dyke area once irrigation has commenced until after haymaking.

Soil Olsen P levels to be maintained below 30.

Fertiliser spreaders to be properly calibrated and optimised.

Aerial fertiliser spread with GPS technology and subsequent print-outs.

Fertiliser will be stored in a covered area.

The fertiliser filling area will be at least 50 m from a watercourse of spring or bore and will have no drains that discharge to clean water or that can discharge straight to ground**.**

5.6 Cultivation

After initial cultivation for the establishment of permanent pasture, little cultivation is expected to be undertaken.

6. Monitoring and Auditing

6.1 Baseline Monitoring

Baseline monitoring is already in place on Irishman Creek Station, as shown below:

Soil	Soil nutrient testing on all treated blocks in rotation (usually 1 in 3 years). Measured parameters include standard suite of soil nutrients, ph, C, N, and organic matter.
Water	Surface water quality of the Irishman Creek at the Tekapo canal underpass. Measured parameters include total N, nitrate, ammonia, other chemicals and suspended solids.
Pasture	Ground cover and species are continually monitored on all blocks and grazing patterns determined accordingly.
Weed & Pest	Rabbit numbers are counted twice a year by ECAN and control measures designed accordingly.
Fertiliser	Volumes, application rates and application uniformity checked and approved at time of application. OVERSEER nutrient budget maintained.
Irrigation	Volumes, application and efficiency continually monitored in accordance with water availability and soil moisture deficit levels.

6.2 6.2 Emergency Conditions

In the event of an occurrence that creates or risks a pollution event we will seek immediate guidelines from ECAN and any other appropriate authorities, e.g. Police, Ambulance, Fire Brigade, Meridian Energy.

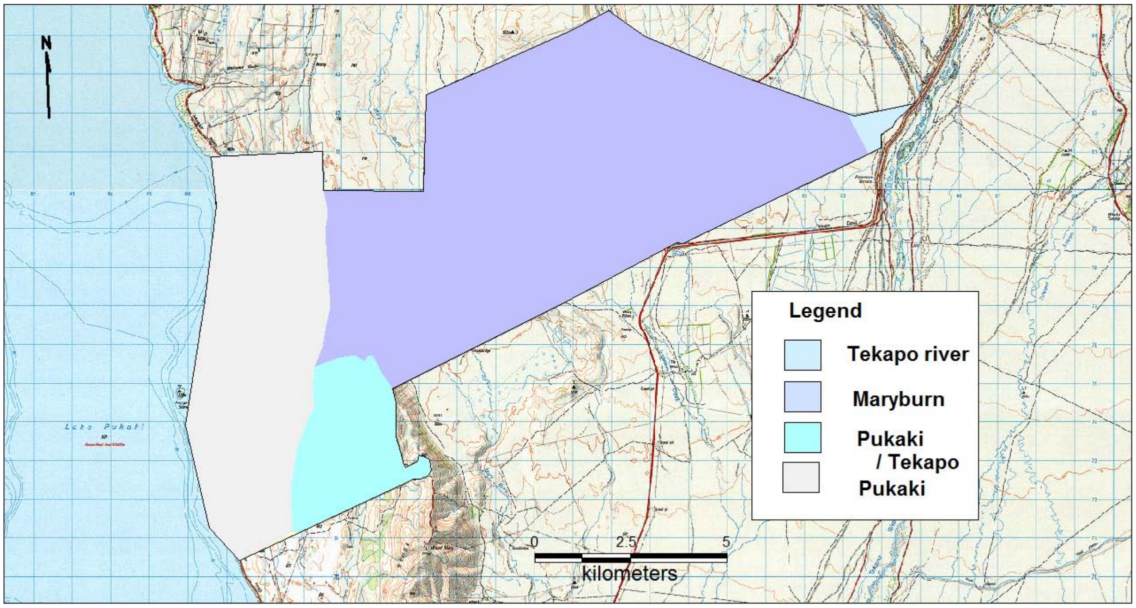
6.3 6.3 Auditing

Records will be maintained to enable an audit by an appropriate authority at any time.

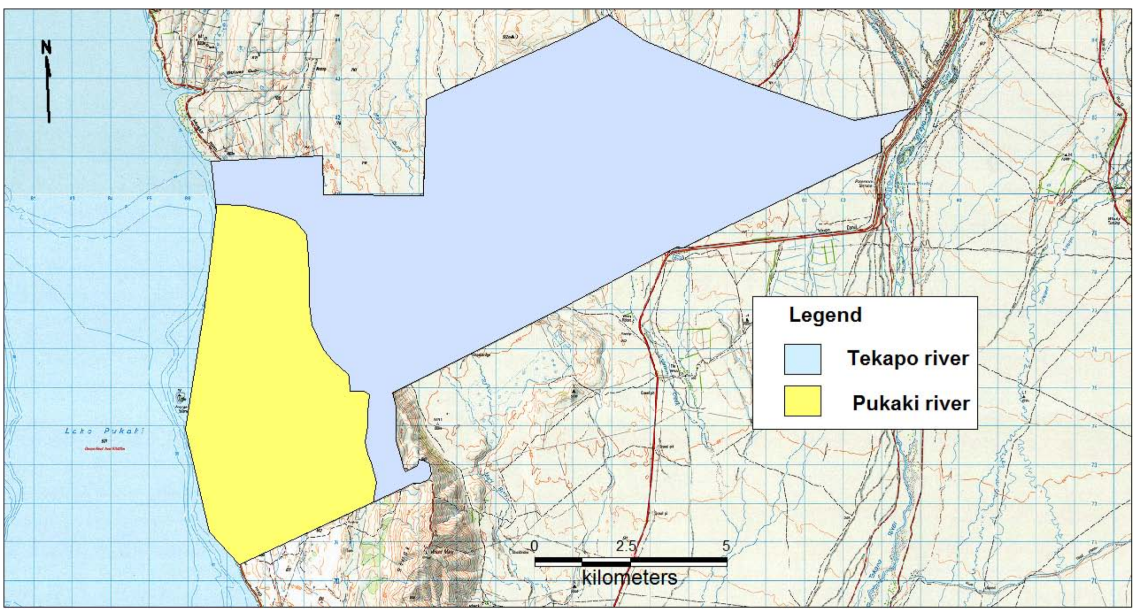
Appendix A - WQS Ground and Surface Water Sub-catchments for Irishman Creek Station

APPENDIX A

Irishman Creek Station surface receiving environment



Irishman Creek Station groundwater receiving environment



Appendix B - Farm Environmental Risk Assessment

Environmental risks on Irishman Creek arise from the following factors:

A) Climatic

The weather at Irishman Creek Station can change extremely quickly.

1) Wind

This regularly exceeds 100 kph at ground level, and can exceed 150 kph. In addition to hazarding trees, structures, and vehicles this can cause significant soil erosion.

2) Rain

Whilst heavy rain (<20 mm per hour) is rare persistent rain (up to 60 mm per day) does occur. which, if prolonged and combined with heavier falls at the Irishman Creek headwaters, can produce dramatic floods. These can spread across the flats east of the Homestead as far as SH8. The Maryburn Stream does not flood to any significant extent.

3) Snow

The principal risk of snow is to stock and structures, but trees can also be severely damaged and the Irishman Creek can be blocked by avalanche.

4) Fire

Wildfires present a significant threat during dry periods, especially in NW wind conditions.

B) Topography

1) Slopes

The majority of Irishman Creek Station is flat or gently rolling. The only significant feature is the northern end of Mary Hill.

2) The property is bisected by the Tekapo/Pukaki canal.

3) The canal contains a large fish farm.

4) The property is crossed by several roads that carry large volumes of traffic, especially in summer.

5) The property is crossed by a row of pylons carrying HT cables from Tekapo B power station.

C) Agricultural Activities

1) Fertiliser

Fertiliser is applied both aerially and by ground spreading.

2) Ground Working

Pastures are renewed on a rotational basis. Pastures total 300 ha (3% of the total area farmed).

3) Stock

Stock graze extensively over the entire Station.

4) Irrigation

This comprises 48 ha border dyke, and 160 ha spray irrigation.

5) Burning

The Station utilises burning to control matagouri and remove stubble when a crop is grown.

Appendix C - OVERSEER Input Parameters

Report from OVERSEER nutrient budgets 2009, version 5.4.3 on 21/09/2009 12:17 p.m.

IRISHMAN CREEK STATION LTD NICKY HAND
PRIVATE BAG 910
TIMARU

Client Reference: 370978

File: NB Irishman.ovp

Parameter report

Parameter name	Units	Value
Region		Canterbury

No Fuel, electricity and other farm inputs
No Farm capital (structure) inputs

Block setup summary

Block name	Block type	Effective area (ha)	Relative productivity
Native Area	Pastoral	7085	0.25
Oversown Country	Pastoral	2700	1.9
Borderdyke Irrigation	Pastoral	48.5	12
Marybum Pivot	Pastoral	55	13
Gun & K-Line	Pastoral	109	10

Total farm area declared as blocks	ha	9997.5
Relative productivity assessment method		Relative yield
Make all block stock ratios same as farm stock ratios		False

Stock Information: Sheep, beef and deer

Sheep	RSU	8047
Beef	RSU	1097
Animal production		
Wool	kg	35000
% beef as male		2

Grazing off options for sheep not used

Advanced pasture supplement feeding options for sheep not used
Grazing off options for beef animals not used
Wintering off/animal shelter options for beef animals not used Advanced pasture supplement feeding options for beef not used

Animal health supplementation used by Non-dairy animals
No animal supplementation has been entered

DCD is not applied
No Wetland information No supplements added

Block Information

Parameter name	Units	Value
Block name		Native Area
Area	ha	7085
Block type		Pastoral

Topography	km	Easyhill
Distance from coast		115
Profile drainage class		Moderately well
Poorly drained		False
Mole/tile drained		False
Receives no liquid or solid effluents No irrigation applied		

Climate

Mean annual rainfall	mm	685
Mean annual temperature	°C	8
Seasonal variation in rainfall		Low
Annual potential evapotranspiration (PET)		651-800
Seasonal variation in PET		Moderate
Hydrophobic condition		Unknown
Latitude South	°	43.7
Altitude	m	680

Sheep	%	90
Merino	%	TRUE
Beef	%	10
Finishing		FALSE
Dairy or beef animals have direct access to streams		FALSE
Development status (organic nutrients)		Developed
Pasture type		Unimproved/Tussock grassland

Soil information

Soil group	Sedimentary
Sand parent material	False
Soil texture	Unknown
Soil profile	
Olsen P	11
QT K	7
QT Ca	7
QT Mg	12
QT Na	3
Organic S	5
TBK reserve K test	Not known
Anion storage capacity or PR	Not known

Block Fertiliser

Fertiliser nutrient forms

Urea	DAP	Other NH4	NO3 Form
0	0	0	0

Super	DAP / DCP	RPR	Other
0	0	0	0

K	Sulphate S	Elemental S	CaMg	Na	
0	0	0	0	0	0

No N added in May, June and July

No soluble P applied in high risk months

Fertiliser P applied within 3 weeks of border dyke irrigation	False

No supplements removed from the block

Block Information

Parameter name	Units	Value
Block name		Oversown Country
Area	ha	2700
Block type		Pastoral
Topography		Easyhill
Distance from coast	km	115
Profile drainage class		Moderately well
Poorly drained		False
Mole/tile drained		False
Receives no liquid or solid effluents		
No irrigation applied		

Climate

Mean annual rainfall	mm	685
Mean annual temperature	°C	8
Seasonal variation in rainfall		Low
Annual potential evapotranspiration (PET)		651-800
Seasonal variation in PET		Moderate
Hydrophobic condition		Unknown
Latitude South	°	43.5

Animals and Pasture

Sheep	%	90
Merino		True
Beef	%	10
Finishing		False
Dairy or beef animals have direct access to streams		False
Development status (organic nutrients)		Developed
Pasture type		Ryegrass / white clover

Soil information

Soil group		Sedimentary
Sand parent material		False
Soil texture		Unknown
Soil profile		
Olsen P		14

QT K	8
QT Ca	7
QT Mg	22
QT Na	5
Organic S	5
TBK reserve K test	1.38
Anion storage capacity or PR	Not known

Block Fertiliser

Fertiliser Calculator

Fertiliser name	Category	Amount (kg/ha/yr)
Sulphur super 30	Ravensdown super	55

No N added in May, June and July

No soluble P applied in high risk months

Fertiliser nutrient forms

Urea	DAP	Other NH4	NO3 Form		
0	0	0	0		
Super	DAP / DCP	RPR	Other		
0	0	0	0		
K	Sulphate S	Elemental S	Ca	Mg	Na
0	0	0	0	0	0

No N added in May, June and July

No soluble P applied in high risk months

Fertiliser P applied within 3 weeks of border dyke irrigation	False
No supplements removed from the block	

Block Information

Parameter name	Units	Value
Block name		Borderdyke Irrigation
Area	ha	48.5
Block type		Pastoral
Topography		Flat
Distance from coast	km	115
Profile drainage class		Moderately well
Poorly drained		False
Mole/tile drained		False
Receives no liquid or solid effluents		
Irrigation	mm	1500

Irrigation

Border dyke	True
Water source is borderdyke outwash	False
Irrigation nutrient concentrations for block	
Irrigation Source	Program default (fixed)
Irrigation Units	mg/l

N	P	K	S	Ca	Mg	Na
2.5	0.1	1.6	2.5	9.3	2.2	9.5

Climate

Mean annual rainfall	mm	6
Mean annual temperature	°C	8
Seasonal variation in rainfall		5
Annual potential evapotranspiration (PET)		
Seasonal variation in PET		8
Hydrophobic condition	.	Low
Latitude South	m	651-800
Altitude		Moderate
		Unknown
Animals and Pasture	%	43.5
Sheep Merino Development status (organic nutrients)		680
Pasture type		
		100

Soil information

Soil group	Sedimentary
Sand parent material	False
Soil texture	Unknown
Soil profile	
Olsen P	20
QT K	4
QT Ca	8
QT Mg	8
QT Na	4
Organic S	5
TBK reserve K test	1.38
Anion storage capacity or PR	Not known

Block Fertiliser

Fertiliser Calculator

Fertiliser name	Category	Amount (kg/ha/yr)
20% potash sulphur super	Ravensdown super	300

No N added in May, June and July

No soluble P applied in high risk months -------------------

Fertiliser nutrient forms

Urea	DAP	Other NH4	NO3 Form
0	0	0	0

Super	DAP / DCP	RPR	Other
0	0	0	0

K	Sulphate S	Elemental S	Ca	Mg	Na
0	0	0	0	0	0

No N added in May, June and July

No soluble P applied in high risk months

Fertiliser P applied within 3 weeks of border dyke irrigation	**False**
No supplements removed from the block	

Block Information

Parameter name	Units	Value
Block name		**Maryburn Pivot**
Area	**ha**	**55**
Block type		**Pastoral**
Topography		**Rolling**
Distance from coast	**km**	**115**
Profile drainage class		**Moderately well**
Poorly drained		**False**
Mole/tile drained		**False**
Receives no liquid or solid effluents		
Irrigation	**mm**	**525**

Irrigation

Border dyke	**False**
Water source is borderdyke outwash	**False**

Irrigation nutrient concentrations for block

Irrigation Source	**Program default (fixed)**
Irrigation Units	**mg/l**

N	P	K	S	Ca	Mg	Na
2.5	**0.1**	**1.6**	**2.5**	**9.3**	**2.2**	**9.5**

Climate

Mean annual rainfall	**mm**	**685**
Mean annual temperature	**°C**	**8**
Seasonal variation in rainfall		**Low**
Annual potential evapotranspiration (PET)		**651-800**
Seasonal variation in PET		**Moderate**
Hydrophobic condition		**Unknown**
Latitude South	**°**	**43.5**
Altitude	**m**	**650**

Animals and Pasture

Sheep Merino Development	**%**	**100**
status (organic nutrients)		**True**
Pasture type		**Developed**
		Ryegrass / white clover

Soil information

Soil group	**Sedimentary**
Sand parent material	**False**
Soil texture	**Unknown**
Soil profile	**Deep**
Olsen P	**17**
QT K	**7**
QT Ca	**7**
QT Mg	**11**
QT Na	**2**
Organic S	**5**
TBK reserve K test	**.38**
Anion storage capacity or PR	**Not known**

Block Fertiliser

Fertiliser Calculator

Fertiliser name	**Category**	**Amount (kg/ha/yr)**
20% potash sulphur super	**Ravensdown super**	**300**

No N added in May, June and July
No soluble P applied in high risk months

Fertiliser nutrient forms

Urea	DAP	Other NH4	NO3 Form		
0	**0**	**0**	**0**		
Super	DAP / DCP	RPR	Other		
0	0	0	0		
K	Sulphate S	Elemental S	Ca	Mg	Na
0	0	0	0	0	0

No N added in May, June and July
No soluble P applied in high risk months

Fertiliser P applied within 3 weeks of border dyke irrigation	**False**
No supplements removed from the block	

Block name		**Gun & K-Line**
Area	**ha**	**109**
Block type		**Pastoral**

Topography		**Flat**
Distance from coast	**km**	**115**
Profile drainage class		**Moderately well**
Poorly drained		**False**
Mole/tile drained		**False**
Receives no liquid or solid effluents		
Irrigation	**mm**	**525**

Irrigation

Border dyke	**False**
Water source is borderdyke outwash	**False**

Irrigation nutrient concentrations for block

Irrigation Source	**Program default (fixed)**
Irrigation Units	**mg/l**

N	P	K	S	Ca	MgNa
2.5	**0.1**	**1.6**	**2.5**	**9.3**	**2.29.5**

Climate

Mean annual rainfall	**mm**	**685**
Mean annual temperature	**°C**	**8**
Seasonal variation in rainfall		**Low**
Annual potential evapotranspiration (PET)		**651-800**
Seasonal variation in PET		**Moderate**
Hydrophobic condition		**Unknown**
Latitude South	**°**	**43.5**

Animals and Pasture

Sheep	**%**	**85**
Merino		**True**
Beef	**%**	**15**
Finishing		**True**
Dairy or beef animals have direct access to streams		**False**
Development status (organic nutrients)		**Developed**
Pasture type		**Ryegrass / white clover**

Soil information

Soil group	**Sedimentary**
Sand parent material	**False**
Soil texture	**Unknown**

Soil profile

Olsen P	**22**
QT K	**6**
QT Ca	**7**
QT Mg	**10**
QT Na	**3**
Organic S	**10**
TBK reserve K test	**Not known**
Anion storage capacity or PR	**Not known**

Block Fertiliser

Fertiliser Calculator

Fertiliser name	**Category**	**Amount (kg/ha/yr)**
20% potash sulphur super	**Ravensdown super**	**300**

No N added in May, June and July

No soluble P applied in high risk months

Fertiliser nutrient forms

Urea	DAP	Other NH4	NO3 Form		
0	**0**	**0**	**0**		
Super	DAP / DCP	RPR	Other		
0	0	0	0		
K	Sulphate S	Elemental S	Ca	Mg	Na
0	0	0	0	0	0

No N added in May, June and July

No soluble P applied in high risk months

Fertiliser P applied within 3 weeks of border dyke irrigation **False**

No supplements removed from the block

Appendix D

OVERSEER Output Data

Report from OVERSEER nutrient budgets 2009, version 5.4.3 on 21/09/2009 12:21 p.m.

IRISHMAN CREEK STATION LTD NICKY HAND
PRIVATE BAG 910
TIMARU
Client Reference: 370978

NB Irishman.ovp

Nutrient Budget

Farm Budget for: Current farm	N	P	K	S	Ca	Mg	N	H+
	(kg/ha/yr)							
Inputs								
Fertiliser and lime	0	1	1	5	3	0	0	0.2
House block imports	0	0	0	0	0	0	0	0.0
Atmospheric/clover N	1	0	1	1	0	1	1	0.0
Irrigation	0	0	0	0	1	0	1	0.0
Slow release	0	3	2	8	3	5	6	0.0
Supplements imported	0	0	0	0	0	0	0	0.0
Outputs								
Product	**1**	**0**	**0**	**0**	**0**	**0**	**0**	0.0
Effluent removed	0	0	0	0	0	0	0	0.0
Supplements removed	0	0	0	0	0	0	0	0.0
Atmospheric	1	0	0	0	0	0	0	0.0
Leaching/runoff	2	0	6	1	17	4	1	0.0
Net immobilisation/absorption	8	1	0	0	0	0	0	0.0
Change in inorganic soil pool	0	-6	1	0	-9	3	-3	0.3
* Acidity- kg H+/ha								

Report from OVERSEER nutrient budgets 2009, version 5.4.3 on 21/09/2009 12:21 p.m. Copyright@ 2009 AgResearch Ltd. All rights Reserved

IRISHMAN CREEK STATION LTD **NICKY HAND**
PRIVATE BAG 910
TIMARU
Client Reference: 370978

NB Irishman.ovp

Block maintenance fertiliser nutrient recommendations

For: Current farm

Block name	Maintenance fertiliser nutrient recommendations to maintain soil tests at current levels							
	P	K	S	Ca	Mg	Na	Lime	Relative
	(kg/ha/yr)							yield (%)
Native Area	7	0	0	13	0	4	0	56
Oversown Country	10	0	0	9	0	0	50	59
Borderdyke Irrigation	24	0	0	0	15	7	170	87
Marybum Pivot	19	23	10	0	0	0	160	86
Gun & K-Line	16	0	0	0	0	0	110	88

It is recommended that a fertiliser company representative or farm consultant with experience in nutrient management is consulted foradvice on the types of fertiliser and on the timing of application of fertilisers.

These rates are to maintain soil test values only. If soil test values areabove optimum, then less than maintenance can be applied to allow soil test values to fall. Conversely, if soil tests are below those required to maintain target pasture production levels, then capital dressings may be required. In both cases, it is recommended that a fertiliser company representative is consulted.

Also note that experienced fertiliser company representatives may advise rates thatdiffer from these results based on local experience.

Report from OVERSEER nutrient budgets 2009, version 5.4.3 on 21/09/2009 12:21 p.m.

IRISHMAN CREEK STATION LTD **NICKY HAND**
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Block nitrogen report

For: Current

Block name	N in drainage * (IDPrn)	N leached (kg N/ha/yr)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)	% reduction in wetland
Native Area	na	2	10	0	0
Oversown Country	na	3	10	0	0
Borderdyke Irrigation	0.7	10	68	0	0
Maryburn Pivot	1.2	7	60	0	0
Gun & K-Line	1.0	6	45	0	0
Overall farm	na	2	11		

*** Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommended level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).**

**** Sum of fertiliser and external factory effluent inputs.**
na : N in drainage not calculated for easy and steep blocks.

IRISHMAN CREEK STATION LTD NICKY HAND
PRIVATE BAG 910
TIMARU
Client Reference: 370978
NB Irishman.ovp

Block phosphorus report

For:

Current farm	P loss factors				P lost (kg P/ha/yr)	% P removed by
	Soil	Fertiliser	Effluent	Overall		
Native Area	Low	n/a	n/a	Low	0.0	n/a
Oversown Country	Low	Low	n/a	Low	0.0	n/a
Borderdyke Irrigation	Low	Medium	n/a	Low	5.5	n/a
Marybum Pivot	Low	Low	n/a	Low	0.4	n/a
Gun & K-Line	Low	Low	n/a	Low	0.1	n/a
Overall farm	Low	Low	n/a	Low*	0.0 *	

* Includes P loss from ponds to waterwaysDisclaimer

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IRISHMAN CREEK STATION LTD **NICKY HAND**
PRIVATE BAG 910
TIMARU

Client Reference: 370978

NB Irishman.ovp

Block pasture report

Current farm

name	On-farm fresh pasture intake (kg DM/ha/yr)	Estimated utilisation (%)	Supplements removed (kg DM/ha/yr)	Pasture growth (kg DM/ha/yr)
Native Area		67	1	211
Oversown Country		67	24	1623
Borderdyke Irrigation		66	218	10316
Maryburn Pivot		66	237	11177
Gun & K-Line		69	180	8595

This report gives an estimated animal intake for each block based on animal production and supplements brought on to farm information supplied. Estimated annual pasture growth is shown for the animal utilisation value shown.
Note: the model is not sensitive to changes in utilisation.
It is recommended that a consultant or software such as StockPol is used to estimate farm pasture production.

Disclaimer

Appendix E

Water Quality information

Water quality has been assessed in Irishman Creek by assessment of water chemistry and aquatic fauna in 2006 and 2008. Sampling sites are shown in Figure 13 and site descriptions are listed in Table 8.

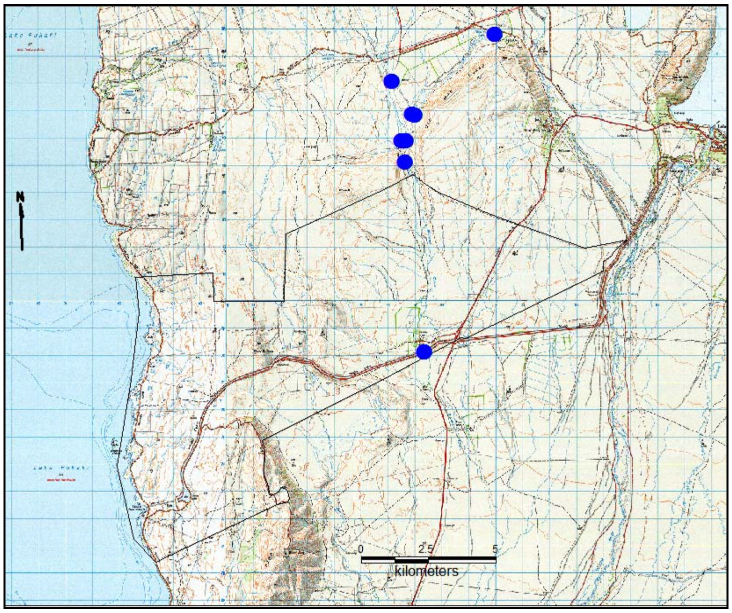

Figure 13. Irishman Creek water quality monitoring sites.

Table 8. Water Quality Site descriptions.

ID	Alt	Site	Description
AQ1	**819**	**Metties Well**	**Spring**
AQ2	**807**	**Irishman Creek Spring**	**Irishman Creek Spring**
		Near Bridge 10 m fm I.Ck.	
AQ3	**776**	**Spring**	**Small stream near stock bridge**
		Old Man Swamp fm Metties	
AQ4	**778**	**Well**	**Small stream 15 m upstream of ford,**
			Stream in Old Man Swamp 200 m from hill
AQ5	**772**	**Old Man Swamp**	**slopes**
AQ6	**769**	**Old Man Swamp/ Irishman**	**Stream in Old Man Swamp**
AQ7	**762**	**Irishman Creek Gorge**	**Small river at start of low open gorge**
IC1	**660**	**Irishman Creek Canal Culvert**	**Small river at culvert under Hydro Canal**

Measurements of water properties are shown in Table 9 and water nitrogen (N) and phosphorous (P) chemistry in Table 10.

Table 9. Irishman Stream water characteristics

ID	pH	Conductivity	Temperature
AQ1	**7.3**	**37.5**	**8.7**
AQ2	**6.3**	**50.4**	**10.7**
AQ3	**7.1**	**35.8**	**15.9**
AQ4	**6.9**	**64.6**	**13.5**
AQ5	**7.2**	**55.4**	**13.0**
AQ6	**7.3**	**29.5**	**12.8**
AQ7	**6.9**	**31.4**	**10.5**

Table 10. Irishman Stream nitrogen & phosphorus chemistry (mg/l).

ID	Total $NO_3 + NO_2$	Nitrate NO_3	Nitrite NO_2	Reactive Phosphate
AQ1	**0.034**	**0.034**	**< 0.002**	**0.013**
AQ2	**< 0.002**	**< 0.002**	**< 0.002**	**< 0.004**
AQ3	**< 0.002**	**< 0.002**	**< 0.002**	**< 0.004**
AQ4	**0.003**	**0.003**	**< 0.002**	**0.005**
AQ5	**0.002**	**< 0.002**	**< 0.002**	**0.005**
AQ6	**0.004**	**0.004**	**< 0.002**	**< 0.004**
AQ7	**0.005**	**0.005**	**< 0.002**	**< 0.004**
IC1	**0.009**	**0.008**	**<0.002**	**< 0.004**

Despite the extensive farming and irrigation on Irishman Creek Station, these water bodies are typical of pristine, high quality uncontaminated water[17].

Water pH values are close to neutral and conductivities are very low. Nitrogen and phosphate levels are very low.

[17] Australian and New Zealand Guidelines for fresh and marine water quality. 2000. National Water management Strategy Paper No. 4

Appendix F

Aquatic fauna information

Electric Fishing Results from 2 sites on Irishman Stream, South Canterbury (G Hughes)

Date:	20.11.02
Location:	Irishman Creek
Operators:	G Hughes, G McClintock (FGNZ, CSI Region), C Scarsbrook (Volunteer)
Equipment:	Backpack, (Kainga EFM 300)
Conditions:	Weather, clear, sunshine. Water, good visibility, normal flows
Method:	Electro fished 50 metres of stream (2 metre strip along left and right banks) Incorporating riffle and pool features, 3 passes with electrode across study area. 90% fish species caught in hand held pole seine net, remainder caught in electro fishing steel mesh dip nets.
Fish Catch:	Anaesthetised with 2-phenoxyethanel, identified, measured and placed in recovery container. Catch released on recovery.

Results

Station 1 - 100 metres upstream of irrigation intake (Infomap 260, I38 975 798)

- Common Bully *(Gobiomorphus cotidianus)* 16,
  63, 77, 71, 66, 59, 55, 56, 61, 55, 76, 25, 54, 52, 25, 50 (mm)
- Upland Bully *(Gobiomorphus breviceps)*, 0
- Galaxid *(G.Vulgaris)* 7
  84, 73, 55, 63, 74, 56, 57 (mm)
- Brown Trout *(salmo trutta)*, 1
  204

Invertebrates

Prolific invertebrate life observed, captured in fine mesh pole seine net. In order of density:

Ephemeroptera	*Coloburiscus*
	Deleatidium
	Nesameletus
Trichoptera	*Olinga*
	Aoteapsyche
	Hydrobiosis
Neuroptera	*Archichauliodes*
Plecoptera	*Zelandoperla*

Station 2 - 100 metres upstream of Irishmans Creek, Station Road Bridge,
(Infomap 260, I38 977 786)

Results

~~Station 1 - 100 metres upstream of irrigation intake (Infomap 260, I38 975 798)~~ - DELETED G.HUGHES 29.11.02

- Common Bully *(Gobiomorphus cotidianus)* 27,
  60, 69, 67, 72, 51, 56, 64, 49, 71, 54, 55, 64, 56, 54, 54, 59, 50, 55, 49, 61, 53, 55, 47, 52, 48, 47, 32 (mm)
- Upland Bully *(Gobiomorphus breviceps)*, 9
  93, 83, 84, 69, 74, 86, 76, 67, 75 (mm)
- Galaxid *(G.Vulgaris)* 4
  104, 119, 80, 54 (mm)
- Brown Trout *(salmo trutta)*, 11
  156, 142, 126, 120, 99, 135, 146, 104, 24, 25, 25 (mm)

<u>Invertebrates</u>

In order of density:

Ephemeroptera	***Coloburiscus***
	Deleatidium
	Nesameletus
Trichoptera	***Olinga***
	Aoteapsyche
	Hydrobiosis
Neuroptera	***Archichauliodes***
Plecoptera	***Zelandoperla***