T J & J A Driscoll as trustees of the T & J Driscoll Family Trust

Resource Consent Application to
Environment Southland
To Use Land for Dairy Farming
and Associated Permits

Updated with additional mitigation post notification: 13 September 2019

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QUALITY INFORMATION

Reference:	L:\17423 - Tim Driscoll - Discharge Consent Variation\Docs\Drafts\20181008_1	
Date:	13 September 2019	
Prepared by:	Tanya Copeland	Update by Mike Freeman
Reviewed by:	Hilary Lennox	Update reviewed by Matilda Ballinger
Client Review:	Tim Driscoll	
Version Number:	**Final update**	

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LIST OF ATTACHMENTS

1. INTRODUCTION

1.1 Overview of Proposal

T J and J A Driscoll on behalf of the T & J Driscoll Family Trust (the applicant) own a 599-cow dairy farm located approximately 5 km south of Winton. Discharge Permit AUTH-301043 authorises the discharge of farm dairy effluent (FDE) and Water Permit AUTH-301044 authorises the taking of groundwater at this farm. These consents do not expire until 2021 but the applicant wishes to expand the dairy platform onto a neighbouring block of land, known as the "East Block", which was purchased in 2016. The applicant would also like to milk up to 680 cows across the extended dairy platform. Consent is sought for the following:

- To use land for a farming activity where the land area of the dairy platform would be greater than at 3 June 2016;
- To replace Discharge Consent AUTH-301043 with a new discharge consent to discharge FDE from the seasonal milking of up to 680 cows; and
- To replace Water Permit AUTH-301044 with a new water permit that allows for enough water to be taken to support the proposed farming operation.

1.2 The Applicant

Applicant Address: T J and J A Driscoll
266 Thomsons Crossing Road East
Winton

Address for Service: C/- Landpro Limited
PO Box 302
Cromwell 9342

1.3 Purpose of Documentation

Under Section 88 of the Resource Management Act 1991 (the RMA), this report provides an assessment of the activities effects on the environment as required by Schedule 4 of the RMA.

2. DETAILS OF PROPOSAL

2.1 Location

The figure below shows the location of the farm in relation to Winton as well as the proposed farm boundary.

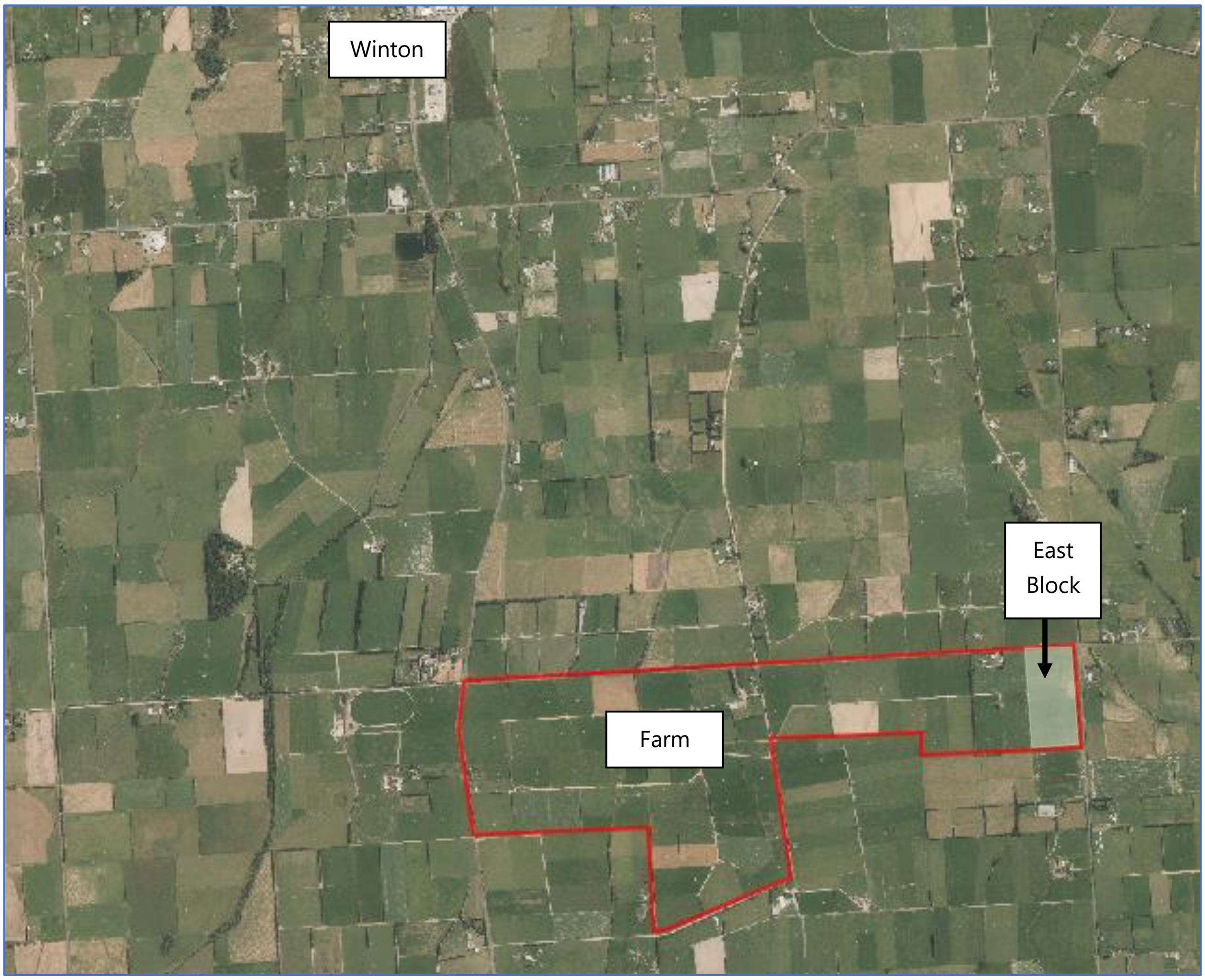

Figure 1: Proposed Farm Boundary, with the new East Block shaded

2.2 Details of Dairy Farm

The following provides further details of the farming system proposed.

Table 1: Details of the Dairy Farm

Property Details	
Property address	266 O'Shannessy Road, RD1, Winton
Property owner(s)	T J, J A, J P and C A Driscoll
Legal Description	Pt Sec 30 Blk I Winton Hundred
	Pt Sec 29 Blk I Winton Hundred
	Sec 43 Blk I Winton Hundred
	Sec 44 Blk I Winton Hundred
	Sec 45 Blk I Winton Hundred
	Sec 54 Blk I Winton Hundred
	Lot 1 DP 449518
	Lot 2 DP 449518 (new block)
Property area (ha)	224.5 ha (previously 210.6 ha)
Change in scale/intensity/farm boundary?	Increase in farm area and cow numbers
Discharge Permit Details:	
Replacement of permit no.	AUTH-301043
Number of dairy cows	680
Stocking rate (cows/ha)	3.0
Winter milking?	No milking between 20 June and 20 July other than slipped cows
Wintering barn?	No
Feed pad/standoff pad?	Two impervious pads that don't drain into the effluent pond
Other sources of effluent?	Vat stand, tanker apron
Type of shed	50 bale rotary (only 6 yrs old – recent conversion)
Effluent treatment	Stirrer in the pond (no need for weeping wall)
Storage available (m^3)	3,261 m^3 lined pond
Storage required (m^3)	2,670 m^3 (as per attached dairy effluent storage calculator[1])
Disposal area (ha)	93.3
Irrigator proposed	RX Plastics Maxi Pods. Slurry tanker may be used rarely, such as when desludging the pond.
Application rate and depth	10 mm/hr rate and 25 mm depth per application 5mm depth for the slurry tanker
Monitoring proposed	None other than that which will be provided for in CAEMP/FEMP
Water Permit Details:	
Replacement of permit no.	AUTH-301044
Freshwater Management Unit	Lower Oreti and Makarewa
Groundwater Zone	Bore is located in the Lower Oreti groundwater management zone
Average rate of take over 24 hrs (L/s)	1

[1] DESC has not been updated - required storage will decrease slightly.

Daily volume (L)	81,600
Allocation per cow (L/cow/day)	120
Location of point of take	Well Number E46/1067, which is located at the house, is currently used for the shed and troughs. There is another well, E46/1089, which is located at the dairy shed but is not currently used.
Freshwater storage onsite?	4 x 30,000 L tanks
Yearly volume (m^3/year)	25,173 (120 L/cow/day for 680 cows over summer, 70 L/cow/day for 86 cows over winter)
Discretionary allocation limit for groundwater zone (m^3/year)	20,700,000
Amount currently allocated from groundwater zone, including current permit (m^3/year)	4,106,038 (20% of allocation limit)
Land Use Consent (use land for dairying)	
Area of new block (ha)	13.9 ha
Use of land pre-May 2016	Sheep grazing
When was it converted to dairying?	Yet to happen – need to wait until consent is granted
Proposed use of land	Incorporation into the dairy platform

Effluent Management

Effluent generated in the dairy shed flows under gravity to the effluent pond via a stone trap. A weeping wall is not necessary at this property because a mechanical stirrer has been fitted on the pond. This is mounted on a concrete pontoon extending into the pond to ensure that the effluent is stirred well. The pond, which was built 6 years ago when the farm was converted, is lined with an HDPE liner and has had no performance issues. All of the farm's effluent infrastructure has been maintained in excellent condition. Given the age, condition and construction of the pond, a pond drop test is superfluous for this consent application. The image below shows that the leak detection system was recently inspected and running clear.

Figure 2: Infrastructure layout

Figure 3: Large stone trap adjacent the effluent pond

Figure 4: Effluent pond

Figure 5: Leak detection port with no trace of effluent

The Dairy Effluent Storage Calculator (DESC) attached shows that the pond is adequately sized to allow for effective deferred irrigation.

This proposal seeks to increase the size of the area to which effluent is actually discharged. Appendix I of Discharge Permit AUTH-301043-01 shows a disposal area of 107.7 ha but this has not been fully utilised and effluent is rarely applied to the east of O'Shannessy Road. Effluent can be applied over a larger area if the effluent disposal field is extended to the south instead. This is an effective way of ensuring that nutrients are distributed over a larger area, thus reducing the intensity of loading in any particular paddock. The current and proposed effluent discharge areas are shown in the figure below, which has been taken from the attached nutrient budget report.

Figure 6: Effluent disposal area

Land Use Consent to Use Land for Dairying

The attached plans from the applicant's Farm Activity Focus Plan confirm what the dairy farm boundary was pre-May 2016. The applicant purchased the East Block in April 2017. This 13.9 ha section has previously been used as a sheep grazing block, but it is proposed that it now be incorporated into the dairy platform.

Inclusion of the new block into the dairy platform will allow for an increase in the number of cows milked at the farm from 599 to 700. To offset the potential increase in N losses from the increased cow numbers, the applicant is proposing to undertake mitigation measures such as:

- reducing the winter crop area on the dairy platform and utilizing 4ha of grass/baleage over winter
- increasing the effluent discharge area so that the concentration is effluent in any one area is reduced; and
- reduced N fertiliser use on the effluent discharge area.
- maintaining the same level of off-platform wintering as the current scenario

These mitigation measures are discussed in further detail in Section 6 of this report. The proposed farming system is essentially one where the majority of the milking herd is wintered offsite, however, the modelling undertaken as part of this application has allowed for some cows of these cows to be on-farm during June and July. This is to allow for delays in removing all of the herd at the start of June, and to allow for early calvers to be brought home early.

Compliance

The compliance history for Discharge Permit AUTH-301043 shows that the consent holder has been fully compliant, with all scores being "1: Fully Compliant". The compliance staff have often commended the consent holder for their performance.

Regarding Water Permit AUTH-301044, this permit requires monthly reporting and the consent holder has sometimes been late in submitting this information. However, there is no record to indicate that there has ever been any over-abstraction.

3. DESCRIPTION OF EXISTING ENVIRONMENT

3.1 Land Use, Topography & Climate

The property, located at approximately 40 m above mean sea level, is an existing dairy farm and conventional farming practices are undertaken. Surrounding land use comprises other dairy farms, sheep and beef farms and some rural dwellings. Based on 30 years of rainfall records of Middle Creek at Otahuti (being the nearest rainfall station to the property) the property is likely to receive an average of 996 mm of rainfall per year.

There are tile drains across the property but most of these were installed before the applicant took possession of the property and so their exact location is not known.

3.2 Water Resources

3.2.1 Surface waterways

According to Beacon, the majority of the property is contained within the Lower Oreti Surface Water Management Zone, and the eastern-most portion is contained within the Tussock Creek catchment/Makarewa Surface Water Management Zone. The Makarewa River is a tributary of the Oreti River. In reality, the sub-catchments identified in the Beacon GIS system are simplifications of actual surface water catchments (see Figure 7b) with the likelihood that little surface runoff enters Tussock Creek.

There are a number of tributaries of the Oreti River on the property, most of which have been modified and all are fenced from stock. The tributaries discharge to the Oreti River approximately 3.6 km downstream of the property boundary. As shown on the plan below (taken from the applicant's Farm Activity Focus Plan), there are no tributaries of Tussock Creek/the Makarewa River on the subject property. Effluent disposal does not occur within 20 m of any surface water body.

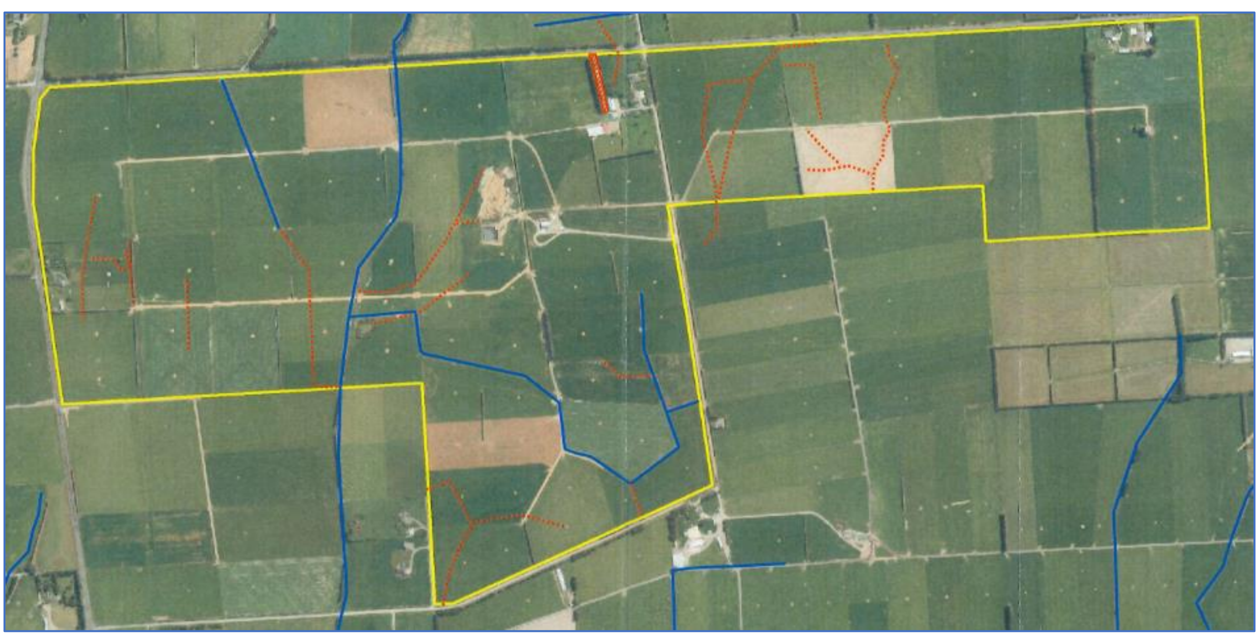

Figure 7a: Surface waterways (blue lines) and CSAs (dotted orange lines)

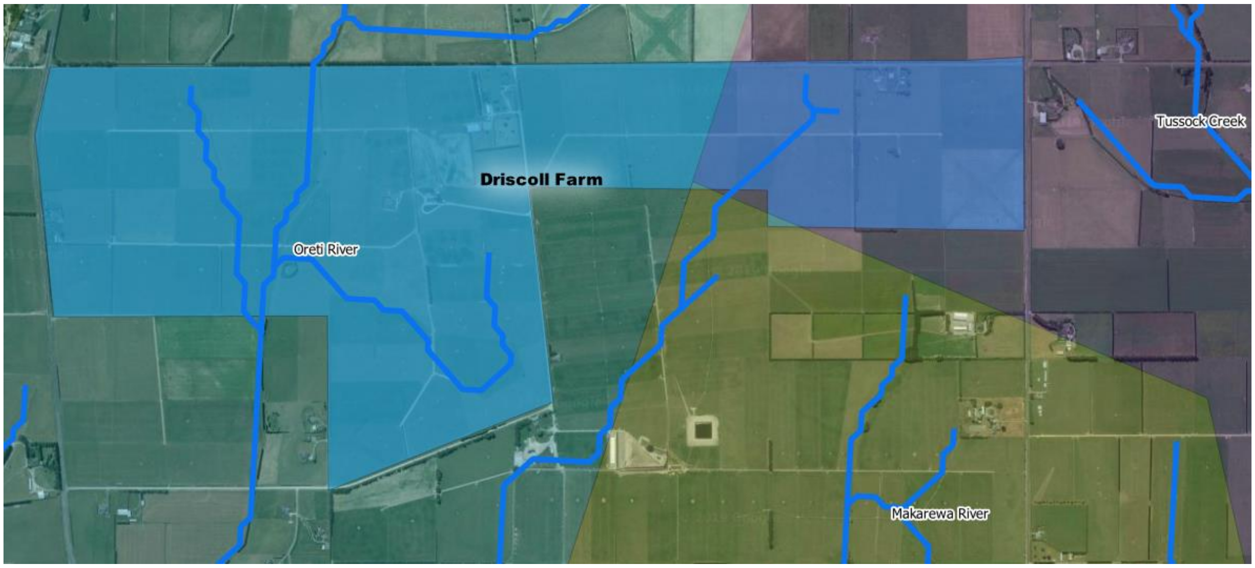

Figure 7(b) Farm location relative to actual surface water catchments and Beacon sub-catchment estimates

3.3 Soils and Physiographic Zones

Soil types and physiographic zones present will guide the choice of which Good Management Practices (GMPs) the applicant will adopt to ensure that potential adverse effects associated with the proposed activities are managed as far as reasonably practicable.

The following provides a description of the soils, FDE classifications and physiographic zone(s) present as well as the associated risks. The farm has been assessed as a whole, following the addition of the new block.

Table 2: Summary of Soils, Physiographic Zone(s) and Risks

Soil Type	Vulnerability Factors			FDE Classification	*Physiographic Zones*
	Structural Compaction	N leaching	Waterlogging		
Pukemutu	Severe	Slight	Severe	Category A	Gleyed (no variant)
Edendale	Slight	Moderate	Slight	Category A	Oxidising (no variant)

3.3.1 Soils

Pukemutu soils have heavy silt loam, grading with depth to silty clay, textures and are poorly drained, with a dense frangipan between 60 and 90 cm depth, which restricts water drainage. They respond well to mole and tile drainage. These soils are poorly drained, with very slow permeability in the subsoil and limited aeration during sustained wet periods.

Edendale soils are well-drained and have a deep rooting depth, high water-holding capacity, and silt-loam textures. Whilst these soils are well-drained, the compact subsoil is slowly permeable and may cause short-term waterlogging after heavy rainfall.

The proposed expansion in the effluent disposal area and expansion of the dairy platform will not impact on any soil types that aren't already included in the effluent disposal area or dairy platform.

3.3.2 Farm Dairy Effluent Classification

All of the soils across the property are categorised as Category A – artificial drainage or coarse soil structure. The average FDE application rate needs to be less than the soil infiltration rate and FDE must only be applied when a soil water deficit exists.

The proposed expansion in the effluent disposal area and expansion of the dairy platform will not impact on FDE categories that aren't already included in the effluent disposal area or dairy platform.

3.3.3 Physiographic Zones

The western part of the property is within the Oxidising physiographic zone, which coincides with the presence of the Edendale soils. The rest of the property, which is underlain by Pukemutu soils, is within the Gleyed physiographic zone.

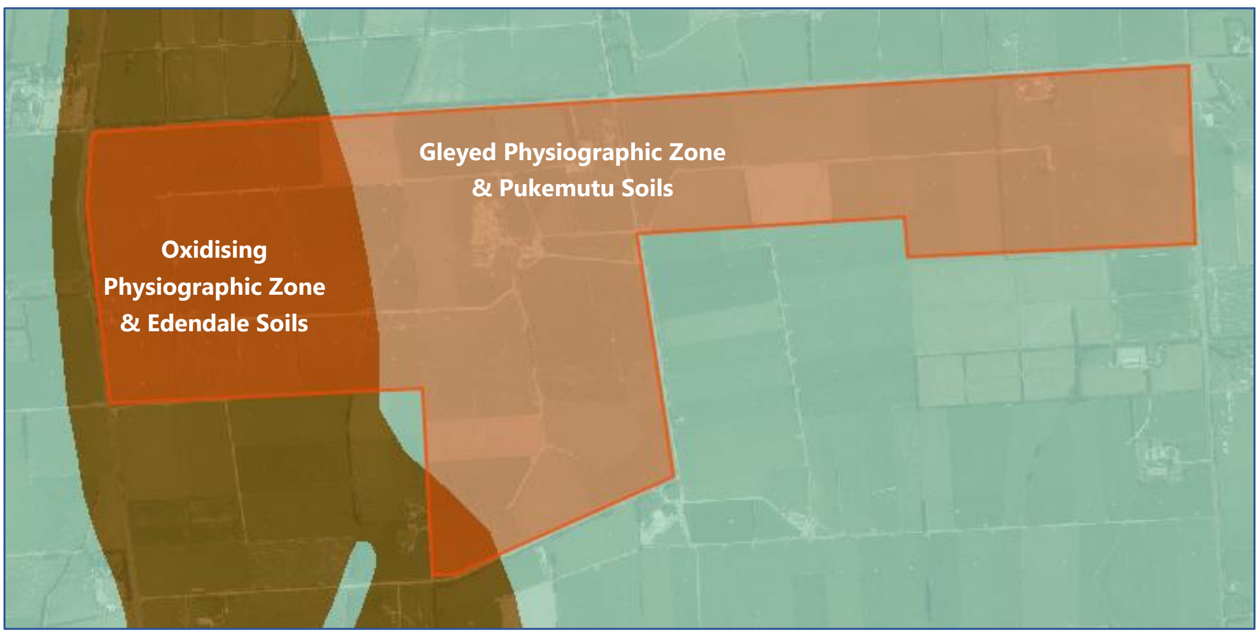

Figure 8: Physiographic zones present across the subject property

The Gleyed physiographic zone comprises predominately flat to undulating land that occurs between major river systems where soils are fine textured and poorly drained. This zone is characterised by soils which have distinctive redoxomphoric features such as mottling and gleying (resulting from extending periods of soil waterlogging). Soils in this zone have some ability to remove nitrogen from water to the atmosphere via denitrification. However this process can be bypassed when contaminants are flushed to nearby surface water bodies via artificial drains and overland flow following heavy or sustained rainfall event.

The Oxidising zone is well aerated with plenty of oxygen. High levels of oxygen allow nitrate nitrogen to develop, and therefore this setting has little to no ability to remove nitrogen (i.e. denitrification). When soils are wet, any nitrogen not used by plants has the potential to drain down into the underlying groundwater. Soils in Oxidising zone generally have good permeability although some soils in this zone have low subsoil permeability making them susceptible to waterlogging and therefore artificial drainage is used. However, Edendale soils are not prone to waterlogging.

The proposed expansion in the effluent disposal area and expansion of the dairy platform will not impact on any physiographic zones that aren't already included in the effluent disposal area or dairy platform.

3.3.4 Summary

The depth of nearby bores (6 – 13 m) indicates that there is a relatively shallow groundwater resource available locally and ES's factsheets for the Lower Oreti and Makarewa groundwater zones suggest that this groundwater resource is recharged predominantly by rainfall. Nutrients, such as N, do leach from the upper soil profiles and enter this groundwater resource. This is particularly true in the western portion of the property that is in the Oxidising physiographic zone, although a significant local groundwater quality issue has not been detected.

The key contaminant pathway on the western-most portion of the property is deep drainage and the key contaminant pathway for the rest of the farm is artificial drainage. In either area, soil moisture deficit FDE application is required to avoid the accumulation of contaminants in the topsoil and subsequent leaching through to tile drains and/or groundwater.

3.4 Water quality

Receiving water bodies

According to the Environment Southland (ES) Beacon GIS mapping system the Driscoll property is spread across upper catchment of the Oreti River and Tussock Creek that subsequently feeds into the Makarewa River and then the Oreti River. The NIWA/MfE River Environment Mapping layer indicates that the vast majority of the property lies within the primary Oreti River catchment with a very small proportion of the property potentially within the Tussock Creek/Makarewa River catchments. There is a long-term water quality monitoring site for the Oreti River at Wallacetown, for Tussock Creek at Cooper Road and for the Makarewa River at Wallacetown. The focus of this report in terms of surface water quality is the Oreti River because the most definitive evidence strongly indicates that the vast majority of surface runoff and likely direction of shallow groundwater recharging surface water will be to the Oreti River and those tributaries south of the property that feed directly into the Oreti River.

Figure 9: **Location of Driscoll property and catchment above the two key long-term water quality monitoring sites**

The NIWA REC information shows that surface water bodies arise on the eastern side of the property and drain directly towards the Oreti River rather than via the Tussock Creek or the Makarewa River. ES staff have acknowledged that these sub-catchment maps are not that accurate and in any regard, this is not critical except to focus downstream water quality attention on the Oreti River water quality monitoring site at Wallacetown.

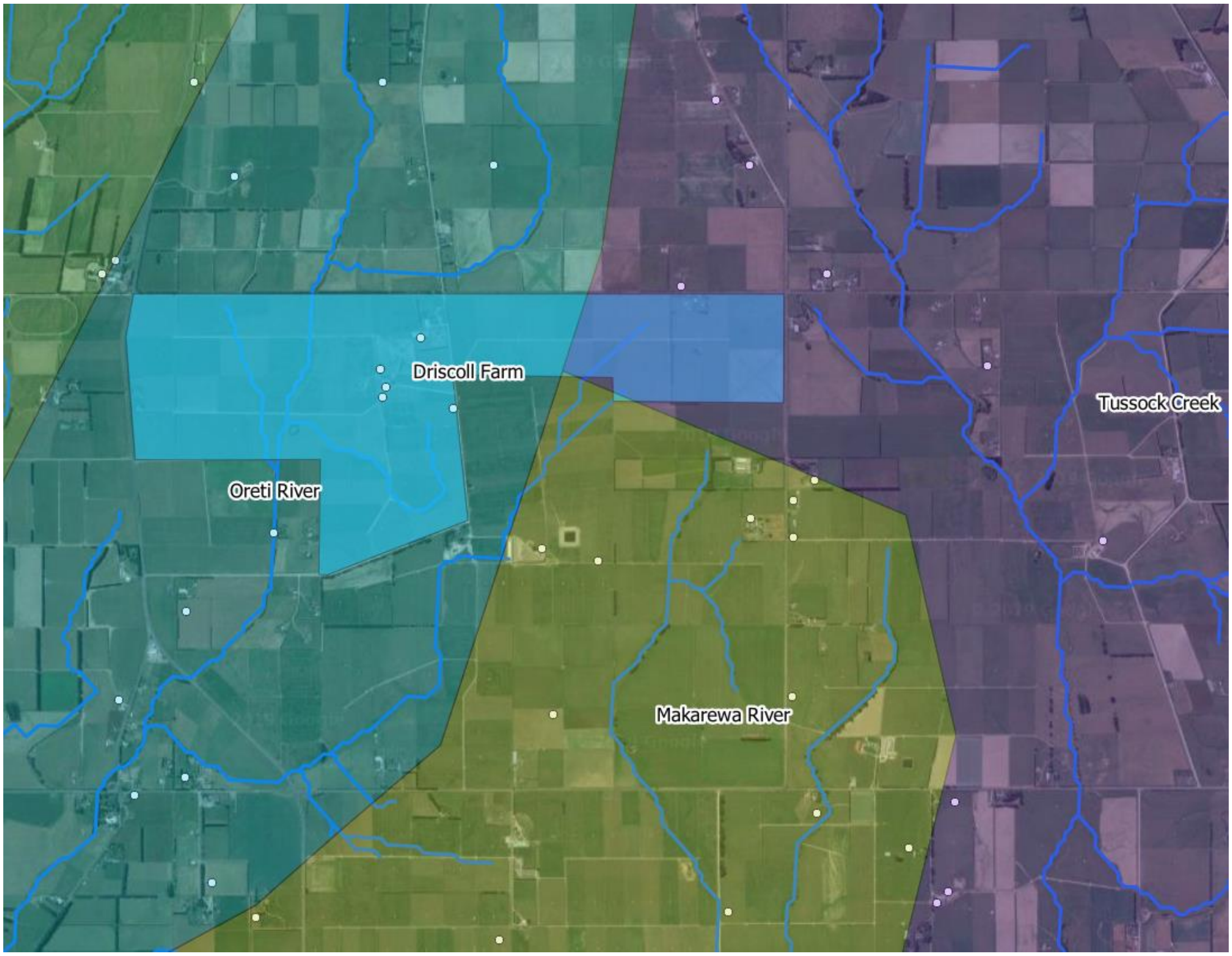

Figure 10: **Location of the property relative to NIWA mapped surface water bodies and ES sub-catchment areas.**

The property is primarily underlain by groundwater that is part of the Lower Oreti groundwater management zone (as specified in the PSWLP), with a small part of the property within the Makarewa groundwater management zone. This is illustrated in the following figure.

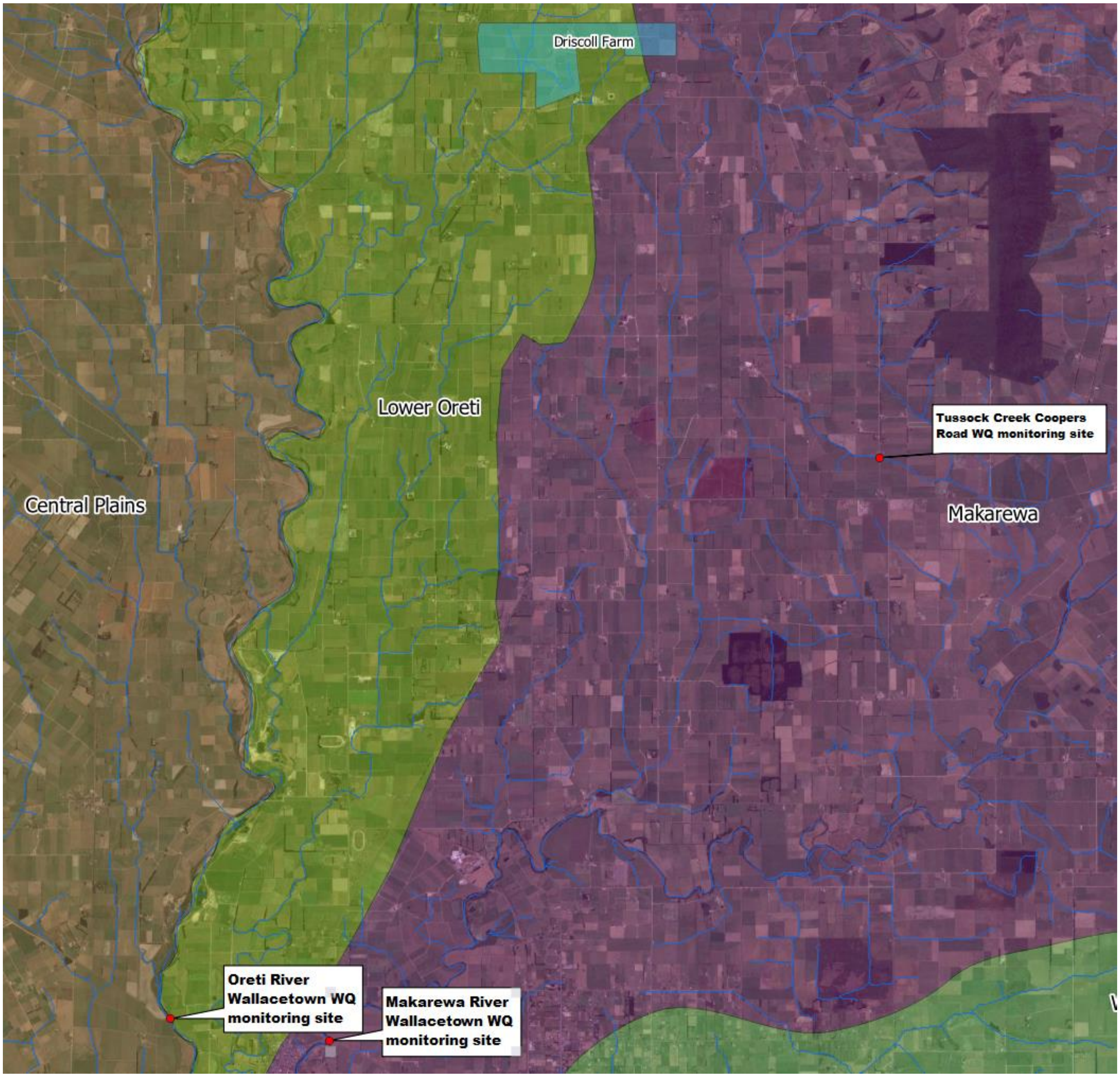

Figure 11: Location of Driscoll property relative to the PSWLP groundwater management zones

There does not appear to be any specific technical reports on groundwater hydrogeology in this area. However, information used to inform the PSWLP process (LWP 2017[2]) strongly indicates that the groundwater in this area is primarily recharged via rainfall, groundwater discharge is primarily to drains and streams in the area, and the general direction of groundwater flow is south south-west.

[2] Landwaterpeople (2017) Groundwater Provisions of the Proposed Southland Water and Land Plan, Technical Background, Report for Environment Southland

Statutory water quality objectives and standards relevant to assessing existing water quality

The most directly relevant planning documents are the Southland Regional Water Plan (SRWP) and the Proposed Southland Water and Land Plan (PSWLP). These describe the values, objectives, policies and 'standards' for water in the Southland region.

Under the PSWLP, surface water bodies on the property are primarily classified as lowland hard and spring-fed streams and the Oreti River at the Wallacetown water quality monitoring site is classified as lowland hard. Table 1 summarises the values associated with these water body types as specified in the SRWP. The PSWLP does not use a classification system to establish values for rivers and streams. However, the relevant regional objectives in the PSWLP are also provided in Table 1.

The relevant numerical water quality standards and guidelines are included in section 5 along with the results from water quality monitoring.

The Southland Regional Coastal Plan also contains a diverse suite of objectives and values that apply to the New River Estuary. Those are not repeated here but it is important to appreciate that there is a relationship between regional plans, the regional coastal plan and the overarching Southland Regional Policy Statement.

Table 3: Summary of key regional plan surface water values & objectives relevant for water quality

Regional Plan	*Classification*	*Values/objectives specified in the relevant plan*
Southland Regional Water Plan 2010 Objective 3	Lowland soft & hard bed	- Bathing in those sites where bathing is popular; - Trout where present, otherwise native fish; - Stock drinking water; - Ngāi Tahu cultural values, including mahinga kai; - Natural character including aesthetics.
Proposed Southland Water and Land Plan Objectives 3, 6, 7, & 8		3 The mauri (inherent health) of waterbodies provide for te hauora o te tangta (health of the people), te hauora o te taiao (health of the environment) and te hauora o te wai (health of the waterbody) 6 There is no reduction in the quality of freshwater and water in estuaries and coastal lagoons by, (a) maintaining the quality of water in waterbodies, estuaries and coastal lagoons, where the water quality is not degraded; and (b) improving the quality of water in waterbodies, estuaries and coastal lagoons, that have been degraded by human activities. 7 Any further over-allocation of freshwater (water quality and quantity) is avoided and any existing over-allocation is phased out in accordance with freshwater objectives, freshwater quality limits and timeframes established under Freshwater Management Unit processes. 8 (a) The quality of groundwater that meets both the Drinking Water Standards for New Zealand 2005 (revised 2008) and any freshwater objectives, including for connected surface waterbodies,

		established under Freshwater Management Unit processes is maintained; and (b) The quality of groundwater that does not meet Objective 8(a) because of the effects of land use or discharge activities is progressively improved so that: (1) groundwater (excluding aquifers where the ambient water quality is naturally less than the Drinking Water Standards for New Zealand 2005 (revised 2008)) meets the Drinking Water Standards for New Zealand 2005 (revised 2008); and (2) groundwater meets any freshwater objectives and freshwater quality limits established under Freshwater Management Unit processes

These values and objectives are relevant reference points to understand the implications of existing water quality particularly where that quality is not consistent with relevant objective and values specified in relevant regional plans.

Surface water quality

The following tables and figures provide summary information on the quality of surface water and groundwater in the vicinity of the proposed dairy expansion. This water quality information is compared to the most relevant guidelines, standards and thresholds, specifically the National Objective Framework (NOF) attributes (e.g., *E. coli*, clarity (black disc), dissolved reactive phosphorus, ammonia, etc.) contained within the National Policy Statement Freshwater Management (2017), the PSWLP Appendix E Water Quality 'Standards' (referenced primarily via Policy 16 of the PSWLP), and the Australia New Zealand Environment and Conservation Council (ANZECC) water quality trigger values.

The vast majority of the property is classed as Lowland Hard Bed under the PSWLP with a very small proportion of the property of the far west in the Spring-fed water quality category. The Oreti River at the Wallacetown water quality monitoring site is classed as Lowland Hard Bed.

Table 4: Summary of state and trend at the Oreti River Wallacetown water quality monitoring site

Primary WQ indicators	State	LAWA National Objective Framework (NOF) Band, Annual Median (2008 – 2017) PSWLP Maximum (2009 -18)	Trend	PSWLP water quality standard (Lowland Hard Bed) & ANZECC∞ trigger values
E. Coli	In the worst 50% of all lowland rural sites	**D** – 20-30% of the time, the estimated risk is >=50 in 1000 (>5% risk). The predicted average infection risk is >3%*. 5-year median = **130 n/100ml** Maximum = **10,000 cfu/100ml**	Likely Improving	≤1,000/100ml Faecal coliforms# Highly unlikely to meet standard
Clarity (Black Disc)	In the best 50% of all lowland rural sites	No NOF attribute band set 5-year median = **1.815 metres** Seven results during 2009 – 2018 did not comply with PSWLP WQ standard	Indetermi nate	≥ 1.6 m when flow below median flow (27.4 m3/s), Does not meet standard
Total Oxidised N	In the worst 25% of all lowland rural sites	**B** – Some growth effect on up to 5% of species. 5-year median = **0.94 g/m³** Maximum = **2.5 g/m³**	Not assessed	≤0.444 g/m³ (ANZECC, 2000)* Greater than this trigger value
Ammoniacal N	In the best 25% of all lowland rural sites	**A** – 99% species protection level. No observed effect on any species tested. 5-year median = **0.005 g/m³** Maximum = **0.04 g/m³**	Not assessed	<2.5-0.9 (pH 6.0-8.0) Meets standard
Dissolved Reactive P	In the best 50% of all lowland rural sites	No NOF attribute set 5-year median = **0.006 g/m³** Maximum = **0.04 g/m³**	Not assessed	≤0.01 g/m³ (ANZECC, 2000)* Greater than this trigger value
Macroinvertebrate Community Index	Poor	MCI 5-year median = 95. Fair ecological condition. Indicative of only fair water quality and/or habitat condition.	Likely degrading	>90 Meets standard
Additional PSWLP Water Quality Stds		**Observed WQ range Jan 2009 – Dec 2018**		**PSWLP water quality standard (Lowland Hard Bed)**
Temperature		4.2 – 21 °C		≤23°C Meets standard
pH		7.0 – 7.8		6.5 – 9.0 Meets standard
Sediment cover		Not assessed by ES		
Dissolved oxygen		82 – 132% (7.4 – 14.2 g/m³) NOF Attribute **B** band		> 80 % sat. Meets standard
Bacterial/fungal slime		Not assessed by ES		
Periphyton		4.5 – 361 mg chl *a*/m² (annual sampling, 2004 - 2018) NOF Attribute possibly **C** band (92%ile = 158)		<120 mg chl *a* /m² filam. algae < 200 mg/m² diatom/cyanob. Does not meet standard
Fish		Not assessed by ES		

∞Australian and New Zealand Environment and Conservation Council, 2000, Australian and New Zealand guidelines for fresh and marine water quality.
PSWLP standard is ≤1,000 faecal coliforms/100 ml. However, *E. coli* is monitored. *E coli* are a subset of faecal coliforms.
* ANZECC trigger values for investigation. These have no legal status in NZ and are included as a reference point only.

The data indicate that water quality in the Oreti River at Wallacetown is not suitable for the all of the uses, values and objectives identified in relevant regional plans and does not meet all the relevant numerical standards or guidelines.

The most significant water quality-related issues in the Oreti River at this location appear to be:

1. Poor microbiological water quality,
2. Infrequent poor water clarity, and
3. Raised nutrient concentrations leading to plant growth in the stream and further downstream.

The relatively frequent high concentrations of faecal indicator microorganisms mean that this location would not be suitable for swimming or other similar water contact recreation (as specified in the LAWA guidance, i.e., a significant risk of infection) and would also generally have implications for microbiological quality further downstream.

The infrequent poor water clarity is likely to be indicative of raised suspended solids in the water column that could impact the macroinvertebrate community. However, the MCI is relatively high and meets the PSWLP water quality standard, strongly indicating that even if suspended solids concentrations are high at times that is not causing any significant adverse effects on the macroinvertebrate community.

While nitrate-nitrogen concentrations in the Oreti River have been rated as 'B' under the NOF attribute, this value has been set on the basis of nitrate toxicity rather than for nitrogen (N) as a nutrient. In the context of nitrate-nitrogen as a nutrient both it and DRP concentrations are relatively high (using ANZECC triggers as a guide). This has the potential to accelerate the growth of macrophytes, periphyton and, lower down in the catchment, in the New River Estuary, phytoplankton and macroalgae.

Periphyton coverage has been monitored annually at this site since 2003 and the results are summarised in the following figure.

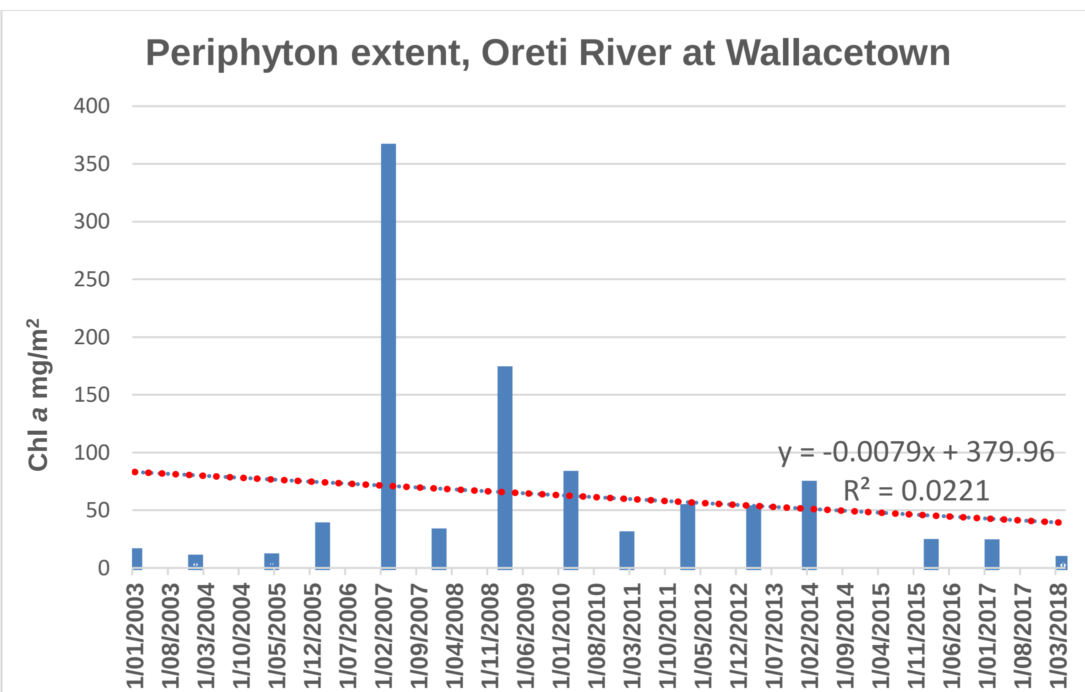

Figure 12: Periphyton extent at the Oreti River water quality monitoring site, 2003 - 2018

The significance of the periphyton results is challenging to interpret. The data from 2003 – 2018 indicate an apparent small trend of improvement. However, the R^2 value (0.0221) is extremely low so the trend is not statistically significant and is likely to be significantly influenced by the two high values.

The NPSFM states that the periphyton attribute applies to the results of monthly, not annual sampling, so this means that definitive conclusions can't be made about the NOF band. Hence the indication in Table 1 that the periphyton attribute band could be C is only indicative, not conclusive.

It is also important to appreciate that there are significant limitations involved in comparing annual results because the sampling was not limited to comparable situations in potential periphyton development. For example, the sampling was not timed to coincide with similar periods of stable flow or linked to flushing events/accrual periods. This means that one sample could have been taken shortly after a significant 'fresh' that may have removed periphyton while another sample may have been taken after a prolonged period of stable flow that would allow periphyton to build up. Therefore, the annual periphyton sampling results can only be taken as a potential indicator of periphyton coverage.

The PSWLP periphyton standards are relatively simple maxima and the results over the monitoring period show at least one significant exceedance with the other high result probably indicating exceedance of the standards but because the standard is written in terms of filamentous algae and diatoms/cyanobacteria and the sampling is just total chlorophyll-*a* it is not possible to be definitive.

Both the property location and the Oreti River water quality monitoring site are classified as the Default Class for the periphyton attribute and therefore leaving aside the fact that monthly sampling has not been undertaken, the Attribute State could potentially be 'C' on the basis of the 2003 – 2018 periphyton data (92%ile value of 158 mg/m^2 based on the fourteen results). The narrative for this state is described in the NPSFM[3] as "Periodic short-duration nuisance blooms reflecting moderate nutrient enrichment and/or alteration of the natural flow regime or habitat."

River nutrient concentrations have not been monitored over as long a period of time as periphyton has been. However, monitoring since 2013 does not indicate a significant trend of increasing nitrate N in the river at this location. There is a small apparent increase but the R^2 value is extremely small and strongly indicates that the apparent increase is not statistically significant. There appears to be a regular annual winter/autumn increase of nitrate N concentrations seen in the Oreti River (this has not been statistically assessed).

[3] National Policy Statement Freshwater Management (2014) Updated 2017.

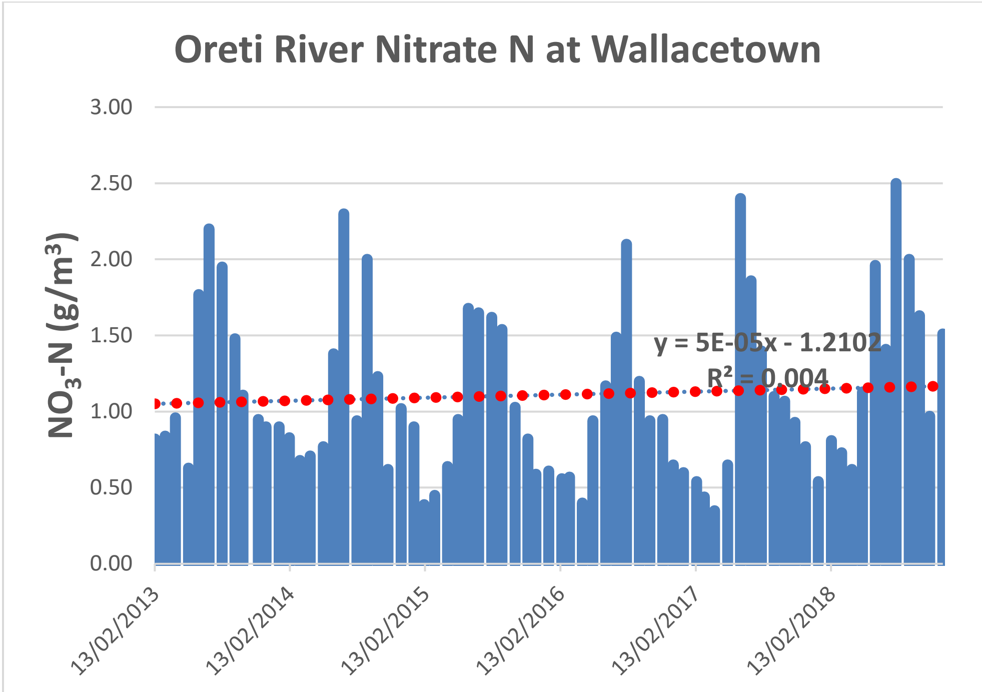

Figure 13: Nitrate N concentrations in the Oreti River at Wallacetown, 2013 - 2018

Similarly, the concentrations of dissolved reactive phosphorus in the Oreti River at Wallacetown have been monitored and while the data shows an apparent trend of decreasing DRP it is not statistically significant (R^2 = 0.01).

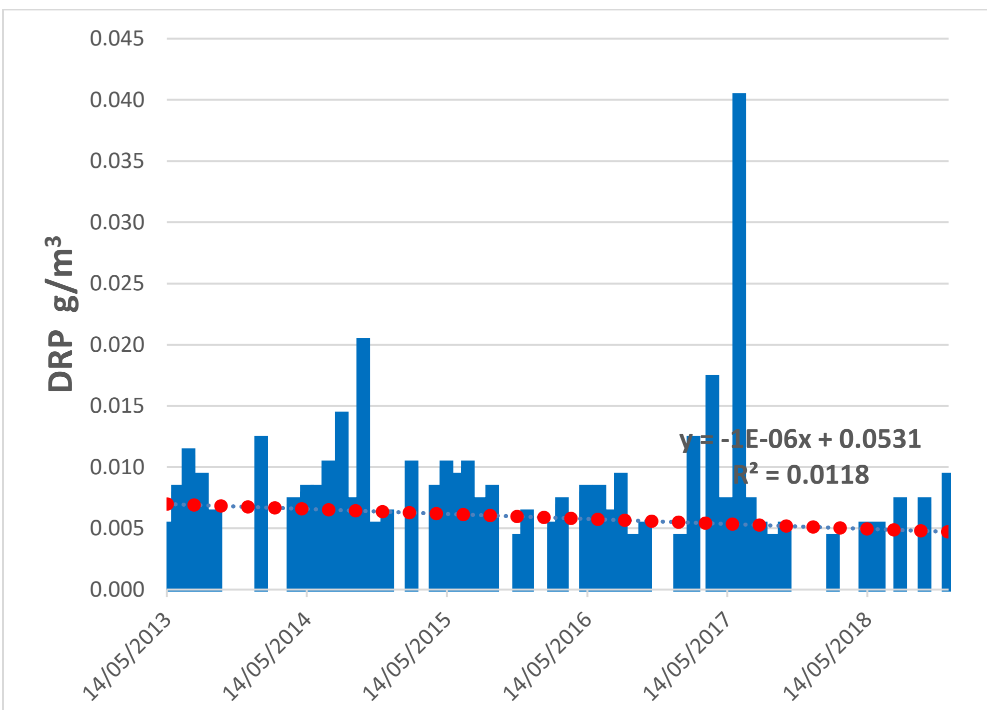

Figure 14: Dissolved reactive phosphorus concentrations in the Oreti River at Wallacetown, 2013 - 2018

The LAWA water quality monitoring information only goes up to December 2017. Additional information was provided separately from Environment Southland in an Excel file. A comprehensive statistical comparison of this dataset with the LAWA statistical summaries has not been undertaken but a review of median values for the 2018 monitoring period indicated that it is unlikely that there are significant changes from the summary data reported in Table 1. It is understood that the LAWA data and analyses will be updated with 2018 data in September this year.

Groundwater Quality

The results of Environment Southland's survey of regional nitrate-nitrogen concentrations are provided as a layer within the Beacon public GIS system and indicates that the property is in an area where the underlying unconfined groundwater nitrate N concentrations were likely to have been primarily between 0.4 – 3.5 mg/L between 2007 – 2012, or indicative of minor to moderate land use impacts. The downgradient area appears to have had slightly higher nitrate N concentrations, between 3.5 – 8.5 mg/L indicative of moderate to high land use impacts. This is illustrated in the following figure.

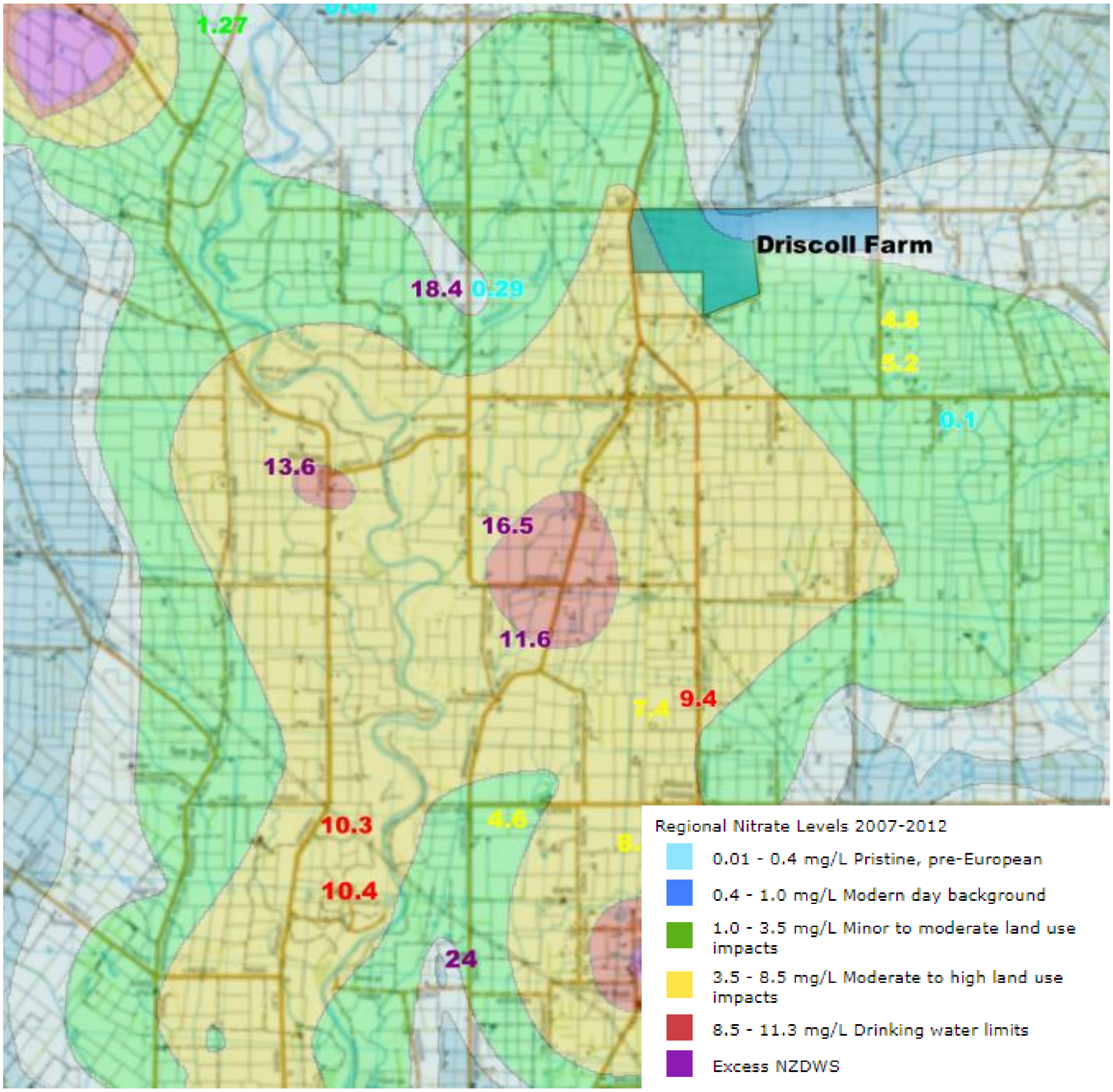

Figure 15: Peak nitrate N concentrations for groundwater from bores in the general area, post-2012 overlaid onto the 2007-2012 nitrate N concentration contour estimates

Interpretation of this data should be done with great care because there are a limited number of results that have been used as the basis for developing these groundwater quality contours, and the source data includes results from a wide range of bores. Some of these bores are very shallow (<5 m depth) and most likely represent a significant proportion of drainage water quality rather than being representative of unconfined groundwater in the area (majority of water supply bores in the area are between 5 – 25 m depth). There is also anecdotal evidence and from old and recent reports that a proportion of bores in Southland have inadequate well head protection that can at times allow contaminated surface water quality to enter groundwater[4]. For example, the 18.4 g NO_3-N/m^3 result from a bore to the west of the Driscoll farm has been acknowledged by Environment Southland as likely caused by a "direct or semi-direct contamination"[5]. Neither Environment Southland nor Landpro has checked the well head protection status of the bore which is about 15 m from a dairy farm laneway close to a relatively new dairy shed. Uncertainties about well head protection make interpretation of the relationship between land use and groundwater results challenging.

Some more recent groundwater quality data has been obtained from Environment Southland and while very limited recent reliable groundwater quality data is available for this general area, what is available indicates that the general pattern of nitrate-nitrogen concentrations in the area does not appear to have changed significantly.

Groundwater from two bores (peak values 8.7 (14.5 km west) and 10.3 g NO_3-N/m^3 (8.5 km south south-west)) appear to indicate higher groundwater nitrate N concentrations than existed during the 2007 – 2012 survey. The data from these bores are illustrated below.

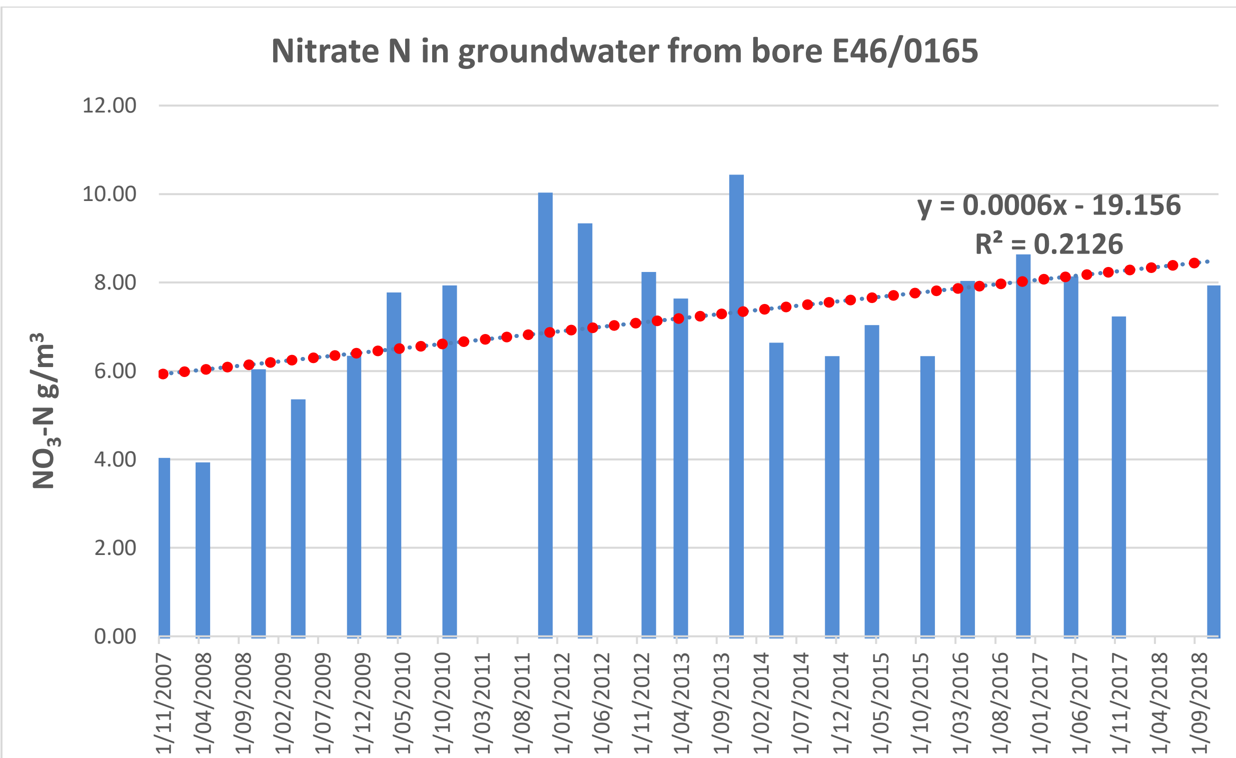

Figure 16: Nitrate N concentrations from bore E46/0165, ~8.5 km south south west of Driscoll property (red 10.3 in Figure 16)

[4] Dairy Green Limited (2019) Groundwater Well and/or Bore Assessment - Heddon Bush; Central Southland

[5] Email from Fiona Smith, Environment Southland, relaying feedback from a "scientist", dated 23 May 2019.

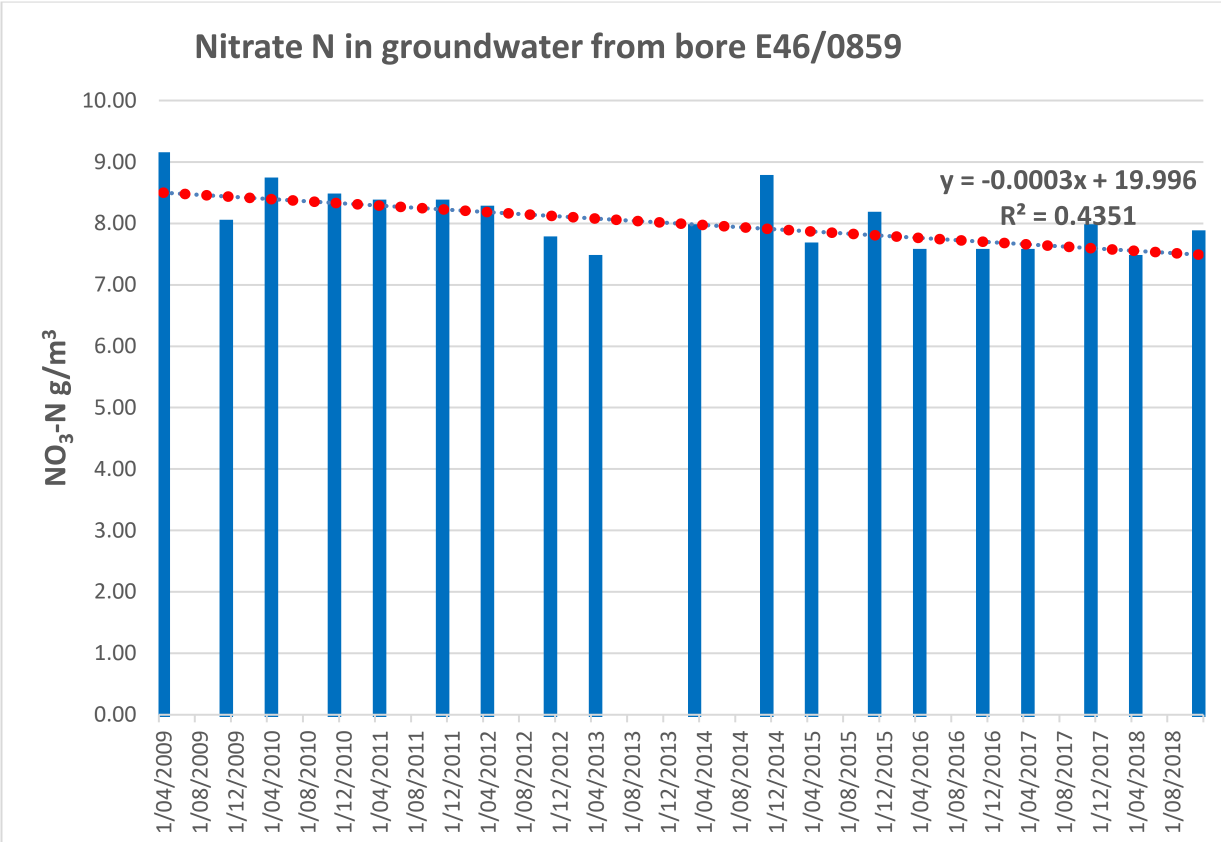

Figure 17: Nitrate N concentrations from bore E46/0859, ~14.5 km west of Driscoll property (red 8.7 in Figure 16)

The information illustrated in figures 20 and 21 indicate some of the difficulties in interpreting groundwater quality. The bore down-gradient of the Driscoll property is quite some distance away, approximately 8.5 km south south-west, and therefore there will be many land use activities occurring in this area that could be influencing groundwater quality. The apparent trend of increasing concentration has a relatively low R^2 value of 0.21. This indicates that while the trend may well be real there may be other factors behind the trend line and the large variability of results over the period will contribute to this relatively low R^2 value.

There is a potential inconsistency between the 2007-2012 survey results reported in the ES contour layer that should have included a nitrate N result in 2009 of 9.1 g/m^3 for this bore. However, this is not apparent from the contour (3.5 – 8.5) given for the area. Therefore, the apparent increase to a peak of 8.7 post 2012 is unlikely to be real in that the earlier result of 9.1 g/m^3 should have been reflected in the 2007 – 2012 survey contour. The apparent downward trend of nitrate N concentration illustrated in Figure 21 still has a relatively low R^2 value (0.43) but is significantly higher than that for the trendline in Figure 20. This indicates that there is a higher level of confidence about the downward trend indicated in Figure 21 compared to the upwards trend indicated in Figure 20.

In general, the groundwater quality data reflects the predominant rural land use in the catchment contributing to nitrate N leaching through to groundwater. There are two key issues in the wider area with some apparent 'hotspots' with elevated nitrate N concentrations, close to or greater than the NZ drinking water standard of 11.3 g nitrate-N/m^3. Each of the bores that have had groundwater sample results greater than the drinking water standard have been checked and all of them are relatively shallow bores (7.5m deep or shallower).

In addition, the discharge of groundwater with elevated nitrate N will result in that groundwater recharging connected surface waters, specifically the Oreti River. However, the nitrate nitrogen concentrations in the Oreti River appear to reflect "minor to moderate land use impacts".

New River Estuary water quality

The key water quality issue in the New River Estuary is eutrophication and sediment deposition that appears to be driven by N, P and sediment loads to the estuary from the main surface water inputs. Nutrients enter the estuary primarily via the major source of the Oreti River, to a lesser extent the Waihopai River and a number of relatively small creeks. Broad-scale macroalgal mapping undertaken by Wriggle Coastal Management in 2018[6] shows that there has been a significant increase in macroalgal growth, and an associated decline in estuary quality, in the upper estuary, since 2016. However, large sections of the lower estuary, which is well flushed in comparison to the upper estuary, remain in good condition. Table 4 below summarises macroalgal cover within the New River Estuary. Macroalgal growth was assessed by mapping the spatial spread and density of macroalgae in the Available Intertidal Habitat.

Table 5: Summary of intertidal opportunistic macroalgal cover, New River Estuary, February 2018[7]

Metric	Face Value	Final Equidistant Score (FEDS)	Quality Status
AIH - Available Intertidal Habitat (ha)	2944		
Percentage cover of AIH (%) = (Total % Cover / AIH) x 100 *where Total % cover = Sum of {(patch size) / 100} x average % cover for patch*	17.9	0.543	Moderate
Biomass of AIH (g.m^{-2}) = Total biomass / AIH *where Total biomass = Sum of (patch size x average patch biomass)*	1205	0.252	Poor
Biomass of Affected Area (g.m^{-2}) = Total biomass / AA *where Total biomass = Sum of (>5% cover patch size x average patch biomass)*	3160	0.191	Bad
Presence of Entrained Algae = (No. quadrats or area (ha) with entrained algae / total no. of quadrats or area (ha)) x 100	35.3	0.298	Poor
Affected Area (use the lowest of the following two metrics)		0.137	Bad
Affected Area, AA (ha) = Sum of all patch sizes (with macroalgal cover >5%)	1123	0.137	Bad
Size of AA in relation to AIH (%) = (AA / AIH) x 100	38.1	0.468	Moderate
OVERALL MACROALGAL ECOLOGICAL QUALITY RATING - EQR (AVERAGE OF FEDS)		**0.284**	**POOR**

The above table indicates that the New River Estuary has been experiencing significant eutrophication with a macroalgal Ecological Quality Rating (EQR) of 'poor' for the 2018 period. The trend for this ecological rating over the 2001-2018 period strongly indicates a significant decline from a 'good' state to a 'poor'

[6] Stevens, L.M. 2018. New River Estuary: 2018 Macroalgal Monitoring. Report prepared by Wriggle Coastal Management for Environment Southland.

state. The upper estuary has been particularly adversely affected by eutrophication. The Wriggle report concluded that "Ecological condition has consistently declined since monitoring commenced in 2001, and particularly since 2007", and the estuary is "…exhibiting significant problems associated with excessive nutrient fuelled macroalgal growth…".

Nutrient loads to the New River Estuary have been estimated by Aqualinc[8]. These are outlined in the following table.

Table 6: Summary of estimated N and P loads to eight Southland catchments

Catchment	Current catchment agricultural source loads (t/year)		Total catchment source nitrogen load (t/yr)	Estimated realised nitrogen loads (t/yr)	Estimated attenuation (%)
	Nitrogen	Phosphorus			
Bluff_Harbour	19	1	36	29	20
Haldane_Estuary	23	0	39	26	33
Jacobs_River_Estuary	1958	53	2133	1300	39
Lake_Brunton	20	0	20	14	30
New_River_Estuary	4969	139	5513	3718	33
Toetoes_Harbour	6256	142	6617	4392	34
Waiau_River	2714	35	4970	1864	62
Waikawa_Harbour	144	4	176	180	-2
Total/average	16,102	374	19, 404	11,524	31 (average)

The Aqualinc report further identified the potential nutrient load reductions that could result from various levels of mitigation. These are summarised in the following two tables.

Table 7: Estimated reductions in the agricultural source loads under three levels of mitigation for all dairy farms in each Southland catchment

Catchment	M1			M2			M3		
	Nitrogen	Phosphorus	Overall[1]	N	P	Overall[1]	N	P	Overall[1]
Bluff_Harbour	4	26	2	4	29	2	12	29	6
Haldane_Estuary	0	0	0	0	0	0	0	0	0
Jacobs_River_Estuary	6	28	5	8	31	6	18	31	15
Lake_Brunton	0	0	0	0	0	0	0	0	0
New_River_Estuary	6	29	5	8	32	7	18	32	15
Toetoes_Harbour	3	17	3	4	19	4	10	18	9
Waiau_River	1	9	0	1	9	1	4	9	2
Waikawa_Harbour	1	4	1	1	5	1	2	5	2

The full suite of mitigations assessed by Aqualinc includes the following measures.

Table 8: Description of mitigations assumed to apply under each mitigation level

[8] Aqualinc, Assessment of farm mitigation options and land use change on catchment nutrient contamination loads in the Southland region, 2014

Mitigation level	Name	Sheep & Beef	Dairy
Mitigation level 1	M1	• Optimised nutrient inputs • Low solubility P • Wetlands	• Stock exclusion from streams • Improved nutrient management • Improved farm dairy effluent (FDE) management
Mitigation level 2	M2	• Stock exclusion from streams • Reduced stocking rates, improved productivity	• Wetlands • Improved FDE management • Reduced stocking rates, improved per animal productivity.
Mitigation level 3	M3	• Grass buffer strips • Feed pad for beef cattle	• Restricted grazing strategies • Grass buffer strips • Improved FDE management

The proposal would provide for many of the relevant mitigation measures suggested by the Aqualinc report. It has not been possible to determine exactly what stocking rate was envisaged in the Aqualinc report or the NZIER report that it was partly based. However, our experience of modelling nutrient loss management is that stocking rate by itself is not generally accepted as the major driver of nutrient loss. Instead, a broader approach is needed that incorporates a full understanding of the whole farm system and all nutrient loss mitigation measures.

Implications of water quality for targeting of mitigation

The water quality results indicate that priorities for contaminant loss mitigation should be faecal indicator organisms, nitrogen, phosphorus (P) and sediment. This is largely reflected in the assessment of the physiographic zones that indicate risks from both artificial drainage and surface runoff because of the generally heavy soils in both areas. Therefore, with mitigation that targets a reduction in sediment loss (and associated P and faecal indicator organisms), N and P loss will be consistent with the identified water quality issues.

The primary contribution to the observed water quality issues will be the wider land use activities in the catchment, with only a tiny contribution from this individual property.

4. ACTIVITY CLASSIFICATION

4.1 Consents Required

The following resource consents are required under Regional Water Plan for Southland, 2010 (RWPS) and Proposed Southland Water and Land Plan, 2018 (PSWLP).

Table 9: Applicable Rules

Consent	Plan	Rule	Activity Status
Discharge Permit to discharge agricultural effluent to land	RWPS	50(d)	*Restricted Discretionary*
	PSWLP	35(c)	*Discretionary*
Water Permit to abstract groundwater for dairy shed wash down and stock drinking	RWPS	23(d)	*Discretionary*
	PSWLP	54(a)	*Permitted*
Land Use Consent to use land for dairy farming	PSWLP	20(e)	*Discretionary*

Overall, the proposal is for ***discretionary*** activity.

4.2 Consents Not Required

In accordance with Schedule 4 of the RMA, an application must describe and demonstrate compliance with any permitted activity that is part of the proposal to which the application relates.

Table 10: Activities for which Consent is Not Required

Activity	Compliance with the relevant permitted rules of the RWPS and PSWLP
Use of land for the maintenance and use of an existing agricultural effluent storage facility (Rule 32D of the pSWLP)	The use of land for the maintenance and use of an existing agricultural storage facility (includes ponds, weeping walls, sumps and stone traps etc) that was authorised before 4 April 2018 is a permitted activity providing the construction of the facility was authorised by a resource consent.
Incidental discharges from farming (Rule 24 pSWLP)	The land use associated with this discharge is authorised under Rules 20, 25 or 70.
Fertiliser (Rule 10 RWPS & Rule 14 pSWLP)	All practicable measures will be taken to minimise fertiliser drift beyond the target areas. Fertiliser will be applied to selected areas of the farms in accordance with nutrient budget recommendations, and soil tests to avoid excess leaching of nutrients to groundwater. Fertiliser will be applied when a soil water deficit exists, and all waterways will have riparian margins with stock excluded.
Silage storage and silage leachate (Rule 51 of the RWPS, and Rules 40 & 41 of the pSWLP.)	All silage storage facilities are located away from sensitive receiving environments, in accordance with permitted rule setbacks and no direct discharge of silage leachate to any waterbody is proposed. The silage pad is not hooked up to the effluent system, and therefore silage leachate is discharged to land in accordance with the rules listed in the column to the left.
Sludge (Rule 38 of the PSWLP)	Solid sludge effluent collected from the stone traps and effluent pond will be laid out to dry before applying to land when conditions are suitable, observing appropriate separation distances, and there will be no disposal of solids to any waterway.
Cleanfill, Farm Landfills and Offal Holes (Rules 53, 54 & 55 of the RWPS, and Rules 42 & 43 of the pSWLP)	No more than 500 m^3 of material will be discharged within cleanfill sites. Stormwater will be directed away from fill areas and no unauthorised material will be placed into proposed fill areas. No naturally formed limestone rock is known to reside within the property. Excavation of fill holes do not intercept springs and are not below the seasonal mean groundwater level in that location. Sensitive areas can be easily avoided when undertaking these associated activities. Offal sites are to be covered and the surfaces to be restored to a similar state as surrounding land upon closing.
Drainage of Land (Rule 9 RWPS & Rule 13 pSWLP)	It is not anticipated that any discharge from subsurface drains would result in a conspicuous change to the colour and/or clarity of the receiving waters at a distance of 20 metres from the point of discharge. The proposed good management practices will significantly reduce the likelihood of any contaminants reaching the subsurface drains.

5. NOTIFICATION AND CONSULATION

A consent authority has the discretion whether to publicly notify an application unless a rule or National Environmental Standard (NES) precludes public notification or section 95A(2) applies.

The effects of the activity will be no more than minor, the applicant does not request public notification and there are no rules or NES' which require the public notification of the application. In addition, there are no special circumstances relating to the application. As such, notification of the application is not necessary.

Clause 6(1)(f) of Schedule 4 of the RMA requires the identification of, and any consultation undertaken with, persons affected by the activity. The assessment of environmental effects below demonstrates that no persons will be adversely affected by the proposal to a degree that is minor or greater. Overall, it is considered that this application can be processed non-notified and without the need for written approvals.

6. ASSESSMENT OF ENVIRONMENTAL EFFECTS

In addition to the application being made in the prescribed forms and manner, Section 88 of the RMA also requires that every application for consent includes an assessment of the effects of the activity on the environment as set out in Schedule 4 of the RMA.

6.1 Effluent Disposal

6.1.1 Application Rate/Depth

The proposed application rate and depth are 10 mm/hr and 25 mm respectively. This is appropriate for Category A soils and will be achieved using a low rate pod system. The slurry tanker will apply effluent at a maximum depth of 5mm.

In Southland, regular soil water deficits greater than 10 mm mainly occur between the months of October to May, which makes it difficult to accurately schedule the application of effluent to coincide with soil moisture deficits over the entire milking season, which usually begins in August. The applicant checks weather forecasts, checks the nearest soil moisture site on the ES website and checks paddocks before application to ensure that effluent is only applied when a soil water deficit exists.

The applicant also plans to install his own soil moisture probe/tapes on the property to ensure a higher level of effluent management that is targeted at site-specific soil conditions. It is appropriate for the discharge consent sought to require that this is installed within 6 months of the consent being exercised.

Careful irrigation scheduling will maintain nutrients within the top 200 mm of soil[9], enabling the assimilation of nutrients into a form which can be used by plants whilst avoiding ponding, odour, overland flow and or/nutrient leaching and microbial leaching to groundwater and surface water. Ensuring that effluent is not

[9] Houlbrooke, D J, Monaghan R M, *The influence of soil drainage characteristics on contaminant leakage risk associated with the land application of farm dairy effluent*, 2009, AgResearch Ltd

applied at depths greater than those specified above will ensure that when there is a soil water deficit, the nutrients should remain in the top 200 mm of soil.

Effluent discharge will observe a 28-day return period. Effluent will be discharged to land year-round, on days when conditions are suitable. Furthermore, "proof of placement" of irrigators provides a record of effluent application and the required information to make informed decisions daily and seasonally regarding the forecasting of FDE disposal.

With regards to the typical tile drain located at least 1 m beneath ground level, the proposed depth of application and assimilation in the topsoil will ensure that an appropriate separation distance to subsurface drains (should they occur in the disposal area) is maintained.

Provided that FDE is applied to land in the manner described, then any potential adverse effects associated with ponding, odour, overland flow and or/nutrient leaching and microbial leaching to groundwater and surface water should be avoided as far as reasonably practicable.

6.1.2 Storage

Currently, effluent storage at the farm consists of a relatively new 3,261m^3 lined pond with a mechanical stirrer, which was designed by RDAgritech Ltd. There are no signs to suggest that the pond is leaking. The attached Dairy Effluent Storage Calculator (DESC) report shows the pond is adequately sized as the total volume exceeds the minimum of 2,670m^3 suggested by the DESC. Adequate storage will enable irrigation of effluent to be deferred when conditions are not suitable.

6.1.3 Nutrient Loading

Calculations using the DESC attached indicates that the farm will produce around 10,200 m^3 of FDE per year[10]. This equates to 148 m^3/ha/yr based on an irrigation area of 69 ha. Using DairyNZ (2010) guideline N concentration of FDE of 0.45 kg/m^3, this equates to an annual loading rate of 67 kg N/ha/yr (assuming all areas receive an equal amount of effluent. An areal loading of 67 kg N/ha/yr equates to 44% of ES's recommended maximum areal rate of 150 kg N/ha/yr for all N inputs, and is less than the limit imposed by current consent conditions.

ES's recommended maximum areal rate of 150 kg N/ha/yr is supported by the 2009 report for ES by AgResearch[11] that recommended the maximum N load as a management criterion to avoid direct losses of land-applied FDE. Given that the proposed areal loading is a fraction of the limit recommended by AgResearch, land-applied FDE nitrogen leaching will be within acceptable limits.

FDE can be used as an organic fertiliser, which means that it relies on soil organisms to break down the organic matter. Nutrients are released more slowly than they are from inorganic fertilisers and this slow-release method reduces the risk of nutrient leaching. Inorganic fertilisers, such as urea, provide the same nutrition in a plant-ready form immediately, but the rapid release of nutrients creates a higher risk of leaching past the root zone.

[10] This figure was calculated using 700 cows. The application has been scaled back to 680 cows. The effluent production figures have not been updated. This provides an additional margin of safety for effluent management.

[11] Houlbrooke, D J, Monaghan R M, *The influence of soil drainage characteristics on contaminant leakage risk associated with the land application of farm dairy effluent*, 2009, AgResearch Ltd

Overall, the effluent disposal system described above allows the effluent to be used as both a fertiliser and soil conditioner with a lower risk of nutrient leaching than inorganic fertilisers.

6.1.4 Disposal Area

A total discharge area is to be extended to 69.3 ha which provides a discharge area to stock ratio of approximately 10 ha per 100 cows, which is greater than the recommendation of 4 ha/100 cows. The available disposal area is also greater than the minimum required in ES's Best Practice Guidelines, which is 8 ha/100 cows. This limit is derived as a further method for ensuring that ES's recommended 150 kg N/ha/yr areal loading limit for N (discussed above) is not exceeded.

Effluent will not be applied within the following buffer zones:

- 20 m of any surface watercourse
- 100 m of any potable water abstraction point
- 20 m to any landholding boundary; and
- 200 m of any residential dwelling on a neighbouring property

There are no other sensitive receptors that require separation measures to be implemented. Provided that these buffers zones are maintained, there should be no significant adverse effects resulting from the siting of the disposal area.

6.1.5 Effects on Water Quality from FDE Disposal

A desktop assessment of the potential effects of the potential loss of N from the disposal of FDE to land has been undertaken.

Using a 304-day milking season, potential effects associated with N leaching have been calculated. It has been assumed that:

- Attenuation (e.g. plant uptake etc) can account for up to 97% of total N input[12] but for this estimation we consider that an attenuation of 50% is more appropriately conservative and realistic and
- Drainage equates to 368 mm/yr (based on land surface recharge for the Lower Oreti Groundwater Management Zone[13]); and
- An average of 50 L/cow/day of FDE will be produced and that FDE has an average TN loading of 0.45 kg/m^3.

Based on these assumptions, the average TN concentration in drainage water as a result of FDE application is likely to be in the order of 9 g/m^3. This is generally consistent with the more robust estimate of drainage N concentrations identified in the Overseer modelling (Attachment C).

This application seeks to increase the size of the disposal area over soils with the same characteristics and within the same physiographic zones as the existing disposal area.

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[12]Houlbrooke D, Longhurst B, Laurenson S and Wilson T, 2014, *Benchmarking N and P loss from dairy effluent derived nutrient sources*

[13]Chanut P, 2014, *Estimating time lags for nitrate response in shallow Southland groundwater*, Environment Southland publication number 2014-03, Invercargill.

There is a registered drinking water site at Lochiel School (LOC001), which is located approximately 1.5 km down-gradient of the subject property. An assessment of the potential adverse effects on this water supply is detailed later in this report.

Other contaminants of concern include sediment and micro-organisms. Contaminant transportation towards sensitive receiving environments is dependent on many factors, including soil type, climate and anthropogenic influences such as the presence of drains. All of these factors have been considered when determining an appropriate irrigation location and method (including rate and depth), and in ensuring that there is adequate storage to allow for deferred irrigation. By restricting effluent irrigation to periods where drainage events are less likely to occur, there is less risk of leaching, overland flow and losses via artificial drains occurring. The proposed application depths will enable nutrients to be assimilated in the root zone in the top 200 mm of soil (tile drains are located beneath this) and avoid direct contamination of waterbodies via discharges.

Provided that effluent is applied at the proposed rate/depths and effluent irrigation is avoided when conditions are not suitable, then any significant adverse effects on water quality will be appropriately avoided or mitigated.

6.1.6 Odour

The effects of odour are most likely to occur from the discharge of FDE or from the storage of effluent where it may be encountered beyond the boundary of the site. The effluent pond is located at a suitable distance from the property boundaries and nearest dwellings. The physical location of the effluent infrastructure coupled with the proposed low application rate irrigation and effluent discharge buffers means there is little risk of adverse effects from odour and spray drift on surrounding land owners and occupiers. As such, the effects of odour are avoided.

6.1.7 Contingency Plans

An alarm and automatic switch-off system is installed and this acts as a contingency measure in the event of an effluent system failure such as sudden pressure drop, irrigator stoppage or breakdown.

A slurry tanker may be used at certain times if the usual methods of effluent discharge are under repair or if conditions allow for more effluent to be applied than the usual system is capable of conveying. Any discharges from the slurry tanker must adhere to the rate and depth limits imposed on the consent.

6.2 Groundwater Abstraction

6.2.1 Allocation

The applicant's proposed abstraction represents a negligible portion of the allocation of the respective groundwater management zone. This application seeks to replace existing groundwater permits with no increase in the volume of water sought, therefore there will be no effect on current allocation volumes.

6.2.2 Stream Depletion and Interference Effects

Policy 29 in the RWPS and Policy 23 of the pSWLP requires a stream depletion assessment when the daily average rate of take is more than 2 L/s because takes less than this are expected to have a minor effect on stream flows. Over 24 hours of pumping, the rate of take is less than 2 L/s and therefore does not require a stream depletion assessment.

Significant interference effects on neighbouring bores are not expected. Given that the average rate of take is relatively low, it is unlikely that the radius of interference would affect any of these bores.

6.2.3 Effects on Groundwater Quality

The low rate of take is highly unlikely to result in the drawdown of contaminants from the upper soil profiles and so the proposed abstraction is highly unlikely to have any adverse effects in terms of groundwater quality. The applicant will need to ensure that the bore head casing is adequately sealed to prevent the ingress of contaminants.

6.2.4 Efficiency of Use

The proposed rate of take is estimated at 120 L/cow/day, which is consistent with Council's recommendations. The applicant is not opposed to the continued monitoring of water abstraction on the property to ensure that use is not excessive.

6.2.5 Monitoring

The proposed abstraction will continue to be metered with records kept on a monthly basis, consistent with the existing conditions of consent. These records will be provided to Council annually at the end of the "water year" and upon request.

6.3 Expansion of the Dairy Platform and the Addition of Cows

Conservative Assessment

The modelling of the "existing environment" has taken into consideration the activities that have been occurring on-site for the past three years, rather than just last year, and also uses actual cow numbers on the dairy platform rather than consented cow numbers. Modelling *actual* cow numbers provides Council with more certainty about how future losses compare with recent historic losses.

The applicant took over ownership of the east block in October 2016 it has since been gradually transitioned into a dairy support block. Before that is was used for sheep grazing only. To create a meaningful assessment of estimated losses for the past three years, three separate budgets were created for the Eastern Block and these are discussed in the attached Overseer modelling report. The modelling undertaken represents a meaningful, conservative estimate of nutrient losses for the past 3 years. The detailed modelling information is contained in Attachment C.

Results from Overseer Modelling

CURRENT SCENARIO

Overseer was used to model losses from the existing sheep farm (east block) and existing dairy farm for the last three years to formulate a current scenario model. Three separate budgets were modelled for the east block to account for the transition that this block has undertaken from a sheep grazing block in the 2015/2016 season to a dairy support block in the 2017/2018 season.

The existing dairy farm has maintained a consistent farm system for the preceding three years and accordingly one nutrient budget was prepared which used actual inputs from farm records which has been averaged for the three years. The applicant peak milked 573 cows producing 473 kg MS/cow. A total of 516 cows were wintered off the platform at a grazier with the remaining average of 83 cows wintered at home on fodder beet.

The cows on fodder beet are averages across the month to allow for some of the herd to stay on farm at the start of June, and to allow for early calvers to be brought home early at the end of July. The numbers used in the model (20 in June and 86 in July) are an average across those months. So, if there were 300 cows on-site for the first two days in June and none for the rest of the month, or 20 cows on-site for every day in June, the effect would be the same.

Combining the two current scenarios for the east block and dairy platform gives a representation of the level of predicted nutrient losses occurring from the whole landholding currently, prior to any proposed land use change.

PROPOSED SCENARIO

Overseer was then used to model the proposed scenario, which sees 680 cows being milked over the expanded dairy platform onto east block. Under the proposed scenario, the same number of cows are wintered at a grazier (516 cows in June and 459 cows in July) with the remainder of the herd being wintered on farm on grass/baleage over the winter period. Supplement usage and fertiliser inputs have been adapted to suit the proposed farm system with the only major changes being the expansion of the effluent discharge area and the concurrent partial substitution of the nutrients in applied fertilizer with effluent to facilitate pasture growth.

COMPARISONS – CURRENT vs PROPOSED SCENARIOS

The results of this modelling are summarised in the following table.

Table 11: Summary of Overseer (6.3.1) and additional nutrient loss modelling for the whole dairy platform

	Current Total Farm System	Proposed Total Farm system	Reduction
N (kg/yr)	11,513	10,507	-~9%
P (kg/yr)	230	212	-~8%

OFF-SITE EFFECTS

The offsite effects have not been included in the above modelling. As detailed in Attachment C the number of mixed age cows and R2 heifers wintered off-site is the same for both the current and proposed scenarios. Young stock numbers grazed with a third party grazier will increase and the modelling undertaken in Attachment C has estimated that the additional nutrient losses associated with this could be approximately 473 kg N/year and 7.8 kg P/year.

The modelling has shown that authorising the expansion of the dairy farm as proposed will result in a significant net reduction in the quantity of N and P lost from the landholding. This is because of the following changes in the way that the land will be used:

- Removing winter crop area from the dairy platform and replacing it with grass/baleage wintering to enable the wintering of 216 cows on farm.
- Increasing the effluent discharge area so that the concentration of effluent in any one area is reduced; and
- Reduced N fertiliser use on the effluent discharge area and overall.
- Increased use of barley.
- Increased in the area utilised for baleage grass wintering.
- A reduction in Olsen P to 30 on the dairy platform (but with the level increasing to 30 on the East Block)

The East Block is flat, there are no waterways on this block and only one new lane will need to be constructed. The photos below show existing ways in which the applicant mitigates against direct P losses to waterways. The installation of bargeboards and sandbags on crossings prevent sediment and effluent runoff from the lane into the waterway and direct drainage to the adjacent pasture.

Figure 18: Laneway crossing with kickboard to prevent direct runoff into creek

Figure 19: Laneway crossing with kickboard to prevent direct runoff into creek

Figure 20: Laneway crossing with sandbags to prevent direct runoff into creek

Artificial drainage is the key contaminant pathway for much of the existing dairy farm and the new east block, but the risk of P infiltrating the topsoil and being transported to surface water via tile drains is low because P adsorbs to soil articles and so it is not prone to leaching in the same way that N is. Overland flow is the more common mechanism for P loss to water and this is not a key contaminant pathway on this property, although the applicant adequately mitigates against the risk of contaminant loss via this pathway in accordance with the measures in the FEMP.

The applicant will operate the farm in accordance with this FEMP to ensure that any potential effects associated with the proposed farming operation will be managed appropriately.

Based on the above, the risk of adverse environmental effects occurring because of an increase in P loss to water as a result of the proposed expansion is negligible.

Microbial Contamination

With respect to microbiological contamination from pastoral farms, research by AgResearch[14] strongly indicates that late autumn until mid-spring is the high-risk period as this is when surface runoff and mole-pipe drainage is most likely to occur. They also note that *"not all areas of the landscape contribute to flow pathways of loss. Those that do are termed critical source areas and are characterised as being directly "connected" to water bodies"*. AgResearch research indicates that improved effluent management, stock exclusion and the elimination of stock crossings will have the greatest impact in reducing microbiological contamination from pastoral farms. These GMPs will be adopted on farm through the implementation of the FEMP, which will ensure that adverse effects resulting from microbial contamination will be reduced as far as reasonably practicable and will be less than occurring prior to the implementation of the FEMP.

6.4 Effects of the proposal on water quality

Contaminant loss mitigation proposals & Overseer modelling

The attached report (Attachment C) prepared by Mo Topham summarises the pre and post-development farm systems and the primary contaminant loss mitigation measures proposed.

The uncertainties involved in Overseer modelling are not currently able to be quantified. They are probably greater than 30% for both N and P modelling[15]. However, this concept of uncertainty applies to the absolute estimate of nutrient loss, i.e., what is the uncertainty relating to a specific numeric estimate.

There are two significant conclusions from this:

- The estimated differences between the current and proposed farm system nutrient loss estimates are significantly less than the likely uncertainties involved in Overseer modelling undertaken to estimate an absolute number.
- Overseer modelling should be considered in conjunction with the specific farm systems and mitigation measures that are proposed to provide a reasonable level of certainty about nutrient loss estimates. This provides a high level of certainty that the actual loss of N and P will be significant and actual.

Local and cumulative surface water quality

The information outlined above on the quality of surface water downstream of this property combined with the estimates of the current and likely futures losses of sediment, faecal indicator organisms, N and P from the properties provide strong evidence for a real but extremely small overall improvement in local

[14] Monaghan, R. M., Semadeni-Davies, A., Muirhead, R. W., Elliott, S and Shankar, U., 2010. *Land use and land management risks to water quality in Southland.* Prepared for Environment Southland, April 2010.

[15] Wheeler D & Shepherd M (2013) Overseer: Answers to commonly asked questions, RE500/2012/027

surface water quality. This improvement would not be measurable with the current Environment Southland surface water quality monitoring programmes. However, if other properties in the wider catchment implemented equivalent good management practices it is highly likely that there would be significant and measurable improvements particularly for the water quality variables that currently do not comply with the relevant guidelines, standards or trigger values. The nature of the water quality issues in the Oreti River such as deposition of sediment in slow-flowing reaches (which may take many years to move downstream) means that some water quality improvements would take a long time to be realised.

The vast majority of surface runoff from the property will be into drains and creeks that discharge into the Oreti River. There is a chance that the most eastern side of the east block has run-off at times that moves to the tributaries of Tussock Creek that in turn drains into the Oreti River. It is acknowledged that the east block will have a slightly higher P loss compared to the current average. This has been estimated by Ms Mo Topham as follows (refer to Attachment C for background supporting information):

> *"losses of P from the East Block are a total of those attributed to the block itself (10kg) plus a proportion of the other losses (farm total of 106). Of this 106 kgP, 13. 9ha/224.5 ha or 6.2% can be attributed to the East Block (6.6 kgP). This takes the total attributable loss of P from the East Block to 16.6 kgP. However, other losses includes losses from laneways, but there will be no laneways on the East Block, so we can take this impact out. Using the same assumptions as I have for my P loss mitigation file note, of the 106 kgP other losses, 104kgP is attributed to laneway losses. Therefore, of the 2kg remaining, 0. 1kgP can be attributed to the East Block. So, P loss from the East Block is predicted to be 10.1 kgP. This is compared to 9.7 kgP for the current (average of 9, 10 and 10)[16]."*

Therefore we have an estimate of an increase of 0.4 kg P/yr (10.1-9.7) or approximately a 4% increase, for the proposed use of the East Block compared to the average for the last three years. This is in the context of a total property reduction of 18 kg P/yr as outlined in the above table.

There is some uncertainty about whether any surface run-off from the East Block would fall towards the drains leading to the Oreti River or Tussock Creek. The location of the property and the East Block relative to drains/creeks on the property and immediately down-gradient is illustrated in the following figure.

[16] Email dated 29 August 2019.

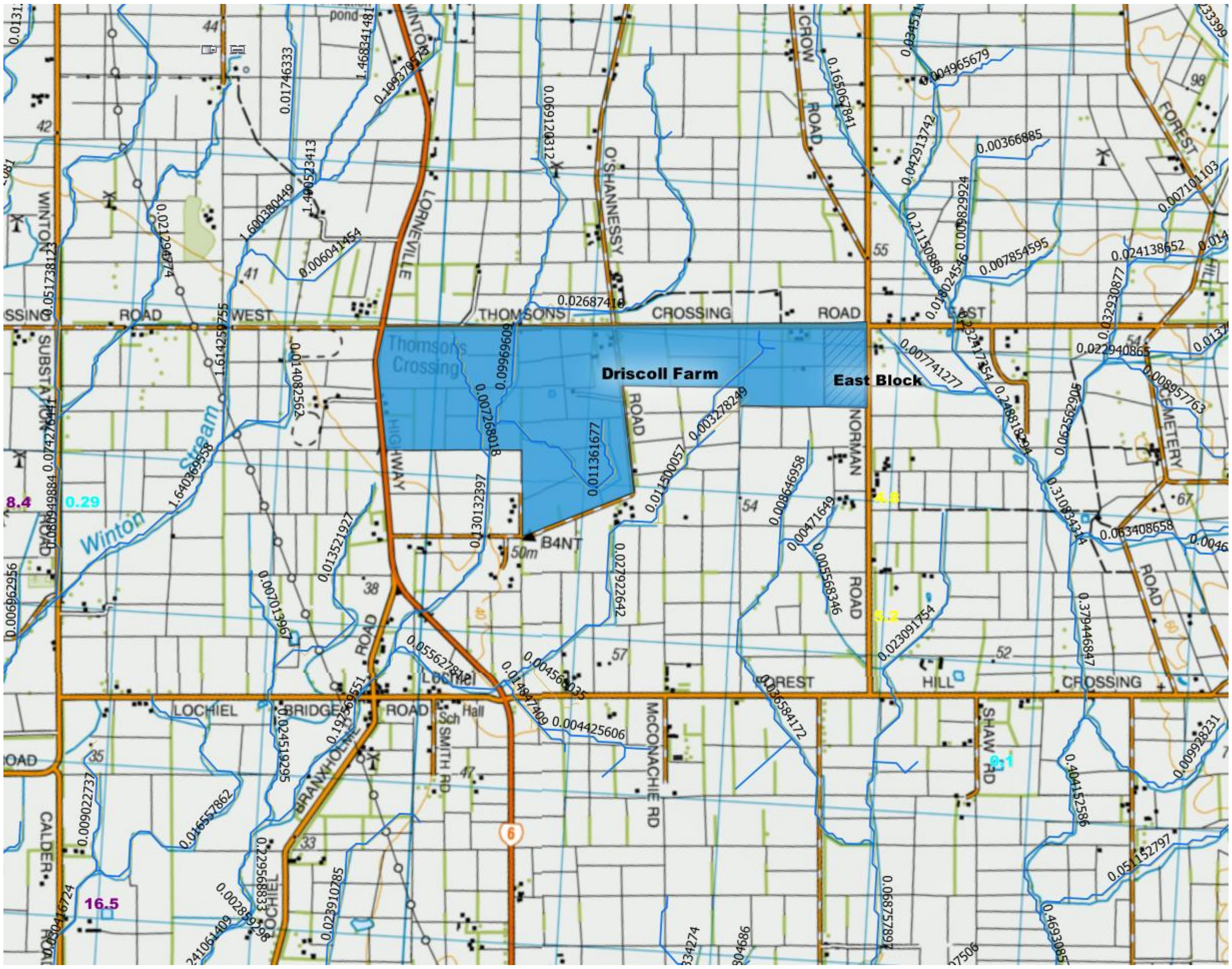


Figure 21: Location of the property, the East Block (hatched area) and creeks/drains in the area.

On the basis of the overall surface topography as indicated by the 20 m contours showing a gentle fall to the south west, and with information from the applicant on what they have observed during major rainfall events it clear that the vast majority, ≥~90%, of runoff from the East Block moves towards the creek directly south west of the block with only a very small amount of the block, ≤~10%, draining west towards Tussock Creek. So, it is likely that any negilible increase going into the creek to the south west of the block would be countered by a negligible decrease coming from the adjacent block. This would just leave say very roughly 10% of 0.4 kg of P potentially moving towards a creek in the headwaters of Tussock Creek. We consider that the effects of this are highly likely to be *de minimus*.

The above figure also includes NIWA modelling estimates of mean annual flows of each surface water reach[17]. This assists to understand the relative amounts of water flowing in each tributary.

The above assessment while relatively crude in nature does strongly indicate that particularly in the context of the overall reduction in nutrient losses and the trivial increase in potential P loss from the East Block

[17] https://shiny.niwa.co.nz/nzrivermaps/ (data imported into QGIS)

mean that it is highly unlikely that there would be any significant adverse effects in any surface water drain/creek.

Local and cumulative groundwater quality

The information from the Overseer modelling combined with the specific good management practices provide strong evidence for a real reduction in the N loading to groundwater and if this occurs across enough properties in this general area there will be an improvement in both the underlying groundwater nitrate N concentrations and eventually the concentrations in drainage water discharging to streams. Because of the complexity of groundwater systems including the inherent heterogeneity of alluvial aquifers, and travel times for drainage water and groundwater it may be many years before reductions in N loads are observed in bores used to monitor groundwater quality and in surface water recharged by that groundwater.

Effects of the proposal on the Lochiel School water supply

The Lochiel School water supply appears to be from bore E46/1473 (unknown depth, unknown diameter, but likely to be between 5 – 20 m depth but there is a small possibility that it could be as deep as 40 m, based on bore depths in this general area).

The Driscoll dairy farm is spread over two main soil types that differ significantly in terms of the predominant contaminant pathways. The predominant Pukemutu soils are poorly drained and the predominant pathway is via runoff and artificial drainage. Conversely, the Edendale soils are well-drained providing a transport route to groundwater. The greatest risk to shallow bores used to supply drinking water is in areas with well-drained soils in locations with activities that can result in contaminants leaching through soils into groundwater.

The location of the Lochiel School water supply is illustrated in the following figure together with the 2007-2012 nitrate nitrogen survey and more recent nitrate nitrogen results.

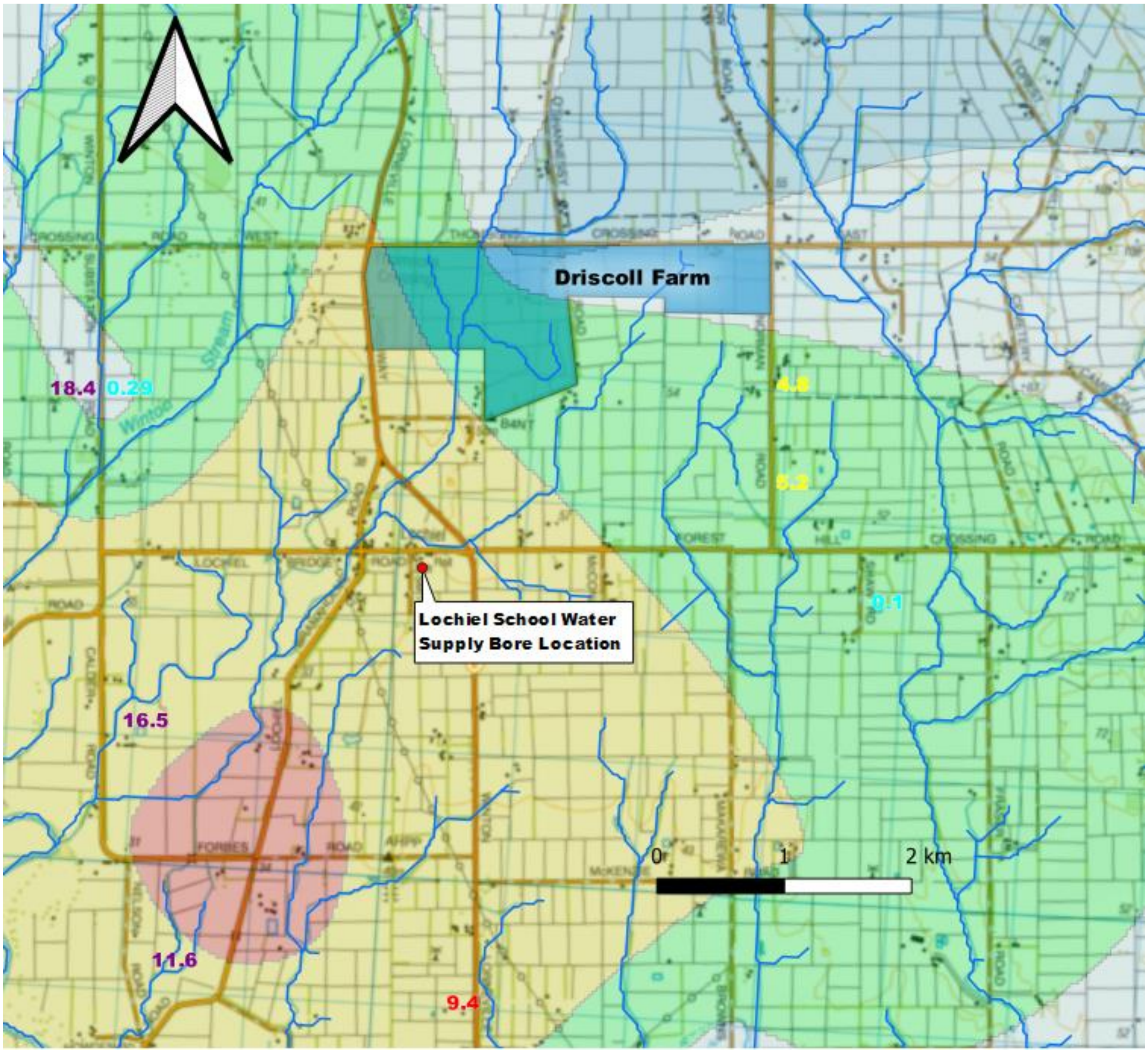


Figure 22: Location of the Lochiel School Water supply bore relative to the Driscoll Farm

The two primary issues for groundwater-sourced drinking water supplies in areas are nitrate nitrogen and faecal indicator organisms (indicators of pathogens, disease-causing organisms). The AEE provided with the application explains in some detail how nitrogen losses from the property will be reduced and consequently reduce the risk. The background concentrations of nitrate nitrogen as indicated by the 2007 – 2012 survey indicate that nitrate nitrogen concentrations in this area are between 3.5 – 8.5 g/m3.

The factors involved in influencing the transport of faecal indicator organisms have the added complexity of a range of complex attenuation factors apply to microorganisms that do not apply to dissolved nitrate nitrogen.

It has been recognised for many decades that shallow groundwater in those parts of Southland (and other parts of New Zealand) with pastoral catchment land use is vulnerable to microbiological contamination[18].

[18] Hamil K (1998) Groundwater Quality in Southland" A Regional Overview, Southland Regional Council Publication No 96, 51p.

This 1998 study showed that 75% of the wells sampled and 25% of the bores samples had faecal coliforms detected. This and other studies around New Zealand have demonstrated that shallow bores/well in areas with well-drained soils and pastoral agriculture are vulnerable to microbiological contamination.

The good management practices and mitigation measures that are proposed will result in a significant reduction in N loss to groundwater and in P loss to surface water. It has been generally accepted that a significant reduction in P loss to surface water will also result in a reduction in the risk of microbiological loss to surface water. While we are not aware of any specific research into the consequences for microbiological groundwater quality of mitigation measures designed to reduce N loss to groundwater and P/sediment/microbiological loss to surface water. We consider that it is conceivably possible that some of these mitigation measures could theoretically result in a very small increased risk of microorganisms entering soils and eventually potentially entering the underlying groundwater. For example, recontouring laneways and installing culvert cut-offs to ensure that contaminated surface water doesn't enter surface water means that that surface water runoff is redirected onto soils to allow it to slowly drain into soils.

However, it would be a complex process to then assess the extent to which a small potential occasional increase in microorganism loss to soils could then eventually move into groundwater and then migrate through an aquifer towards drinking water supplies. The scope of this assessment does not allow a quantitative assessment of the potential risks. In the context of the existing relatively high risk of microbiological contamination of shallow groundwater supplies it is highly likely that the increased risk posed by these mitigation measures would be insignificant.

We also note the recent Government Enquiry Report[19] into the outbreak of campylobacteriosis in Havelock North has made some strong recommendations regarding the risks of untreated drinking water and recommended that all drinking water supplies (including those delivered by self-suppliers) should be appropriately and effectively treated.

We understand that the Lochiel School water supply is disinfected. However, we have not yet had that corroborated by the Ministry of Education's representative.

Finally, we note that in the s42A report for a since granted, expansion of South Dairy 1 application in Feb 2018, the Consents officer, Emily Allan, concluded that:

> "*Any potential effects on the water supply are likely to be negligible. The discharge of effluent is not directly to water and the maintenance of buffer zones, along with other mitigation methods, will be required by consent conditions. Provided the conditions are adhered to, then the discharge is not likely to introduce or increase the concentrations of contaminants at the drinking water abstraction point that would cause a breach of standards.*"

Estimates of faecal indicator organisms and sediment losses before and after development

[19] Havelock North Drinking Water Inquiry (2017) Government Inquiry into Havelock North Drinking Water Stage 2 Report, 286p.

It is very difficult to develop quantitative estimates of the loss of faecal indicator organisms or sediment loss. There are no equivalent readily available farm-scale models that can be used. However, one common approach[20] is to use Overseer modelled P loss as a surrogate for both. This is because a key component of Overseer P loss modelling is based on an assessment of soil loss which will include faecal indicator organisms as well as sediment. Therefore, a combination of the Overseer modelled P loss indicating a very small reduction in P loss and the broader good management practices being proposed and outlined in the AEE, provide a very strong indication that there is highly likely to be at least equivalent small reductions in both sediment and faecal indicator loss to water from the development.

Although Overseer phosphorus loss modelling can be used as an approximate proxy for sediment and microbiological contaminants, as indicated above Overseer does not currently model many of the possible farm management techniques that can be employed to manage P loss partly because the model is not spatially explicit.

The FEMP includes a list of proposed management tools which will result in less phosphorus, and generally less sediment and microbiological contaminant loss to water. The table also summarises whether or not they are modelled in Overseer and which management practices the applicant will undertake to further minimise P and generally sediment and faecal indicator organism loss on farm under the proposed dairy expansion. With the adoption of these management measures, losses of these three contaminants will be further reduced.

The applicant is willing to have these measures imposed as appropriate resource consent conditions, which will provide the consent authority sufficient certainty about the likely effects of the proposal.

Effects on the New River Estuary

As a proportion of the estimated catchment loads, the overall load from this property is understandably extremely small. On a modelled catchment source load basis, the overall load would amount to approximately 0.2% (9,908/4,969,000 or 9.908/5,513,000) of the modelled catchment N load. While this calculation is useful to get a broad appreciation of the potential scale of the overall contributions to N and P catchment loads, it can't be used in any meaningful way to estimate contributions to concentrations in either the Oreti River or the New River Estuary because of the complex hydrogeological, physical, chemical and biological processes that operate in the catchments. However, it does highlight the importance of targeted catchment-wide implementation of contaminant loss measures to address water quality issues.

The new good management practices that will be implemented will reduce this contribution by an almost insignificant amount. By itself this would be virtually insignificant but combined with similar initiatives across the whole New River Estuary catchment would result in significant reductions in the nutrient and sediment loadings to the estuary which has the potential to contribute to a significant improvement in a broad range of water quality indicators.

[20] It was accepted at a 2018 ES consultant meeting that phosphorus loss modelling can be used as an approximate proxy for sediment and microbiological contaminant losses.

6.5 Good Management Practices

The applicant already has a Farm Activity Focus Plan, and this has been incorporated into the attached draft FEMP. The FAFP doesn't cover the East Block but there is no waterways or CSAs on the East Block that require specific management.

Plans showing the areas to be cultivated and the areas to be intensively winter grazed over the following season need to be provided before the FEMP can be completed, however, there is no sense in doing this until the applicant knows if/when the new land use consent might be granted. For example, the cultivation and winter grazing areas could be mapped now, but if consent is not granted soon then these maps may not longer be applicable.

The subject site covers two different physiographic units therefore it requires a range of GMPs to be adopted, with the key contaminants pathways being deep drainage and artificial drainage (see earlier in this report report). Rule 20(d)(ii)(2) of the PSWLP requires a detailed mitigation plan for any mitigations proposed, that identifies the mitigation or actions to be undertaken including any physical works to be completed, their timing, operation and their potential effectiveness. Although this application is made under Rule 20(e), the applicant has included a mitigation plan for completeness. This mitigation plan has been incorporated into the FEMP to ensure that there is one comprehensive document that can be incorporated into consent conditions and be used as an operational guide.

The property includes Oxidising and Gleyed physiographic zones, so requires a range of GMPs to be adopted, with the key contaminant pathways being deep drainage, artificial drainage and a risk of surface runoff. The table below describes the mitigation measures which will be adopted. The GMPs will ensure that the farm is operated in accordance with industry accepted and promoted good practice.

Table 12: Mitigation Plan Outline – refer to FEMP for detail

Mitigation	Timing	Operation	Level of effectiveness
Effluent mitigations (increased area and targeted applications)	Only apply effluent when there is a sufficient soil deficit.	Ensure effluent only applied to appropriate areas and spread as widely as possible, with Nitrogen applications taking into account the additional effluent nutrients. Avoid sensitive areas as detailed in FEMP.	High level of effectiveness for reducing contaminant losses via, artificial drainage and deep drainage contaminant pathways when applied at a depth less than soil water deficit which allows nutrients to be utilised in pasture production. Effluent spread little and often reduces the risk of losses.

Mitigation	Timing	Operation	Level of effectiveness
Calving Pad	Autumn and Spring period (shoulder seasons)	With additional milking cows, an ability to reduce risk of pugging to pastures over spring and at autumn is required.	The risk of pugging reduces infiltration of soils and increases overland flow of nutrients. Also, nutrients are held and spread onto soil by effluent applications when pastures are more able to receive the nutrients and thus lowers risk of losses.
Best practice pasture/baleage grazing techniques	Winter period	All pasture/baleage grazing will be undertaken using good management practices to reduce risks of overland flow and loss of nutrients via artificial drainage and profile leaching pathways. (See table 3 in FEMP)	Grazing on a flat block reduces risk of overland flow of contaminants and reduces the width of buffer zones required. Losses via artificial drainage and leaching represent the greatest risk but are mitigated with GMPs.
Fertiliser usage based on soil tests	Soil testing to be undertaken on regualar (at least every 3 years) basis, preferably at the same time each year.	Soil tests are used to guide fertiliser recommendations, particularly to guide the decision whether to apply capital or maintenance fertiliser. Maintain Olsen P levels at optimum levels (30).	High level of effectiveness as using soil testing can significantly reduce nutrient inputs and avoid the excess accumulation of nutrients in the soils – especially P. Higher than optimum Olsen P levels in the soil increases the risk of P losses from the farm system.
Little and often N fertiliser applications timed to avoid high risk periods.	Throughout the growing season	Reduced split application for effluent blocks. Fertiliser is not applied during the winter period.	High level of effectiveness for reducing potential nutrient losses via all three contaminant pathways. Fertiliser application is designed to meet pasture demand and reduce the likelihood of excess nutrients applied.
Control of runoff risk from lanes, gateways	Prior to the start of the season	Bridges and culverts to be updated to reduce runoff.	High level of effectiveness for reducing P losses via "other sources" as modelled in Overseer.

The table below outlines which GMPs will be adopted and which physiographic zones they provide most benefit in.

Table 13: Site Specific Good Management Practices and mitigation measures

Good Management Practices to be adopted	Most effective in these zones
Protect soil structure • Wintering the majority of the herd off the milking platform • Wintering a small portion of the herd on grass/baleage • Re-sow bare soils as soon as possible • Use of calving pad when ground conditions are saturated (not for a fixed period)	Gleyed
Manage CSAa • Avoid working CSAs and their margins • Leave grassed areas (or native vegetation) around CSAs • All riparian margins to be fenced and planted • Increase buffer width along laneway • Direct water way through vegetated areas for filtering • Riparian planing	CSAs (Gleyed and Oxidising)
Reduce P loss • Reduce use of P fertiliser where Olsen P values are above agronomic optimum • Reduce the risk of run-off to water from laneways and other sources • Changer fertiliser type on Eastern Block to a less water-soluble fertiliser. • Improve kickboards on bridges and culverts.	Gleyed
Reduce N accumulation in soil • Control the intensity of grazing of pasture by opening up breaks during adverse weather conditions • Wintering the majority of the herd off the milking platform • Optimise timing and amounts of FDE application to avoid high risk drainage periods and saturated soils • Time N fertilizer application to meet pasture and crop demand using split applications • Re-sow bare soils as soon as possible	Gleyed, Oxidising
Avoid preferential flow of FDE through drains • Defer effluent application when soil conditions unsuitable • Apply effluent at low rates • Utilize the full effluent discharge area to reduce N loading	Gleyed

6.6 Other Assessment Matters

In accordance with Clause 7 of Schedule 4 of the RMA the following provides an assessment of the activity's effects on the environment:

a) any effect on those in the neighbourhood and, where relevant, the wider community, including any social, economic, or cultural effects

The effects of the proposal to abstract ground water and discharge dairy shed effluent already form part of the existing environment. Throughout the duration of the existing consents, there have been no known complaints from neighbours, which indicates that the potential adverse effects on the neighbourhood are less than minor.

The proposed activities will result in net positive benefits to the neighbourhood as there will be capacity to provide for the social and economic benefits with the employment of staff, as well as contractors and consultants, and the farm is serviced by local schools and many businesses that would not benefit if the activities were unable to occur. More generally, the dairy sector continues to contribute greatly to the New Zealand economy in many ways including gross domestic productivity, employment, community growth and resilience and reinvestment capacity via tax revenues. The ability for the applicant to continue to operate their dairying operation will enable them to provide for their own social, economic and cultural wellbeing.

In terms of the potential effects on cultural values, an assessment of the proposal against the Te Tangi a Tairua is the Iwi Environmental Management Plan (applicable to the Southland Region), is made below. The proposal is considered to be wholly consistent with the relevant policies of the Iwi Management Plan.

b) any physical effect on the locality, including any landscape and visual effects

In terms of landscape and visual effects, the presence of effluent irrigation, other farming equipment and cows is expected within the rural locality. It is expected that the proposal will not have any significant physical effects on the locality over and above that currently experienced.

c) any effect on ecosystems, including effects on plants or animals and any physical disturbance of habitats in the vicinity

The dairy farm is located within a highly modified ecological landscape and it is anticipated that the proposal will not have any significant adverse effects on ecosystems above that which has been occurring for many decades.

d) any effect on natural and physical resources having aesthetic, recreational, scientific, historical, spiritual, or cultural value, or other special value, for present or future generations

It is not considered that the activities will have any effect on aesthetic values, as the existing dairy platform is established and in keeping with the general rural nature of the area. The land in this area is historically known for farming activity, and the presence of a dairy operation on this property does not result in any effect contrary to the historical values associated with the natural and physical resources in the vicinity.

The waterways within the proposed dairy platform are non-navigable and public access would be by permission of the applicant only. There is no evidence to suggest popular recreation fishing spots nearby which may be affected by the proposal. The effects on any cultural values are assessed below.

e) *any discharge of contaminants into the environment, including any unreasonable emission of noise, and options for the treatment and disposal of contaminants*

Effluent is proposed to continue to be treated and discharged to land as described earlier in this report. The assessment of alternatives provided in this report has concluded that this is the preferred solution for managing FDE generated at the property. The activity is in keeping with the rural nature of the area, therefore it is not considered there will be any unreasonable emission of noise or odour.

f) *any risk to the neighbourhood, the wider community, or the environment through natural hazards or the use of hazardous substances or hazardous installations*

All hazardous materials carried and used onsite will comply with the relevant rules of the Part operative Southland District Plan 2012, and the Hazardous Substances and New Organisms Act 1996. As such, there will be no risk to the neighbourhood, wider community or the environment due to natural hazards or the use of hazardous substances or hazardous installations.

6.7 Assessment of Alternatives

Clause 6(1) of the Resource Management Act requires that an assessment of environmental effects must include a description of any viable alternative locations or methods for undertaking the activity if it is likely that the activity will result in any significant adverse effect on the environment and/or if the activity includes the discharge of contaminants. None of the activities described in this report are expected to result in significant adverse effects on the environment and so this assessment of alternatives considers the proposed discharge of FDE only.

Method of Discharge
Deferred irrigation methods will be utilised on the property to ensure that effluent is only applied when conditions are suitable. Detention in the effluent pond also provides some level of treatment to the effluent before it is applied to land. Alternative methods may include direct discharge of the effluent to land on an as-required basis, regardless of the conditions. This would likely result in over-saturation of soils, ponding, overland flow and/or excessive leaching of contaminants, all of which can lead to significant adverse environmental effects. There are no other practicable environmentally acceptable alternatives to applying FDE to land.

Receiving Environment
Discharging effluent to land, if conducted appropriately, enables the reuse of a waste product as a soil conditioner and provides nutrients for plant growth. Attenuation of contaminants cannot occur if effluent is discharged directly to water and is therefore considered unsuitable. Direct discharge to water would almost certainly be more detrimental to the receiving environment than discharging to land.

Overall, the proposed discharge methods and receiving environment are the most suitable for managing the FDE generated at the farm.

6.8 Summary

This proposal seeks to expand the footprint of an existing dairy farm and increase the number of cows milked. Modelling indicates that the proposal with a suite of farm system changes and mitigations will significantly reduce the amount of N, P sediment and faecal indicator organisms lost to water.

The effluent collection, treatment and disposal methods proposed are appropriate given on-site conditions and will ensure that any potential effects associated with effluent disposal are managed appropriately. No adverse effects are anticipated from the continued abstraction of groundwater.

Potential adverse effects associated with the operation of the dairy farm will be managed through the FEMP, which contains site-specific GMPs and mitigation measures that have been identified as being the most effective for managing the risks associated the soil types and physiographic zones present.

The proposed activities will enable the applicant to provide for their economic and social wellbeing while providing environmental benefits in the form of significantly reduced contaminant losses to the environment and no cultural values will be compromised.

7. STATUTORY CONSIDERATIONS

Schedule 4 of the RMA requires that an assessment of the activity against the matters set out in Part 2 and any relevant provisions of a document referred to in Section 104 of the RMA is provided when applying for a resource consent for any activity. These matters are assessed as follows.

7.1 Part 2 of the RMA

The proposal is consistent with the purpose and principles of the RMA, as outlined in Section 5. The proposal will have less than minor effect on the environment's ability to meet the reasonably foreseeable needs of future generations, or on the life-supporting capacity of the environment and any ecosystems associated with it. The proposal ensures that adverse effects on the environment are avoided or appropriately mitigated.

There are no matters of national importance under Section 6 of the RMA that will be affected by the proposal. In regard to Section 7, particular regard has been given to the efficient use and development of natural resources, and the maintenance and enhancement of the quality of the environment. Regarding Section 8, the proposed activity is not inconsistent with the principles of the Treaty of Waitangi.

Overall, the activity is considered to be consistent with Part 2 of the RMA, given the minor nature of the activity and the proposed mitigations.

7.2 Section 104(1)(b) of the RMA

In accordance with Schedule 4 of the RMA, an assessment of the activity against the relevant provisions of a document referred to in 104(1)(b) of the RMA must be included in an application for resource consent. Relevant documentation covered by this section are:

- National Environmental Standard for Sources of Human Drinking Water, 2007
- National Policy Statement for Freshwater Management, 2014

- Te Tangi a Tauira - The Cry of the People, Ngai Tahu Ki Murihiku, Natural Resource and Environmental Iwi Management Plan, 2008
- Regional Policy Statement for Southland, 2017
- Regional Water Plan for Southland, 2010
- Proposed Southland Water and Land Plan, 2018

Under the RMA, regional plans need to give effect to NPSs, NESs and RPSs. For an application of this scale, an assessment of the application against the regional plans is adequate as these plans ultimately give effect to the higher order statutory instruments.

Regional Water Plan for Southland, 2010

The following policies, which give effect to the plan's objectives, are relevant to this application for resource consent.

Table 14: Applicable policies from the RWPS 2010

Policy	Wording	Comment
1A	Any assessment of an activity covered by this plan must take into account any relevant Iwi Management Plan.	Te Tangi a Tauira is considered below.
7	Prefer discharges to land over discharges to water where this is practicable, and the effects are less adverse.	The proposed discharge is to land, not water.
14A	To determine the term of a water permit consideration will be given, but not limited, to: (a) the degree of certainty regarding the nature, scale, duration and frequency of adverse effects from the activity; (b) the level of knowledge of the resource; (c) relevant tangata whenua values (d) the allocation sought, particularly the proportion of the resource sought; (e) the duration sought by the applicant, plus material to support the duration sought; (f) the permanence and economic life of the activity; (g) capital investment in the activity; (h) monitoring and review requirement in permit conditions; (i) the desirability of applying a common expiry date for water permits that allocate water from the same resource; and (j) the applicant's compliance with the conditions of the previous permit (where a new water permit is sought for a previously authorised activity).	The consent term sought is discussed later in this report.
21	To ensure that the rate of abstraction and abstraction volumes specified on water permits to take and use water are no more than reasonable for the intended end use.	The rate and volume sought are reasonable for the intended use.

22	Require, where appropriate, the installation of water measuring devices on all new permits to take and use water.	The water take will be metered.
25	To avoid, remedy or mitigate the adverse effects arising from point source and non-point source discharges so that there is no deterioration in groundwater quality after reasonable mixing, unless it is consistent with the promotion of the sustainable management of natural and physical resources, as set out in Part 2 of the Resource Management Act 1991, to do so.	Adverse effects on groundwater from the discharge of FDE will be appropriately avoided and mitigated as discussed earlier in this report.
28	To manage groundwater abstraction to avoid significant adverse effects on: • long-term aquifer storage volumes • existing water users • surface water flows and aquatic ecosystems and habitats • groundwater quality	There will be no adverse effects on any of the matters listed from the proposed groundwater abstraction.
29	Manage the stream depletion effect of any groundwater abstraction with a rate of take exceeding 2 L/s.	The average rate of abstraction over 24 hrs is less than 2 L/s.
31	Limit the cumulative interference effect of any new groundwater abstraction (in conjunction with other lawfully established groundwater takes) to no more than 20 percent of the available drawdown in any unconfined aquifer or up to 50 percent of the potentiometric head in any confined aquifer. The effects on any neighbouring bore will be considered where that bore is lawfully established and an assumption will be made that the bore fully penetrates the aquifer.	This application is for a replacement consent and so this policy is not applicable.
31A	Matching discharges to land to the level of risk posed by the following risk factors: (a) Nature and quantity of contaminants; (b) Sloping land; (c) Soil drainage characteristics; (d) Climate; (e) Proximity to surface water; (f) Natural hazards	As discussed earlier in this report, the proposed discharge method, rate and depth are appropriate for the subject property.
31C	Manage discharges to land to avoid, remedy or mitigate adverse effects on: (a) soil quality; (b) amenity values; (c) ecological factors; (d) historic, cultural and traditional values; (e) natural character; (f) outstanding natural features.	As discussed earlier in this report, the proposed discharge will not have any significant adverse effects on any of the matters listed.
31D	Encourage the beneficial reuse of materials, to promote discharges of these materials onto land to maximise potential reuse of nutrients	As discussed earlier in this report, the proposed discharge allows for the beneficial reuse of FDE.

42	Avoid adverse effects on water quality and other adverse environmental effects associated with the application of farm dairy effluent to land by matching farm dairy effluent management to receiving environment risk.	As discussed earlier in this report, the proposed discharge method, rate and depth are appropriate for the subject property.
43	Match consent duration and inspection and audit requirements on resource consents to apply farm dairy effluent to land to the level of risk of adverse environmental effects.	The consent term sought is discussed later in this report.

Proposed Southland Water and Land Plan, 2018

The following policies, which give effect to the plan's objectives, are relevant to this application for resource consent.

Table 15: Applicable policies from the pSWLP 2018

Policy	Wording	Comment
1	Enable papatipu rūnanga to effectively undertake their kaitiaki (guardian/steward) responsibilities in freshwater and land management through the Southland Regional Council: 1. providing copies of all applications that may affect a Statutory Acknowledgement area, tōpuni (landscape features of special importance or value), nohoanga, mātaitai or taiāpure to Te Rūnanga o Ngāi Tahu and the relevant papatipu rūnanga; 2. identifying Ngāi Tahu interests in freshwater and associated ecosystems in Murihiku (includes the Southland Region); and 3. reflecting Ngāi Tahu values and interests in the management of and decision-making on freshwater and freshwater ecosystems in Murihiku (includes the Southland Region), consistent with the Charter of Understanding.	Te Tangi a Tauira is considered below.
2	Any assessment of an activity covered by this Plan must: 1. take into account any relevant iwi management plan; and 2. assess water quality and quantity, taking into account Ngāi Tahu indicators of health.	Te Tangi a Tauira is considered below.
6	In the Gleyed, Bedrock/Hill Country and Lignite-Marine Terraces physiographic zone, avoid, remedy, or mitigate adverse effects on water quality from contaminants, by: 1. requiring implementation of good management practices to manage adverse effects on water quality from contaminants transported via artificial drainage, and overland flow where relevant; and 2. having particular regard to adverse effects on water quality from contaminants transported via artificial drainage, and overland flow where relevant when assessing resource consent	Potential contaminant transportation pathways in the Gleyed physiographic zone and appropriate GMPs/mitigation measures are discussed elsewhere in this report. The addition of the East Block requires the expansion of the dairy platform further into the Gleyed physiographic zone. Appropriate mitigation

	applications and preparing or considering Farm Environmental Management Plans.	measures have been applied across the Gleyed zone to ensure that there is an overall decrease in contaminant losses. The very small potential increase in P loss from the East Block will be effectively offset by significant decreases of P loss elsewhere on the property.
10	In the Oxidising physiographic zone, avoid, remedy, or mitigate adverse effects on water quality from contaminants, by: 1. requiring implementation of good management practices to manage adverse effects on water quality from contaminants transported via deep drainage, and overland flow and artificial drainage where relevant; 2. having particular regard to adverse effects on water quality from contaminants transported via deep drainage, and overland flow and artificial drainage where relevant when assessing resource consent applications and preparing or considering Farm Environmental Management Plans; and 3. decision makers generally not granting resource consents for additional dairy farming of cows or additional intensive winter grazing where contaminant losses will increase as a result of the proposed activity.	Potential contaminant transportation pathways in the Oxidising zone and appropriate GMPs/mitigation measures are discussed elsewhere in this report. Contaminant losses will decrease as a result of the proposed activities. The addition of the East Block into the milking platform doesn't extend into the Oxidising physiographic zone.
13	1. Recognise that the use and development of Southland's land and water resources, including for primary production, enables people and communities to provide for their social, economic and cultural wellbeing. 2. Manage land use activities and discharges (point source and non-point source) to enable the achievement of Policies 15A, 15B and 15C.	Granting of the consents sought will enables people and communities to provide for their social, economic and cultural wellbeing. The proposed discharge will be managed appropriately.
14	Prefer discharges of contaminants to land over discharges of contaminants to water, unless adverse effects associated with a discharge to land are greater than a discharge to water. Particular regard shall be given to any adverse effects on cultural values associated with a discharge to water.	The proposed discharge is to land, not water.
15B	Where existing water quality does not meet the Appendix E Water Quality Standards or bed sediments do not meet the Appendix C ANZECC sediment guidelines, improve water quality including by: 1. avoiding where practicable and otherwise remedying or mitigating any adverse effects of new discharges on water quality or sediment quality that would exacerbate the exceedance of	As noted in Section 3.4 the PSWLP Appendix E water quality standards are not fully met but the farm system changes, GMPs and mitigation measures demonstrate that the significant reduction in contaminant losses

	those standards or sediment guidelines beyond the zone of reasonable mixing; and 2. requiring any application for replacement of an expiring discharge permit to demonstrate how and by when adverse effects will be avoided where practicable and otherwise remedied or mitigated, so that beyond the zone of reasonable mixing water quality will be improved to assist with meeting those standards or sediment guidelines.	to water will result in improvements in water quality. Therefore the proposal is fully compliant with this policy.
16	1. Minimising the adverse environmental effects (including on the quality of water in lakes, rivers, artificial watercourses, modified watercourses, wetlands, tidal estuaries and salt marshes, and groundwater) from farming activities by: (a)… (b) ensuring that, in the interim period prior to the development of freshwater objectives under Freshwater Management Unit processes, applications to establish new, or further intensify existing, dairy farming of cows or intensive winter grazing activities will generally not be granted where: (i) the adverse effects, including cumulatively, on the quality of groundwater, or water in lakes, rivers, artificial watercourses, modified watercourses, wetlands, tidal estuaries and salt marshes cannot be avoided or mitigated; or (ii) existing water quality is already degraded to the point of being overallocated; or (iii) water quality does not meet the Appendix E Water Quality Standards or bed sediments do not meet the Appendix C ANZECC sediment guidelines; and (c)… 2. Requiring all farming activities, including existing activities, to: (a) implement a Farm Environmental Management Plan, as set out in Appendix N; and (b) actively manage sediment run-off risk from farming and hill country development by identifying critical source areas and implementing practices including setbacks from waterbodies, sediment traps, riparian planting, limits on areas or duration of exposed soils and the prevention of stock entering the beds of surface waterbodies; and (c) manage collected and diffuse run-off and leaching of nutrients, microbial contaminants and sediment through the identification and management of critical source areas within individual properties. 3. When considering a resource consent application for farming activities, consideration should be given to the following matters:	1. The key consideration under this policy is the fact that some PSWLP Appendix E water quality standards are not fully met. However, given the other important conclusions of this assessment that the proposal will result in an overall reduction in the contaminant losses to water, it is considered that the exception provided by the policy should be applied particularly in the light of the assessment of the proposal against Policy 15B. 2 The applicant's intentions regarding the FEMP are discussed elsewhere in this report. A Farm Activity Focus Plan has already been developed for the existing dairy platform. This details the setbacks, fencing, riparian planting and avoidance of CSAs that the applicant is already doing. 3. The consent term sought is discussed later in this report.

	(a)… (b) granting a consent duration of at least 5 years.	
17	1. Avoid significant adverse effects on water quality, and avoid, remedy, or mitigate other adverse effects of the operation of, and discharges from, agricultural effluent management systems. 2. Manage agricultural effluent systems and discharges from them by: (a) designing, constructing and locating systems appropriately and in accordance with best practice; and (b) maintaining and operating effluent systems in accordance with best practice guidelines; and (c) avoiding any surface run-off or overland flow, ponding or contamination of water, including via sub-surface drainage, resulting from the application of agricultural effluent to pasture; and (d) avoiding the discharge of untreated agricultural effluent to water.	Collected agricultural effluent is treated and stored by means of a recently-constructed effluent pond, which has been kept in immaculate condition. The rate, depth and location of effluent application is appropriate for the soil types present.
20	Manage the taking, abstraction, use, damming or diversion of surface water and groundwater so as to: 1A. recognise that the use and development of Southland's land and water resources, including for primary production, can have positive effects including enabling people and communities to provide for their social, economic and cultural wellbeing; 1. avoid, remedy or mitigate adverse effects from the use and development of surface water resources on: (a) the quality and quantity of aquatic habitat, including the life supporting capacity and ecosystem health and processes of waterbodies; (b) natural character values, natural features, and amenity, aesthetic and landscape values; (c) areas of significant indigenous vegetation and significant habitats of indigenous fauna; (d) recreational values; (e) the spiritual and cultural values and beliefs of tangata whenua; (f) water quality, including temperature and oxygen content; (g) the reliability of supply for lawful existing surface water users, including those with existing, but not yet implemented, resource consents; (h) groundwater quality and quantity; (j) mātaitai, taiāpure and nohoanga; 2. avoid, remedy or mitigate significant adverse effects from the use and development of groundwater resources on: (a) long-term aquifer storage volumes;	The volume of water sought is reasonable for the intended use and none of the adverse effects listed in this policy will result from the proposed abstraction of groundwater.

	(b) the reliability of supply for lawful existing groundwater users, including those with existing, but not yet implemented, resource consents; (c) surface water flows and levels, particularly in spring-fed streams, natural wetlands, lakes, aquatic ecosystems and habitats (including life supporting capacity and ecosystem health and processes of waterbodies) and their natural character; and (d) water quality; 3. ensure water is used efficiently and reasonably by requiring that the rate and volume of abstraction specified on water permits to take and use water are no more than reasonable for the intended end use following the criteria established in Appendix O and Appendix L.4.	
21	Manage the allocation of surface water and groundwater by: 1. determining the primary allocation for confined aquifers not identified in Appendix L.5, following the methodology established in Appendix L.6; 2. determining that a waterbody is fully allocated when the total volume of water allocated through current resource consents and permitted activities is equal to either: (a) the maximum amount that may be allocated under the rules of this Plan, or (b) the provisions of any water conservation order; 3. enabling secondary allocation of surface water and groundwater subject to appropriate surface water environmental flow regimes, minimum lake and wetland water levels, minimum groundwater level cutoffs or seasonal recovery triggers, to ensure: (a) long-term aquifer storage volumes are maintained; and (b) the reliability of supply for existing groundwater users (including those with existing resource consents for groundwater takes that have not yet been implemented) is not adversely affected; 4. when considering levels of abstraction, recognise the need to exclude takes for nonconsumptive uses that return the same amount (or more) water to the same aquifer or a hydraulically connected lake, river, modified watercourse or natural wetland.	The proposed abstraction of groundwater is a replacement of an existing consent and so there will be no adverse effects related to allocation limits.
22	Manage the effects of surface and groundwater abstractions by: 1. avoiding allocating water to the extent that the effects on surface water flow would not safeguard the mauri of that waterway and mahinga kai, taonga species or the habitat of trout and salmon;	The proposed rate of abstraction is less than 2 L/s as an average over 24 hrs and so none of the adverse effects listed in this policy are expected.

	2. ensuring interference effects are acceptable, in accordance with Appendix L.3; 3. utilising the methodology established in Appendix L.2 to: (a) manage the effects of consented groundwater abstractions on surface waterbodies; and (b) assess and manage the effects of consented groundwater abstractions in groundwater management zones other than those specified in Appendix L.5.	
23	Manage stream depletion effects resulting from groundwater takes which are classified as having a Riparian, Direct, High or Moderate hydraulic connection, as set out in Appendix L.2 Table L.2, to ensure the cumulative effect of those takes does not: 1. exceed any relevant surface water allocation regime (including those established under any water conservation order) for groundwater takes classified as Riparian, Direct, High or Moderate hydraulic connection; or 2. result in abstraction occurring when surface water flows or levels are less than prescribed minimum flows or groundwater levels for takes classified as Riparian, Direct or High hydraulic connection.	The proposed rate of abstraction is less than 2 L/s as an average over 24 hrs and so none of the adverse effects listed in this policy are expected.
39	When considering any application for resource consent for the use of land for a farming activity, the Southland Regional Council should consider all adverse effects of the proposed activity on water quality, whether or not this Plan permits an activity with that effect.	The applications have considered all adverse effects of the proposed activities on water quality. Note this policy cannot override the requirements of Section 104(2) of the RMA.
39A	When considering the cumulative effects of land use and discharge activities within whole catchments, consider: 1. the integrated management of freshwater and the use and development of land including the interactions between freshwater, land and associated ecosystems (including estuaries); and 2. through the Freshwater Management Unit process, facilitating the collective management of nutrient losses, including through initiatives such as nutrient user groups and catchment management groups.	The proposal has incorporated careful consideration of the contaminant transportation mechanisms through the identification of the physiographic zones present. This assessment has considered these interactions, particularly between groundwater and surface water.
40	When determining the term of a resource consent consideration will be given, but not limited, to: 1. granting a shorter duration than that sought by the applicant when there is uncertainty regarding the nature, scale, duration and frequency of adverse effects from the activity or the capacity of the resource;	The consent term sought is discussed later in this report.

	2. relevant tangata whenua values and Ngāi Tahu indicators of health; 3. the duration sought by the applicant and reasons for the duration sought; 4. the permanence and economic life of any capital investment; 5. the desirability of applying a common expiry date for water permits that allocate water from the same resource or land use and discharges that may affect the quality of the same resource; 6. the applicant's compliance with the conditions of any previous resource consent, and the applicant's adoption, particularly voluntarily, of good management practices; and 7. the timing of development of FMU sections of this Plan, and whether granting a shorter or longer duration will better enable implementation of the revised frameworks established in those sections.	
42	When considering resource consent applications for water permits to take and use water: 1. except for non-consumptive uses, consent will not be granted if a water body is over allocated or fully allocated; or to grant consent would result in a water body becoming over allocated or would not allow an allocation target for a water body to be achieved within a time period defined in this Plan; and 2. except for non-consumptive uses, consents replacing an expiring resource consent for an abstraction from an over-allocated water body will generally only be granted at a reduced rate, the reduction being proportional to the amount of over-allocation and previous use, using the method set out in Appendix O; and 3. installation of water measuring devices will be required on all new permits to take and use water and on existing permits in accordance with the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010; and 4. where appropriate, minimum level or flow cut-offs and seasonal recovery triggers on resource consents for groundwater abstraction will be imposed; and 5. conditions will be specified relating to a minimum flow or level, or environmental flow or level regime (which may include flow sharing), in accordance with Appendix K, for all new or replacement resource consents (except for water permits for non-consumptive uses, community water supplies and water bodies subject to minimum flow and level regimes established under any water conservation order) for:	The water sought is within the allocation limits set for the subject aquifer. The take will continue to be metered as it has been. No minimum level cut-offs are necessary.

	(a) surface water abstraction, damming, diversion and use; and (b) groundwater abstraction in accordance with Policy 23.	

Other Documentation

Te Tangi a Tauira is the Iwi Environmental Management Plan for the Murihiku area. This plan replaces Te Whakatau Kaupapa O Murihiku which is recognised in Policy 1.2 of the RPS. The application is not contrary to the relevant policies of Te Tangi a Tauira, particularly as;

- The provision of buffer zones to water abstraction sites and waterways;
- The application of effluent is proposed to land rather than water;
- The applicant proposes best practice for land application of managing farm effluent;
- Those existing riparian margins will be protected;
- Deferred application of FDE is provided for;
- Nutrient loading from effluent discharges to land will be within industry best practice limits;
- The system and management practices are considered appropriate for the risks associated with the receiving environment;
- Water abstraction will be monitored with metering results to be submitted to Council;
- The applicant is not averse to appropriate potential monitoring conditions; and
- Regarding Policies 3.5.14.17 and 3.5.1.17, the consent periods proposed are less than 25 years.

7.3 Sections 105 and 107 of the RMA

In addition to the matters in Section 104(1) of the RMA, if an application is for a discharge permit a consent authority must have regard to the matters as specified in Section 105. The proposed discharge can be undertaken in a manner which avoids contaminants from entering water through controls on application method and conditions of consent. As nutrients can be reused, there is a direct benefit to the property as a method for improving soil fertility. The discharge of effluent to land is the best method for avoiding adverse effects on water as might otherwise occur in the event that the discharge was directly to water, which would result in a worse environmental outcome.

There are no matters under Section 107(1) of the RMA that would require the consent authority to decline this application.

7.4 Section 104 (2A)

The discharge permit and water permit applications are affected by section 124 of the RMA and as such under section 104(2A) regard must be given to the value of the investment. As at 2018, the property has a capital rating valuation of approximately $9 million.

8. CONSENT DURATION, REVIEW AND LAPSE

With regard to consent duration, special consideration has been given to Policies 14A and 43 of the RWPS and Policy 40 of the pSWLP, which have been grouped below for ease of assessment.

Certainty of the nature, scale, duration and frequency of effects

Potential effects of the proposed activities are understood reasonably well and these are to be managed as far as reasonably practicable. Whilst the potential adverse effects of this dairy farm are expected to be similar to those expected from an average dairy farm, it is noted that the level of understanding in this field is increasing. Council's level of knowledge regarding the underlying aquifer, the receiving soils and surface water management zone is also improving, with continued knowledge and research of Southland and the site being achieved in the form of the proposed physiographic units and future catchment specific studies.

Potential adverse effects have in the first instance been mitigated by appropriate management techniques on farm followed by contingency planning, ongoing monitoring and reporting in an auditable format.

Matching consent duration to the level of risk of adverse effects

The extent and nature of the actual and potential adverse effects of the activities on the existing environment (which includes the current dairy farm) were assessed in this document and concluded to be no more than occurring historically in the existing environment, with potential for improvement following the implementation of a FEMP.

Relevant Tangata Whenua values and Ngai Tahu Indicators of Health

The application has been assessed as consistent with the relevant tangata whenua values as outlined in the iwi management plan, with particular regard to the proposed consent duration being less than 25 years.

Duration sought by the applicant and supporting information

A consent term of 10 years is sought for all of the consents applied for.

The permanence and economic life of any investment

Significant investment has been required just to get to the point of making application with expenditure on professional services, including business feasibility studies, nutrient advice, effluent system review, water quality and policy and planning assessments.

Commodity market influence is always a factor in the permanence of individual dairying units, hence why effluent discharge activities are often considered to have semi-permanent economic life. The economic life of the farm is firstly dependent on the granting of the relevant consents. Should consents be granted, the permanence of the dairying operation and associated activities should be inter-generational. Furthermore, the permanence of the economic life of the activity requires resource consents be granted from the Council for a reasonable duration.

Common expiry date for permits that affect the same resource

A common expiration date for all the permits applied for is considered appropriate.

Applicant's compliance history

The applicant has demonstrated an overall good compliance history with the existing resource consents and there is no evidence to suggest that future compliance will not continue to be good, and water records will be provided to Council on time in future.

Timing and development of FMUs

It is considered that granting a longer consent duration (i.e. 15 years) will better enable implementation of any revised framework established in the FMU section of the PSWLP, as Council will be able to review all consents in the catchment collectively, which will serve to better implement any limit setting process.

In conclusion, due to the low level of environmental risk of the proposed activities and a substantial value of investments on the property, 10-year consent durations are considered appropriate.

Review and Lapse

The applicant is agreeable to the Council imposing standard review conditions in accordance with Sections 128 and 129 of the RMA. In accordance with Section 125 of the RMA, the applicant seeks a 5-year lapse period for these consents.

9. CONCLUSION

A decision to grant consent under Section 104B can be made on the basis that:

a) The adverse effects on the environment will be minor or less.
b) The proposal meets the non-notification requirements of Section 95A of the RMA.
c) The proposal is consistent with the requirements of the RMA, relevant planning provisions and other relevant matters.

Granting of the consents will be consistent with the purpose of the RMA for the reasons explained within this report. The proposed activities would contribute to an improvement in water quality and potential adverse effects will be appropriately avoided or mitigated.

Attachment A

Dairy Effluent Storage Calculator
Summary Report

Regional authority: Environment Southland Regional Council
Authorised agent: RDAgritech - KML
Client: Landpro (T Driscoll)
Program version: 1.48
Report date: Thursday, 22 March 2018
General description:

Updated storage model for proposed changes to farm system:
Milking 700 cows 01/08 - 31/05 @ 50L/c/day average water use for peak cows, (as advised by the Client).
The entire property is classified as high risk for effluent application and the Nutrient Budget has calculated a minimum required area of 41ha for effluent application.
Cow numbers are monthly averages with a median calving date of 20 August.
Stormwater from the shed roof is diverted all year, and the yards diverted outside of the milking season only.
Raw stirred effluent is irrigated using RX "Maxi-pods" with a nominal application rate of 4mm/hr at 24m3/hr flow.
No irrigation during June & July (low soil temperatures).
Winter irrigation depth of minimum 2mm @ 48m3/day.
Summer irrigation of minimum 4mm @ 96m3/day.
The existing storage pond allows the required minimum 3 days emergency storage. No sludge buildup is allowed for due to the use of a foot stirrer to incorporate solids into irrigated effluent.

Climate

Rainfall site: Winton
Mean annual rainfall: 958 mm/year

Effluent Block

Area of low risk soil: 0.0 hectares
Minimum area of high risk soil: 41.0 hectares
Surplus area of high risk soil: 73.0 hectares

Wash Water

Yard wash:

- Milking season starts: 01 August
- Milking season ends: 31 May

Month	Number of Cows	Hours in Yard	Wash Volume (cubic metres)
January	700	5.0	35.0
February	700	5.0	35.0
March	700	5.0	35.0
April	677	5.0	34.0
May	608	5.0	31.0
June	0	0.0	0.0
July	0	0.0	0.0
August	280	3.0	27.0
September	537	5.0	28.0
October	700	5.0	35.0
November	700	5.0	35.0
December	700	5.0	35.0

Irrigation

Winter-spring depth: 2 mm
Spring-autumn depth: 4 mm

Winter-spring volume:	48 cubic metres
Spring-autumn volume:	96 cubic metres
Irrigate all year?	No
Don't irrigate start:	01 June
Don't irrigate end:	31 July

Catchments

Yard Area:	1200 square metres
Diverted?	Yes
- diversion start:	01 June
- diversion end:	31 July
Shed Roof Area:	450 square metres
Diverted?	Yes
Feedpad Area:	0 square metres
Covered?	No
Diverted?	Yes
- diversion start:	01 June
- diversion end:	01 August
Animal Shelter Area:	0 square metres
Covered?	Yes
Diverted?	No
Other Areas:	0 square metres

Storage

Pond/s present?	Yes
No. of ponds:	1 pond/s
Includes irregular ponds?	No
Pond 1	
- total volume:	3261 cubic metres
- pumpable volume:	2771 cubic metres
- surface area:	1681 square metres
- width:	41.0 metres
- length:	41.0 metres
- batter:	2.0:1
- total height:	2.5 metres
- pumped?	Yes
Tank/s present?	No
Emergency storage period:	3 days

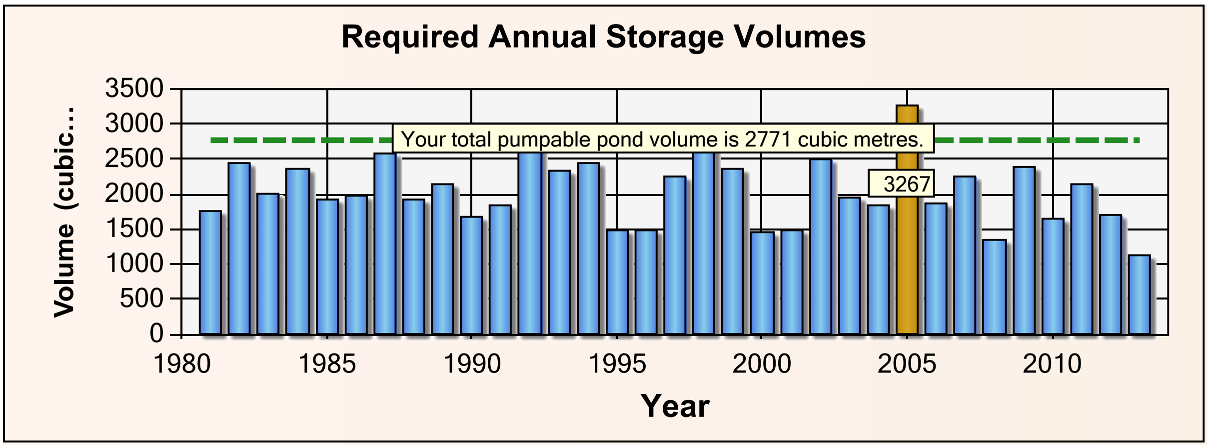
Solids Separation

Solids separator/s present?	No

Outputs

Maximum required storage pond volume:	3267 cubic metres
90 % probability storage pond volume:	2670 cubic metres
During the period from:	01 July 1980

To: 30 June 2013



Attachment B

FARM ENVIRONMENTAL MANAGEMENT PLAN

A: Property Overview

Contact Person(s)	Tim and Jocelyn Driscoll	**Plan Prepared By**	Landpro Ltd
Contact Phone	022 076 9093	**Date**	17 July 2018
Email Address	driscolldairy@gmail.com	**Date of Next Review**	17 July 2019
Physical Address	266 O'Shannessy Road, Winton		
Consent Numbers and Expiry Dates	TBC		
Farm Area	224.5 ha	**Peak Milked Herd Size**	680
Legal Descriptions	Pt Secs 29 & 30 Blk I Winton Hundred, Secs 43 – 45 & 54 Blk I Winton Hundred, Lots 1 & 2 DP 449518		

This FEMP sets out the management practices that will be implemented and adopted to actively manage the operation of the property to ensure that environmental risks are managed appropriately, and resource consent conditions complied with.

Objectives of this plan:

- Comply with all legal requirements related to land use and discharge.
- Take all practicable steps to minimise the risk of harm to onsite and nearby water resources.
- Take all practicable steps to ensure that there is an adequate supply of soil nutrients to meet plant needs.
- Take all practicable steps to minimise the risk of harm to significant vegetation and/or wildlife habitat.

This will be achieved through;

- Identifying and documenting contaminant pathways for the property (based on Physiographic Zones);
- Identifying relevant good management practices (GMP) and where they are required to be implemented to minimise environmental risks; and
- Documenting evidence to be provided to show adherence with consent conditions.

As the person responsible for implementing this plan, I confirm that the information provided is correct:

Name:..Signed:..Date:..

B: Site Plans

This FEMP contains various site plans identifying key features of the subject property in accordance with Part B(3) of Appendix N of the proposed Southland Water and Land Plan, 2018. The following table can be used as a reference point for locating these features.

Table 1: Schedule of where key features have been mapped

	Plan(s) where features are mapped
Site boundary	All site plans in this FEMP
Physiographic zones, variants and soil types	Figure 1: Physiographic zones and variants present
Lakes, rivers, streams ponds, artificial watercourses, modified watercourses and natural wetlands	Attachment B: Existing Waterways and Critical Source Areas (from Environment Southland Farm Activity Focus Plan)
Other critical source areas (gullies, swales etc)	Attachment B: Existing Waterways and Critical Source Areas (from Environment Southland Farm Activity Focus Plan)
Land with a slope greater than 20 degrees	N/A
Existing and proposed riparian vegetation and fences (or other stock exclusion methods) adjacent to waterbodies	Attachment B: Riparian Fencelines and Planting (from Environment Southland Farm Activity Focus Plan)
Places where stock access or cross water bodies (including bridges, culverts and fords)	Attachment B: Riparian Fencelines and Planting (from Environment Southland Farm Activity Focus Plan)
Known subsurface drainage system(s) and the location of drain outlets	TBC
All land that may be cultivated over the next 12 months	TBC
All land that may be intensively winter grazed over the next 12 months	TBC

C: Physiographic Zones and Key Contaminant Pathways

This section of the FEMP documents the physiographic zones and variants present across the property and key contaminant pathways associated these. The Physiographic Plan (figure 1) shows the location and extent of the physiographic zones on the property.

Table 2: Key transport pathways and contaminants for each physiographic zone

Physiographic Zone	**Key Contaminant Transport Pathways (✓)**	
	Deep Drainage	**Artificial Drainage**
Oxidising	✓	-
Gleyed	-	✓

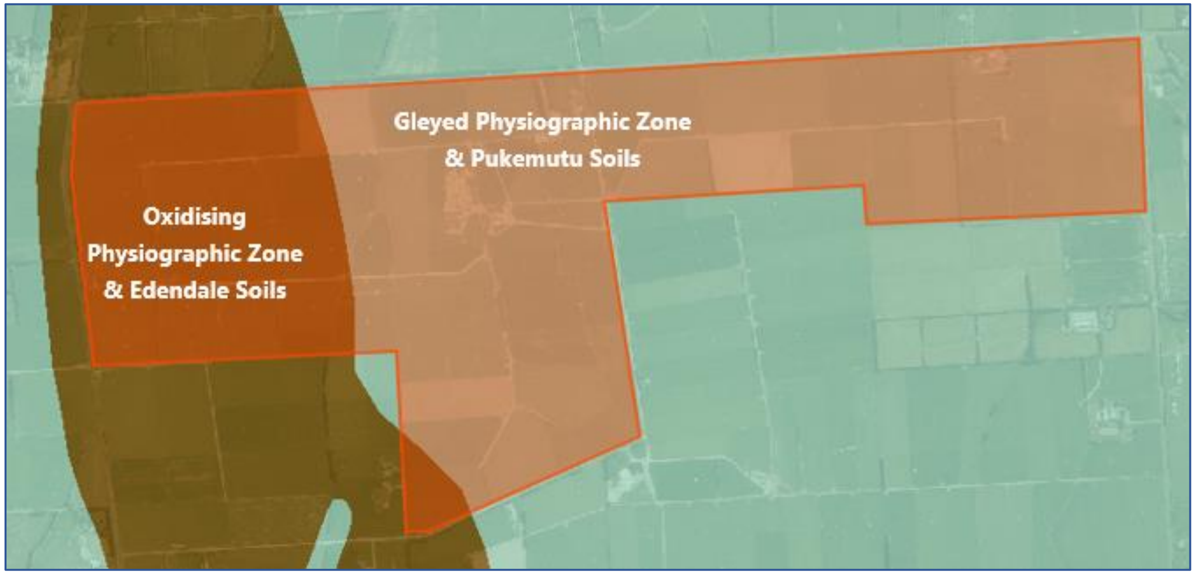


Figure 1: Physiographic Zones and variants present

Figure 1 shows that:

- The Oxidising physiographic zone is the predominant physiographic zone in the western part of the farm.
- The Gleyed physiographic zone is the predominant physiographic zone in central and the eastern part of the farm;
- No variants of either of these physiographic zones are present.
- The key contaminant pathway on the western-most portion of the property is deep drainage and the key contaminant pathway for the rest of the farm is artificial drainage.

D: Good Management Practices

The table below outlines general good management practices which will be undertaken across the whole farm over the 12-month period from the first exercise of the land use consent for expanded dairying. Critical Source Areas (CSAs) for this property consist predominantly of drains and waterways, as shown on the attached maps.

Table 3: Good Management Practices for the Farm

Mitigation	Good Management Practice	Area where most effective
Protect soil structure (will also help to reduce P and N loss)	1. Wintering herd off-site	Whole farm
	2. Re-sow bare soils as soon as possible	
	3. Use stand-off pads when soils are saturated	
Manage Critical Source Areas (will also help to reduce P loss)	4. Avoid working CSAs and their margins following periods of heavy rain or when water is lying in them.	CSAs (see Attachment B)
	5. Leave grassed areas (or native vegetation) around CSAs	
	6. All riparian margins to be fenced and planted	
	7. When winter grazing, leave CSA areas to be grazed last. For sensitive areas leave a 20m buffer.	
Additional P loss reduction GMPs	8. Reduce use of P fertilizer where Olsen P values are above agronomic optimum.	Whole farm
	9. Reduce the risk of run-off to laneways and other sources by ensuring crossings are designed and maintained adequately	
Additional GMPs to reduce accumulation of N in soil	10. Control the duration of grazing of pasture and forage crops by using stand-off pads on shoulder seasons	Whole farm
	11. Time N fertilizer application to meet crop demand using split applications	
	12. Optimise timing and amounts of FDE application	FDE disposal area
Avoid preferential flow of FDE through drains	13. Defer effluent application when soil conditions unsuitable	
	14. Apply effluent at low rates and depths	

The GMPs above have been chosen as being the most optimal methods for minimising the risks associated with the key contaminant pathways identified for the property, which are deep drainage in the western-most portion of the property (oxidising physiographic zone) and artificial drainage for the rest of the farm (gleyed physiographic zone).

Practices that protect soil structure and ensure appropriate management of CSAs to ensure that the risk of sediment and nutrient loss via overland flow is minimised are included in the table above (particularly GMPs 1, 2, 3, 4, 5, 6, 8, 12, 13)

Cultivation practices are included in the table above (particularly GMPs 3, 5, 6, 7, 8, 13, 14). Areas to be cultivated over the forthcoming 12-month period are shown on Attachment X.

Winter grazing practices are also included in the table above (particularly GMPs 2, 4, 12). Areas planted for winter grazing over the forthcoming winter are shown on Attachment X.

Riparian management practices are included in the table above (particularly GMPs 4, 5 6) and addressed in more detail below.

Additional mitigations that are above and beyond the GMPs will be put in place. These are described in the following table. The location of these mitigations are shown on Attachment C.

Mitigation	Additional Mitigation	Area where most effective
Protect soil structure (will also help to reduce P and N loss)	1. Stand springer (calving) cows on the calving pad during period of high soil moisture content to minimise soil damage and leaching risk.	Whole farm
Manage Critical Source Areas (will also help to reduce P loss)	2. Increased buffer width along the laneway at the southern end of the property (paddock 5) **Approx. E1240942 N4874091**	CSAs (see Attachment B)
	3. Water to be directed through vegetated areas to allow for filtering. **As above**	
	4. Additional riparian planting. **Various location, see Attachment C**	
Additional P loss reduction GMPs	5. Change in fertiliser from a water-soluble super phosphorus fertiliser to a non-water-soluble serpentine super and reactive phosphorus rock on the Eastern Block.	Eastern Block.
	6. Reduce Olsen P levels from 32 to 30.	Whole Farm
	7. Improvement of kickboards on bridges/culverts. **Bridge E1240535 N4874788** **Bridge E1240427 N4874409** **Culvert E1240172 N4874765** **Culvert E1240927 N4874158**	
	8. Careful management of bridges/culverts through improvements in structures. **As above**	
Additional GMPs to reduce accumulation of N in soil	10. Effluent applied in accordance with GMPs (less than 150 kg N/ha/yr/ at times when ground conditions are appropriate.)	Whole farm

	11. Correct fertiliser application, at correct rate and not in close proximity of laneways, as per fertiliser recommendation for maintenance fertiliser. >7 degrees soil temper and not when soil is saturated	
	12. Regular soil testing (at least every 3 years)	FDE disposal area

E: Riparian Management

The majority of the property is contained within the Lower Oreti Surface Water Management Zone, and the eastern-most portion is contained within the Tussock Creek catchment/Makarewa Surface Water Management Zone. The Makarewa River is a tributary of the Oreti River.

There are several tributaries of the Oreti River on the property. The tributaries discharge to the Oreti River approximately 3.6 km downstream of the property boundary. As shown on Attachment B, there are no tributaries of Tussock Creek/the Makarewa River on the subject property.

All waterways across the property have been fenced to prevent stock access, as shown on Attachment B. An unnamed tributary of the Oreti River runs through the property in a north-south direction and this is maintained by Envrionment Southland's catchment team. Any drain cleaning works facilitated by the consent holder will be undertaken in accordance with Environment Southlands *Drainage and Channel Maintenance Fact Sheet.*

Where appropriate and as part of good grazing management, temporary fencing will also be erected to prevent any point source discharges occurring. This includes fencing off swale areas where they may directly discharge to surface water. Such practices will be adopted as set out elsewhere in this plan as part of the management of CSAs, and as set out in the Environment Southland Factsheet on *Critical Source Areas,* and *Dairy NZ Wintering in Southland and South Otago Guide.*

Several small culvert crossings exist on the property, as shown on Attachment B. These will all be inspected over the next 12 months and additional containment and diversion mechanisms will be installed as necessary to ensure there is no direct run-off of effluent from any crossing to water, in accordance with the GMPs outlined in the table above.

F: Farm Dairy Effluent

This section of this plan documents the methods that will be employed in the operation of the Farm Dairy Effluent (FDE) System to ensure that the discharge of effluent occurs in accordance with conditions of consent.

Table 4: Effluent System Overview

Total Effluent Disposal Area (ha):	93.3	**Available Storage Volume:**	3,261	**Storage Type:**	Lined pond with mechanical stirrer installed in the pond
Effluent Application Method(s):		RX Plastics Maxi Pods Slurry tanker may also be used on rare occasions		**Maximum Rate and Depth of Application:**	10 mm/hr 25 mm depth

Table 5: FDE Good Management Practices (existing and proposed to continue to be undertaken on farm)

Mitigation	Good Management Practice	Monitoring
Reduction in effluent generation	• Reduce water use in shed by reusing clean water where possible • Treat the herd gently to avoid upset	N/A
Effluent applied only when soil conditions are appropriate	• Sufficient storage provided so that when soils are at or above field capacity and/or during adverse weather conditions, effluent can be stored in the effluent storage pond until conditions are suitable for application • Monitoring of soil moisture and temperature will be used to determine soil water deficits for sustainable application depths, from data obtained from the ES website. • Paddocks will be inspected before effluent application to check that soil water deficit exists. • Low rate application will be used at all times.	Record irrigation dates, times, areas on the Irrigator run sheet (attached)
Avoidance of direct effluent disposal or runoff to sensitive areas	• Effluent discharge will observe a range of buffers from sensitive receiving environments as shown on the Appendix I plan attached to the discharge permit • Low rate effluent discharge will avoid ponding and/or runoff • Effluent will not be discharged onto any land areas that have been grazed within the previous 5 days • Effluent disposal will be to an area of at least 4 ha/100 cows	Record irrigation dates, times, areas on the Irrigator run sheet (attached)

Mitigation	Good Management Practice	Monitoring
Avoidance of effluent contamination in tile drains	• Low rate effluent discharge to reduce the risk of through-drainage and associated risk of effluent entering water	N/A
Efficient and effective collection, storage and delivery infrastructure at all times	• Monthly/frequent system checks will be undertaken using the Monthly Effluent Check Sheet attached • All parts of the effluent system will be checked and maintained regularly • Leaks will be repaired immediately • Fail safe systems will be kept in place and kept in good working order i.e. automatic alarm and shut off system • Application Rates shall be assessed annually thereafter in accordance with the methodology specified in *Dairy NZ Staff Guide to Operating Your Effluent Irrigation System – Low Rate System*	Record all repairs and maintenance Monthly Effluent Check Sheets filled out and signed
Staff appropriately trained in operation and understand the effluent system	• All staff involved in the management of the effluent system are fully trained in its use • All staff are familiar with and understand the conditions of consent • All new staff will be taken through the "Staff Training Guide" (attached) • Staff to take immediate action if incident or breakdowns occur including; - Rectifying the problem - Cleaning up if possible	Keep signed training record in the back off this FEMP Ensure both farm manager and employee sign to confirm training
Application that is not offensive to neighbours	• Wind conditions will be checked to ensure the effluent can be discharged without resulting in spray drift and odour beyond the property boundary • Observation of buffers to dwellings not located on the property (200 m) and property boundaries (20 m)	Complaints received by Environment Southland

G: Compliance & Reporting

This section sets out the records which are required to be kept which will enable the Consent Holder to demonstrate compliance, as well as detailing the reporting requirements of the consents. The Consent Holder will also participate in annual compliance monitoring inspection programs that are to be implemented by Environment Southland.

Table 6: Records to be kept by the consent holder

Record	Date of most recent version
Nutrient budget	
Fertiliser application records	
Soil sampling results	
Water meter certification	
Water abstraction records	
Effluent system Staff Training Record	
Effluent system monthly maintenance check sheets	
Effluent proof of placement	
Effluent application depth test results	

Annual reporting requirements are set out in the conditions of resource consent and include;

- Prior to the first exercise of the Effluent Discharge Consent the Consent Holder shall notify Environment Southland of the operator of the effluent system
- The Farm Environmental Management Plan shall be reviewed annually, and any amendments reported to Environment Southland by 31 June each year
- The Consent Holder shall provide records from the Water Permit to ES by 31 May each year

H: Annual Review & Audit of FEMP

This FEMP shall be reviewed on an at least annual basis. The review shall include (but not be limited to) an assessment of;

- Verification of compliance with conditions of consent
- Details of the implementation of GMPs and identification of any new GMPs that would be appropriate to employ on the farm to manage risks identified
- Review of the data obtained from the monitoring undertaken in accordance with this FEMP and any changes to farming practice required as a consequence
- A report detailing items above shall be submitted to the consent authority each year including an updated version of the FEMP if any amendments made

I: Industry Guidelines

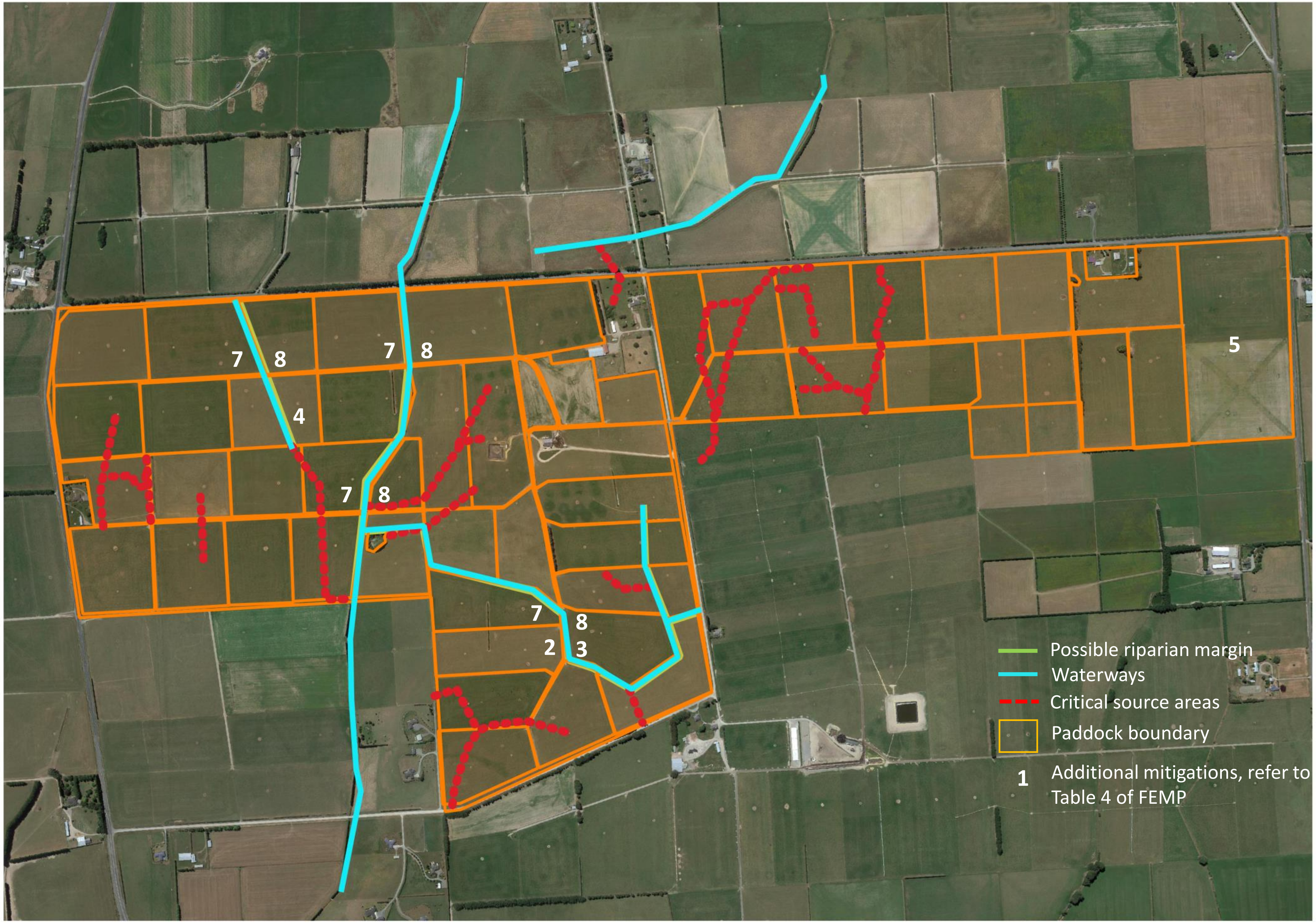
A complete list of the industry guidelines which have been referenced in the development of this FEMP are listed below. The Consent Holder is also referred to the following general sources for guidance in respect to the operation and management of their property.

Environment Southland **www.es.govt.nz** **Dairy NZ** **www.dairynz.co.nz** **Fonterra** **www.fonterra.com**

Dairy NZ – A staff guide to operating your effluent irrigation system – Low Rate System
Dairy NZ – A farmer's guide to managing farm dairy effluent – A good practice guide for land application systems
Dairy NZ – Wintering in Southland and South Otago – A land management guide to good environmental practice
Dairy NZ – Land management on Canterbury Dairy Farms – Managing land to reduce sediment and phosphorous loss
Environment Southland Factsheet – Critical Source Areas
Environment Canterbury – Information Sheet for Farmers on OVERSEER®
Sustainable Dairying: Water Accord

Attachment A – Consents

Attachment B – Farm Plans



7
8
7
8
4
7
8
7
8
2
3
5
Possible riparian margin
Waterways
Critical source areas
Paddock boundary
1
Additional mitigations, refer to Table 4 of FEMP

Attachment C – Nutrient budget for the previous season

Attachment D – Effluent Management

Dairy Shed Effluent Monthly Check Sheet

On a monthly basis the following checks and measures must be undertaken. The details of the monthly check shall be recorded on this sheet, and at the completion of the inspection the sheet shall be filed for future reference. If there are any matters requiring follow up work i.e. you note that an effluent nozzle needs replacing, please make a note of these, and ensure that the actions are followed up immediately.

Employee Name:

Date of Inspection:

Task	Done? (Y/N)	Any further action required?
Clean out stone trap		
Clean out sump		
Check all inlet and outlet pipes to storage pond to ensure they are free of debris to prevent blockages.		
Check the pond's leak detection system for the presence of effluent (visual and odour)		
Check effluent nozzles are clear and in good working order		
Check effluent irrigator pipe is in good working order and does not have any leaks		
Check well-head(s) remain capped and in good condition		

Effluent Orientation and Training Record

Season___/___

Effluent Competencies	Employee name	Employee name	Employee name
General			
Understands the regional council rules and farm policies for effluent management			
Understands health and safety around the effluent system			
Understands record keeping for irrigator runs and maintenance			
At the Dairy			
Use of stormwater diversion system			
Good hosing practice and water management			
Animal handling to minimise effluent volume			
Cleaning the stone trap			
Sump, pump & pond monitoring and management (including float switches)			
In the Paddock			
When to irrigate: assessing soil and weather conditions			
Where to irrigate: runs, paddock rotations, high risk vs low risk soils etc (mark on farm map)			
Where not to irrigate: near waterways, drains, boundaries, slopes etc (mark on farm map)			
How the irrigator works, how to use it, set up, hose layout and performance checks			
Measuring the depth of effluent application			
Irrigator, pump maintenance/cleaning			
Greasing and general maintenance requirements (how and when)			
How to check and replace rubber nozzles and seals (same time as dairy rubber ware)			
Tyre pressure and condition			
Pipe-work, hose and hydrant condition			
Wire-rope, cam and ratchet condition			
Other			

Trainer signature			
Employee signature			
Date			

Date when staff become competent in each skill. If all training provided in one day, tick and date at the bottom.

Irrigator run sheet

- ☑ Check the records to ensure effluent is due to be applied to that particular area
- ☑ Allow a minimum interval of 10 days between applications and grazing for animal health
- ☑ Ensure irrigator will be applying effluent to short pasture.

Date	Paddock	Run	Name	Comments

dairynz.co.nz
0800 4 DairyNZ (0800 4 324 7969)

You can use your Fonterra Dairy Diary as an alternative to this form, or photocopy a farm map – draw and date the runs on the copy then file it.

Attachment C

Mo Topham
CNMA
Southland
Ph: 027 279 7449
Email: mo.topham@outlook.com

File Note: T and J Driscoll Family Trust consent application

Please find below a file note in relation to Overseer modelling completed for the T and J Driscoll Family Trust. This file note is intended to be read in conjunction alongside the previous Overseer modelling reports, dated 1st October 2018 and the previous file note "Further information: T And J Driscoll Family trust consent application," dated 18th December 2018. Both of these reports have been included in the appendices of this file note.

Purpose of this Report

The applicant (T and J Driscoll Family Trust) have instructed further modelling to be undertaken to reduce nutrient loss in the proposed dairy farm.

Previous Modelling Results

Overseer modelling was completed for the T and J Driscoll Trust in October 2018 using Overseer version 6.3.0. Summarised results from this modelling is shown in Table 1.

Table 1. Predicted nitrogen and phosphorus losses in the current and proposed systems (From modelling report dated 1st October 2018 – in appendices)

	Current system	Proposed system
Total Farm N Loss (kg)	11,503	11,345
N Loss/ha (kgN/ha/yr)	51	51
Total Farm P Loss (kg)	262	278
P loss/ha (kgP/ha/yr)	1.2	1.2

Following this modelling, Environment Southland raised concern that the predicted Phosphorus losses using Overseer are higher in the proposed than the current system. A file note was completed to quantify the impact of mitigations that are not accounted for in Overseer. Results including the phosphorus mitigations modelled outside of Overseer 6.3.0 are shown in table 2.

Table 2. Predicted nitrogen and phosphorus losses in the current and proposed systems, including phosphorus mitigations modelled outside of Overseer 6.3.0 (From "Further information: T and J Driscoll Family Trust consent application" - in appendices)

	Current system	Proposed system
Total Farm N Loss (kg)	11,503	11,345
N Loss/ha (kgN/ha/yr)	51	51
Total Farm P Loss (kg)	229 (including 33kg P mitigation modelled outside of Overseer)	226 (including 52kg P mitigation modelled outside of Overseer)
P loss/ha (kgP/ha/yr)	1.0	1.0

Using the Overseer 6.3.0 model and supporting phosphorus loss calculation outside of Overseer, it is predicted that losses of nitrogen will decrease by 1.4% and losses of phosphorus will decrease by 1.3%.

The key drivers of a decrease in nitrogen loss are shown below. In comparison to the current system, the proposed system has:

- Increased the area that effluent is applied to – reduced N application in effluent to this area
- Reduced nitrogen fertiliser use
- Increased cow numbers – increasing loss risk

The key driver of the decrease in phosphorus loss are shown below. In comparison to the current system the proposed has:

- Improved laneway sediment loss mitigations

Changes in Overseer since October 2018

Since October 2018 there have been two key changes in Overseer:

- Overseer moved to the OverseerFM platform. Please note that this was a change in the Overseer platform and working interface rather than a change to the mechanics of Overseer. This movement therefore created no change in predicted nitrogen and phosphorus losses.
- In February 2019 version 6.3.1 of OverseerFM was released. Version 6.3.1 made a change to the OverseerFM model relating to fodder crops. This has had a small impact on the results predicted for the T and J Driscoll Family Trust.

The Overseer files related to this consent application were reopened in OverseerFM version 6.3.1. Climate location and maintenance fertiliser inputs have been updated and the method is consistent between the current and proposed files. No other changes were made. Summary results from OverseerFM 6.3.1 are shown below with changes shown in red.

Table 3. Predicted nitrogen and phosphorus losses in the current system as modelled in OverseerFM 6.3.1

	Current Dairy Platform (3yr average)	East Block – Sheep (15-16 season)	East Block – Transition (16-17 season)	East Block – Dairy Support (17-18 season)	East block (average of 3yrs)	Current Total (averaged over 3 years)
Total Farm N Loss (kg)	11273	203	132	385	240	11513
N Loss/ha (kgN/ha/yr)	54	14	9	27	17	51
N Concentration in Drainage (ppm)	Pastoral – 10 to 13 Crops – 21 to 42	Pastoral – 3	Pastoral – 2	Pastoral - 6		
Total Farm P Loss (kg)	253	10	9	10	10	263
P loss/ha (kgP/ha/yr)	1.2	0.7	0.7	0.7	0.7	1.2
Overseer - predicted pasture grown (tDM/ha/yr)	16.2	11.8	11.8	11.9		

Table 4. Predicted nitrogen and phosphorus losses in the current and proposed systems, including phosphorus mitigations modelled outside of OverseerFM 6.3.1

	Current system	Proposed system
Total Farm N Loss (kg)	11513	11348
N Loss/ha (kgN/ha/yr)	51	51
N Concentration in Drainage (ppm)		Pastoral – 10 to 29
Total Farm P Loss (kg)	230 (including 33kg P mitigation modelled outside of Overseer)	226 (including 52kg P mitigation modelled outside of Overseer)
P loss/ha (kgP/ha/yr)	1.0	1.0
Overseer - predicted pasture grown (tDM/ha/yr)		16.2

Further Modelling

During conversations with Environment Southland and LandPro it has become clear that under the Proposed Water and Land Plan that the applicant needs to demonstrate a farm system (through modelling) that would contribute to a clear improvement to water quality.

Key changes from the original proposal are as follows (see appendices for detailed assumptions):

- Reduction in peak cows milked (from 700 to 680)
- Reduction in young stock numbers (aligned to reduction in cow numbers)

- Reduction in nitrogen applied as fertiliser overall
- Increased use of barley as a purchased in feed (lower protein feed)
- Increase in area utilised for baleage grass wintering
- A reduction in Olsen P to 30 on the milking platform (note the Olsen P on the East Block will increase from the current 20)

The East Block has been blocked separately and additional mitigation strategies have been implemented on this block (see appendices for detailed assumptions):

- No wintering on this block (June and July)
- No grazing of livestock in the months of May to August, requiring less pasture cover May to August and a subsequent reduction in fertiliser N applications, and consequently overall lower pasture grown on this block
- No supplements fed on block
- Baleage made on the East block due to distance from cowshed
- Low solubility P fertiliser is applied (assumed Reactive Phosphate Rock in the modelling, may also be serpentine super in practice)

The results of these mitigations are shown in Table 5.

Table 5. Predicted nitrogen and phosphorus losses in the current and proposed system before and after further mitigations were included, including phosphorus mitigations modelled outside of OverseerFM 6.3.1

	Current system	Proposed system (before further mitigations applied)	Proposed system (following further mitigations)
Total Farm N Loss (kg)	11513	11348	9908
N Loss/ha (kgN/ha/yr)	51	51	44
N Concentration in Drainage (ppm)		Pastoral – 10 to 29	Pastoral – 3 to 19
Total Farm P Loss (kg)	230 (including 33kg P mitigation modelled outside of Overseer)	226 (including 52kg P mitigation modelled outside of Overseer)	204 (including 52kg P mitigation modelled outside of Overseer)
P loss/ha (kgP/ha/yr)	1.0	1.0	0.9
OverseerFM - predicted pasture grown (tDM/ha/yr)		16.2	16.0 (excluding East Block) 15.6 (East Block)

Taking into account the further mitigations made to the proposed farm system, OverseerFM predicts that overall nitrogen will decrease by 14% and losses of phosphorus will decrease by 11%. The nutrient budget, nitrogen summary and phosphorus summary are shown for each system in the appendices.

Adjustments to nitrogen losses in the proposed system

Baleage grass wintering:

OverseerFM has estimated that the loss of nitrogen from the grass baleage system is 567kgN (or 81kgN/ha). Modelling of the grass baleage wintering system in OverseerFM is likely to underestimate nitrogen losses as OverseerFM is not able to adequately reflect the on-farm realities of this system. OverseerFM assumes that the pasture plants will regrow post grazing and take up urinary N from the wintering activity. However, in reality, due to the soil type and climate on the applicant's property, the plants are not viable following the winter grazing. As a result the area is cultivated and regrassed in spring.

I am unaware of any research that has quantified the impact of baleage grass wintering in terms of nitrate and phosphorus loss. I have therefore completed a desktop modelling exercise that attempts to more accurately estimate the nutrient losses from this system.

The following assumptions have been made:

- Same as the proposed system file
    - Soils / climatic conditions
    - Tile drains
    - Stock numbers
    - Imported / exported supplement
    - Fertiliser and nitrogen use

- Different from the proposed system file
    - Used kale instead of pasture to allow a defoliation event and regressing activity
    - Used kale as has a similar crude protein to average quality pasture
    - Reduced yield of kale to 3TDM/ha to reflect pasture accumulated for winter in practice
    - Regrassed the area in October in line with when the applicant would usually regrass following a grass baleage wintering event
    - Direct drilled kale (rather than conventional cultivation to minimise the impact of the mineralisation of N during cultivation)

Overseer predicted that the losses from the Kale block would be 99kgN/ha (total of 693kgN lost for the 7ha wintered on). Without comparative research, it is difficult to assess the accuracy of the above results. However, from a common sense perspective, losses from the baleage grass system are likely to be more comparable to a traditional fodder crop paddock than a permanent pasture paddock. Therefore, it is predicted that the losses from the grass baleage wintering system will be 126kgN higher than predicted in the Proposed scenario.

Table 6. Predicted nitrogen and phosphorus losses in the current and proposed system after further mitigations were included, including phosphorus mitigations modelled outside of OverseerFM 6.3.1

	Current system	Proposed system (following further mitigations)	Percentage change in losses
Total Farm N Loss (kg)	11513	10034 (including 126kgN adjustment modelled outside of Overseer)	12.8% reduction
N Loss/ha (kgN/ha/yr)	51	45	
N Concentration in Drainage (ppm)		Pastoral – 3 to 19	
Total Farm P Loss (kg)	230 (including 33kg P mitigation modelled outside of Overseer)	204 (including 52kg P mitigation modelled outside of Overseer)	11.3% reduction
P loss/ha (kgP/ha/yr)	1.0	0.9	
OverseerFM - predicted pasture grown (tDM/ha/yr)		16.0 (excluding East Block) 15.6 (East Block)	

Taking into account the further mitigations to the proposed farm system and the adjustment required for modelling the baleage grass wintering system, Overseer predicts that overall nitrogen will decrease by 13% and losses of phosphorus will decrease by 11.3%.

Off site effects of wintering:

No adjustment to nutrient losses to account for off site effects of wintering has been made as the number of animals wintered off farm (mixed age cows and R2 heifers) is the same in the current as the proposed. All additional stock in the proposed system will be wintered on farm and have therefore been accounted for in the modelling. The number of stock wintered on and off farm are described in detail in the appendices.

Off site effects of young stock:

As a result of the increased cow numbers on farm, there will also be an increase in the number of young stock reared for the property. These animals have been and will continue to be grazed off site with a third party grazier. The applicant does not have direct control over the management of these stock or the property that they are grazing. As agreed between Alex Erceg (ES) and Tanya Copeland (Landpro) in an email dated 21st February, the off site effects of these animals has not been included in the OverseerFM modelling. A copy of the relevant correspondence is available from Landpro upon request.

However, should quantification be required, I have made the following estimation of the scale of the effect of these extra young stock. The applicant rears 28% replacements (calves as a percentage of cows milked at peak). This is equivalent to 160 calves in the current system and 190 calves in the proposed system – an increase of 30 animals. Young stock are grazed off farm from weaning (1st

December), until their return as incalf heifers (1st Jun, 18months later). This system will continue to occur in the proposed scenario.

Rising 1 year old heifers have been traditionally wintered on fodder beet, although in the 2019 winter they were grazed on a baleage grass system. The off site effect of the extra young stock grazing can be estimated as follows:

- 30 rising 1 year olds, wintered on crop for 77days
- Require 5kgDM fodderbeet per head per day (the balance of the diet is made up of supplement as per standard practice)
- 5kgDM/head/day x 77days x 30animals = 11,550kgDM fodderbeet required
- At a 25,000tDM/ha yield of fodderbeet, the stock will require 0.5ha.
- It is assumed that the fodderbeet crop has losses of 225kg N/ha and 1.2kgP/ha. This is based on the losses modelled for the applicant under fodderbeet in the current scenario.

Therefore, it can be estimated that the off site effects of wintering the 30 increased rising 1 year olds is:

- 113kgN/year
- 0.6kgP/year

Please note that this estimate of nutrient losses during winter grazing is conservative, ie it is very likely to be overestimating the actual nutrient losses due to the winter feed type (fodder beet) and the intensity of the wintering (25tDM crop yield).

In addition to the winter grazing it is assumed that the additional 30 head of young stock are grass grazed when they aren't on winter crop. The 30 stock would require approximately 12ha of pasture. If this pasture has an N loss of 30kgN/ha and a p loss of 0.6kgP/ha, it can be estimated that the offsite effect of the young stock pasture grazing is:

- 360kgN/year
- 7.2kgP/year

Therefore, it can be estimated that the total offsite effect of the additional young stock is:

- 473kgN/year
- 7.8kgP/year

Note – the estimate above is intended to give an estimate of scale of effect, rather than to suggest any accuracy. There are too many variables that are unknown (including soil type, climate, stocking rate and fertiliser policy) to provide accuracy.

Table 7. Predicted nitrogen and phosphorus losses in the current and proposed system after further mitigations were included, including phosphorus mitigations modelled outside of OverseerFM 6.3.1

	Current system	Proposed system (following further mitigations)	Percentage change in losses
Total Farm N Loss (kg)	11513	10507 (including 126kgN grass baleage and 473kgN young stock adjustments modelled outside of Overseer)	8.7% reduction
N Loss/ha (kgN/ha/yr)	51	47	
N Concentration in Drainage (ppm)		Pastoral – 3 to 19	
Total Farm P Loss (kg)	230 (including 33kg P mitigation modelled outside of Overseer)	212 (including 52kg P laneway mitigation and 7.8kgP young stock adjustment modelled outside of Overseer)	7.8% reduction
P loss/ha (kgP/ha/yr)	1.0	0.9	
OverseerFM - predicted pasture grown (tDM/ha/yr)		16.0 (excluding East Block) 15.6 (East Block)	

Taking into account the further mitigations to the proposed farm system and the adjustment required for modelling the baleage grass wintering system, Overseer predicts that overall nitrogen will decrease by 8.7% and losses of phosphorus will decrease by 7.8%.

Conclusions from the modelling

Table 8. Predicted nitrogen and phosphorus losses in the current and proposed system after further mitigations were included, including phosphorus mitigations modelled outside of OverseerFM 6.3.1

	Current system	Proposed system (following further mitigations)	Percentage change in losses
Total Farm N Loss (kg)	11513	10507 (including 126kgN grass baleage and 473kgN young stock adjustments modelled outside of Overseer)	8.7% reduction
N Loss/ha (kgN/ha/yr)	51	47	
N Concentration in Drainage (ppm)		Pastoral – 3 to 19	
Total Farm P Loss (kg)	230 (including 33kg P mitigation modelled outside of Overseer)	212 (including 52kg P laneway mitigation and 7.8kgP young stock adjustment modelled outside of Overseer)	7.8% reduction
P loss/ha (kgP/ha/yr)	1.0	0.9	
OverseerFM - predicted pasture grown (tDM/ha/yr)		16.0 (excluding East Block) 15.6 (East Block)	

Taking into account the further mitigations to the proposed farm system and the adjustment required for modelling the baleage grass wintering system, Overseer predicts that overall nitrogen will decrease by 8.7% and losses of phosphorus will decrease by 7.8%.

The key drivers of a decrease in nitrogen loss are shown below. In comparison to the current system, the proposed system has:

- Increased the area that effluent is applied to – reduced N application in effluent to this area
- Reduced nitrogen fertiliser use
- Change in the farms culling policy to one of culling earlier
- Lower protein content supplementary feed (Barley)

The key driver of the decrease in phosphorus loss are shown below. In comparison to the current system the proposed has:

- Improved laneway sediment loss mitigations
- A reduction in the Olsen P on the current dairy platform area (although an increase in Olsen P on the East Block)
- Use of Reactive Phosphate Rock fertiliser on the East Block

Appendices:

Appendix 1: Updated detailed description of modelling inputs

Appendix 2: Nutrient budgets taken from OverseerFM

Appendix 3: Overseer modelling report for the purposes of as part of a consent application for expanded dairying, dated October 2018

Appendix 4: Further information: T and J Driscoll Family Trust consent application, December 2018

Appendix 5: T and J Driscoll Family Trust – Farm Maps

Appendix 1: Updated detailed description of modelling inputs

Blocks

The farm has been split into the following pastoral (effluent and non-effluent) and fodder crop blocks. Total farm area has been taken from the legal area (ex the rates demand). The area of each block has been determined using the measure function on Beacon. Soils on the property were assessed utilising the topoclimate information. OverseerFM soil settings were obtained from SMap for all soil types.

Changes from original modelling (dated October 2018) are shown in red. Original modelling inputs are shown in black

Block Name	Soil Type (from Beacon)	Smap Ref	Contour	Current Dairy Platform (ha)	East Block (ha)	Proposed Land Use (ha)
Effluent – Waikiwi	Edendale	Waiki_30a.1	Flat	**20.1**		**41.7 41.1**
Effluent – Pukemutu	Pukemutu	Pukem_6a.1	Flat	**41.9**		**49.9 49.2**
Non Effluent – Waikiwi	Edendale	Waiki_30a.1	Flat	**42.2**		**19.4 19.1**
Non Effluent – Pukemutu	Pukemutu	Pukem_6a.1	Flat	**98.4**		**101.5 86.2**
East Block - Pukemutu	Pukemutu	Pukem_6a.1	Flat		**13.9**	**13.9**
Baleage winter Eff Waikiwi	Edendale	Waiki_30a.1	Flat			**0.8 1.4**
Baleage winter Eff Pukemutu	Pukemutu	Pukem_6a.1	Flat			**0.9 1.6**
Baleage Winter Non Eff Waikiwi	Edendale	Waiki_30a.1	Flat			**0.4 0.7**
Baleage winter Non Eff Pukemutu	Pukemutu	Pukem_6a.1	Flat			**1.9 3.3**
	Effective Farm Area			**202.6**	**13.9**	**216.5**
	Non productive			8.0		8.0
	Total Farm Area			**210.6**	**13.9**	**224.5**
Rotating fodder crops						
Fodder beet				2.8		
Winter Turnips				1.0		

Climate Data

- The following climate information has been used from the OverseerFM climate station tool;
    - 1094mm of rainfall (updated to 1092mm – consistent across all nutrient budgets)
    - 10.1 degrees Celsius mean annual temperature
    - Annual PET of 711mm (updated to 710mm – consistent across all nutrient budgets)

Farm System

Description	Current Dairy Platform (average of three seasons)	East Block – Sheep (15-16 season)	East Block – Transition (16-17season)	East Block – Dairy Support (17-18season)	Proposed Land Use
File name	CURRENT PLATFORM – AUG19	CURRENT – EAST SHEEP AUG19	CURRENT – EAST TRANSITION AUG19	CURRENT – EAST DAIRY SUPPORT AUG19	PROPOSED – AUG19 MITIGATED
Milk solids production	271,130 kg MS 473 kgMS/cow Median calving date – 20th August Drying off – 31st May				329,000kgMS 319,600 kg MS 470 kgMS/cow Median calving date – 20th August Drying off – 31st May
Cows on farm (Lactating and wintered)	Breed Fr J X Jul 140 Aug 599 Sep 593 Oct 573 Nov 573 Dec 573 Jan 573 Feb 573 Mar 573 Apr 530 May 487 Jun 83 Peak cows: 573 *Note: Some cows wintered off farm at a grazier's property* *June – 516* *June – 459*			Breed Fr J X Winter grazing for 100MA (July) and 125R2 cows (Jun and Jul)	Breed Fr J X Jul 273 252 Aug 732 711 Sep 724 702 Oct 700 680 Nov 700 680 Dec 700 680 Jan 700 680 Feb 700 650 Mar 700 620 Apr 647 590 May 595 570 Jun 216 195 Peak cows: 700 Peak cows: 680 *Note: Some cows wintered off farm at a grazier's property* *June – 516* *July – 459* *Note: change in culling policy*

Description	Current Dairy Platform (average of three seasons)	East Block – Sheep (15-16 season)	East Block – Transition (16-17season)	East Block – Dairy Support (17-18season)	Proposed Land Use
Dairy replacements on farm	Calves are reared on farm until weaning (1-4months old) Aug - 135 Sep - 160 Oct - 160 Nov – 160		Grazing for R2 heifers May 125	Grazing for R2 heifers Jan 125 Feb 125	Calves are reared on farm until weaning (1-4months old) Aug - 152 160 Sep - 187 190 Oct - 187 190 Nov – 187 190 Note: error found in original modelling
Breeding bulls	Thirteen 2yr old Jersey bulls (Dec and Jan)				Fifteen 2yr old Jersey bulls (Dec and Jan)
Sheep		Wintered: 120 MA ewes 46replacements 3rams Coopworth 125% lambing percentage 20% replacement rate Mean lambing date of the 15th September. All non-replacement lambs sold by the end of May			
Relative productivity	No differences between blocks	No differences between blocks	No differences between blocks	No differences between blocks	No differences between blocks Relative productivity of East Block Pukemutu 0.97unit due to lower N useage. All other blocks have a relative productivity of 1.

Description	Current Dairy Platform (average of three seasons)	East Block – Sheep (15-16 season)	East Block – Transition (16-17season)	East Block – Dairy Support (17-18season)	Proposed Land Use
Structures	Calving Pad Not modelled as used when ground conditions are saturated rather than for fixed time				Calving Pad Not modelled as used when ground conditions are saturated rather than for fixed time
In Shed Feeding	Management 100% of milkers fed Aug - May				Management 100% of milkers fed Aug – May
Rotating fodder crop management	2.8ha fodder beet Yield: 25tDM/ha Conventional cultivation October Fertiliser: 500kg/ha Winton Fodder Beet mix at sowing (delivering 50kg/ha N, 32kg/ha P, 75kg/ha K and 27kg/ha S) 100kg/ha Urea in December 100kg/ha Potassium Chloride in December 100kg/ha Urea in January Grazed by dairy cows May – Aug Resown in permanent pasture in September				Cows on farm in June/July are wintered on a baleage grass diet. 4ha 7ha Baleage/Grass wintering This area rotates around all blocks except the East Block Pukemutu the platform. This wintering system forms part of the property's regrassing strategy All feed required is imported (160tDM baleage) (150tDM baleage)
	1.0ha Turnips Yield: 8tDM/ha Conventional cultivation February				

Description	Current Dairy Platform (average of three seasons)	East Block – Sheep (15-16 season)	East Block – Transition (16-17season)	East Block – Dairy Support (17-18season)	Proposed Land Use
	Fertiliser: 150kg/ha DAP and 150kg/ha super at sowing 100kg/ha Urea in March Grazed by dairy cows Jun – Aug Resown in permanent pasture in September				
Imported Supplements	In shed: 236t PKE 38t Barley (typo in original modelling) In paddock: 418tDM silage			In paddock: 65 tDM baleage	In shed: 300tDM PKE 40tDM PKE 100tDM barley 400tDM Barley 100tDM DDG In paddock: 850tDM silage (fed over entire platform) 500tDM silage (fed on all bocks except East Block) For wintering: 160tDM baleage 150tDM baleage Supplement harvested on the East block: 140tDM fed out on all blocks except East Block
Exported Supplements			130tDM baleage		
Soil Fertility	Olsen P 32 (soil test results June 2017) All other values entered at agronomic optimum	All soil test values entered at agronomic optimum (Olsen P of 20)	All soil test values entered at agronomic optimum (Olsen P of 20)	All soil test values entered at agronomic optimum (Olsen P of 20)	Olsen P 32 Olsen P 30 All other values entered at agronomic optimum

Description	Current Dairy Platform (average of three seasons)	East Block – Sheep (15-16 season)	East Block – Transition (16-17season)	East Block – Dairy Support (17-18season)	Proposed Land Use
Fertiliser	Phosphorus, Potassium and Sulphur applied to maintain fertility levels	Phosphorus, Potassium and Sulphur applied to maintain fertility levels	Phosphorus, Potassium and Sulphur applied to maintain fertility levels	Phosphorus, Potassium and Sulphur applied to maintain fertility levels	Phosphorus, Potassium and Sulphur applied to maintain fertility levels Note: Phosphorus applied as RPR on the East Block
Pastoral Nitrogen Fertiliser	213 kgN/ha in split applications (Aug – April)				Non Effluent blocks (Excluding East Block) 218kgN/ha (203kgN/ha) in split applications (Aug – April) Effluent Blocks 197kgN/ha (183kgN/ha) in split applications (Aug – April) East Block 154kgN/ha in split applications (Sep – Mar)
Drainage	100% mole and tile drained	100% mole and tile drained	100% mole and tile drained	100% mole and tile drained	100% mole and tile drained
Farm dairy effluent	Holding pond Solids aren't separated from the liquid Liquid effluent is applied at a depth of <12mm to the "effluent" blocks An effluent area of at least 31 ha is required to achieve a loading of less than 150 kg N / ha / year				Holding pond Solids aren't separated from the liquid Liquid effluent is applied at a depth of <12mm to the "effluent" blocks An effluent area of at least 34 (now 32) ha is required to achieve a loading of less than 150 kg N / ha / year

Appendix 2: Nutrient budgets taken from OverseerFM

Report disclaimer:

The OverseerFM 6.3.1 model has been utilised to assess the nutrient losses from this property. Details of how the property is operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement.

OverseerFM 6.3.1 predicted results have been extracted from the model on 22 August 2019

Current system - Dairy Platform (File name - CURRENT PLATFORM - AUG19)

Table 9. Current system whole farm nutrient budget

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	11,273	54
Phosphorus	253	1.2

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	201	26	2	25	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements	80	11	58	9	9	6	4
Rain/clover fixation	74	0	3	5	3	7	35

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	54	1.2	12	38	61	6	20
As product	87	15	21	5	19	2	6
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	89	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	125	19	11	-3	7	3	1
Inorganic mineral	0	2	-23	0	-2	-3	-3
Inorganic soil pool	1	0	43	0	-72	6	15

Table 10. Current system Nitrogen and Phosphorus summary reports

Nitrogen summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)	N IN DRAINAGE (PPM)	N ADDED (KG/HA)	N SURPLUS (KG/HA)
PUKEMUTU EFFLUENT	2474	60	13	287	273
PUKEMUTU NON EFFLUENT	4850	50	11	211	220
WAIKIWI EFFLUENT	1007	51	12	287	265
WAIKIWI NON EFFLUENT	1793	43	10	211	213
FODDER BEET	630	225	42	142	21
TURNIPS	111	111	21	72	2

Phosphorus summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)
PUKEMUTU EFFLUENT	40	1
PUKEMUTU NON EFFLUENT	79	0.8
WAIKIWI EFFLUENT	9	0.5
WAIKIWI NON EFFLUENT	17	0.4
FODDER BEET	3	1.2
TURNIPS	1	1.1

Current system – East Block sheep (File name - CURRENT - EAST SHEEP AUG19)

Table 11. East Block – Sheep whole farm nutrient budget

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	203	14
Phosphorus	10	0.7

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	0	16	0	24	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements	0	0	0	0	0	0	0
Rain/clover fixation	96	0	3	5	3	7	34

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	14	0.7	7	34	33	6	19
As product	20	3	1	3	5	0	1
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	37	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	25	11	0	-8	0	0	0
Inorganic mineral	0	0	-25	0	-2	-3	-4
Inorganic soil pool	0	2	19	0	-33	4	18

Table 12. East Block - sheep nitrogen and phosphorus summary reports

Nitrogen summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)	N IN DRAINAGE (PPM)	N ADDED (KG/HA)	N SURPLUS (KG/HA)
EAST BLOCK - PUKEMUTU	199	14	3	0	74

Phosphorus summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)
EAST BLOCK - PUKEMUTU	9	0.6

East Block – Transition (file name CURRENT - EAST TRANSITION AUG19)

Table 8. East Block – Transition whole farm nutrient budget

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	132	9
Phosphorus	9	0.7

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	0	36	203	33	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements	0	0	0	0	0	0	0
Rain/clover fixation	150	0	3	5	3	7	34

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	9	0.7	15	29	29	6	19
As product	0	0	0	0	0	0	0
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	4	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	-23	11	6	-8	1	0	0
Inorganic mineral	0	0	-22	0	-2	-3	-4
Inorganic soil pool	0	0	6	0	-71	-7	10

Table 9. East Block - transition nitrogen and Phosphorus summary reports

Nitrogen summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)	N IN DRAINAGE (PPM)	N ADDED (KG/HA)	N SURPLUS (KG/HA)
EAST BLOCK - PUKEMUTU	132	9	2	0	-15

Phosphorus summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)
EAST BLOCK - PUKEMUTU	9	0.7

East Block – Dairy support (file name - CURRENT - EAST DAIRY SUPPORT AUG19)

Table 11. East Block – Dairy support whole farm nutrient budget

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	385	27
Phosphorus	10	0.7

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	0	1	0	11	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements	0	0	0	0	0	0	0
Rain/clover fixation	80	0	3	5	3	7	34

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	27	0.7	9	33	43	6	19
As product	9	2	1	1	5	0	0
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	39	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	78	12	4	-7	1	0	0
Inorganic mineral	0	0	-16	0	-2	-3	-4
Inorganic soil pool	0	0	98	0	-20	12	25

Table 12. East Block – Dairy support nitrogen and phosphorus summary reports

Nitrogen summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)	N IN DRAINAGE (PPM)	N ADDED (KG/HA)	N SURPLUS (KG/HA)
EAST BLOCK - PUKEMUTU	381	27	6	0	139

Phosphorus summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)
EAST BLOCK - PUKEMUTU	8	0.6

Proposed system – (file name - PROPOSED - AUG19 MITIGATED)

Table 14. Proposed system whole farm nutrient budget

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	9,908	44
Phosphorus	256	1.1

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	185	22	15	25	8	0	0
Irrigation	0	0	0	0	0	0	0
Supplements	104	14	71	9	15	7	5
Rain/clover fixation	71	0	3	5	3	7	35

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	44	1.1	13	39	54	6	20
As product	96	16	23	5	21	2	7
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	84	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	136	18	13	-5	8	3	1
Inorganic mineral	0	2	-19	0	-2	-3	-3
Inorganic soil pool	0	0	58	0	-54	6	16

Table15. Proposed system nitrogen and phosphorus summary reports

Nitrogen summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)	N IN DRAINAGE (PPM)	N ADDED (KG/HA)	N SURPLUS (KG/HA)
BALEAGE WINTER - PUKEMUTU EFF	140	88	19	234	396
BALEAGE WINTER - PUKEMUTU NON EFF	277	84	19	203	368
BALEAGE WINTER - WAIKIWI NON EFF	47	67	16	203	340
BALEAGE WINTER - WAIKIWI EFF	103	74	17	234	382
EAST BLOCK - PUKEMUTU	183	13	3	154	61
PUKEMUTU EFFLUENT	2408	49	11	234	249
PUKEMUTU NON EFFLUENT	3903	45	10	203	218
WAIKIWI EFFLUENT	1700	41	9	234	244
WAIKIWI NON EFFLUENT	719	38	9	203	205

Phosphorus summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)
BALEAGE WINTER - PUKEMUTU EFF	1	0.8
BALEAGE WINTER - PUKEMUTU NON EFF	2	0.7
BALEAGE WINTER - WAIKIWI NON EFF	0	0.4
BALEAGE WINTER - WAIKIWI EFF	1	0.4
EAST BLOCK - PUKEMUTU	10	0.7
PUKEMUTU EFFLUENT	43	0.9
PUKEMUTU NON EFFLUENT	67	0.8
WAIKIWI EFFLUENT	18	0.4
WAIKIWI NON EFFLUENT	8	0.4

Appendix 3: Overseer modelling report for the purposes of as part of a consent application for expanded dairying, dated October 2018

Report disclaimer:

The OverseerFM 6.3.1 model has been utilised to assess the nutrient losses from this property. Details of how the property is operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement.

OverseerFM 6.3.1 predicted results have been extracted from the model on 22 August 2019

FarmWise

T & J Driscoll Family Trust

266 O'Shannessy Road, Winton

Overseer modelling report for the purposes of as part of a consent application for expanded dairying

Report prepared for:
Tim and Jocelyn Driscoll
266 Thomsons Crossing Road East
RD1, Winton

Prepared By:
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1 October 2018

Report Peer Reviewed By:
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B.Agr.Sci

CNMA

Executive Summary

T & J Driscoll Family Trust operate a high performance dairy farm near Winton, in Central Southland. The partially self-contained 210.6ha total property has a flat contour. There are two soil types on the property – Waikiwi and Pukemutu, separated by a small terrace. Calves are grazed on the platform until weaning and return to the platform as incalf heifers. Over the past three years, an average of 2.8ha of fodder beet and 1ha of winter turnips were planted. The farm has peak milked 573cows on average over the last three seasons.

In October 2016, Tim and Jocelyn purchased a neighbouring 13.9ha sheep grazing block – called the East Block. Following the purchase of the block, Tim and Jocelyn have transitioned the block into dairy support. It is proposed that the East Block (13.9ha) be converted to dairy and incorporated into the milking platform. In the proposed farm system, a portion of the herd will be wintered on 4ha with a baleage and grass diet. Young stock will continue to be grazed off farm from weaning to their return as incalf heifers.

Using Overseer (version 6.3.0) nutrient budgets have been constructed for the current land use and a proposed dairy unit nutrient budget to inform the consent application for expanded dairying. The nutrient budgets show the average nutrient losses for the last three years. Data inputs and methodology are explained in detail within this report.

A summary of the modelling output is given in Table 1. It shows a small decrease (loss than 5%) in the total Nitrogen loss from the property. Total Phosphorus loss from the property is predicted to increase (by less than 7%).

Table 13. Summary data from the Overseer analysis of the T & J Driscoll Family Trust Current and Proposed systems

	Current Total (averaged over 3 years)	Proposed system
Total Farm N Loss (kg)	11503	11345
N Loss/ha (kgN/ha/yr)	51	51
N Concentration in Drainage (ppm)		Pastoral – 9.8 – 29.3
Total Farm P Loss (kg)	262	278
P loss/ha (kgP/ha/yr)	1.2	1.2
Overseer - predicted pasture grown (tDM/ha/yr)		16.2

The key drivers of a decrease in nitrogen loss are shown below. In comparison to the current system, the proposed system has:

- Increased the area that effluent is applied to – reduced effluent N application to this area
- Reduced nitrogen fertiliser use on the effluent block
  Increased cow numbers – increasing loss risk

The key driver of the increase in phosphorus loss is an increase in losses from “other sources”.

Overseer can model a range of good management practices. However, some farm specific good management practices cannot be modelled. Recommendations of further good management practices that cannot be modelled by Overseer are given within this report to further reduce the nutrient losses from this farm system.

Property legal description

Part Section 29 and 30 Block I Winton HUN

Section 1 and 2 SO 12000

Section 43, 44, 45 and 54 Block I Winton HUN

Lot 1 and 2 DP 449518

Report purpose

To quantify the losses of nitrogen and phosphorus from the current and the proposed farm systems being operated on this property. The report details the data inputs, the modelling outputs and areas of environmental risk within the system.

Disclaimer

The Overseer 6.3.0 model has been utilised to assess the nutrient losses from this property. Details of how the property is operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement.

The proposal

Farm objectives

T & J Driscoll Family Trust operate their farm business with the following objectives:

- To refine the farm system to maximise farm profitability – targeting $2000/ha EBIT at a $5.00 milk price
- To operate in an environmentally sustainable manner with an emphasis on continual education and improvement
- Consolidate the business to ensure it is resilient
- "Farm for the future" – the property must remain flexible to deal with changes in market forces

Current System

Nutrient budgets have been constructed to determine the average actual nutrient losses over three years (June 2015 – May 2018).

Dairy platform

T & J Driscoll Family Trust operate a high performing dairy farm near Winton, in Central Southland. The farm is owned by the Driscoll trust (JP, CA, TJ and JA Driscoll), and is operated under a lease arrangement by T & J Driscoll Family Trust (Tim and Jocelyn Driscoll). The partially self-contained 210.6ha total property has a flat contour. There are two soil types on the property – Waikiwi and Pukemutu. Calves are grazed on the platform until weaning and return to the platform as incalf heifers.

Over the previous three seasons, the property has milked an average of 573cows at peak. There has been an average of 2.8ha fodder beet and 1ha turnips grown on farm for winter and early spring grazing. Nitrogen fertiliser has been applied at an average of 213kgN/ha in split applications from August to April over the whole milking platform. In the last three seasons, the majority of the herd has been wintered off farm at a graziers property. On average, 83 cows were wintered at home in June and July, while the remaining 516 were off farm. Early calving heifers and cows return to the platform in mid July. Bought in feed has been assumed to ensure that a feasible pasture growth rate is achieved in an average season.

East Block

In October 2016, Tim and Jocelyn purchased a neighbouring 13.9ha sheep grazing block – called the East Block. Following the purchase of the block, Tim and Jocelyn have transitioned the block into dairy support. In order to create accurate actual budgets for the previous three years, three separate budgets have been created for the East Block:

- Pre purchase use (15-16 season) – a sheep grazing block. Accurate stock numbers were not available. A conservative estimation of stocking rate and management practice has been made utilising Google Earth imaging and the Beef and Lamb farm monitoring data.
- Transition (16-17 season) – All feed grown on farm was cut as baleage. This was fed to incalf heifers or exported from the block.

- Dairy support (17-18 season) – 125incalf heifers and 100cows were wintered on a baleage/grass diet on the block. The block was grazed by heifers in January and February of 2018. All other feed grown was made into baleage.

Proposed system:

Through the development of the proposed system, a number of scenarios were run through Overseer. The proposed system detailed below was chosen as it was in line with the farm objectives, the farm system preferences and the proposed Water and Land Plan.

It is proposed that the East Block (13.9ha) be converted and incorporated into the milking platform. The total farm area would then be 224.5ha total and peak cow numbers would be increased to 700 cows. The property will winter 216cows on farm, and continue to winter the remaining 516cows off farm at a graziers property. The cows wintered on farm will be grazed of 4ha with a baleage grass diet. Young stock will continue to be grazed off farm from weaning to their return as incalf heifers. The effluent system will be extended to 93.3ha and fertiliser nitrogen applications will be targeted to 197kgN/ha on the effluent area and 218kgN/ha on the non-effluent area. Bought in feed has been assumed to ensure that a feasible pasture growth rate is achieved in an average season when consented cow numbers are being milked.

Modelling method

Nutrient losses have been estimated using the Overseer Version 6.3.0 model. Overseer is a software application that models nutrient movements within a farm system. Input data detailing the farm system is entered into the software and interpreted through the use of a series of sub-model that calculate the flow of seven major farm nutrients (Nitrogen, Phosphorus, Sulphur, Calcium, Magnesium and Sodium). Output data is reported for interpretation and to inform farm management practices. It currently requires an expert user to describe the physical and management details of a farm.

Overseer assumptions

Within the Overseer software, assumptions have been made of the farm management:

- Long term annual average model
  The model uses annual average input and produces annual average outputs
- Near equilibrium conditions
  Model assumes that that the farm is at a state where there is minimal change each year
- Actual and reasonable inputs
  It is assumed that input data is reasonable and a reflection of the actual farm system. If any parameter changes, it is assumed that all other parameters affected will also be changed.
- Good management practices are followed
  Overseer assumes the property is managed is line with accepted industry good management practice.

Overseer limitations

Key limitations of the Overseer model are:

- Overseer does not predict transformations, attenuation or dilution of nutrients between the root zone or farm boundary and the eventual receiving water body. A catchment model is needed to estimate the effects of the nutrient losses from farms on groundwater, river or lake water quality.
- Overseer does not calculate outcomes from extreme events (floods and droughts), but provides a typical years result based on a long-term average.
- Overseer does not calculate the impacts of a conversion process, rather it predicts the long-term annual average nutrient budgets for changed land use.
- Overseer is not spatially explicit beyond the level of defined blocks
- Not all management practices or activities that have an impact on nutrient losses are captured in the Overseer model
- Overseer does not represent all farm systems in New Zealand
- Components of Overseer have not been calibrated against measured data from every combination of farm systems and environment

Information on Overseer can be obtained from the following reports:

- Technical Description of OVERSEER for Regional Councils, September 2015
- Review of the phosphorus loss submodel in OVERSEER®, September 2016
- Using OVERSEER® in Regulation – Technical Resources and Guidance for Regional Councils, August 2016

Data input standards

Nutrient budgets have been constructed using the Overseer Version 6.3.0 model.

The nutrient budget have been developed in accordance with the Overseer data input protocols - "Overseer, Best Practice Data Input Standards, March 2018." No deviations have been made from these protocols.

Modelling Inputs

To construct the nutrient budgets the following assumptions have been made;

Blocks

The farm has been split into the following pastoral (effluent and non-effluent) and fodder crop blocks. Total farm area has been taken from the legal area (ex the rates demand). The area of each block has been determined using the measure function on Beacon. Soils on the property were assessed utilising the topoclimate information. Overseer soil settings were obtained from SMap for all soil types.

Block Name	Soil Type (from Beacon)	Smap Ref	Contour	Current Dairy Platform (ha)	East Block (ha)	Proposed Land Use (ha)
Effluent – Waikiwi	Edendale	Waiki_30a.1	Flat	**20.1**		**41.7**
Effluent – Pukemutu	Pukemutu	Pukem_6a.1	Flat	**41.9**		**49.9**
Non Effluent – Waikiwi	Edendale	Waiki_30a.1	Flat	**42.2**		**19.4**
Non Effluent – Pukemutu	Pukemutu	Pukem_6a.1	Flat	**98.4**		**101.5**
East Block - Pukemutu	Pukemutu	Pukem_6a.1	Flat		**13.9**	
Baleage winter Eff Waikiwi	Edendale	Waiki_30a.1	Flat			**0.8**
Baleage winter Eff Pukemutu	Pukemutu	Pukem_6a.1	Flat			**0.9**
Baleage Winter Non Eff Waikiwi	Edendale	Waiki_30a.1	Flat			**0.4**
Baleage winter Non Eff Pukemutu	Pukemutu	Pukem_6a.1	Flat			**1.9**
	Effective Farm Area			**202.6**	**13.9**	**216.5**
	Non productive			8.0		8.0
	Total Farm Area			**210.6**	**13.9**	**224.5**
Rotating fodder crops						
Fodder beet				2.8		
Winter Turnips				1.0		

Climate Data

- Southland as the location setting
- The following climate information has been used from the Overseer climate station tool;
  - 1094mm of rainfall
  - 10.1 degrees Celsius mean annual temperature
  - Daily rainfall pattern setting of 731 to 1450mm, low
  - Mean annual PET of 711mm (moderate variation)

Farm System

Description	Current Dairy Platform (average of three seasons)	East Block – Sheep (15-16 season)	East Block – Transition (16-17season)	East Block – Dairy Support (17-18season)	Proposed Land Use
Milk solids production	271,130 kg MS 473 kgMS/cow Median calving date – 20th August Drying off – 31st May				329,000 kg MS 470 kgMS/cow Median calving date – 20th August Drying off – 31st May
Cows on farm (Lactating and wintered)	Breed Fr J X Jul 140 Aug 599 Sep 593 Oct 573 Nov 573 Dec 573 Jan 573 Feb 573 Mar 573 Apr 530 May 487 Jun 83 Peak cows: 573			Breed Fr J X Winter grazing for 100MA and 125R2 cows (Jun and Jul)	Breed Fr J X Jul 273 Aug 732 Sep 724 Oct 700 Nov 700 Dec 700 Jan 700 Feb 700 Mar 700 Apr 647 May 595 Jun 216 Peak cows: 700
Dairy replacements on farm	Calves are reared on farm until weaning (1-4months old) Aug - 135 Sep - 160 Oct - 160 Nov – 160		Grazing for R2 heifers May 125	Grazing for R2 heifers Jan 125 Feb 125	Calves are reared on farm until weaning (1-4months old) Aug - 152 Sep - 187 Oct - 187 Nov – 187
Breeding bulls	Thirteen 2yr old Jersey bulls (Dec and Jan)				Fifteen 2yr old Jersey bulls (Dec and Jan)
Sheep		Wintered: 120 MA ewes 46replacements 3rams Coopworth 125% lambing percentage 20% replacement rate			

Description	Current Dairy Platform (average of three seasons)	East Block – Sheep (15-16 season)	East Block – Transition (16-17season)	East Block – Dairy Support (17-18season)	Proposed Land Use
		Mean lambing date of the 15th September. All non-replacement lambs sold by the end of May			
Relative productivity	No differences between blocks	No differences between blocks	No differences between blocks	No differences between blocks	No differences between blocks
Structures	Calving Pad Not modelled as used when ground conditions are saturated rather than for fixed time				Calving Pad Not modelled as used when ground conditions are saturated rather than for fixed time
In Shed Feeding	Management 100% of milkers fed Aug - May				Management 100% of milkers fed Aug - May
Rotating fodder crop management	2.8ha fodder beet Yield: 25tDM/ha Conventional cultivation October Fertiliser: 500kg/ha Winton Fodder Beet mix at sowing (delivering 50kg/ha N, 32kg/ha P, 75kg/ha K and 27kg/ha S) 100kg/ha Urea in December 100kg/ha Potassium Chloride in December 100kg/ha Urea in January Grazed by dairy cows May – Aug				Cows on farm in June/July are wintered on a baleage grass diet. 4ha Baleage/Grass wintering This area rotates around the platform and is part of the property's regrassing strategy All feed required is imported (160tDM baleage)

Description	Current Dairy Platform (average of three seasons)	East Block – Sheep (15-16 season)	East Block – Transition (16-17season)	East Block – Dairy Support (17-18season)	Proposed Land Use
	Resown in permanent pasture in September				
	1.0ha Turnips Yield: 8tDM/ha Conventional cultivation February Fertiliser: 150kg/ha DAP and 150kg/ha super at sowing 100kg/ha Urea in March Grazed by dairy cows Jun – Aug Resown in permanent pasture in September				
Imported Supplements	In shed: 236tDM PKE 33tDM Barley In paddock: 418tDM Silage			In paddock: 65 tDM baleage	In shed: 300tDM PKE 100tDM Barley 100tDM DDG In paddock: 850tDM baleage For wintering: 160tDM baleage
Exported Supplements			130tDM baleage		
Soil Fertility	Olsen P 32 (soil test results June 2017) All other values entered at agronomic optimum	All soil test values entered at agronomic optimum (Olsen P of 20)	All soil test values entered at agronomic optimum (Olsen P of 20)	All soil test values entered at agronomic optimum (Olsen P of 20)	Olsen P 32 (soil test results June 2017) All other values entered at agronomic optimum

Description	Current Dairy Platform (average of three seasons)	East Block – Sheep (15-16 season)	East Block – Transition (16-17season)	East Block – Dairy Support (17-18season)	Proposed Land Use
Fertiliser	Phosphorus, Potassium and Sulphur applied to maintain fertility levels	Phosphorus, Potassium and Sulphur applied to maintain fertility levels	Phosphorus, Potassium and Sulphur applied to maintain fertility levels	Phosphorus, Potassium and Sulphur applied to maintain fertility levels	Phosphorus, Potassium and Sulphur applied to maintain fertility levels
Nitrogen Fertiliser	213 kgN/ha in split applications (Aug – April)				Non Effluent blocks 218kgN/ha in split applications (Aug – April) Effluent Blocks 197kgN/ha in split applications (Aug – April)
Drainage	100% mole and tile drained	100% mole and tile drained	100% mole and tile drained	100% mole and tile drained	100% mole and tile drained
Farm dairy effluent	Holding pond Solids aren't separated from the liquid Liquid effluent is applied at a depth of <12mm to the "effluent" blocks An effluent area of at least 39 ha is required to achieve a loading of less than 150 kg N / ha / year				Holding pond Solids aren't separated from the liquid Liquid effluent is applied at a depth of <12mm to the "effluent" blocks An effluent area of at least 34 ha is required to achieve a loading of less than 150 kg N / ha / year

Predicted Overseer Results

Current land use

	Current Dairy Platform (3yr average)	East Block – Sheep (15-16 season)	East Block – Transition (16-17 season)	East Block – Dairy Support (17-18 season)	East block (average of 3yrs)	Current Total (averaged over 3 years)
Total Farm N Loss (kg)	11262	204	132	386	241	11503
N Loss/ha (kgN/ha/yr)	53	15	10	28	17	51

N Concentration in Drainage (ppm)	Pastoral – 9.9 to 12.8 Crops – 21.1 to 42.1	Pastoral – 3.2	Pastoral – 2.1	Pastoral - 6.1		
Total Farm P Loss (kg)	252	10	9	10	10	262
P loss/ha (kgP/ha/yr)	1.2	0.7	0.7	0.7	0.7	1.2
Overseer - predicted pasture grown (tDM/ha/yr)	16.2	11.8	11.8	11.9		

Proposed system

	Current Total (averaged over 3 years)	**Proposed system**
Total Farm N Loss (kg)	11503	11345
N Loss/ha (kgN/ha/yr)	51	51
N Concentration in Drainage (ppm)		Pastoral – 9.8 – 29.3
Total Farm P Loss (kg)	262	278
P loss/ha (kgP/ha/yr)	1.2	1.2
Overseer - predicted pasture grown (tDM/ha/yr)		16.2

Conclusions from the modelling

Nutrient budgets have been developed for Driscoll Dairy. These budgets compare the nutrient loss of the current farm system with the proposed farm system. Overseer has predicted that losses of nitrogen will decrease slightly (less than 5%) and losses of phosphorus will increase slightly (less than 7%).

The key drivers of a decrease in nitrogen loss are shown below. In comparison to the current system, the proposed system has:

- Increased the area that effluent is applied to – reduced N application in effluent to this area
- Reduced nitrogen fertiliser use on the effluent block
- Increased cow numbers – increasing loss risk
-

The key driver of the increase in phosphorus loss is an increase in losses from "other sources".

Please note: Losses from "other sources" include predicted losses from laneways, calving pads and yards. The increase in losses from other sources is a result of an increase in animal excretion onto laneways. Overseer estimates amount of excreta and assumes all P ends up in dung. Some of this dung is assumed to fall on laneways and 30% of that P is assumed to be lost from the farm. Furthermore, Overseer is not spatially explicit; so it does not take into account critical source area on farms. These critical source areas accumulate overland flow from adjacent areas and deliver overland flow to surface water bodies. On farms where there is not a direct connection (or a less connection) via critical source areas, or where management mitigates risk, Overseer cannot model the impact of these at an individual farm scale.

Recommendations:

Apart from the system changes outlined above, the following recommendations are given to reduce the nutrient losses from this farm system.

Overseer can model a range of good management practices. However, some farm specific good management practices cannot be modelled. It is recommended that the following good management practices are implemented on this property:

- Fertiliser is applied at the correct rate, and is not applied in close proximity to waterways
- Identify and manage critical source areas to reduce the risk of losses. These include loses from laneways, gateways and high traffic zones.
- Stand cows off on the calving pad during periods of high soil moisture content to minimise soil damage and leaching risk.
- Fertiliser applications are made during periods of plant growth.
- An effluent management plan is in place that takes into account soil moisture and temperature, and includes a fail safe system

The nutrient budgets within this report have been developed assuming that the Olsen P is 32 and all other soil fertility measures are at the agronomic optimum. It also assumes that fertiliser is applied at a maintenance rate. A soil testing regime should be implemented and fertiliser recommendations should be developed in line with these soil testing results.

The proposed Southland Water and Land Plan is currently in process. It will be important to stay up to date with developments in Environment Southland policy and rules, including the Limit Setting Process which will develop over the next few years

A farm environmental management plan detailing the recommendations within this report should be developed for the property.

Current system - Dairy Platform

Table 14. Current system whole farm nutrient budget

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	201	24	2	34	0	0	0
Rain/clover N fixation	74	0	3	5	3	7	35
Irrigation	0	0	0	0	0	0	0
Supplements	80	11	58	9	9	6	4
Nutrients removed							
As products	87	15	21	5	19	2	6
Exported effluent	0	0	0	0	0	0	0
As supplements and crop residues	0	0	0	0	0	0	0
To atmosphere	89	0	0	0	0	0	0
To water	53	1.2	12	46	61	6	20
Change in farm pools							
Plant Material	0	0	-2	0	0	0	0
Organic pool	125	19	11	-3	7	3	1
Inorganic mineral	0	2	-23	0	-2	-3	-3
Inorganic soil pool	1	-2	43	0	-72	6	15

Table 15. Current system Nitrogen report

Block name	Total N lost kg N/yr	N lost to water kg N/ha/yr	N in drainage * ppm	N surplus kg N/ha/yr	Added N ** kg N/ha/yr
Waikiwi Effluent	1,003	51	**11.4**	264	285
Pukemutu Effluent	2,464	60	**12.8**	272	285
Waikiwi non effluent	1,793	43	9.9	213	211
Pukemutu non effluent	4,850	50	11.2	220	211
Fodder Beet	630	225	**42.1**	21	142
Turnips	111	111	**21.1**	2	72
Other sources	410				
Whole farm	11,262	53			
Less N removed in wetland	0				
Farm output	11,262	53			

Table 16. Current system Phosphorus report

Block name	Total P lost kg P/yr	P lost to water kg P/ha/yr	P loss categories		
			Soil	Fertiliser	Effluent
Waikiwi Effluent	9	0.5	Low	Low	Low
Pukemutu Effluent	39	0.9	Medium	Low	Medium
Waikiwi non effluent	17	0.4	Low	Low	N/A
Pukemutu non effluent	79	0.8	Medium	Low	N/A
Fodder Beet	3	1.2	N/A	N/A	N/A
Turnips	1	1.1	N/A	N/A	N/A
Other sources	104				
Whole farm	252	1.2			

East Block – Sheep

Table 17. East Block – Sheep whole farm nutrient budget

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	0	16	0	24	0	0	0
Rain/clover N fixation	97	0	3	5	3	7	35
Irrigation	0	0	0	0	0	0	0
Nutrients removed							
As products	20	3	1	3	5	0	1
Exported effluent	0	0	0	0	0	0	0
As supplements and crop residues	0	0	0	0	0	0	0
To atmosphere	37	0	0	0	0	0	0
To water	15	0.7	7	35	33	6	19
Change in farm pools							
Plant Material	0	0	0	0	0	0	0
Organic pool	25	11	0	-8	0	0	0
Inorganic mineral	0	0	-25	0	-2	-3	-4
Inorganic soil pool	0	2	19	0	-33	4	18

Table 18. East Block - sheep nitrogen report

Block name	Total N lost kg N/yr	N lost to water kg N/ha/yr	N in drainage * ppm	N surplus kg N/ha/yr	Added N ** kg N/ha/yr
East block - Pukemutu	200	14	3.2	74	0
Other sources	4				
Whole farm	204	15			
Less N removed in wetland	0				
Farm output	204	15			

Table 19. East Block - Sheep phosphorus report

Block name	Total P lost kg P/yr	P lost to water kg P/ha/yr	P loss categories		
			Soil	Fertiliser	Effluent
East block - Pukemutu	9	0.6	Low	Low	N/A
Other sources	1				
Whole farm	10	0.7			

East Block – Transition

Table 8. East Block – Transition whole farm nutrient budget

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	0	36	204	33	0	0	0
Rain/clover N fixation	152	0	3	5	3	7	35
Irrigation	0	0	0	0	0	0	0
Nutrients removed							
As products	0	0	0	0	0	0	0
Exported effluent	0	0	0	0	0	0	0
As supplements and crop residues	162	24	203	17	46	11	9
To atmosphere	4	0	0	0	0	0	0
To water	10	0.7	15	30	29	6	19
Change in farm pools							
Plant Material	0	0	0	0	0	0	0
Organic pool	-24	12	6	-8	1	0	0
Inorganic mineral	0	0	-22	0	-2	-3	-4
Inorganic soil pool	0	0	5	0	-72	-7	10

Table 9. East Block - transition nitrogen report

Block name	Total N lost kg N/yr	N lost to water kg N/ha/yr	N in drainage * ppm	N surplus kg N/ha/yr	Added N ** kg N/ha/yr
East block - Pukemutu	132	9	2.1	-15	0
Other sources	1				
Whole farm	132	10			
Less N removed in wetland	0				
Farm output	132	10			

Table 10. East Block - Transition phosphorus report

Block name	Total P lost kg P/yr	P lost to water kg P/ha/yr	P loss categories		
			Soil	Fertiliser	Effluent
East block - Pukemutu	9	0.7	Low	Low	N/A
Other sources	0				
Whole farm	9	0.7			

East Block – Dairy support

Table 11. East Block – Dairy support whole farm nutrient budget

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	0	0	0	8	0	0	0
Rain/clover N fixation	81	0	3	5	3	7	35
Irrigation	0	0	0	0	0	0	0
Nutrients removed							
As products	9	2	1	1	5	0	0
Exported effluent	0	0	0	0	0	0	0
As supplements and crop residues	0	0	0	0	0	0	0
To atmosphere	40	0	0	0	0	0	0
To water	28	0.7	9	30	43	6	19
Change in farm pools							
Plant Material	-75	-14	-94	-11	-23	-8	-7
Organic pool	79	12	4	-7	1	0	0
Inorganic mineral	0	0	-16	0	-2	-3	-4
Inorganic soil pool	0	-1	98	0	-21	12	25

Table 12. East Block – Dairy support nitrogen report

Block name	Total N lost kg N/yr	N lost to water kg N/ha/yr	N in drainage * ppm	N surplus kg N/ha/yr	Added N ** kg N/ha/yr
East block - Pukemutu	381	27	6.1	139	0
Other sources	5				
Whole farm	386	28			
Less N removed in wetland	0				
Farm output	386	28			

Table 13. East Block – Dairy support phosphorus report

Block name	Total P lost kg P/yr	P lost to water kg P/ha/yr	P loss categories		
			Soil	Fertiliser	Effluent
East block - Pukemutu	8	0.6	Low	N/A	N/A
Other sources	2				
Whole farm	10	0.7			

Proposed system

Table 14. Proposed system whole farm nutrient budget

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	199	21	0	30	0	0	0
Rain/clover N fixation	73	0	3	5	3	7	35
Irrigation	0	0	0	0	0	0	0
Supplements	103	21	97	16	22	11	7
Nutrients removed							
As products	99	17	24	5	21	2	7
Exported effluent	0	0	0	0	0	0	0
As supplements and crop residues	0	0	0	0	0	0	0
To atmosphere	87	0	0	0	0	0	0
To water	51	1.2	13	49	59	6	20
Change in farm pools							
Plant Material	0	0	0	0	0	0	0
Organic pool	138	20	15	-3	8	4	1
Inorganic mineral	0	2	-19	0	-2	-3	-3
Inorganic soil pool	0	2	67	0	-62	9	17

Table15. Proposed system nitrogen report

Block name	Total N lost	N lost to water	N in drainage *	N surplus	Added N **
	kg N/yr	kg N/ha/yr	ppm	kg N/ha/yr	kg N/ha/yr
Waikiwi Effluent	1,887	45	10.2	241	249
Pukemutu Effluent	2,662	53	**11.5**	249	249
Waikiwi non effluent	830	43	9.8	210	215
Pukemutu non effluent	5,030	50	11.1	217	215
Baleage winter - waikiwi Eff	88	111	**25.2**	506	249
Baleage winter - Pukemutu Eff	120	133	**29.3**	530	249
Baleage winter - Waikiwi Non Eff	40	99	**22.6**	451	215
Baleage winter - Pukemutu Non Eff	240	126	**28.3**	498	215
Other sources	449				
Whole farm	11,345	51			
Less N removed in wetland	0				
Farm output	11,345	51			

Table 20. Proposed system phosphorus report

Block name	Total P lost	P lost to water	P loss categories		
	kg P/yr	kg P/ha/yr	Soil	Fertiliser	Effluent
Waikiwi Effluent	19	0.5	Low	Low	Low
Pukemutu Effluent	46	0.9	Medium	Low	Medium
Waikiwi non effluent	8	0.4	Low	Low	N/A
Pukemutu non effluent	82	0.8	Medium	Low	N/A
Baleage winter - waikiwi Eff	0	0.5	Low	Low	Low
Baleage winter - Pukemutu Eff	1	0.9	Medium	Low	Medium
Baleage winter - Waikiwi Non Eff	0	0.4	Low	Low	N/A
Baleage winter - Pukemutu Non Eff	2	0.8	Medium	Low	N/A
Other sources	121				
Whole farm	278	1.2			

Farm Map

Figure 1. Driscolls farm map showing the current and proposed effluent areas

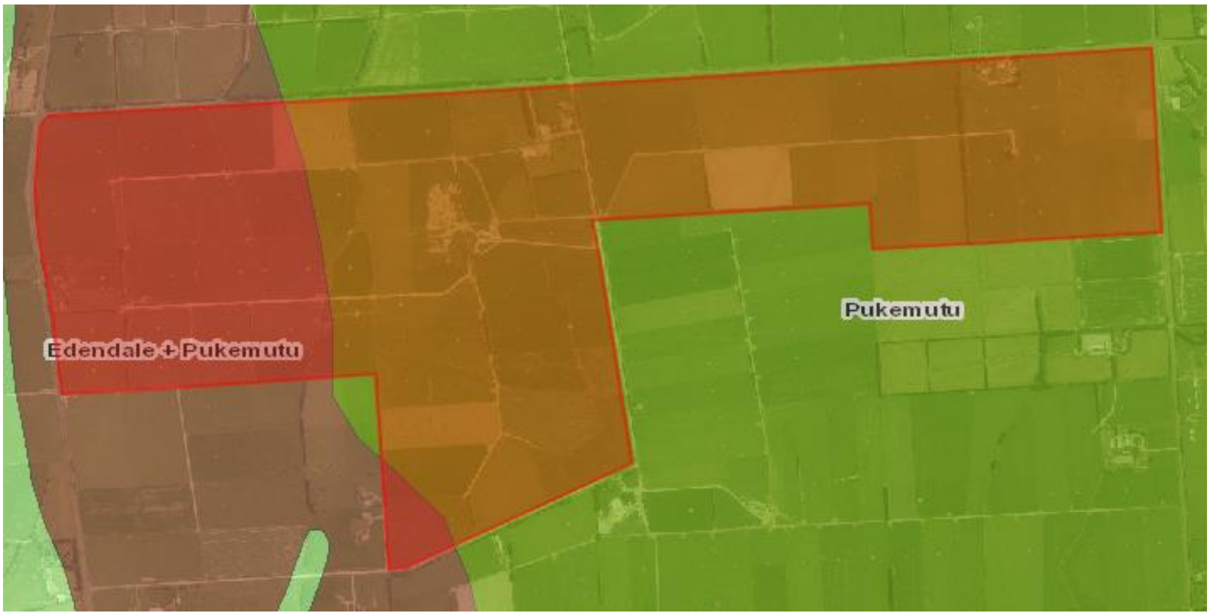

Figure 2. Driscolls farm map showing the soil types on farm

Report disclaimer:

The OverseerFM 6.3.1 model has been utilised to assess the nutrient losses from this property. Details of how the property is operated currently, and how the property will be operated going forward have been gathered from the farm owner. Where accurate data was unavailable, conservative assumptions have been made using professional judgement.

OverseerFM 6.3.1 predicted results have been extracted from the model on 22 August 2019

Appendix 4: Further information: T and J Driscoll Family Trust consent application, December 2018

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Further information: T and J Driscoll Family Trust consent application

Please find below a file note in relation to Overseer modelling completed for the T and J Driscoll Family Trust. This file note is intended to be read alongside the Overseer Modelling Report, dated 1st October, 2018.

Executive summary

An application for consent to use land for dairying was made by the T and J Driscoll Family Trust in October 2018. This application utilised Overseer data to quantify predicted losses of nitrogen and phosphorus from the current and proposed systems. Environment Southland has raised concern that the predicted P losses using Overseer are higher in the proposed system than the current system. However, there are a range of P loss mitigations that are not accounted for, or are not fully accounted for, in Overseer. This file note seeks to quantitatively estimate the difference in P loss between the current and proposed systems using both Overseer and the results of recent New Zealand research.

Overseer has predicted the following total P loss:

Current situation	262 kg P/yr
Proposed situation	278 kg P/yr
Difference	**16 kg P/yr increase**

The Overseer model has a reasonable degree of calibration and evaluation/validation within the nitrogen leaching sub-model. However, the P loss sub-model has been developed using a less extensive calibration and evaluation/validation base. The model is not spatially explicit and as such it uses a number of assumptions to make estimates of both N and P loss. It is important to appreciate that there are significant uncertainties associated with Overseer nutrient loss estimates and Overseer currently only provides for a very limited range of mitigation options to be incorporated.

We have considered the current mitigations in place to reduce nutrient loss from laneways and further mitigations planned. These are described in the report. Revised Overseer P loss estimates have been calculated, taking into account the effect of the laneway mitigations for the current and proposed systems:

	Overseer P loss estimate	– estimated P loss mitigated	= revised P loss
Current system	262 kg P/yr	- 33kg P	= 229kgP
Proposed system	278 kg P/yr – 19.1kgP	- 52kg P	= 226kgP
Difference			**= 3kg P/yr decrease**

Further mitigations that may be implemented in the future are to apply 50% of the phosphorus fertiliser in a low solubility form and to lower the Olsen P to 30. Overseer predicts that these mitigations would reduce P loss from the pastoral areas by a further 10 kg P.

P runoff from laneways

Overseer has a built in assumption that 30% of phosphorus deposited on laneways as dung is lost. This is accounted for in the "other sources" losses within the Phosphorus report (shown in the appendices of the consent application). Research has shown that a dairy cow consuming 15.5kgDM/day on a pasture diet will consume 0.4 kg P/week, of which 66% will be deposited in dung (shown in the table below, source: Massey University). Assuming that the farm has a lactation season of 270 days, each cow will ingest 15.4 kg P/cow, and **10.2kgP/animal would be deposited as dung.** A study by Ledgard *et al.* (1999) reported that **5% of cow excreta was deposited on laneways.** We have assumed that Overseer incorporates this information. Overseer then assumes that for phosphorus deposited on laneways in dung, **30% is lost from the system to water.**

Table 1.4 The fate of minerals ingested by a lactating dairy cow (ingesting 15.5 kg DM/day) (adapted from During 1984).

Element	Consumption	Percentage in			
	Kg /week	Faeces	Urine	Milk	Retained
N	5.1	26	53	17	4
P	0.4	66	-	26	8
K	2.9	11	81	5	3
Mg	0.2	80	12	3	5
Ca	0.4	77	3	11	9
Na	0.4	30	56	8	6

There is opportunity to mitigate the losses from laneways through careful management of bridges/culverts, buffer zone planting, laneway cambering and siting laneways away from waterways. These mitigations all reduce P loss by ensuring laneway runoff is filtered through a vegetated buffer strip. Research has shown that vegetated buffer strips can reduce P losses by 38-59% (figure 1). None of these mitigation strategies are provided for in Overseer.

As described in the application for consent, this property has already implemented some mitigations to reduce phosphorus loss from laneways. These include kickboards on the two bridges (see pictures in consent application) and having some cut outs from the lane that direct runoff into paddocks rather than into waterways. The process of applying for consent has identified areas where further mitigations could be implemented. This includes improving the kickboards on the bridges, and improving the camber and increasing the size of the buffer on the laneway south of the cowshed which runs alongside an open drain. Water flow will be redirected through vegetated areas to allow for filtering. These areas of laneway are considered critical source areas – small areas that contribute a relatively high proportion of nutrient/phosphorus losses.

These improvements in laneway management will further mitigate losses of P. A study in the Mangakino stream by McDowell et al. (2006) found that the majority (c. 80%) of P losses were occurring from a small tributary that contributed less than 20% of the flow. Investigation of the tributary found that there was a heavily used, poorly managed dairy farm stream crossing less than 200m upstream from the confluence. Management of these high risk areas of laneway can therefore have significant positive effects on Predicted losses.

Given the evidence above, it has been assumed that the Driscoll property is currently mitigating at the low end of the range of reported mitigation, i.e., 38% of the losses from laneways assumed by Overseer, for the current 573 cows.

P loss mitigated	= Cows x	P in dung	x Excreted on lanes	x assumed losses	x current mitigations	
Current system	= 573	x 10.2kg P	x 5%	x 30%	x 38%	
	= 33 kg P/yr					

Revised Overseer estimated P loss (current system) = 262 kg P – 33kg P = 229 kg P

Going forward, as a result of this consent application, the Driscolls will make further mitigations to reduce laneway losses through increased use of vegetated buffers, as described above. We consider that these improvements can reduce annual P loss from laneways to the midpoint of the range of reported mitigation, i.e., 49% of the losses assumed by Overseer, for the proposed 700cows.

P loss mitigated	= Cows x	P in dung	x Excreted on lanes	x assumed losses	x extra mitigations	
Proposed system	= 700	x 10.2kgP	x 5%	x 30%	x 49%	
	= 52 kg P/yr					

Revised Overseer estimated P loss (proposed system) = 278 kg P – 52kg P = 226 kg P

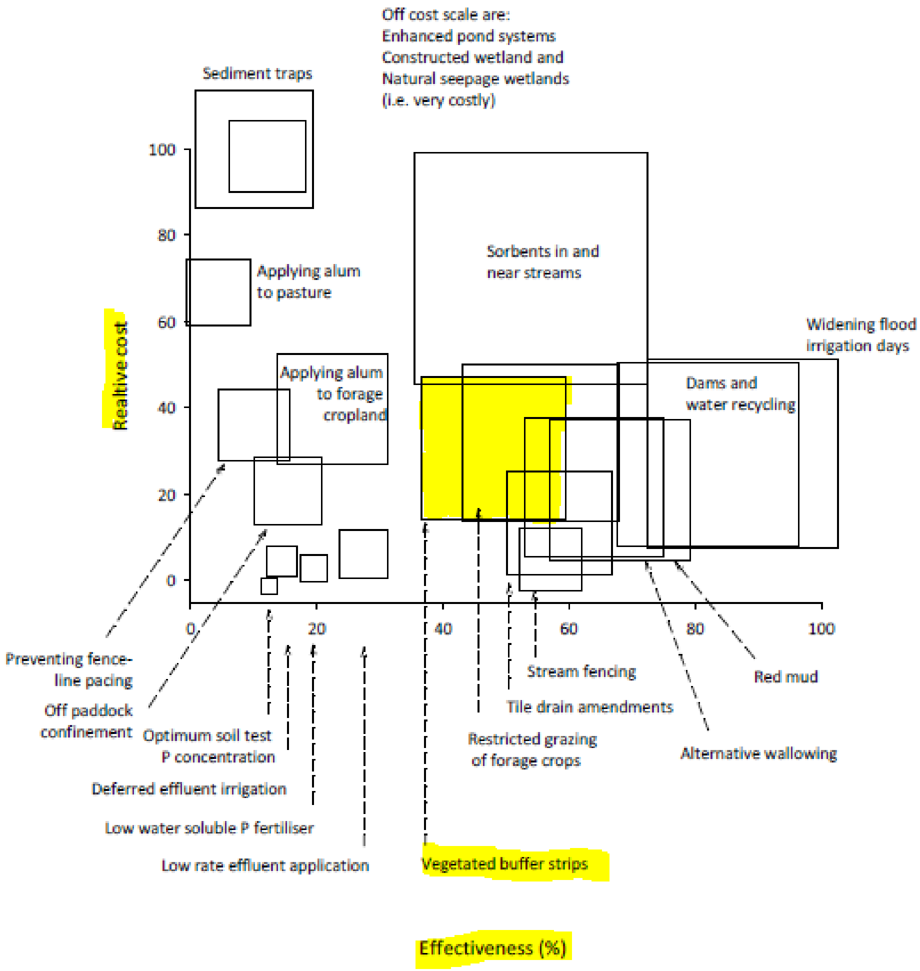

Figure 3. Diagram of the cost and effectiveness of strategies to mitigate phosphorus losses to water at the farm-scale. Cost is shown as the cost per kg of P mitigated relative to the most expensive strategy - sediment traps at $360 per kg P retained/ha/yr. From McDowell et al (2013)

Further future mitigation options:

Lower solubility Phosphorus fertilisers

The modelling completed assumed that fertiliser P would be applied as super phosphate – the most commonly used P fertiliser in New Zealand. This assumption was made in order to show a conservative estimate of losses, and to ensure that the systems were compared fairly. Going forward, the Driscolls have indicated that they are considering using RPR/serpentine super instead of super phosphate. This was not shown in the modelling as a transition to RPR/serpentine super should be untaken over a number of years in order to maintain pasture production.

Super phosphate fertiliser is 100% water soluble. In comparison, serpentine super and Reactive Phosphate Rock (RPR) have lower water solubility - 2.9% and 0% respectively (McNaught et al, 1968). As a result, the risk of P loss is higher in situations where super phosphate has been applied compared to RPR or serpentine super.

To show the effectiveness of this as a mitigation, I have modelled applying a maintenance application of P as 50% super phosphate and 50% RPR instead of 100% super phosphate. Please note that the amount of P, in kg P per ha, has not changed, but the form of the fertiliser has. Overseer assumes that serpentine super has the same solubility as superphosphate (Wheeler and Watkins, 2016), and therefore the same fertiliser runoff risk profile. However, due to it's similar water solubility, serpentine super is expected to have similar losses of P as RPR. **This change in fertiliser form has resulted in a reduction in predicted P loss by 4kgP**. The Overseer P loss reports are shown in the appendices.

Soil Olsen P

Olsen P is a commonly used measure of plant available soil P. From an agronomic perspective, the optimum Olsen P level is 30. The Driscolls have an average Olsen P of 32. In the modelling completed for the Driscoll's it was assumed that maintenance fertiliser would be applied going forward, and that the Olsen P would therefore remain the same.

The consent application process has highlighted the environmental risk of a higher Olsen P to Tim and Jocelyn. As a result Tim and Jocelyn are considering reducing their Olsen P. **Overseer predicts that a reduction in Olsen P from 32 to 30 is expected to reduce P loss by 6kgP**. The Overseer P loss reports are shown in the appendices.

Conclusions:

Overseer has predicted the following total P loss:

Current situation	262 kg P/yr
Proposed situation	278 kg P/yr
Difference	**16 kg P/yr increase**

We have considered the current mitigations in place to reduce nutrient loss from laneways and further mitigations planned. These are described in the report. Revised Overseer estimates have been calculated, taking into account the effect of the laneway mitigations for the current and proposed systems:

	Overseer P loss estimate –	estimated P loss mitigated	= revised P loss
Current system	262 kg P/yr	- 33kg P	= 229kgP
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Difference			**= 3kg P/yr decrease**

Further mitigations that may be implemented in the future are to apply 50% of the phosphorus fertiliser in a low solubility form and to lower the Olsen P to 30. Overseer predicts that these mitigations would reduce P loss from the pastoral areas by 10 kg P.

References

Ledgard, S., Penno, J., & Sprosen, M. (1999). Nitrogen inputs and losses from clover/grass pastures grazed by dairy cows, as affected by nitrogen fertiliser application. *Journal of Agricultural Science 132*, 215-225.

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McDowell, R., Wilcock, B., & Hamilton, D. (2013). *Assessment of Strategies to Mitigate the Impact or Loss of Contaminants from Agricultural Land to Fresh Waters.* Prepared for MfE.

McNaught, K., Karlovsky, J., & Hogg, D. (1968). Serpentine-superphosphate and dolomite as magnesium sources on Whakarewarewa sandy loam. *New Zealand Journal of Agricultural Research*, 849-862.

Orchiston, T., Monaghan, R., & Laurenson, S. (2013). Reducing Overland Flow and Sediment Losses From Winter Forage Crop Paddocks Grazed by Dairy Cows. *Fertiliser and Lime Research Conference.* Palmerston North.

Wheeler, D., & Watkins, N. (2016). *Overseer Technical Manual: Characteristics of Fertilisers.* AgResearch.

Appendices:

Table 21. Block P loss table, as estimated by overseer for the Proposed system (same as in the consent application)

Farm name: Driscolls Proposed FINAL 1Oct

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
Waikiwi Effluent	19	0.5	Low	Low	Low
Pukemutu Effluent	46	0.9	Medium	Low	Medium
Waikiwi non effluent	8	0.4	Low	Low	n/a
Pukemutu non effluent	82	0.8	Medium	Low	n/a
Baleage winter - waikiwi Eff	0	0.5	Low	Low	Low
Baleage winter - Pukemutu Eff	1	0.9	Medium	Low	Medium
Baleage winter - Waikiwi Non Eff	0	0.4	Low	Low	n/a
Baleage winter - Pukemutu Non Eff	2	0.8	Medium	Low	n/a
Other farm sources	121				
Whole farm	278	1.2			

Table 22 Block P loss table, as estimated by overseer for the Proposed system – after applying 50% of the phosphorus fertiliser in a lower solubility form.

Farm name: Driscolls Proposed FINAL 1Oct - 50% RPR

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
Waikiwi Effluent	19	0.4	Low	Low	Low
Pukemutu Effluent	45	0.9	Medium	Low	Medium
Waikiwi non effluent	8	0.4	Low	Low	n/a
Pukemutu non effluent	79	0.8	Medium	Low	n/a
Baleage winter - waikiwi Eff	0	0.4	Low	Low	Low
Baleage winter - Pukemutu Eff	1	0.9	Medium	Low	Medium
Baleage winter - Waikiwi Non Eff	0	0.4	Low	Low	n/a
Baleage winter - Pukemutu Non Eff	1	0.8	Medium	Low	n/a
Other farm sources	121				
Whole farm	274	1.2			

Table 23. Block P loss table, as estimated by overseer for the Proposed system – after reducing Olsen P to 30.

Farm name: Driscolls Proposed FINAL 1Oct - Olsen P 30

Block Phosphorus

Block name	Total P lost (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
Waikiwi Effluent	19	0.4	Low	Low	Low
Pukemutu Effluent	44	0.9	Medium	Low	Medium
Waikiwi non effluent	8	0.4	Low	Low	n/a
Pukemutu non effluent	79	0.8	Medium	Low	n/a
Baleage winter - waikiwi Eff	0	0.4	Low	Low	Low
Baleage winter - Pukemutu Eff	1	0.9	Medium	Low	Medium
Baleage winter - Waikiwi Non Eff	0	0.4	Low	Low	n/a
Baleage winter - Pukemutu Non Eff	2	0.8	Medium	Low	n/a
Other farm sources	120				
Whole farm	272	1.2			

Appendix 5: T and J Driscoll Family Trust – Farm Maps

Farm Map

Figure 4. Driscolls farm map showing the current and proposed effluent areas, and the East Block.

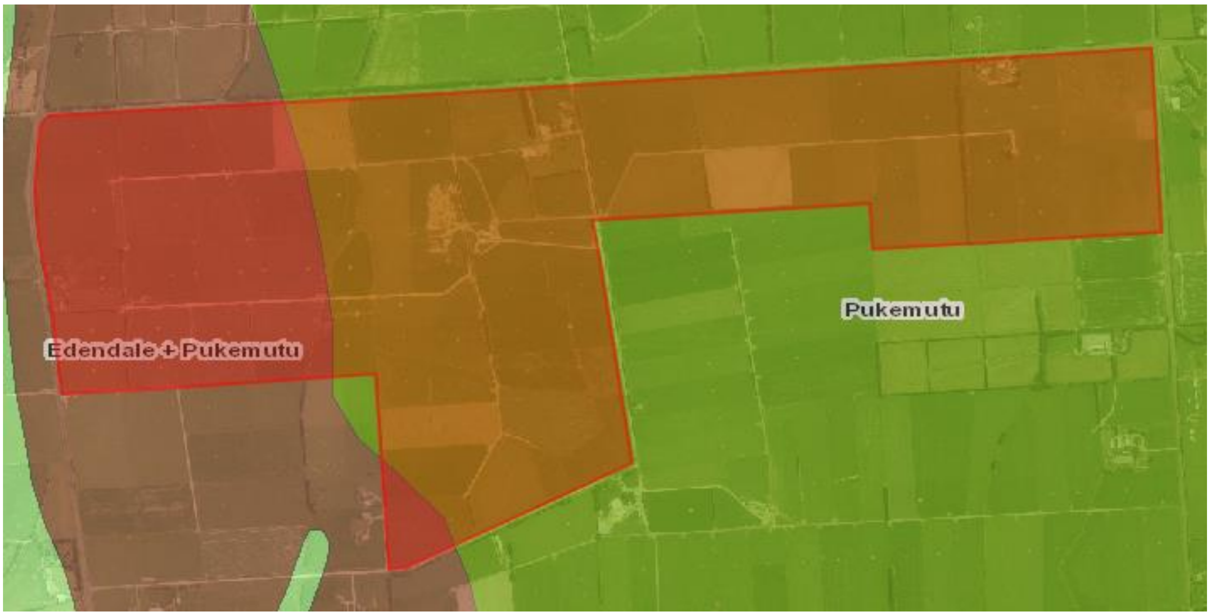

Figure 5. Driscolls farm map showing the soil types on farm