M & C Adams

Resource Consent Application to Environment Southland

To Use Land for Dairy Farming and Associated Permits

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QUALITY INFORMATION

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Prepared by:	Hilary Lennox
Client Review:	Mike Adams
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1. INTRODUCTION

1.1 Overview of Proposal

M & C Adams, being Trustees of the M J Adams Trust (the applicant), own a dairy farm located approximately 1 km south east of Nightcaps, Western Southland. Discharge Consent AUTH-302700-01-V1 authorises the discharge of farm dairy effluent (FDE) and Water Permit AUTH-302700-03 authorises the taking of groundwater at this farm. These consents are not due to expire until 14 January 2024.

The applicant proposes to expand the existing dairy platform across adjacent land to the north and the east and increase the number of maximum cows to be milked across the expanded dairy platform from 1,000 to 1,150 cows. There will also be winter grazing of up to 1,200 cows across the expanded dairy platform.

The land to the north ("Northern Block") has been purchased by the applicant and has been used for intensive winter grazing. The land to the east ("Eastern Block") has also been purchased by the applicant and has been used as a sheep breeding and finishing unit, with some grazing of cattle since early 2018.

Consents to authorise the proposed dairy expansion, and replacement consents for AUTH-302700-01-V1 and AUTH-302700-03 are hereby sought.

Section 124 applies to this application for the replacement of the current discharge and water permits.

1.2 The Applicant

Applicant Address: M & C Adams being Trustees of the M J Adams Trust
1079 Aparima Road
Wairio

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

1.3 Purpose of Documentation

Pursuant to 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 Nightcaps as well as the proposed farm boundary.

Figure 1: The proposed farm boundary

2.2 Details of the Dairy Farm

The following provides further details of the farming system proposed.

Table 1: Details of the Dairy Farm

Property Details		
Property address	1570 Otautau Nightcaps Road, R D 1, Otautau	
Property owner(s)	M & C Adams	
Legal Description	Existing Milking Platform	
	Pt Section 21 WAIRIO SD	SL172/151
	Section 132 WAIRIO SD	SO 1783
	Section 131 WAIRIO SD	SL40/84
	Section 338 WAIRIO SD	SL2A/232
	Closed Road Wairio Survey District	SL152/238
	Section 1 Survey Office Plan	SL172/151
	Northern Block	
	Pt Section 17 WAIRIO SD	SL163/103
	Eastern Block	
	Pt Section 124 WAIRIO SD	SL11A/263
	Lot 1 DP 13608	SL11A/263
Property area (ha)	Existing Property Area = 327.9 ha	Proposed Property Area = 487.8 ha
Change in scale/intensity/farm boundary?	Increase in land area Increase in cows from 1,000 to 1,150 cows Increase in groundwater take	
Discharge Permit Details:		
Replacement of permit no.	AUTH-302700-01-V1	
Number of dairy cows	Existing Number: 1,000 cows	Proposed Number: 1,150 cows
Stocking rate (cows/ha)	Existing Stocking Rate: 3.0 cows/ha	Proposed Stocking Rate: 2.4 cows/ha
Type of milking shed	64 bale rotary shed	
Winter milking?	No milking between 20 June and 20 July other than slipped cows	
Wintering barn?	No	
Feed pad/standoff pad?	No	
Other sources of effluent?	200 m^3 vat stand, tanker stand and other concreted areas (existing silage pad and new underpass not linked to effluent pond)	
Greenwash?	Yes – treated effluent from pond is reused to wash yard	
Effluent treatment	Weeping wall	
Storage available (m^3)	8,511 m^3 pond providing 6,136 m^3 of pumpable storage	
Storage required (m^3)	4,752 m^3 (as per attached dairy effluent storage calculator)	
Disposal area (ha)	245 ha (quoted in the s42A report for APP-302700-01-V1 and there will be no increase from current consented area)	
Irrigator proposed	Briggs Travelling Irrigator and low rate pods. Slurry tanker may be used on rare occasions, such as desludging the pond.	
Application rate and depth	10 mm/hr rate and 15 mm average depth per application	
Monitoring proposed	No monitoring proposed	

Water Permit Details:		
Replacement of permit no.	AUTH-302700-03	
Freshwater Management Unit	Aparima Freshwater Management Unit	
Average rate of take over 24 hrs (L/s)	1.7 L/s (max capacity of the pump is 2.9 L/s)	
Daily volume (L)	126,500 L/day	
Allocation per cow (L/cow/day)	110 L/cow/day (greenwash used)	
Location of point of take	Bore/well D45/0318 NZTM2000: 1217413E 489531N	
Freshwater storage onsite?	4 x 30,000 L tanks	
Yearly volume (m^3/year)	46,172.5 m^3/yr	
Groundwater Zone	Upper Aparima (RWPS)	Upper Aparima (PSWLP)
Discretionary allocation limit for groundwater zone (m^3/year)	93,000,000	41,060,000
Amount currently allocated from groundwater zone, including current permit (m^3/year)	3,520,272	4,077,723
Percentage Currently Allocated	4%	10%
Land Use Consent (use land for dairying)		
Area of new blocks (ha)	159.9 ha	
Use of land pre-May 2016	Northern Block – intensive winter grazing Eastern Block – sheep breeding and finishing unit	
Proposed use of land	Dairy platform for milking of 1,150 cows On-site wintering of up to 1,200 cows 37 ha of fodder beet and 12 ha of summer turnips grown	

Effluent Infrastructure

At present, agricultural effluent is collected at the dairy shed and gravity fed to two sludge beds and a weeping wall system. The sludge beds are emptied periodically. Liquid effluent then seeps from the weeping wall to a very large effluent pond.

The effluent storage pond, which was built in 2014 by Nightcaps Contracting, is clay-lined. Given the age and excellent maintenance of the pond, a pond drop test has not been conducted, nor is it considered necessary as part of this application, despite it being clay-lined. The applicant chose not to line the pond with an HDPE liner because good clay was available locally and the presence of a liner can cause its own problems, such as presenting the risk of tearing the liner. Pond design specifications, drawings and photographs are attached to this report. Certification of construction can be obtained from Civil Works upon request.

As can be seen from the photos below, the pond has been kept in immaculate condition. The chance of this pond being unsuitable for the storage of effluent (i.e. the chances of it leaking) are extremely low and therefore a pond drop test is considered to be superfluous as part of this consent application.

A greenwash system is used at the farm, which involves a portion of the liquid effluent being recirculated back to the yard and being pumped through the backing gate to help wash down the yard.

Figure 2: Effluent Infrastructure Layout

Figure 3: Weeping Wall (pond is to the right)

Figure 4: Effluent Pond, which is fully fenced

The Dairy Effluent Storage Calculator (DESC) attached shows that the current pond is more than adequate to enable effective deferred irrigation of FDE from the milking of 1,150 cows. The applicant proposes to irrigate liquid effluent all year round provided soil moisture conditions allow, and as informed by checking the Environment Southland Soil Moisture site at Wairio at Otautau Nightcaps Road (approximately 2 km south of the existing property boundary). This soil moisture site is also located on Aparima soils and is of a similar elevation to the subject property.

Liquid effluent is pumped from the pond to all paddocks on the existing dairy platform. Effluent is applied to land using a Williams GB Magnum travelling irrigator. The specifications for this irrigator (attached) stipulate that the irrigator is capable of achieving an application rate of less than 10 mm/hr and average depths as low as 2.1 mm per pass. This irrigator was tested recently (see attached report)) to demonstrate that it is more than capable of achieving the consented rates and depths of 10 mm/hr and 15 mm depth. The applicant would like to maintain the option of using low rate pods too, although the travelling irrigator is the main method used presently.

Consent to Use Land for Dairying – Northern Block

Consent is sought to use a 100 ha (approx.) block of land to the north of Knobby Road for dairying. This land has been bought by the applicant and has historically been used as an intensive winter grazing operation.

A Farm Activity Focus Plan (FAFP) has been prepared by Environment Southland and identifies Critical Source Areas, such as gullies and more minor swales/depressions that must be managed appropriately. The Riparian Fencelines and Planting map from the FAFP is attached and shows that all waterways/drains on the Northern Block are fenced.

The applicant is not proposing to install an underpass under Knobby Road but will walk the cows across the road for milking instead. Lanes had already been constructed on the Northern Block prior to purchase, and the applicant has constructed one more lane to the road crossing, which is up on the hill rather than down in a gully. There is one lane that runs alongside a farm drain that has been fenced and planted (NTZM2000 1215700E 4896288N), but the applicant has advised that this lane is likely to be decommissioned, which reduces the risk of runoff from lanes to water.

Figure 5: Winter cropping on the Northern Block

Figure 6: Winter cropping on the Northern Block

Figure 7: Winter cropping on the Northern Block

Consent to Use Land for Dairying – Eastern Block

This application seeks to also include a 60 ha (approx.) block of land to the northeast of the Wreys Bush Nightcaps Highway. This land was bought by the applicant in 2017 and has been used in the past as a sheep breeding and finishing block. The topography is very similar to the existing dairy platform in that it is gently rolling, with no significant gullies or swales.

The applicant will need to install an underpass under the Wreys Bush Nightcaps Highway to bring the cows across the road for milking.

Compliance

The compliance history for Discharge Permits AUTH-302700-01 and AUTH-302700-01-V1 shows no issues and there are comments to show that the systems were very tidy. The only issue was that the consent referred to the wrong type of irrigator, but this was rectified when the consent was amended in 2016.

The compliance history for Water Permit AUTH-302700-03 indicates that the applicant has been late in supplying their water take data. The compliance history implies that the water use data needs to be submitted to ES monthly but Condition 5 of Water Permit AUTH-302700-03 only requires annual reporting. The data has been supplied annually, but not always by the due date.

3. DESCRIPTION OF EXISTING ENVIRONMENT

3.1 Land Use, Topography & Climate

The property, located at approximately 160 m above mean sea level, is an existing farm and conventional farming practices are undertaken. Surrounding land use comprises other dairy farms, sheep and beef farms, with the rural town of Nightcaps located approximately 1km north west of the existing farm boundary. Based on 30 years of rainfall records of Nightcaps (being the nearest rainfall station to the property) the property is likely to receive an average of 1,005 mm of rainfall per year.

3.2 Water Resources

The map below illustrates surface waterways located on the property.

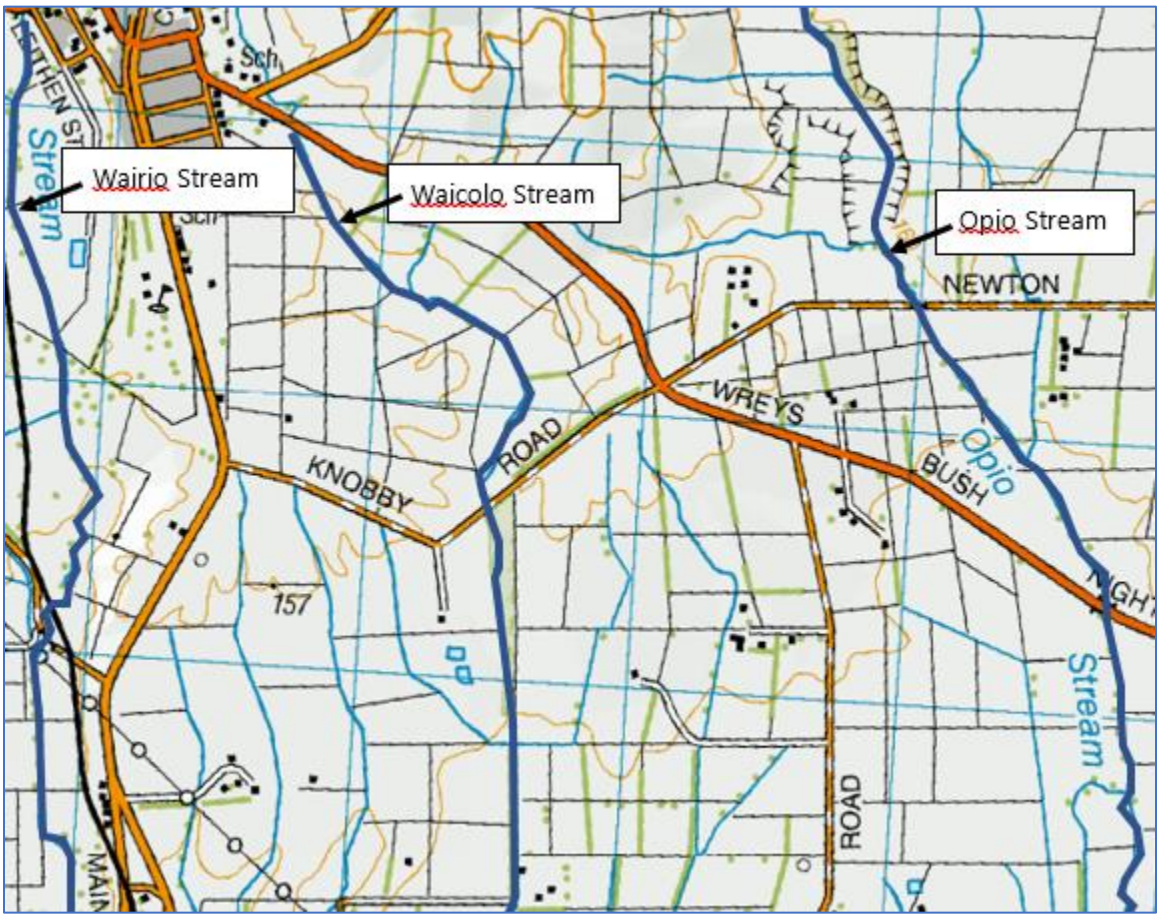

Figure 8: Surface waterways located on and near the property

3.2.1 Surface waterways

A tributary of the Waicolo Stream runs through the property and the Opio Stream is to the east of the farm. The Wairio Stream is to the west of the farm. There are several smaller, and sometimes ephemeral tributaries that run through the property. All waterways have been fenced from stock and there is extensive planting across the entire proposed dairy platform. The Waicolo Stream, Opio Stream and Wairio Stream are all

tributaries of the Otautau Stream, which is a tributary of the Aparima River. The property is wholly contained within the Aparima Surface Water Management Zone.

Figure 9: Farm drain on new block with fencing and planting

Under the RWPS, waterbodies on the property are classified as Lowland hard bed. The table below summarises the values associated with this water body type as specified in the RWPS. The Proposed Southland Water and Land Plan, 2018 (PWLP) does not use a classification system to establish values for rivers and streams.

Table 2: Summary of regional plan's surface water values for streams in the property area

Regional Plan	*Values specified in the Regional Water Plan*
Regional Water Plan for Southland, 2010 Objective 3	– 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.

A search of the New Zealand Freshwater Fish Database did not reveal the presence of fish within the tributaries on the property. However, a site surveyed on the Waicolo Stream in 2001, located approximately 7 km downstream of the property, revealed the presence of Brown Trout and Upland bully.

Land Air Water Aotearoa (LAWA) is the most up to date national database which connects people with New Zealand's environmental monitoring data, enabling communities to access information relating to the different pressures and conditions on freshwater resources. The state of water quality presented on the LAWA website compares the median of monitoring result for the last five years at a site with other sites around the country. The median for a site can be compared to all other sites with similar land use and altitude. The data used to calculate trends is the same as used for the regional state. LAWA displays regional trends for the last five to ten years which helps to identify whether a site has improved, degraded or stayed the same. The state of water quality is assessed against the objectives within the National Policy Statement for Freshwater Management (NPS-FM; New Zealand Government 2014) and the trigger values for physical and chemical stressors in New Zealand rivers from the ANZECC guidelines (ANZECC 2000).

Table 3: Summary of State and Trend at the Otautau Stream at the Waikouro Monitoring Site (nearest downstream LAWA monitoring site)

	State	NOF Band Annual Median	Trend
E. Coli	In the worst 25% of all lowland rural sites	D – high risk of infection to waders/boaters	Indeterminate
Clarity	In the worst 25% of all lowland rural sites	N/A	Indeterminate
Total Oxidised N	In the worst 50% of all lowland rural sites	A – unlikely to be effects on sensitive species	Indeterminate
Ammoniacal N	In the worst 25% of all lowland rural sites	A – 99% species protection level. No observed effect on any species tested.	N/A
Dissolved Reactive P	In the 25% of all lowland rural sites	N/A	Indeterminate

The results presented above strongly indicate that water quality for all parameters measured on the mainstem of the Otautau Stream at Waikouro is not good when compared other lowland rural sites, however, an increase in river nutrient concentrations moving downstream is normally found in lowland New Zealand rivers. Total Oxidised N and Ammoniacal N results are consistent with the regional plan objectives. E. Coli concentrations are classed under Band D, and the D Band is defined as "water quality… not considered suitable for the designated use". Dissolved reactive phosphorus concentrations comply with the relevant ANZECC trigger values.

There is insufficient data over the past 10 years to determine a trend for all key water quality indicators. No data is available for local tributaries of the Otautau Stream.

3.2.2 Groundwater

The property is located within the Upper Aparima Groundwater Management Zone, which is bordered by quaternary gravel deposits along the base of the Taringatura and Takitimu foothills. The depth of gravels is greater than 50 m over much of the area. The gravel deposits in the Wairio area are remnants of the weathered mid-Quaternary gravels that have been reworked by second and third order streams to form the rolling topography. These gravels are generally very tightly claybound forming a low yielding unconfined aquifer. This aquifer is recharged by direst rainfall infiltration and runoff from surrounding hills and streams. The Upper Aparima GMZ is a terrace aquifer.

According to the ES GIS Database, the nitrate classification level for the subject property is mapped as pristine pre-European to modern day background (0.01 – 1.0 mg/L[1]).

Depth to groundwater beneath the property varies, ranging from 18 m to 70 m according to bores logs for D45/0294 and D45/0415. A 2 km bore search revealed 10 bores located within the vicinity of the property (other than those bores located on the property). Of the 10 bores, 2 are listed as proposed bores, 3 are listed as providing for stock supply, 4 are listed for dairy use and 1 used for domestic purposes. Based on region topography, it is fair to assume that groundwater movement is in an overall southerly direction.

Properties in Nightcaps, which are to the north, are serviced by town supply water that is taken under Water Permit AUTH-20171350, at a location over 7 km to the northwest of the subject property. This water supply will not be affected by the proposed activities and so it is not considered any further in this report.

There is no site-specific groundwater quality monitoring at this property, as it is not a current condition of consent.

3.2.3 Estuary

Jacobs River Estuary is a medium sized, "tidal lagoon" type estuary that drains the Aparima and Pourakino Rivers. The estuary is shallow (mean depth approximately 2 metres) and has extensive mudflats (80% of estuary exposed at low tide), seagrass and saltmarsh areas. Nuisance blooms of macroalgae (*Enteromorpha* and *Gracilaria*) are common with the water often having a greenish tinge. Water quality is moderately to highly degraded (low clarity, elevated faecal coliforms, elevated nutrients) with sedimentation resulting in areas of soft muds that are often poor in oxygen with elevated sulphide concentrations. Several very eutrophic arms tend to collect organic matter and nitrogen (the major driver of eutrophication) loads are moderate[2]. A coastal risk assessment undertaken by Wriggle Coastal Management in 2008 shows that while eutrophication and sedimentation are an issue in the estuary, overall vulnerability and susceptibility ranges from very low to very good, as shown in the table below.

Table 4: Risk assessment for Jacobs River Estuary (Source: Wriggle Coastal Management, 2008)

	Existing Condition Rating	***Susceptibility Rating***	***Vulnerability Rating***
Sedimentation	*Fair*	*Low*	*Moderate*
Eutrophication	*Fair*	*Low*	*Moderate*
Disease Risk	*Good*	*Low*	*Low*
Contaminants	*Very Good*	*Very Low*	*Very Low*
Habitat Loss	*Fair*	*Low*	*Moderate*
Invaders	*Good*	*Low*	*Low*
Shellfish	*Good*	*Very Low*	*Very Low*

[1] Rissmann, C., 2012. *The extent of nitrate in Southland groundwaters: Regional 5 year median (2007-2012 (June)).* Environment Southland publication number 2012-09, Invercargill.

[2] Wriggle Coastal Management, 2008. *Southland Coast Te Waewae Bay to the Catlins: Habitat mapping, risk assessment and monitoring recommendations.* Prepared for Environment Southland, August 2008.

In 2011, it was identified that eutrophication and sedimentation have been a major issue within the estuary since at least 2007, with the overall condition described as "very poor"[3].

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 land.

Table 5: Summary of Soils, Physiographic Zone(s) and Risks

Soil Type	Vulnerability Factors			FDE Classification	*Physiographic Zones & key contaminant pathway(s)*
	Structural Compaction	N leaching	Waterlogging		
Ohai	Moderate	Medium	High	Category C (Sloping Land)	**Lignite – Marine Terraces** Overland Flow **Bedrock/Hill Country** Overland Flow **Gleyed**
Aparima	Moderate	Medium	High	Category A (Artificial Drainage or Coarse Soil Structure)	**Lignite – Marine Terraces** Artificial Drainage **Bedrock/Hill Country** Artificial Drainage **Gleyed**
Makarewa	Moderate	Very Low	High		**Gleyed**

3.3.1 Soils

Ohai soils are Perch-gley Pallic soils and are formed in fine colluvium or in weathered coal measure mudstone. These soils are stone free in the topsoil with a clay texture and are poorly drained. They have unlimited rooting depth and due to their slow subsoil permeability, there is a high risk of waterlogging (and are therefore likely to have extensive artificial drainage). However nutrient leaching risk is medium. The base saturation and anion storage capacity (or P-retention) of these soils is low (22%).

Aparima soils are classified as Brown soils (NZSC Order) and are formed in fine alluvium generally derived from greywacke rock. These soils are relatively stone free with a silty loam texture and are imperfectly drained. They have rooting depth between 45-75 cm, with a fragipan at 60-90 cm depths. Due to their slow subsoil permeability, there is a high risk of waterlogging (and are therefore likely to have extensive artificial drainage). However nutrient leaching risk is medium and have high plant available water. The base saturation and anion storage capacity (or P-retention) of these soils is medium (43%).

[3] Wriggle Coastal Management, 2011. *Jacobs River Estuary: Macroalgal Monitoring 2010/11*. Prepared for Environment Southland, July 2011.

Makarewa soils are classified as Gley soils (NZSC Order) and are formed in fine alluvium generally derived from greywacke rock. These soils are relatively stone free with a silty clay texture and are poorly drained. They have deep rooting depth and due to their slow subsoil permeability, there is a severe risk of waterlogging (and are therefore likely to have extensive artificial drainage) however nutrient leaching risk is slight due to their high water holding capacity. These soils have moderate organic matter levels which combined with their poor drainage means they are likely to have increased denitrification potential. The base saturation and anion storage capacity (or P-retention) of these soils is moderate (generally between 30-50%).

3.3.2 Farm Dairy Effluent Classification

This section examines the existing dairy platform only because it is not proposed to apply FDE to either of the new blocks. Policy 42 of the RWPS identifies criteria for minimum management of the application of effluent to land and is summarised in the table below.

Table 6: Minimum management criteria for a land applied effluent system to achieve

	Category A	Category C
Soil and Landscape feature	Artificial drainage or coarse soil structure	Sloping Land
Application depth (mm)	Less than soil water deficit	
Instantaneous application rate (mm/hr)	Not an essential criterion, however level of risk and management is lowered if using low application rates	Less than soil infiltration rate
Average application rate (mm/hr)	Less than soil infiltration rate	
Storage requirement	Apply effluent only when a soil water deficit exists	
Maximum N load	150 kg N/ha/year	

Accounting for these criteria, the irrigation system proposed is a low rate pod irrigation system and travelling irrigator, with a maximum application depth of 15 mm and rate of 10 mm/hour. Depths of up to 15mm are appropriate on Category A and C soils so long as a soil water deficit at least matching the depth of application is available.

It should be noted that whilst there are areas on the existing dairy platform are classed at Category C, this land has a slope of less than 7 degrees (see s42A report for APP-302700-01-V1). Consequently, an amendment to Discharge Permit AUTH-302700-01-V1 was granted in 2016 because it was considered suitable to use the travelling irrigator on this land.

A low rate system is generally preferred because it minimises risks of run-off and incorporating low rate application of effluent over the soils with mixed contour and good drainage is suitable. This is consistent with Policy 42 of the RWPS.

3.3.3 Physiographic Zones

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 Bedrock/Hill Country zone comprises predominately undulating to sloping land where soils overlie bedrock or glacial till. This zone occurs across prominent landforms and has no significant areas of groundwater. Contaminant loss to surface water is the main water quality risk associated with this zone. In areas where there are steeper slopes, this predominately occurs as overland flow and in flatter areas, artificial drainage often occurs (particularly around the base of hills). Similar to the Gleyed zone, soils within this zone have some denitrification ability provided there is sufficient residence of drainage water within the soil matrix. Given the generally flat to undulating slopes on this property, artificial drainage represents the major contaminant pathway.

The Lignite – Marine Terraces zone refers to areas where organic-rich sediment occurs at or near the land surface. This zone within the Ohai, western Southland area comprises predominately coal sediments, and occurs over flat to gently undulating land. Contaminant loss to surface water is the main water quality risk associated with this zone. In areas where there are steeper slopes, this predominately occurs as overland flow and in flatter areas, artificial drainage often occurs (particularly around the base of hills). Similar to the Gleyed zone, soils within this zone have high rates of denitrification ability given that the area comprises of coal sediments and therefore in close proximity to organic carbon sediments.

Given the generally flat to undulating slopes, along with the overland flow variant and Category C (sloping land) soil classification on this property, both artificial drainage and overland flow represent major contaminant pathways.

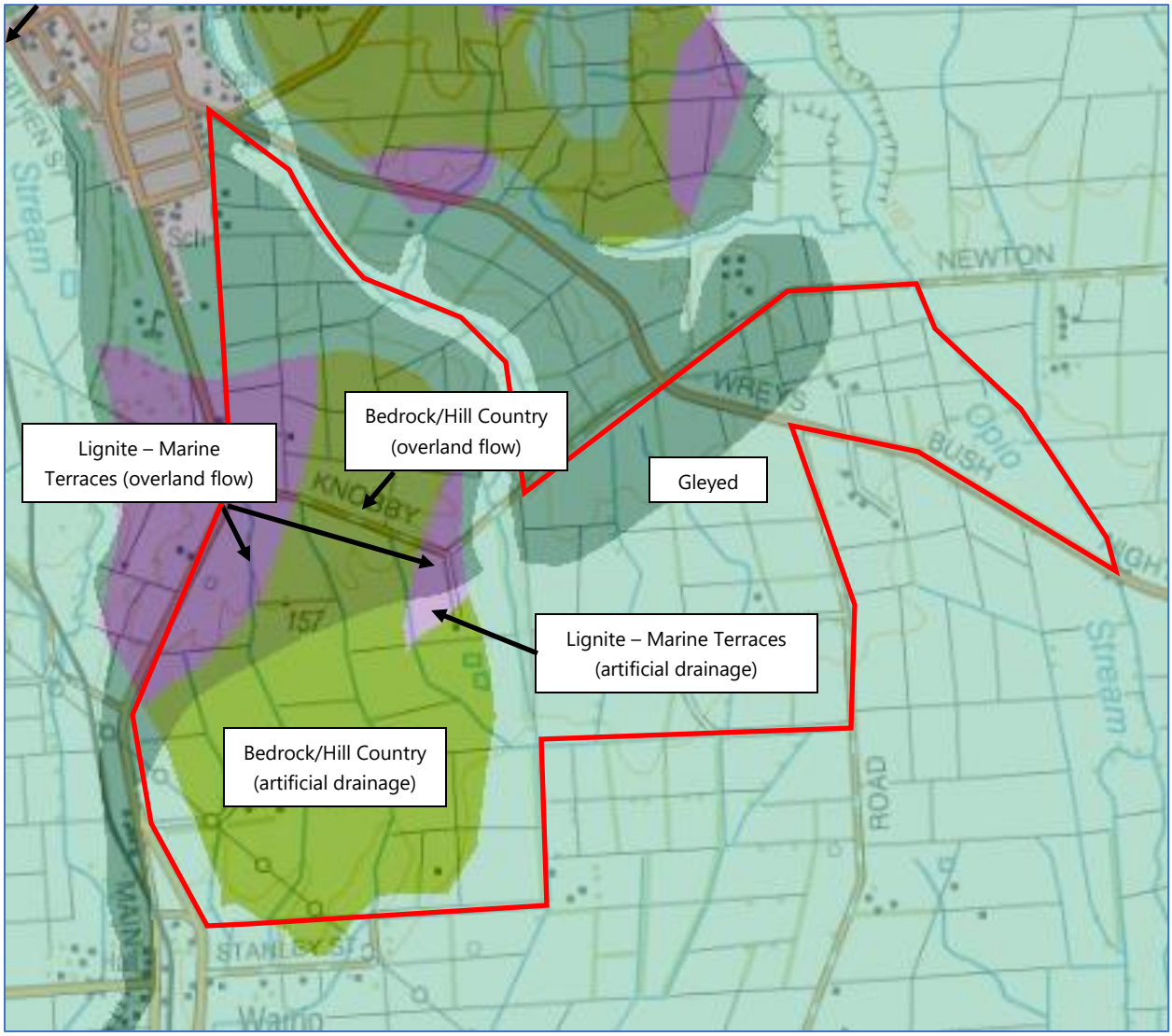

Figure 10: Physiographic zones present across the property

3.3.4 Summary

The Northern Block (north of Knobby Road) is dominated by sloping land, soil types and physiographic zone variants that pose a risk of contamination via overland flow. No effluent will be discharged on the Northern Block, so it is only the grazing of stock that must be managed in such a way as to prevent transport contamination via overland flow.

The Eastern Block is dominated by flatter land, soil types and physiographic zone variants that pose a risk of contamination via artificial drainage. No effluent will be discharged on the Eastern Block, so it is only the grazing of stock that must be managed in such a way as to prevent transport contamination via artificial drainage.

The existing dairy platform is dominated by flatter land, soil types and physiographic zone variants that pose a risk of contamination via artificial drainage. Effluent disposal and grazing of stock on the flatter land to the south of Knobby Road will need to be managed in such a way as to prevent transport contamination via artificial drainage.

Figure 11: Northern Block, which is dominated by more rolling country. This image also shows the intensity of winter cropping that has been occurring on this block.

Figure 12: Existing dairy platform, which is dominated by flatter land

4. ACTIVITY CLASSIFICATION

4.1 Consents Required

The following resource Consents are required under the Regional Effluent Land Application Plan, 1998 (RELAP), Regional Water Plan for Southland, 2010 (RWPS) and Proposed Southland Water and Land Plan, 2018 (PSWLP).

Table 7: Applicable Rules

Consent	Plan	Rule	Activity Status
Discharge Permit to discharge agricultural effluent to land	RELAP	5.4.6	*Discretionary*
	RWPS	50(d)	*Restricted Discretionary*
	PSWLP	35(c)	*Discretionary*
Water Permit to abstract groundwater for dairy shed wash down and stock drinking	RWPS	23I(i)	*Restricted Discretionary*
	PSWLP	54(d)	*Discretionary*
Land Use Consent to use land for dairy farming	PSWLP	22(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 8: 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

Activity	Compliance with the relevant permitted rules of the RWPS and PSWLP
	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 will 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

Effluent will be applied using a travelling irrigator at a rate of no more than 10 mm/hr and 15 mm depth to Category A and C soils. There will be no change to the existing disposal area, which is located on the existing dairy platform to the south of Knobby Road. Whilst there are areas to the south of Knobby Road that are classed at Category C, this land is actually not very sloping. Consequently, an amendment to Discharge Permit AUTH-302700-01-V1 in 2016 because it was considered suitable to use the travelling irrigator on this land.

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.

Careful irrigation scheduling will maintain nutrients within the top 200 mm of soil[4], 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 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. This low rate application will ensure the main risk, artificial drainage, is avoided.

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.

[4] 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

6.1.2 Storage

Currently, effluent storage at the farm consists of a 4-year old, clay-lined effluent pond. Given the age and excellent maintenance of the pond, a pond drop test has not been conducted, nor is it considered necessary as part of this application, despite it being clay-lined. The applicant chose not to line the pond with an HDPE liner because good clay was available locally and the presence of a liner can cause its own problems, such as presenting the risk of tearing the liner. As can be seen from the photos in Section 2 of this report, the pond has been kept in immaculate condition. The chance of this pond being unsuitable for the storage of effluent (i.e. the chances of it leaking) are extremely low and therefore a pond drop test is considered to be superfluous as part of this consent application.

The attached DESC shows that the pond is more than adequately sized for the proposed use. Providing 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 14,508 m^3 of FDE per year. This equates to 59 m^3/ha/yr based on an irrigation area of 245 ha. Using DairyNZ (2010) guideline N concentration of FDE of 0.45 kg/m^3, this equates to an annual loading rate of 27 kg N/ha/yr (assuming all areas receive an equal amount of effluent. An areal loading of 27 kg N/ha/yr equates to 18% 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.

The applicant uses a greenwash system, but this only reduces the volume of effluent generated marginally (an average of 20% less effluent generated). This may increase the concentration of N in the effluent, but it would not necessarily result in 20% more concentrated effluent. If it did, it could result in an aereal loading of 32 kg N/ha/yr, which still only equates to 21% of ES's recommended maximum areal rate of 150 kg N/ha/yr for all N inputs.

ES's recommended maximum areal rate of 150 kg N/ha/yr is supported by the 2009 report for ES by AgResearch[5] 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.

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.

[5] 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

6.1.4 Disposal Area

A total disposal area of 245 ha provides a disposal area to stock ratio of 19 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) accounts for 97% of total N input[6]; and
- Drainage equates to 417 mm/yr (based on land surface recharge for the Upper Aparima Groundwater Management Zone[7]); 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 will be 0.19 g/m^3. These concentrations are well within limits set by the New Zealand Drinking Water Standards, 2005.

According to ES's Beacon GIS, the nearest registered drinking water supply is at Otautau, which is over 16 km downstream. There are not expected to be any adverse effects associated with nutrient losses from the proposed activity on this drinking water supply because of the very low calculated level of TN in drainage water and the distance to Otautau.

There are no downstream potable drinking water supplies beyond the applicant's property that will be adversely affected by the proposed activity.

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

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

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 adverse effects on water quality should be avoided as far as reasonably practicable.

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.

6.1.8 Monitoring

No monitoring is proposed other than that provided for in the Farm Environmental Management Plan (FEMP) that will be prepared once the requirements for FEMPs in the new Water and Land Plan are known.

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 not expected 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

Results from Overseer Modelling

Overseer was used to model losses from all three blocks for the past four years, when the new blocks were used for intensive winter grazing and sheep breeding/finishing. If the new blocks were added to the existing dairy farm but the use of that land was not changed, average nutrient losses from the whole landholding would be:

- 51 kg N/ha/yr
- 1.1 kg P/ha/yr

This is equivalent to 24.7 tonnes of N and 0.56 tonnes of P per year[8]. These figures represent modelled long-term average losses with inherent uncertainties and are in no way absolute.

[8] *If the 2018 wintering activity was excluded from this modelling then the modelled losses would be 46 kg N/ha/yr and 1.1 kg P/ha/yr, which is what was presented in a previous consent application lodged 6 August 2018. Given the time that has elapsed since that consent application was lodged, it is appropriate to include the most recent data in this consent application. Furthermore, the applicant has indicated that if he is not able to milk off the Northern Block, then he will continue to use the Northern Block for intensive winter grazing at a rate equal to, or greater than, that currently occurring.*

Overseer has also been used to model the proposed scenario, which sees 150 extra cows being milked at the farm and the new blocks being used to graze dairy cows. Average nutrient losses from the entire landholding are predicted to be:

- 45 kg N/ha/yr
- 1.2 kg P/ha/yr

This is equivalent to 21.9 tonnes of N and 0.58 tonnes of P per year. These figures represent modelled long-term average losses with inherent uncertainties and are in no way absolute.

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

- Decrease in the winter crop area;
- Decrease in the cows wintered; and
- Decrease in stocking rate.

The applicant is happy for the maximum number of cows wintered on (1,200) to be imposed as a condition of consent. Allowing the applicant to winter the milking herd on the landholding will provide the applicant with greater ability to manage the overall effects of the operation. If the herd was sent to another landholding for winter, then the applicant would not be able to manage the environmental effects from this activity.

Phosphorous

The modelling undertaken as part of this consent application indicates that there could be a 3% increase in the amount of P lost to water from the landholding following the expansion of the dairy farm (from 0.56 tonnes to 0.58 tonnes per year).

The attached nutrient budget executive summary report notes:

> *When using the crop model in Overseer, the contour is not entered. It is therefore likely that the phosphorus loss* (from the current environment) *is underestimated (as the loss pathway is overland flow, which will be increased with the rolling contour). For example, the "Reducing surface runoff from grazed winter forage crop paddocks by strategic grazing management" trial at Telford (pallic soils of rolling contour) showed a phosphorus loss of 6.9 kg P/ha and sediment loss of 6635 kg/ha on the control sites (significantly higher than the 1.7 kg/ha of phosphorus loss estimated by Overseer in the fodder crop block report).*

This means that the P loss from the current wintering activity on the Northern Block is likely to be significantly underestimated.

Furthermore, mitigation measures and GMPs that reduce the loss of P from a dairy farm are often not accounted for when modelling using Overseer, so the losses of P modelled for the proposed scenario are likely to be over-estimated. Most of the predicted P losses are attributed to runoff from "other sources" in the Overseer model. "Other sources" includes standoff/feed pads, effluent management systems (such as from uncovered stored solid effluent), silage stacks, yards, laneways and crossings. For example, Overseer assumes that 30% of P deposited on a lane is lost to water, even if the lanes are on flat land and there are

no nearby surface water bodies. The model has assumed that there are no lanes on the new blocks and that the construction of those lanes will result in an increase in P loss to water. As noted previously, lanes were constructed on the Northern Block before the applicant acquired it. The modelled change in P loss to water from the Northern Block is, therefore, overestimated. Regarding the Eastern Block, this land is flatter and there are no waterways running through this block so there is less risk of direct runoff from any new lanes to water.

For the existing dairy farm and the Eastern Block, artificial drainage is the key contaminant pathway, 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 a key contaminant pathway in the Northern Block. A Farm Activity Focus Plan has been prepared for this block and the maps within show that vulnerable drains and waterways across the Northern Block have already been fenced. Critical Source Areas have also been identified and they will be managed appropriately through the implementation of the FEMP for the farm, which will contain GMPs as outlined later in this report.

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.

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. Although Council must consider activities that are authorised by a resource consent as part of the lawful existing environment (Hawthorne Estates Ltd v QLDC, 2006), modelling of *actual* cow numbers has been undertaken a more conservative approach, and is consistent with what ES have been asking for.

The applicant took over ownership of the Eastern Block in December 2017 and since the start of 2018 there have been cows grazed on this land. However, the modelling undertaken represents a conservative estimate of nutrient losses from sheep grazing only, and this has been based on Google Earth imaging, the applicant's knowledge, Beef & Lamb farm monitoring data and professional judgement. This is because there is no easy way of including only the last 5 months' activity in the nutrient budget. Plus, by assessing the losses from sheep grazing only (and excluding the cows), the modelling underestimates current losses to the environment and is, therefore, more conservative.

A less conservative assessment would model the consented cow numbers on the current milking platform (1,000), plus only the maximum cropping area that has occurred on the northern block in the past, plus the presence of cows grazed on the eastern block. This would drive up the modelled losses from the "current" scenario to over 56 kg N/ha/yr, making the proposal seem more attractive and potentially allowing more "headroom" for further intensification.

Receiving Environments Affected

The existing dairy platform contains the same physiographic zones as the new blocks, however, the "overland flow" variants are more prevalent across the Northern Block. Previously, artificial drainage had been the key contaminant pathway of concern across the dairy platform, but now overland flow is also a

significant contaminant pathway that needs to be managed. The effluent disposal area will not be extended and so there will be no discharge of effluent on the hillier land on the Northern Block. The movement and grazing of cows are, therefore, the main activities that will be occurring on the "overland flow" variants that need to be managed. Appropriate GMPs are detailed below and will be contained in the FEMP for the expanded dairy platform.

No new surface water catchments will be affected by the proposed expansion of the dairy platform.

Given that N losses are expected to decrease, the proposal will result in a reduction in cumulative N loading to the catchment. Considering that the pSWLP sets a strong direction for halting the decline in water quality, the proposed land use change will be environmentally beneficial, although there are no catchment nutrient limits set yet.

Microbial Contamination

With respect to microbiological contamination from pastoral farms, research by AgResearch[9] shows 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 suggest 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 should be less than occurring prior to the implementation of the FEMP.

6.4 Effects of Off-Farm Activities

Modelling of the proposal shows that there were previously around 1,470 cows (based on the average crop grown over the last 4 years) wintered on the Northern Block, 940 of which were from the subject milking platform. Through the cessation of the commercial wintering activity on the Northern Block, there could be around 530 cows that are now being wintered somewhere else.

According to recent advice from ES, when assessing an application for resource consent to increase cow numbers, where the increase in cow numbers is being justified or off-set by exporting some of the increased losses to an off-farm site, it may be appropriate to consider consequential effects on the receiving environment at the off-farm site if not too uncertain or remote. A legal opinion provided by ES dated 27 July 2018 identifies that the decision whether to consider alleged remoter effects, especially where other intervening activities (which require resource consents) may be more direct causes of those effects, is a matter if discretion in all circumstances. The following qualifications are listed:

- Relevant rules governing the applications and other necessary consents;
- Fairness and procedural efficiency in the particular circumstances;
- Remoteness and indirectness of effects;

[9] 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.

The legal opinion further identifies that the exercise of discretion may also be influence by a range of more general factors, including:

- A presumption that remoter effects will generally be assessed at the time they are subject to a direct application, but this is subject to the following considerations:
    - The risk that the relevant benefits of the activity will not be assessed; and
    - In the context of allocation of resources, whether conditions placed on the initial consent will be relevant to the subsequent activity.

The use of the term landholding in the pSWLP helps to clearly distinguish between activities undertaken as part of the single operating unit and those undertaken by a third party, which in turns provides ES with all the context needed to undertake the assessment above.

Any subsequent wintering activity undertaken on a different landholding will be controlled by relevant provisions of the pSWLP. The effects of the off-site wintering of up to 530 cows will not be controlled by the consent sought and would, therefore, be more adequately and appropriately assessed as part of a separate consent application made by the owner of the offsite landholding.

Nonetheless, the following provides an assessment of potential subsequent offsite effects that may result from the proposed dairy platform expansion and the "displacement" of 530 cows that were once wintered on the Northern Block.

The attached nutrient budget executive summary report identifies that if the 530 displaced cows were wintered offsite on 17.3 ha of fodderbeet,, on a site with the same characteristics as the Northern Block, then the losses of N below the root zone would be:

- 2.6 tonnes of N per year.

Modelling has shown that the proposal will result in a reduction of N losses from the landholding from 24.7 tonnes per year to 21.9 tonnes per year, a difference of -2.8 tonnes per year. This reduction in onsite losses of N is greater than the modelled potential increase in offsite losses of N (2.6 tonnes per year) resulting from the offsite wintering of 530 displaced cows[10].

There are other clear environmental benefits resulting from the proposal that are not necessarily rewarded by the Overseer modelling, as discussed in a meeting at ES on 27 September 2018:

- Less intensive land use occurring on the sloping Northern Block;
- More permanent pasture cover on the sloping Northern Block;
- Reduced stocking rate across the whole landholding;
- The milked herd will be wintered onsite, providing the applicant with greater ability to manage the overall effects of their operation.

In the meeting at ES, it was agreed that containing the applicant's wintering activity on the landholding would be the preferred approach. If the herd was sent to another landholding for winter, then the applicant

[10] Modelling has assumed that offsite conditions are comparable to those on the Northern Block. This is a conservative assessment because the Northern Block is not ideal for wintering, and so modelled losses from this block are high when compared to losses from properties that are more suitable for intensive winter grazing.

would not be able to manage the environmental effects from this activity, and the activity would not be controlled under the resulting consent sought as part of this consent application. It is clear that the onsite benefits from the proposal will be significant, and that the proposal will also guarantee a reduction in N loading to the catchment.

Whilst the potential offsite effects are not certain, and whilst there is a question as to whether offsite effects should even be considered as part of this consent application, what is certain is that the proposal will result in positive environmental effects both locally and in the wider catchment. The proposal does not seek to make full use of the potential headroom created through the "displacement" of 530 cows, and so the definite reduction of losses from the subject property can be considered to compensate, and prevail over, unknown and uncertain offsite effects when ES make a determination on this activity pursuant to s104(1)(ab) of the RMA.

6.5 Cumulative Effects

The proposal detailed in this report seeks to reduce the amount of N lost to water, which will reduce the total load of N that may accumulate further down in the catchment. Losses of P are modelled to increase slight but for the reasons outlined earlier in this report, this increase is not actually expected to occur. Overall, the proposal will result in net positive outcomes in terms of cumulative effects on the catchment.

6.6 Good Management Practices

A draft FEMP has been prepared, which contains details of Good Management Practices (GMPs) adopted by the applicant to ensure that the farm is operated in accordance with industry accepted and promoted good practice. A Farm Activity Focus Plan has already been prepared on behalf of the vendor of the Northern Block, and the applicant will be asking ES's Land Sustainability staff to prepare a Farm Activity Focus Plan for the whole dairy block if/when land use consent is granted to expand the dairy platform. This will supplement the FEMP, which will then be finalised and submitted to Council before the new land use consent is exercised.

The subject site covers three different physiographic units so requires a range of GMPs to be adopted, with the key contaminants pathways being overland flow and artificial drainage (see earlier in this report report).

The table below outlines which GMPs will be adopted and which physiographic zones they provide most benefit in. The GMPs detailed in the first three lines of the table below will be particularly effective in managing the risk of P loss to water.

Table 9: Site Specific Good Management Practices for the Subject Property

Good Management Practices to be adopted	Most effective in these zones
Protect soil structure • Re-sow bare soils as soon as possible • Wintering some of the herd off the dairy platform • Avoid grazing on steeper soils, especially when wet • Reduce stocking rate • Cultivate along contours on sloping ground	• Gleyed • Lignite-Marine Terraces (both variants) • Bedrock/Hill Country (both variants)

Manage Critical Source Areas • Restrict grazing of crop and pasture CSAs when soils are near saturation • Avoid working CSAs and their margins • Leave grassed areas (or native vegetation) around CSAs and margins • Plant and maintain riparian margins • Move troughs and gateways away from water flow paths • Reduce runoff from tracks and races (using cut offs and shaping) • Graze from the top of the slope toward the CSA at the bottom of the slope. Leave a buffer zone to be grazed last. • Use low solubility P if applying to CSAs	• Gleyed • Lignite-Marine Terraces (overland flow variant) • Bedrock/Hill Country (overland flow variant)
Reduce P loss • Reduce use of P fertilizer where Olsen P values are above agronomic optimum • Plant and maintain riparian margins	• Gleyed • Lignite-Marine Terraces (overland flow variant) • Bedrock/Hill Country (overland flow variant)
Reduce N accumulation in soil • Control the duration of grazing of pasture and forage crops • Wintering some of the herd off the dairy platform • Optimise timing and amounts of FDE application • Time N fertilizer application to meet crop demand using split applications • Re-sow bare soils as soon as possible • Reduce stocking rate	• Gleyed • Lignite-Marine Terraces (artificial drainage variant) • Bedrock/Hill Country (artificial drainage variant)
Avoid preferential flow of FDE through drains • Defer effluent application when soil conditions unsuitable • Apply effluent at low rates and depths	• Gleyed • Lignite-Marine Terraces (artificial drainage variant) • Bedrock/Hill Country (artificial drainage variant)

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

6.7 Existing Conversion Permit

Land Use Consent AUTH-302700-02 was granted on 14 January 2014 to authorise the conversion of land to a dairy farm and applied to what is now the current dairy platform. This consent required the consent holder to submit a Farm Environmental Management Plan, and this was provided with the original consent application. This FEMP will soon be superseded by the FEMP that will be finalised before the new land use consent is exercised (see Section 6.7 of this report).

The original consent application stated that all waterways will be planted over the first five years of the conversion but does not specify what will be planted. All riparian margins contain established vegetation and planting of trees is widespread across the farm. In the unlikely event that any additional planting is required, this will be identified when ES's Land Sustainability staff prepare a Farm Activity Focus Plan for the whole farm.

The applicant wishes to surrender Land Use Consent AUTH-302700-02.

6.8 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 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 that 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.

6.9 Assessment of Alternatives

Clause 6(1) of the Resource Management Act requires that an assessment of environmental effects must include a description of any possible 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 a 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.

6.10 Summary

This proposal seeks to expand the footprint of an existing dairy farm, increase the number of cows milked, but decrease the intensity of the farming operation through a reduction in the stocking rate for the dairy farm. Modelling indicates that the proposal will reduce the amount of N lost to water. The modelled very slight increase in P loss is not actually expected to occur.

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 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 reduced losses to the environment and no cultural values will be compromised.

Overall, no adverse effects over and above those occurring from the existing dairy farm (which forms part of the existing environment) are proposed. For the reasons outlined in this report, such as the implementation of the FEMP, the proposal should even result in a reduction in environmental effects associated with the existing land use activities.

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 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, 2007
- Regional Effluent Land Application Plan, 1998
- 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 Effluent Land Application Plan, 1998

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

Policy 4.2.1 – Protect the sustainability of the soil ecosystem from adverse effects of effluent and sludge discharges onto or into land

Policy 4.2.2 – Utilise land treatment of effluent
Policy 4.2.3 – Avoid where practicable, remedy or mitigate adverse effects on water
Policy 4.2.7 – Promote good practice and regular maintenance of effluent systems
Policy 4.2.9 – Avoid where practicable, remedy or mitigate any adverse effects on amenity values
Policy 4.2.10 – Monitor, as appropriate, discharges of effluent

The proposal is not contrary to any of these policies. Effluent will be applied as a low rate so that it can be taken up by plants, which helps to maintain the soil ecosystem and prevent bioaccumulation of contaminants. Adverse effects on water will be avoided, remedied and mitigated as far as reasonably practicable. The effluent system will be maintained and managed appropriately in accordance with the FEMP. No impacts on amenity are anticipated from the discharge of FDE as it's an existing activity.

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 10: 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 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.
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 is no expected to 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 11: 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 applications and preparing or considering Farm Environmental Management Plans.	Potential effects in these physiographic zones and appropriate GMPs are discussed earlier in this report. The proposal will see a reduction in N losses from the subject landholding and the physiographic zones contained within, and a reduction in the intensity of wintering occurring on the Northern Block (where the risk of contaminant transportation via overland flow is greatest). Overall, the proposal will result in positive effects on water quality, both locally and in the wider catchment.
13	1. Recognise that the use and development of Southland's land and water resources, including for primary production, enables	Granting of the consents sought will enables people and communities to provide for their

	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.	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.
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.	1(b) The proposal seeks to slightly decrease the actual losses to the environment and would be seen to significantly reduce the losses if compared to the consented activities. There are no adverse effects expected over and above what are currently occurring, and so the proposal will not result in a reduction in the quality of groundwater, or water in any receiving surface water body. Given the very conservative assessment provided in this report, the proposal is actually expected to result in an improvement to the quality of the receiving environment. 2 The applicant's intentions regarding the FEMP are discussed elsewhere in this report. A Farm Activity Focus Plan has been developed for the Northern Block, but the use of this block is going to be changing and so Dave Moate from ES has been contacted to come out and prepare a new Farm Activity Focus Plan for the whole farm. This will detail the setbacks, fencing, riparian planting and avoidance of CSAs

	3. When considering a resource consent application for farming activities, consideration should be given to the following matters: (a)… (b) granting a consent duration of at least 5 years.	that the applicant is already doing. 3. The consent term sought is discussed later in this report.
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 weeping wall and effluent pond, which have both 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;	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.

	2. avoid, remedy or mitigate significant adverse effects from the use and development of groundwater resources on: (a) long-term aquifer storage volumes; (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 with a very slight increase in allocation that is well within the 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	The proposed rate of abstraction is less than 2 L/s as an average over 24 hrs and so none of the

	waterway and mahinga kai, taonga species or the habitat of trout and salmon; 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.	adverse effects listed in this policy are expected.
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.
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....	This report discusses the contaminant transportation mechanisms through the identification of the physiographic zones present.
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; 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;	The consent term sought is discussed later in this report.

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

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 other 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.

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. Whilst the potential effects are reasonably well understood, the advances in research and development suggest that there is still a lot to be understood. It is because of this that a 35-year term is not proposed.

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 10-year consent 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. 10 years) will better enable implementation of any revised framework establish 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 happy for ES to impose 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. These consents must not be exercised until any current consents for the same activity have been surrendered or have expired.

9. CONCLUSION

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

a) It is expected that 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, Council policy 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 are not expected to result in further degradation of water quality and potential adverse effects will be avoided, remedied or mitigated as far as practicable.

Attachment A

Dairy Effluent Storage Calculator
Summary Report

Regional authority: Environment Southland Regional Council
Authorised agent: Landpro
Client: Mike and Cindy Adams
Program version: 1.48
Report date: Wednesday, 14 March 2018
General description:

This storage pond calculation is based on the following assumptions, Any changes to irrigation practices or other inputs should be re-run through the calculator to ensure that sufficient storage is provided.

Storage has been sized for 1,300 cows milked twice daily for a total milking time of 5 hours per day. Catchment areas in the shed include 800m2 plus 200m2 of other areas.

Irrigation infrastructure has been based on two sets of 6 pods to pump for a total of 4 hours per day including one shift after two hours pumping to achieve an application depth of 5mm.

Washwater has been entered at 40 litres/cow/day

Climate

Rainfall site: Nightcaps
Mean annual rainfall: 1005 mm/year

Effluent Block

Area of low risk soil: 0.0 hectares
Minimum area of high risk soil: 245.0 hectares
Surplus area of high risk soil: 0.0 hectares

Wash Water

Yard wash:

- Milking season starts: 01 August
- Milking season ends: 15 May

Month	Number of Cows	Hours in Yard	Wash Volume (cubic metres)
January	1300	5.0	52.0
February	1300	5.0	52.0
March	1300	5.0	52.0
April	1300	5.0	52.0
May	650	5.0	26.0
June	0	0.0	0.0
July	0	0.0	0.0
August	650	5.0	26.0
September	1300	5.0	52.0
October	1300	5.0	52.0
November	1300	5.0	52.0
December	1300	5.0	52.0

Irrigation

Winter-spring depth:	5 mm
Spring-autumn depth:	6 mm
Winter-spring volume:	176 cubic metres
Spring-autumn volume:	176 cubic metres
Irrigate all year?	Yes

Catchments

Yard Area:	800 square metres
Diverted?	Yes
- diversion start:	15 May
- diversion end:	31 July
Shed Roof Area:	175 square metres
Diverted?	Yes
Feedpad Area:	0 square metres
Covered?	No
Diverted?	No
Animal Shelter Area:	0 square metres
Covered?	No
Diverted?	No
Other Areas:	200 square metres

Storage

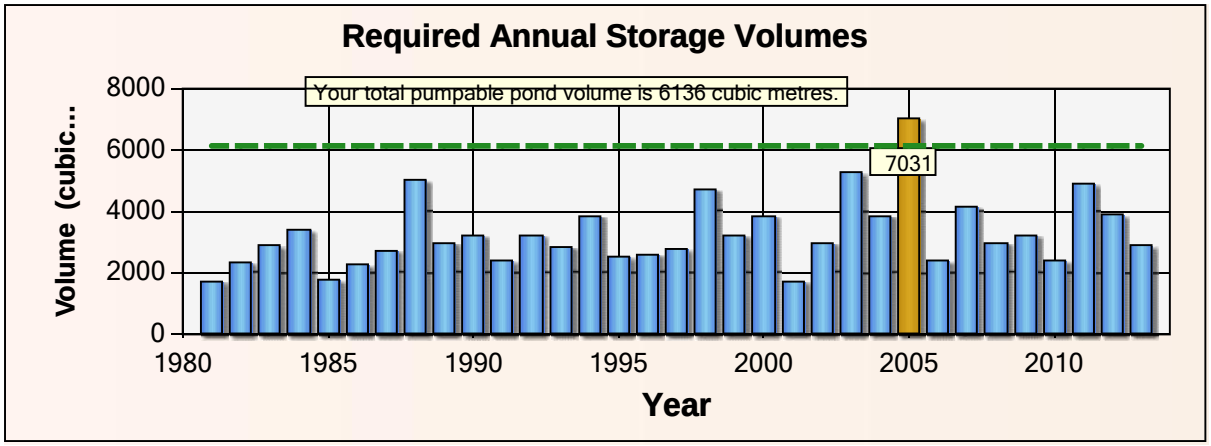
Pond/s present?	Yes
No. of ponds:	1 pond/s
Includes irregular ponds?	No
Pond 1	
- total volume:	8511 cubic metres
- pumpable volume:	6136 cubic metres
- surface area:	3500 square metres
- width:	56.0 metres
- length:	62.5 metres
- batter:	2.0:1
- total height:	3.0 metres
- pumped?	Yes
Tank/s present?	No
Emergency storage period:	3 days

Solids Separation

Solids separator/s present?	No

Outputs

Maximum required storage pond volume:	7031 cubic metres
90 % probability storage pond volume:	4752 cubic metres
During the period from:	01 July 1980
To:	30 June 2013


Required Annual Storage Volumes
Your total pumpable pond volume is 6136 cubic metres.
7031
Volume (cubic...
8000
6000
4000
2000
0
1980
1985
1990
1995
2000
2005
2010
Year

Attachment B

FARM ENVIRONMENTAL MANAGEMENT PLAN

A: Property Overview

Contact Person(s)	Mike and Cindy Adams	**Plan Prepared By**	Landpro Ltd
Contact Phone	027 225 7097	**Date**	1 October 2018
Email Address	cindyl@xtra.co.nz	**Date of Next Review**	1 October 2019
Physical Address	1079 Aparima Road, Wairio		
Consent Numbers and Expiry Dates	TBC		
Farm Area	487.8 ha	**Peak Milked Herd Size**	1,150
	Pt Secs 17, 21, 124 Wairio SD, Secs 131, 132, 338 Wairio SD, Sec 1 SO Plan, Lot 1 DP 13608, CLOSED Road Wairio SD		

Legal Descriptions

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 adverse effects on water quality; and
- Take all practicable steps to ensure that there is an adequate supply of soil nutrients to meet plant needs.

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	TBC
Lakes, rivers, streams ponds, artificial watercourses, modified watercourses and natural wetlands	TBC
Other critical source areas (gullies, swales etc)	TBC
Land with a slope greater than 20 degrees	TBC
Existing and proposed riparian vegetation and fences (or other stock exclusion methods) adjacent to waterbodies	TBC
Places where stock access or cross water bodies (including bridges, culverts and fords)	TBC
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 (✓)	
	Overland Flow[1]	Artificial Drainage[1]
Lignite – Marine Terraces	✓	✓
Bedrock/Hill Country	✓	✓
Gleyed	-	✓

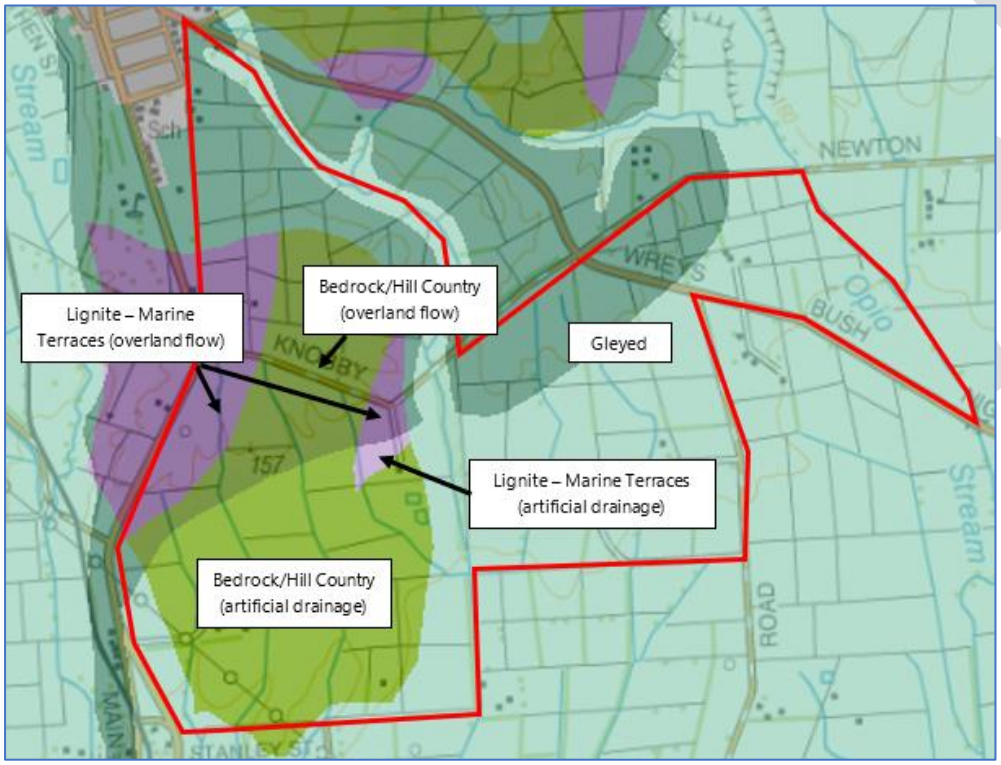


Figure 1: Physiographic Zones and variants present

Figure 1 shows that:

- The Gleyed physiographic zone is the predominant physiographic zone in the eastern part of the farm;
- The artificial drainage variants of the Bedrock/Hill Country and Lignite – Marine Terraces physiographic zones occur on the central and southern parts of the farm where the topography is gently rolling;
- The overland flow variants of the Bedrock/Hill Country and Lignite – Marine Terraces physiographic zones occur on the northern part of the farm where there is steeper topography; and
- The key contaminant pathway in the northern part of the farm is overland flow, but artificial drainage is the key contaminant pathway across the rest of the farm.

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 are shown on the attached plans.

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. Reduce stocking rate to 2.4 cows/ha	Whole farm
	2. Winter no more than 1200 cows on the dairy platform	
	3. Re-sow bare soils as soon as possible	
	4. No grazing on steeper slopes when soils are near saturation	Northern Block
	5. Cultivate along contours on sloping ground	
Manage Critical Source Areas (will also help to reduce P loss)	6. Use low solubility P if applying to CSAs	Whole farm
	7. Avoid working CSAs and their margins	
	8. Leave grassed areas (or native vegetation) around CSAs and margins	
	9. All riparian margins to be fenced and vegetation managed	
	10. Move troughs and gateways away from water flow paths	
	11. Reduce runoff from tracks and races (using cut offs and shaping)	
	12. Graze from the top of the slope toward the CSA at the bottom of the slope, leave a buffer zone to be grazed last	Northern Block
Additional P loss reduction GMPs	13. Reduce use of P fertilizer where Olsen P values are above agronomic optimum	Whole farm

Mitigation	Good Management Practice	Area where most effective
Additional GMPs to reduce accumulation of N in soil	14. Time N fertilizer application to meet crop demand using split applications	Whole farm
	15. Optimise timing and amounts of FDE application	FDE disposal area
Avoid preferential flow of FDE through drains	16. Defer effluent application when soil conditions unsuitable	
	17. 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.

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 – 13 and 15 - 17).

Cultivation practices are included in the table above (particularly GMPs 3, 5, 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 8 & 9) and addressed in more detail below.

E: Riparian Management

A tributary of the Waicolo Stream runs through the property and the Opio Stream is to the east of the farm. The Wairio Stream is to the west of the farm. There are several smaller, and sometimes ephemeral tributaries that run through the property. The Waicolo Stream, Opio Stream and Wairio Stream are all tributaries of the Otautau Stream, which is a tributary of the Aparima River. The property is wholly contained within the Aparima Surface Water Management Zone.

All waterways across the property have been fenced to prevent stock access, as shown on Attachment X. 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 X. 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):	245 ha	**Available Storage Volume:**	8,511 m^3	**Storage Type:**	Clay-lined pond
Effluent Application Method(s):		Briggs Travelling Irrigator and low rate pods. Slurry tanker may be used on rare occasions, such as desludging the pond.		**Maximum Rate and Depth of Application:**	10 mm/hr rate and 15 mm average depth per application

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	Record irrigation dates, times, areas on the Irrigator run sheet (attached)

Mitigation	Good Management Practice	Monitoring
	• Effluent disposal will be to an area of at least 4 ha/100 cows	
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

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 sludge bed levels and if it needs clearing, shift solids to drying area		
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.

DairyNZ

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.

DairyNZ

Attachment C

Overseer Modelling Report

Prepared as part of a consent application for expanded dairying

Report prepared for:

M & C Adams

1079 Aparima Road

Wairio

Report Prepared In Collaboration By:

Miranda Hunter, Roslin Consultancy Limited

miranda.hunter@xtra.co.nz 0274 341 140

B.Agr.Sci

And:

Mo Topham, FarmWise Consultant

Mo.topham@lic.co.nz 0275467623

B.Agr.Sci SNM (Advanced)

2nd October 2018

Executive Summary

The property is located in the Western Southland area and operates as a milking platform and is consented to peak milk 1000 cow and all cows are wintered off. It is intended to purchase two neighbouring properties – a dairy support unit and a sheep breeding and finishing unit. It is proposed to expand the dairy platform onto the two purchased blocks, increase the peak cow numbers to 1150 and winter the cows on farm.

Using Overseer (version 6.3) nutrient budgets have been constructed for the current land use (using actual cow numbers of 900 cows rather than consented cow numbers of 1000 cows) and a proposed dairy unit nutrient budget to inform the consent application for expanded dairying.

Predicted results from the Overseer modelling are shown below:

	Current Milking Platform (900 cows)	**Current Dairy Support Block**	**Current Sheep Breeding Block**	**Total Current Land Use**
Total Farm N Loss	15092 kg	8198 kg	1395 kg	24685 kg
N Loss/ha	46	82	23	51
N Concentration in Drainage	Pastoral – 9.2 to 14.1 ppm Crop – 10.7 to 39.7 ppm	Pastoral – 4.9to 5.7 ppm Crop – 29.5 to 33.7 ppm	Pastoral – 3.2 – 3.6 ppm Crop – 27.1 ppm	
Total Farm P Loss	349 kg	175 kg	36 kg	560 kg
Average P loss/ha	1.1 kg/ha/yr	1.8 kg/ha/yr	0.6 kg/ha/yr	1.1 kg/ha/yr
Pasture Grown Kg DM / ha / year	16.1	11.0	14.0	

Table 1: Summarised predicted results from the Overseer analysis of the Adams current nutrient budgets

	Proposed Dairy Unit (1150 cows)
Total Farm N Loss	21893 kg
N Loss/ha	45
N Concentration in Drainage	Pastoral – 7.4 to 10.9 ppm Crop – 9.3 to 26.9 ppm
Total Farm P Loss	579 kg
Average P loss/ha	1.2 kg/ha/yr
Pasture Grown Kg DM / ha / year	15.8

Table 2: Summarised predicted results from the Overseer analysis of the Adams proposed nutrient budget

Using Overseer, nutrient budgets have been constructed for Adams, comparing the nutrient loss of the current farm system against the proposed farm system. Overseer has predicted that the nitrogen loss will decrease and phosphorus loss will increase slightly (by less than 5%).

Key drivers for the reduction in nitrogen loss are:

- Decrease in winter crop area
- Decrease in cows wintered
- Decrease in stocking rate (on a per hectare basis)

Key drivers for the increase in phosphorus loss are:

- An increase in losses from "other sources"

Off Site Effects

The impact of off site effects of extra cow wintering has been raised by Environment Southland in a pre lodgement meeting. While the interpretation of this is unclear, an attempt has been made below to account for the off site effects.

There were previously around 1,470 cows (based on the average crop grown over the last 4 years). Through the cessation of the commercial wintering activity on the support block, there could be around 530 cows that are now being wintered somewhere else.

	Cows Wintered On Land Holding	**Cows Wintered Off Land Holding**	**Total Cows**
Current	1470	940 (Adams)	2410
Proposed	1200	1470 (3rd party)	2670
	Increase of	**530 cows wintered**	Off land holding

Assuming the extra 530 cows are wintered on a 25 t DM crop of fodderbeet, they would require 17.3 ha of fodderbeet (9 kg DM of fodderbeet for 77 days at 85% utilisation).

Assuming that the fodderbeet crop on average has the following loses (based on the modelling assumptions from the current neighbouring dairy support block of an average N loss of 148 kg N / ha and 1.6 kg P / ha))

- 2560 kg N on 17.3 ha of fodderbeet
- 28 kg P on 17.3 ha of fodderbeet

	Proposed Dairy Unit (1150 cows)	**Off Site Effect of 530 extra cows on 17.3 ha fodderbeet**	**Proposed 1150 cows plus offsite effect**
Total Farm N Loss	21893 kg	2560 kg	24453
Total Farm P Loss	579 kg	28	607

Table 3: Assessment of the off site effects of Adams proposal (calculated outside of Overseer)

Note

The above should be interpreted with caution

- The land would have been used for another land use prior to cow wintering off site , the nutrient loss of this prior activity has not been taken account of (and would reduce the offsite effect of the extra cows)
- Different locations (different soils and climate) would provide different loss data
- This assumes that the cows are alive and wintered in Southland (and on crop)

Recommendations from here

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:

- Ensure there are appropriate buffer zones in place for winter grazing to reduce the risk of sediment runoff
- Winter crops should be grazed with the use of back fences and portable water troughs. A grazing plan of the winter crop should be developed to take into account the contour of the paddock and any waterways.
- 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.

The nutrient budgets within this report have been developed assuming that soil fertility is at the agronomic optimum and that maintenance fertiliser is applied each year. 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.

Introduction

The property is located in the Western Southland area and operates as a milking platform and is consented to peak milk 1000 cow and all cows are wintered off. It is intended to purchase two neighbouring properties – a dairy support unit and a sheep breeding and finishing unit. It is proposed to expand the dairy platform onto the two purchased blocks, increase the peak cow numbers to 1150 and winter cows on farm.

Using Overseer (version 6.3) nutrient budgets have been constructed for the current land use (using actual cow numbers of 900 cows rather than consented cow numbers of 1000 cows) and a proposed dairy unit nutrient budget to inform the consent application for expanded dairying.

Local Environment and Current Regulations

The proposed Southland Water and Land Plan has been notified by Environment Southland and is currently in the appeals process.

Key elements of the Southland Water and Land Plan are as follows:

- The use of physiographic zones to inform policies and rules in the plan
- Use of good management practices and farm environmental management plans
- A focus on new dairy farming and intensification
- Implementation plan for stock exclusion from waterways
- Buffer zone requirements for cultivation on sloping land
- Importance of discharges from tile drains
- Surface and ground water takes
- Management of biodiversity

This report will emphasise the relevant requirements in the Southland Water and Land Plan from a nutrient budgeting perspective. The broader range of requirements should be captured in the Farm Environment Plan. The Farm Environment Plan is outside the scope of this report, however this report will inform the Farm Environment Plan

Current Land Use

The current milking platform of 327.9 ha (310.0 ha effective) is located in Western Southland (close to Nightcaps). The property is currently consented to peak milk 1000 cows with all cows wintered off. Following the notification of the Water and Land Plan on the 4th of April 2018 and subsequent advice from Environment Southland the current milking platform has been modelled as the actual farming enterprise (peak milking 900 cows). Calves leave the property following weaning and all heifers are grazed off. 6.0 ha of fodderbeet is planted on the milking platform to bring cows home to in the early spring and 9 ha of summer turnips are also grown. 224kg ha of inorganic nitrogen is applied, effluent is applied to 168.4 ha. 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.

The neighbouring dairy support block (of 99.6ha) is owned and operated by another farmer. Information has been provided by the neighbouring farmer to enable modelling of the current land use to be undertaken.

Winter crop has been grown as follows:

Year	Area crop (ha)
2015	30
2016	35
2017	52
2018	76

For the current land use nutrient budget the average winter crop area for the last 4 years has been assumed at 48 ha, with 1470 cows grazing the crop for 77 days (cows fed 9 kg DM in fodderbeet at 85% utilisation)

The neighbouring sheep breeding block (of 60.3ha) was purchased in December 2017. Since its purchase, it has been operated as a silage block. A full season's data is not available and the ongoing management of the block will depend on whether a consent to dairy farm the block is obtained. The block has been modelled in Overseer as per its pre purchase management – a sheep breeding and finishing property. Accurate stock numbers were not available. At the time of inspection the block was assessed as a highly productive unit. Due to lack of data, an estimate of stocking rate and management practice has been made utilising Google Earth imaging, Mike Adam's knowledge, Beef and Lamb farm monitoring data and professional judgement.

Proposed Land Use

Property management objective:

- To operate a sustainable and resilient farm system across a range of payout conditions

It is proposed to operate the total property of 487.8 ha (464.9ha effective) as a property that peak milks 1150 cows and winters 1200 cows. Calves will leave the property following weaning and all heifers are grazed off. 37 ha of fodderbeet will be planted (rotating as part of the regrassing programme), and used for autumn transition, wintering and the early spring period. 12 ha of summer turnips will also be grown. 224kg per ha of inorganic nitrogen will be applied to the non effluent areas and 196 kg per ha of inorganic nitrogen to the effluent areas. Effluent is applied to 168.4 ha. Bought in feed has been assumed to ensure that a feasible pasture growth rate is achieved in an average season when the proposed farm system is operating.

Modelling Method

Nutrient losses have been estimated using Overseer. There are a number of different methods that could be used to model the current land use. The modelling method was discussed with Fertiliser and Lime Research Centre staff at Massey University. Taking their advice the current land use has been modelled as three separate nutrient budgets (milking platform, dairy support and sheep breeding) and the results combined outside of Overseer.

As the proposed is one farm system, the proposal has been modelled as one nutrient budget.

Further information on Overseer can be found in the following reports:

- Technical Description of OVERSEER for Regional Councils, September 2015
- Review of the phosphorus loss submodel in OVERSEER®, September 2016

Overseer Version and Protocols

The nutrient budgets have been developed using Overseer 6.3 and the "Overseer Best Practice Data Input Standards, August 2016". No deviations have been made from the protocol.

Overseer Assumptions

- 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

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), fodder crop (rotating) and crop blocks.

Block Name	Soil Type	Contour	Current Milking Platform	Current Dairy Support Block	Current Sheep Breeding Block	Proposed Dairy Unit
Ohai MP Eff Flat	Auchr_9b.1	Flat	28.0			28.0
Ohai MP Eff Rolling	Auchr_9b.1	Rolling	18.7			18.7
Makarewa MP Eff Flat	Makar_3b.1	Flat	7.8			7.8
Aparima MP Eff Flat	Apar_6a.1	Flat	112.3			112.3
Aparima MP Eff Rolling	Apar_6a.1	Rolling	1.6			1.6
Ohai Non Eff Flat	Auchr_9b.1	Flat	17.6	10.1	16.4	92.1
Makarewa Non Eff Flat	Makar_3b.1	Flat	8.6	3.2	13.9	25.7
Makarewa Non Eff Rolling	Makar_3b.1	Rolling		5.3		5.3
Aparima Non Eff Flat	Apar_6a.1	Flat	99.9		27.9	127.8
Aparima Non Eff Rolling	Apar_6a.1	Rolling	0.3			0.3
Ohai Non Eff Rolling	Auchr_9b.1	Rolling	15.2	30.1		45.3
Fodderbeet (1st crop)	Auchr_9b.1			24.0		
Fodderbeet (2nd crop)	Auchr_9b.1			24.0		
	Effective Farm Area		**310.0 ha**	**96.7 ha**	**58.2**	**464.9 ha**
	Non productive area		17.9 ha	2.9 ha	2.1	22.9 ha
	Total Farm Area		**327.9 ha**	**99.6 ha**	**60.3**	**487.8 ha**
Fodderbeet (rotating)			6.0			37.0
Summer turnips (rotating)			9.0			12.0
Swedes (rotating)					6.0	

- Soils areas were obtained from soils mapping provided by LandPro and SMaps (refer appendices)
- Soil settings were obtained from SMap for all soil types
- It is assumed that 60% of the land is mole and tile drained.

Climate Data

- Southland as the location setting
- Climate station tool for the block climate data
    - 995 mm of rainfall
    - 9.6 degrees Celsius has been used as the mean annual temperature
    - Daily rainfall pattern setting 731-1450mm, low
    - 710 mm mean annual PET

Farm System

Description	**Current Milking Platform**	**Current Neighbouring Block**	**Current Sheep Breeding Block**	**Proposed Dairy Unit**
Milk solids production	432,000 kg ms Mean calving date 23rd August Dry Off 31st[h] May	N/A	NA	552,000 kg ms Mean calving date 23rd August Dry Off 31st May
Cows peak **milked** and **wintered**	<u>Breed (Fr J X)</u> July 0 Aug 940 Sept 925 Oct 900 Nov 900 Dec 900 Jan 855 Feb 855 March 810 Apr 765 May 711 June 0 Cows peak milked =900 27 bulls (Angus) Dec and Jan	<u>Breed (Fr J X)</u> May 390 June 1470 July 1470 Aug 390	<u>NA</u>	<u>Breed (Fr J X)</u> July 1200 Aug 1170 Sept 1160 Oct 1150 Nov 1150 Dec 1150 Jan 1090 Feb 1090 March 1030 Apr 970 May 900 June 1200 Cows peak milked = 1150 34 bulls (Angus) Dec and Jan
Dairy replacements on farm	234 calves (all off property by 1st of January)	200 yearling heifers from Sept to April	NA	300 calves (all off property by 1st of January)

Description	Current Milking Platform	Current Neighbouring Block	Current Sheep Breeding Block	Proposed Dairy Unit
Sheep			Wintered 521 ewes and 125 replacements 160% lambing 5 rams 3400kg wool	
Milking shed feeding	100% of cows fed during lactation	N/A	NA	100% of cows fed during lactation
Structures	None	None	NA	None
Area crop	<u>6.0 ha fodderbeet platform</u> (yield 20 t DM / ha) Conventional cultivation Nov Fert at sowing 47N, 38P, 50K, 18S 100 kg urea in Jan and March Grazed Aug and Sept with cows <u>9 ha Summer turnips</u> (yield 8 t DM / ha) Conventional cultivation Oct 350 kg CM 15 at sowing 80 kg urea in Dec Grazed by cows Feb (3 hours) Resown into pasture March	<u>24.0 ha fodderbeet (1st crop)</u> (yield 25 t DM / ha) *modelled as 18 t due to Overseer overfeeding error messages Conventional cultivation Nov Fert at sowing 175kg DAP 150 kg SustaiN (Dec and Jan) 150 kg SustaiN (March) Grazed May to Aug with cows <u>24.0 ha fodderbeet (2nd crop)</u> (yield 25 t DM / ha)*modelled as 18 t due to Overseer overfeeding error messages Conventional cultivation Nov Fert at sowing 175kg DAP	<u>6.0ha Swedes</u> (yield 12tDM/ha) Conventional cultivation November 200kg/ha DAP at sowing 40kg/ha Potassium Chloride at sowing 100kg/ha Urea in January Grazed Jun – Aug by sheep Resown into permanent pasture in October	<u>37.0 ha fodderbeet</u> (yield 20 t DM / ha) Conventional cultivation Nov Fert at sowing 47N, 38P, 50K, 18S 100 kg urea in Jan and March GrazedApril (2 hours), May (3 hours) June to Aug with cows <u>12 ha Summer turnips</u> (yield 8 t DM / ha) Conventional cultivation Oct 350 kg CM 15 at sowing 80 kg urea in Dec Grazed by cows Feb (3 hours) Resown into pasture March

Description	Current Milking Platform	Current Neighbouring Block	Current Sheep Breeding Block	Proposed Dairy Unit
		150 kg SustaiN (Dec and Jan) 150 kg SustaiN (March) Grazed May to Aug with cows		
Supplements	Imported • 480 t DM PKE (fed in paddocks) • 200 T DM of barley grain (fed in milking shed) • 400 t DM silage (fed across pastoral areas) • 50 t DM baleage (fed on fodderbeet)	• Imported • 150t DM Baleage (fed on fodderbeet)	NA	Imported • 400 t DM PKE (fed in paddocks) • 425t DM of barley grain (fed in milking shed) • 200 t DM baleage (fed on fodderbeet)
Soil tests and fertiliser	Soil fertility at the agronomic optimum and that maintenance fertiliser is applied each year.	Soil fertility at the agronomic optimum and that maintenance fertiliser is applied each year.	Soil fertility at the agronomic optimum and that maintenance fertiliser is applied each year.	Soil fertility at the agronomic optimum and that maintenance fertiliser is applied each year.
Nitrogen	224 kg N / ha split Aug to March	84 kg N / ha split Oct to April	31 kg N/ha in September	Non Effluent 224 kg N / ha split Aug to March Effluent 196 kg N / ha split Aug to March
Farm dairy effluent	Holding pond Solids separated 12 to 24mm application	N/A	NA	Holding pond Solids separated 12 to 24mm application

Description	Current Milking Platform	Current Neighbouring Block	Current Sheep Breeding Block	Proposed Dairy Unit
	58 ha required to achieve a loading of less than 150kg N / ha from effluent			71 ha required to achieve a loading of less than 150kg N / ha from effluent

Predicted Overseer Results –

	Current Milking Platform (900 cows)	Current Dairy Support Block	Current Sheep Breeding Block	Total Current Land Use
Total Farm N Loss	15092 kg	8198 kg	1395 kg	24685 kg
N Loss/ha	46	82	23	51
N Concentration in Drainage	Pastoral – 9.2 to 14.1 ppm Crop – 10.7 to 39.7 ppm	Pastoral – 4.9to 5.7 ppm Crop – 29.5 to 33.7 ppm	Pastoral – 3.2 – 3.6 ppm Crop – 27.1 ppm	
Total Farm P Loss	349 kg	175 kg	36 kg	560 kg
Average P loss/ha	1.1 kg/ha/yr	1.8 kg/ha/yr	0.6 kg/ha/yr	1.1 kg/ha/yr
Pasture Grown Kg DM / ha / year	16.1	11.0	14.0	

Table 4: Summarised predicted results from the Overseer analysis of the Adams current nutrient budgets

It should also be noted that the soils on the neighbouring support block are pallic and gleyed with a rolling contour. This greatly increases the risk of contaminant loss.

When using the crop model in Overseer, the contour is not entered. It is therefore likely that the phosphorus loss is underestimated (as the loss pathway is overland flow, which will be increased with the rolling contour). For example, the "Reducing surface runoff from grazed winter forage crop paddocks by strategic grazing management" trial at Telford (pallic soils of rolling contour) showed a phosphorus loss of 6.9 kg P / ha and sediment loss of 6635 kg / ha on the control sites (significantly higher than the 1.6 kg / ha of phosphorus loss estimated by Overseer in the fodder crop block report).

Reference: Reducing surface runoff from grazed winter forage crop paddocks by strategic grazing management /www.dairynz.co.nz/media/5787285/reducing_surface_runoff.pdf

	Proposed Dairy Unit (1150 cows)
Total Farm N Loss	21893 kg
N Loss/ha	45
N Concentration in Drainage	Pastoral – 7.4 to 10.9 ppm Crop – 9.3 to 36.9 ppm
Total Farm P Loss	579 kg
Average P loss/ha	1.2 kg/ha/yr
Pasture Grown Kg DM / ha / year	15.8

Table5: Summarised predicted results from the Overseer analysis of the Adams proposed nutrient budget

Off Site Effects

The impact of off site effects of extra cow wintering has been raised by Environment Southland in a pre lodgement meeting. While the interpretation of this is unclear, an attempt has been made below to account for the off site effects.

There were previously around 1,470 cows (based on the average crop grown over the last 4 years). Through the cessation of the commercial wintering activity on the support block, there could be around 530 cows that are now being wintered somewhere else.

	Cows Wintered On Land Holding	**Cows Wintered Off Land Holding**	**Total Cows**
Current	1470	940 (Adams)	2410
Proposed	1200	1470 (3rd party)	2670
	Increase of	**530 cows wintered**	Off land holding

Assuming the extra 530 cows are wintered on a 25 t DM crop of fodderbeet, they would require 17.3 ha of fodderbeet (9 kg DM of fodderbeet for 77 days at 85% utilisation).

Assuming that the fodderbeet crop on average has the following loses (based on the modelling assumptions from the current neighbouring dairy support block)

- Average N loss of 148kg N per ha (2560 kg N on 17.3 ha of fodderbeet)
- Average P loss of 1.6 kg P per ha (28 kg P on 17.3 ha of fodderbeet)

	Proposed Dairy Unit (1150 cows)	**Off Site Effect of 530 extra cows on 17.3 ha fodderbeet**	**Proposed 1150 cows plus offsite effect**
Total Farm N Loss	21893 kg	2560 kg	24453
Total Farm P Loss	579 kg	28	607

Table 6: Assessment of the off site effects of Adams proposal (calculated outside of Overseer)

Note

The above should be interpreted with caution

- The land would have been used for another land use prior to cow wintering off site, the nutrient loss of this prior activity has not been taken account of (and would reduce the offsite effect of the extra cows)
- Different locations (different soils and climate) would provide different loss data
- This assumes that the cows are alive and wintered in Southland (and on crop)

Conclusions from the modelling

Using Overseer, nutrient budgets have been constructed for Adams, comparing the nutrient loss of the current farm system against the proposed farm system. Overseer has predicted that the nitrogen loss will decrease and phosphorus loss will increase slightly (by less than 5%)

Key drivers for the reduction in nitrogen loss are:

- Decrease in winter crop area
- Decrease in cows wintered
- Decrease in stocking rate (on a per hectare basis)

Key drivers for the increase in phosphorus loss are:

- An increase in losses from "other sources"

These losses include predicted losses from laneways, calving pads and yards. The increase in losses from other sources includes an increase in animal excretion onto laneways. Overseer estimates amount of excreta and assumes all P ends up in dung and assumes that 30% of the P added to lanes is lost from the farm. Overseer is not spatially explicit; so 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 can not 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:

- Ensure there are appropriate buffer zones in place for winter grazing to reduce the risk of sediment runoff
- Winter crops should be grazed with the use of back fences and portable water troughs. A grazing plan of the winter crop should be developed to take into account the contour of the paddock and any waterways.
- 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.

The nutrient budgets within this report have been developed assuming that soil fertility is at the agronomic optimum and that maintenance fertiliser is applied each year. 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 and the next stage is likely to be the Limit Setting Process. It will be important to stay up to date with developments in Environment Southland policy and rules.

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

Overseer reports

Current Farm System (Milking Platform)

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	204	20	2	16	0	0	0
Rain/clover N fixation	63	0	2	4	2	5	19
Irrigation	0	0	0	0	0	0	0
Supplements	79	13	50	10	7	7	3
Nutrients removed							
As products	91	15	22	5	20	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	92	0	0	0	0	0	0
To water	46	1.1	14	30	50	4	18
Change in farm pools							
Plant Material	-3	0	-5	0	0	0	0
Organic pool	108	13	4	-6	1	1	0
Inorganic mineral	0	3	-20	0	-2	-4	-4
Inorganic soil pool	11	1	40	0	-60	9	2

Table 1 Current system nutrient budget

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
Fodder Beet Platform	1,065	177	**39.7**	116	139
Ohai MP Eff Flat	1,566	59	**14.1**	267	262
Ohai MP Eff Rolling	1,132	64	**14.1**	270	262
Makarewa MP Eff Flat	252	34	9.7	243	262
Aparima MP Eff Flat	4,342	41	**11.5**	241	262
Ohai MP Non Eff Flat	893	53	**13.3**	248	235
Makarewa MP Non Eff Flat	257	31	9.2	225	235
Aparima MP Non Eff Flat	3,650	38	10.9	223	235
Summer turnips	425	47	10.7	35	89
Aparima MP Eff Rolling	62	42	**11.5**	242	262
Aparima MP Non Eff Rolling	12	38	10.9	223	235
Ohai MP Non Eff Rolling	776	54	**13.3**	248	235
Other sources	660				
Whole farm	15,092	46			
Less N removed in wetland	0				
Farm output	15,092	46			

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

** Fertiliser, organic and effluent inputs.

N/A: N in drainage not calculate for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Table 2 Current system nitrogen report

Block name	Total P lost kg P/yr	P lost to water kg P/ha/yr	P loss categories		
			Soil	Fertiliser	Effluent
Fodder Beet Platform	8	1.3	N/A	N/A	N/A
Ohai MP Eff Flat	23	0.9	Medium	Low	Low
Ohai MP Eff Rolling	46	2.6	High	High **	Low
Makarewa MP Eff Flat	4	0.5	Low	Low	Low
Aparima MP Eff Flat	28	0.3	Low	Low	Low
Ohai MP Non Eff Flat	14	0.9	Medium	Low	Low
Makarewa MP Non Eff Flat	4	0.5	Low	Low	Low
Aparima MP Non Eff Flat	25	0.3	Low	Low	Low
Summer turnips	9	1.0	N/A	N/A	N/A
Aparima MP Eff Rolling	1	0.5	Low	Low	Low
Aparima MP Non Eff Rolling	0	0.5	Low	Low	Low
Ohai MP Non Eff Rolling	37	2.6	High	High **	Low
Other sources	151				
Whole farm	349	1.1			

** Fertiliser loss is outside the range for New Zealand data - see comments for each block

Table 3 Current system phosphorus loss report

Current Farm System (Dairy Support Block)

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	155	25	0	9	0	0	0
Rain/clover N fixation	33	0	2	4	2	5	19
Irrigation	0	0	0	0	0	0	0
Supplements	21	4	27	3	7	2	2
Nutrients removed							
As products	10	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	58	0	0	0	0	0	0
To water	82	1.8	7	26	84	6	21
Change in farm pools							
Plant Material	-8	0	-26	5	-1	-2	0
Organic pool	40	2	3	-16	1	0	0
Inorganic mineral	0	1	-21	0	-2	-4	-4
Inorganic soil pool	26	23	64	0	-77	6	4

Table 4 Support block nutrient budget

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
Fodder Beet Support (1st Crop)	3,720	155	**33.7**	263	237
Fodder Beet Support (2nd Crop)	3,386	141	**29.5**	263	237
Ohai Support Flat	232	23	5.7	140	83
Ohai Support Rollling	692	23	5.7	140	83
Makarewa Support Flat	53	17	4.9	131	83
Makarewa Support Rolling	88	17	4.9	131	83
Other sources	27				
Whole farm	8,198	82			
Less N removed in wetland	0				
Farm output	8,198	82			

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

** Fertiliser, organic and effluent inputs.

N/A: N in drainage not calculate for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Table 5 Support block nitrogen loss report

Block name	Total P lost kg P/yr	P lost to water kg P/ha/yr	P loss categories		
			Soil	Fertiliser	Effluent
Fodder Beet Support (1st Crop)	39	1.6	N/A	N/A	N/A
Fodder Beet Support (2nd Crop)	39	1.6	N/A	N/A	N/A
Ohai Support Flat	7	0.7	Low	Low	N/A
Ohai Support Rollling	64	2.1	High	Medium	N/A
Makarewa Support Flat	1	0.4	Low	Low	N/A
Makarewa Support Rolling	6	1.2	Medium	Low	N/A
Other sources	17				
Whole farm	175	1.8			

Table 6 Support block phosphorus loss report

Current farm system (sheep breeding block)

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	35	18	2	29	0	0	0
Rain/clover N fixation	91	0	2	4	2	5	19
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	48	0	0	0	0	0	0
To water	23	0.6	7	34	27	3	16
Change in farm pools							
Plant Material	-12	-1	-14	0	-1	-1	-1
Organic pool	33	8	0	-4	0	0	0
Inorganic mineral	0	1	-23	0	-2	-4	-4
Inorganic soil pool	14	7	33	0	-26	6	7

Table 7 Sheep block nutrient budget

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
Makarewa	137	11	3.2	108	31
Ohai	213	15	3.6	116	31
Aparima	306	12	3.5	106	31
Swedes	719	120	**27.1**	79	81
Other sources	19				
Whole farm	1,395	23			
Less N removed in wetland	0				
Farm output	1,395	23			

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

** Fertiliser, organic and effluent inputs.

N/A: N in drainage not calculate for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Table 8 Sheep block nitrogen loss report

Block name	Total P lost kg P/yr	P lost to water kg P/ha/yr	P loss categories		
			Soil	Fertiliser	Effluent
Makarewa	5	0.4	Low	Low	N/A
Ohai	9	0.6	Low	Low	N/A
Aparima	6	0.2	Low	Low	N/A
Swedes	9	1.4	N/A	N/A	N/A
Other sources	7				
Whole farm	36	0.6			

Table 9 Sheep block phosphorus loss report

Proposed Farm System

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	192	26	14	21	0	0	0
Rain/clover N fixation	74	0	2	4	2	5	19
Irrigation	0	0	0	0	0	0	0
Supplements	41	9	21	6	3	4	2
Nutrients removed							
As products	78	13	19	4	17	2	5
Exported effluent	0	0	0	0	0	0	0
As supplements and crop residues	0	0	0	0	0	0	0
To atmosphere	84	0	0	0	0	0	0
To water	45	1.2	13	33	50	5	18
Change in farm pools							
Plant Material	-6	0	-14	1	-1	-1	0
Organic pool	86	12	3	-8	1	0	0
Inorganic mineral	0	2	-33	0	-2	-4	-4
Inorganic soil pool	19	6	49	0	-60	7	1

Table 10 Proposed system nutrient budget

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
Fodder Beet Platform	6,147	166	36.9	300	139
Ohai MP Eff Flat	1,153	46	10.8	226	241
Ohai MP Eff Rolling	871	52	10.8	229	241
Makarewa MP Eff Flat	196	28	7.8	221	241
Aparima MP Eff Flat	3,020	30	8.4	205	241
Ohai MP Non Eff Flat	3,433	42	10.3	212	234
Makarewa MP Non Eff Flat	573	25	7.4	204	234
Aparima MP Non Eff Flat	3,229	28	8.0	191	234
Ohai MP Non Eff Rollling	1,784	44	10.9	223	234
Summer turnips	496	41	9.3	39	89
Aparima MP Eff Rolling	47	34	9.1	220	241
Makarewa MP Non Effluent Rolling	117	25	7.4	204	234
Aparima MP Non Eff Rolling	9	30	8.5	201	234
Other sources	816				
Whole farm	21,893	45			
Less N removed in wetland	0				
Farm output	21,893	45			

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

** Fertiliser, organic and effluent inputs.

N/A: N in drainage not calculate for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Table 11 Proposed system nitrogen loss report

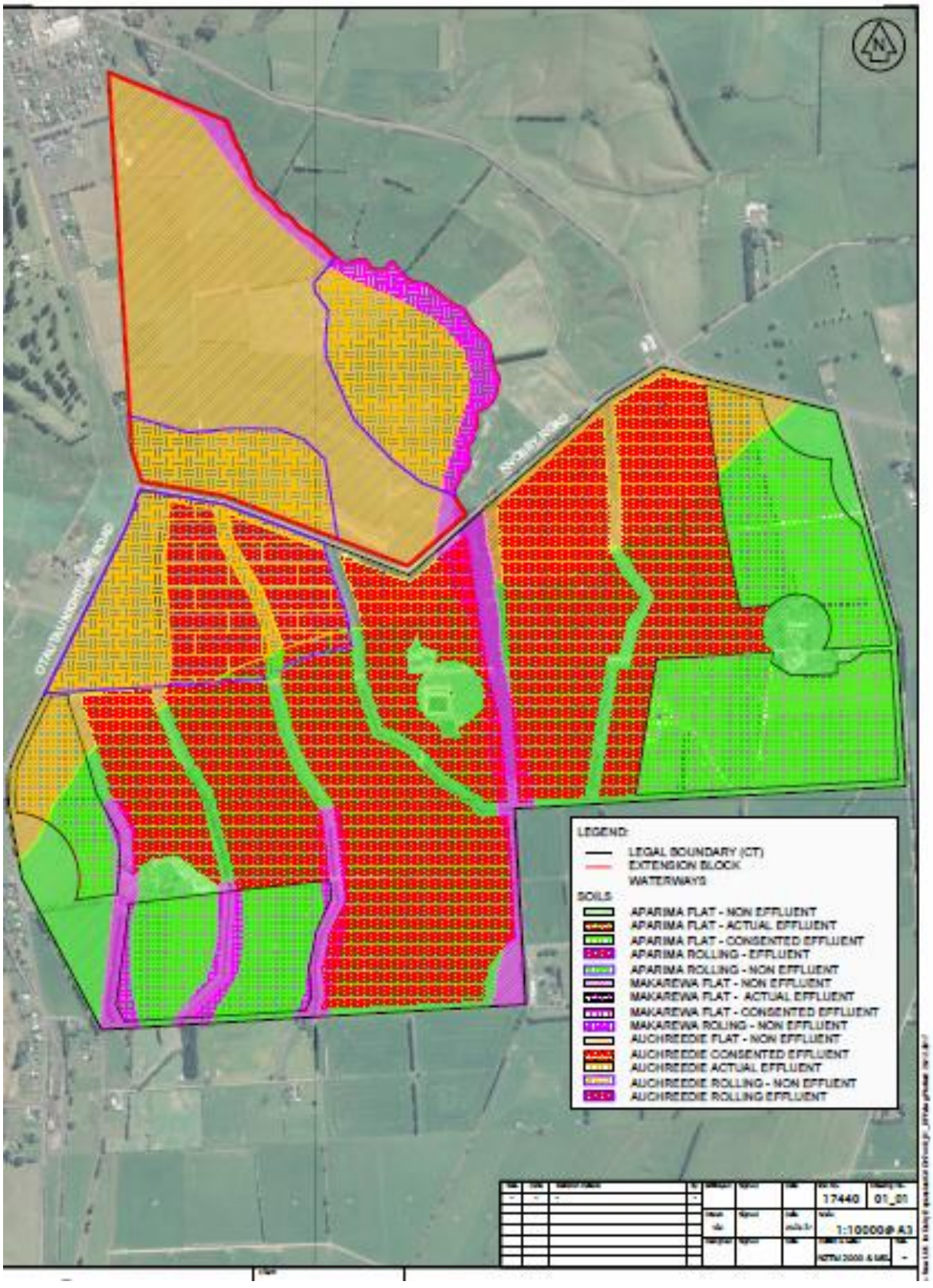
Block name	Total P lost kg P/yr	P lost to water kg P/ha/yr	P loss categories		
			Soil	Fertiliser	Effluent
Fodder Beet Platform	53	1.4	N/A	N/A	N/A
Ohai MP Eff Flat	22	0.9	Medium	Low	Low
Ohai MP Eff Rolling	44	2.6	High	High **	Low
Makarewa MP Eff Flat	4	0.5	Low	Low	Low
Aparima MP Eff Flat	27	0.3	Low	Low	Low
Ohai MP Non Eff Flat	72	0.9	Medium	Low	Low
Makarewa MP Non Eff Flat	12	0.5	Low	Low	Low
Aparima MP Non Eff Flat	30	0.3	Low	Low	N/A
Ohai MP Non Eff Rollling	105	2.6	High	High **	Low
Summer turnips	13	1.1	N/A	N/A	N/A
Aparima MP Eff Rolling	1	0.5	Low	Low	Low
Makarewa MP Non Effluent Rolling	6	1.4	Medium	Medium	Low
Aparima MP Non Eff Rolling	0	0.5	Low	Low	Low
Other sources	190				
Whole farm	579	1.2			

** Fertiliser loss is outside the range for New Zealand data - see comments for each block

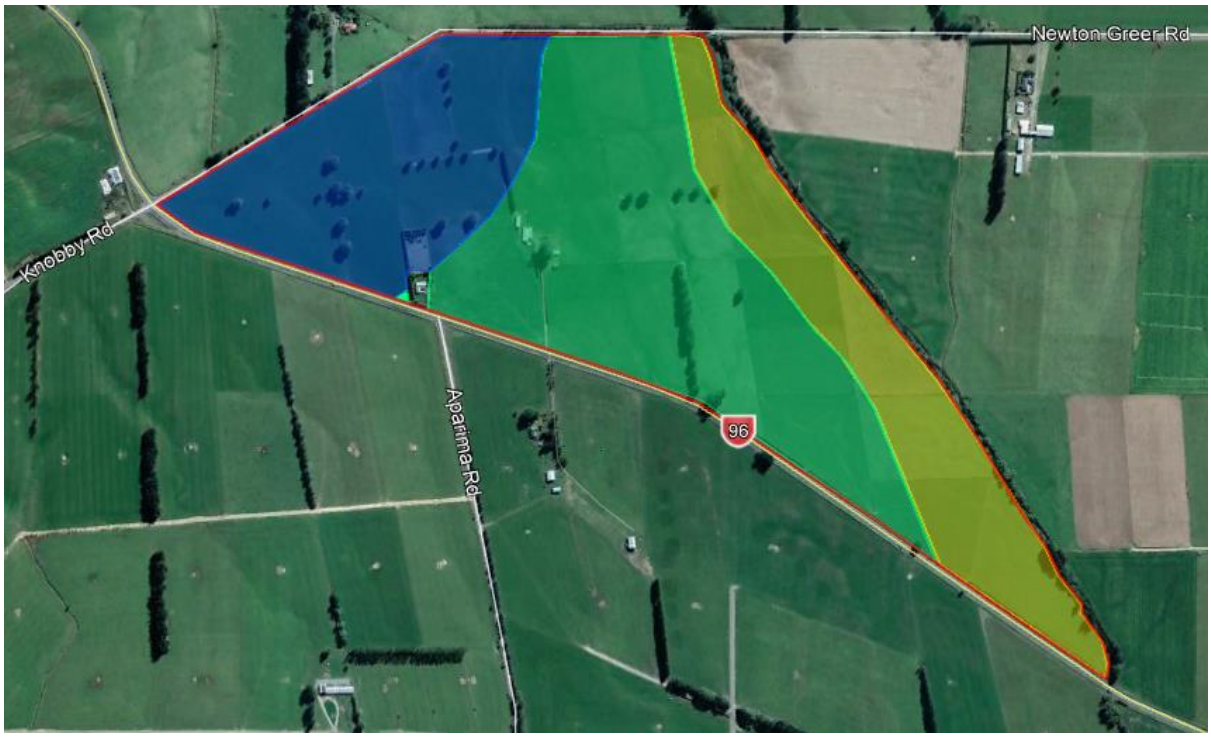
Table 12 Proposed system phosphorus loss report

Appendices

Farm Map – Dairy Platform and Support block



Farm Map – Neighbouring Sheep block



Attachment D

Specification for Earthworks Construction

for Dairy Effluent Storage Pond

Client: M J Adams

Location: Wairio

Project No.: 1232

1. Scope

This specification covers the construction of earthworks including: the clearing and removal of all obstacles within the limits of the earthworks; Stripping of topsoil; excavation of all cuts, including excavation below the final subgrade surface; the excavation of borrow areas, benches, keyways and surface drainage facilities; the carting of excavated material to fill or waste; and construction of fills and subgrade; shaping, compacting, trimming and topsoiling. Any changes to the construction of the pond must be discussed with the certifier and any changes to the original plan will be confirmed in writing.

2. Initial site meeting

At the first meeting on site the location of the pond will be confirmed and any hazards identified that would affect the construction. Contractors shall confirm that the equipment that will be used on the site is appropriate and has sufficient roll over protection to work on slopes. All underground services about the site are to be confirmed. ie power, telecom, water and drainage etc.

3. Construction progress and recording

The contractor shall retain sufficient records to show what work was constructed each day, and suitable photographs held to record this.

4. Pond set out

The pond shall be set out so that the final dimensions of the pond and the levels of the walls correspond to the plans to ensure that the full design capacity of the pond is achieved and that the pond operates as it is designed.

5. Clearing

The area contained by the limits of the earthworks and any additional area shown on the drawings shall be cleared of all obstructions. Clearing shall include the complete removal fences, stumps, trees, scrub and disposal by dumping and burying as required.

6. Removal of topsoil

Topsoil shall be removed to outside of the top of the pond wall. Care shall be taken to avoid contamination of the structural fill material below the topsoil layer.

7. Surface drainage

Adequate provision shall be made for the control of surface water within the construction area to safeguard the integrity of the works. The earthworks shall be carried out in such a manner that their surfaces have at all times a sufficient fall to shed water and prevent flooding. No silt contaminated water shall be pumped into any open drain but spread to pasture to filter silt prior to entering an open drain.

8. Excavation

Excavation shall be carried out in such a manner to avoid mixing of the materials if they are to be used for lining the pond rather than for the construction of the walls. Excavation shall be carried out so as to limit overbreak as far as is practical.

9. Unforeseen irregularities

If during excavation any of the following are exposed, the method of resolving the irregularities are to be discussed with the certifier and the best option to remove or modify the excavation confirmed. These may include mole or tile drains, under runners, sand or gravel inclusions, bog wood, trees or rubbish pits.

10. Keyway construction

On all walls of the pond that are to be constructed a keyway shall be constructed to a minimum depth of 600mm deep and 2m wide. The backfill to the keyways shall be compacted as detailed in section 14.

11. Filling

The earthworks shall be managed in such a manner that the best material for clay lining is reserved for placement on the inside of the main storage pond. The location of this material shall be discussed with the certifier. The material used in fill shall be spread and compacted in layers of uniform quality and thickness. The thickness of each layer shall be limited to ensure that the specified compaction is achieved for the full depth of each layer. The movement of construction traffic shall be even distributed over the full width of the filling area, so as to avoid damage or overstress the compaction. If material which has already been placed in fill is considered by the certifier to be too wet then, the Contractor shall either dry or mix the material so that it is suitable for fill or excavate the material to waste and replace it with suitable material.

12. Compaction Methods

The Contractor shall submit to the certifier details of the proposed compaction methods and details of the compaction equipment before filing commences.

13. Layer Thickness

The maximum thickness of each layer of fill before compaction shall be 200mm

14. Compaction

Compaction of each layer shall continue until the whole layer has obtained a dense condition. The degree of compaction of each layer shall be such that when trimmed to a smooth surface, the resultant impression in the surface under a smooth wheel roller having a minimum loading of 6260kg per metre width of fill shall not be greater than 5 mm. The maximum dry density achieved shall be 90%. This will require a minimum number of four passes over the total fill area and all layers. Construction will be accepted on the basis of an area at a time. Each area offered for acceptance shall consist of material which is basically the one soil type which appears to be constant moisture content and which has received a uniform number of roller

passes. The Certifier or his representative shall determine the locations of tests within each area. Test results shall be analysed in groups of five. When drying is necessary it shall be carried out to allow the full depth of the layer to dry uniformly. Drying and compaction shall be carried out under favourable weather conditions. Compaction shall not continue if the material shows signs of heaving or weaving excessively. In this situation the material shall be either left to dry naturally or where job progress would be affected by delay the material shall be dried to a moisture content at which heaving and weaving does not occur.

15. Disturbance and working of cut surfaces

Where the pond is cut into the existing clay subgrade that is of suitable quality for pond lining, it shall be scarified to a depth of 450mm and re compacted to provide a dense tight surface to the same density as any other compacted surface. Where there is clay bound rotten rock, 450mm shall be removed and replaced, in a minimum of two layers of suitable clay from the top 1m.

16. Clay Lining

The clay layer below the topsoil is to be retained and placed to line the pond. The clay liner shall be placed in a minimum of two layers. Each layer shall be compacted as per section 14 of this specification. The clay shall be placed at a moisture content that will allow rolling without heaving or slumping.

17. Finished surface slopes

The pond walls shall be shaped to a maximum slope of two horizontal to one vertical or flatter. All outside top of walls shall be sloped to shed water to the outside of the storage pond or sludge beds so that excess stormwater does not enter the ponds

18. Trimming and rolling

The entire surface of the inside of the pond shall be made firm, uniform and smooth by blading, grading and rolling. Rolling associated with the surface finishing shall be the same as that which would produce the compaction for that material type.

19. Surface water channels

All areas where the existing ground surface slopes toward the ponds a shallow surface water channel shall be constructed as shown on the plans. This will lead water away from the pond to a suitable outfall.

20. Topsoiling

Topsoil shall be re spread to provide smooth and natural transitions between the ponds and the surrounding pasture areas. The topsoil shall be worked and trimmed to a tilth suitable for typical farm machinery to finish suitable for grass. The outside batters shall be topsoiled and sloped so that they can be cultivated, sown with grass and mown if required.

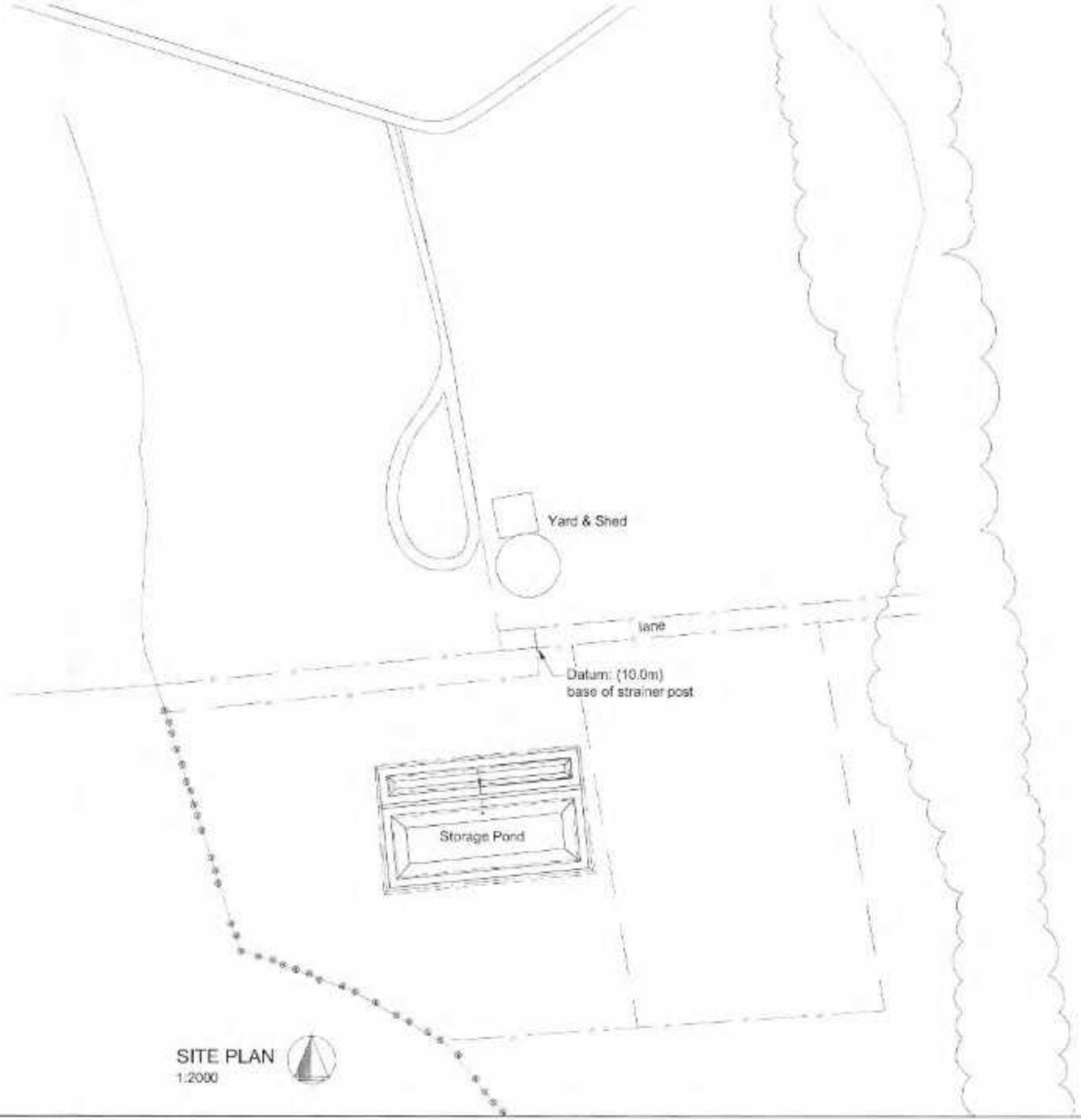
21. Fencing

Fencing, although required on all ponds, shall not be the responsibility of the contractor or certifier.

Test Pit Cut

Test Pit Material

Note:
This design is site specific and is not to be used for other similar projects unless permission has been obtained in writing from Civil Tech Limited.



SITE PLAN
1:2000

Designed for:
1100 cows

A3

civil tech

M J ADAMS

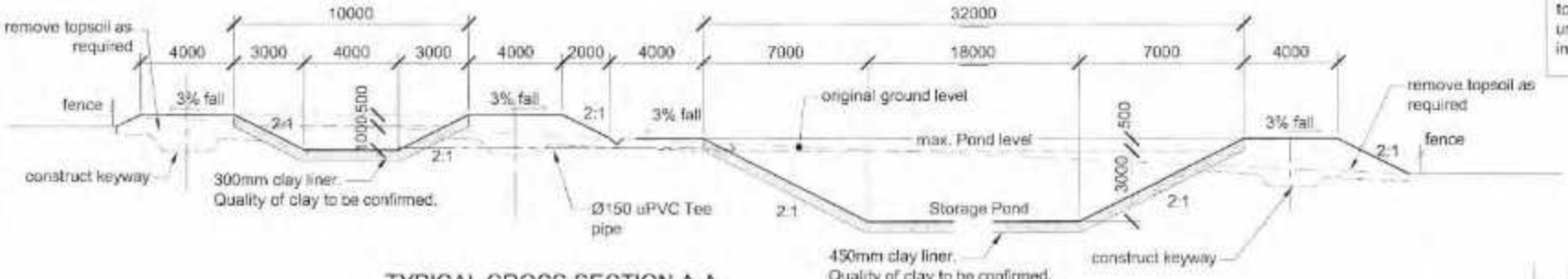
WAIRIO

DAIRY EFFLUENT
STORAGE POND
CIVIL WORKS

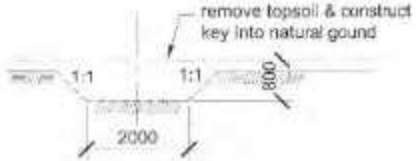
1232 C01

A

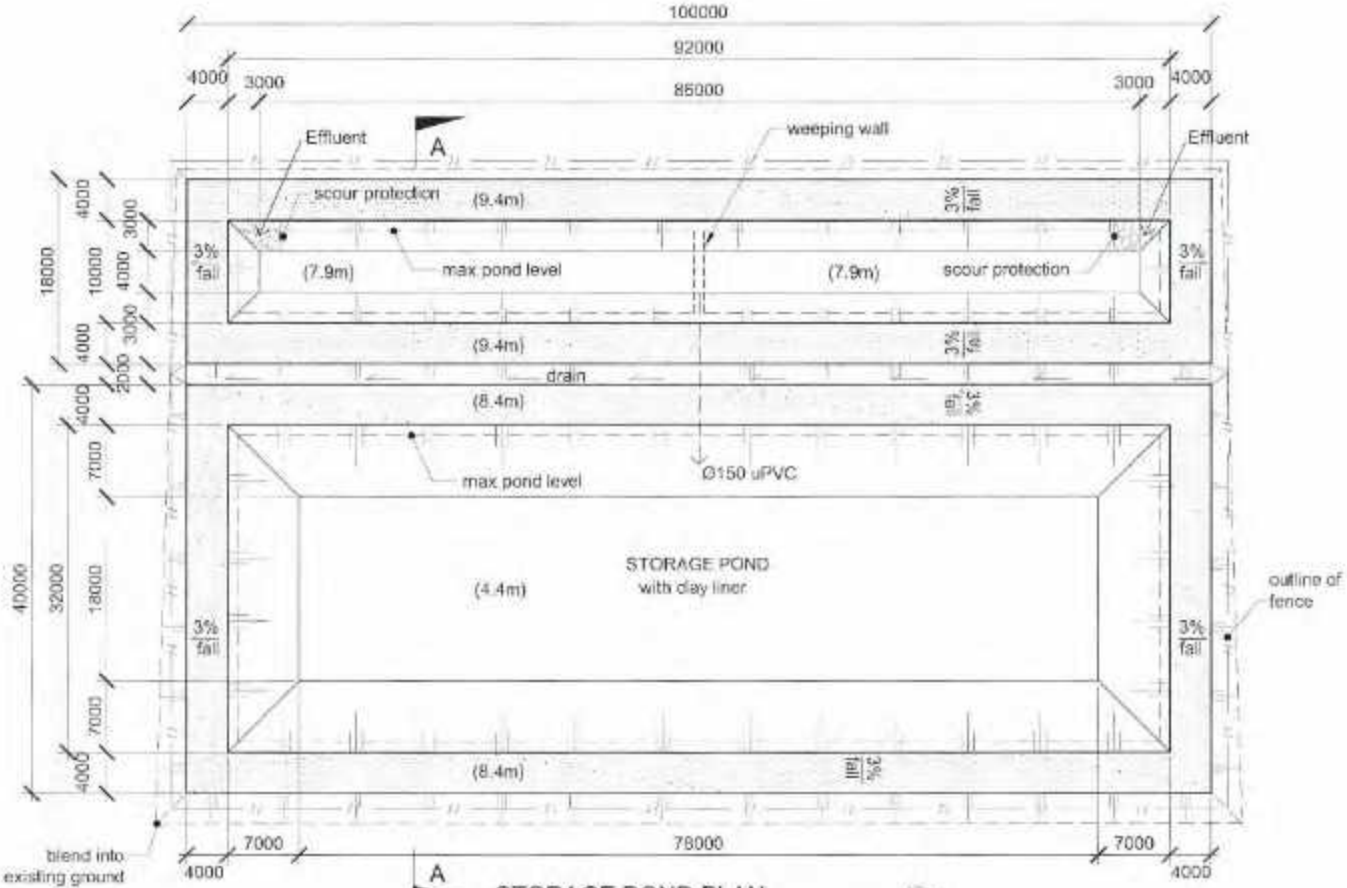
Note:
This design is site specific and is not to be used for other similar projects unless permission has been obtained in writing from Civil Tech Limited.



TYPICAL CROSS SECTION A-A
1:200



KEY DETAIL
1:100



STORAGE POND PLAN
1:500

Allow for safety fence around ponds

Designed for:
1100 cows

A3

civil tech

M J ADAMS

WAIRIO

DAIRY EFFLUENT
STORAGE POND
CIVIL WORKS

1232 C02

A

CODE OF PRACTICE
Compliance Certificate

DESIGN AND CONSTRUCTION REVIEW

ISSUED BY: Civil Tech Ltd

TO: M J Adams

IN RESPECT OF: Dairy Effluent Storage Pond – 6,600m3

AT: Knobby Road, Wairio

Design:
Civil Tech Ltd
Director: Murray Gardyne

I have designed the dairy effluent storage pond to comply with the Environment Southland Code of Practise and appropriate standards and accepted engineering practice.

.....Signature 8/5/2014.....Date

Construction
The pond was constructed by Nightcaps Contracting Ltd

Construction Review:
Civil Tech Ltd
Director: Murray Gardyne

I have supervised construction of the dairy effluent storage pond and consider that the contractor has exercised reasonable control over the construction process carried out in accordance with the design and specification.

.....Signature 8/5/2014.....Date

Attachment E

WaterForce

Effluent Application Test

Date: 9th December, 2014

Farm Owner/Manager: M & C Adams / M Wise

Address: Knobby Road, Wairio.

Weather and Soil Conditions

The Morning of the application test had a very light westerly wind blowing 5-9 kph. Soils moisture was in deficit and at 65% of field capacity (ES Soil Moisture Unit).

Application Test – Williams Green Back Magnum Traveling Irrigator

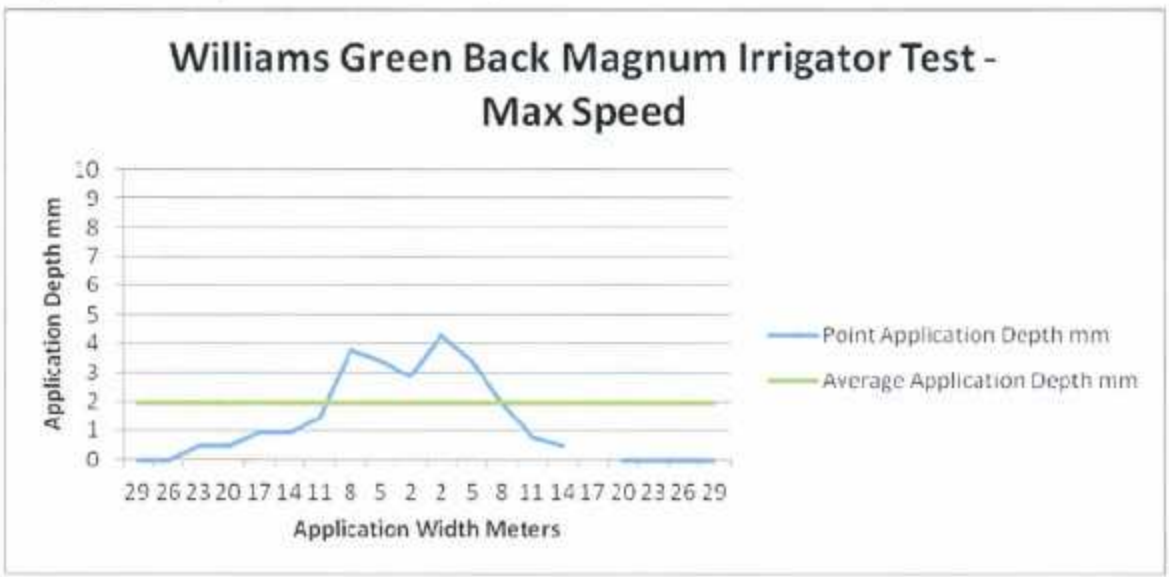
Table 1.1

Flow Rate	20.5 M^3/hr (20,520 Lph)
Pressure at Hydrant	5 Bar
Pressure at Irrigator	3.5 Bar
Pressure at Irrigation Gun	3 Bar
Wetted Width	50m
Traveling Irrigator Speed Variable	3.5m
Application Time High Speed	20 Minutes
Average Application Depth (mm) (Variable with Speed)	2.1mm
Application Rate (Average)	<7 mm/hr
DUuq (Uniformity)	1.2038

Depth Measurement

To test the low application depth of the Williams Green Back Magnum Irrigator High Speed setting was chosen to decrease application depth & Rate. To measure this, a series of collection containers was spaced out at 3m intervals to measure point application depth as the traveling irrigator passed over. This data has been graphed below to take a cross section of the irrigator run and display point application depth.

Graph 1.2 Full Speed Run 3.5 Meters / Min



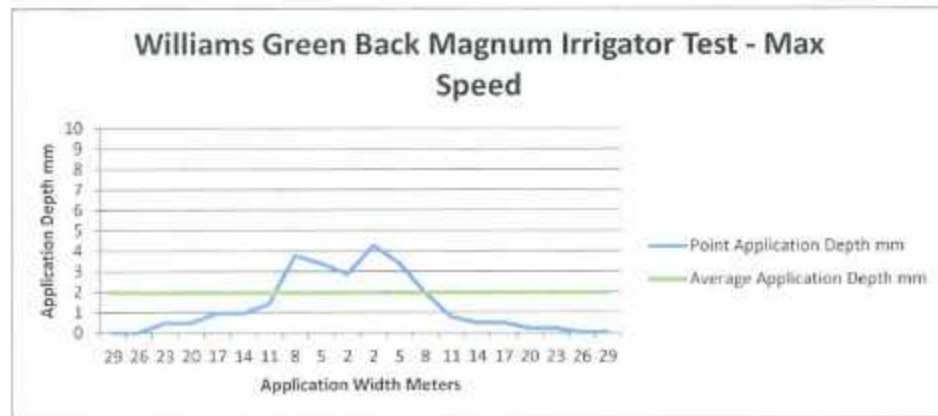
On the graph the Irrigator sits in the middle at the 0m spreading effluent left and right of this point. The Average Application Depth is 2.1mm, with the highest point application depth of 4.4mm. The winds affects on the Irrigation Gun can be seen on the containers as the westerly wind blew right to left, with more effluent applied on the left side. Uniformity is excellent with a DUuq of 1.20 for a run at this application depth and speed.

Ground Conditions Post Test - Williams Green Back Magnum Traveling Irrigator

After the application test the ground which was compacted had slow infiltration rate with this low application of effluent being taken up in 5-10mins after application, the surface was wet under foot but and no ponding or runoff was witnessed. Less compacted ground would have a higher infiltration rate and would take up the application depth in less time.

Farm	M & C Adams
Date	9/12/2014
Diameter of irrigation	50 metres
Irrigator make/model	Williams Green Back Magnum - 14mm Gun Nozzle, 9mm Drive Arm Nozzle
Irrigator setting	Maximum 3.5 Meter / Min
Time taken for full pass of irrigator	19 Minutes 30 Seconds

Tray Number	Volume of effluent in tray (ml)		Average Application Depth
1	0	0 29	1.96
2	0	0 26	1.96
3	50	0.48 23	1.96
4	50	0.48 20	1.96
5	100	0.95 17	1.96
6	100	0.95 14	1.96
7	150	1.43 11	1.96
8	400	3.79 8	1.96
9	350	3.39 5	1.96
10 Centre	300	2.86 2	1.96
11 Centre	450	4.27 2	1.96
12	350	3.39 5	1.96
13	200	1.91 8	1.96
14	100	0.76 11	1.96
15	50	0.48 14	1.96
16	50	0.48 17	1.96
17	20	0.2 20	1.96
18	20	0.2 23	1.96
19	0	0 26	1.96
20	0	0 29	1.96
Total (ml)	**2740**		



Average Volume (ml)	210.7692308
Container Area (mm^2)	103125
Average Application Depth (mm)	2.043822844
Average Application Rate (mm/hr)	6.131469145
m^3 applied/hectare	20.43822844