2 August 2019

Cnr North Rd & Price St

Waikiwi

Invercargill 9810

Attention: Alex Erceg, processing officer

Dear Alex,

Re: Application by Aerodrome Farm Limited & Piobiare Homestead Limited for Land Use Consents for Farming and Associated Activities

Please find enclosed the above consent application for your consideration. The key aspects of the consent application (among other things) are as follows:

Aerodrome Farm Limited – 95 Aerodrome Road, RD6, Invercargill 9876

- Increase in the total number of cows milked on the Aerodrome dairy platform;
- Increase in the size of the land contained within the existing dairy platform;
- Use of a new calving pad (for standing off and feeding cattle) at Aerodrome dairy platform (as a permitted activity);

Piobiare Homestead Limited – 939 Lochiel Branxholme Road, RD4, Invercargill 9874

- Increase in the number of cows housed in Piobiare Wintering barn (at the wintering block); and
- Increase in the number of milking cows intensive winter grazed on Piobiare.

There are a number of documents contained within this application and these are summarised in the table below.

	Aerodrome	Piobiare
Description of proposal, assessment of environmental effects, policies assessment,	All details are contained within the Landpro document titled "**Aer Farm Limited & Piobiare Homestead Limited** Resource Application to the Southland Regional Council (Environment Southl Land Use Consents for Farming and Associated Activities"	

	Aerodrome	Piobiare
notification recommendation, conclusion etc...		
Water Quality Technical Comment	One technical comment has been prepared for both properties titled. Proposal at both properties will result in small but real improvements in overall water quality.	
Dairy Effluent Storage Calculations	Donna Corbin – RES For effluent pond and sludge beds. Used Massey DESC. Ample storage available for proposal.	John Scandrett For effluent pond For wintering barn effluent DESC is inappropriate, see attached alternative calculations. Ample storage available for proposal.
Effluent Structures 'assessment/testing'	Pond drop test of pond and weeping wall. Visual inspection of pond and one sludge bed. Completed by John Scandrett.	Pond drop test of effluent pond. Visual inspection of concrete sumps and effluent pond. Completed by John Scandrett.
Nutrient budgets audit/review	Irricon review completed of *a) New Block* *b) Ovr-Aerodrome Farm Ltd proposal -15-18 readjcownos-copy 3- copy1* *c) Ovr-Aerodrome Farm Ltd current 2015-18/19 – copy2 adinos* and *Farm Scenario Plan - A plan to cover the Current 3 Year Averaged Farm System and the Proposed Farm System Nutrient Budgets after an*	Completed by Mark Crawford Irricon review completed of *a) PIOBIARE HOMESTEAD LTD c/-N&R PYPER – adj-copy 1* *b) PIOBIARE HOMESTEAD LTD c/-N&R PYPER – proposed1 - copy 1- copy 1* and *Farm Scenario Plan -2015/18 Averaged Nutrient Budget & Report – Prepared by Mark Crawford, Senior Farm Environmental Consultant*

	Aerodrome	Piobiare
	adjacent property purchase - Prepared by Mark Crawford	
Nutrient budgets/final farm scenario plans	OVERSEERFM Updated Farm Scenario Plan Aerodrome Limited appended to this application (includes amendments as/if required by Irricon OVERSEER audit).	OVERSEERFM Updated Farm Scenario Plan Piobiare Homestead Limited appended to this application (includes amendments as/if required by Irricon OVERSEER audit).

A $1,500 consent processing deposit fee has been paid already, prior to the pre-application review of nutrient budgets completed by Irricon.

If you have any questions in relation to this application, please don't hesitate to contact me directly (details below).

Yours Sincerely

Zoe McCormack

Resource Management Planner

13 Pinot Noir Drive | PO Box 302 | Cromwell 9342

P 03 445 9905

zoe@landpro.co.nz | www.landpro.co.nz

Application for Resource Consent (PART A)

This application is made under Section 88 of the Resource Management Act 1991

environment SOUTHLAND REGIONAL COUNCIL Te Taiao Tonga

The purpose of this Part A form and the relevant Part B form(s) is to provide applications with guidance on information that is required under the Resource Management Act 1991. Please note that these forms are to act as a guide only, and Environment Southland reserves the right to request additional information.

To: Environment Southland
Private Bag 90116
Invercargill 9840

Full name, address and contact details of applicant *(in whose name consent is to be issued)*

Name: Aerodrome Farm Limited & Piobiare Homestead Limited

Address: Aerodrome Farm Limited — Piobiare Homestead Limited

95 Aerodrome Road, RD6, Invercargill — 939 Lochiel Branxholme Road RD 4 Invercargill

Email: peter.moynihan@westpac.co.nz

Phone: 027 4328599 (*Preferred*) ____ (*Additional*) Fax: ____

Date(s) of birth: Not relevant to the consent application

Consultant contact details *(if different from above)*

Contact name/agent: Zoe McCormack

Address: 13 Pinot Noir Drive

P O Box 302, Cromwell 9342

Email: zoe@landpro.co.nz

Phone: 03 777 6022 (*Preferred*) ____ (*Additional*) Fax: ____

Please tick the box for the consent(s) you are applying for and complete the relevant Part B form(s) where available:

Land Use

	Bore/well
X	New or expanded dairy farming
X	Effluent storage
	Cultivation
	Tree planting
	Gravel extraction
X	Feed-pad, wintering pad, calving pad or silage pad
	Riverbed activity
	Bridges and culverts

Discharge

	To air
	To water
X	To land

Water

	Take and use surface water
X	Take and use groundwater
	Dam water
	Divert water

Coastal

	Whitebait stand
	Structures/occupation of space
	Removal of natural materials
	Disturb foreshore/seabed
	Discharge/deposit substances
	Commercial surface water activity
	Reclaim/drain foreshore/seabed
	Marine farming
	Other coastal activities

1 Are there any **current** or **expired** consents relating to this proposal? [X] Yes [ ] No

If yes, please provide consent number(s) and description:

Aerodrome Farm Limited: Discharge Permit 301219 Water Permit 301220	Piobiare Homestead Ltd: Discharge Permit AUTH-3009980-V1

2 Are any other consents required from Environment Southland or **other authorities**? [X] Yes [ ] No

If yes, please state the relevant authority and the type of consent(s) required:

Aerodrome Farm Limited: Land Use Consent for Farming Land Use Consent for Feed Pad	Piobiare Homestead Limited: Land Use Consent for Farming Land Use Consent for existing effluent storage facility Land Use Consent for Feed Pad

3 For what **purpose** is this consent(s) required: (e.g. discharge of effluent, gravel extraction etc.)

See attached AEE

4 **Location** of proposed activity

Address: See attached AEE

Legal Description:

Map Reference (NZTM 2000): ____________ E ____________ N

5 The name and address of the **owner /occupier**: (if other than the applicant)

Name: ____________ Phone: ____________

Address:

6 **Please attach a map or a coloured aerial photograph, showing at a minimum, the location of the proposed activities.**

7 Assessment of effects on the environment (AEE)

Please complete the applicable Part B form(s) for the proposed activities. For those activities where no Part B form is available, please attach a written statement that assesses the effects that your activities may have on the environment. An assessment of effects **must** include the following information:

(a) *if it likely that the activity will result in any significant adverse effect on the environment, a description of any possible alternative locations or methods for undertaking the activity;*
(b) *an assessment of the actual or potential effect on the environment of the activity;*
(c) *if the activity includes the use of hazardous substances and installations, an assessment of any risks to the environment that are likely to arise from such use;*
(d) *if the activity includes the discharge of any contaminant, a description of—*
  (i) *the nature of the discharge and the sensitivity of the receiving environment to adverse effects; and*
  (ii) *any possible alternative methods of discharge, including discharge into any other receiving environment;*
(e) *a description of the mitigation measures (safeguards and contingency plans where relevant) to be undertaken to help or prevent or reduce the actual or potential effect;*
(f) *identification of the persons affected by the activity, any consultation undertaken, and any response to the views of any persons consulted;*
(g) *if the scale and significance of the activity's effects are such that monitoring is required, a description of how and by whom the effects will be monitored if the activity is approved;*
(h) *if the activity will, or is likely to, have adverse effects that are more than minor on the exercise of a protected customary right, a description of possible alternative locations or methods for the exercise of the activity (unless written approval for the activity is given by the protected customary rights group).*

You should also include:

(a) *an assessment of the activity against any relevant provisions of any relevant objectives, policies, or rules;*
(b) *any information specified to be included in the application in accordance with the relevant regional plan;*
(c) *for an application to replace an existing consent, an assessment of the value of the investment of the existing consent holder:*

An assessment of effects **must** address the following matters:

(a) *any effect on those in the neighbourhood and, where relevant, the wider community, including any social, economic, or cultural effects;*
(b) *any physical effect on the locality, including any landscape and visual effects;*
(c) *any effect on ecosystems, including effects on plants or animals and any physical disturbance of habitats in the vicinity;*
(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;*
(e) *any discharge of contaminants into the environment, including any unreasonable emission of noise, and options for the treatment and disposal of contaminants;*
(f) *any risk to the neighbourhood, the wider community, or the environment through natural hazards or the use of hazardous substances or hazardous installations.*

8 Affected Parties

Please attach written approval from parties who may be affected by your activity. *Written Approval of an Affected Party* forms are available on the Environment Southland website. During the processing of your application, Council may determine that additional approvals are required.

9 Correspondence from Council when using a consultant

It is standard practice that both you and your consultant are copied into all correspondence relating to the consent process. This is so that you know what is going on with your application. Please let us know below if you would like us to only contact your consultant. This means you will only hear from us when your application is/is not accepted, when a decision is made or if we feel that you need to be contacted.

I want all correspondence about my application to go to my consultant only [X] Yes [ ] No

10 Site visit from the Consents Team

Consents staff are able to meet with you, visit your site and see what you are proposing to do. We find that this is beneficial to everyone involved. The cost of the visit will be included in the total cost of processing your consent. However, we find that applications that have an on-site visit are processed with less congestion and at a similar or lesser overall cost. Please let us know below if you would like us to come and see your site. Alex has already visited the site but may want another visit?

I would like a member of the Consents Team to visit my site [X] Yes [ ] No

11 How much will it cost to process my application?

The cost of a consent depends on the complexity of the activities. Staff time is charged out at a rate of $145/hr and vehicle use for site visits is charged at $0.73/km (inclusive of GST).

The fees shown below under section two are **deposits to be paid at the time of application**. Due to the complexity of these activities, this deposit will not usually cover the full cost of processing the application. **Further costs may be incurred** relating to staff time, disbursements, legal charges, consultation fees, and hearing commissioner fees. Environment Southland's User Charges and Fees document is available at:

www.es.govt.nz/fees-and-charges

When the consent has been processed you will receive an invoice for an additional fee, or for a refund.

The Council's user charges are fixed under Section 36 of the Resource Management Act 1991. Our fee schedule is:

1. Fixed fee:	
Bores and wells	**$290**
Whitebait stand	**$220**
2. Deposit:	
All other non-notified applications including: • Certificates of compliance • Changes to consent conditions (variations) • Change of lapse date	**$1,500**
Applications that require notification or limited notification	**$2,000**

How to pay
Environment Southland accepts payment in the forms of cash, Eftpos, cheque, or electronic transfer. All electronic transfers must include the applicant's name and "consent application" as a reference. Please make electronic payments to: Environment Southland, 01-0961-0018998-00.

User Charges
Please note that additional Annual User Charges will apply to all consents. These are payable in advance on the first day of July each year. Tables 4, 5 and 6 of the Environment Southland User Charges and Fees Schedule outlines the fees associated with Annual Administration Charges and Annual Consent Monitoring and Inspection Charges. Table 7: Annual Research and Monitoring Charges applies only to surface and groundwater takes and comprises the following:

- **Surface water takes (per consent, for volumes up to 50,000 m^3/day):**
  - A charge of **$1.89** per year per cubic metre authorised as a maximum daily take.
  - Minimum of **$138**, maximum of **$7,585**.
- **Surface water takes (per consent, for volumes over 50,000 m^3/day):**
  - **$0.0031** per cubic metre authorised as a maximum daily take.
- **Groundwater takes (per consent):**
  - A charge of **$0.89** per year per cubic metre.
  - Minimum of **$162**, maximum of **$1,782**.

Municipal and stock water discount (of 50%) no longer applies.

12 Checklist: Have you included the following?

X	Payment of the required deposit *(see fee schedule)*
X	Written approval from all potentially affected parties *(forms available from the Environment Southland website)*
X	Site plan/location map/sketch of the proposed activity
X	A copy of the Certificate of Incorporation (*where applicant is a company*) included in email
X	~~Part B form(s) specific to your activity and~~/or a separate assessment of environmental effects (AEE)

Note:
(a) If your application does not contain the necessary information and the appropriate fee, Environment Southland must return the application.

Signature of applicant

I hereby certify that to the best of my knowledge and belief, the information given in this application is true and correct.

I undertake to pay all actual and reasonable application processing costs incurred by Environment Southland.

Name (block capitals) ZOE McCORMACK - LANDPRO LIMITED (on behalf of the appliant)

Signed ______________________ **Date** 2 August 2019

(*Signature of applicant or person authorised to sign on behalf of applicant)*

LANDPRO	RESOURCE MANAGEMENT FORMS	*Section:* RF06 *No. of Pages:* 4
RESOURCE CONSENT APPLICATION SCHEDULE 4 CHECKLIST		*Issue:* 1 *Date:* 3 December 2015

Job No: ***18250*** ***Date:*** ***2 August 2019***

Client Name: ***Aerodrome Farm Limited and Piobiare Homestead Limited***

1. Information must be specified in sufficient detail

Any information required by this schedule, including an assessment under clause 2(1)(f) or (g), must be specified in sufficient detail to satisfy the purpose for which it is required.

2. Information required in all applications

1. An application for a resource consent for an activity (the activity) must include the following:

	Checklist	Yes	N/A	Report Section	Comments
a)	A description of the activity	☒	☐	2	
b)	A description of the site at which the activity is to occur	☒	☐	3	
c)	The full name and address of each owner of occupier of the site	☒	☐	1.1	
d)	A description of any other activities that are part of the proposal to which the application relates	☒	☐	2 and 4.2	
e)	A description of any other resource consents required for the proposal to which the application relates	☒	☐	2 and 4.1	
f)	An assessment of the activity against the matters set out in Part 2	☒	☐	8.1	
g)	An assessment of the activity against any relevant provisions of a document referred to in section 104(1)(b)	☒	☐	8.2.2	

2. The assessment under subclause (1)(g) must include an assessment of the activity against:

	Checklist	Yes	N/A	Report Section	Comments
a)	Any relevant objectives, policies, or rules in a document; and	☒	☐	8.2.2	
b)	Any relevant requirements, conditions, or permissions in any rules in a document; and	☒	☐	8 and 4	
c)	Any other relevant requirements in a document (for example, in a national environmental standard or other regulations.	☒	☐	8	

3. Additional information required in some applications

An application must also include any of the following that apply:

	Checklist	Yes	N/A	Report Section	Comments
a)	If any permitted activity is part of the proposal to which the application relates, a description of the permitted activity that demonstrates that it complies with the requirements, conditions, and permissions for the permitted activity (so that a resource consent is not required for that activity under section 87A(1):	☒	☐	4.2	
b)	If the application is affected by section 124 or 165ZH(1)(c) (which relate to existing resource consents), an assessment of the value of the investment of the existing consent holder (for the purposes of section 104(2A)):	☐	☒		
c)	If the activity is to occur in an area within the scope of a planning document prepared by a customary marine title group under section 85 of the Marine and Coastal Area (Takutai Moana) Act 2011, an assessment of the activity against any resource management matters set out in that planning document (for the purposes of section 104(2B)).	☐	☒		

4. Additional information required in an application for subdivision consent

An application for a subdivision consent must also include information that adequately defines the following:

	Checklist	Yes	N/A	Report Section	Comments
a)	The position of all new boundaries	☐	☒		
b)	The areas of all new allotments, unless the subdivision involves a cross lease, company lease, or unit plan:	☐	☒		
c)	The locations and areas of new reserves to be created, including any esplanade reserves and esplanade strips:	☐	☒		
d)	The locations and areas of any existing esplanade reserves, esplanade strips, and access strips:	☐	☒		
e)	The locations and areas of any part of the bed of a river or lake to be vested in a territorial authority under section 237A:	☐	☒		
f)	The locations and areas of any land within the coastal marine area (which is to become part of the common marine and coastal area under section 237A):	☐	☒		
g)	The locations and areas of land to be set aside as new roads.	☐	☒		

5. Additional information required in application for reclamation

An application for a resource consent for reclamation must also include information to show the area to be reclaimed, including the following:

	Checklist	Yes	N/A	Report Section	Comments
a)	The location of the area:	☐	☒		
b)	If practicable, the position of all new boundaries:	☐	☒		
c)	Any part of the area to be set aside as an esplanade reserve or esplanade strip.	☐	☒		

6. Information required in assessment of environmental effects

1. An assessment of the activity's effects on the environment must include the following information:

	Checklist	Yes	N/A	Report Section	Comments
a)	If it is likely that the activity will result in any significant adverse effect on the environment, a description of any possible alternative locations or methods for undertaking the activity:	☐	☒	7.1	
b)	An assessment of the actual or potential effect on the environment of the activity:	☒	☐	5 and 6	
c)	If the activity includes the use of hazardous substances and installations, an assessment of any risks to the environment that are likely to arise from such use:	☐	☒	7	
d)	If the activity includes the discharge of any contaminant, a description of -: i. The nature of the discharge and the sensitivity of the receiving environment to adverse effects; and ii. Any possible alternative methods of discharge, including discharge into any other receiving environment:	☒	☐	2, 5, 6 and 7.1	
e)	A description of the mitigation measures (including safeguards and contingency plans where relevant) to be undertaken to help prevent or reduce the actual or potential effect:	☒	☐	5.1 and 6.1	
f)	Identification of the persons affected by the activity, any consultation undertaken, and any response to the views of any person consulted:	☒	☐	10	
g)	If the scale and significance of the activity's effects are such that monitoring is required, a description of how and by whom the effects will be monitored if the activity is approved:	☒	☐	5.1.6, 5.3.7, 6.1.6, 6.3.7	.
h)	If the activity will, or is likely to, have adverse effects that are more than minor on the exercise of a protected customary right, a description of possible alternative locations or methods for the exercise of the activity (unless written approval for the activity is given by the protected customary rights group).	☐	☒		

2. A requirement to include information in the assessment of environmental effects is subject to the provisions of any policy statement or plan.

7. Matters that must be addressed by assessment of environment effects

1. An assessment of the activity's effects on the environment must address the following matters:

	Checklist	Yes	N/A	Report Section	Comments
a)	Any effect on those in the neighbourhood and, where relevant, the wider community, including any social, economic, or cultural effects:	☒	☐	7	
b)	Any physical effect on the locality, including any landscape an visual effects:	☒	☐	7	
c)	Any effect on ecosystems, including effects on plants or animals and any physical disturbance of habitats in the vicinity:	☒	☐	7	
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:	☒	☐	7	
e)	Any discharge of contaminants into the environment, including any unreasonable emission of noise, and options for the treatment and disposal of contaminants:	☒	☐	7	
f)	Any risk to the neighbourhood, the wider community, or the environment through natural hazards or the use hazardous substances or hazardous installations.	☒	☐	7	

2. The requirement to address a matter in the assessment of environmental effects is subject to the provisions of any policy statement or plan.

Aerodrome Farm Limited & Piobiare Homestead Limited

Resource Consent Application to the Southland Regional Council (Environment Southland)

For Land Use Consents for Farming and Associated Activities

LANDPRO
Make the most of your land

Cromwell
13 Pinot Noir Drive
PO Box 302
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46 Vivian Street
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0800 023 318
info@landpro.co.nz
www.landpro.co.nz

Prepared For

Aerodrome Farm Limited and Piobiare Homestead Limited

Prepared By

Landpro Ltd

13 Pinot Noir Drive

PO Box 302

Cromwell

Tel +64 3 445 9905

QUALITY INFORMATION

Reference: https://nzlandpro-my.sharepoint.com/personal/zoe_landpro_co_nz/Documents/20190731_18250_Aerodrome Farm Ltd_Dairy Expansion AEE_FINAL DRAFT V3.docx

Date: 2 August 2019

Prepared by: Zoe McCormack

Reviewed by: Tanya Copland and Nick Williams

Client Review: Peter Moynihan and Nelson Pyper of Aerodrome Farm Limited and Piobioare Homestead Limited

Version Number: DRAFT

TABLE OF CONTENTS

LIST OF ATTACHMENTS

1. INTRODUCTION

1.1 The Applicants

Applicant Address:	Aerodrome Farm Limited 95 Aerodrome Road RD6 Invercargill 9876	Piobiare Homestead Limited 939 Lochiel Branxholme Road RD 4 Invercargill 9874
Address for Service:	C/- Landpro Limited PO Box 302 Cromwell 9342	

1.2 Executive Summary

Aerodrome Farm Limited currently own and operate a property 2 km north of Invercargill:

- The existing Aerodrome dairy farm (authorised by consents 301219 and 301220-V1); and
- Recently purchased a sheep farm with rotational vegetable cropping.

Piobiare Homestead Limited currently own, lease and operate a property 5.5 km north of Wallacetown:

- A dairy young stock and dairy winter grazing property with a few sheep; and
- Winter grazing is on fodder beet with baelage and in a wintering barn.

The intent of this application is to apply for one suite of consents for Aerodrome and one suite of separate consents for Piobiare. Usually, a suite of "global consents" would be appropriate where the two properties are considered as one 'landholding' under the PSWLP. The two properties are separate landholdings for the following reasons:

- Even though Nelson Pyper is a common director between each property, Aerodrome and Piobiare are separate landholdings;
- The landholdings are not contiguous;
- The landholdings are managed separately and are run as separate financial businesses, which constitutes 'single operating unit';

- Aerodrome, in order to operate as a dairy farm, utilise Piobiare as a support block where young stock are grazed, and milking cows are wintered. However, these activities could occur on any other property in Southland without consent;
- Piobiare can operate independently of Aerodrome altogether if they grazed stock from another property and can operate in their own right; and
- Each landholding individually can't meet the permitted activity Rule 20 (for different reasons) and therefore each property on its own would require a land use consent irrespective of this application.

Aerodrome and Piobiare operate in a kind of partnership; milking cows on one farm and wintering/grazing cows on the other farm, but essentially each operation is its own business. For this purpose, it is critical for each business to have their own consents, much would be the case in any other instance where there wasn't a common director of each separate company. The effects of each activity have been assessed below, and the intent of the proposed conditions will ensure that each can operate financially independently in future. Furthermore, if there's no difference in environmental effect or certainty of effects, then there's no reason why separate consents, subject to approval, can't be granted.

This application represents (among other things):

- Increase in the total number of cows milked on the Aerodrome dairy platform;
- Increase in the size of the land contained within the existing dairy platform;
- Use of a new calving pad (for standing off and feeding cattle) at Aerodrome dairy platform (as a permitted activity);
- Increase in the number of cows housed in Piobiare Wintering barn (at the wintering/dairy support block); and
- Increase in the number of milking cows intensive winter grazed on Piobiare.

This application seeks consent under Rule 20 (e) for the farming activity at Aerodrome, and consent under Rule 20(e) for the farming activity proposed at Piobiare. The assessment of effects contained within this application includes a full assessment of the activities proposed and the actual and potential effects on the environment on both landholdings.

This assessment is guided by advice from Environment Southland, and the relevant provisions of all relevant planning documents as required by S104 of the RMA, and supported by the attached water quality technical comment. Overall, the adverse effects of all activities proposed are less than minor. The proposal includes the implementation of a wide range of good management practices and mitigation measures which avoid, remedy and mitigate adverse effects on the environment. These are described in detail in this application and are also included in the attached Farm Environmental Management Plans (one for each property).

This proposal includes the recommendation that a nitrogen output limit is imposed on the resulting land use consents for each landholding. This limit ensures that the activity is undertaken at a nitrogen loss level which is equal to or less than the baseline when modelled using the latest version of Overseer. Other methods to control and restrict nutrients on the landholding are imposed by way of the implementation of the good management practices and the Farm Environmental Management Plans (FEMP).

This assessment has assessed the proposed farming activities in their entirety, against the state of the ***existing*** environment. This baseline is the most appropriate from which to make an assessment with the greatest level of certainty, and a permitted baseline or consented baseline approach has not been taken.

Nutrient budgeting has been used extensively to model the applicant's operations in the decision making process for this proposal. OVERSEER® is the best available tool for comparing likely nutrient losses between farm scenarios. In the course of deciding on a final proposal, numerous farm systems were investigated and run through nutrient budget software which sited different activities on different parts of the landholding under various forms of management. The resulting proposal provides for the greatest minimisation of nutrient losses that could be sustained by the applicant.

1.3 Purpose of Documentation

Under s.88 of the Resource Management Act 1991 (the RMA), this report provides a description of the activities and environment and an assessment of the activities effects on the environment as required by Schedule 4 of the RMA. This application is deemed to reflect the scope and scale of the proposed activities.

2. DETAILS OF PROPOSAL

2.1 Aerodrome Farm Limited

The dairy farm is located at 95 Aerodrome Road, Invercargill. The proposed discharge and water permits will replace the existing consents, subject to granting.

Details of the changes to the farm system and relevant consents are listed in the tables below. Cow numbers discussed throughout out this proposal refer to the peak milking cows on farm. Stock numbers throughout the year are relative to the peak number of cows able to be milked, i.e. only so many replacements and young stock are raised to maintain the milking herd numbers over time. Complete details of the stock numbers can be found in the attached nutrient budget report for Aerodrome Farm Limited (Attachment F).

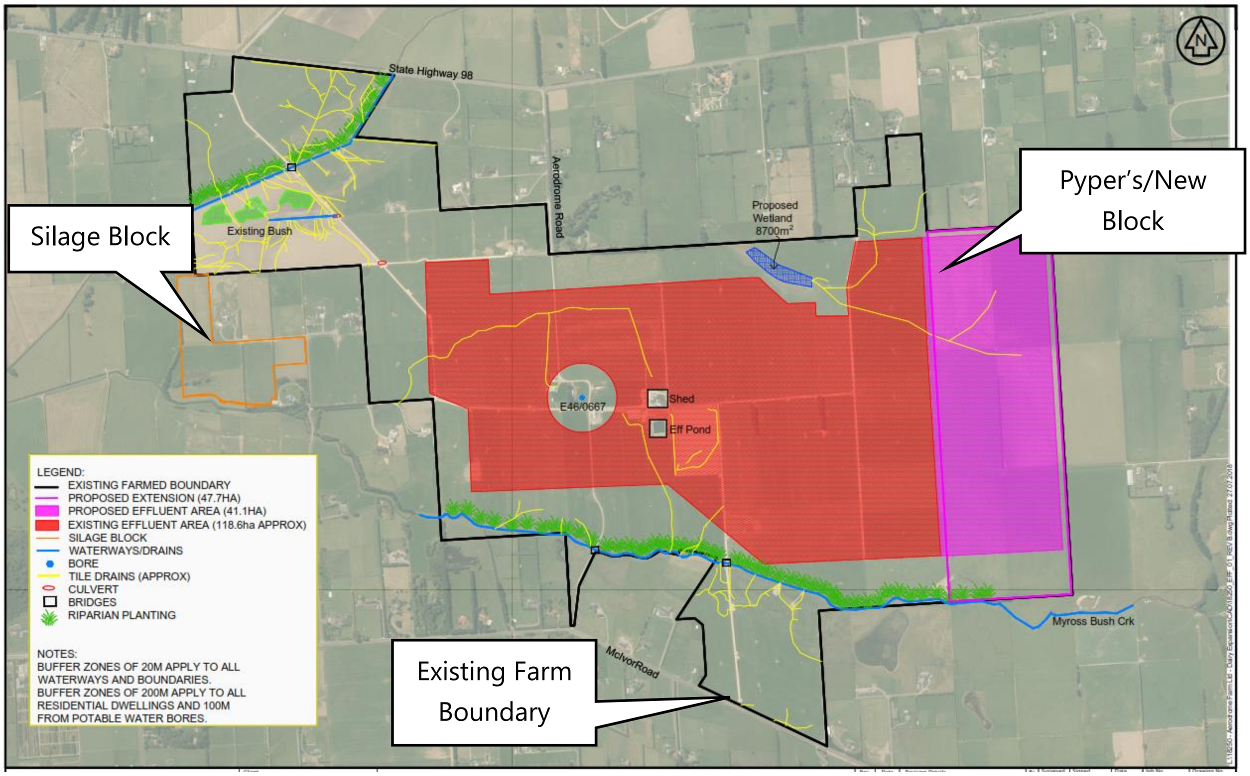

Figure 1: New farming land and new effluent disposal area shown in pink, property boundary and silage block.

2.1.1 Land use consent to use land for a farming activity

- Increase peak milking cow numbers on farm from 800 consented to 850 consented (on average, a maximum of 780 milking cows have been milked between 2015 and 2018);
- Increase the dairy platform from 267 ha to 315 ha (note these areas include paper roads and are the farmed areas proposed including effective and ineffective land areas);
- Not graze any milking cows on the 'silage block (orange polygon on Figure 1 above)';
- Send the majority of the milking herd to Piobiare for winter;
- Intensively winter graze[1] stock on 7.2 ha of fodder beet during April, May, July, August and September; and

[1] Defined as: Grazing of stock between May and September (inclusive) on forage crops (including brassica, beet and root vegetable crops), excluding pasture and cereal crops. PSWLP (4 April 2018).

- No grazing of milking herd on the silage block.

The purpose of grazing stock on fodder beet on the dairy platform is to transition stock from grass feed to fodder beet when the cattle leave the property in autumn and vice-versa when they return in spring/late July. A handful of stock could remain on farm in winter, and an allowance for example, for some sick cows (or healthy cows for that matter) could be left on Aerodrome over the winter so that the farm manger can keep an eye on them. This has been modelled as a contingency to allow the applicant flexibility to carry some stock and to assess what the likely losses may be if some stock remain on Aerodrome in winter. We note, this doesn't always occur every year, and the model doesn't specify 'sick' cows. However, it does explain to the Consent Authority some of the inputs to the model. The milking herd will be brought back to Aerodrome from Piobiare over time, from July onwards, as the cows are ready to calve.

The property is flat, and no areas of sloping land are grazed. Rule 20(a)(iii)(3) lists practices that must be implemented in order for a property to meet the permitted activity Rule 20(a)(iii) where intensive winter grazing forms part of the farming activity on a landholding. Compliance with these practices is detailed below:

1. Portable troughs are utilised in the fodder beet crops, and all waterbodies are permanently fenced from stock, preventing access. Further to this, where a paddock is on/off grazed then a portable trough isn't required because stock don't need water for the short period they are in that paddock, and will drink from a trough in the pasture paddock/calving pad they are otherwise located;

2. Furthermore, a hot-wire is set up to increase the buffer from the creek to the grazed area to be no less than 5 m;

3. Break feeding and back fencing will occur;

4. Portable feeders are used where baleage is fed on crop paddocks;

5. When stock are transitioned from pasture to fodder beet and vice-versa they aren't typically left in the crop paddock for a long period and the applicants utilise 'on-off' grazing during these periods, switching from fodder beet to pasture and back to fodder beet until the stock have either fully transitioned to one crop or pasture;

6. In terms of mob sizes, these can be more or less than 120 cattle and changes over time depending on the size of the herd; and

7. As discussed below, strategic grazing is a mitigation implemented on farm as and where required, whereby CSAs are grazed last (the 'last bite strip').

Table 1: Summary of LUC details for farming activity on Aerodrome Farm Limited

Land use consent for dairy farming:	
Property Address	95 Aerodrome Road, Lorneville
Property Owners	Aerodrome Farm Limited
Legal Description of dairy platform	Lot 2 DP 444882, Lot 1 DP 387607, Lot 3 DP 307719, Lot 2 DP 500581, Lot 6 DP 403135, Section 33 BLK IV Invercargill Hundred, Lot 2 DP 375267, Sections 1, 2, 3 & 4 BLK IX Invercargill Hundred, Lot 2 DP 449748 and Lot 2 DP 451891.
Property Area (proposed)	315 ha
Map reference	NZTM 2000: 1245258E 4855827N (Dairy Farm)
Peak milking cows on farm (proposed)	850
Stocking rate	2.8 cows/ha

Full details of proposed stock classes and numbers are detailed on page 18 of the attached Ravensdown Nutrient Budget Farm Scenario Plan for Aerodrome (Attachment F).

2.1.2 Discharge Permit to discharge agricultural effluent to land

- To treat and store effluent in a sump, weeping wall and sludge beds and effluent pond;
- To discharge effluent generated at the dairy shed from up to 850 peak milked cows to land via pods (or equivalent low rate application methods), slurry tanker and umbilical;
- Collection and discharge of silage leachate to land via the effluent disposal system;
- Collection and discharge to land of liquid/slurry effluent from a new calving pad from up to 120 cows to be primarily used July – September and outside of these times during adverse weather conditions;
- Discharge of slurry effluent from the sludge beds and effluent pond when de-sludged;
- To increase the effluent disposal area from 118.6 ha to approximately 159.7 ha; and
- No effluent spread on the 'silage block'.

The following figure shows the overall layout of the effluent treatment, storage and disposal system. The silage pad currently drains to the effluent pond, the new calving pad location is yet to be confirmed but will also drain to the effluent pond. The sump is located between the dairy shed and sludge beds.

Figure 2: Overview of layout showing dairy shed and effluent treatment system (Source: ES Beacon).

The new calving pad will drain rainwater (and effluent) to the effluent pond and may be diverted from the effluent pond when not in use. As the attached DESC shows, the applicant has enough effluent storage working volume to not have to divert the calving pad (Attachment D). Sludge/solids from the calving pad are to be scraped and washed down with a little bit of water when required. Liquid effluent will drain to the existing effluent system.

The following table summarises the key discharge permit details relevant to the proposal.

Table 2: Summary of Discharge Permit details

Replacement of permit no.	**301219**	
Peak number of dairy cows	850	
Winter milking[2]?	No milking between 20 June and 20 July other than slipped cows and/or early calvers, the herd won't typically begin calving until 21 July each year.	
Sources of effluent?	Dairy shed, silage pad leachate (existing) and effluent from the proposed calving pad, slurry from weeping wall sludge beds, effluent pond when de-sludged and sump.	
Effluent treatment	Weeping wall, solid separation Solids/slurry from proposed calving pad will be discharged to land via the slurry tanker.	
Storage	**Pond**	**Sludge beds**
Storage available (m^3) – working volume	3,816 m^3	342.5
Storage required (m^3) – as per attached dairy effluent storage calculator	1,940 m^3 (90% probability) and 2,513 m^3 (maximum)	250.7 (maximum)
Disposal area proposed (ha)	159.7 ha. See Attachment A for current and proposed effluent disposal area.	
Irrigator proposed	Pod irrigation (or equivalent low rate irrigation method), slurry tanker and umbilical	
Instantaneous application rate and maximum depth per application (See Attachment A for EFFLUENT category Plan)	10 mm/hr rate and 12 mm maximum depth per application (for pods applying EFFLUENT in Category A and D soil risk zones). 10 mm/hr rate and 10 mm maximum depth per application (for pods applying EFFLUENT in Category C soil risk zones). 10 mm maximum depth for umbilical in Category A and D only. 5 mm maximum depth for slurry tanker in Category A and D only.	
Effluent pond details	Clay-lined, constructed in 2012 by way of AUTH-301221. Pond and weeping wall passed drop-tests. The pond and one sludge bed has also	

[2] Not defined in the PSWLP (decisions version 4 April 2018).

Replacement of permit no.	301219
	been visually inspected by a suitably qualified professional. See Attachment B for further details.

2.1.3 *Water Permit to take and use groundwater*

- Take and use 102 m^3 of groundwater per day (an increase from the 96 m^3 currently authorised) at a rate not exceeding 2 L/s; and
- To abstract water from two bores being the existing E46/0667 and recently constructed E46/1442 for the purpose of stock drinking and dairy farming operation.

Table 3: Summary of Water Permit Details

Replacement of permit no.	301220-V1	
Location of point of take	NZTM2000: 1244931E 4855816N (Bore E46/0667) NZTM 2000: 1245336E 4855868N (Bore E46/1442)	
Freshwater storage onsite?	3 x 30,000 L tanks (90,000 L)	
Rate of take over 24 hrs (L/s)	1.18 L/s (average over 24 hours)	
Peak daily volume (L)	102,000 L/day	
Allocation per cow (L/cow/day)	120 L/cow/day	
Yearly volume (m^3/year)	31,312 m^3/year. Includes, volume required during milking season and a stock drinking allowance in July for cows brought back early/on calving pad	
Groundwater Zone	***Makarewa (RWPS)***	***Waihopai (PSWLP Decision Version)***
Amount currently allocated, including current permit (m^3/year) and percentage currently allocated.	3,935,161 (8 %)	2,775,508 (6.2 %)

2.1.4 *Associated Permitted Activities Proposed*

The activities below relate to the proposal, but consent is not required for them specifically.

2.1.4.1 Use of a feed pad/lot (calving pad)

- The use of a feed pad/lot (calving pad) for up to 120 adult cattle or equivalent numbers of young stock at any one time between 1 July and 31 September;
- The use of the feed pad/lot (calving pad) during adverse weather conditions during and outside of this period (not exceeding 120 cattle or equivalent numbers of young stock at any one time, nor for a *continuous* period of more than 3 months); and
- Any material scraped from the feed pad/lot is applied to land in accordance with the discharge permit details as applied for above.

The exact location of the calving pad is yet to be determined, it will be constructed of concrete materials, and probably rubber and/or sawdust, this will be in accordance with the permitted activity rule in the PSWLP. The calving pad will be located a suitable distance from water bodies, tile drains and sensitive receiving environments. ***This calving pad will be constructed within 12 months of the commencement of the Land use consent for a farming activity on Aerodrome Farm Limited and is proposed to mitigate effects of the overall farming activities as applied for in this application.***

Table 4: Summary of details for Feed pad/lot

Type of structure	Calving pad – where animals may also be fed
Location	95 Aerodrome Road, Invercargill
Peak Number of cows 1 July – 31 September	No more than 120 adult cattle. Up to 120 cattle outside of these months. Other (equivalent) stock classes when not utilised by adult cattle.
Material	Concrete with sawdust or rubber in accordance with Rule 35A(a)(iv).
Dimensions of pad	Up to 1,200 m^2 (10 m^2 per animal)
Proposed construction completed date	Within 12 months of commencement of the land use consent as applied for a farming activity on Aerodrome Limited
Directed to pond?	Yes

The pad will be used mostly over a three month period, during calving. Calving won't start officially until 21 July and should be finished by mid-September each year. Due to the modelling constraints in both the OVERSEER® model and DESC the use of the calving pad has been over-estimated. It won't be used 'continuously' i.e. cows will not be on the pad for 24 hours at a time continuously, but the pad can be used as and when required. As can be seen in the attached DESC, if the applicant needed to utilise the pad for

24 hours a day, even up to four months continuously then they could do so as there is enough effluent storage capacity to accommodate the increased effluent collection/generation. The applicant recognises that any use of the pad for more than three months continuously requires a resource consent, and while they do not intend to use it for four months, if they need to, they will apply for appropriate authorisations at that time, and the storage is sufficient.

The use and construction of the pad meets all of the permitted activity rule conditions of Rule 35A and therefore the applicant does not require consent for the use of this pad.

As the new pad is proposed as a mitigation in relation to the overall farming activity as applied for, the effects of the activity have been assessed for completeness below (i.e. an assessment of all activities permitted or otherwise has been undertaken). The pad is proposed to be constructed within 12 months from the commencement of any LUC for a farming activity at Aerodrome as applied for, and as such ***a condition of consent requiring that be constructed would be appropriate (subject to granting) on the LUC for farming.***

2.2 Piobiare Homestead Limited

Piobiare is located at 939 Lochiel Branxholme Road, Lochiel. The property is an existing wintering/ dairy support runoff block. The property is part owned and part leased. A & L Roxburgh own the land leased by Piobiare that forms the existing dairy support runoff block. The farm boundary is shown on the Scheme Plan contained within Attachment A.

2.2.1 Land use consent to use land for farming activity

- To peak farm 885 milking cows, 220 young stock, 61 bulls and steers, and 40 sheep; and
- Intensively winter graze[3] stock on no more than 18 ha of fodder beet between 1 May and 31 September.

Land Use Consent for Farming on Piobiare

Following the proposed expansion at Aerodrome, the Piobiare property is to be used solely for the grazing of Aerodrome dairy cows and young stock. Piobiare is proposed to winter up to 885 milking cows, young

[3] Defined as: Grazing of stock between May and September (inclusive) on forage crops (including brassica, beet and root vegetable crops), excluding pasture and cereal crops. PSWLP (4 April 2018).

stock, bulls' steers and sheep using the wintering barn, pasture, baelage and crop. ***No more than*** 18 ha of fodder crop will be planted and grazed in-situ. As shown in Figure 3 below, the applicant has sown a fodder crop for the 2019 winter (photo taken early March 2019). Bales are placed in the paddock before stock graze and portable feeders are utilised.

Figure 3: View of fodder crop planted for winter 2019

The property is flat, and no areas of sloping land are intensively winter grazed. Rule 20(a)(iii)(3) lists practices that must be implemented where intensive winter grazing forms part of the farming activity on a landholding. These practices are listed below.

- Portable troughs ***are not*** utilised, but all waterbodies are permanently fenced from stock, preventing access. An assessment of the effects of not using portable troughs is discussed below in Sections 6.1.2 and 8.2.2.2;
- Furthermore, a hot-wire is set up to increase the buffer from any waterbody to the grazed crop area to be no less than 5 m where crops adjacent to waterbodies are grazed;
- Break feeding does occur, and some back fencing occurs when stock have grazed all crop to one side of the fixed water troughs. Water troughs are located in the middle of each paddock;
- Mob sizes can be more than 120 cattle and changes over time depending on the size of the herd; and
- As discussed later in this application, strategic grazing is a mitigation implemented on farm whereby CSAs are grazed last (last bite strip).

Table 5: Summary of Proposal for Piobiare Homestead Ltd

Property details:	
Property address	939 Lochiel Branxholme Road, Branxholme
Property use	Dairy Support Runoff
Property Owner	Piobiare Homestead Limited and A & J Roxburgh (lease land)
Legal description of wintering platform	Lot 1 DP 12462, Lots 1 & 2 DP 429633, Section 2 and Part Section 3 Block III New River HD, Section 2 Survey Office Plan 385656, Lots 1-3 DP 517446, Lot 1 Deposited Plan 7084
Property area	165.1 ha
Proposed winter grazing in-situ	18 ha of crop
Peak stock number on farm	885 milking cows and 220 young stock
Map reference	NZTM 2000: 1238402E 4864404N

2.2.2 Land use consent for a feed pad/lot (wintering barn)

- To house ***either*** a minimum of 400 milking cows and a maximum of 440 milking cows in the wintering barn during June and July, ***or*** an average of 425 cows between 1 June and 31 August which accounts for early calvers and cows sent back to Piobiare over time;
- To house other stock in the wintering barn in May and September as informed by the FEMP; and
- The use of the wintering barn during adverse weather conditions outside of this period to house stock.

Land Use Consent for Wintering Barn

The wintering barn capacity will remain the same, in that usually the applicant will house 400 cows over winter. However, there is space for 10 % more cows to be housed in the barn (existing capacity and not expanded capacity) for short durations where not all cows utilise the water beds and stand around in the barn. Therefore, up to 440 cows may be housed in the wintering barn during the winter period. Cows housed in the wintering barn will return to Aerodrome as they calve. Changes to the current farm system mean that the barn will be better utilised on the shoulders of the season (May, and August to September) with the intention to accommodate dry stock. Dry stock as a term includes all dairy animals that are not milking, and this would easily be achieved as milking cows will be on the dairy farm on the shoulders of the season and unlikely to be on Piobiare (unless they're not milking).

The barn will also be used on an as required basis outside of these specified months (and during) if there are adverse weather events that require stock to be housed to protect pasture and soil structure, and hence have a lesser environmental effect.

The applicant has modelled the use of the wintering barn based on peak 400 cows during winter and dry/young stock on the shoulders of the season. It is not possible to accurately model 'one-off' wintering barn uses during adverse weather conditions and so this has not been modelled. While more cows may be housed in the barn at any one time i.e. up to 440 milking cows, the nutrient budgets model a more conservative scenario where more cows are on the paddocks.

Housing more cows will have a lesser environmental effect in-terms of less losses of P, N, Sediment and *E. coli* that may potentially enter water bodies where they are housed, rather than if they are grazing paddocks. The effects of increased usage of the wintering pad will be positive and less than that modelled. This is discussed further later in this report (Section 5.5).

Table 6: Summary of details for land use consent for wintering barn

Type of structure	Wintering barn
Location	NZTM2000: 1238445E 4864407N
Cow numbers modelled/proposed	May: 125 June: 400 – 440 July: 400 – 440 August: 150 – 440 September: 25
Material	Constructed of concrete, steel, rubber and water beds
Directed to pond?	Yes

2.2.3 Discharge permit to discharge agricultural effluent to land

- Collect effluent from the wintering barn between 1 May and 31 September from no more than 440 cows;
- Operate an effluent system that includes concrete sumps, mechanical separator and effluent pond;
- Discharge of liquid effluent and slurry to land by way of slurry tanker, umbilical and k-line (or equivalent low rate application); and

- Extend and remove parts of the effluent disposal area, of which the total area will remain as currently consented (94 ha as accurately mapped accounting for buffers from waterbodies).

The following figure show the overall layout of the effluent treatment, storage and disposal system.

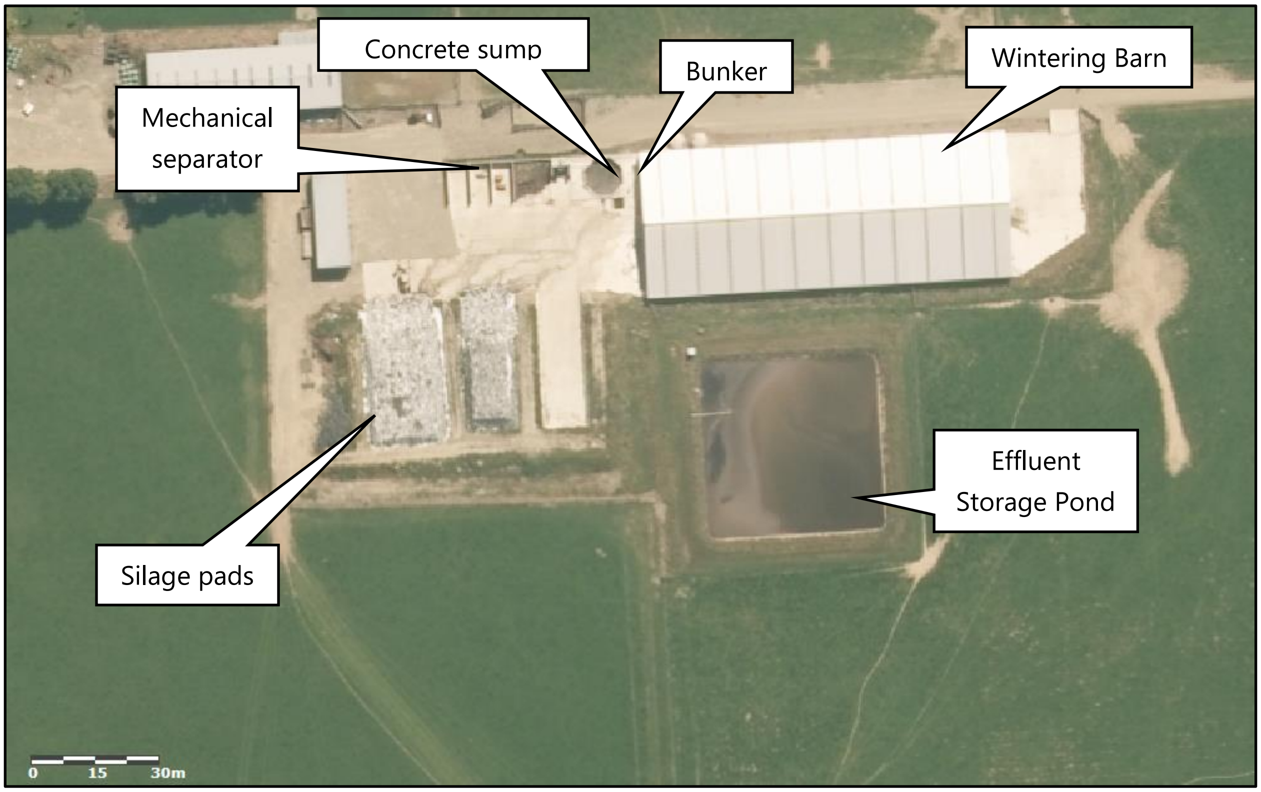

Figure 4: Overview of layout showing dairy shed and effluent treatment system at Piobiare Homestead (Source: ES Beacon).

Effluent is collected at the wintering barn and is scraped/washed down to the bunker at one end of the barn (Figure 6). Effluent is then pumped from the bunker to a stone trap, and gravity fed from the stone trap to an adjacent concrete sump (figures 7 and 8). The bunker has less than 35 m^3 storage capacity. Effluent is then treated via a mechanical screw press as shown in figure 9.

Solids are applied to land via a slurry tanker, and liquid effluent then is pumped to the existing clay lined effluent pond.


Figure 5: Wintering barn


Figure 6: Bunker at the end of wintering barn

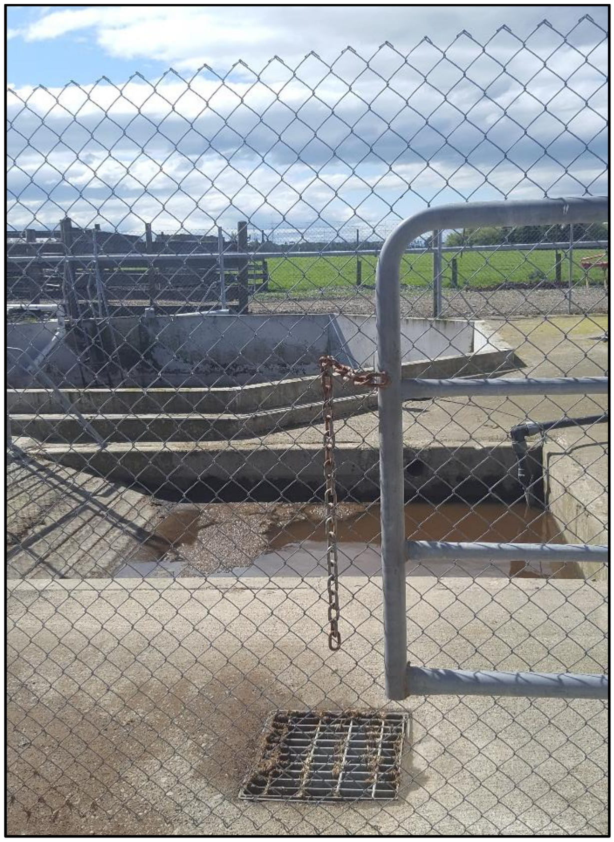

Figure 7: Stone trap

Figure 8: View of concrete sump (referred to a pump sump in Dairy Green Ltd reports attached)

Figure 9: View of mechanical separator

Table 7 below summarises key details of the discharge activities proposed.

Table 7: Summary of details for Discharge Permit

<table>
<tr><th>Permit no.</th><th colspan="3">AUTH-3009980-V1</th></tr>
<tr><td rowspan="2">Number of dairy cows accommodated in wintering shed</td><td colspan="2">Consented Number</td><td>Proposed Number</td></tr>
<tr><td colspan="2">400</td><td>Maximum 440</td></tr>
<tr><td>Sources of effluent?</td><td colspan="3">Wintering shed effluent produced from up to 440 cows, from 1 May to 30 September each year.</td></tr>
<tr><td>Effluent treatment</td><td colspan="3">Screw press solid separation</td></tr>
<tr><td>Storage</td><td>Pond</td><td>Concrete Sump (pump sump)</td><td>Bunker</td></tr>
<tr><td>Storage available (m^3) – working volume</td><td>2,945 m^3 (excluding 0.5 m freeboard)</td><td>72.4 m^3</td><td>30 m^3</td></tr>
<tr><td>Storage required (m^3) – as per attached</td><td colspan="3">1,899 m^3 (total)</td></tr>
<tr><td>Disposal area proposed (ha)</td><td colspan="3">94 ha (see Attachment A)</td></tr>
</table>

Irrigator proposed	Pod irrigation/K-Line (or equivalent low rate irrigation), slurry tanker and umbilical
Application rate and depth	Pod irrigation: 10 mm/hr rate and 12 mm depth per application Umbilical system: 10 mm depth per application Slurry tanker: 5 mm depth per application
Effluent pond details	Clay-lined, constructed in 2012 by way of AUTH-300999. The pond passed a drop-test and it and other effluent storage structures have been visually inspected by a suitably qualified professional as per Attachment C

2.2.4 Associated Permitted Activities Proposed

The activities below relate to the proposal, but consent is not required for them specifically.

2.2.4.1 Land use consent to use and maintain existing effluent storage facility

The applicant utilises an existing concrete sump as described in Section 2.2.3 above. The structure has capacity greater than 35 m^3 is below ground, made entirely of concrete and was authorised by way of a building consent in 2012. The sump has been visually inspected by a suitably qualified professional as not containing any visual defects or signs of leaking (Attachment C).

The concrete sump does not require land use consent for the continued use and maintenance of the structure, as discussed in more detail Section 4.2 below. This structure has existing use rights under S20A of the RMA.

The concrete bunker stores less than 35 m^3. This structure is also unlikely to be leaking. Even though these activities are permitted, consistent with Council correspondence, an assessment of the effects of these permitted activities is assessed below.

2.2.4.2 Water abstraction details

While the proposal meets the permitted activity Rule, the applicant is required to supply the details as required under Rule 54(a)(iii) of the PSWLP. These details are listed in the table below for completeness. The activity is a permitted activity under the RPWS because Rule 23 stipulates, *"In addition to the takes authorised by Section 14(3) of the Act and the abstraction and use of groundwater permitted under Rule 23(b), the abstraction and use of up to 20,000 litres of groundwater per landholding per day is a permitted activity* *provided"* that the rate of take is no more than 2L/s and there are no adverse effects. We confirm the rate of take is no more than 2 L/s because the pump capacity doesn't allow a greater rate of take than this, and this is a lawfully established take with no known neighbour complaints.

Table 8: Assessment of Water abstraction against Rule 54 of the PSWLP

Detail required by Rule 54(a)(iii) PSWLP	Piobiare Homestead Limited
Farm type	Primarily dairy support runoff
Stocking rate	5.4 cows/ha (although most are housed)
Point of abstraction	At or about NZTM 2000: 1238500E 4864400N
What the water is used for	Stock drinking and some general farm purposes/cleaning
The maximum rate of take	No more than 2 L/s
Where more than 20,000 L/day is abstracted…	The applicant will be required to install a water meter within 6 months of the date that Rule 54 becomes operative. A water meter isn't currently installed but will be in-line with this timeline requirement.

The applicant will meet the permitted activity conditions of Rule 54 and no water permit is required. The water abstraction and use enable the dairy support runoff operation and as such the effects of water use are assessed later in this application for the purpose of providing a complete assessment as it relates to the overall farming activity applied for at Piobiare Homestead Limited.

3. DESCRIPTION OF EXISTING ENVIRONMENT

The scope of the 'Environment' for this application is limited to the terrestrial environment within the proposed dairy platform boundary, and that within the Piobiare winter grazing block boundary (including all leased and recently purchased land that forms the existing and proposed landholding). Surface water resources includes the immediate receiving water bodies, their receiving water bodies and the estuary at the bottom of the catchment. Ground water resources are those underlying each property (Aerodrome and Piobiare). The following section describes the existing environment for both landholdings.

3.1 Land Use, Topography & Climate

Aerodrome Dairy platform

The proposed dairy platform will be made up of the existing dairy platform, and adjacent sheep farm with vegetable cropping and located at about 20 m above mean sea level. Conventional farming practices are undertaken. The property is in close proximity to Invercargill City, and the predominant surrounding land use is rural-lifestyle. Both Donovan Park and Anderson Park are located approximately 550 metres west of the farm boundary. The site is divided by the Invercargill City Council and Southland District Council boundaries and is wholly contained within the Rural Zonation for both district councils. According to Map 2 of the ICC Planning Maps, the property is identified as being within a "Riverine Inundation Level 2A" area. This means that the property "*has a high degree of risk in a flood event greater than the design limits of the flood protection system*"[4]. The locations of these areas can be seen on the ICC and SDC planning maps which are publicly available. The flood risk applies to both the Waikiwi Stream and Myross Creek, however both waterways have not flooded in recent years, likely influenced by Councils flood management programme. The effluent pond and infrastructure are located outside of the flood zone. There are also high voltage transmission lines traversing through the property.

The dairy farm comprises flat to gently rolling land, with a visibly defined catchment towards a proposed wetland area to the north of the property, and a gentle slope/terrace down to the south of the property on the banks of the Myross Creek. The DESC (Attachment D) reports that Aerodrome is likely to receive an annual average of 1,031 mm of rainfall per year, based on the Woodlands Garvie Road rainfall monitoring site, being the nearest site with 30 years of rainfall records.

The existing environment includes existing activities which are occurring under enduring resource consents or existing use rights. Permitted activities occurring are also included in the assessment of the existing environment. The existing environment includes:

- Peak milking of 769 cows on average on farm between 2015 and 2018, as authorised under Discharge Permit 301219;
- Peak stocking rate of 2.9 cows/ha;
- Dairy platform of 266.8 ha;
- The discharge of effluent collected at the dairy shed to 94 ha of land via k-line/pods;
- The storage of effluent in a sump, weeping wall sludge beds, and effluent pond;
- No effluent disposal or milking cows grazing on the 'silage block';

[4] Invercargill City Council, 2017. Explanation of Hazard Data.

- Groundwater abstraction of up to 96,000 L/day from bore E46/0667 and E46/1442 as authorised under Water Permit 301220-V1;
- Rotational cropping of approximately 8 ha of fodder beet over the past three years; and
- Rotational vegetable cropping of approximately 7.8 ha of swedes/barley/pasture and 7.8 ha of potatoes/carrots over the past three years and sheep farming on the new block.

Piobiare Dairy Runoff Support block

The 165.1 ha dairy runoff support block is an established dairy wintering and grazing operation (dairy runoff support) and comprises land owned by the operator, and land that has been leased for a number of years. The surrounding land uses are distinctly rural in nature. The property is approximately 1.1 km south west of Ryal Bush Township and located at Map Reference NZTM 2000 1238607E 4864272N. Grazing stock on crop in-situ has been a permitted activity. The existing environment includes the following activities:

- Sheep grazing along the Tomopokorau Creek (0.1 ha of land);
- Cattle grazing of 165.1 ha of land;
- Rotational cropping of approximately 17.6 ha of fodder beet and grazing stock in-situ during 2015-2018;
- Use of a wintering barn between June and August to house up to 400 cows;
- Operate an effluent system that includes concrete bunker, concrete sump, mechanical separator and effluent pond; and
- Discharge of effluent to land by way of slurry tanker and umbilical to 90.7 ha of land (modelled as actual effluent application area). It's noted that Discharge Permit AUTH-300998-V1 authorises application by way of travelling irrigator, pods and slurry tanker to 94 ha of land (consented), but that some of this land is no longer leased. For the purpose of completing the nutrient budgets the applicant has modelled actual application of effluent including actual methods and areas and not consented (this is consistent with assessing effects compared to the existing environment)

The Piobiare landholding is generally flat to gently rolling and is contained wholly within the Makarewa River catchment. Annual rainfall at the subject property is estimated to be 1,110 mm/year (as estimated in the nutrient budget).

3.2 Surface Water Resources

Table 9 summarises key receiving surface waterbodies to both properties.

Table 9: Description of receiving surface water bodies

<table>
<tr><th colspan="2">Aerodrome Farm Limited</th><th colspan="2">Piobiare Homestead Limited</th></tr>
<tr><td>Myross Creek</td><td>Flows in a south westerly direction along the southern boundary of the property. This creek discharges to the mainstem of the Waikiwi Stream near to the property boundary.</td><td>Tomopokorau Creek and tributary</td><td>Travels in a southerly direction through the property. The creek is highly modified and looks to have been straightened through this part of the property. The catchment of this creek is estimated at 7.5 km^2</td></tr>
<tr><td>Waikiwi Stream</td><td>Flows in a south westerly direction along the north-western boundary of the property. This Stream discharges to the Oreti River just north of Otatara, some 12 km downstream of the property. Waikiwi Stream catchment is 118 km^2</td><td>Makarewa River</td><td>Tomoporakau Creek discharges to Makarewa River approximately 14 km downstream of the subject property.</td></tr>
<tr><td colspan="2">Oreti River</td><td colspan="2">Both the Waikiwi and Makarewa discharge to the Oreti River</td></tr>
<tr><td colspan="2">New River Estuary</td><td colspan="2">At the mouth of the Oreti and Waihopai Catchment 12 km and 30 km downstream of the properties respectively.</td></tr>
</table>

There are no regionally significant wetland or sensitive waterbody listed in Appendix A of the PSWLP in the vicinity of the proposed activities. The Scheme Plans in Attachment A shows the location of water bodies in relation to the properties, and the approximate locations of known tile drains on Aerodrome. Noting that the location of tile drains on Piobiare is not known but is assumed to be extensively underlain with tile drains throughout the property. The average depths of subsurface tile drains identified at the property are approximately 1.5 metres below ground level.

There are a number of small sediment ponds/traps located on both properties, specifics of these are discussed below. On Aerodrome, these capture overland flow and subsurface flow before they discharge to the Creeks and have tile drains/open drains connected to these settling ponds. The figures below show the current state of water bodies within the properties with fenced margins.

The applicant is also proposing to construct an 8,700 m^2 wetland (approximate area) on Aerodrome, at the location as shown within Attachment A. Otway soils underly this area, which have soil properties consisting of peat soils with very poor drainage and are extremely acidic. This area is therefore unsuitable for productive land. There is an existing duck pond located to the north of the property.

Details of the function and effectiveness of these mitigations is given in Section 6 below.

Figure 10: Sediment pond located to the north of Aerodrome (March 2019).

Figure 11: View looking upstream of Myross Creek (March 2019).

Figure 12: View looking upstream of Waikiwi Stream (March 2019).

Figure 13: Tomoporakau Creek looking downstream (March 2019)

Figure 14: Tomoporakau Creek looking upstream (March 2019)

Instream values

Under the Regional Water Plan for Southland (RWPS), waterbodies on the landholdings are classified as Lowland hard bed. The list below summarises the values associated with lowland hard bed waterbodies, as specified in the RWPS. The PSWLP does not use a classification system to establish values for rivers and streams but has set objectives. These and a comment on the state and general quality of surface water in the vicinity of the proposal (at the nearest downstream monitoring site) are contained within the Attached Water Quality Technical Comment (Attachment E).

Values include, bathing where bathing is popular, trout (and natives where trout aren't present), stock drinking, Ngai tahu cultural values including mahinga kai and natural character. Under the PSWLP the objectives include:

- The mauri of water bodies provide for te hauora o te tangta (health of the people), te hauora o te taiao (health of the environment) and te hauora o te wai (health of the waterbody);
- No reduction in the quality of water bodies, particularly improving the quality where it has been degraded by human activities; and
- Groundwater quality meets the drinking water quality standards.

A search of the New Zealand Freshwater Fish Database has revealed the presence of fish located within the ***Myross Creek***, approximately 1 km east of the proposed property boundary. These fish species were all identified in the 1980s to 1990s. These identified fish species include Longfin eel, Big nose galaxias, Koura, and a number of Bullies. No other recent records were noted in the database, but it is interesting to note that trout weren't identified 20 years ago in the last survey. The applicant can confirm that they often see fish in their creeks including large brown trout, koura and eels. According to NIWA, big nose galaxias are found in the Mackenzie Basin and upper Waitaki River catchment. No records of fish surveys exist for the Tomoporakau Creek.

Water Quality

As documented in Attachment E, two nearby SOE monitoring sites have been used as a proxy for likely water quality in the vicinity of each landholding. There are limitations with the use of each site, but on the whole the results are the best guess at the likely water quality we have. Further details of state and water quality trends can be found in Attachment E.

3.3 Groundwater Resources

Aerodrome Farm Limited

The site is wholly located within the Makarewa and Waihopai GMZ under the RWPS and PSWLP, respectively. Both GMZ's have a similar hydrogeological setting, in that they both primarily consist of relatively thin (<30 metre) quaternary gravel deposits overlying Tertiary deposits and Gore Lignite Measures. The Quaternary gravels form part of the Kamahi Terrace which extends across much of eastern Southland from Gore to Invercargill. Both aquifers are recharged exclusively by rainfall infiltration, and extensive land drainage from artificial, mole and tile drainage may have significant influence on the actual rate of groundwater recharge. The Makarewa GMZ is classified as a lowland aquifer.

The current allocation (as indicated in the Groundwater Allocation Table provided by ES) for the Waihopai GMZ is much less than what is available to be allocated (the discretionary allocation limit). In terms of quantity, the Table 3 provided earlier in this report shows that allocation of the Makarewa GMZ is only 8% of the allocation limit for the RWPS. In addition, the Waihopai GMZ is only 6.2 % of the allocation limit for the PSWLP. These figures are up to date, as of 13 May 2019.

Piobiare Homestead Limited

The site is wholly located within the Lower Oreti GMZ under the RWPS and PSWLP, with a small portion of the leased block at the site contained within the Makarewa GMZ. The hydrogeological setting of the Lower Oreti GMZ primarily consists of a relatively thin layer of quaternary gravel deposits of less than 10 metres in the Wallacetown area. The groundwater level fluctuates seasonally, which is characteristic of Lowland aquifers. To the south of Lochiel, the Lower Oreti GMZ is perched above the bed of the Oreti River and is recharged predominately by rainfall infiltration.

Groundwater values

With respect to groundwater values and objectives, the most relevant is that groundwater quality meets the drinking water quality standards.

According to ES's Beacon GIS, the nearest registered drinking water supply to Aerodrome Farm is at Myross Bush School, which is approximately 1 km down-gradient of the subject property. This site is located within the Myross Bush Creek catchment and the Waihopai/Makarewa GMZ. The Myross Bush School drinking water site supplies between 101-500 people and the NZ Register of Drinking Water Supplies indicates that it is sourced from a bore. The Waihopai GMZ is rainfall recharged and discharges to surface water bodies.

The nearest registered drinking water supply to Piobiare is located approximately 2 km downgradient of the property boundary. This bore supplies Invercargill City (site INV001) for >10,000 people and the NZ Register of Drinking Water Supplies indicates that it is sourced from the Oreti River.

Groundwater Quality

Within Attachment E, Mike Freeman has mapped the maximum nitrate nitrogen concentrations (g/m^3) measured since 2012 (i.e. after the ES mapped 2007-2012 period) surrounding each landholding, and overlayed that data with the ES 2007-2012 records on Beacon. A full description of the state and trends of Groundwater Quality in the vicinity can be found in Attachment E.

3.4 New River Estuary

The waterways identified at both Aerodrome and Piobiare properties, as described above, discharge to the New River Estuary, approximately 12 km and 30 km downstream of the property boundaries, respectively.

This estuary drains several coastal catchments including the Oreti River Catchment.

Section 3.11 in the Regional Coastal Plan describes the key values for the New River Estuary. In summary, the key values relevant to this application are the exceptional bird and waterfowl habitat, recreational, shellfish gathering and heritage values which can be adversely affected by excessive levels of microbes, sediment and nutrients.

The assessment within Attachment E concludes that the New River Estuary has been experiencing significant eutrophication with a macroalgal Ecological Quality Rating (EQR) of 'poor' for the 2018 period. The trend for this ecological rating over the 2001-2018 period strongly indicates a significant decline from a 'good' state to a 'poor' state. The report also presents estimated nutrient loads from Aqualinc[5], assuming 33% attenuation actual catchment loads overall could be 3718 tonnes Nitrogen per year. Across Southland, the New River Estuary potentially realises some of the highest N loads on a per catchment basis. Full details, substantiating this summary can be found within Attachment E.

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

3.5 Soils and Physiographic Zones

The following provides a description of the soils, effluent classifications and physiographic zone(s) present as well as the associated risks. The soils described in Section 3.5.1 for Aerodrome are present on both the current dairy farm and new block, there are no new soils. Otway soils are within the existing dairy platform only. FDE shall not be discharged onto Otway soils.

Table 10: Summary of Soils, Physiographic Zone(s) and Risks at Aerodrome

Soil Type[6]	Vulnerability Factors[6]			FDE Classification[7] and Risk[8]	*Physiographic Zone[8]*
	Structural Compaction	N leaching	Waterlogging		
Waikiwi	Low (0.48)	Low	Moderate	Category D (Well drained flat land (<7º)) *Low Risk*	**Oxidising** Artificial Drainage Variant
Woodlands	Moderate (0.57)	Low	High	Category C (Sloping land (>7º)) *High Risk*	**Gleyed** No Variant
Paroa	High (0.65)	Very low	High	Category A (Artificial Drainage or Coarse soil structure) *High Risk*	
Waimairi	Moderate (0.54)	Very Low	High		
Otway	Very High (0.76)	Very Low	High	Not applicable	**Peat Wetlands**

Table 11: Summary of Soils, Physiographic Zone(s) and Risks at Piobiare

Soil Type[9]	Vulnerability Factors[10]			FDE Classification[10] and Risk[11]	*Physiographic Zone[12]*
	Structural Compaction	N leaching	Waterlogging		
Paroa	High (0.65)	Very low	High	Category A	**Gleyed** No Variant

[6] Retrieved from https://smap.landcareresearch.co.nz on 29 October 2018.
[7] Retrieved from ES Beacon on 29 October 2018.
[8] As classified in the DESC.
[9] Retrieved from https://smap.landcareresearch.co.nz on 29 October 2018.
[10] Retrieved from ES Beacon on 29 October 2018.
[11] As classified in the DESC.

				(Artificial Drainage or Coarse soil structure) *High Risk*	
Waikiwi	Low (0.48)	Low	Moderate	Category D (Well drained flat land (<7º)) *Low Risk*	**Oxidising** (Artificial Drainage Variant applies to part of oxidising zone only)
Woodlands	Moderate (0.57)	Low	High	Not applicable	

3.5.1 Soils

- **Waikiwi soils – Aerodrome and Piobiare**

  A large proportion of the aerodrome proposed FDE disposal area consists of Waikiwi soils. The FDE area on the new block consists entirely of Waikiwi soils. Waikiwi soils are classified as Typic Firm Brown soils and are formed in deep wind-deposited loess derived from greywacke and schist rocks. These soils are stone free in the topsoil with a silty loam texture and are well drained. They have deep rooting depth and due to their moderately limited aeration and slow permeability, there is moderate risk of waterlogging (and therefore may be likely to have some artificial drainage). Nutrient leaching risk is low due to their high water holding capacity, although the soils are well drained. These soils have high Profile Available Water (PAW). The base saturation and anion storage capacity (or P-retention) of these soils is medium (43%).

- **Woodlands soils – Aerodrome and Piobiare**

  Woodlands soils are classified as Mottled Firm Brown soils and are formed in deep wind-deposited loess derived from greywacke and schist rocks. Soil properties are similar to that of Waikiwi soils, in that they are stone free in the topsoil with a silty loam texture. Woodlands soils are imperfectly drained. They have unlimited rooting depth and due to their compact subsoil, permeability is slow, resulting in high risk of waterlogging (and are therefore likely to have artificial drainage present). Nutrient leaching risk is moderate. These soils have high Profile Available Water (PAW). The base saturation and anion storage capacity (or P-retention) of these soils is medium (43%).

  This soil type is classified as Category C for soil risk on Aerodrome, and therefore FDE disposal in this area shall be disposed at a depth of up to 10 mm and instantaneous rate of up to 10 mm/hour, in accordance with Policy 42 of the RWPS.

- **Paroa soils – Aerodrome and Piobiare**

  Paroa soils are classified as Acidic Recent Gley soils and are formed into fine alluvium from rewashed loess. Soil properties are similar to that of Waikiwi soils, in that they are stone free in the topsoil with a silty loam texture. However, these soils are poorly drained and have very limited aeration. They have deep rooting depth and due to their moderately limited aeration and slow permeability, there is high risk of waterlogging (and therefore likely to have extensive artificial drainage). Nutrient leaching risk is very low due to their high water holding capacity. These soils have very high Profile Available Water (PAW). The base saturation and anion storage capacity (or P-retention) of these soils is medium (35%).

- **Waimairi – Aerodrome**

  Waimairi soils are classified as classified as Peaty Orthic Gley soils. These soils are well drained stoneless soils located generally on the banks of the Waikiwi Stream. The applicant has three sediment ponds located within these peaty soils. These soils have very high Profile Available Water (PAW). The base saturation and anion storage capacity (or P-retention) of these soils is medium (35%).

- **Otway soils – Aerodrome**

  Otway soils are classified as Sphagnic Fibric Organic soils and occur as raised peat bogs (up to 6m deep) overlaying fine alluvium and gravel and formed in weakly to moderately decomposed organic material. Soil properties are stone free in the topsoil with peat texture, resulting in the topsoil consisting of no clay. Soils are very poorly drained with very limited rooting depth and due to their slow permeability and high profile available water, there is very high of structural compaction and waterlogging. There is very low nutrient leaching risk and low P retention (26%). Effluent is not proposed to be disposed to this soil type.

3.5.2 Farm Dairy Effluent Classification

Policy 42 of the RWPS identifies criteria for minimum management of the application of FDE (specifically) to land and is summarised in Table 12 below.

Table 12: Minimum management criteria for a land applied effluent system to achieve[12]

	Category A	Category B	Category C	Category D
Soil and landscape feature	Artificial drainage or coarse soil structure	Impeded drainage or low infiltration rate	Sloping land (>7°)	Well drained flat land (<7°)
Application depth (mm)	< SWD*	< SWD	< SWD	< 50% of PAW#
Instantaneous application rate (mm/hr)	N/A**	N/A**	< soil infiltration rate	N/A
Average application rate (mm/hr)	<soil infiltration rate	<soil infiltration rate	<soil infiltration rate	<soil infiltration rate
Storage requirement	Apply only when SWD exists	Apply only when SWD exists	Apply only when SWD exists	24 hours drainage post saturation
Maximum N load	150 kg N/ha/yr	150 kg N/ha/yr	150 kg N/ha/yr	150 kg N/ha/yr

For both properties, pods (or equivalent low rate), slurry tankers and umbilical's will be utilised to dispose of effluent. Depths of up to 10 mm for Category C soils are appropriate on Aerodrome so long as a soil water deficit at least matching the depth of application is available. A low rate system (such as pods or equivalent) is generally preferred because it minimises risks of run-off. However, the use of an umbilical has environmental benefits as it applies very low depths, but at a high rate (travelling quickly and covering a lot of ground). Umbilical and slurry tanker won't be used on Category C soils, as they are high rate application methods.

Accounting for these criteria, a pod irrigation system with a maximum application depth of 12 mm and rate of 10 mm/hour is appropriate for Category A, C and D soils, so long as a soil water deficit at least matching (or more than) the depth of application is available (as determined by Councils website). We note however that the applicant proposes more sources of effluent than just farm dairy (i.e. from a calving pad and wintering barn) but the risks have been assumed the same for completeness. Where differential treatment is required it will happen, and for completeness discharge of all sources and forms of effluent has been applied for as part of this application for both landholdings.

[12] Regional Water Plan for Southland. April 2010. Objectives/Polices – Page 2.

3.5.3 *Physiographic Zones*

- **Oxidising (Artificial Drainage Variant) - Aerodrome and Piobiare**

Oxidising means well aerated with plenty of oxygen. High levels of oxygen allow nitrogen to build up, and therefore this setting has little to no ability to remove nitrogen (i.e. denitrification).

Soils generally have good permeability although some soils in this zone have low subsoil permeability making them susceptible to waterlogging and therefore artificial drainage. Overland flow can also occur when rainfall intensities exceed the soil's ability to absorb water. This zone has a high risk of nitrogen build-up in soils and aquifers (due to little denitrification ability) and in some areas, have a risk of nitrogen, sediment, phosphorus and microbial contaminant loss where overland flow and artificial drainage occur.

The oxidising physiographic zone is the predominant zone at Aerodrome, which underlies a terrace running through the property, including the silage block. The new block proposed to be incorporated into the dairy platform is an extension of the Oxidising physiographic zone. For the Piobiare property, the artificial drainage variant only underlies part of the property within the oxidising zone.

- **Gleyed – Aerodrome and Piobiare**

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 events[13].

The Gleyed physiographic zone underlies the north west corner and southern boundary of Aerodrome, including the silage block, and parts of Piobiare.

- **Peat wetlands – Aerodrome**

The Peat Wetlands physiographic zone comprises predominately low-lying flat land where soils overlie poorly permeable material. Peat soils are prone to waterlogging and will often have a seasonal water table that sits close to the ground surface. Contaminant loss to surface water is therefore the main water quality risk associated with this zone as it often requires extensive artificial drainage to nearby waterways.

[13] Environment Southland Physiographic Zone Fact Sheets (2015).

Peat soils within this zone are extremely acidic and have high levels of organic matter, resulting in high soil and aquifer denitrification potential. Therefore, nitrogen build-up is not an issue for aquifers in this zone.

4. ACTIVITY CLASSIFICATION

If there are other Rules not covered in the assessment below, that are relevant but do not change the activity status of the overall application then the Consent Authority may make their own assessment of those matters. Exclusion of a rule would not warrant the application to be considered as incomplete, because of the level of detail provided throughout the entire application. It is highly unlikely that those matters (if the situation exists) aren't assessed elsewhere in this document and therefore the application meets Section 88 requirements under the RMA.

4.1 Consents Required

As summarised in Table 13 and 14 below the following resource consents are required under the Regional Water Plan for Southland, 2010 (RWPS) and Proposed Southland Water and Land Plan, 2018 (pSWLP).

Table 13: Applicable Rules for Aerodrome Farm Limited

Consent	Plan	Rule	Activity Status
Discharge Permit to discharge agricultural effluent to land (slurry, liquid, silage leachate etc…), excluding high rate application on Category C land.	RWPS	50 (d)	Restricted Discretionary
	PSWLP	35 (c)	Discretionary
Water Permit to take and use groundwater for dairy shed wash down and stock drinking	RWPS	23 (d)(ii)	Discretionary
	PSWLP	54 (d)	Discretionary
Land Use Consent for farming activity	RWPS	N/A	N/A
	PSWLP	20 (e)	Discretionary

Table 14: Applicable Rules for Piobiare Homestead Limited

Consent	Plan	Rule	Activity Status
Discharge Permit to discharge agricultural effluent to land (slurry, liquid, silage leachate etc…)	RELAP	5.4.6	Discretionary
	PSWLP	35 (c)	Discretionary
Land use consent for farming activity	RWPS	N/A	N/A
	PSWLP	20 (e)	Discretionary

Consent	Plan	Rule	Activity Status
Land use consent for a wintering barn	PSWLP	35A(b)	Discretionary

Overall, the proposal is for a **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 15: Activities for which Consent is Not Required for Aerodrome and Piobiare Homestead Limited

Activity	Compliance with the relevant permitted rules of the RWPS and PSWLP	
	Aerodrome Farm Limited	**Piobiare Homestead Limited**
Use of land for the maintenance and use of existing agricultural effluent storage facilities (Rule 32D of the PSWLP)	The use of land for the maintenance and use of an existing agricultural storage facility (includes ponds, weeping walls and sumps etc) that was authorised before 4 April 2018 is a permitted activity providing the construction of the facility was authorised by a resource consent (for the pond: AUTH-301221). As the weeping wall and sludge beds did not require a resource consent, the structure has been drop-tested and visual inspected to meet 32D(a)(ii)(2)(a) in 2019. Environment southland have advised that while one of the weeping wall sludge beds has not been visually inspected, it has been drop-tested and passed. The effluent pond, and half of the weeping wall comply with the Rule 32D PA conditions.	The use of land and maintenance and use of an existing agricultural storage facility that was lawfully constructed without resource consent and meets the drop test requirements of Appendix P and has been visually inspected to meet 32D(a)(ii)(2)(a) in the last three years is a permitted activity. The pond when drop tested did not need to be de-sludged, but it was completely emptied and thus meets the intent of Appendix P testing requirements. It is our understanding that there is agreement between drop test providers and Environment Southland that a pond cannot be de-sludged if there is no sludge to be de-sludged. The concrete sump on Piobiare provides greater than 35 m^3 of effluent storage and is of concrete construction. At the time of lodging this consent ES confirmed that they would

<table>
<tr><th rowspan="2">Activity</th><th colspan="2">Compliance with the relevant permitted rules of the RWPS and PSWLP</th></tr>
<tr><th>Aerodrome Farm Limited</th><th>Piobiare Homestead Limited</th></tr>
<tr><td rowspan="2"></td><td>While one part of the weeping wall structure does not technically comply with the permitted activity conditions of Rule 32D, as the Rule is not yet operative no resource consent is required for the part structure and the applicant holds existing use rights until the applicant gives effect to any new consent which is granted for the proposed expansion which would change the scale and nature of effluent storage than which can currently occur. It is anticipated that Rule 32D will be subject to change and that consent may be applied for at some point in future if triggered/required.</td><td>not require a pond drop test on this structure. It has however been visually inspected to not have any visible cracks or holes. While the structure does not technically comply with the permitted activity conditions of Rule 32D, as the Rule is not yet operative no resource consent is required for the effluent sump, and it holds existing use rights under S20A of the RMA.</td></tr>
<tr><td colspan="2">Note on visual inspection: Appendix P of the PSWLP does not specify the methodology for visual inspections – if point (a) follows from (2) then, Appendix P is lacking. In absence of methodology specified the suitably qualified professional has completed the assessments of the pond structure to the best of their ability and resources available. The methodology is detailed within Attachments B and C. Given that there is no methodology specified, then the ponds/sludge beds/weeping walls etc… must meet the permitted activity rules as outline above.</td></tr>
<tr><td>Incidental discharges from farming
(Rule 24 PSWLP)</td><td colspan="2">The land use associated with this discharge is authorised under Rules 20, 25 or 70.</td></tr>
</table>

Activity	Compliance with the relevant permitted rules of the RWPS and PSWLP	
	Aerodrome Farm Limited	Piobiare Homestead Limited
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 diverted to the effluent system, and therefore silage leachate is discharged to land in accordance with the rules listed in the column to the left.	
The use of land for feed pads/lots (Rule 35A of the PSWLP)	Aerodrome is proposing to construct a calving pad to accommodate up to 120 cows during the winter months although not continuously for three months. Effluent produced at the calving pad will be diverted to the existing effluent storage infrastructure and will consist of either a rubber or a carbon pad (i.e: wood chips or rocks) to absorb solid effluent. Solids will be spread to land after calving finishes in early October, when soil conditions are suitable. The calving pad will not have a roof and will be humped and hollowed for drainage.	Piobiare does not meet this permitted activity Rule, as such consent is applied for under Rule 35A.
Cleanfill, Farm Landfills and Offal Holes	No more than 500 m^3 of material will be discharged within cleanfill sites on each property. 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	

Activity	Compliance with the relevant permitted rules of the RWPS and PSWLP	
	Aerodrome Farm Limited	**Piobiare Homestead Limited**
(Rules 53, 54 & 55 of the RWPS, and Rules 42 & 43 of the PSWLP)	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.	
Wetlands (Rule 74 PSWLP)	In future, once the applicant has constructed a wetland on farm, the continued use of that land as a wetland will be a permitted activity as: The wetland will be maintained or enhanced once constructed, no indigenous vegetation is destroyed or removed, no neighbouring land is flooded, and all endeavours will be undertaken to ensure that no pest species are established. The area isn't presently known to be (or classified as) an existing wetland.	Not applicable.
Groundwater (Rule 23 RWPS and Rule 54 PSLWP)	The permitted activity rule cannot be met and therefore consent is sought to authorise water abstraction.	Under Rule 23(a) of the RWPS up to 20,000 L/day may be taken as a permitted activity, in addition to takes authorised by S14(3) of the Act. The applicant takes water for their reasonable stock drinking requirements from a bore with no bore log and some additional water for general farm use. This would not exceed 20,000 L/day. Under Rule 54 of the

Activity	Compliance with the relevant permitted rules of the RWPS and PSWLP	
	Aerodrome Farm Limited	**Piobiare Homestead Limited**
		PSWLP up to 86,000 L/day may be taken as a permitted activity inclusive of S14(3) water taken for stock drinking. The applicant is below this threshold. This report supplies the details required under Rule 54(a)(iii). As the take will exceed 20,000 L/day a water meter will need to be installed and daily records kept proving compliance with Rule 54 at any time.
Sludge	For completeness, all effluent sources have been assumed to form either liquid or slurry and consent is applied for Aerodrome to discharge all forms of slurry and liquid effluent, and all sources of effluent (dairy shed, calving pad, silage pad) to the proposed effluent disposal land area.	For Piobiare, the use of a mechanical separator means that solid effluent is dry when applied to land and therefore can be applied in accordance with the relevant Rules that relate to sludge located throughout the suite of regional Plans under which Environment Southland operate. The applicant applies to discharge slurry and liquid effluent to land under the relevant rules and will be controlled by the discharge permit.
Stock exclusion from waterbodies (Rule 70 PSWLP)	All waterbodies are fenced, and crossings are bridged over the Waikiwi Stream and Myross Creek. Bed disturbance from stock is thus avoided and dairy cattle on the dairy platform are excluded from waterbodies.	The Tomopokorau Creek and tributary are fenced from dairy support, and bridges or culverts exist where crossings are located. Sheep graze the verge of the Tomopokorau Creek as can be seen in Figure 14 earlier in this report. There are no roosting or nesting areas, and the creeks are not regionally significant wetlands or listed in Appendix A of the PSWLP. Stock are moved across the Creek via the existing

Activity	Compliance with the relevant permitted rules of the RWPS and PSWLP	
	Aerodrome Farm Limited	**Piobiare Homestead Limited**
		crossings, with Sheep moved along the unfenced margin but not directly across. Table 1 does not specify fencing for sheep and therefore is permitted under Rule 70.

5. ASSESSMENT OF ENVIRONMENTAL EFFECTS – AERODROME

To understand the context of the assessment provided below, first we have described the overall activities as proposed in Section 2 above, then outlined the existing environment in Section 3 above which includes the existing consented and permitted activities. The scope and scale of the assessment of the effects of the proposal is commensurate to the scope and scale of the proposal. It is advised that the reader reads the attached water quality technical comment prior to continuing through the following sections.

5.1 Use of Land for Dairy farming

This assessment of environmental effects (AEE) describes the risks to the environment resulting from the proposed land use change of the new block from sheep farming & vegetable cropping land to dairy farming land and the subsequent increase in cows milked from current (actual) levels up to the proposed peak herd size of 850 cows.

We have earlier outlined that Aerodrome and Piobiare are separate landholdings, and whilst connected (in terms of trading stock and a common director), they are two 'single operating units'. The effects from each farm scenario proposed are assessed together where appropriate and separately where appropriate.

The assessment below assesses the farming activity in its entirety, and at the block level and doesn't use a permitted baseline approach to the assessment.

The key water quality concerns in the Waikiwi Stream area:

1. ***Poor ecological status of the macroinvertebrate community;***
2. ***High concentrations of faecal indicator microorganisms;***
3. ***Raised nutrient concentrations leading to plant growth in the stream and further downstream; and***
4. ***Apparent poor water clarity; but***
5. ***The existing trend in surface water quality indicates that it is likely improving over time (as concluded in the attached Technical comment).***

The assessment below considers the above specific surface water quality issues (as the baseline for the existing environment) to the nearest monitoring site of the property. The Myross Creek discharges to the Waikiwi Stream immediately downstream of the property, and we can only assume that the downstream monitoring site is reporting similar water quality as exists at the property boundary. The assessment below provides an assessment of the possible and actual environmental effects of the overall proposal and in the minute detail at the block level (consistent with current ES requirements and in line with the blocks reported in the Nutrient Budget for Aerodrome). Water quality results are presented in a greater scale than the properties themselves. The farm system changes, GMP's and Mitigations are tailored (as best as possible) to address specific water quality issues relative to the proposal.

Section 5.1.1 presents the modelled nutrient losses between the current and proposed farm system and concludes that the consent authority may have certainty that the farm system and predicted losses proposed will occur as described in Section 2 above.

Section 5.1.2 introduces the contaminants of concern and gives some details as to the effectiveness of each mitigation and whether the GMP/mitigation is rewarded in OVERSEER® i.e. is it 'over and above' and will it reduce the predicted losses beyond that predicted and presented in Section 5.1.1.

Section 5.1.3 presents a Table **Error! Reference source not found.**which assesses the potential effect of each individual farm activity on the environment.

Section 5.1.4 makes an overall broad scale assessment of the overall proposal (all components combined) and concludes that based on some specific farm system inputs and the implementation of proposed mitigations/GMPs the proposal will not result in adverse effects on the environment.

Section 5.1.5 then presents an assessment of other effects, and Section 5.1.6: the restrictions that could be imposed as conditions of consent that are defensible in both a legal and practical sense, intra vires, certain and enforceable.

5.1.1 OVERSEER Nutrient Budgeting

OVERSEER® nutrient budgets have been prepared by Mark Crawford of Ravensdown who is a Certified Nutrient Management Adviser (CNMA). These OVERSEER® budgets have been used to show the annual amount of nitrogen and phosphorus discharged from the landholding for both Aerodrome and Piobiare landholdings. A copy of all OVERSEER® Nutrient Budget Farm Scenario Reports can be found attached to this application (Attachment F). Copies of the xml files have been sent to Council separately. We note that these have already been independently peer reviewed by Arron Hutton CNMA, and by Irricon as part of pre-application checks.

The nutrient budgets contained within this application have been completed to compare the predicted nutrient losses beneath the root zone under the existing established land use, which is made up of two nutrient budgets (one for the new block, and one for the dairy platform and silage block combined), to the predicted nutrient losses beneath the root zone under the proposed land use, in the form of one nutrient budget which proposes a dairy farm with all paddocks having been converted, i.e. post the initial activities that result in the new block being physically able to carry dairy cows.

Things to note:

- The blocks in the proposed scenario have been set up in accordance with the protocols for using OVERSEER® and they are modelled based on proposed land use, soils and management i.e. effluent or non-effluent.
- No distinction has been made under the proposed scenario between what was dairy and what was not dairy, i.e. 'special blocking' has not been undertaken. In this instance, that is not a valid input to the nutrient budgets to represent the long-term status quo for future.
- In absence of 'special blocking' that does not align to actual future management of the farm at the block scale, an assessment of each of the relevant activities to convert the new block to dairy have been assessed separately below and some effort has been made to assess this in sufficient detail so that the consent authority may have certainty of the effects of that part of the overall activity proposed i.e. land use for farming on new dairy land (as a part of the whole).
- Those initial 'conversion' activities include, re-fencing, setting up lanes, installing new troughs, and bringing the existing block up to the required fertility so that in the long run the new block can sustain a dairy operation that has the optimum soil fertility to efficiently utilise fertiliser available. When soil is not at peak fertility, then nutrient utilisation is inefficient, which conversely results in losses from the farm system that would be greater than if operating at peak fertility. These activities individually are currently permitted to occur.

The OVERSEER® budget modelling for the current farm systems, is an accurate description of the applicants' existing farm systems and consequent N & P losses beneath the root zone as averaged over the preceding three years. All inputs into the model have been taken from farm records and/or accounts and are actual figures and therefore fairly represent the scale of the farm system as it has been operating since 2015. Environment Southland have agreed that three years of averaged inputs would give them the most certainty of the existing farm system, and thereby existing environment and existing nutrient losses beneath the root zone based on the farm system inputs to the model. Table 16 presents the summary of overall N and P losses beneath the root zone.

Table 16: Summary of modelled nutrient losses to water for Aerodrome Farm Ltd

Nutrient Losses	Combined Current Farm System (3 Year Average)	Proposed Farm System	Difference
Aerodrome Farm Limited			
N Loss from the root zone	48 kg N/ha/year or; 14,961 kg N/year	47 kg N/ha/year or; 14,727 kg N/year.	***-1 kg*** N/ha/year ***- 234 kg*** N/year
P Loss from the root zone	225 kg P/year 0.7 kg P/ha/year or;	224 kg P/year 0.7 kg P/ha/year or;	***-1 kg*** P/ha/year ***0.0 kg*** P/ha/year

The key drivers resulting in the overall reductions of N and P loss at the farm scale for Aerodrome are outlined below:

Table 17: Summary of key management changes rewarded in OVERSEER®

Aerodrome Farm Limited
Reduced stocking rate from 2.0 to 2.8 cows/ha
Lesser proportion of dry cows brought back to the dairy farm after winter
Reducing effluent applications to tiled areas at high risk times (May – September)
Installation and use of a new calving pad
Differential nitrogen fertiliser applications between effluent and non-effluent blocks
Slight reduction in overall nitrogen fertiliser applied on average across all blocks
Reduced cropping (grazed in-situ and vegetable) from 15.8 ha total under current scenarios to 7.2 ha (grazed in-situ only)
Fewer imported supplements
Continued wintering off the dairy platform (except for a few carry-overs)
Cultivation of oats catch crop after grazing crop in Autumn

No capital P fertiliser application when the farm is operating within optimal Olsen P for the farm system proposed

Further to Table 17 above, the proposed nutrient budget assumes a long term equilibrium where fluctuations in nutrient levels does not occur, therefore the modelled no capital P fertiliser management tool (a farm operating within optimum Olsen P for the farm system proposed is a GMP) is on the assumption that the farm is able to operate within Olsen P range continuously. In reality however, P levels in soil can fluctuate significantly between paddocks and from year to year. For this reason, the applicant proposes to undertake frequent and representative soil samples and operate to a nutrient management plan which aims to operate within a set Olsen P range. As discussed in Section 5.1.5 an appropriate condition of consent therefore would be related to the required imposition of GMPs via a Farm Environmental Management Plan (FEMP).

Overall, the proposal represents a decrease in total N losses by 234 kg N/year and a decrease in total P losses of 1 kg P/year on Aerodrome. Also, the annual amount of nitrogen and phosphorus discharged from the landholding will be no greater than that which was lawfully discharged annually on average for the three years prior (2015-2018).

The above management changes are the key drivers that have ensured the proposed farm system overall does not result in more losses past the root zone than the current 3-year averaged farm system. The Table above is not a complete list of all inputs, because it's the entire farm system overall that influences the predicted losses, but the key ones in Table 17 above are the most notable changes between the current and proposed farm system and are listed above to give Council some understanding as to why stock numbers are proposed to increase but that overall losses will decrease.

In recent months, there have been two publications of note regarding the use of Overseer in both a regulatory framework and for water management planning. These include the Parliamentary Commissioner for the Environment's Report on Overseer[14] and Overseer Ltd's review contracted to Enfocus titled Using Overseer in Water Management Planning.[15] Both reports highlight various issues associated with using Overseer models in a regulatory context, as a decision-making tool and for compliance. The Enfocus report

[14] Parliamentary Commissioner for the Environment, *Overseer and regulatory oversight: Models, uncertainty and cleaning up our waterways*, December 2018

[15] Enfocus, *Using Overseer in Water Management Planning*, October 2018.

specifically provides for a solution to some of these known limitations and issues by advising that N loss output figures are used in a regulatory context. Using an output figure in regulation enables Overseer version changes to be accounted for and allows the applicant to demonstrate the improvement in N loss outputs whilst still maintaining the flexibility to farm to environmental, political and economic conditions as well as provide for innovations on farm. We concur with these recommendations and note that the RMA is an effects-based piece of legislation.

As expanded on further in the Attached Technical Comment, the nutrient modelling and recently published reports expanding on its appropriateness in use as a regulatory tool summarise the following points:

- The estimated differences between the current and proposed farm system nutrient loss predictions is significantly less than the likely uncertainties involved in Overseer modelling;
- Overseer modelling should be considered in conjunction with the specific farm systems and mitigation measures that are proposed. to provide a reasonable level of certainty about the relativities of nutrient loss estimates.

"This means that while there may be a relatively high level of uncertainty about nutrient loss estimates, if there are clear, measurable and verifiable changes to a farm system there will be a high level of certainty about the relative changes to long-tern annual average nutrient loss estimates[16]. Therefore, provided that assurance is provided that the farm system changes have occurred there will be a high level of certainty there will be relative reduction in long-term annual average N and P losses to water." (Attachment E)

Therefore, we agree that a N loss output condition will give the consent authority the most certainty that the proposal will occur as proposed in future (subject to granting of consents) and that from the further assessment in the following sections that the effects of the proposal and predicted losses on the environment will:

1. ***Overall be no more than what has lawfully been occurring, and future losses will be restricted to a level which we consider does not cause adverse effects on the environment;***
2. ***No more than what is currently consented to occur; and***

[16] Freeman, M, Robson, M, Lilburne L, McCallum-Clark, M, Cooke, A, & McNae, D. (2016) Using OVERSEER in regulation - technical resources and guidance for the appropriate and consistent use of OVERSEER by regional councils, August 2016. Report prepared by Freeman Environmental Ltd for the OVERSEER Guidance Project Board.

3. ***Will at least result in some reduction in losses from the farm system and consequent nutrient concentrations in the receiving environments (if the mitigations and GMPS proposed are implemented on farm).***

5.1.2 Potential Water Quality Effects

OVERSEER® tells us what the losses beneath the root zone may be, but not what the potential or actual effects of that loss on water quality are. The effects of the proposal on water quality are assessed in this section and the attached water quality technical comment.

The contaminants of concern as outlined in the PSWLP are N, P, sediment and microbiological contaminants that have the potential to affect water quality. These contaminants and potential effects of those contaminants are outlined below.

- **Nitrogen and Phosphorus** (nutrients) are needed by plants for growth but when there are too many nutrients in water, it can result in eutrophication and toxicity for humans and animals. High levels of nitrate in water can make it unsafe to drink for humans and can be toxic for sensitive organisms (like young trout and salmon). Ammonia is highly toxic to fish and other creatures that live in water (at lower concentrations than nitrate) and too many nutrients in water can lead to excessive plant growth, algal blooms and depletion of oxygen in the water;
- **Sediment** (or water clarity) refers to particles of eroded soil and rock. Sediment is also a major source of phosphorous because phosphorous sticks to the surface of soil particles carried to water. When erosion rates are excessive, sediment can damage instream plants (effectively abrading and scouring them away) and can damage the gills and delicate body parts of invertebrates and native fish. Finer sediment suspended in water can also reduce light penetration (visibility) which plants need to grow and some creatures need to find food. Where sediment blankets the bed of a waterway, it can smother and kill plants and animals (this problem can be particularly severe in estuaries); and
- **Faecal indicator micro-organisms** (indicators of microbial pathogens) which can have a detrimental effect on human and animal health, particularly when ingested. The main sources of pathogens in fresh water in New Zealand are human sewage and animal manure[17].

[17] Parliamentary Commissioner for the Environment, 2012. *Water quality in New Zealand: Understanding the science.* New Zealand Government, Wellington. 76p.

Assessing the environmental impact of modelled nutrient losses from a subject property is complex because these nutrients travel via a number of different pathways through the receiving environment undergoing attenuation, mixing, dilution and dispersion processes which can significantly change the quantity and nature of these nutrients in the receiving water bodies.

Effects of conversion to dairy

As well as the ongoing effects of the proposal once the entire platform has been converted to dairy, there will be a short period of time where the applicant is converting to dairy. This includes, re-grassing paddocks, re-fencing, bringing up soils to agronomic optimum nutrient levels to operate the expanded dairy farm (which they are currently not due to the existing land use), sowing vegetable crop and fodder beet crop paddocks into pasture, constructing a calving pad and increasing the stocking rate over time over the whole dairy platform. The applicant can lawfully continue to increase dairy production on their property up to a peak herd of 800 cows (which they have not yet completed, given that consent for the increase was only granted a few years ago).

The effects of the first portion of cow number increase on farm is therefore consented to occur and anticipated to occur. During the conversion there may be slight increases or decreases in predicted losses to water, which logically follows the two modelled scenarios. As assessed outlined in the attached water quality technical comment, slight changes in losses would be immeasurable at the catchment scale. Therefore, the effects of the actual conversion from sheep/vegetable cropping to dairy and increase in cow numbers will not be adverse, and in some part will be anticipated and are already consented to occur.

N loss in drainage water

At the block scale, of the 26 blocks set up in the OVERSEER® xml files, 4 of these predict an increase in N loss beneath the root zone, between the existing farm system and the proposed farm system. These four blocks make up 137.2 ha of the total proposed property area (44 % of the proposed dairy platform). All other blocks predict less N lost beneath the root zone. There are no P loss increases at the block level. The management on those blocks are predominantly Waikiwi soils where effluent is currently and proposed to continue to be applied and where there is a pasture to fodder beet, and fodder beet to fodder beet crop rotation (4.6 ha). Approximately 13.5 ha of Woodlands soils where no liquid effluent is applied has a predicted increase at the block level. Other sources accounts for a predicted increase in N loss and P loss. While this is internally reported at the block scale, OVERSEER is not spatially explicit, and therefore the block boundaries cannot be aligned to physical paddock boundaries at the farm scale.

Table 18: Management tools that will reduce N losses to water and effectiveness[18]

Type of Strategy	Nitrogen Loss Mitigation	Rewarded in OVERSEER®?	Proposed to be implemented	Effectiveness (range)
To be implemented prior to the first day of milking under new consent				
Riparian	Fencing Streams	Yes	✓	52 – 61 %
	Appropriate vegetated buffers from water ways	Not assessed – but likely to be rewarded for 3 m buffers	✓	38 – 58 %
	Filter areas downstream of unfenced waterways	Partially – only if wetland able to be captured	✓ (constructed wetland unable to be captured in overseer, but waterways fenced anyway)	-
	Uncultivated ephemeral stream margins (crop)	No	✓ (grass buffer strips/uncultivated ephemeral stream margins – increased sizing for critical source areas)	-
Infrastructure	Identification of critical source areas with regards to N loss	Not assessed – but unlikely to be rewarded	✓	-
	Infrastructure to keep stock away from unfenced streams (e.g. troughs, shade)	No	✓	-
	Culverts and bridges	No	✓	-
To be implemented as of the first day of milking under future consent				
Effluent Management	Using low rate effluent application	Not assessed – but may be rewarded in that OVERSEER® assumes good management practices	✓ (it is unclear if low rate of effluent irrigation would be assumed as a good management practice on farm)	12 – 19 %

[18] McDowell, R., Wilcock, B., and Hamilton, D., 2013. Assessment of Strategies to Mitigate the Impact or Loss of Contaminants from Agricultural Land to Fresh Waters. Report prepared for MfE. Publication RE500/2013/066.

Type of Strategy	Nitrogen Loss Mitigation	Rewarded in OVERSEER®?	Proposed to be implemented	Effectiveness (range)
		have been implemented on farm		
	Providing sufficient effluent storage to enable deferred application	Not assessed – but likely to be rewarded	✓	12 – 19 %
Nutrient Management	Spread fertiliser evenly	No – assumed already	✓	-
	Avoiding high risk times for fertiliser application	Yes	✓	-
	Avoiding applying fertiliser directly to streams	No	✓	-
	Appropriate fertiliser rates	Yes	✓	-
	Improved N use efficiency	Yes	✓	15-17%
Stock Management	Reducing ability of stock to form camps	No	✓	-
	Low-N feeds	Yes	✓ (mix of feeds of pasture, supplement, crop and in the shed)	0-5%
Infrastructure	Managing track runoff	No	✓	-
To be implemented following the first milking season				
Wintering and Grazing Management	Wintering majority stock off farm	Yes	✓	-
	Restricted grazing and animal confinement	Not assessed – but unlikely to be rewarded	✓	17-28%

Type of Strategy	Nitrogen Loss Mitigation	Rewarded in OVERSEER®?	Proposed to be implemented	Effectiveness (range)
	Planting catch crops	Yes	✓	-
To be implemented within 12 months of giving effect to consent				
Riparian	Constructed Wetlands	No	✓	*35-55%*
	Continued use of sediment ponds	No	✓	-
Total effectiveness of mitigations not likely to be rewarded in OVERSEER® as a conservative estimate				***181 %***

Table 19 above presents a list of some of the GMPs and Mitigations, which will result in less N loss to water and summarises whether or not they are rewarded in OVERSEER®. As outlined above, if each mitigation is as effective as outlined above and each percentage can be added, then at a conservative estimate N may be reduced by at least 181 %. This assumption includes those GMPs already, or likely to be rewarded in OVERSEER® i.e. already accounted for in the reduced total N loss predicted from the farm system. When not accounting for mitigations that are already rewarded, then at a conservative estimate N loss beyond the root zone may be reduced by at least 52 %. Therefore, implementation of Table 19 on farm will mean that the effects of N on receiving waterbodies even at the block scale are mitigated because less than what is predicted to be lost will actually leave the farm boundary.

The primary receiving environment for N loss beneath the root zone will be deep drainage to underlying aquifers, which discharge to surface water bodies. According to ES's Beacon GIS, the nearest registered drinking water supply is at Myross Bush School, which is approximately 1 km away from the subject property. The NZ Register of Drinking Water Supplies indicates that it is sourced from a bore. The property isn't located within any groundwater protection zones,

Groundwater nitrate concentrations are of particular concern to human health. The risk of bottle fed infants getting 'blue baby syndrome' from consuming high nitrate nitrogen water is widely accepted and is the primary driver for the current NZ Drinking water standard for nitrate nitrogen. The proposal sees a reduction in N losses overall beneath the root zone. Other studies indicate that other contaminants, or dietary nitrate sources, may also play a role in the syndrome.[19] A recent Danish study suggested a link

[19] https://en.wikipedia.org/wiki/Blue_baby_syndrome accessed 8 February 2019

between groundwater nitrates and bowel cancer. The study found that those people exposed to nitrate levels in excess of 9.3 mg/L (NZ drinking water standard is 11.3 mg/L) had a 15% increased carcinogenic risk. In December 2018, Agriview NZ published an article attempting to correlate the Danish study within the New Zealand agricultural context. The article noted that "most of the international research conducted throughout the past four decades on this topic has found either a negligible or only slight correlation between nitrates in drinking water and colon/bowel cancer rates" and also that "the idea that colon cancer is heavily influenced by diet surfaces in many of the studies evaluating its link to the intake of nitrate through drinking water." The article further noted "Ian Shaw, professor of toxicology at the University of Canterbury, says it is this very factor that makes the associations between water nitrate and colon cancer unconvincing:

"In my opinion nitrate is associated with colon cancer because it can be converted to nitrite by gut bacteria and form nitrosamines with dietary amino compounds. Nitrosamines are profound carcinogens. Links with water nitrate would, therefore, not be definitive because other components of the diet would be necessary to facilitate carcinogenesis. If exposure to an appropriate dietary mixture, plus the right bacterial species in the microbiome do not coincide carcinogenesis will not occur. This is a complex scenario that cannot be attributed to a single exposure to a single chemical.

In other words, attributing high colon cancer rates to nitrates in drinking water would be oversimplifying things to a considerable level. One must consider the variations of diet and lifestyle also considered potential factors for increasing colon cancer risk, and this is something the Danish study failed to do."[20]

In summary, the evidence about the current state of nitrate nitrogen concentrations in groundwater in this area and the OVERSEER® modelling that strongly indicates that drainage nitrogen concentrations at the level predicted by OVERSEER® will not have a significant adverse effect on actual existing groundwater quality. Furthermore, any groundwater from the property would be unlikely to directly impact the Myross School bore given the direction of water movement is likely downstream towards Invercargill rather than Myross Bush (as can be determined from the Scheme plans and technical comment). There will be further attenuation, dilution and dispersion processes that will further reduce the concentration of nitrate nitrogen in groundwater between the discharge location and any sensitive receptors including drinking water sites.

Sediment, P and microbiological contamination

[20] https://www.agriview.nz/forum/2018/12/11/investigating-the-nitrate-colon-cancer-link accessed 8 February 2019

Sediment and microbiological contaminants are not modelled within OVERSEER® so attempting to show a reduction in the annual amounts of these nutrients in the proposed scenario compared to the amount which has been lawfully discharged currently is more difficult. P loss modelling can be used as a proxy for sediment and microbiological contaminant losses. The reason being is that phosphorus in the soil readily bonds to fine soil particles and is therefore lost to the environment via the same contaminant pathways: runoff/overland flow and erosion. Microbiological contaminants are also lost to the environment by the mechanics of water flow via these same pathways. However, P loss prediction is not exactly the same as Microbial and sediment losses, and therefore the assessment cannot be absolute, but provides the best indication of likely losses and risks to the environment.

Table 19 below presents a list of potential management tools which will result in less phosphorus, sediment and microbiological contaminant loss to water and summarises whether or not they are rewarded in OVERSEER and which management practices the applicant will undertake to minimise P loss on farm under the proposed dairy expansion. With the adoption of these management measures, losses of these three contaminants will be further reduced to that which is modelled in OVERSEER. The applicant is willing to have these measures imposed as consent conditions through the implementation of a FEMP.

Table 19: Management tools that will reduce P losses to water[21] and effectiveness[22]

Type of Strategy	Phosphorous Loss Mitigation	Rewarded in OVERSEER®?	Proposed to be implemented	Effectiveness (range)
To be implemented prior to the first milking under new consent				
Riparian	Fencing Streams	Yes	✓	52 – 61 %
	Appropriate vegetated buffers from water ways	Not assessed – but likely to be rewarded for 3 m buffers	✓	38 – 58 %
	Filter areas downstream of unfenced waterways	Partially – only if wetland able to be captured	✓ (constructed wetland unable to be captured in overseer, but waterways fenced anyway)	-

[21] *Hurunui-Waiau Nutrient Budgeting Case Studies*, report prepared by Rebecca Hyde & James Hoban (December 2014). http://www.landcare.org.nz/files/file/1445/Hurunui-Waiau%20Nutrient%20Budgeting%20Case%20Studies.pdf

[22] McDowell, R., Wilcock, B., and Hamilton, D., 2013. Assessment of Strategies to Mitigate the Impact or Loss of Contaminants from Agricultural Land to Fresh Waters. Report prepared for MfE. Publication RE500/2013/066.

Type of Strategy	Phosphorous Loss Mitigation	Rewarded in OVERSEER®?	Proposed to be implemented	Effectiveness (range)
	Uncultivated ephemeral stream margins	No	✓ (grass buffer strips/uncultivated ephemeral stream margins – increased sizing for critical source areas)	-
	Swales/gullies which run into creeks are to be fenced with a wider buffer zone to act as an additional filter	Not assessed – but unlikely to be rewarded	✓	-
	Continued use of sediment ponds	No	✓	-
Effluent Management	Providing sufficient effluent storage to enable deferred application	Not assessed – but likely to be rewarded	✓	12 – 17 %
Infrastructure	Identification of critical source areas with regards to P loss	Not assessed – but unlikely to be rewarded	✓	-
	Infrastructure to keep stock away from unfenced streams (e.g. troughs, shade)	No	✓	-
	Culverts and bridges	No	✓	-
	Amend tile drains	Not assessed – but unlikely to be rewarded	✓	50 – 70 %
To be implemented as of the first day of milking under new consent				
Effluent Management	Using low rate effluent application	Not assessed – but may be rewarded in that OVERSEER® assumes good management practices have been implemented on farm	✓ (it is unclear if low rate of effluent irrigation would be assumed as a good management practice on farm)	25 -32 %

Type of Strategy	Phosphorous Loss Mitigation	Rewarded in OVERSEER®?	Proposed to be implemented	Effectiveness (range)
Sediment Management	Cultivating with contour – rather than up and downslope	No	✓	-
Nutrient Management	Spread fertiliser evenly	No – assumed already	✓	-
	Avoiding high risk times for fertiliser application	Yes	✓	-
	Change fertiliser type	Yes	✓ (low solubility P fertiliser)	18 – 22 %
	Avoiding applying fertiliser directly to streams	No	✓	-
	Appropriate fertiliser rates	Yes	✓	-
	Targeting optimum Olsen P	Yes	✓	
Stock Management	Reducing ability of stock to form camps	No	✓	-
Infrastructure	Managing track runoff	No	✓	-
To be implemented following the first milking season under new consent				
Wintering and Grazing Management	Wintering stock off farm	Yes	✓	-
	Restricted grazing including remaining crop cover after grazing	Not assessed – but unlikely to be rewarded	✓	42 – 70 %
	Shifting break fences strategically (back fencing)	No	✓ (strategic grazing of winter forage crop)	86 %[23]
Total effectiveness of mitigations not likely to be rewarded in OVERSEER® as a conservative estimate				***323 %***

The potential water quality effect of phosphorus, sediment and microbiological contaminant in the key receiving environment (surface water bodies) could result in eutrophic conditions that adversely affect the life-supporting capacity of the water body. Given the proposal will reduce these beyond that which is modelled to occur, and that which is currently occurring the proposal will not exacerbate any existing effects on the environment, and will seek to improve water quality so that the life-supporting capacity of the waterbodies and catchment are not compromised as a result of the proposal.

[23] Environment Southland Critical Source Areas Factsheet. Es.govt.nz. Retrieved: 6 May 2018.

Our assessment is that the proposed expansion of Aerodrome will result in a real but extremely small overall improvement on local surface water quality. Quantification of the improvement has not been completed because it is unlikely to be measurable with the current ES surface water quality monitoring programme at the local scale. Total nitrogen losses predicted will be less than currently occurring and modelled, particularly after further dilution, attenuation and dispersion processes (which have not been accounted for in the modelling). The proposal meets Policy 16 of the PSWLP which requires expanded or intensified dairy farming activities to **fully mitigate and avoid** effects on the quality of water, including cumulatively, of groundwater, waterbodies, coastal lakes, lagoons, tidal estuaries, salt marshes and coastal wetlands. As a result, the proposal is likely to at a minimum maintain water quality, and not further exacerbate cumulative effects on existing water quality in relation to dissolved reactive phosphorus, nitrate nitrogen, sediment or faecal indicator microorganisms.

The attached FEMP's and the GMP's detail various management practices which will be adopted in order to reduce sediment, and bacteria losses via overland flow, artificial drainage channels and deep drainage. The primary mechanism of mitigating and avoiding these losses is by appropriate management of critical source areas on the farm, improved effluent management, stock exclusion from riparian margins and CSA's and the adoption of best management practices for intensive winter grazing (such as strategic grazing). These mechanisms are likely to have the greatest impact in reducing sediment losses and microbiological contamination of waterways. Our assessment is that the implementation of the practices in the FEMP will **fully mitigate or avoid** adverse effects on water quality in accordance with Policy 16 of the PSWLP.

The proposal does 'export' stock from Aerodrome to Piobiare, and Piobiare 'exports' stock to Aerodrome. The importation of stock to Aerodrome and subsequent farm management practices are fully assessed in this application. The effects relative to Piobiare are assessed in Section 6 below. Accordingly, any increase in wintering activities or dairy farming activities between the current and proposed systems have been **fully included, accounted for and effects mitigated** in the budgets supplied with this application in accordance with Policy 16.

This assessment also assesses the proposed activity in its entirety against the actual existing environment, i.e. not using a permitted or consented baseline approach because that represents the actual effect of any changes beyond that which has lawfully been occurring and forms the existing environment.

Remember, that the four key water quality concerns for the Waikiwi Stream downstream of the property are:

1. Poor ecological status of the macroinvertebrate community;
2. High concentrations of faecal indicator microorganisms;
3. Raised nutrient concentrations leading to plant growth in the stream and further downstream; and
4. Apparent poor water clarity.

Some of these may be affected by natural sources or caused by land uses. The state of the environment cannot specify what caused that state, but what we can conclude is that some water quality indicators demonstrate an improving trend at the local level, while at the catchment scale, the New River Estuary has been experiencing significant eutrophication with a macroalgal Ecological Quality Rating (EQR) of 'poor' for the 2018 period. The trend for this ecological rating over the 2001-2018 period strongly indicates a significant decline from a 'good' state to a 'poor' state.

Discounting natural causes of existing water quality (that are unaffected by any land use changes) the proposal will contribute to reduced concentrations of faecal indicator microorganisms and reduced nutrient levels leading to plant growth. Reduced sediment (through GMPs and Mitigation outlined below) loss from this farm system will contribute to improving the apparent poor water quality further downstream.

Given that the proposal seeks to reduce nutrient losses by various farm system changes and by virtue of the proposal itself, and then further seeks to reduce their likely effect on the environment overall, and that these mitigations are specific to not only the activities themselves (the whole and each part) but also the water quality indicators of concern this proposal will result in a real but very small improvement in water quality overall.

5.1.3 Mitigations and GMPs

The PSWLP encourages that good management practices are implemented on all farms in Southland, at a minimum. OVERSEER® assumes some of these are already in place on farm when modelling predicted losses from the farm system. With respect to N, wetland installation is a mitigation that is not robustly awarded in OVERSEER® and is over and above GMP, in that it mitigates the losses from a system by essentially treating them before water leaves the property boundary.

Error! Reference source not found. Table 20 below assesses the potential effect of each individual farm activity (noting that the proposal is for a combination of all those activities and that they are all related to each other). Then the applicant presents GMPs and Mitigations that will be/or have been applied to each activity in order to avoid, mitigate or remedy the effects of each activity on the receiving environment. The outcome column is the resulting likely environmental effect of that portion of the activity. The Table below forms only one part of the application and assessment and is presented below to give the Consent Authority certainty of each of the individual components of the proposal. As the applicant is proposing to operate a dairy farm on 315 ha of land, and that consent would be granted for the overall activity, the Table below must be read in conjunction with the overall broad scale/cumulative effects assessment in Section 5.1.4.

Table 20: Assessment of Effects at the activity level for Aerodrome Farm Limited

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
Capital fertiliser applications ***during conversion*** of 47.8 ha of sheep/vegetable cropping land to dairy farming land	The Overseer model does not include capital fertiliser applications because it is based on a long term average farm system operating in equilibrium. Therefore, N and P losses as result of capital fertiliser applications over the conversion period may be higher than modelled by Overseer. Capital fertiliser applications will apply larger quantities of N, P, K and S to land in order to increase fertility in the short term. These applications of larger quantities of nutrients have the potential to result in losses to the environment if applied at rates which exceed the plants ability to utilise these applied nutrients. Excess applied N is likely to be lost to water bodies via nutrient leaching and artificial drainage channels on both Woodlands and Waikiwi soils. Excess applied P may be lost to water bodies via overland flow only. Excess N and P in water bodies may lead to water quality degradation resulting in ecological stresses on aquatic life and human health consequences such as blue baby syndrome.	Capital fertiliser application timings avoid high drainage periods such as late autumn and winter and periods when soil temperature is less than 7 degrees to mitigate against excess N leaching through the soil profile. All other fertiliser applications will use a little and often approach to avoid the application of excess nutrients which cannot be utilised. Regular soil testing to guide capital fertiliser requirements to avoid the application of excess N and P which cannot be used for plant uptake to mitigate against losses via artificial drainage. Capital fertiliser applications will only be applied as required by the latest soil test results from the new block and will be undertaken where P, K or S levels are below agronomical optimum levels. P = 20-40 K = 6-10 S= 10-12 P fertiliser applications will match soil demand. It is not clear from the nutrient budget report if the new block has been soil tested, if not the soils will be tested prior to including this into the milking platform. This will ensure that in the interim no excess P is applied than what is normal.	Not applicable.	Capital fertiliser applications are only undertaken where there is a nutrient deficit and are done at a rate which meets this deficit and avoids the application of excess nutrients. There is a low risk of adverse effects eventuating as application of fertiliser will meet pasture demand and will only occur for a short period of time throughout the conversion process. The effects of fertiliser on this short timeframe would be immeasurable at the catchment scale, in terms of effect on water quality and would be unlikely to result in any significant localised effect on surface water quality. Any effect on water quality (at a downstream monitoring site) would not be measured due to the lag times between contaminant loss and receipt in the receiving environment, and that the block is almost ready to be included in the dairy platform, the actual conversion timeframes is temporary in the scheme of things. Furthermore, bringing the existing block up to the required fertility will mean that in the long run the new block can sustain a dairy operation that has the optimum soil fertility to efficiently utilise fertiliser available. When soil is not at peak fertility nutrient utilisation is inefficient, which conversely results in losses from the farm system that would be greater than if operating at peak fertility in the long run. Therefore, increasing fertility will have positive effects on water quality overall when compared to not establishing good fertility from the outset. The fertiliser regime described in the nutrient budgets will be the default fertiliser regime and capital fertiliser applications will be applied during the initial phase of the land conversion and completed using GMP principles which should adequately mitigate adverse effects. GMPs provide adequate mitigation of effects.
Cultivation of new pastures on new 47.8 ha block	Short term increase in potential sediment, microbial and phosphorus losses to the environment which can cause ecological stresses on plants and animals due to sedimentation, algae blooms and water temperature	Re-sow bare paddocks as soon as possible as part of cultivating pastures and sowing vegetable crops into pasture.	Further mitigations not required as land is mostly flat which reduces the risk of overland flow of sediment and phosphorus when cultivating land.	Adverse effects should be adequately avoided as this is a low risk activity in this location. GMPs provide adequate mitigation of effects. There are some areas of sloping land in the new block that may experience sediment loss from cultivation, however the conversion from

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
	increases in waterways and estuaries in extreme circumstances.	Use buffer zones around critical source areas when cultivating and use direct drilling if possible. Cultivation will be undertaken to meet permitted activity criteria in Rule 25(a) of the PSWLP maintaining a 5 metre buffer zone from water bodies (Myross Creek).		the current land use to pasture will likely result in less sediment loss overall than the current land use practices particularly as paddocks will not be left fallow and will be immediately re-sown/have already been re-sown. Therefore, the effects will not be adverse, significant or experienced for a long and continuous duration that may directly result in the potential effects listed in the column to the left. No further mitigations at the block scale are proposed or necessary because soil disturbance of this block has already occurred since purchasing the property and has occurred as a permitted activity. Furthermore, the potential effects of re-grassing paddocks are significantly less than the effects of the continued vegetable cropping where paddocks are left fallow for months. On this basis, and the basis that the soil disturbance activities associated with land construction, and re-grassing have already occurred , a condition of consent relating to interim soil conservation would be intra-vires as it cannot be implemented after the fact, and the effects associated with paddock cultivation, form the existing environment and are not so significant that consent may be declined.
Construction of new lanes on new 47.8 ha block	New laneways create high risk areas for sediment, microbial and P losses. Short term increase in potential sediment, microbial and phosphorus losses to the environment which can cause ecological stresses on plants and animals due to sedimentation, algae blooms and water temperature increases in waterways and estuaries	No stockpiling of earthworks material near waterways. Laneways include camber and contouring to direct runoff to pasture and away from waterways Buffer zones of 3 m will be created with riparian margins to waterways where races run alongside waterbodies.	The paddock and lane layout have been designed to ensure new lanes are not located adjacent to waterways.	Overseer assumes 30 % of dung deposited on lanes is lost directly to waterways, regardless of where the waterways are located in relation to the laneways. Overseer may have overestimated P losses (and hence sediment losses) because it doesn't recognise that the applicant will be implementing these GMPs and also siting lanes away from waterways as a mitigation measure. That means that the effects will not occur as outlined in the column to the left.
Increase of nutrient losses from the 47.8 ha new block	That the proportional predicted increase in N loss at the block scale may result in an adverse water quality effect. Overall across both the existing platform and the new dairy land Woodlands and Waikiwi soils predict an increase in N loss. This area of Waikiwi land is also contained within the Oxidising PZ with an artificial drainage variant.	Appropriate applications of effluent in accordance with Policy 42 of the RWPS. Split fertiliser applications and preferential Nitrogen applications on effluent and non-effluent blocks.	The installation of a wetland which drains a portion of Waikiwi Soils to the north of the property boundary (and new block). This area of land is also contained within the Oxidising PZ with an artificial drainage variant. Directing tile drains within that catchment area to the proposed wetland (where possible) will directly treat	In the Waituna Catchment, Tanner[24] estimated that Wetlands occupying 2-3% of the land area of contributing subcatchments were predicted to be able to reduce annual nitrate-N losses by ~30-40 %, with suspended solids and particulate P loads would also be substantially reduced. OVERSEER® wetland model is not robust enough to accurately incorporate predicted losses as a result of this mitigation.

[24] Tanner.C., Sukias, J., and Burger, F. 2015. *Realising the value of remnant farm wetlands as attenuation assets.* Niwa, Dairy NZ.

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
	Excess nutrients lost from one specific area of land may result in water quality degradation in the receiving waters causing ecological stress for plants and animals.		potential losses and mitigate the effects on increases at the new block. This mitigation is not awarded in OVERSEER®. Reduced stocking rate overall, and averaged increased losses at the block scale are mitigated by other farm system changes overall from the entire farm system. The existing sheep block is located within the same groundwater and surface water catchments as the remainder of the landholding which ensures that the modelled losses entering the receiving water bodies does not increase under the proposal in its entirety. The block is located within the same physiographic zones as the remainder of the landholding which ensures that the modelled losses from these physiographic zones does not increase under the proposal in its entirety. The mitigation measures to reduce modelled nutrient losses (contained throughout this table) are located across the entire landholding and therefore will mitigate against contaminant losses from activities located on both the new block and the existing platform.	This wetland may contribute to the regional stock and provide benefits to not only the farm itself, but also the wider catchment and enhance the biodiversity of the property. The increased modelled contaminant losses on part of the property, are also mitigated overall by reductions in predicted nutrient loss elsewhere on the property. So that overall, and at a scale that is more measurable than the block scale, and cumulatively that the proposed overall farm system will have a slight positive effect on water quality in the New River Estuary. These practices combined will mitigate the effects of localised increased nutrients and create a buffer of assimilative capacity in the receiving environment, which enables dilution of nutrients, so that levels of nutrients do not increase overall as a result of the proposal.
Increase in nutrient losses from the existing dairy platform.	The nutrient budgets show a potential increase in N loss on crop blocks, and a proportional increase on the Waikiwi Effluent and Woodlands non-effluent blocks. Other sources also predict an increase in N. OVERSEER® predicts no P loss increase on any block. Although there	Wintering stock off paddocks in winter (currently implemented and modelled in OVERSEER®) with the exception of a few carry overs.	Differential N fertiliser applications between effluent and non-effluent blocks (not currently implemented on farm).	The increased modelled contaminant losses at the block level are mitigated by the wider distribution of modelled contaminant losses across the remainder of the landholding. The existing dairy platform and the expanded dairy platform are located within the same catchments and physiographic zones meaning that there will be no

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
	are potential losses associated with crop blocks including P, sediment and Microbiological contaminants. Excess losses from one particular block of land may result in concentrated nutrient accumulation in the soil profile and/or in localised drainage channels which can result in water quality degradation and ecological stressors on aquatic life and human health issues. Increased nutrients, N P Sediment and *E.coli* have the potential to adversely impact surface water quality.	Reduction in winter cropped areas (for transitional grazing). Reduced stocking rate proposed overall from 2.9 cows/ha to 2.8 cows/ha. Re-sow areas of bare or damaged soil as soon as practicable.	Specific mitigation related to cropping includes strategic grazing of crops. This includes protecting CSAs from stock by fencing and grazing the least risky areas first and grazing towards the higher risk areas. In effect, this leaves the CSA (most vulnerable area) with minimal soil damage for as long as possible throughout the grazing period. This in turn reduces the overland flow and sediment loss. Strategic grazing does not mean that the CSA is not grazed, but rather that it is only grazed when conditions are suitable, or last such as a last bite strip. The Agresearch[25] strategic grazing trial in 2011 and 2012 showed that strategic grazing of dairy winter forage paddocks can considerably reduce volumes of overland flow. The study correlated reduced overland flow with reduced sediment and nutrient yields carried in the overland flow. Furthermore, the on-off grazing of stock on crop (as modelled) in overseer reduces the risk of sediment, P N and *E.coli* contaminant losses from the farm system. The installation of a calving pad means that N losses are mitigated from the farm system on the shoulders of the season, which is when crop paddocks are typically	modelled increase in contaminant losses to water bodies in accordance with the physiographic zone policies and Policy 16 of the PSWLP. The planting and grazing of a catch crop will have significant benefits as modelled in the nutrient budget. Incidental positive effects include not leaving paddocks bare over winter as the autumn crop is re-sown as soon as stock have finished grazing (subject to appropriate weather conditions etc). Strategic grazing combined with fewer stock on paddocks (overall reduced stocking rate) will result in fewer losses, and greater management of timing for stock on crop during these times may result in up to 80%[26] less losses from these sources than what is currently and predicted to occur. The rapid export of nutrients via some of the known artificial drainage pathways are intercepted via a new wetland or existing sediment ponds which slows the movement of water so that contaminates are not directly discharged to surface water bodies which avoids acute increases in nutrients during periods of high rain fall (not accounting for attenuation and dilution). Overall, it is the combination of these GMPs and mitigations which will result in the potential effects of the proposal on water quality being avoided (i.e. removing stock off wet paddocks), mitigated (i.e. strategic grazing of CSAs) or remedied (i.e. cultivation of an oats catch crop) so that water quality is not degraded at this location and as a result of the proposal.

[25] T.S Orchiston, R.M. Monaghan S. Laurenson. (2012). Reducing overland flow and sediment losses from winter forage crop paddocks grazed by dairy cows. Agresearch, Invermay Agriculture Centre, Private Bag 50034, Mosgiel, New Zealand.
[26] https://www.es.govt.nz/Document%20Library/Factsheets/Good%20management%20practice%20factsheets/Winter%20Grazing/critical_source_areas.pdf retrieved 7 May 2019.

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
			grazed. Less time on the paddocks reduces the accumulation and rapid drainage of N through the soil profile deposited as urine and dung patches. The existing dairy platform and expanded dairy platform (and remainder of the landholding) are located within the same groundwater and surface water catchments which ensures that the modelled losses entering the receiving water bodies does not increase under the proposal. The mitigation measures to reduce modelled nutrient losses (contained throughout this table) are located across the entire landholding and therefore will mitigate against contaminant losses from activities located on both the existing platform and the expanded dairy platform. Additional and existing mitigations include the sediment ponds draining the northern portion of the property which is an existing dairy farm. These ponds enable sediments to settle out and are connected to tile drain areas. Sediment with nutrient attached to the particle (for example) can drop out of the water column and not be transported rapidly directly to the Waikiwi stream as would otherwise occur if these drainage pathways were not intercepted.	

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
Increase in nutrient losses from "other sources"	Nutrients are lost directly from other sources to water bodies without any potential for attenuation. Increased nutrients, N P Sediment and *E.coli* have the potential to adversely impact surface water quality. OVERSEER® assumes that 30 % of dung deposited on a lane is lost to water, even if there is no nearby surface water body, which is not actually the case.	Location of new laneway and stand-off structures (proposed calving pad) away from water bodies. Cambering laneways away from waterbodies where they are adjacent to those water bodies and planting riparian margins to capture overland flow containing contaminants before direct discharge to water bodies. Where lanes cross a waterbody, management of culverts/crossings (critical sources areas) will also be important, which will avoid point source discharges and avoid and/or mitigate the potential P losses from other sources. Specific design features include the construction of raised edges of the laneway (existing) and landscaped cut off drains landscaped from the edge of the laneway before and after the culvert to direct water off the laneway and away from the waterway (also existing).	The installation of a calving pad at Aerodrome.	In the first instance, the losses predicted in OVERSEER® from other sources are over-stated. These losses are not directly to water because of the implementation of the GMP and Mitigations in the preceding two columns. Any potential diffuse discharges will be less than direct discharges, and diffuse discharges are able to be attenuated before they enter the receiving waterbody. As assessed below, 33 % attenuation may occur in the New River Estuary Catchment[27]. Overall the use of these structures will reduce the nutrients entering the soil profile during high risk periods which in turn reduces the nutrients that could potentially be lost past the root zone and does not conversely result in actual increase in losses from other sources. Use of bridged stock crossings avoids the direct entry of faeces, urine and entrained hoof mud to water bodies, which in turn reduces SS loads of particular concern in the receiving waterbodies.
Intensive winter grazing	Potential for significant amounts of contaminants (N, P, sediment and microbials) to be lost to both surface and groundwater bodies as a result of the complete de-vegetation of pasture/crop, treading damage on soil structure and runoff following rainfall events. Nutrient losses from this activity occur via deep drainage through the soil profile into the underlying aquifer or via overland flow into adjacent waterways (Waikiwi and Myross Creek) or artificial drainage channels which rapidly export nutrients Excessive nutrient losses can cause nutrient accumulation in groundwater and excessive nutrient load in waterways causing water quality degradation and the resulting ecological stress on plants and animals when the life-supporting capacity of the water is compromised by excess nutrients.	Buffer zones maintained between crop cultivation and critical source areas to provide an area where runoff can be filtered and captured limiting risks of entering water. Back fencing and use feeding crates/portable feeders where bales are fed on crop to limit treading damage over already de-vegetated ground. Cultivation of paddocks timed to avoid paddocks sitting bare for long periods of time which reduces risks of contaminant losses through leaching and overland flow. All other GMPs listed in rule 20 will be implemented by May 2019 (including portable water troughs where stock need drinking water). Paddocks sitting bare for long periods of time is avoided which reduces risks of losses of excess nutrients remaining	The intensive winter grazing will continue to rotate throughout the dairy platform, so that overall nutrient losses from this area of land is not concentrated to one land area. Grazing direction will be away from buffer zones/critical source areas leaving last bite to provide a buffer zone for nutrient capture through until the end of the fodder grazing period. The last bite is not a fixed size as it depends on crop tonnage, number of animals and break length. Therefore, the 'last bite size' is the width of crop required for a days feed which is eaten on the last day of grazing that paddock.	Adverse effects potentially still exist from this activity due to the high level of contaminant losses which occur from intensive winter grazing despite the implementation of GMPs and mitigations. The overall nutrient budget has taken this high contaminant loss activity into account and provided mitigations and reductions in nutrient loss in other areas and activities across the landholding to offset adverse effects to ensure overall nutrient losses are kept to a practical minimum. The GMPs and the mitigations proposed will mitigate adverse effects of intensive winter grazing. The reduced cropped area will reduce the exposure of stock to crop areas and the risks associated with contaminant loss specific to those areas. The purpose of identifying CSA's and grazing last/implementing specific management tools is to bind soil, prevent its mobilisation and reduce rainfall impact (which is typically higher on the shoulders of the season when grazed, than summer).

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

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
	Groundwater and surface water flow from the property is primarily on a south westerly direction.	from the grazing activity to the environment via overland flow and leaching.	Fence off areas where stock camp if pasture damage is occurring to limit risks of further pasture damage. Utilisation of a catch crop such as oats following autumn grazing of crop paddocks. The installation of a calving pad where animals can be stood off will ensure that fewer stock will be on paddocks during high risk periods.	The timing of when stock are on crop is May, July, August and September. Particularly in July, August and September the calving pad will definitely be utilised as that's when cows will be calving. Removing stock from crop paddocks in particular will avoid effects of urine deposition which is one of the key N loss risks for intensive winter grazing. Capturing these nutrients and applying them via the effluent disposal system will ensure that they can be re-used by the soil resource and taken up by plants and not lost to groundwater. The pad may be used in May as well if required, but we note that cows will be on-off grazing anyway between crop and pasture as is common for this type of transition crop feeding and required from an animal health perspective. Overall, it is the combination of these GMPs and mitigations which will result in the potential effects of the proposal on water quality being avoided (i.e. removing stock off wet paddocks), mitigated (i.e. strategic grazing of CSAs) or remedied (i.e. cultivation of an oats catch crop) so that water quality is not degraded at this location and as a result of the proposal.
Increase in cow numbers above consented discharge permit levels across the entire landholding	The grazing of more cows on pasture during high risk periods increases the risk of the leaching of nutrients (N, P and microbials) through the soil profile from urine and dung spots or transported via subsurface drainage. Pasture damage from cows grazing during adverse periods can result in increased sediment, microbial and P loss if erosion or soil loss occurs from paddocks Increased nutrient losses as total figures due to more cows, to groundwater and surface water bodies may potentially cause water quality degradation which can cause ecological stresses on aquatic plants and animals from algal growth, temperature increases and eutrophication. Human health concerns can also arise from microbial contamination of waterways upon contact and risks of blue baby syndrome from nitrate accumulation in groundwater and potentially bowel cancer as discussed elsewhere.	Use of selective grazing to avoid grazing very wet paddocks during adverse weather conditions to reduce risks of pugging and treading damage to soil structure which can accelerate contaminant losses. Increase the size of feed breaks, during adverse conditions to give animals more of the paddock to graze than the volume of feed required. This is to reduce stocking rate on wet and vulnerable pasture to avoid pugging and treading damage of feed. Use nutrient budgeting to manage nutrient inputs and outputs to guide farm management decisions which can maintain overall nutrient losses at desired level.	Stocking rate will reduce from 2.9 cows/ha to 2.8 cows/ha with the introduction of the additional land to the dairy platform with a comparatively smaller increase in cow numbers. A stocking rate reduction results in a reduction in nutrient losses on a per hectare basis as a result of an increase of cows producing urine and dung spots which are significant sources of contaminant losses to the root zone over a larger area of land, thereby reducing per hectare nutrient loadings. Reduced proportion of dry cows are brought back to the dairy platform after winter (which makes sense as they won't be milking anyway).	A reduction in stocking rate mitigates effects of the small increase in cow numbers on total nutrient losses modelled by Overseer. Adverse effects on the environment adequately mitigated with combination of GMPs and mitigations which have a high level of effectiveness for mitigating risks of grazing cows on pasture throughout the milking season.

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
			Fence off areas where stock camp if pasture damage is occurring to limit risks of further pasture damage. Use of in-shed feeding when feed deficits occur to ensure stock are well fed prior to entering the paddock break which can limit pugging and treading damage, particularly under adverse weather conditions.	
Fertiliser application regime across entire landholding	The application of nutrients in fertiliser has the potential to result in direct nutrient losses to the environment if fertiliser is applied either in excess to plant requirements or at a time when it cannot be utilised for pasture/crop production. Nitrogen losses from fertiliser application is most likely to occur via deep drainage. Phosphorus losses from fertiliser is most likely to occur via soil loss and/or direct loss through runoff or erosion. Adverse effects of inappropriate fertiliser application or excess application include a loss of excess nutrients to water causing water quality degradation in both groundwater and surface water bodies. Water quality degradation can adversely impact aquatic plant and animal ecosystems and impact on human health.	Time N, P, K and S fertiliser application to meet crop and pasture demand using split applications and avoid high risk times of the year i.e. when soil temperature is less than 7 degrees, during drought periods and during periods when soils are at field capacity. Observe permitted activity conditions including buffers of application from creeks to avoid direct discharge of fertiliser to water bodies. Reduce use of P fertiliser where Olsen P values are above agronomic optimum. Maintain Olsen P levels between 20-40. Use nutrient budgeting and annual soil testing to manage nutrient inputs from fertiliser and outputs to guide farm management decisions which can maintain overall nutrient losses at desired level.	Urea applications on all blocks occur using a little and often approach with a reduction in the application rate compared to the baseline scenario. The effluent blocks also receive a reduced rate of N application (deferential applications) across the various applications compared to the current scenario. The total fertiliser nitrogen applied to the milking platform is reduced for non-effluent blocks and for effluent blocks. An overall reduction in fertiliser rate across the entire farm compared to current.	Overall on average less fertiliser will be applied to all blocks, which is commensurate to the reduced overall stocking rate on farm and less feed to be grown. Adverse effects are both avoided and mitigated with use of GMPs for fertiliser usage and further mitigations to reduce fertiliser across the dairy platform. Fertiliser will be applied to land, and not directly to water which enables the nutrients to be taken up by plants. Overall less fertiliser is applied, fewer nutrients entering the farm system result in fewer nutrients leaving the root zone. Also, the type of fertiliser utilised is appropriate to ensure that as much of the nutrients may be taken up at the appropriate times and over-application does not occur. A lower potential for diffuse discharges of fertiliser nutrients into the receiving environment reduces the risk of the proposal to have significant adverse effects on the environment. Consequently, the effects of fertiliser application have been avoided and mitigated so that degradation of water quality does not occur.
Imported supplementary feed and feed made on-farm and fed during the season across existing platform and new block.	Supplementary feed usage has an impact on the pasture production of the farm system and can change the quantity of N particularly in the farm system compared to an all-grass based diet. Low N supplementary feeds can reduce estimated N losses to the environment as less N needs to be supplied to fuel pasture production which in turn can have beneficial effects on water quality by reducing nutrient load in groundwater and surface water bodies.	Reduction in imported feeds and utilisation of silage made on farm.		The reduced stocking rate has necessitated the reduction in imported supplementary feed to reconcile pasture production between the two systems. Which is likely to have positive effects on the environment in the form of less intensive farming occurring overall and enables the applicant to respond to changes in feed budgets and requirements with agility as supplements are made on farm and able to be controlled by the applicant.

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
Discharge of liquid effluent to land via low rate application predominantly using pods (or equivalent low rate application method) and occasional discharge via slurry tanker/umbilical to the proposed effluent discharge area	The proposal sees an increase in the number of cows actually peak milked on farm from 780 to 850 which means more effluent will be generated which needs to be discharged to land. Potential for contaminant losses via all three pathways: leaching (N), artificial drainage (N, P, microbials) and overland flow (N, P, microbials) when nutrients in effluent are applied to land. Potential for contaminant losses to cause excess nutrients in surface water and groundwater bodies in the vicinity of the property, particularly via tile drain pathways on the Waikiwi Soils. In general, excess nutrients result in water quality degradation causing ecological stress for plants and animals. Further, excess *E.coli* directly discharging to water bodies has the potential to affect human health and make surface waterbodies unsafe for human contact.	Effluent will always be applied at a depth less than the soil water deficit which ensures nutrients remain in the root zone to be taken up and utilised by plants for pasture production. Effluent area receiving liquid effluent is sized to ensure nutrient loadings from the application of effluent are maintained at less than 150 kgN/ha/year to avoid excess nutrient loading. Utilizing low rate effluent application (10mm/hr) is appropriate to ensure nutrients in effluent are able to be taken up by plants. High rate application (>10 mm) as with the effluent application by umbilical will not occur on sloping soils (Category C) which avoids the effects associated with runoff of effluent on these land areas. Use of deferred storage of effluent to allow effluent to be stored when it is unsafe to apply to land. Use of an umbilical and slurry tanker to discharge larger volumes of effluent to low risk soils (Category D in particular) when soil moisture deficit levels are appropriate to lower storage volume. Buffer zones created from effluent application areas to critical source areas and other sensitive receptors such as bores, property boundaries and dwellings.	No further mitigations are required over and above GMP level as liquid effluent management system is designed to meet best practice by utilising low rate application, deferred storage of effluent and application at a rate less than the soil moisture deficit as guided by the ES soil moisture monitoring sites on the website. The effluent discharge area at 157 ha is large enough to cater for the additional effluent generated by the additional cows and maintain effluent N loadings at less than 150kg N/ha/year. This area has been increased beyond that currently consented to occur which enables effluent applications to be applied less frequently to the same paddocks.	Adverse effects to the environment from the discharge of effluent should be no more than minor. Effluent application rates, GMPs and the resulting avoidance of effects of effluent application on the receiving environment supported by Policy 42 of the RWP. The discharge of effluent is governed by the consent conditions in the discharge permit giving certainty that the activity will be regulated. The effluent pond is unlikely to over-top as an umbilical can be utilised to empty the pond quickly if need be and as a contingency in the event the pods are unavailable or being repaired. This would avoid significant effects on water quality whereby no direct discharge of effluent to a water body would occur as a result of manging effluent pond volumes. Effluent is applied in a manner that is consistent with best practice to avoid potential effects such as overland flow, over application, and direct losses of nutrients via contaminant pathways such as tile drains. The outcome is that water quality will not be degraded to a point that it is become unsafe for drinking purposes and recreational contact as a result of the proposal.
Slurry effluent application across entire landholding (except for silage block)	The nutrient concentration of slurry effluent is higher than liquid effluent due to the lack of dilution from rainwater or washdown water. Due to the higher concentration of nutrients, application of slurry effluent to land needs to be carefully managed to ensure that nutrient loadings on any particular land area do not exceed the recommended level of 150 kg N/ha/year from effluent. This loading is achieved by ensuring the land area is large enough and the application depth is restricted to 5mm. If nutrient	The maximum loading rate of nitrogen from the application of effluent (both slurry) to land is 150 kg N/ha/year. Slurry effluent is not discharged onto the same area any more frequently than once every two months.	Slurry effluent is applied to effluent blocks in the Overseer model i.e. blocks where liquid effluent is also applied. Slurry effluent applied to paddocks low in potash (K levels lower than 6-10) and with low Olsen P levels (P levels lower than 25).	Adverse effects to the environment from the discharge of slurry effluent should be no more than minor. Effluent application rates, GMPs and the resulting avoidance of effects supported by Policy 42 of the RWP. The discharge of effluent is governed by the consent conditions in the discharge permit giving certainty that the activity will be regulated. Application of slurry effluent to paddocks low in P and K can act as a capital fertiliser application and bring soil test levels up to agronomical

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
	loadings exceed 150 kg N/ha/year or nutrients are applied in excess then there is a risk of contaminant loss (N, P, sediment and microbial) to groundwater and surface water bodies. Adverse effects from contaminant loss to water include water quality degradation which can adversely impact aquatic ecosystems and the overall health of water bodies. Slurry effluent will be applied to areas within the proposed liquid discharge area. Slurry effluent is generally considered lower risk to apply to land because it doesn't have the same risks of leaching, overland flow/runoff that purely liquid effluent has.	Slurry effluent is only discharged to land when soil temperature is greater than 5 degrees in winter and 7 degrees in spring. Effluent will always be applied at a depth less than the soil water deficit which ensures nutrients remain in the root zone to be taken up and utilized by plants for pasture production. Application of effluent in accordance with Policy 42 of the RWPS. Use of deferred storage of effluent to allow effluent to be stored when it is unsafe to apply to land. Use of a slurry tanker to discharge larger volumes of effluent to low risk soils particularly Category D when soil moisture deficit levels are appropriate to lower storage volumes. Avoid application to Buffer zones created from effluent application areas to critical source areas and other sensitive receptors such as bores, property boundaries and dwellings.		optimum which will increase pasture productivity. As noted above, a farm system that operates within optimal fertility can more efficiently utilise nutrients which results in fewer long term losses. The appropriate re-use of nutrients results in reduced fertiliser application requirements (as noted above). Adverse effects from contaminant loss to water will be avoided and mitigated by a combination of the GMPs and mitigations proposed, so that water quality is not degraded.
Use of the existing effluent storage facilities on existing dairy platform	If a structure is leaking or not structurally sound there is a risk of contaminant losses directly to shallow groundwater. Contaminant accumulation in groundwater can lead to human health issues from blue baby syndrome or *E.coli* contamination if drinking water is abstracted nearby. Contaminants may also reach surface water bodies if there is a groundwater/surface water connection which can cause water quality degradation effects such as algal blooms, smothering and eutrophication in surface water bodies.	Monthly/frequent effluent system checks will be undertaken in accordance with the farm's maintenance checklist. 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 All staff involved in the management of the effluent system are fully trained in its use.	The main effluent clay lined storage pond has passed a drop down test in 2019 to confirm that it is not leaking beyond normal operating parameters. The pond also has had written confirmation from a suitably qualified professional that the pond has no visible cracks or defects. (Attachment B) The weeping wall sludge beds have also passed a drop test in 2019 and has written confirmation from a suitably qualified professional that it has no visible cracks	Effluent storage facilities are fit for purpose and leaks are identified through regular testing and checking of the effluent storage structures. Adverse effects from leakage should be avoided or remedied immediately. Furthermore, the use and maintenance of these structures are a permitted activity and therefore the PSWLP projects that the effects of the use and maintenance of these structures are less than minor as they meet the permitted activity conditions.

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
			or defects in accordance with the methodology as set out in the attached.	
Groundwater abstraction on existing dairy platform	Groundwater abstractions must be at a rate which doesn't cause drawdown effects on adjacent bores which can compromise the availability and reliability of the resource for other users. Groundwater abstractions must be at a level which does not result in an over-allocation of the resource which can adversely impact on drinking water availability, water availability for commercial and industrial uses. Water use in the dairy shed should be managed to ensure there is little wastage because the more water used, the more effluent generated which needs to be discharged to land. Lack of wellhead protection can result in direct contamination of groundwater which may result in elevated N levels and water that is unsafe for use in the dairy shed and for stock to drink.	Reduce water usage in the shed by re-using clean water whenever possible. Treating cows gently to avoid upset, which minimises water use in the dairy shed. Protection of the well head to ensure no nutrients can enter the bore directly to contaminate	N/A	No adverse effects on aquifer sustainability or the availability and reliability of water for other users. Groundwater usage is reasonable in terms of end use. Adverse effects should be less than minor.
Use of a Calving Pad	If effluent is not contained and collected in an appropriate way, there is a risk of direct discharge of contaminants to waterbodies. Direct discharges of *E.coli, N, P,* and sediment have the potential to make water unsafe for drinking and swimming in as well as choking water bodies making them uninhabitable for aquatic life.	The calving pad is maintained in good order. All effluent can be captured and safely delivered to and through the effluent disposal system. Siting calving pad away from tile drains and surface water bodies.	The construction of the calving pad.	No adverse effect on water quality as a result of the use of a calving pad and reduced environmental effects in the form of avoiding losses to water during high risk periods – i.e. spring. Further the appropriate siting and collection of effluent will ensure that no direct discharge of contaminants to water can occur thereby avoiding potential adverse effects on water quality.

In addition to the assessment above, specific comment regarding the wetland and sediment trap/pond mitigations are discussed further. The sediment ponds are existing, and a wetland is proposed, and these are located as shown within Attachment A.

Wetlands and sediment ponds (also commonly known as sediment traps), whilst not located at the 'end of a field' are considered 'edge of field mitigations' that aim to reduce runoff velocity and trap suspended sediment. The existing sediment ponds and proposed wetlands are located within natural basins within Waimairi (loamy peat over silty loam) and Otway (Peat) soils generally draining surrounding Waikiwi (silty loam) soils. The topography of the land and natural depressions in the surrounding land are where sub-surface drains have historically been installed, and can be seen to drain to these areas as shown on Attachment A.

The vegetated margins of a sediment pond, and the vegetated areas of wetlands essentially bind soil slowing the water velocity which mitigates direct discharges of overland flows directly to water bodies. The buffers are the same as riparian buffers which are assigned an estimated effectiveness percentage in Section 5.1.2 above, the ponds then have a theoretical added benefit of capturing runoff where flows have the opportunity to stop entirely and suspended sediment can drop out. Further, these sediment ponds have tile drains draining towards and away from them, which captures the rapid export of nutrients via the sub-surface pathway prior to direct discharge to a stream, creating further opportunity for less nutrients to reach nearby surface water bodies, for parts of the property. These mitigations will be effective and efficient at removing contaminants and have not been rewarded in the OVERSEER® nutrient budgets. These are located at appropriate locations and combined with other GMPs and mitigations as assessed extensively above will result in actual reduced contaminants entering water, which will result in small but real improvements in water quality. Without the imposition of catchment wide strategies co-ordinated at the regional level, the rewards of small on farm improvements such as those proposed within this application may not be observed at the catchment scale overall.

The reader will note that each activity has been assessed individually, and the wetland and sediment pond mitigations have been assessed in relation to the overall activity once it is established. There will be an interim period, being the time, it takes to establish a wetland, so for that reason the application proposes to begin wetland construction within 12 months of given effect to any resulting land use consent. Council raised some concerns about the potential increase in nutrients resulting from the proposal that are not able to be captured in the short term as the wetland is established and suggested that there be an assessment of the efficiency of wetland mitigation when the wetland is not constructed. Logically, we would assume that a part completed wetland it is less effective than a fully established wetland. However, the proposal is for the long-term status quo of more land and more dairy cows and in the long run the benefits of the installation of a wetland will far outweigh the temporary inconvenience when it is being established. The effects of commencing expansion prior to full wetland establishment are not so significant that consent should be declined especially because the short term water quality effects are immeasurable at the water quality monitoring levels (even when not accounting for additional reductions anticipated in losses from the wetland itself) and any changes could not be proven to be caused as a result of the proposal itself in such a short time period.

The farm system changes themselves will result in less nutrient loss to the environment as demonstrated by the nutrient modelling undertaken. Less nutrients lost will result in less nutrients making their way into water bodies which will have positive environmental effects. Adherence to the proposal as modelled will at least maintain if not improve water quality. Even without the mitigations proposed Council can have certainty that the environmental effects will be less under the proposal.

5.1.4 Broad Scale/Cumulative Effects Assessment

Section 5.1.4 makes an overall broad scale assessment of the overall proposal (all components combined) and concludes that based on some specific farm system inputs and the implementation of proposed mitigations/GMPs the proposal will result in a reduction of contaminants in the receiving environments.

Specifically for Aerodrome the mitigations and GMPs proposed are exemplary and when the Consent Authority are able to set catchment limits, other users in the catchment would be able to look to this property as an example for how they can also contribute to the improved well-being and mauri of freshwater in the Oreti catchment.

As has been established in the attached water quality technical comment, overall the proposal (modelled losses, and further mitigations proposed over and above that rewarded in OVERSEER®) will have a positive benefit on existing water quality at the local and catchment level. The improvements in water quality are real but will be difficult to measure at the catchment scale, or even attributed to the proposed changes to this farm system given the huge catchment area.

At the catchment level, Aqualinc[28] in 2014 estimated that if all farms in the New River Estuary catchment undertook mitigation options such as stock exclusion, improved nutrient and effluent management, installation/use of wetlands, reduced stocking rates and restricted grazing which is probably similar to strategic grazing techniques, on average the New River Estuary would see a reduction in catchment N & P loads by 15 % overall.

As a proportion of the estimated catchment loads, the overall loads from both properties combined is understandably extremely small. On a modelled catchment source load basis, the overall loads (see Attachment E) would amount to approximately 0.3% and 0.2% (both current and proposed) of the modelled catchment loads. While this calculation is useful to get a broad appreciation of the potential scale of the overall contributions to N and P catchment loads, it can't be used in any meaningful way to estimate contributions to concentrations in either the Waikiwi Stream/Makarewa River or the New River Estuary because of the complex hydrogeological, physical, chemical and biological processes that operate in the catchments. However, it does highlight the importance of targeted catchment wide implementation of contaminant loss measures to address water quality issues. Further to this, if other similar properties in these catchments are not implementing the same range of mitigation measures as the applicant, they will be contributing proportionally more contaminants particularly sediment, P and faecal indicator organisms to surface waters.

Currently the applicant is operating their dairy farm under restrictions imposed on the discharge activity only and there is no capping or restriction on the amount of nutrients "lost" beneath the root zone, or consequently ending up in receiving water bodies (discounting the effects of attenuation and dilution). Under the proposal, the applicant volunteers both an ongoing restriction on the level of nitrogen outputs modelled by Overseer and the ongoing implementation of specific GMPs and mitigation measures. The result of long term restrictions on the applicant as an operator is that they will be unable to further increase their contribution to contaminant load within either of the receiving water catchments. In time, as other operators in the catchment are restricted in the same manner then there is an expectation that overall nutrient loads will reduce which will further improve water quality and could be observed and measured at the catchment scale.

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

The proposal will see a 2.6 % and 0.4 % reduction in the applicant's contribution (excluding the effectiveness of further mitigations not rewarded in OVERSEER®) to nitrogen and phosphorus load respectively for both the Waikiwi and Myross Stream catchments. These contributions seem not irrelevant given as a total area of the Waikiwi Catchment the applicants property represents 2.6 % of the total catchment area.

Improvements made under the proposal are likely to reduce total nutrient load and nutrient concentration but in isolation from other farms will only have an extremely small impact on long-term water quality. This highlights the importance of catchment wide implementation of water quality mitigation measures and the ongoing restriction on the applicant's operation in accordance with nutrient output limits to give certainty that water quality will not be further degraded in the long term.

Summary

The proposal will result in a reduction in P, N, sediment and faecal indicator organisms lost to the environment and a concurrent reduction in the resulting concentration of these contaminants in receiving waters, albeit at an extremely low level. The overall effects on water quality will be positive and make a very small contribution to the existing trends of improving water quality at the local scale.

5.1.5 Other effects

Overall the proposal will have positive effects on the environment seeing a reduction in modelled losses beneath the root zone overall and at the block scale any potential increase is mitigated or avoided so that it is not significant or a cause of isolated adverse effects. The mitigations proposed are not inexpensive and will require ongoing effort to monitor and manage on behalf of the applicant to ensure that they occur as proposed.

Preparation of the application has required significant investment of time and money by the applicant and their advisors. This includes not only a number of site visits, sourcing and verifying all OVERSEER® inputs, testing of the effluent structures and visual inspections plus report writing. The application itself has taken over 12 months to prepare, and the applicant has made concessions in that the proposal represents a viable farm system but does not represent the best return of investment in terms of income. Other farm systems may be more profitable on this same land area but may have greater environmental effect and that does not align with the applicant's values and vision for the property.

The expansion of the dairy farm will enable the applicant to continue a sound but relatively secure dairy farm operation, that is as close to a self-contained farm system as possible. The property directly employs 3.5 full time equivalents, who support families and local schools and the continuation and prosperity of the business will have economic and social benefits to the landowner and wider community that would not benefit in the event that consent is not granted.

5.1.6 Proposed Consent Conditions

We wish to request the imposition of a form of output-based consent conditions for Aerodrome and look forward to working with the processing officer on these during the processing of the application.

Our intention with this application is that the following is included in the consent conditions:

- Some conditions relating to inputs that give certainty as to the scale of the activities that will occur as proposed within this application are appropriate. A condition that specifies that the proposal occurs in general accordance with this application would suffice. Alternatively (or in addition to) the following input limits could be appropriate:
    - Land area to be used as milking platform;
    - Liquid effluent discharge area;
    - Peak cow numbers milked (as all other stock classes carried in a closed farm system are directly related to the peak cows milked on farm);
    - Minimum and maximum number of cows on the calving pad (this restriction ensures that the calving pad is utilised); and
    - The majority of the herd is wintered off site.
- The requirement to have a FEMP at all times which is updated and reviewed at least on an annual basis, or when material farm system changes occur;
- Agreed output-based consent conditions which are workable, allow for flexibility in farm system and are based around long-term averages. We request that the conditions include a requirement to re-model the farm using OVERSEER for any proposed farm system changes. A baseline nutrient budget may be appropriate and is suggested as follows;

X	(a) The subject land shall only be used in a manner such that when modelled with the current version of OVERSEER, the OVERSEER estimated losses of N to water shall not exceed the Nitrogen Baseline (current combined). The determination of	This condition essentially provides a compliance limit, which is assessed based on the baseline file provided in the application. The condition

	compliance with this condition will be made using the modelled N loss from the most recent reporting year, applied to a four year rolling average, commencing the first season that this consent is given effect to.	ensures that version changes in Overseer are accounted for.

- No P output loss figures limit on the land use consent because of the uncertainty around the OVERSEER® modelling and because as discussed above, mitigations that aren't rewarded in OVERSEER® are effective at reducing P loss and a consent holder could be held accountable to the implementation of GMPs (as documented in an FEMP). Imposing a requirement to implement these GMPs and mitigations measures is a meaningful and effective way of managing the risk of P loss to water. A GMP such as operating within Olsen P range (more appropriate condition than a P loss limit). The proposed wording ensures that the applicant will not willingly exceed the agronomic optimum Olsen P (and will aim to operate within a range such as 20 – 40 mg/L), but that they are enabled to manage fertiliser on as needs basis. Regular and representative soil testing will ensure that applications of fertiliser match soil requirements.
- Reference to wintering on Piobiare within the land use consent for Aerodrome, with a distinction made in the structure of the consent conditions that certain restrictions intended for the dairy platform do not relate to the activities on Piobiare. Particularly as restrictions on the dairy support block may be unlawful;
- Restrictions on the area of land that may be cropped and grazed in-situ;
- A requirement to construct a feed pad within 12 months of commencing the consent;
- Any other consent conditions which relate to the proposed mitigation measures contained in this application. Monitoring of surface water quality would be the most appropriate (given the contaminant pathways), but as can be seen from all of the assessment above and in Attachment E, it only provides a snapshot of the observed water quality and the applicant cannot be responsible for the water quality that enters their property boundary; and

The conditions imposed on the applicant must recognise the level of risk of environmental effect, and give sufficient certainty to the consent authority, whilst still enabling a viable farm system that may respond to market and environmental changes. Farming by nature is flexible and responsive, season to season, it is not possible to farm well to a 'recipe' that restricts a farmer's ability to make some immaterial farm changes, particularly if those changes will protect animal health and the receiving environment. For this reason, the list of conditions suggested above is not extensive.

The conditions above are defensible, certain and enforceable.

5.2 Effects of the use of a feed pad/lot (calving pad)

As described in Section 2.1.4.1 a feed pad is to be constructed of a concreted floor area with a concrete feed apron. The pad will not be roofed, and all effluent and stormwater from the pad will be scraped mostly, but some small amounts of water may be used to give a thorough clean if required. Effluent will be directed to the existing effluent storage facilities. Solids from the feed pad will be separated using the existing weeping wall and sludge beds. More details of the effluent management features (dimensions etc) can be found in the Dairy Effluent Storage Calculator report attached. The exact location of where the feed pad will be constructed is yet to be determined, although the applicant shall ensure it will be located a suitable distance from water bodies, tile drains and sensitive receiving environments.

The following table provides further details of the use of the feed pad at Aerodrome and assesses this use against the criteria set out under Rule 35(a) of the PSWLP. The table shows that the use of the wintering barn is consistent with Rule 35(a)(i) and Rule 35(a)(1), as the barn accommodates no more than 120 adult cattle (or equivalent young stock) and the structure won't technically be used ***continuously*** for three months or more, due to the usual start of calving date on farm (21 July).

Table 21: Feed pad details

<table>
<tr><th colspan="3">a) The use of land for a feed pad/lot is a permitted activity provided the following conditions are met:</th></tr>
<tr><td rowspan="4">Each feed pad/lot services no more than 120 adult cattle, or 250 adult deer, or equivalent numbers of young stock at any one time;</td><td>July</td><td>120</td></tr>
<tr><td>August</td><td>120</td></tr>
<tr><td>September</td><td>120</td></tr>
<tr><td>Adverse weather events</td><td>Up to 120 cows outside of these months during adverse weather</td></tr>
<tr><td>Animals do not remain on the feed pad/lot for longer than three continuous months;</td><td colspan="2">The pad is not used for longer than 3 continuous months, which meets this condition.</td></tr>
</table>

The feed pad/lot is not located: (1) within 50 metres from the nearest sub-surface drain, lake, river (excluding ephemeral rivers), artificial watercourse, modified watercourse, natural wetland, or another feed pad/lot on the same landholding; or	The location of the feed pad is yet to be determined, but will be constructed in a location which meets the setback requirements described in the left column
(2) within a microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the abstraction point of a drinking water supply site identified in Appendix J; or	The proposed feed pad will not be sited within a microbial health protection zone or drinking water supply identified in Appendix J
(3) within 200 metres of a place of general assembly or dwelling not located on the same landholding, or	The feed pad shall be sited well over 250m of any general assembly or dwelling not located on the same landholding
(4) within 20 metres of the boundary of any other landholding; or	The feed pad shall be sited well over 20 m off the property boundary (i.e. near to the dairy shed and existing effluent infrastructure)
(5) within a critical source area;	The feed pad will not be sited within a critical source area
(iv) the feed pad/lot is constructed with: (1) a sealed and impermeable base and any liquid animal effluent or stormwater containing animal effluent discharging from the feed pad/lot is collected in a sealed animal effluent storage system authorised under Rule 32B or Rule 32D; or	The feed pad is to be constructed of concrete and will not be roofed. Effluent and stormwater collected at the feed pad is directed to the main effluent system. The discharge permit applied for in this application is seeking to authorise the disposal of effluent from up to 120 cows using the feed pad at any one time. The existing pond and sludge beds have had drop tests and undertaken and have been visually inspected. And as such on Aerodrome these structures are authorised under Rule 32B of the PSWLP.
(2) a minimum depth of 500 millimetres of wood-based material (bark, sawdust or chip) across the base of the feed pad/lot; and	TBC

(v) any material scraped from the feed pad/lot, including solid animal effluent, is collected and if applied to land is applied in accordance with Rule 38; and	Any materials scraped from the pad are either separated and solids applied to land in accordance with Rule 38, or separated and authorised by way of the discharge permit applied for.
(vi) the overland flow of stormwater or surface runoff from surrounding land is prevented from entering the feed pad/lot.	The feed pad will have some bunding or equivalent to prevent stormwater or surface runoff from entering the pad

5.2.1 Positive Effects of the Feed Pad

The feed pad is proposed to be constructed within 12 months of the first exercise of the land use consent for farming. Effluent from the feed pad will probably be gravity fed directly to an effluent storage facility. The discharge permit applied for in this consent application is seeking to authorise the disposal of effluent from up to 120 cows using the feed pad at any one time.

The use of the feed pad will create a positive effect to the management of stock, feed and nutrients on farm. From an environmental perspective, effluent generated from cows using the feed pad will be treated via the weeping wall prior to being stored in the effluent storage pond. The DESC shows that both the pond and sludge beds are more than sufficiently sized to allow for deferred storage of effluent produced by up to 120 cows on the pad, so that effluent from the feed pad can be discharged to land when soil conditions are suitable for receiving effluent. Restricting the number of cows housed on the feed pad to a maximum number of cows in effect controls the number of cows brought back to the property at a time for calving. This enables the feed pad to be fully utilised so as to prevent damage to soil structure from winter grazing on crop when stock are transitioned back to pasture from fodder beet. The use of the feed pad in the shoulder seasons and other times of the year outside of these months during adverse weather events further avoids damage to pasture when soils are saturated and reduces the amount of pugging that can occur from winter grazing. The use of the feed pad therefore results in lesser adverse effects to the receiving environment, with reduced risk of overland flow of microbes, sediment and phosphorus, along with less potential for nutrient leaching to groundwater via deep drainage that would otherwise occur if all stock was winter grazed instead.

From an economic and animal wellbeing perspective, the use of the feed pad will also be beneficial to cow health, as cows are fed supplementary feed during the winter period (July) and shoulder seasons (August and September). Ensuring that cows are well-fed will mean that they can meet weight targets and maintain optimum condition throughout the season and especially calving. When cows are at appropriate weights and in good condition, milk production is likely to increase and meet production targets, thereby allowing the applicants to operate with a viable business.

Potential adverse effects may arise from the construction of the feed pad, in terms of earthworks required to remove topsoil and installing the concrete slab. Once the feed pad is constructed, there are no known adverse effects from the ongoing operation of the feed pad. This is because the pad will be sited well away from sensitive receiving environments and will be appropriately designed to ensure that all effluent and stormwater from the pad is treated prior to disposal at appropriate times.

5.3 Discharge of Agricultural Effluent

This assessment of environmental effects (AEE) describes the risks to the environment resulting from the proposed discharge of farm dairy effluent to land from the proposed increase in cows milked from current (actual) levels up to the proposed 850 cows. The assessment specifically addresses those matters referred to in Rules 50(d) and 35(c) of the RWPS and PSWLP, respectively.

Under the RWPS the restrictions of discretion for the discharge activity include:

> *(a) application depth and rate, storage requirements, nutrient loading (in particular nitrogen) and contingency plans;*
>
> *(b) the separation distance (beyond that required under conditions 1, 2 and 3 above) of the discharge from surface water bodies, artificial watercourses, subsurface drains, the coastal marine area, residential dwellings, places of assembly, urban areas, property boundaries, water abstraction points and registered drinking-water supplies;*
>
> *(c) other measures to avoid, remedy or mitigate adverse effects (including cumulative effects directly related to the discharge of farm dairy effluent) on water quality taking into account the nature and sensitivity of the receiving environment.*

The assessment of the proposed 10-year consent duration is considered more broadly in Section 9 below.

As outlined above, the key contaminant pathway outlined for this property is the rapid export of nutrients via artificial drainage networks.

5.3.1 Application Rate/Depth/Timing

Liquid effluent will be applied to land using low rate pods. Slurry/solids will be applied to land using slurry tanker. Umbilical can be used for both slurry and liquid effluent. Proposed application rates are:

- Umbilical: Maximum depth per application of 10 mm;
- Slurry tanker: 5mm maximum depth per application;
- Low rate pods: Maximum application rate 10mm/hr and 12 mm depth per application (for pods applying effluent in Category A and D soil risk zones) and 10 mm/hr rate and 10 mm depth per application (for pods applying effluent in Category C soil risk zones); and
- No high rate application methods on Category C land as shown within Attachment A scheme plans.

The proposed low rate pod irrigation depth of up to 10 mm is appropriate given the effluent classification of the soil types on the property, which are Category C (sloping land) and is more suited to the identified contaminant pathways of artificial drainage. Irrigation depths of 12 mm is appropriate for soil types classified as Category A (artificial drainage or coarse soil structure) and Category D (well drained flat land). These areas are identified on the attached effluent disposal plan. The proposed irrigation depths are considered to be at sufficient depths for effluent disposal without the need for buffer zones around known tile drains. The proposed application rate of 10 mm/hour is appropriate given that the proposed irrigation method (using low rate pods or equivalent low rate application method) allows the applicant to utilise another effluent method that is low rate, while not having an adverse environmental effect.

Some of the benefits of using low rate pods are:

- Low application depths and rates;
- Good even spread;
- Can irrigate on one side - great in close proximity to drains; and
- Ability to be used in a stationary position if required.

The timing of the effluent discharge is assessed according to the attached DESC. The two sets of low rate pods can apply effluent at a rate of 20 m^3/hour for 4 hours per day during the winter period. During the summer period, the low rate pods can apply effluent at a rate of 20 m^3/hour for 8 hours per day.

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[29], 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 effluent disposal. The applicant keeps records of all effluent applications in a diary.

The proposed depth of application and assimilation in the topsoil will ensure that an appropriate separation distance to subsurface drains is maintained.

Effluent will be applied to land in the manner described, and therefore potential adverse effects associated with ponding, odour, overland flow and or/nutrient leaching and microbial leaching to groundwater and surface water will be appropriately avoided or mitigated.

5.3.2 Storage

Deferred effluent storage at the farm will consist of two primary storage areas:

- Liquid effluent will be stored in the 3,816 m^3 clay lined effluent storage pond. Liquid effluent is comprised of effluent generated at the dairy shed from up to 850 cows, silage pad leachate and effluent from the feed pad which is primarily to be used between July and September each year; and
- Slurry/solids are stored in the 343 m^3 double sided sludge bed/weeping wall. Slurry effluent is comprised of the more solid components of effluent and calving pad effluent.

The sump is used as a transfer sump and will temporarily hold effluent but is not considered a site for deferred storage of effluent.

[29] 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

The DESC attached in Appendix D shows that 1,940 m^3 of pumpable liquid storage is required (90th percentile probability) to enable effective deferred irrigation for liquid FDE, silage pad leachate and liquid components of feed pad effluent. The DESC shows that 251 m^3 of solid storage is required (maximum volume). The sizing of the effluent storage pond and sludge beds are sufficient to meet the requirements of the DESC.

5.3.3 Disposal Area

The effluent discharge area will be 159.7 ha which represents an increase to the existing discharge areas approved under current discharge permit 301219 (118 ha). A total disposal area of 159.7 ha provides a disposal area to stock ratio of 18.8 ha per 100 cows, which is greater than the recommendation of 4 ha/100 cows.

The OVERSEER® nutrient budget scenario report for Aerodrome states that 150 ha is required to maintain N loading at less than 150 kg N/ha/year from liquid effluent. Calculations using the DESC attached indicates that the farm will produce around 19,987 m^3 of effluent per year, which equates to 127 m^3/ha/yr based on the proposed effluent disposal area. Using DairyNZ (2010) guideline N concentration of effluent of 0.45 kg/m^3, this equates to an areal loading of 57 kg N/ha/yr which equates to 38 % 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.

Liquid effluent will be applied to land all year round when soil conditions permit safe application. 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.

5.3.4 Effects on Water Quality from EFFLUENT Disposal

As assessed above in Section 5.1 effluent management GMPs and mitigations proposed will ensure that the effects of effluent discharge are avoided, mitigated or remedied so that they are less than minor.

5.3.5 Odour

The effects of odour are most likely to occur from the discharge of FDE. The effluent pond is located approximately 398 metres from the property boundary and approximately 571 metres from the nearest dwelling outside the property boundary. The physical location of the effluent infrastructure coupled with the proposed low application rate irrigation and effluent discharge buffers means there is no significant risk of adverse effects from odour and spray drift on surrounding landowners and occupiers. As such, the effects of odour are avoided.

5.3.6 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 and umbilical 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.

5.3.7 Monitoring

Surface water quality monitoring from watercourses is a condition of consent (condition 10) under existing discharge permit 301219, as briefly discussed in Section 3 of this report.

Whilst the current consent requires infrequent monitoring of surface water that may be affected by the discharge activity, ES have since identified that infrequent sampling at inconsistent locations, cannot adequately determine what impact, if any, the activity is having on surface water. As outlined in Attachment E, for this property, overall surface water is likely to be the main critical receiving environment for contaminants. However, water quality monitoring of waterways located at the property will not provide any meaningful information about the effects of the effluent disposal on surface water quality primarily because of the lack of a control site. Surface water sampling has only been effective in confirming the impact of gross pollution incidents for compliance purposes. Surface water monitoring of watercourses should not, therefore, be imposed as a monitoring condition on the replacement discharge consent.

The information on the state of the current environment together with the proposed management regime strongly support a conclusion that the proposed activity will not have any significant adverse effects on surface water quality or any existing groundwater users. We therefore consider that the continuation of this monitoring would not provide any meaningful information on the effects of the discharge of effluent.

5.4 Take and Use of Groundwater

This assessment of environmental effects (AEE) describes the risks to groundwater allocation and water quality resulting from the proposed increase in abstraction of groundwater to provide for the purpose of dairy shed use and stock drinking water for up to the proposed 850 cows. Overall the effects of water abstraction are considered to be less than minor due to the small volumes sought, the allocation status of the underlying groundwater management zones, and that the water applied for is no more than what is considered efficient for the intended uses.

5.4.1 Allocation

The applicant seeks groundwater abstraction from bores:

- E46/0667 located at NZTM2000 1244931E 4855816N and on Sec 79 Blk IX New River HUN; and
- E46/01442 located at NZTM2000 1245336E 4855868N and on Sec 51 Blk I Winton HUN.

The applicant is applying for:

- Instantaneous Rate: <2 L/s
- Daily Volume: 102,000 L/day over the 304-day milking season (1 August – 31 May approx.)
- Annual Volume: 31,312 m^3 (includes the volume required during the milking season and stock drinking during the month of July when cows return to Aerodrome).

The proposed abstraction rate during the milking season of 102,000 L/day equates to a rate of take of 120 L/cow/day, broken down as 50 L/cow/day for shed wash down water and 70 L/cow/day for stock drinking water for the peak milking 850 cows on the property. This allocation is consistent with Environment Southland recommendations. The proposed daily volume equates to a rate of take of 1.18 L/s (over 24 hours) which is less than 2 L/s. This means that effects on stream depletion and interference of other neighbouring bores is negligible and not required to be assessed in this report.

The proposed abstraction is from the Makarewa groundwater zone (RWPS) and the Waihopai GMZ (PSWLP). The Makarewa GMZ has a current allocation of 8 % of the discretionary allocation specified in the RWPS whilst the Waihopai GMZ has a current allocation of 6.2 % of the discretionary allocation specified in the PSWLP.

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. There are three 30,000 L freshwater storage tanks at the dairy shed to ensure the instantaneous rate of take is less than 2 L/sec.

5.5 Summary

Overall, the effects on the environment:

- *Will be no more than what has lawfully been occurring, and future losses will be restricted to a level which we consider does not cause adverse effects on the environment;*
- *Will be no more than what is currently consented to occur; and*
- *Will at least result in some reduction in losses from the farm system and consequent nutrient concentrations in the receiving environments (if the mitigations and GMPS proposed are implemented on farm).*

6. ASSESSMENT OF ENVIRONMENTAL EFFECTS – PIOBIARE

To understand the context of the assessment provided below, first we have described the overall activities as proposed in Section 2 above, then outlined the existing environment in Section 3 above which includes the existing consented and permitted activities. The scope and scale of the assessment of the effects of the proposal is commensurate to the scope and scale of the proposal.

6.1 Use of Land for Farming

This assessment of environmental effects (AEE) describes the risks to the environment resulting from the proposed changes to the dairy support run off farming activity, including the wintering of more dairy cows from Aerodrome Farm Limited.

We have earlier outlined that Aerodrome and Piobiare are separate landholdings, and whilst connected (in terms of trading stock), they are two 'single operating units'. The effects from each farm scenario proposed are assessed together where appropriate and separately where appropriate.

The assessment below assesses the Piobiarre Homestead farming activity in its entirety, and at the 'block level' (i.e. OVERSEER® block level) and doesn't use a permitted baseline approach to the assessment.

As contained within the Attached Technical Comment, Water quality (based on ES sampling records) at the Makarewa River monitoring site (used as a proxy for likely surface water quality in Tomopokorau Catchment) is slightly better than the state of water quality in the Waikiwi Stream (Aerodrome). However, the same water quality issues are likely to be of concern here which are:

1. ***Poor ecological status of the macroinvertebrate community;***
2. ***High concentrations of faecal indicator microorganisms;***
3. ***Raised nutrient concentrations leading to plant growth in the stream and further downstream; and***
4. ***Apparent poor water clarity.***

Some data collected on the former Southland Demonstration Farm in 2012[30] and 2016[31] indicate that average nitrate nitrogen and dissolved reactive phosphorus concentrations are significantly higher (~5 g NO_3-N /m^3 and ~0.03 g/m^3 respectively) in this creek compared to concentrations in the Waikiwi Stream. Now these records do not show a trend or a state in water quality and are rather a snapshot in time.

With respect to groundwater quality, mapping of **maximum** nitrate nitrogen concentrations sampled between 2013 – 2018 show one bore upgradient and one bore adjacent to the property where groundwater nitrate nitrogen levels have peaked above MAV for drinking water quality, although note that there is a huge range of sampled groundwater quality results. Overall, trends in groundwater nitrate nitrogen concentrations in the Piobiare area appear to be generally increasing with some locations not increasing (Attachment E). The highest and immediate water quality concern would appear to be drinking water quality based on these levels. However, the reliability of collected groundwater records accurately representing the state of groundwater quality in general is in question and the context for these elevated levels is unknown (i.e. poor well head protection or long term nitrate leaching to groundwater resources). From an ecological and catchment perspective the broader general issue is the discharge of groundwater to surface water bodies contributing to plant growth in streams, receiving rivers, and the New River Estuary at the bottom of the catchment.

The assessment below considers the above specific surface water quality issues to the nearest monitoring site. It looks at the property scale and within the property at specific management/landscape blocks, and

[30] https://www.massey.ac.nz/~flrc/workshops/14/Manuscripts/Paper_Cameron_2014.pdf
[31] http://flrc.massey.ac.nz/workshops/16/Manuscripts/Paper_Jackson_2016.pdf

the likely contaminant pathways that may impact the water quality issues. Water quality results are presented in a greater scale than the properties themselves. Addressing specific water quality issues relative to the proposal includes farm system changes proposed and documented in the OVERSEER® budgets, GMPs and mitigations, their effectiveness and appropriateness at Piobiare and the proportion this property contributes to water quality measured at the catchment scale.

Section 6.1.1 presents the modelled nutrient losses between the current and proposed farm system and concludes that the consent authority may have certainty that the predicted losses and farm system proposed will occur as described in Section 2 above.

Section 6.1.2 introduces the contaminants of concern and gives some details as to the effectiveness of each mitigation and whether the GMP/mitigation is rewarded in OVERSEER® i.e. is it 'over and above' and will it reduce the predicted losses beyond that predicted and presented in Section 6.1.1

Section 6.1.3 presents a Table **Error! Reference source not found.**which attempts to assess the potential effect of each individual farm activity on the environment.

Section 6.1.4 makes an overall broad scale assessment of the overall proposal (all components combined) and concludes that based on some specific farm system inputs and the implementation of proposed mitigations/GMPs the proposal will not result in adverse effects on the environment.

Section **Error! Reference source not found.** then presents an assessment of other effects followed by Section 6.1.6 the restrictions that could be imposed as conditions of consent that are defensible in both a legal and practical sense, intra vires, certain and enforceable.

6.1.1 OVERSEER Nutrient Budgeting

OVERSEER® nutrient budgets have been prepared by Mark Crawford of Ravensdown who is a Certified Nutrient Management Adviser (CNMA). These OVERSEER® budgets have been used to show the annual amount of nitrogen and phosphorus discharged from the Piobiare landholding. A copy of all OVERSEER® Nutrient Budget Farm Scenario Reports can be found attached to this application (Attachment F). Copies of the xml files have been sent to Council separately however, we note that these have already been independently peer reviewed by Arron Hutton CNMA, and by Irricon as part of pre-application checks.

The OVERSEER® budget modelling of the current farm system, is an accurate description of the applicants' existing farm system and consequent N & P losses beneath the root zone as averaged over the preceding three years. All inputs into the model have been taken from three years of farm records and/or accounts and are actual figures and therefore fairly represent the scale of the farm system as it has been operating since 2015. Environment Southland have agreed that three years of averaged inputs would give them the most certainty of the existing farm system, and thereby existing environment and existing nutrient losses beneath the root zone based on the farm system inputs to the model. Table 22 presents the summary of overall N and P losses beneath the root zone for Piobiare.

Table 22: Summary of modelled nutrient losses to water for Piobiare Homestead Ltd

Nutrient Losses	Combined Current Farm System (3 Year Average)	Proposed Farm System	Difference
Piobiare Homestead Limited			
N Loss from the root zone	4,699 kg N/year or 28 kg N/ha/year	4,385 kg N/year or 27 kg N/ha/year	***- 284 kg*** N/ha/year ***- 1 kg*** N/ha/year
P Loss from the root zone	121 kg P/year or 0.7 kg P/ha/year	118 kg P/year or 0.7 kg P/ha/year	***- 3 kg*** P/ha/year ***0.0 kg*** P/ha/yea

Overall, the proposal represents a decrease in total N losses by 284 kg N and a decrease in total P losses of 3 kg P. Also, the annual amount of nitrogen and phosphorus discharged from the landholding will be no greater than that which was lawfully discharged annually on average for the three years prior.

The key drivers resulting in the overall reductions of N and P loss at the farm scale for Piobiare are outlined below, and explains the losses predicted in the modelling.

Table 23: Summary of key farm system influences on N loss for the farm system

Piobiare Homestead Limited
Grazing on fodder beet crop
Extended use of the wintering barn from May to September (modelled as a percentage of the herd and therefore likely to be modelling a 'worst case-scenario')
Pastoral productivity which reduces the amount of N loss via tile drainage pathways
No increase in young stock grazing
Maintaining an appropriate effluent disposal area

Slight reduction in stocking on pasture as a result of young stock changes and extended use of the wintering barn, mitigates the slight increase in stocking rate over winter on the crop blocks.

The above management changes are the key drivers that have ensured the proposed farm system overall does not result in more losses past the root zone than the current 3-year averaged farm system. The Table above is not a complete list of all inputs, because it's the entire farm system overall that influences the predicted losses, but the key ones in Table 23 above are the most notable changes between the current and proposed farm system and are listed above to give Council some understanding as to why stock numbers are proposed to increase but that overall losses will decrease.

The use of a wintering barn is one of the most effective and significant mitigation measures available for NZ dairy farms for reducing effects of N leaching beyond the root zone through to groundwater and surface water receiving bodies. The wintering shed allows the applicant to remove cows from pasture and hold them inside during high risk drainage periods. In doing so, N deposited via urine and dung patches is collected within the effluent system and can be redistributed to pasture evenly, at a lower rate and timed to avoid high risk drainage periods. This significantly reduces the risk of N leaching through the soil profile as it is preferentially used in the root zone. The proposed changes will result in at least the maintenance of water quality in the receiving GMZ.

As outlined in Section 5.1.1 above, there have been two publications of note regarding the use of Overseer in both a regulatory framework and for water management planning. Of these reports, the Enfocus report specifically provides for a solution to some of these known limitations and issues by advising that N loss output figures are used in a regulatory context. Using an output figure in regulation enables Overseer version changes to be accounted for and allows the applicant to demonstrate the improvement in N loss outputs whilst still maintaining the flexibility to farm to environmental, political and economic conditions as well as provide for innovations on farm. We concur with these recommendations in light of the fact that the Resource Management Act is an effects-based piece of legislation.

As expanded on further in the attached Technical Comment, the nutrient modelling and recently published reports expanding on its appropriateness in use as a regulatory tool summarise the following points:

- The estimated differences between the current and proposed farm system nutrient loss predictions is significantly less than the likely uncertainties involved in Overseer modelling;

- Overseer modelling should be considered in conjunction with the specific farm systems and mitigation measures that are proposed. to provide a reasonable level of certainty about the relativities of nutrient loss estimates.

"This means that while there may be a relatively high level of uncertainty about nutrient loss estimates, if there are clear, measurable and verifiable changes to a farm system there will be a high level of certainty about the relative changes to long-tern annual average nutrient loss estimates[32]. Therefore, provided that assurance is provided that the farm system changes have occurred there will be a high level of certainty there will be relative reduction in long-term annual average N and P losses to water." (Attachment E)

Therefore, we agree that a N loss output condition will give the consent authority the most certainty that the proposal will occur as proposed in future (subject to granting of consents) and that from the further assessment in the following sections that the effects of the proposal and predicted losses on the environment will:

1. ***Overall be no more than what has lawfully been occurring, and future losses will be restricted to a level which we consider does not cause adverse effects on the environment;***
2. ***No more than what is currently consented to occur; and***
3. ***Will at least result in some reduction in losses from the overall farm system and consequent nutrient concentrations in the receiving environments (if the mitigations and GMPS proposed are implemented on farm).***

6.1.2 Potential Water Quality Effects

OVERSEER® tells us what the losses beneath the root zone may be, but not what the potential or actual effects of that loss on water quality are. The effects of the proposal on water quality are assessed in this section and the attached water quality technical comment (Attachment E).

The contaminants of concern as outlined in the PSWLP are N, P, sediment and microbiological contaminants have the potential to affect water quality. These contaminants and potential effects of those contaminants are outlined in Section 5.1.2 above and not repeated here.

[32] Freeman, M, Robson, M, Lilburne L, McCallum-Clark, M, Cooke, A, & McNae, D. (2016) Using OVERSEER in regulation - technical resources and guidance for the appropriate and consistent use of OVERSEER by regional councils, August 2016. Report prepared by Freeman Environmental Ltd for the OVERSEER Guidance Project Board.

Assessing the environmental impact of modelled nutrient losses from a subject property is complex because these nutrients travel via a number of different pathways through the receiving environment undergoing attenuation, mixing, dilution and dispersion processes which can significantly change the quantity and nature of these nutrients in the receiving water bodies.

N loss

At the block scale, of the 20 blocks set up in the OVERSEER® xml files, 4 of these predict a total increase in N loading (kg N/year) loss beneath the root zone but only two of these represent an increase at the kg/N/ha scale, between the existing farm system and the proposed farm system. The four blocks at any one time (noting that the applicant rotates crop paddocks) make up 30.8 ha of the total proposed property area (19 % of the proposed property boundary). All other blocks predict less N lost beneath the root zone. With respect to N in drainage, one block predicts a very minimal increase of 0.6 %, which is negligible and immeasurable at the farm or catchment scale, all other blocks predict a decrease of N in drainage or no change. The management of these blocks (crudely summarised here) is where effluent applications currently and are proposed to occur, and where crop is currently and proposed to continue to be rotated. These blocks are predominantly Waikiwi Soils, which are freer draining soils with low denitrification potential. All other blocks demonstrate a reduction in N loss beneath the root zone.

Other sources predicts an increase in N loss and reduction in P loss, the increases in N are predicted as a result of increase wintering barn usage, but overall the positive effects of the use of the barn far outweigh any assumed increase of N loss as a result of using the wintering barn, particularly if all contaminants are collected and applied to land at appropriate times.

While this is internally reported at the block scale, OVERSEER® is not spatially explicit, and therefore the block boundaries cannot be aligned to physical paddock boundaries at the farm scale.

Table 24: Management tools that will reduce N losses to groundwater water and effectiveness[33]

Type of Strategy	Nitrogen Loss Mitigation	Rewarded in OVERSEER®?	Proposed to be implemented	Effectiveness (range)
Effluent Management	Using low rate effluent application	Not assessed – but may be rewarded in that OVERSEER® assumes good management practices have been implemented on farm	✓ (it is unclear if low rate of effluent irrigation would be assumed as a good management practice on farm)	12 – 19 %
	Providing sufficient effluent storage to enable deferred application	Not assessed – but likely to be rewarded	✓	12 – 19 %
Nutrient Management	Spread fertiliser evenly	No – assumed already	✓	-
	Avoiding high risk times for fertiliser application	Yes	✓	-
	Avoid applying fertiliser directly to streams	No	✓	-
	Appropriate fertiliser rates	Yes	✓	-
	Improved N use efficiency	Yes	✓	15-17%
Stock Management	Reducing ability of stock to form camps	No	✓	-
Infrastructure	Managing track runoff	No	✓	-
Total effectiveness of mitigations not likely to be rewarded in OVERSEER® as a conservative estimate				***39%***

Error! Reference source not found. above presents a list of some of the GMPs and Mitigations explored above, which will result in less N loss to water and summarises whether or not they are rewarded in OVERSEER. As outlined above, if each mitigation is as effective as outlined above and each percentage can be added, then at a conservative estimate N may be reduced by at least 39 %. This assumption includes those GMPs already, or likely to be rewarded in OVERSEER® i.e. already accounted for in the reduced total

[33] McDowell, R., Wilcock, B., and Hamilton, D., 2013. Assessment of Strategies to Mitigate the Impact or Loss of Contaminants from Agricultural Land to Fresh Waters. Report prepared for MfE. Publication RE500/2013/066.

N loss predicted from the farm system. Less losses = less effect on water quality, because higher concentrations means that the range of effects as listed in the second column of Table 26 would be more likely to occur.

According to ES's Beacon GIS, the nearest registered drinking water supply is the Invercargill City Council supply from the Lower Oreti GMZ, and the Wallacetown School from the Makarewa GMZ. These sites are 2 km and 5.6 km away respectively from the existing dairy support property. Given the estimated TN concentration in drainage overall is predicted to decrease under the proposal, the distance between these sites, and not accounting for attenuation or dilutions, it is highly unlikely that there would be any adverse effects associated with nutrient losses from the proposed activity on these drinking water supply or any other bores that may be nearby. While at the block level, there is a slight increase in N in drainage, this level of increase on its own would be immeasurable. There is significant uncertainty with respect to the existing nitrate nitrogen concentrations in nearby bores, and if the most upgradient bore has exceeded MAV on one occasion, then it is entirely unaffected by the proposal because it is upgradient. Furthermore, the adjacent bore is a monitoring bore likely established to monitor water quality related to the neighbouring land use.

As shown on Figure 15 below, the neighbouring property is a commercial operation with large dis-coloured ponds immediately upgradient of this monitoring bore. The bore is used for monitoring purposes only and is not a known domestic supply. While these comments are speculative only, we draw to the council's attention that many land-uses result in accumulation of N in groundwater which are observed as elevated nutrient levels and that while tracing groundwater movements can occur, direct connection between a diffuse discharge and an observed elevated level at the farm scale cannot be effectively undertaken or enforced. A catchment wide approach teamed to land use while ensuring each and every bore in southland has adequate well head protection would see cumulative reductions in nitrate levels over time throughout the groundwater management zone.

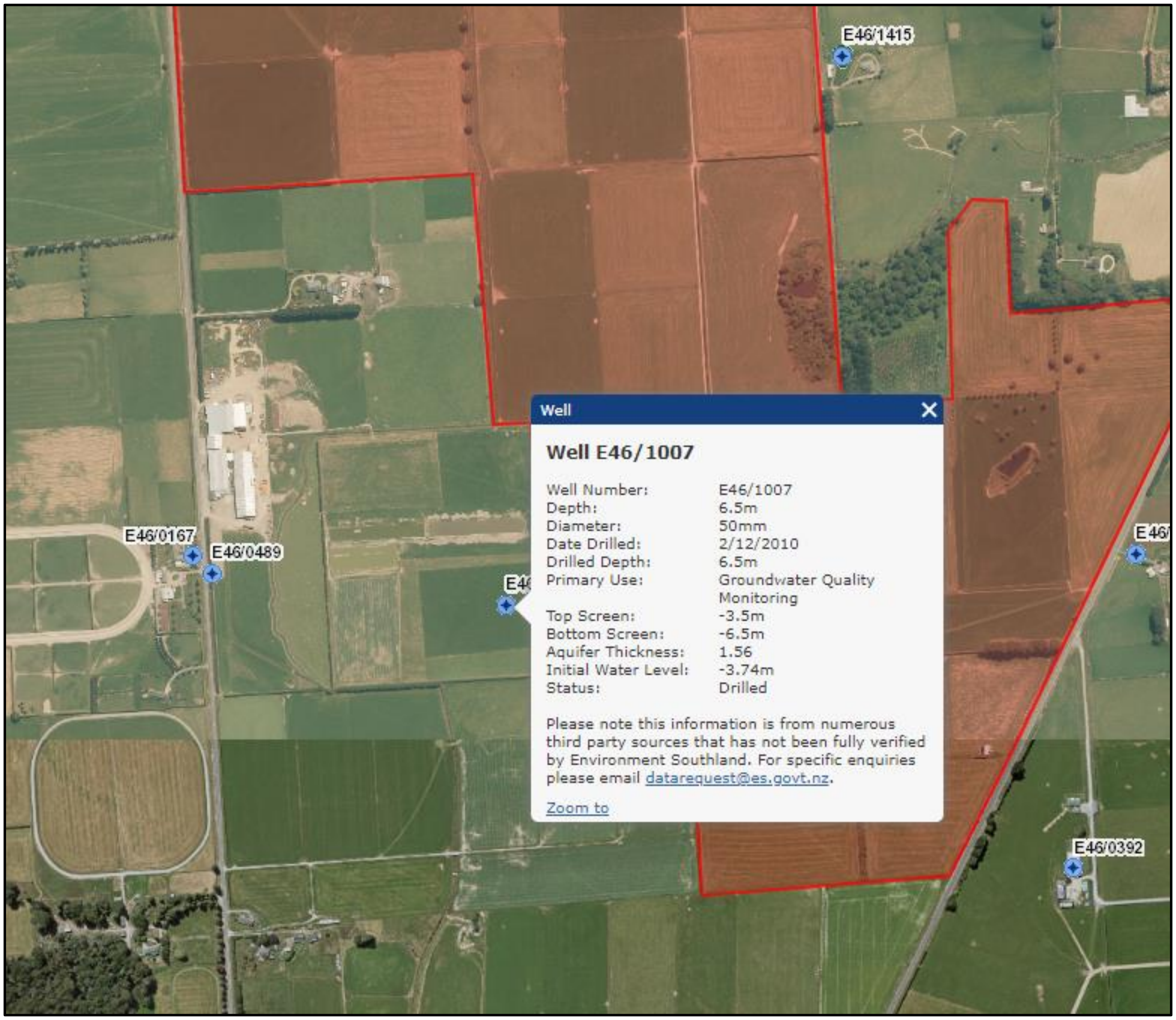

Figure 15: Shallow monitoring bore E46/1007 on neighbouring property

There were no down gradient monitoring bores from the property, and further additional monitoring bores at appropriate locations monitored according to the appropriate standards with good well head protection would give a greater indication of actual state of groundwater quality at the vicinity of the property. For this purpose, the applicant proposes to install a shallow groundwater monitoring bore and undertake frequent sampling of the bore, which will aim to detail actual groundwater quality.

There will be further attenuation, dilution and dispersion processes that will further reduce the concentration of nitrate nitrogen in groundwater between the discharge location and any sensitive receptors.

Groundwater nitrate concentrations are of particular concern to human health. The risk of bottle fed infants getting 'blue baby syndrome' from consuming high nitrate nitrogen water is widely accepted and is the primary driver for the current NZ Drinking water standard for nitrate nitrogen. The proposal sees a reduction in N losses overall beneath the root zone. Other studies indicate that other contaminants, or dietary nitrate sources, may also play a role in the syndrome.[34] A recent Danish study suggested a link between groundwater nitrates and bowel cancer. The study found that those people exposed to nitrate levels in excess of 9.3 mg/L (NZ drinking water standard is 11.3 mg/L) had a 15% increased carcinogenic risk. In December 2018, Agriview NZ published an article attempting to correlate the Danish study within the New Zealand agricultural context. The article noted that "most of the international research conducted throughout the past four decades on this topic has found either a negligible or only slight correlation between nitrates in drinking water and colon/bowel cancer rates" and also that "the idea that colon cancer is heavily influenced by diet surfaces in many of the studies evaluating its link to the intake of nitrate through drinking water." The article further noted "Ian Shaw, professor of toxicology at the University of Canterbury, says it is this very factor that makes the associations between water nitrate and colon cancer unconvincing:

"In my opinion nitrate is associated with colon cancer because it can be converted to nitrite by gut bacteria and form nitrosamines with dietary amino compounds. Nitrosamines are profound carcinogens. Links with water nitrate would, therefore, not be definitive because other components of the diet would be necessary to facilitate carcinogenesis. If exposure to an appropriate dietary mixture, plus the right bacterial species in the microbiome do not coincide carcinogenesis will not occur. This is a complex scenario that cannot be attributed to a single exposure to a single chemical.

In other words, attributing high colon cancer rates to nitrates in drinking water would be oversimplifying things to a considerable level. One must consider the variations of diet and lifestyle also considered potential factors for increasing colon cancer risk, and this is something the Danish study failed to do."[35]

The information from the Overseer modelling overall combined with the specific management practices provide strong evidence for a real but small reduction in the N loading and N in drainage to groundwater and if this occurs across enough properties in this general area there will be an improvement in both the underlying groundwater nitrate N concentrations and eventually the concentrations in drainage water

[34] https://en.wikipedia.org/wiki/Blue_baby_syndrome accessed 8 February 2019

[35] https://www.agriview.nz/forum/2018/12/11/investigating-the-nitrate-colon-cancer-link accessed 8 February 2019

discharging to streams. Because of the complexity of groundwater systems including the inherent heterogeneity of alluvial aquifers, and travel times for drainage water and groundwater it may be many years before reductions in N loads are observed in bores used to monitor groundwater quality and in surface water recharged by that groundwater.

In summary, the evidence about the current state of nitrate nitrogen concentrations in groundwater in this area and the OVERSEER® modelling that strongly indicates that drainage nitrogen concentrations at the level predicted by OVERSEER® will not have a significant adverse effect on actual existing groundwater quality.

Sediment, P and microbiological contamination

At the block scale, the proposal predicts a minor increase of P loss on 4 blocks (1 - 5 kg P/ha/year, but overall a reduction in P loss at the farm system scale.

Sediment and microbiological contaminants are not modelled within OVERSEER® so attempting to show a reduction in the annual amounts of these nutrients in the proposed scenario compared to the amount which has been lawfully discharged currently is more difficult. P loss modelling can be used as a proxy for sediment and microbiological contaminant losses. The reason being is that phosphorus in the soil readily bonds to fine soil particles and is therefore lost to the environment via the same contaminant pathways: runoff/overland flow and erosion. Microbiological contaminants are also lost to the environment by the mechanics of water flow via these same pathways. However, P loss prediction is not exactly the same as Microbial and sediment losses, and therefore the assessment cannot be absolute, but provides the best indication of likely losses and risks to the environment.

Error! Reference source not found. below presents a list of potential management tools which will result in less phosphorus, sediment and microbiological contaminant loss to water and summarises whether or not they are rewarded in OVERSEER and which management practices the applicant will undertake to minimise P loss on farm under the proposed dairy expansion. With the adoption of these management measures, losses of these three contaminants will be further reduced to that which is modelled in OVERSEER. The applicant is willing to have these measures imposed as consent conditions via the implementation of a FEMP.

Table 25: Management tools that will reduce P losses to water[36] and effectiveness[37]

Type of Strategy	Phosphorous Loss Mitigation	Rewarded in OVERSEER®?	Proposed to be implemented	Effectiveness (range)
Riparian	Fencing Streams	Yes	✓	52 – 61 %
	Appropriate vegetated buffers from water ways	Not assessed – but likely to be rewarded for 3 m buffers	✓	38 – 58 %
	Uncultivated ephemeral stream margins	No	✓ (grass buffer strips/uncultivated ephemeral stream margins – increased sizing for critical source areas)	-
	Swales/gullies which run into creeks are to be fenced with a wider buffer zone to act as an additional filter	Not assessed – but unlikely to be rewarded	✓	-
Effluent Management	Providing sufficient effluent storage to enable deferred application	Not assessed – but likely to be rewarded	✓	12 – 17 %
Infrastructure	Identification of critical source areas with regards to P loss	Not assessed – but unlikely to be rewarded	✓	-
	Infrastructure to keep stock away from unfenced streams (e.g. troughs, shade)	No	✓	-
	Culverts and bridges, managing track runoff	No	✓	-
Nutrient Management	Spread fertiliser evenly	No – assumed already	✓	-

[36] *Hurunui-Waiau Nutrient Budgeting Case Studies*, report prepared by Rebecca Hyde & James Hoban (December 2014). http://www.landcare.org.nz/files/file/1445/Hurunui-Waiau%20Nutrient%20Budgeting%20Case%20Studies.pdf

[37] McDowell, R., Wilcock, B., and Hamilton, D., 2013. Assessment of Strategies to Mitigate the Impact or Loss of Contaminants from Agricultural Land to Fresh Waters. Report prepared for MfE. Publication RE500/2013/066.

Type of Strategy	Phosphorous Loss Mitigation	Rewarded in OVERSEER®?	Proposed to be implemented	Effectiveness (range)
	Avoiding high risk times for fertiliser application	Yes	✓	-
	Change fertiliser type	Yes	✓ (low solubility P fertiliser)	18 – 22 %
	Avoiding applying fertiliser directly to streams	No	✓	-
	Appropriate fertiliser rates	Yes	✓	-
	Targeting optimum Olsen P	Yes	✓	
Stock Management	Reducing ability of stock to form camps	No	✓	-
Wintering and Grazing Management	Utilising the wintering barn between May and September	Yes	✓	-
	Restricted grazing including remaining crop cover after grazing	Not assessed – but unlikely to be rewarded	✓	42 – 70 %
	Shifting break fences strategically (back fencing where possible)	No	✓ (strategic grazing of winter forage crop)	86 %[38]
Total effectiveness of mitigations not likely to be rewarded in OVERSEER® as a conservative estimate				***323 %***

The potential water quality effect of phosphorus, sediment and microbiological contaminant in the key receiving environment (surface water bodies) could result in eutrophic conditions that adversely affect the life-supporting capacity of the water body. Given the proposal will reduce these beyond that which is modelled to occur, and that which is currently occurring the proposal will not exacerbate any existing effects on the environment, and will seek to improve water quality so that the life-supporting capacity of the waterbodies and catchment are not compromised as a result of the proposal.

Our assessment is that the proposed farm system changes on Piobiare on their own will result in a real but extremely small overall improvement on local groundwater and surface water quality. Quantification of the improvement has not been completed because they are unlikely to be measurable with the current ES surface water quality monitoring programme at the local scale. Total nitrogen losses predicted will likely be

[38] Environment Southland Critical Source Areas Factsheet. Es.govt.nz. Retrieved: 6 May 2018.

less, particularly after further dilution, attenuation and dispersion processes (which have not been accounted for in the modelling). The proposal therefore meets Policy 16 of the PSWLP which requires farming activities to **fully mitigate and avoid** effects on the quality of water, including cumulatively, of groundwater, waterbodies, coastal lakes, lagoons, tidal estuaries, salt marshes and coastal wetlands. As a result, the proposal is likely to at a minimum maintain water quality, and not further exacerbate cumulative effects on existing water quality in relation to dissolved reactive phosphorus, nitrate nitrogen, sediment or faecal indicator microorganisms.

Various management practices will (or already have been) adopted in order to reduce sediment, and bacteria losses via overland flow, artificial drainage channels and deep drainage. The primary mechanism of mitigating and avoiding these losses is by appropriate management of critical source areas on the farm, improved effluent management, stock exclusion from riparian margins and CSA's and the adoption of best management practices for intensive winter grazing (such as strategic grazing). These mechanisms are likely to have the greatest impact in reducing sediment losses and microbiological contamination of waterways. Our assessment is that the implementation of the practices in the FEMP will **fully mitigate or avoid** adverse effects on water quality in accordance with Policy 16 of the PSWLP.

The dry stock component alters slightly under the proposal, including increased usage of a wintering barn on Piobiare, and exporting of existing dairy grazing contract for young stock (not from Aerodrome) will cease in future. At the farm scale, there will be no significant effect as a result of the change in young stock on both properties. With respect to the dairy grazing stock exported elsewhere, this assessment concludes that the effects of grazing young stock are minimal and cannot be accurately assessed for the purpose of this proposal. This is because, young stock grazing is a permitted activity under the RWPS and PSWLP and therefore the effects of that activity in isolation are probably less than minor, and the new grazier for those stock is unknown and it would be the responsibility of that grazier to obtain appropriate authorisations if required to graze the displaced dry stock.

This assessment also assesses the proposed activity in its entirety against the actual existing environment, i.e. not using a permitted or consented baseline approach because that represents the actual effect of any changes beyond that which has lawfully been occurring and forms the existing environment.

Remember, that the four key water quality concerns for the Makarewa River downstream of the property are:

1. ***Poor ecological status of the macroinvertebrate community;***
2. ***High concentrations of faecal indicator microorganisms;***
3. ***Raised nutrient concentrations leading to plant growth in the stream and further downstream; and***
4. ***Apparent poor water clarity.***

The state of the environment cannot specify what caused that state, but what we can conclude is that some water quality indicators demonstrate an improving trend at the local level, while at the catchment scale, the New River Estuary has been experiencing significant eutrophication with a macroalgal Ecological Quality Rating (EQR) of 'poor' for the 2018 period. The trend for this ecological rating over the 2001-2018 period strongly indicates a significant decline from a 'good' state to a 'poor' state.

Given that the proposal seeks to reduce nutrient losses by various farm system changes by virtue of the proposal itself, and then further seeks to reduce their likely effect on the environment overall, and that these mitigations are specific to not only the activities themselves (the whole and each part) but also the water quality indicators of concern this proposal will result in a real but very small improvement in water quality overall.

6.1.3 Mitigations and GMPs

The PSWLP encourages that good management practices are implemented on all farms in Southland, at a minimum. OVERSEER® assumes some of these are already in place on farm when modelling predicted losses from the farm system. Those that are to occur on farm and are not rewarded in OVERSEER® are mentioned earlier in this report in respect to P, Sediment and Microbiological losses.

Table 26 below attempts to assess the potential effect of each individual farm activity (noting that the proposal is for a combination of all of those activities and that they are all related to each other). The applicant then presents GMPs and Mitigations that will/or have been applied to each activity in order to avoid, mitigate or remedy the effects of each activity of the receiving environment. The outcome column is the resulting likely environmental effect of that portion of the activity. The Table below forms only one part of the application and assessment and is presented below to give the Consent Authority certainty of each of the individual components of the proposal and to demonstrate that the effects at each individual scale will be avoided, mitigated or remedied. As the applicant is proposing to operate a dairy support runoff on

165.1 ha of land, and that consent would be granted for the overall activity, Table 26 below must be read in conjunction with the overall broad scale/cumulative effects assessment in Section 6.1.4.

Table 26: Assessment of Effects at the activity level for Piobiare Homestead Limited

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
Increase in nutrient losses from the existing dairy support land use.	The nutrient budgets show a potential increase in kg of N loss at the block level for crop and effluent Waikiwi blocks. OVERSEER® predicts a P loss increase on some blocks. At the block level one block predicts a 1 ppm increase in N in drainage which is attributed to the Waikiwi effluent block. All other blocks demonstrate reductions in N and P loss at the block scale both in total N and P loss and in N in drainage. Excess losses from one particular block of land may result in concentrated nutrient accumulation in the soil profile and/or in localised drainage channels which can result in water quality degradation and ecological stressors on aquatic life and human health issues.	Re-sow areas of bare or damaged soil as soon as practicable. On the Waikiwi effluent block, deferred effluent application, applying appropriate depths of effluent, at appropriate times when nutrients can be assimilated. Effluent applications will be targeted to the effluent disposal area which is much greater than the minimum required to ensure loading is no more than 150kgN. A larger effluent disposal area is applied for (94 ha) than that modelled (90.8 ha) which will reduce the effluent areal loading that is modelled to occur on farm.	Differential N fertiliser applications between effluent and non-effluent blocks (not currently implemented on farm). Tile drain mapping and avoiding effluent applications to tile drain areas. Effluent applications will be restricted to the months of October to April which avoids usual high risk periods associated with drainage. Specific mitigation related to cropping includes strategic grazing of crops. This includes protecting CSAs from stock by fencing and grazing the least risky areas first and grazing towards the higher risk areas. In effect, this leaves the CSA (most vulnerable area) with minimal soil damage for as long as possible throughout the grazing period. This in turn reduces the overland flow and sediment loss. Strategic grazing does not mean that the CSA is not grazed, but rather that it is only grazed when conditions are suitable. The Agresearch[39] strategic grazing trial in 2011 and 2012 showed that strategic grazing of dairy winter forage paddocks can considerably reduce volumes of overland flow. The study correlated reduced overland flow with reduced sediment and nutrient yields carried in the overland flow. The mitigation measures to reduce modelled nutrient losses (contained throughout this table) are located across the entire landholding and therefore will mitigate against contaminant losses.	The increased modelled contaminant losses at the block level are mitigated by the wider distribution of modelled contaminant losses across the remainder of the landholding. There is no change to the existing farm area, and consequently no new receiving environments. Overall, there will be no overall modelled increase in contaminant losses to water bodies in accordance with the physiographic zone policies and Policy 16 of the PSWLP. Strategic grazing will result in fewer losses, and greater management of timing for stock on crop during these times may result in up to 80%[40] less losses from these sources than what is currently and predicted to occur. Overall, it is the combination of these GMPs and mitigations which will result in the potential effects of the proposal on water quality being avoided (i.e. removing stock off wet paddocks and effluent application changes), mitigated (i.e. strategic grazing of CSAs and back fencing) so that water quality is not degraded at this location as a result of the proposal.

[39] T.S Orchiston, R.M. Monaghan S. Laurenson. (2012). Reducing overland flow and sediment losses from winter forage crop paddocks grazed by dairy cows. Agresearch, Invermay Agriculture Centre, Private Bag 50034, Mosgiel, New Zealand.
[40] https://www.es.govt.nz/Document%20Library/Factsheets/Good%20management%20practice%20factsheets/Winter%20Grazing/critical_source_areas.pdf retrieved 7 May 2019.

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
Increase in nutrient losses from "other sources"	Nutrients are lost directly from other sources to water bodies without any potential for attenuation. Increased nutrients, (N, P, Sediment, and *E.coli)* have the potential to adversely impact surface water quality. OVERSEER® assumes that 30 % of dung deposited on a lane is lost to water, even if there is no nearby surface water body, which is not actually the case. OVERSEER® predicts no increase in P from other sources, but assumes an increase in N.	No new laneways or structures are proposed as the property is not predicted to increase; therefore, the model does not assume new P losses from this source. Where lanes cross a waterbody, management of culverts/crossings (critical sources areas) will also be important, which will avoid point source discharges and avoid and/or mitigate the potential P losses from other sources. Effluent and contaminant capture at the wintering barn.	The improved utilisation of the existing wintering barn.	In the first instance, the losses predicted in OVERSEER® from other sources are over-stated. These losses are not directly to water because of the implementation of the GMP and Mitigations in the preceding two columns. Any potential diffuse discharges will be less than direct discharges, and diffuse discharges are able to be attenuated before then enter the receiving waterbody. As assessed below, 33 % attenuation may occur in the New River Estuary Catchment[41]. Overall the use of the barn will reduce the nutrients entering the soil profile during high risk periods which in turn reduces the nutrients that could potentially be lost past the root zone and does not conversely result in actual increase in losses from other sources. Use of culvert stock crossings avoids the direct entry of faeces, urine and entrained hoof mud to water bodies, which in turn reduces SS loads of particular concern in the receiving waterbodies.
Rearing/grazing of dairy beef cross cows that would have otherwise continued grazing on Piobiare Homestead Limited	Potential displacement of contaminants to another receiving environment, with possible increased nutrients, N, P, Sediment, and *E.coli* have the potential to adversely impact surface water quality in an environment not accounted for in this application.	Not applicable	Not applicable	While the applicant recognises that there are some cows displaced as a result of this proposal, the applicant has no control over those cows to be displaced and therefore an assessment of the effects of that part of the activity is not a matter for consideration of this application. It is outside of the scope of this application.
Grazing of sheep	Possible nutrient loss as a result of sheep grazing.	Not applicable	Not applicable	Sheep grazing is a permitted activity and no parts of the application result in any intensification of that part of the existing land use on Piobiare. The effects of this are negligible and immeasurable.
Intensive winter grazing	Potential for significant amounts of contaminants (N, P, sediment and microbials) to be lost to both surface and groundwater bodies as a result of the complete de-vegetation of pasture/crop, treading damage on soil structure and runoff following rainfall events. Nutrient losses from this activity occur via deep drainage through the soil profile into the underlying aquifer or via	Buffer zones maintained between crop cultivation and critical source areas to provide an area where runoff can be filtered and captured limiting risks of entering water. Grazing direction will be away from buffer zones/critical source areas leaving last bite to provide a buffer zone for nutrient capture	The intensive winter grazing will continue to rotate throughout the dairy platform, so that overall nutrient losses from this area of land is not concentrated to one land area. Fence off areas where stock camp if pasture damage is occurring to limit risks of further pasture damage.	Adverse effects potentially still exist from this activity due to the high level of contaminant losses which occur from intensive winter grazing despite the implementation of GMPs and mitigations. The overall nutrient budget has taken this high contaminant loss activity into account and provided mitigations and reductions in nutrient loss in other areas and activities across the landholding to offset adverse effects to ensure overall nutrient losses are kept to a practical minimum.

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

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
	overland flow into adjacent waterways (Tomopokorau) or artificial drainage channels which rapidly export nutrients Excessive nutrient losses can cause nutrient accumulation in groundwater and excessive nutrient load in waterways causing water quality degradation and the resulting ecological stress on plants and animals when the life-supporting capacity of the water is compromised by excess nutrients. Groundwater and surface water flow from the property is primarily on a south westerly direction.	through until the end of the fodder grazing period. Back fencing and use feeding crates where bales are fed on crop to limit treading damage over already de-vegetated ground. Cultivation of paddocks timed to avoid paddocks sitting bare for long periods of time which reduces risks of contaminant losses through leaching and overland flow. All other GMPs listed in rule 20 will be implemented by May 2019 (except for portable water troughs). Bare soils are cultivated using full cultivation and timed to avoid paddocks siting bare for long periods of time which reduces risks of losses of excess nutrients remaining from the grazing activity to the environment via overland flow and leaching.	Further use of a wintering barn where animals can be housed will ensure that fewer stock will be on paddocks during high risk periods.	The GMPs and the mitigations proposed will mitigate adverse effects of intensive winter grazing. The reduced cropped area will reduce the exposure of stock to crop areas and the risks associated with contaminant loss specific to those areas. The timing of when stock are on crop is May to September. Removing stock from crop paddocks in particular will avoid effects of urine deposition which is one of the key N loss risks for intensive winter grazing. Capturing these nutrients and applying them via the effluent disposal system will ensure that they can be re-used by the soil resource and taken up by plants and not lost to groundwater. Overall, it is the combination of these GMPs and mitigations which will result in the potential effects of the proposal on water quality being avoided (i.e. removing stock off wet paddocks), mitigated (i.e. strategic grazing of CSAs) so that water quality is not degraded at this location and as a result of the proposal. It is considered that not using a portable water trough will not have a significant adverse effect on water quality, because stock graze the furthest parts of the paddocks from any creek first anyway, with the remaining crop acting as a buffer between the fixed troughs (in the middle of the paddock) and any waterbodies. Further, stock have no access to water bodies for drinking purposes, which is the key explanation for why ES require this as a GMP for permitted farming activities under the PSWLP. Furthermore, the permanent water troughs are sufficient as they are located in the middle of the crop paddocks, and so stock will graze away from the troughs at either side, once the crop is grazed first (the side furthest away from a waterbody) the bottom side will be grazed, which stops stock from re-entering grazed land for a prolonged period of time.
Increase in cow numbers across the entire landholding	The grazing of more cows on pasture during high risk periods increases the risk of the leaching of nutrients (N, P and microbials) through the soil profile from urine and dung spots or transported via subsurface drainage.	Use of selective grazing to avoid grazing very wet paddocks during adverse weather conditions to reduce risks of pugging and treading damage to soil structure which can accelerate contaminant losses.	Fence off areas where stock camp if pasture damage is occurring to limit risks of further pasture damage. Strategic grazing.	A reduction in stocking rate in the summer mitigates effects of the small increase in cow numbers on total nutrient losses modelled by Overseer. Adverse effects on the environment adequately mitigated with combination of GMPs and mitigations which have a high level of effectiveness for mitigating risks of grazing cows on pasture.

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
	Pasture damage from cows grazing during adverse periods can result in increased sediment, microbial and P loss if erosion or soil loss occurs from paddocks Increased nutrient losses, as total figures due to more cows, to groundwater and surface water bodies may potentially cause water quality degradation which can cause ecological stresses on aquatic plants and animals from algal growth, temperature increases and eutrophication. Human health concerns can also arise from microbial contamination of waterways upon contact and risks of blue baby syndrome from nitrate accumulation in groundwater and potentially bowel cancer as discussed in section 8.1 above.	Increase the size of feed breaks, during adverse conditions to give animals more of the paddock to graze than the volume of feed required. This is to reduce stocking rate on wet and vulnerable pasture to avoid pugging and treading damage of feed. Use nutrient budgeting to manage nutrient inputs and outputs to guide farm management decisions which can maintain overall nutrient losses at desired level.		
Fertiliser application regime across entire landholding	The application of nutrients in fertiliser has the potential to result in direct nutrient losses to the environment if fertiliser is applied either in excess to plant requirements or at a time when it cannot be utilised for pasture/crop production. Nitrogen losses from fertiliser application is most likely to occur via deep drainage. Phosphorus losses from fertiliser is most likely to occur via soil loss and/or direct loss through runoff or erosion. Adverse effects of inappropriate fertiliser application or excess application include a loss of excess nutrients to water causing water quality degradation in both groundwater and surface water bodies. Water quality degradation can adversely impact aquatic plant and animal ecosystems and impact on human health.	Time N, P, K and S fertiliser application to meet crop and pasture demand using split applications and avoid high risk times of the year i.e. when soil temperature is less than 7 degrees, during drought periods and during periods when soils are at field capacity. Reduce use of P fertiliser where Olsen P values are above agronomic optimum. Maintain Olsen P levels between 20-40. Use nutrient budgeting and annual soil testing to manage nutrient inputs from fertiliser and outputs to guide farm management decisions which can maintain overall nutrient losses at desired level.	Urea applications on all blocks occur using a little and often approach with a reduction in the application rate compared to the baseline scenario. The effluent blocks also receive a reduced rate of N application (deferential applications) across the various applications compared to the current scenario. The total fertiliser nitrogen applied is reduced for non-effluent blocks and for effluent blocks. An overall reduction in fertiliser rate across the entire farm compared to current is proposed.	Overall on average less fertiliser will be applied to all blocks, which is commensurate to the reduced overall stocking rate on farm and less feed to be grown. Adverse effects are both avoided and mitigated with use of GMPs for fertiliser usage and further mitigations to reduce fertiliser across the dairy platform. Fertiliser will be applied to land, and not directly to water which enables the nutrients to be taken up by plants. Overall less fertiliser is applied, fewer nutrients entering the farm system result in fewer nutrients leaving the root zone. Also, the type of fertiliser utilised is appropriate to ensure that as much of the nutrients may be taken up at the appropriate times and over-application does not occur. A lower potential for diffuse discharges of fertiliser nutrients into the receiving environment reduces the risk of the proposal to have significant adverse effects on the environment. Consequently, the effects of fertiliser application have been avoided and mitigated so that degradation of water quality does not occur.
Supplementary feed made on-farm and fed during the winter	Supplementary feed usage has an impact on the pasture production of the farm system and can change the quantity of N particularly in the farm system compared to an all-grass based diet. Low N supplementary feeds can reduce estimated N losses to the environment as less N	N/A		While more stock are carried on farm, no more feed is required as the property already operates with a feed surplus. No imported feed is required, which is likely to have positive effects on the environment in the form of less intensive farming occurring overall.

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
	needs to be supplied to fuel pasture production which in turn can have beneficial effects on water quality by reducing nutrient load in groundwater and surface water bodies.			
Discharge of liquid effluent to land via pods (or equivalent low rate application method) slurry tanker/umbillical to effluent discharge area	The proposal sees an increase in the number of cows housed in the wintering barn, which means more effluent will be generated which needs to be discharged to land. Potential for contaminant losses via all three pathways: leaching (N), artificial drainage (N, P, microbials) and overland flow (N, P, microbials) when nutrients in effluent are applied to land. Potential for contaminant losses to cause excess nutrients in surface water and groundwater bodies in the vicinity of the property, particularly via potential tile drain pathways. In general, excess nutrients result in water quality degradation causing ecological stress for plants and animals.	Effluent will always be applied at a depth less than the soil water deficit which ensures nutrients remain in the root zone to be taken up and utilised by plants for pasture production. Effluent area receiving liquid agricultural effluent is sized to ensure nutrient loadings from the application of effluent are maintained at less than 150 kgN/ha/year to avoid excess nutrient loading. Utilising low rate effluent application (10mm/hr) is appropriate to ensure nutrients in effluent are able to be taken up by plants. Use of deferred storage of effluent to allow effluent to be stored when it is unsafe to apply to land. Use of an umbilical and slurry tanker to discharge larger volumes of effluent to low risk soils (Category D in particular) when soil moisture deficit levels are appropriate to lower storage volume. Buffer zones (of at least 3 m) created from effluent application areas to critical source areas and other sensitive receptors such as bores, property boundaries and dwellings.	No further mitigations are required over and above GMP level as liquid effluent management system is designed to meet best practice by utilising low rate application, deferred storage of effluent and application at a rate less than the soil moisture deficit as guided by the ES soil moisture monitoring sites on the website. The effluent discharge area at 94 ha is large enough to cater for the additional effluent generated by the additional cows and maintain effluent N loadings at less than 150kg N/ha/year.	Adverse effects to the environment from the discharge of effluent should be no more than minor. Effluent application rates, GMPs and the resulting avoidance of effects of effluent application on the receiving environment supported by Policy 42 of the RWP. The discharge of effluent is governed by the consent conditions in the discharge permit giving certainty that the activity will be regulated. The effluent pond is unlikely to over-top as an umbilical can be utilised to empty the pond quickly if need be and as a contingency in the event the pods are unavailable or being repaired. This would avoid significant effects on water quality whereby no direct discharge of effluent to a water body would occur as a result of manging effluent pond volumes.
Slurry effluent application	The nutrient concentration of slurry effluent is higher than liquid effluent due to the lack of dilution from rainwater or washdown water. Due to the higher concentration of	The maximum loading rate of nitrogen from the application of effluent (both slurry and liquid) to land is 150 kg N/ha/year.	Slurry effluent applied to paddocks low in potash (K levels lower than 6-10) and with low Olsen P levels (P levels lower than 25).	Adverse effects to the environment from the discharge of slurry effluent should be no more than minor. Effluent application rates, GMPs and the resulting avoidance of effects supported by Policy 42 of the RWP.

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
	nutrients, application of slurry effluent to land needs to be carefully managed to ensure that nutrient loadings on any particular land area do not exceed the recommended level of 150 kg N/ha/year from effluent. This loading is achieved by ensuring the land area is large enough and the application depth is restricted to 5mm. If nutrient loadings exceed 150 kg N/ha/year or nutrients are applied in excess then there is a risk of contaminant loss (N, P, sediment and microbial) to groundwater and surface water bodies. Adverse effects from contaminant loss to water include water quality degradation which can adversely impact aquatic ecosystems and the overall health of water bodies. Slurry effluent will be applied to areas outside of the liquid discharge area. Slurry effluent is generally considered lower risk to apply to land because it doesn't have the same risks of leaching, overland flow/runoff that purely liquid effluent has.	Slurry effluent is not discharged onto the same area any more frequently than once every two months. Slurry effluent is only discharged to land when soil temperature is greater than 5 degrees in winter and 7 degrees in spring. Effluent will always be applied at a depth less than the soil water deficit which ensures nutrients remain in the root zone to be taken up and utilised by plants for pasture production. Application of effluent in accordance with Policy 42 of the RWPS. Use of deferred storage of effluent to allow effluent to be stored when it is unsafe to apply to land. Buffer zones created from effluent application areas to critical source areas and other sensitive receptors such as bores, property boundaries and dwellings.	Mechanical separation which means that most slurry effluent will actually be discharged as solid effluent which is a permitted activity and incorporated to silage and crop paddocks at cultivation.	The discharge of effluent is governed by the consent conditions in the discharge permit giving certainty that the activity will be regulated. Application of slurry effluent to paddocks low in P and K can act as a capital fertiliser application and bring soil test levels up to agronomical optimum which will increase pasture productivity.
Use of the existing effluent storage facilities on existing dairy support land	If a structure is leaking or not structurally sound there is a risk of contaminant losses directly to shallow groundwater. Contaminant accumulation in groundwater can lead to human health issues such as blue baby syndrome or *E.coli* contamination if drinking water is abstracted nearby. Contaminants may also reach surface water bodies if there is a groundwater/surface water connection which can cause water quality degradation effects such as algal blooms, smothering and eutrophication in surface water bodies.	Monthly/frequent effluent system checks will be undertaken in accordance with the farm's maintenance checklist. 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	The main effluent clay lined storage pond has passed a drop down test in 2019 to confirm that it is not leaking beyond normal operating parameters. The pond also has had written confirmation from a suitably qualified professional that the pond has no visible cracks or defects. (Attachment B) The concrete sump has written confirmation from a suitably qualified professional that it has no visible cracks or defects.	Effluent storage facilities are fit for purpose and leaks are identified through regular testing and checking of the effluent storage structures. Adverse effects from leakage should be avoided or remedied immediately. Furthermore, the use and maintenance of these structures are a permitted activity and therefore the PSWLP projects that the effects of the use and maintenance of these structures are less than minor as they meet the permitted activity conditions.

Activity	Potential effects	Good Management Practices adopted	Mitigations over and above GMPs	Outcome
		All staff involved in the management of the effluent system are fully trained in its use.		
Groundwater abstraction on existing dairy support land	Groundwater abstractions must be at a rate which doesn't cause drawdown effects on adjacent bores which can compromise the availability and reliability of the resource for other users. Groundwater abstractions must be at a level which does not result in an over-allocation of the resource which can adversely impact on drinking water availability, or water availability for commercial and industrial uses. Water use in the dairy shed should be managed to ensure there is little wastage because the more water used, the more effluent generated which needs to be discharged to land. Lack of wellhead protection can result in direct contamination of groundwater which may result in elevated N levels and water that is unsafe for use in the dairy shed and for stock to drink.	Minimal to no water usage in the wintering barn and continued use of a scraper in the barn. Treating cows gently to avoid upset, which enables less water to be used in the barn. Protection of the well head to ensure no nutrients can enter the bore directly to contaminate. Installation of a water meter to ensure that water usage is not excessive.	N/A	No adverse effects on aquifer sustainability or the availability and reliability of water for other users. Groundwater usage is reasonable in terms of end use. Adverse effects should be less than minor.

6.1.4 *Broad Scale/Cumulative Effects Assessment*

Section 6.1.4 makes an overall broad scale assessment of the overall proposal (all components combined) and concludes that based on some specific farm system inputs and the implementation of proposed mitigations/GMPs the proposal will result in a reduction of contaminants in the receiving environments. Further, when considering the specific risks in each catchment. Specifically, for Piobiare the mitigations and GMPs proposed are exemplary (significant investment in effluent management, winter grazing strategies and winter barn infrastructure) and when the Consent Authority are able to set catchment limits, other users in the catchment would be able to look to this property as an example for how they can also contribute to the improved well-being and mauri of the receiving water bodies.

Overall the proposal (modelled losses, and further mitigations proposed over and above that rewarded in OVERSEER®) will have a positive benefit on water quality at the local and catchment level. The improvements in water quality are real but will be difficult to measure at the catchment scale, or even attributed to the proposed changes to this farm system given the huge estuarine catchment area.

At the catchment level, Aqualinc[42] in 2014 estimated that if all farms in the New River Estuary catchment undertook mitigation options on average the New River Estuary would see a reduction in catchment N & P loads by 15 % overall.

Currently there is no capping or restriction on the amount of nutrients "lost" beneath the root zone, or consequently ending up in receiving water bodies (discounting the effects of attenuation and dilution). Under the proposal, the applicant volunteers both an ongoing restriction on the level of nitrogen outputs modelled by OVERSEER® and the ongoing implementation of specific GMPs and mitigation measures. The result of long term restrictions on the applicant as an operator is that they will be unable to further increase their contribution to contaminant load within either of the receiving water catchments. In time, as other operators in the catchment are restricted in the same manner then there is an expectation that overall nutrient loads will reduce which will further improve water quality and could be observed and measured at the catchment scale.

The contribution of this farm system to an overall groundwater quality issue is slight. The property itself is far less intensive in terms of predicted nutrient loading and losses predicted, than the dairy farm for

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

example. Losses beneath the root zone for N are at least three times less on the dairy runoff support than the dairy platform. A more intensive land use in the vicinity of Piobiare potentially causing greater losses beneath the root zone may not meet water quality standards or water quality policies of the PSWLP.

Improvements made under the proposal are likely to reduce total nutrient load and nutrient concentration but in isolation from other farms will only have an extremely small impact on long-term water quality. This highlights the importance of catchment wide implementation of water quality mitigation measures and the ongoing restriction on the applicant's operation in accordance with nutrient output limits to give certainty that water quality will not be further degraded in the long term.

Summary

The proposal will result in a reduction in P, N, sediment and faecal indicator organisms lost to the environment and a concurrent reduction in the resulting concentration of these contaminants in receiving waters, albeit at an extremely low level. The overall effects on water quality will be positive and make a very small contribution to the existing trends of improving water quality at the local scale.

6.1.5 Other effects

Overall the proposal will have positive effects on the environment. The mitigations proposed are not inexpensive and will require ongoing effort to monitor and manage on behalf of the applicant to ensure that they occur as proposed.

Preparation of the application has required significant investment of time and money by the applicant and their advisors. This includes not only a number of site visits, sourcing and verifying all OVERSEER® inputs, testing of the effluent structures and visual inspections plus report writing. The application itself has taken over 12 months to prepare, and the applicant has made concessions in that the proposal represents a viable farm system but does not represent the best return of investment in terms of income. Other farm systems may be more profitable on this same land area but may have greater environmental effect and that does not align with the applicant's values and vision for the property.

The continuation of the existing dairy support runoff block will enable the applicant to continue a sound but relatively secure farming operation, that is as close to a self-contained farm system as possible.

6.1.6 Proposed Consent Conditions

We wish to request the imposition of a form of output-based consent conditions for Aerodrome and look forward to working with the processing officer on these during the processing of the application.

Our intention with this application is that the following is included in the consent conditions:

- Some conditions relating to inputs that give certainty as to the scale of the activities that will occur as proposed within this application are appropriate. A condition that specifies that the proposal occurs in general accordance with this application would suffice. Alternatively (or in addition to) the following input limits could be appropriate:
  - Land area to be used as dairy runoff support;
  - Agricultural effluent discharge area;
  - Peak cow numbers wintered; and
  - Minimum and maximum number of cows in the wintering barn (this restriction ensures that the wintering barn is utilised) or an average number over critical months.
- The requirement to have a FEMP at all times which is updated and reviewed at least on an annual basis, or when material farm system changes occur;
- Agreed output-based consent conditions which are workable, allow for flexibility in farm system and are based around long-term averages. We request that the conditions include a requirement to re-model the farm using OVERSEER for any proposed farm system changes. A baseline nutrient budget may be appropriate and is suggested as follows;

X	(a) The subject land shall only be used in a manner such that when modelled with the current version of OVERSEER, the OVERSEER estimated losses of N to water shall not exceed the Nitrogen Baseline (current combined). The determination of compliance with this condition will be made using the modelled N loss from the most recent reporting year, applied to a four year rolling average, commencing the first season that this consent is given effect to.	This condition essentially provides a compliance limit, which is assessed based on the baseline file provided in the application. The condition ensures that version changes in Overseer are accounted for.

- No P output loss figures limit on the land use consent because of the uncertainty around the OVERSEER® modelling and because as discussed above, mitigations that aren't rewarded in

OVERSEER® are effective at reducing P loss and a consent holder could be held accountable to the implementation of GMPs (as documented in an FEMP). Imposing a requirement to implement these GMPs and mitigation measures is a meaningful and effective way of managing the risk of P loss to water. A GMP such as operating within Olsen P range (more appropriate condition than a P loss limit). The proposed wording ensures that the applicant will not willingly exceed the agronomic optimum Olsen P (and will aim to operate within a range such as 20 – 40 mg/L), but that they are enabled to manage fertiliser on as needs basis. Regular and representative soil testing will ensure that applications of fertiliser match soil requirements.

- Restrictions on the area of land that may be cropped and grazed in-situ;
- The construction and frequent monitoring of a shallow groundwater monitoring bore down gradient of the property;
- Any other consent conditions which relate to the proposed mitigation measures contained in this application, and representative monitoring requirements (i.e. groundwater quality on Piobiare to gain further insight to actual Nitrate nitrogen levels on the property) and the potential risk of surrounding groundwater quality on potential drinking water sources; and

6.2 Use of Land for Wintering Barn

This assessment specifically addresses those matters referred to in Rule 35A(b) of the PSWLP.

Discharge permit AUTH-300998-V1 authorises the discharge of wintering shed effluent from up to 400 cows. The applicant proposes to house up to 440 cows in the barn over winter as an additional 10 % can be housed and stood in the barn when required (better utilising the exiting maximum capacity). The barn will also be used on an as required basis outside of these specified months (and during) if there are adverse weather events that require stock to be housed to protect pasture and soil structure. Land use consent is hereby sought for the use of a feed pad (wintering barn) to house a maximum of 440 cows between 1 May and 30 September, and during adverse weather events outside of these dates.

The barn is constructed of a concreted floor area with rubber mats sited adjacent to a farm-lane that is accessed from Lochiel Branxholme Road. Concrete indoor feeding bins and waterbeds have been constructed within the wintering barn. The wintering barn is roofed.

All effluent produced in the wintering barn is scraped without using water and directed to the effluent storage areas. Stormwater from the roof is not diverted to the pond. Solids are separated via a mechanical separator. More details of the effluent management features (dimensions etc) can be found in the effluent report attached, and Section 2.2.3 above.

The permitted activity criteria have been used below to assess the effects of the use of the wintering barn, but it is noted the activity is discretionary and any number of matters may be assessed.

Table 27: Wintering barn details at each farm

a) The use of land for a feed pad/lot is a permitted activity provided the following conditions are met:				
	Month	Minimum stock	Maximum stock	Average
Stock usage of wintering barn	May	105	440	
	June	400	440	425
	July	400	440	
	August	315	440	
	September	50	440	
Animals do not remain on the feed pad/lot for longer than three continuous months;	The wintering barn is used for longer than 3 continuous months, which does not meet this condition, however the use of the barn for longer than 3 months has significant benefits to the overall farm system as more nutrients can be captured and applied via the effluent disposal system at appropriate times.			
The feed pad/lot is not located: (1) within 50 metres from the nearest sub-surface drain, lake, river (excluding ephemeral rivers), artificial watercourse, modified watercourse, natural wetland, or another feed pad/lot on the same landholding; or	The wintering barn is located approx. 130 m from the nearest watercourse (Tomoporakau Stream). There are sub-surface drains throughout the property, but the exact locations of these is not known. Notwithstanding proximity all effluent and contaminants are captured at the source and there is very little risk of any direct discharges to these identified receiving areas.			
(2) within a microbial health protection zone of a drinking water supply site identified in Appendix J, or where no such zone is identified, then within 250 metres of the	The wintering barn is not sited within a microbial health protection zone or drinking water supply identified in Appendix J. The use of the wintering barn will reduce potential effects on groundwater drinking supplies as less N may be lost beneath the root zone			

abstraction point of a drinking water supply site identified in Appendix J; or	in the form or urine patches that would otherwise occur if all stock were grazing crop during the winter months. This has positive effects in terms of any potential potable water supplies.
(3) within 200 metres of a place of general assembly or dwelling not located on the same landholding, or (4) within 20 metres of the boundary of any other landholding; or	The wintering barn is sited well over 250m of any general assembly, dwelling not located on the same landholding, or property boundary. There have been no known complaints by neighbouring property owners, the operation is tidy and odour effects are nil beyond the property boundary.
(5) within a critical source area;	The wintering barn is not sited within a critical source area, all contaminants are captured from this area and discharged to land via the effluent disposal system proposed.
(iv) the feed pad/lot is constructed with: (1) a sealed and impermeable base and any liquid animal effluent or stormwater containing animal effluent discharging from the feed pad/lot is collected in a sealed animal effluent storage system authorised under Rule 32B or Rule 32D; or (2) a minimum depth of 500 millimetres of wood-based material (bark, sawdust or chip) across the base of the feed pad/lot; and	The wintering barn is constructed of concrete, a sealed and impermeable base. Effluent collected at the wintering barn is directed to the main effluent system. Effluent discharge from this source is to be authorised by way of consent (subject to approval). The existing pond has been drop-tested and is therefore authorised under Rule 32B.
(v) any material scraped from the feed pad/lot, including solid animal effluent, is collected and if applied to land is applied in accordance with Rule 38; and	Effluent is scraped from the bunkers without using water and solids are separated via a mechanical separator. Liquid effluent is stored in the effluent storage pond. Separated solids are applied to land in accordance with Rule 38 (such as those separated via the screw press) and the conditions of the Discharge Permit (when the pond or sumps are de-sludged/emptied) applied for.

(vi) the overland flow of stormwater or surface runoff from surrounding land is prevented from entering the feed pad/lot.	The winter barn has walls that prevent the stormwater from entering the barn, there are no areas which drain towards the barn as the surrounding land is generally of lower elevation than the barn.

6.2.1 Positive Effects of the Wintering Barn

The extended use of the wintering barn has significant positive benefits to the overall farm system as more stock are housed inside during the shoulders of the season. The increase in capacity means that more stock can be brought off paddocks, and the provision for 'adverse weather events' means that even more contaminant losses can be avoided during extreme weather events.

The nutrient budgets assume a percentage of stock housed in the barn on average, and when the applicant can house the maximum number proposed in the barn, then the actual losses will be less than those predicted (which has made a conservative assessment of stock in the barn as a worst case scenario).

The attached wintering barn calculations show that the effluent infrastructure is sufficiently sized to store the increased effluent generated at the wintering barn.

Restricting the number of cows housed in the wintering barn to a minimum and maximum number of cows in effect controls the number of cows wintered outside. This enables the wintering barn to be fully utilised so as to prevent damage to soil structure from winter grazing on crop. The use of the wintering barn in the shoulder seasons and other times of the year outside of these months during adverse weather events further avoids damage to pasture when soils are saturated and reduces the amount of pugging that can occur from winter grazing.

From an economic and wellbeing perspective, the use of the wintering barn will also be beneficial to cow health, as cows are fed supplementary feed during their stay in the barn. Ensuring that cows are well-fed will mean that they can meet weight targets and maintain optimum condition throughout the winter season, and in preparation for calving when moved back to Aerodrome. When cows are at appropriate weights and in good condition, milk production is likely to increase and meet production targets, thereby allowing the applicants to operate with a viable business.

There are no known adverse effects from the ongoing operation of the wintering barn. This is because the barn sited at Piobiare is appropriately designed to ensure that all effluent from the barn is treated in the effluent storage facilities, which are sufficiently sized to allow for deferred storage of effluent generated at the barn.

6.3 Discharge of Agricultural Effluent

This assessment of environmental effects (AEE) describes the risks to the environment resulting from the proposed discharge of wintering barn effluent to land from the proposed increase in cows housed in the barn, from consented numbers up to the proposed 440 cows. The assessment specifically addresses those matters referred to in Rules 5.4.6 of the RELAP and 35(c) of the PSWLP.

The key contaminant pathway on Piobiare is deep drainage via freer draining soils, and tile drains where these exist.

6.3.1 Application Rate/Depth/Timing

Liquid effluent is currently authorised to be discharged via travelling irrigator and low rate pods. Upon the granting of consent, effluent will be applied to land primarily using an umbilical or pods (or equivalent low rate irrigation method). Liquid effluent and slurry will be applied to land using an umbillical. Proposed application rates are:

- Umbilical: Maximum depth per application of 10 mm;
- Slurry tanker: 5 mm maximum depth per application; and
- Low rate pods: Maximum application rate 10mm/hr and maximum 12mm depth per application.

The proposed pod irrigation depth of up to 12 mm is appropriate given the EFFLUENT classification of the soil types on the property, which are classified as Category A (artificial drainage or coarse soil structure) and Category D (well drained flat land). The proposed application rate of 10 mm/hour is appropriate given that the proposed irrigation method (using low rate pods or equivalent low rate application method) allows the applicant to utilise another effluent method that is low rate, while not having an adverse environmental effect.

Some of the benefits of using low rate pods are:

- Low application depths and rates;
- Good even spread;
- Can irrigate on one side - great for sidlings or in close proximity to drains;
- Ability to be used in a stationary position if required.

Effluent applications will be timed so that high risk periods such as winter and the shoulders of the season are avoided. 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[43], 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. 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 effluent disposal. The applicant keeps records of all effluent applications in a diary.

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.

6.3.2 Storage

Deferred effluent storage at the farm will consist of the clay lined pond primarily. Liquid effluent will be stored in the 2,945 m^3 clay lined effluent storage pond. Liquid effluent is comprised of effluent generated at the wintering barn from up to 440 cows which is able to be used between 1 May and 30 September.

The intermediary effluent storage areas including the concrete sump and bunker provide a buffer in the event of pump failure at the effluent pond. The pond and other areas have been assessed as low risk for continued effluent storage due to visual inspections and pond drop tests.

Sufficient storage is available to enable deferred application of effluent.

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[43] 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

6.3.3 Disposal Area

The effluent discharge area will be 94 ha which represents an increase to the existing discharge areas approved under current discharge permit AUTH-300998-V1. This is because the current discharge permit authorises effluent to be spread on land that no longer forms part of the farm boundary and as such alternate areas have been proposed to maintain the same disposal area. A total disposal area of 94 ha provides a disposal area to stock ratio of 21.3 ha per 100 cows, which is greater than the recommendation of 4 ha/100 cows. Overseer nutrient budget scenario reports state that 150ha is required to maintain N loading at less than 150 kg N/ha/year from liquid effluent.

Effluent will be applied to land when soil conditions permit safe application. 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.

6.3.4 Effects on Water Quality from Effluent Disposal

As determined by the nutrient budget effluent disposal on farm does not pose a significant water quality risk. Depths are low, and estimated N loading and N in drainage within effluent disposal blocks are not significant. While at the block scale for Piobiare, effluent blocks predict greater N losses to water, this is due to the difference in the modelling area (90.8 ha) and the proposed actual area (94 ha), plus the model assumes that all effluent is emptied from the pond over a two month period only. In future the applicant will spread effluent over time when conditions are suitable. The applicant currently contracts an umbilical but will reduce their reliance on contractors in future to reduce costs and investigate utilising pod irrigation more frequently, which results in lower volumes being able to be spread but over a greater time period which will mitigate the potential effects of effluent application by sole reliance on an umbilical only.

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.

Overall the effects of effluent disposal would be immeasurable on their own and any increase in nutrients in groundwater couldn't be attributed to effluent applications alone, given the proposed and surrounding land uses. Notwithstanding this, the effects of localised block losses are mitigated by other farm system changes at the farm scale elsewhere. Which means that cumulatively the overall activity will result in lower N losses beneath the root zone, and hence lower potential for environmental degradation as a result of N loading.

6.3.5 Odour

The effects of odour are most likely to occur from the discharge of effluent. The effluent pond is located approximately 261 metres from the property boundary and approximately 309 metres from the nearest dwelling outside the property boundary. The physical location of the effluent infrastructure coupled with the proposed low application rate irrigation and effluent discharge buffers means there is no significant risk of adverse effects from odour and spray drift on surrounding landowners and occupiers. As such, the effects of odour are avoided.

6.3.6 Contingency Plans

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

While umbilical will be the primary method of application of effluent, it can also be used at any time as a contingency. Also, a slurry tanker may be used for shifting small volumes of effluent. Any discharges from the slurry tanker must adhere to the rate and depth limits imposed on the consent.

An umbilical when in use is constantly monitored and is stopped manually if there any issues arise.

6.3.7 Monitoring

Surface water quality monitoring from watercourses is a condition of consent under existing discharge permit AUTH-3009980-V1.

Whilst the current consent requires infrequent monitoring of surface water that may be affected by the discharge activity, ES have since identified that infrequent sampling at inconsistent locations, cannot adequately determine what impact, if any, the activity is having on surface water. Given that the EFFLUENT disposal area is located within the Gleyed and Oxidising physiographic zones, the key contaminant pathway is deep drainage to groundwater and artificial drainage. This means that surface water is likely to be the critical receiving environment for contaminants. However, water quality monitoring of waterways located at the property will not provide any meaningful information about the effects of the effluent disposal on surface water quality primarily because of the lack of a control site. Surface water sampling has only been effective in confirming the impact of gross pollution incidents for compliance purposes. Surface water monitoring of watercourses should not, therefore, be imposed as a monitoring condition on the replacement discharge consent.

In response to the identified levels of Nitrate Nitrogen in surrounding shallow groundwater, a monitoring bore may be more appropriate for this property, but that it is noted monitoring of groundwater would seek to measure any effects of the overall proposal on groundwater quality and not just effluent disposal.

7. 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*

Many of the effects of the proposal already form part of the existing environment, and the applicant seeks to reduce environmental effects by reducing nutrient loading overall, and sediment and *E.coli* contamination risks. 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.

For Piobiare, the property is located within an established rural neighbourhood and surrounded entirely by other farming or farming related activities. Aerodrome is surrounded by rural lifestyle land uses mostly, and that neighbourhood will have an existing tolerance for farming based on the existing activities. It is not considered that the proposal will result in increased on intensified reverse sensitivity particularly as the expansion is further away from Invercargill and most lifestyle blocks, and overall will reduce their environmental effects. The property is barely discernible from the road and has a pleasing visual appearance (well looked after) to passers-by or neighbours.

The proposals will result in net positive benefits to the wider communities 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.

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

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

In terms of landscape and visual effects, the presence of effluent irrigation, other farming equipment and cows is expected within the rural locality and established at Aerodrome on the fringes of the city boundary. Much of Invercargill's city boundary is bound by farms and farming activities, and there are two more dairy farms southwest of the property closer to Invercargill. The proposal will not have any significant physical effects on the locality over and above that currently experienced and will not encroach on rural lifestyle uses, particularly with the maintained silage block buffer between a few residences and the conversion from one established rural land use to another on the new block.

The physical effects of land conversion are permitted to occur including re-grassing, fencing and lane installation. These will all be completed in a manner that reflects the existing high standard of 'tidiness' on farm.

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

The dairy farm and dairy support runoff are located within a highly modified ecological landscape and the proposal will not have any significant adverse effects on ecosystems above that which has been occurring for many decades. The reduced environmental footprint in terms of contaminant losses to water

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 and dairy support runoff 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 and dairy support runoff 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. Effluent storage, treatment and application observes appropriate buffers from dwellings and places of assembly so that the effects of noise and odour are avoided. Diffuse discharges will be less than those currently consented to occur (and existing) overall, and wetland installation and continued sediment trap usage will ensure that these may be treated as far as reasonably practicable by the applicant. For Piobiare, the activity is in keeping with the rural nature of the area; therefore, it is not considered there will be any unreasonable emission of noise or odour. While the wintering barn will house more cows, it is a sufficient distance from other dwellings and places of assembly to not cause unreasonable nuisance in this environment.

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 Dis9trict 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. The proposal will not exacerbate an existing flood risk as identified on Aerodrome and all significant infrastructure, like the dairy shed, calving pad and effluent pond are located above the natural creek level and terrace. The applicant would be required to contact Environment Southland in any emergency immediately, as is a standard condition of consent.

7.1 Assessment of Alternatives

Schedule 4 of the RMA 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 effluent only.

Method of Discharge

Deferred irrigation methods will be utilised on the properties to ensure that effluent is only applied when conditions are suitable. Effluent is treated either via mechanical separator or weeping wall separation. 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 EFFLUENT 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 environments are the most suitable for managing the effluent generated at both farms.

7.2 Positive Effects

The Region is facing much greater and wider water quality issues that cannot be solved off the back of one consent application. However, one farm system change can make a reasonable contribution to maintaining and improving water quality as we have demonstrated is the case for this application.

Overall the proposal sees on farm improvements at both landholdings implemented which aligns with Council policies and objectives. The applicants are forward thinking and the proposal will enable them to make environmental improvements and subject to appropriate conditions of consent continue to operate a dairy farm and dairy support block into the future, where they can implement adaptive management techniques to respond to environmental and market pressures.

The proposal forms part of the NZ dairy sector, and growth in the dairy sector will have benefits for the New Zealand economy. Further, on farm improvements and investment in environmental mitigations means that the products produced and exported globally could be sold at an above market price which could respond to the global markets value of sustainable, grass fed milk products (assumed).

As well as positive environmental effects to seek to maintain the life-supporting capacity of freshwater, the proposal also enables the social and economic well-being of the applicants, their employees and the wider communities they support.

7.3 Summary of Assessment of Environmental Effects

Summary of key points in relation to how the proposed activities will be managed on the sites:

Aerodrome:

- There is a thorough understanding of the land in terms of terrain, and soil type, critical source areas, key contaminant pathways and the risks associated with them;
- Farming practices are modern and have benefited from significant investment in infrastructure and staff knowledge;
- The systems for collection and discharge of effluent are modern and over-specified in terms of capacity to provide a buffer for managing unforeseen events;
- Methods of effluent management are adaptable and tailored to the environment and weather conditions in which it occurs;
- GMPs and proposed mitigations are well considered and are at the core of how the farming operations are managed (they are factored into the day-to-day management and decisions on the property at all times);
- Sediment (P, *E,Coli)* and runoff are acknowledged as being a high risk for contaminant pathways and have been allowed for in design of laneways, stream crossings and fencing of waterways along with additional measures for management of sediment such as the proposed wetland (and others);
- N leaching via deep drainage are acknowledged as being high risk for contaminant pathways and has been considered in terms of farming inputs (reduced stocking rate, standing off, on/off grazing, wintering practices and strategic grazing) and edge of field remediation (such as wetlands and sediment ponds);

- Artificial drainage is also acknowledged as being high risk for contaminant pathways and has been considered in terms of farming inputs/management and mitigations proposed, and remedial edge of field treatment;
- Despite the expansion it has been calculated that overall the discharges from the operation will be less than under the current regime;
- The way the property is managed sets a good example for others in the area; and
- Use of a Farm Environmental Management Plan is the best means available to the applicant to manage their farm and the environmental effects of the farming activities proposed.

Piobiare:

- As above with the addition of…
- There is a clear recognition of the risks involved with winter grazing and significant investment has been made into managing this better with the wintering shed and associated effluent treatment system; and
- Managing the wintering property exclusively provides the operators with a high level of control over the activities on the property which allows them to better manage operations on and between sites.

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 or the construction of a new effluent pond.

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 the existing environment) are proposed.

8. 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.

8.1 Part 2 of the RMA

Part 2 of the RMA states the general purpose to the Act which is to promote the sustainable management of natural and physical resources. Sustainable management is explained to mean managing the use, development, and protection of natural and physical resources in a way which enables people and their communities to provide for their economic social and cultural wellbeing while sustaining the reasonably foreseeable needs of future generations, or on the life-supporting capacity of the environment and any ecosystems associated with it and avoiding remedying and mitigating adverse effects on the environment.

The proposal is for a farming activity which utilises natural resources. The continuation of the activity as proposed will enable the applicant to provide for their economic and social wellbeing, and that of the immediate small Southland community and the wider regional economy in which it operates. The applicant has described that potential adverse effects of the proposal may exist, however they consider that these adverse effects have been adequately identified and assessed as able to be avoided, remedied and mitigated under their proposal.

Section 6 of the RMA requires consideration of several matters of natural importance. The matters specifically relevant to this proposal include:

- The preservation of the natural character of the coastal environment, wetlands, and lakes and rivers and their margins and the protection of them from inappropriate subdivision, use and development
- The relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu and other taonga

The proposed activities will not impact directly on the coastal environment, wetlands, lake and rivers however there is the potential for water quality effects on the wider receiving environment which includes these features. The applicants assessment of environmental effects identifies potential effects on these receiving water bodies and provides appropriate and adequate mitigation measures to avoid adverse effects. The applicant acknowledges Maori have a long history and relationship with the area and consider that their proposal will not compromise or have an adverse impact on Maori culture, traditions or taonga.

Section 7 lists matters which all persons shall have regard to. This application has given particular regard to the efficient use and development of natural resources, intrinsic values of ecosystems and the maintenance and enhancement of the quality of the environment. The proposed activity is not inconsistent with the principles of the Treaty of Waitangi as required by Section 8.

Overall, the activity is considered to be consistent with Part 2 of the RMA, given the incorporation of proposed mitigations for the activity.

8.2 Section 104(1) of the RMA

The remaining matters of Section 104(1) to be considered when assessing an application for a resource consent are as follows:

(a) any actual and potential effects on the environment of allowing the activity; and

(b) any relevant provisions of:

- *(i) a national environmental standard;*
- *(ii) other regulations;*
- *(iii) a national Policy statement;*
- *(iv) a New Zealand coastal Policy statement;*
- *(v) a regional Policy statement or proposed regional Policy statement;*
- *(vi) a plan or proposed plan; and*

(c) any other matter the consent authority considers relevant and reasonably necessary to determine the application.

8.2.1 Environmental Effects

The actual and potential environmental effects of the proposed activities were considered in Sections 5 and 6 of this report. Proposed conditions of consent will ensure that any adverse effects are avoided, remedied or mitigated.

8.2.2 Section 104(1)(b) of the Act

For ease, policies from these documents listed in 104(1)(b) above, have been grouped together under subjects relevant to this application. The most relevant objectives and policies to this application have been selected, with particular weighting and consideration given to the policies contained with the Proposed Southland Water and Land Plan 2018 (PSWLP). The PSWLP is currently under appeal but we trust that the PSWLP has considered all of the other planning documents in its development. For this reason, a higher level of assessment is provided for the policies it contains. There are no other policies within the RELAP or RWPS that are significantly contrary to those in the PSWLP, therefore we consider this assessment to also be relevant for those planning documents.

The policy assessment below is structured for ease of assessment only. The PSWLP does not direct certain policies to have more weight than others, however some policies may be more relevant to one proposal than another. The policies that are most relevant (of all policies in the PSWLP) are water quantity, water quality, land use change and discharge activities. There are also some miscellaneous policies which have not been grouped below but that are still relevant. We note that the proposal is for a discretionary activity and as such while there is a wide variety of matters that may be considered in assessing the effects of the proposal, an application does not need to demonstrate full compliance with every policy in the PSWLP in order for the purpose of the act to be achieved and for Council to grant consent. ***A decision maker need only have regard to the policies in their decision making process.*** On balance, the proposal meets the objectives of the PSWLP and RWPS in maintaining and improving water quality, even though some policies cannot be met.

8.2.2.1 Water Quantity

Regulatory Document	Particularly relevant Sections
National Policy Statement for Freshwater Management	Objective B5 Policies B1, B2, B4, B7, B8
Southland Regional Policy Statement	Policy WQUAN.3, WQUAN.6, WQUAN.7
Regional Water Plan for Southland	Policy 21, 28
Proposed Southland Water and Land Plan	Policy 20, 21, 22, 23
Te Tangi a Tauira	Section 3.5.14 Policies 4, 16

These objectives and policies set a clear direction that freshwater needs to be allocated to safeguard the life supporting capacity of freshwater ecosystems whilst still enabling communities to provide for their economic well-being. The policies of particular relevance from the Southland Policy Statement relate to ensuring that the volume of water abstracted is needed for a particular use and is allocated to it. In this instance, the groundwater abstractions are required for dairy farming purposes and are set at a quantity which is suitable for the intended end use based on nutritional requirements of dairy cows and the infrastructure setup at the dairy sheds. This notion is supported by policy 21 of the RWPS. This application is consistent with Policy 28 of the PSWLP and Policy 21 of the RWPS as effects on aquifer storage volumes, existing water users, surface water flows and groundwater quality will not be adversely affected due to the proposed decrease in water quantity sought by the applicant. The proposal is consistent with all water quantity policies in Te Tanga a Tauira specifically Policy 4 preferring groundwater abstractions and policy 16 requiring monitoring devices which either have been or will be installed.

8.2.2.2 Land use change

Regulatory Document	Particularly relevant Sections
Southland Regional Policy Statement	Objectives RURAL.1, RURAL.2 Policies RURAL.1, RURAL.2,
Proposed Southland Water and Land Plan	Policies 13, 6, 10, 11 and 16
Te Tangi a Tauira	Section 3.5.7, 3,5,13

Policies 6, 10, 11, 13 and 16 of the PSWLP have equal weighting, and the proposal achieves the intent of each of these.

The proposal represents a sustainable farming operation. Through nutrient modelling the applicants have demonstrated that real reductions in nutrients can be achieved whilst enhancing the productive capacity of each of the landholdings, providing for the economic and social well-being of the applicants and the communities it supports. ***The proposal is consistent with the objectives and policies in the SRPS and Policy 13 of the PSWLP by supporting the sustainable use and development of rural land resources, both environmentally and economically, if undertaken in the manner as proposed.***

The properties are contained within the Gleyed and Oxidising zones primarily, with a small area of Peat Wetlands located on Aerodrome Farm limited. Policy 6, 10 and 11 all require the implementation of good management practices to manage adverse effects on water quality via the various potential contaminant pathways. Sections 5.1 and 6.1 assess each activity, individually and cumulatively, and proposes GMPs and mitigations (where appropriate) to mitigate, remedy and/or avoid effects of the activities on water quality. These GMPs and mitigations are proposed to be implemented by way of Farm Environmental Management Plans. Genuine attention and thought has been given to the potential adverse effects of the proposal on water quality, in the context of the most likely contaminant pathways. Contaminant pathways are most likely to be deep drainage, which are associated within the oxidising physiographic zone and artificial drainage, where these tile drains are known to exist. The proposal has made an assessment of the effects and modelled the proposal via OVERSEER® modelling which assigns likely percentages of tile drained areas but does not align management blocks with physiographic zones, rather blocks have been developed relative to soils, and the risks associated with different contaminant losses assessed specific to the soils modelled. Point 3 of Policy 10 and Policy 11 direct a decision maker to generally not grant resource consent for additional dairy farming of cows or additional intensive winter grazing where contaminant losses will increase as a result of the proposed activity. Contaminant losses will not reduce overall as a result of the proposal as demonstrated by the farm system changes in the nutrient modelling, and as a result of further mitigations that cannot be rewarded in OVERSEER® such as wetland construction. The effect overall is for no increase in nutrient losses and actual reductions in contaminant losses which can be achieved at the farm scale. Therefore, the proposal meets the intent of policies 6, 10 and 11.

Policy 16.1 requires the minimisation of adverse environmental effects from farming activities as a priority. ***Part (a) does not apply*** as there are no sensitive waterbodies identified in Appendix A in close proximity to the proposal. Furthermore, policy 16.1 (a) only refers to new dairy farming of cows and new intensive winter grazing, the proposal seeks changes to the existing dairy farming and winter grazing activities only.

Part (b) of the policy states that prior to limit setting dairy farming and intensive winter grazing shouldn't be granted where adverse effects ***including cumulatively*** cannot be avoided or mitigated. The assessments above have extensively demonstrated that the effects have been avoided or mitigated. Existing water quality is not degraded to the point of being over-allocated, with some indications showing an improvement overtime. The groundwater samples of two isolated bores in proximity to Piobiare in particular, do not indicate an overall status of over-allocated groundwater water quality and the sampling method and appropriateness at these sites is under question for its accuracy. Inaccurate or mis-represented sampling data cannot be used to conclude that water quality is over-allocated. Furthermore, water quality limits have not been set meaning that an assessment against this part of the policy cannot be made in a complete sense.

The likely water quality at Aerodrome has been assessed against Appendix E standards and the ANZECC guidelines as far as reasonably practicable. The ***Waikiwi Stream at North Road monitoring site*** doesn't meet all of the ANZECC trigger values, and of the Appendix E standards monitored by ES, surface water quality at this site doesn't meet DO and there is a possible natural cause for marginally lower pH in this catchment. All upstream land uses influence these water quality results sampled and the proposal sees reductions in N and P lost beneath the root zone at the farm scale, as well as *E. coli* and sediment losses, which will improve water quality at this monitoring site (all things remaining the same). The installation of wetlands and continued use of sediment ponds/traps, and riparian planting/stock exclusions, and all other relevant GMPs/mitigations cumulatively if implemented elsewhere in this catchment would see water quality samples that meet set standards.

The likely water quality at Piobiare has been assessed against Appendix E standards and the ANZECC guidelines as far as reasonably practicable. The ***Makarewa River Wallacetown Monitoring Site*** doesn't meet all of the ANZECC trigger values, and of the Appendix E standards monitored by ES, surface water quality at this site doesn't meet DO, but does meet pH and water temperature. All upstream land uses influence these water quality results sampled and the proposal sees overall reductions in N and P lost beneath the root zone, as well as *E.coli* and sediment losses, which will improve water quality in the vicinity of the proposal but will immeasurable at this site due to its upstream location of the confluence.

Policy 16.1(b)(iii) is intended to make sure that consent for activities that will have the effect of worsening water quality (as defined by a set of measured standards) should not be granted. The dairy expansion and dairy support runoff activities proposed will not worsen water quality. It could be argued that compliance with point (b)(iii) is not intended to apply to a proposal where water quality will improve. Where a plan is deficient, assessment against high order matters can be made. The proposal is consistent with objectives A1 – A4 of the NPSFWM which are broader to enable water quality to be maintained and improved in anyway, not only in the ways specified by a regional council in a regional plan. Furthermore, the water quality standards set in the PSWLP are so simplistic that they do not adequately correspond with the NPSFWM standards, and not all these standards are even sampled for by the regional council. Irrespective of this, an application need not demonstrate full compliance with all or any policy in a plan, and we have given regard to all relevant policies in this assessment.

Both landholdings will implement farm environmental management plans which will be generally in accordance with Appendix N. The obvious exception is the requirement for portable troughs which are not necessary (i.e. when on/off grazing) or not used on Piobiare (for the reasons outlined elsewhere). GMPs and mitigations are most effective at the farm scale if they are targeted to the risk areas, in this instance for Piobiare and Aerodrome the effects of stock drinking from a stationary trough in a crop paddock are mitigated by on-off grazing, back fencing, buffer zones between waterbodies and grazed areas, and the implementation of strategic grazing on farm. For these reasons portable troughs are unnecessary on Piobiare. We believe the applicants meet the intention of implementing FEMPs and hence part 2 of Policy 16. Sediment run-off is managed to a level that it is low risk for the farm system proposed. The plans contained within the FEMPs identify the critical source areas on the landholdings and describes how they will be managed to minimise nutrient losses at these points.

Council can grant one land use consent for farming at each site (two consents total) which are subject to the conditions proposed above in Sections 5.1.6 and 6.1.6. Later in this report there is a specific assessment relating to the appropriate consent duration for a proposal of this nature and scale. At least 12 years is appropriate.

8.2.2.3 Water Quality

Regulatory Document	Particularly relevant Sections
Southland Regional Policy Statement	Objectives WQUAL.1, WQUAL.2 Policies WQUAL, 1, 2, 5, 7, 8
Proposed Southland Water and Land Plan	Policy A4 of NPS Objective 8 Policies 15A 15B
Te Tangi a Tauira	Section 3.5.13

Objective WQUAL.1 is of significant relevance to the proposal as it sets the water quality framework for the management of water quality in Southland. This objective requires four primary things:

- The life supporting capacity of water and related ecosystems is safeguarded;
- The health of people and communities is safeguarded;
- Water quality is maintained or improved in accordance with the National Policy Statement for Freshwater Management 2014; and
- Freshwater quality is managed to meet the reasonably foreseeable social, economic and cultural needs of future generations.

Overall the policies direct a ‘holding the line’ approach to water quality where further degradation of water quality (except due to natural causes) would be contrary to the PSWLP, SRPS, NPSFWM and Te Tangi a Tauira.

The assessments above and attached technical comment confirm that the contribution of these properties to water quality at the catchment scale is de-minimis, and highly unlikely to be measured at the catchment scale, or current ES monitoring sites. The technical comment concludes that current water quality does not meet all standards of Appendix E, where ES have monitored these. We do however note that Longfin eel, Big nose galaxias, Koura, and a number of Bullies have been surveyed in the Myross Creek, and the applicant confirms that they often see fish in their creeks (Myross and Waikiwi) including large brown trout, koura and eels.

ES do not monitor sediment at the nearest surface water monitoring locations, and the Appendix C ANZECC sediment guidelines are 'recommended' only.

The proposal adopts a variety of measures which either avoid or mitigate against adverse effects on water quality which are described in detail earlier. For example, the use of a wintering shed avoids direct deposition of nutrients in dung and urine to land during the winter period. The use of a calving pad avoids direct deposition of nutrients in dung and urine to land during calving. The implementation of a fertiliser regime that uses partial substitution of fertiliser with effluent and a little and often approach mitigates the effects of nutrient losses particularly through deep drainage processes. GMPs in relation to riparian management, laneway runoff and CSA management mitigates the effects of nutrient losses directly to surface water bodies. The proposal will not exacerbate the exceedance of the Appendix E standards and will not worsen groundwater quality particularly in the vicinity of Piobiare.

8.2.2.4 Effluent discharge

Regulatory Document	Particularly relevant Sections
Southland Regional Policy Statement	Objectives WQUAL.1, Policies WQUAL.8, WQUAL.10
Proposed Southland Water and Land Plan	Policies, 13, 14 and 17
Te Tangi a Tauira	Section 3.5.1

Policies throughout the relevant planning documents stress a preference for the discharge of contaminants to land as it creates less environmental effects, enables an effective and efficient re-use of a waste product and protects cultural values as described in Te Tangi a Tauira. The management of effluent in the proposal meets best practice and is designed to completely avoid any surface runoff, overland flow, ponding, contamination of water via subsurface drainage channels, deep drainage or overland flow from the application of effluent to land. The lands which will be receiving effluent has been considered suitable and the discharge areas are sized appropriately to lower overall nutrient loads from the application of effluent.

The effluent discharge activities will continue for the duration of the consents in the manner in which they have been described in the application. The proposal enables the applicants, their staff and the communities they support to provide for their economic and social wellbeing.

8.2.2.5 Tangata Whenua

Regulatory Document	Particularly relevant Sections
Southland Regional Policy Statement	Policies TW.3, TW.4
Proposed Southland Water and Land Plan	Policy 1, 2, 3
Te Tangi a Tauira	Entire document

The Southland Regional Policy Statement describes the resource management issues important to Ngai Tahu in the Southland region and includes ensuring tangata whenua is considered in decision making, iwi management plans are recognised, taonga and sites of special significance are protected and food gathering resources are protected. Te Tangi a Tauira is the iwi management plan recognised by Ngāi Tahu which encompasses the Southland region. Policies TW.3 and Policy 2 of the PSWLP require iwi management plans to be taken into account.

This proposal includes activities which are contained within the Aerodrome Farm and Piobiare property boundaries and should not materially impact on tangata whenua values or compromise sites of special significance or food gathering sites. The cumulative effects assessment concludes that any effects felt outside the boundary of the property will not degrade water quality and not impact on cultural values such as mahinga kai.

In addition, the application provides for the following in accordance with Te tangi a tauira:

- The provision of buffer zones to water abstraction sites and waterways;
- The application of effluent is to land rather than water;
- The applicant already adopts best practice for land application of managing farm effluent;
- The existing riparian margins are protected;
- Deferred application of EFFLUENT is provided for;
- Nutrient loading from effluent discharges to land is already within industry best practice limits;
- The system and management practices are considered appropriate for the risks associated with the receiving environment;
- Water abstraction is monitored with metering results to be submitted to Council;
- Regarding Policies 3.5.14.17 and 3.5.1.17, the consent periods proposed are less than 25 years.

8.2.2.6 Other Matters

Other objectives and policies of the PSWLP not directly addressed above but relevant to the proposal include:

Objectives: 1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 13A, 14, 15, 16 and 18
Policies: 18, 34, 37, 39, 40, 41, and 42.

The proposal either meets or is not contrary to the objectives listed above. The water and land resource is an enabler of primary production which is the 'back bone' for the Southland economy with the fertility and versatility of the soil resource to be improved on the new block. Overall, water quality will not be degraded as a result of the proposal. All activities proposed will operate in accordance with GMPs or better and this can be monitored through the imposition of conditions of consent requiring a FEMP for each property.

All stock are excluded from waterbodies, with the exception of sheep on Piobiare which graze the verge next to the Tomopokorau Creek. The new wetland on Aerodrome will be in accordance with Policy 34, and the importance of wetlands is recognised, particularly their water quality improving potential. The proposal will enable the applicant to buffer the effects of climate change on their business.

All effects of the permitted and consented activities have been assessed. The effects have been assessed in terms of the actual existing environment, not the consented (i.e. 800 peak milked cows) nor permitted baseline (i.e. 15% of the landholding where intensive winter grazing may occur). This is a far more accurate baseline from which to assess the activities, and so whilst regard to Policy 39 must be had, council should not consider all adverse effects of the proposal as if the existing land and water were natural state (which is the current ES interpretation of Policy 39). The proposed activities have been assessed in their entirety against the actual existing environment, because that represents the actual effect of any changes beyond that which has ***lawfully been occurring and forms the existing environment.***

Consent duration is addressed in Section 9 below in accordance with Policy 40 of the PSWLP.

Overall, the proposal is low risk in terms of environmental effect or risk of degrading the environment. Groundwater quality monitoring would be suitable at Piobiare, due to the apparent observed groundwater quality results. The effects of the proposal on water quality are not significant or catastrophic. Therefore, we would expect monitoring to be representative and match the scale of effects proposed in this application. We also note that Section 104(2) of the RMA outlines that Council *"may disregard an adverse effect of the activity on the environment if a national environmental standard or the plan permits an activity with that effect".*

The proposal is consistent with policy 42.

8.3 Section 104(1)(c)

Section 104(1)(c) outlines that the decision maker must have regard to 'a*ny other matter the consent authority considers relevant and reasonably necessary to determine the application'*.

The value of existing investment is a matter we believe is relevant and reasonably necessary to determine the application. The established land uses at both landholdings afford land values in the order of $6 to $15 million dollars. On top of the land values, are other assets including stock, tractors, machinery, plant and other capital expenses are in the order of $300,000 to $1.85 million.

In terms of the cost to prepare this application, significant cost and effort has been expended over the past 12 months to create environmentally sustainable and financially profitable proposed farm systems. Actual costs to date, including effluent pond drop tests and inspection, soil fertility testing and employing the services of planning, water quality and nutrient management expertise are in the order of $60,000. The purpose of disclosing these figures are to draw attention of the processing officer to the actual and real economic benefits of the proposal to the applicant and the wider community, and to also highlight that genuine, real and considered thought has been put into devising the proposal as it stands.

8.4 Sections 105 and 107 of the RMA

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

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

9. CONSENT DURATION, COMMENCEMENT, REVIEW AND LAPSE

9.1 Consent Duration

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

The environmental effects of the changes in land use and farm system proposed are known. The assessment above and contained within the attached documents explains these activities and effects so that Council may have certainty in their nature (what they are), scale (how minor they are in the wider context of the catchment), their duration and frequency of effects (i.e. ongoing positive effects overall with some fluctuations in nutrients season to season which are managed and responded to by way of the FEMP).

The effects of the dairy support runoff are expected to be three times less than those of the Aerodrome dairy farm, given that the nutrient loading and concentrations will be three times less. Overall, both proposals will reduce nutrient, sediment and *E. coli* concentrations and loads beyond that currently experienced.

The existing environment is reasonably well known about, albeit council have gaps in their monitoring and sampling regime making it impossible to completely assess the proposal against policy 16, 15A and 15B of the PSWLP. Notwithstanding this, the proposal will improve water quality beyond that which is observed in the existing environment.

Matching consent duration to the level of risk of adverse effects

The risk of adverse effects arising from dairy farming and dairy support land uses varies on a case to case basis and for the most part the risk level is most greatly controlled by human behaviour and farm management. The effluent structures and infrastructure are of sound construction and are not leaking, they will be frequently monitored in future to ensure that the risk of raw effluent discharges to water bodies (adverse effect) is low.

With respect to the potential contaminant loss risks from intensive winter grazing and dairy farming, these risks are lowered by implementing FEMPs that require GMPs and mitigations to be implemented. The absence of these mitigations and GMPs will increase the risk of potential adverse effects from the proposal.

Overall, the risk of unanticipated or unexpected adverse effects occurring is low because of the mitigations, GMPs, farm system changes proposed combined with the knowledge of the farm operators. Ongoing development and investigation in new technologies, mitigations, and of farm education will ensure that the risks can remain low throughout the 12 year consent duration proposed.

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. The proposed consent duration is less than 25 years.

Duration sought by the applicant and supporting information

The applicant seeks a 12 year consent duration, with is greater than the standard or common 10 year consent duration often granted by council for similar activities. It is largely the investment in new land and new infrastructure (calving pad) and cost and effort of new mitigations (i.e. wetland) that support a longer than 'standard/common' consent term, as the consent duration will provide the applicant sufficient security of their operation to implement the changes as proposed in a manner that is meaningful and will result in improved water quality beyond their farm boundary.

Further to this, the process to apply for and renew consents is at least 12 months, plus council processing time which can be lengthy depending on if it is required to go to a hearing. For this purpose, a 12 year consent would give the application 10 years of operation plus two years contingency to prepare to replace the consents. Given the cost and investment to date, the low environmental risk and the certainty of effects, a 12 year consent duration is entirely reasonable.

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, as assessed above.

The investment in both landholdings is significant and in the order of millions of dollars. The market for dairy products both nationally and globally is strong, with prices common to fluctuate particularly in the last few years. Commodity market changes will influence the profitability of individual farming operations. An appropriate consent duration will encourage investment and improvements on farm which can improve environmental outcomes and buffer the applicant's ability to respond to commodity market changes which secures the permanence of the activity. Farming has been and will be intergenerational. A 12 year consent duration is half of a generation (i.e. 25 years as encouraged by the iwi management plan) is an appropriate duration.

Common expiry date for permits that affect the same resource

A common expiration date for all the permits applied for is appropriate for all activities as they relate to the same property, land and water resources. A common expiration will make application for replacement consents a more streamlined process (subject to granting) as one application can be made in future to replace all consents at the same time.

Applicant's compliance history

Aerodrome farm Limited have demonstrated a record of full compliance for almost every compliance inspection for the Discharge Permit AUTH-301219. Out of a total of 10 routine compliance inspections, only one inspection was for an incident relating to "odour from dairy farmer north of property" which occurred in 2013. Given the proximity of the property to rural-lifestyle properties; the fact that the event occurred almost 6 years ago and has a performance rating which states 'not confirmed', this minor non-compliance is negligible. It can be disregarded. More general compliance comments comprise of "Pods well set up", "nice work on farm" and "no issues on site. Tidy systems."

Condition 10 of Discharge Permit AUTH-301219 specifies the monitoring of surface water quality of watercourses. Section 6.3.7 of this report discusses that this condition shall be removed from any replacement discharge permit.

The property has also been subject to frequent compliance monitoring for Water Permit AUTH-301220-V1, regarding the submission of water abstraction records. Of a total of eight inspections, only three inspections have received a status of non-compliance, regarding their monthly abstraction records which were submitted late. Late record submission is very common, particularly as records are due manually at the time of a public holiday. On public holidays, NZ post do not deliver mail.

Land Use Consent AUTH-301221 also has compliance records for the effluent pond construction. The records confirm that the Pond Construction Report complies with consent conditions, as at 26/04/2013.

The overall compliance history therefore strongly indicates that Aerodrome Farm Limited is ensuring efficient application of EFFLUENT at low rates, has demonstrated excellent compliance with their existing permits. Therefore, the existing consented activities at the property represent a low level of environmental risk, and it can be concluded that future compliance will be good.

Piobiare Homestead Limited have also demonstrated a good compliance history with no know complaints. The s.42A recommending report (dated 3 June 2015) for recent changes to the applicants discharge permit provides historical records of compliance for the wintering barn effluent discharge, from 2013 to 2014. These records show full compliance, with general comments of "silage/sump/separator areas all tidy" and "pods well set up". The overall compliance history therefore strongly indicates that the applicant is ensuring efficient application of EFFLUENT at low rates, is demonstrating good compliance with their existing discharge permit and that the existing consented effluent discharge activities represent a low level of environmental risk, and Piobiare will be compliant in future as well.

Timing and development of FMUs

It is considered that granting a longer consent duration (i.e. 12 years) will better enable implementation of any revised framework established in the FMU section of the PSWLP, as Council will be able to review all consents in the catchment collectively, which will serve to better implement any limit setting process.

In conclusion, due to the low level of environmental risk of the proposed activities and a substantial value of investments on the property, 12-year consent durations are considered entirely appropriate.

9.2 Consent Commencement

For completeness a comment with regards to consent commencement is given. Any consents granted subject to this application will commence as of the date they are given effect to.

Therefore, the existing consents will need to be surrendered (Section 138 of the RMA) or expire (Section 123 of the RMA) prior to the new consents being given effect to. With respect to the new land use consent for a wintering barn applied for, the applicant may continue their existing activities under Section 20A of the RMA, until they give effect to the new consent, or until 6 months after the new provisions of the PSWLP become operative. Council cannot impose any condition on any of the consents that may be granted by council that seeks to impose a commencement date and/or place a condition which cancels and replaces existing consents, because it would be ultra vires (meaning unlawful and beyond the powers of).

9.3 Review and Lapse

The applicants are happy for ES to impose standard review conditions in accordance with Sections 128 and 129 of the RMA, albeit it is not necessary to impose a review condition, as a review is provided for under the Act. We note however, that as Environment Southland have not fixed charges related to reviews of consents under Section 36 of the Act, the cost of a review then falls with the consent authority and not the consent holder.

In accordance with Section 125 of the RMA, a 5-year lapse period is standard and appropriate.

These consents must not be exercised until any current consents for the same activity have been surrendered or have expired.

10. NOTIFICATION AND CONSULTATION

A consent authority must publicly notify an application if an activity will or is likely to have adverse effects on the environment that are more than minor; public notification is requested; or a National Environmental Standard (NES) requires public notification.

In deciding whether an activity will have or is likely to have adverse effects on the environment that are more than minor; any adverse effect on the landholders must be disregarded; and Council may disregard an adverse effect of the activity, if a rule in the PSWLP permits an activity with that effect. For example, for the purpose of deciding whether to publicly notify or not, the adverse effects of all activities listed in Table 15 of Section 4.2 may be disregarded. Furthermore, the PSWLP permitted intensive winter grazing activities that have similar effects as those proposed on Piobiare in terms of nutrient losses to the environment and subsequent eutrophication of waterbodies.

Adverse effects

In accordance with Section 95D we conclude that the adverse effects of the proposal are minor or less. For the reasons outlined above, specifically in Sections 5.1 and 6.1, the proposal includes the activities themselves plus proposed GMPs and mitigations that form the overall proposal for which consent is sought. The change in land uses on Aerodrome and Piobiare and the discharges of effluent to land will result in effects on the environment that are less than minor. The water abstraction activities, and wintering barn use are likely to result in effects on the environment that are less than minor or no effect.

Effects of the proposal will be minor or less because:

- The nitrogen and phosphorous losses from the overall proposed scenarios are less than that of the existing environment, and in addition to this the applicants are proposing to implement GMP's and mitigation measures that are intended to further mitigate nitrogen losses from the dairy farm and the dairy support runoff;
- Although the OVERSEER® Nutrient Budgets show a slight increase nutrient loss at the block scale for some blocks, these losses do not consider the influence of the other blocks on the overall losses at the farm scale (for both landholdings). All of the GMPs and mitigations proposed, are likely to fully mitigate the adverse effects of the land being used for dairy farming and dairy support runoff land;
- The P loss GMPs and mitigations will be effective and efficient for mitigating potential sediment and *E. coli* losses so that they are less than minor;
- The effluent discharge application methods, rates and depths are matched to the risk associated with land they are applied to, therefore minimising the risks to water quality;
- The effluent storage facilities are either permitted, or present a low environmental risk;
- The effluent storage is existing, has been constructed appropriately and passed the relevant tests and visual inspections;
- The water abstraction is either permitted, or is from a groundwater management zone with no allocation issues and at a rate where there are no concerns about interference or stream depletion effects; and
- Any reduction in nutrient accumulation in the receiving environments as a result of this proposal at the resolution of current ES monitoring will be unlikely to be detectable and traced to the effects of farming at this location. Detection of this will be impossible or negligible.

Therefore, the adverse effects of the proposal either have no effect (not detectable) or are less than minor (fully mitigated).

The applicants do not request public notification and there are no rules or NES which require the public notification of the application.

With respect to special circumstances, there are none. Dairy farming of this scale and nature is not out of the ordinary in Southland, and the proposal is entirely consistent with the objectives of the PSWLP and not contrary to any other relevant document. All details pertaining to the application have been included and the assessment includes such detail as corresponds with the scale and significance of the effects that the activity may have on the environment. Any potential negative public perception of dairy farming is unlikely to be associated with or directed at a proposal that seeks consent in order to reduce their overall effects on the environment, and there are no known special interest groups that may be adversely affected. There are no sensitive receiving waterbodies that may be affected by the proposal and there are no circumstances around the application that are unusual or exceptional (Peninsula Watchdog Group (Inc) v Minister of Energy [1996] 2 NZLR). Therefore, public notification on the grounds of special circumstances is not warranted.

There are no other persons considered to be affected by the proposal, with the existing silage block to remain outside of the actual dairy milking platform for this reason. Therefore, the proposal may proceed non-notified.

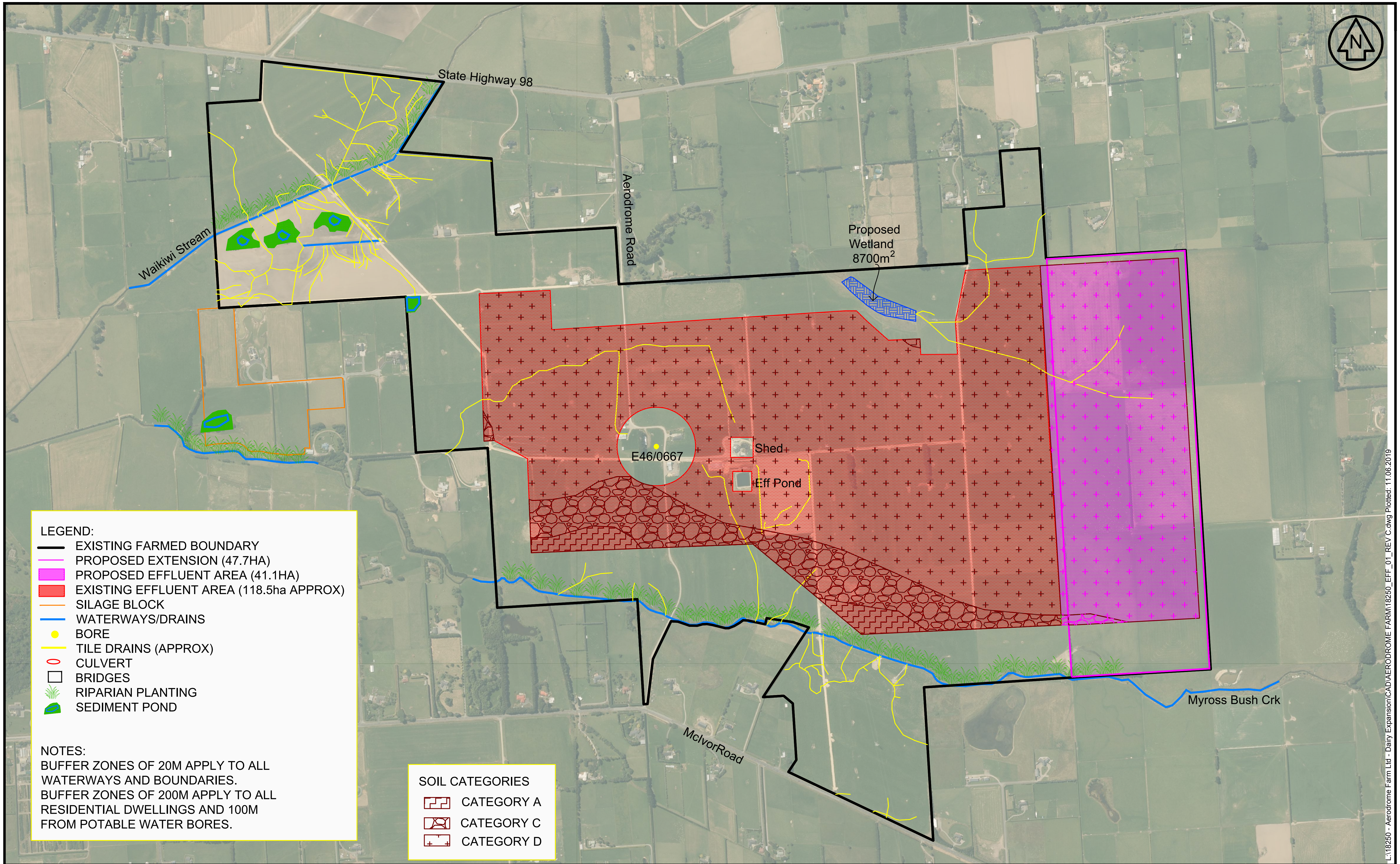
11. CONCLUSION

The bottom line is that if the proposal is declined, real and actual improvements in water quality will not be achieved. The proposal is entirely consistent with all of the relevant policies, and a comprehensive assessment of the overall proposal and each component of the proposal has been undertaken. This complete assessment ensures that the effects of the proposal area known and anticipated to occur. The proposed conditions are defensible, intra-vires, certain and enforceable.

Should the application for consent be declined the applicant will not only be unable to achieve environmental improvements, Council will have no recourse for ensuring water quality is improved at the local and catchment scale until the future anticipated limit setting process. The applicant is requesting their losses from the farm system will be capped at the levels proposed, so that they can sustainably, efficiently and profitably run their dairy farm and dairy runoff support blocks, whilst improving water quality.

Overall, the sustainable management of natural and physical resources is promoted; the effects on the environmental will be avoided and/or mitigated; the life supporting capacity of resources are safe-guarded as far as can be reasonably expect at the consent level; and the use of the land and water resources are sustained so that they will continue to provide for future generations. Any decision to decline the consent, would be contrary to Part 2 of the RMA.

Attachment A: Scheme Plans



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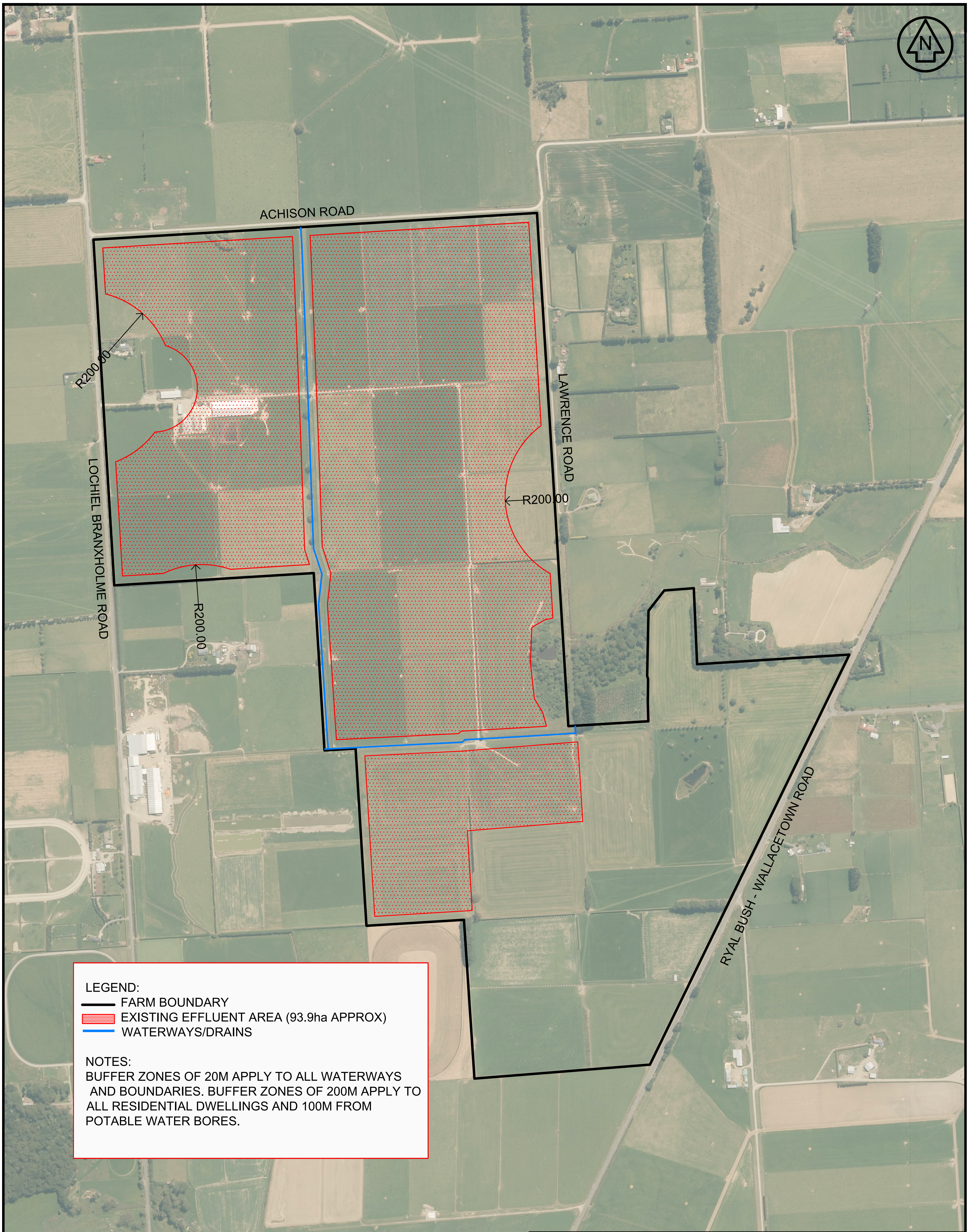
EFFLUENT DISPOSAL AERA

Rev.	Date	Revision Details	By
A	26.7.18	EFF AREA ADDED IN EXTENTION AREA	SLC
B	28.7.18	EFF AREA CHANGED, IN BOTH AREAS	SLC
C	23.5.19	SOIL CATEGORIES ADDED	SLC

Surveyed	Signed	Date	Job No.	Drawing No.
			18250	01_01
Drawn SLC	Signed	Date 23.7.18	Scale 1:5000 @ A1 1:10000 @ A3	
Designed	Signed	Date	Datum & Level NZTM 2000 & MSL	Rev. B



Rev.	Date	Revision Details	By
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Surveyed	Signed	Date	Job No.	Drawing No.
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Drawn	**Signed**	**Date**	**Scale**	
SLC		2.5.19	1:8000@ A3	
Designed	**Signed**	**Date**	**Datum & Level**	**Rev.**
			NZTM 2000 & MSL	-

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-If this plan is being used as part of sale and purchase agreement then it is done so on the basis that it is preliminary only, final dimensions and areas may vary on final survey

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EFFLUENT DISPOSAL AREA

L:\18250 - Aerodrome Farm Ltd - Dairy Expansion\CAD\WINTERING BLOCK\18250_02_WINTERING BLOCK_EFF.dwg Plotted: 02.05.2019

Attachment B: Aerodrome Farm Limited Effluent Storage

1 February 2019

Peter Moynihan
46 Albert Street
Invercargill 9810

Dear Peter

Drop Test Results: Aerodrome Farm Ltd Effluent Pond, 25 - 28 January 2019.

1. Background
The discharge consent for the property is 301219

As required by Environment Southland, to confirm your effluent pond is not leaking, a drop down test was carried out between the 25 & 28 January 2019.

Site and Set Up
The farm is located at 95 Aerodrome Road, Invercargill.

Effluent flows by gravity from the dairy shed to a sump. From there it flows to two sludge beds. Liquid effluent flows through the weeping walls and is pumped in to a clay lined storage pond. The pond has been emptied in the last 12 months and confirmation received that desludging wasn't required. There was no crust on the pond and the surface was not frozen during testing.

The pond was isolated by not allowing any inflow and by not pumping out during the test period.

The dimensions of the storage pond at the water level during the test period were:
North 38.5m
East 38.0m
South 39.0m
West 39.7m

The dimensions of the storage pond at the top bank level during the test period were:
North 42.8m
East 42.4m
South 42.5m

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Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz

West 42.2m

The total pond catchment area was 20.1% greater than the wetted area during the test.

The maximum design depth for the pond is 2.9m including 0.5m of freeboard. At the time of the test the liquid level was 1.1 below design height, i.e.75% full.

Below is an aerial photo that shows the pond and dairy shed. The laser drop test unit was installed at the west side of the pond, as marked.

3. Test Methodology

You were notified when the test was to be run and confirmation was received that there would be no liquid inflow or outflow during the test period.
The monitoring equipment was set up at the pond by Evan Sanderson, as described below. The NIWA Neon website was checked to confirm that data was being recorded and sent to the website.

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843
Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz

3.1. Water Level Monitoring Unit

A laser distance measuring unit was set up vertically over the pond surface. A reflective disc was placed on the pond surface to ensure constant, repeatable readings.
The laser was set up within a PVC pipe which acts as a stilling well.
Distance readings to the pond surface were taken at 10 second time intervals and sent to NIWA's Neon logging system.

3.2. Meteorological Station

A Vaisala weather station orientated to the North was also set up and the data it collected sent to NIWA's Neon system at 10 second intervals. It measured:

- Air Temperature
- Wind speed
- Wind direction
- Rainfall

3.3 Evaporation Loss Monitoring

To record evaporation and rainfall in real time a bucket was installed suspended from a strain gauge with 9.0L of effluent in it, on the pond bank.

4. Results Recording

Recording of results was carried out to comply with the Appendix P of the Environment Southland Land and Water Plan, recording details are summarized below:

- The minimum test period has to be 48 hours.

- Readings are to be taken every 10 seconds.

- For maximum accuracy the wind velocity has to be less than 1.0m/sec. This limit has been set because wind at the test site has been observed to have two affects, the first being to cause waves and the second to push water to one side of the pond from the other, (a seiche effect). The accuracy of the laser distance recorder is such it will detect changes as small as 0.2mm. To accurately determine the true pond level requires calm conditions at the start and end of the test period.

- When a period of 48 hours or more has elapsed the information is down loaded and the results interpreted.

- The GPS location of the pond and equipment set up is recorded. For this test the equipment was located at **E**1245257, **N**4855740, at the west side of the pond.

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Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz

Laser at the west side of the pond.

5. Results Summary

The results for the test are summarised in Table 1 and discussed below.
The plot of wind speed and pond height shows that at times wind caused waves on the pond surface. However a period was identified at the start and end of the test period when the pond surface was stable and accurate height readings were established.

The start time was assumed to be at 22:19:50 hours on the 25 January 2019.
The distance from the laser to the reflective disc on the pond surface was 209.5mm and the wind speed 0.8m/sec.

The finish time was assumed to be at 09:00:00 hours on the 28 January 2019.
The distance reading was 197.5mm and the wind speed 0.7m/sec.

The total time elapsed was 58 hours and 40 minutes, 10 seconds.

The laser measured a change in distance to the pond surface of a 12.0mm decrease. Therefore the pond surface rose 12.0mm over the test period.

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The total rainfall recorded by the evaporation bucket during the test period was 14.5mm. This rainfall depth was corrected for the 20.1% larger pond catchment so 14.5mm becomes 17.5mm for the calculations regarding changes to the pond height.

The change in level in the evaporation bucket on site for the test period was calculated as 5.3mm increase in level. This is the net result of rainfall less evaporation, evaporation must have been 14.5mm - 5.3 mm = 9.2mm.

During the test period the pond should have risen 17.5mm due to rainfall and fallen 9.2mm due to evaporation, a net change of 8.3mm increase. The change in pond height was an increase of 12.0mm. This is a difference of 3.7mm.

The change in pond depth due to either rainfall or evaporation follows exactly the same trend line as the evaporation bucket change in weight, except the magnitude is different. There are two reasons for this. The pond, because of its size, is a better rain gauge than a bucket which has a relatively small surface area.

Secondly it has been observed before that the evaporation bucket will lose liquid to evaporation at a faster rate than the pond. This has resulted in a lesser net reduction in pond height compared to the evaporation bucket, or a greater apparent change when rain occurs. The pond level was above ground level during the test precluding any potential ingress of ground water.

The pond performance was looked at closely for an 8.5 hour period when the wind velocity was relatively low and evaporation rates were low. At 00:30:20 hours on the 28th the pond level was 198.0mm. At 9:00:00 hours on the 28th the pond level was 197.5mm, a net change of 0.5mm increase. During this period the evaporation bucket gained 0.46mm, due to rainfall. These two changes are in close agreement. They also suggest the pond isn't leaking.

TABLE 1 : DROP TEST RESULTS SUMMARY, Aerodrome Farm Ltd

Start Time	25 January, 22:19:50
Finish Time	28 January, 09:00:00
Total Time	58 hrs, 42 minutes, 10 seconds
Start Depth (mm)	209.5
Finish depth (mm)	197.5
Change in depth (mm)	+12.0
Rainfall (mm)	+17.4
Evaporation (mm)	-9.2
Net Change in Depth After	
Rain and Evaporation (mm)	+3.8
Net Change per 24 Hours (mm)	+1.6
Pond Level, % of Design Depth	75

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Email: scandrettrural@xtra.co.nz

Net Change if Pond at 75% of	
Design Height. (mm/24hrs)	

6. Conclusion

The pond complies with the requirement of the Environment Southland Land and Water Regional Plan for effluent discharge (Rule 35 b. iii.), with a leakage rate of less than 2.0mm / day.

Yours faithfully

JOHN SCANDRETT
Agricultural & Engineering Consultant

Appended

Depth and wind speed graph for the test period.
Depth and rainfall graph for the test period.
Depth and wind speed for the start of the test period.
Depth and wind speed for the end of the test period.

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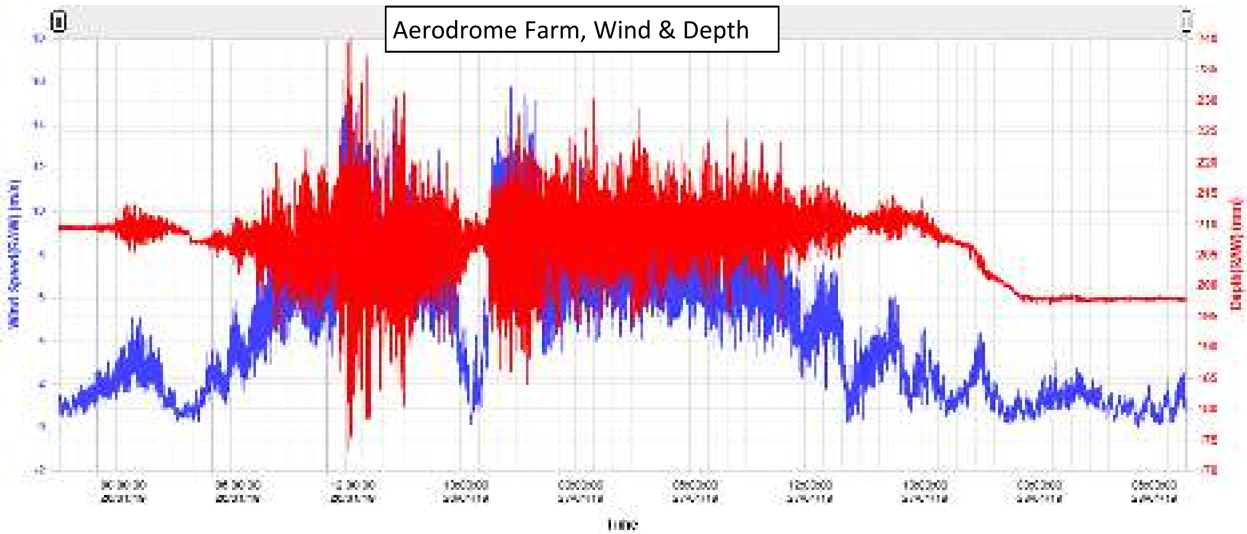
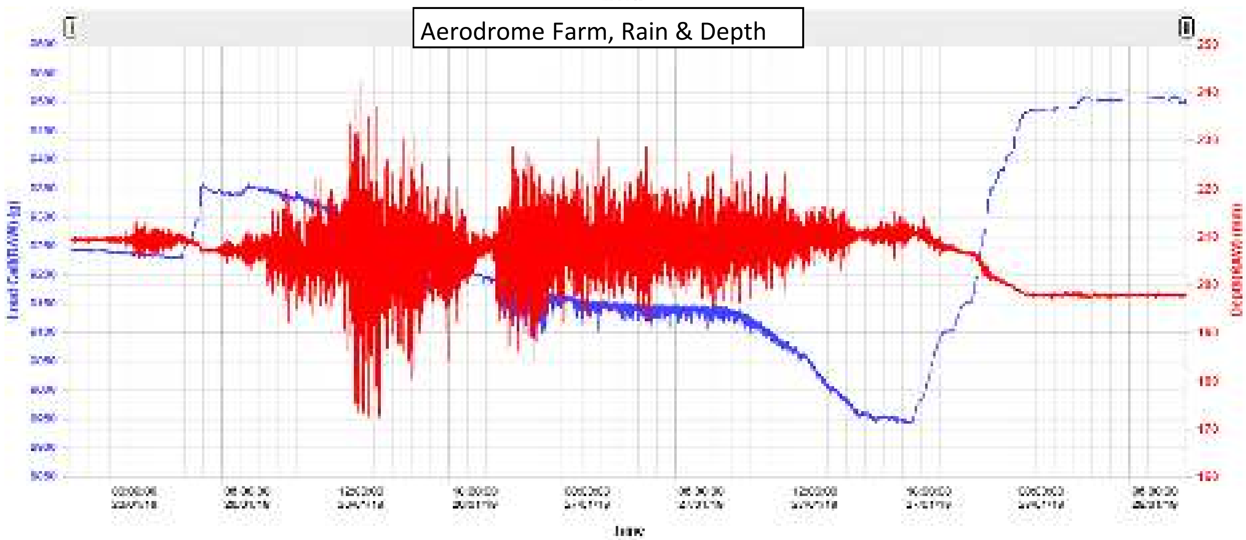
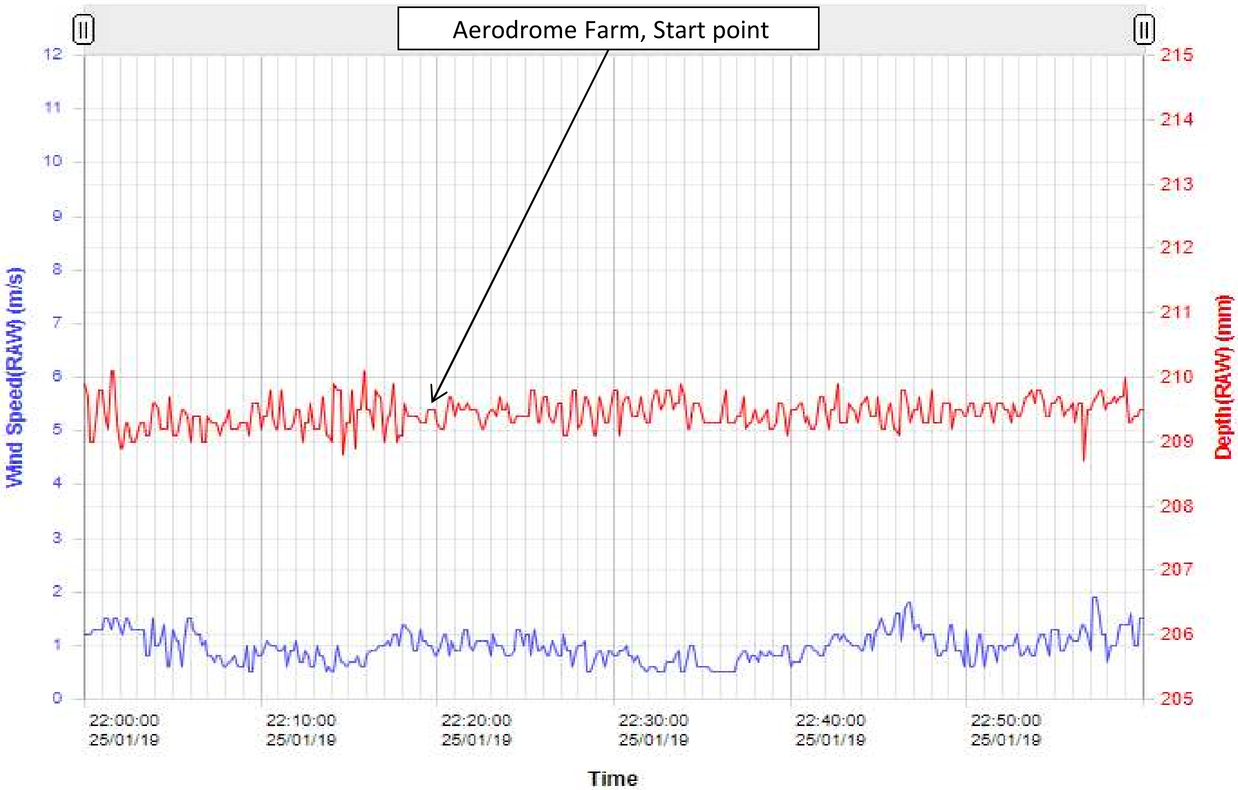
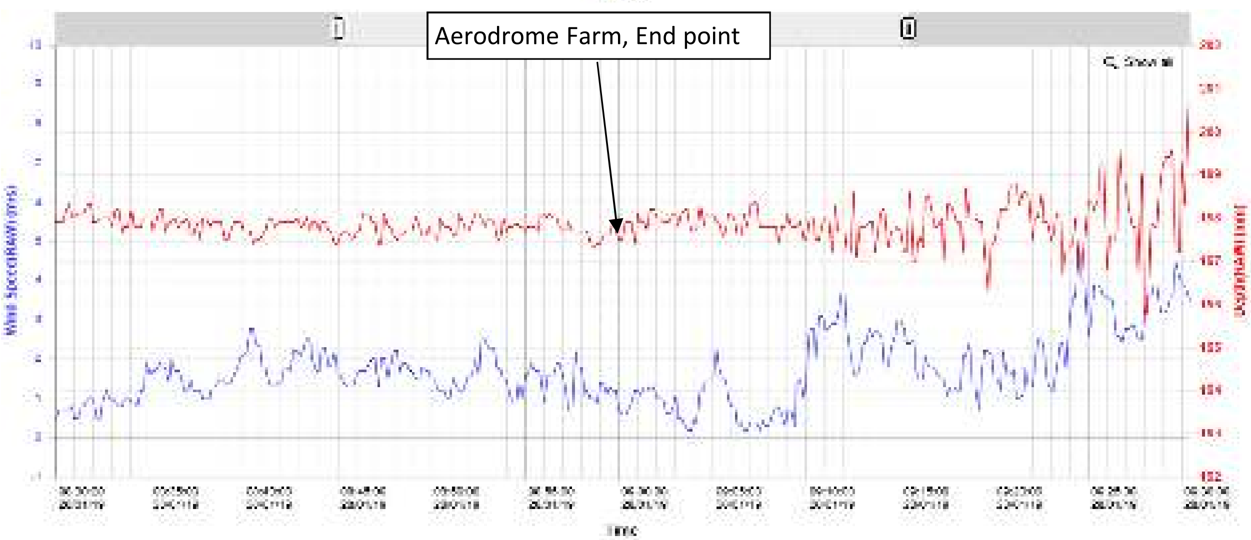
Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz


Aerodrome Farm, Wind & Depth


Aerodrome Farm, Rain & Depth


Aerodrome Farm, Start point
Wind Speed(RAW) (m/s)
Depth(RAW) (mm)
0
1
2
3
4
5
6
7
8
9
10
11
12
205
206
207
208
209
210
211
212
213
214
215
22:00:00 25/01/19
22:10:00 25/01/19
22:20:00 25/01/19
22:30:00 25/01/19
22:40:00 25/01/19
22:50:00 25/01/19
Time


Aerodrome Farm, End point
Time

20 March 2019

John Scandrett
Dairy Green Ltd.
10 Kinloch Street
PO Box 5003
Waikiwi
INVERCARGILL

RE: Aerodrome Farm Drop Test, January 2019

Dear John

At your request, we have reviewed the data collected for the above test. From this we confirm that:

1. The raw data collected via our Neon data collection system is as you have stated.

2. There were no significant complicating factors during the test, though because of conditions it was necessary to inspect the load cell data in detail.

3. Your conclusion that leakage from the pond complies with the Council's effluent discharge rule appears to be correct.

Yours faithfully

Jeremy Bulleid
NIWA Instrument Systems

26 March 2019

Peter Moynihan
46 Albert Street
Invercargill 9810

Dear Peter

Drop Test Results: Aerodrome Farm Ltd sludge beds, 15-17 March 2019.

1. Background
The discharge consent for the property is 301219.

As required by Environment Southland, to confirm your sludge beds are not leaking, a drop down test was carried out between the 15th & 17th March 2019. This tested both beds at the same time.

Site and Set Up
The farm is located at 95 Aerodrome Road, Invercargill.

Effluent flows by gravity from the dairy shed to a sump. It then flows to two sludge beds. Liquid effluent flows through the weeping walls and is pumped into a clay lined storage pond.
The sludge beds had been emptied and sludge removed just prior to the test being done. There was no crust on the surface and it was not frozen during testing.

The sludge beds where isolated by not allowing any inflow and by not pumping out during the test period.

The dimensions of the combined sludge beds at the water level during the test period were:
North 62.0m
East 8.0m
South 62.0m
West 7.0m

The dimensions of the sludge beds at the top bank level during the test period were:
North 64.0m
East 9.0m

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843
Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz

South 64.0m
West 8.0m

The total catchment area was 17 % greater than the wetted area during the test.

The maximum design depth for the sludge beds is 1.2m including 0.2m of freeboard. At the time of the test the liquid level was 0.2m below design height, i.e.100 % full.

Below is an aerial photo that shows the pond, sludge beds and dairy shed. The laser drop test unit was installed at the north side of the sludge beds, as marked.

3. Test Methodology

You were notified when the test was to be run and confirmation was received that there would be no liquid inflow or outflow during the test period.
The monitoring equipment was set up at the sludge beds by Evan Sanderson, as described below. The NIWA Neon website was checked to confirm that data was being recorded and sent to the website.

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Email: scandrettrural@xtra.co.nz

3.1. Water Level Monitoring Unit

A laser distance measuring unit was set up vertically over the effluent surface. A reflective disc was placed on the effluent surface to ensure constant, repeatable readings.
The laser was set up within a PVC pipe which acts as a stilling well.
Distance readings to the effluent surface were taken at 10 second time intervals and sent to NIWA's Neon logging system.

3.2. Meteorological Station

A Vaisala weather station orientated to the North was also set up which collected data every 10 seconds and sent it to NIWA's Neon system. It measured:

- Air Temperature
- Wind speed
- Wind direction
- Rainfall

3.3 Evaporation Loss Monitoring

To record evaporation and rainfall in real time a bucket was installed suspended from a strain gauge with 9.0L of effluent in it, on the sludge bed bank.

4. Results Recording

Recording of results was carried out to comply with the Appendix P of the Environment Southland Land and Water Plan, recording details are summarized below:

- The minimum test period has to be 48 hours.

- Readings are to be taken every 10 seconds.

- For maximum accuracy the wind velocity has to be less than 1.0m/sec. This limit has been set because wind at the test site has been observed to have two affects, the first being to cause waves and the second to push water to one side of the sludge beds from the other, (a seiche effect). The accuracy of the laser distance recorder is such it will detect changes as small as 0.2mm. To accurately determine the true effluent level requires calm conditions at the start and end of the test period.

- When a period of 48 hours or more has elapsed the information is down loaded and the results interpreted.

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Email: scandrettrural@xtra.co.nz

- The GPS location of the sludge beds and equipment set up is recorded. For this test the equipment was located at **E**1245264, **N**4855763, at the north side of the sludge beds.

Laser at the north side of the sludge beds.

5. Results Summary

The results for the test are summarised in Table 1 and discussed below.

The plot of wind speed and Effluent height shows that at times wind caused waves on the surface.
However a period was identified at the start and end of the test period when the surface was stable and accurate height readings were established.

The start time was assumed to be at 01:53:50 hours on the 15th March 2019.
The distance from the laser to the reflective disc on the effluent surface was 220.6mm and the wind speed 0.5m/sec.

The finish time was assumed to be at 05:25:30 hours on the 17th March 2019.
The distance reading was 228.7mm and the wind speed 0.1m/sec.

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The total time elapsed was 51 hours and 31 minutes, 40 seconds.

The laser measured a change in distance to the effluent surface of a 8.1mm increase. Therefore the surface fell 8.1mm over the test period.

There was no rainfall during the test. The evaporation bucket was calculated to lose 5.2mm depth during the test period.
The sludge beds should have mimicked the evaporation bucket result. It can be concluded the sludge beds should have fell 5.2mm due to evaporation.
The change in sludge bed height was a decrease of 8.1mm. It is assumed the difference of 2.9mm is leakage.

TABLE 1 : DROP TEST RESULTS SUMMARY, Aerodrome Farm Limited

Start Time	15 March, 01:53:50
Finish Time	17 March, 05:25:30
Total Time	51 hours, 31 minutes, 40 seconds
Start Depth (mm)	220.6
Finish depth (mm)	228.7
Change in depth (mm)	-8.1
Rainfall (mm)	+0
Evaporation (mm)	-5.2
Net Change in Depth After	
Rain and Evaporation (mm)	-2.9
Net Change per 24 Hours (mm)	-1.35
Sludge beds Level, % of Design Depth	100
Net Change if Sludge beds at 75% of	
Design Height. (mm/24hrs)	-1.0

6. Conclusion

The sludge beds complies with the requirement of the Environment Southland Land and Water Regional Plan for effluent discharge (Rule 32 D, appendix P), with a leakage rate of no more than 1.4mm / day.
The sludge beds are suitable for storing effluent as the infiltration rate from the sludge beds is no more than 1.4 mm per 24 hours.

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Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz

Yours faithfully

JOHN SCANDRETT
Agricultural & Engineering Consultant

Appended
Depth and wind speed graph for the test period.
Depth and rainfall/evaporation graph for the test period.
Depth and wind speed for the start of the test period.
Depth and wind speed for the end of the test period.

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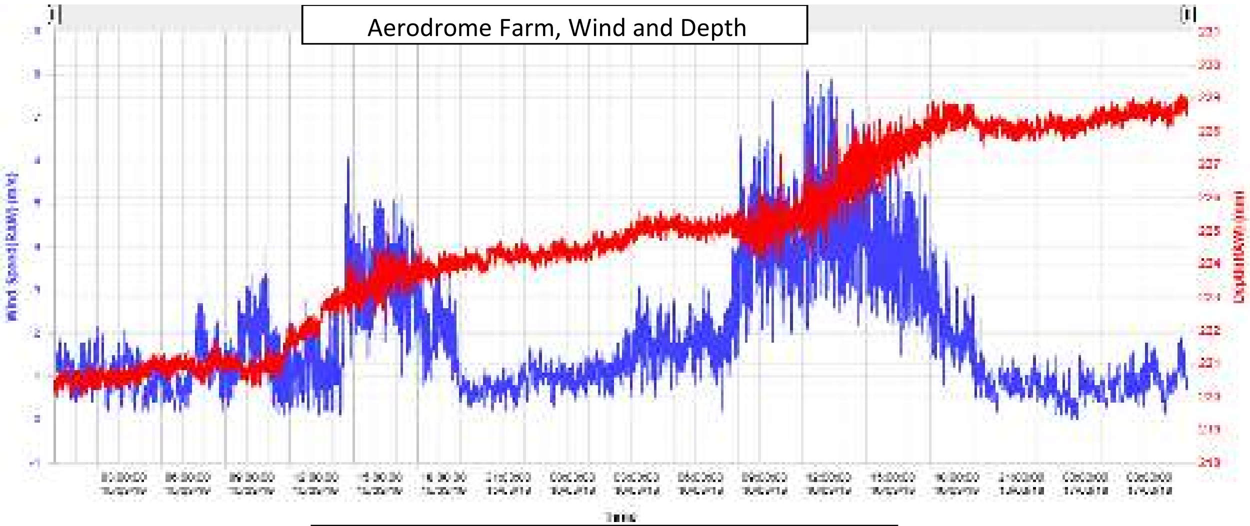
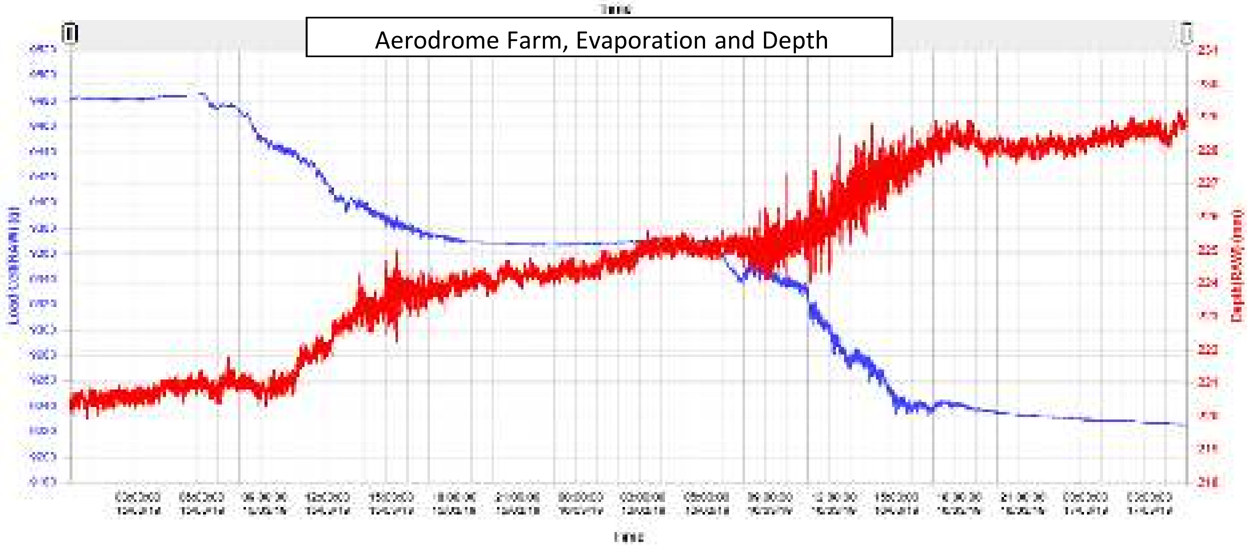
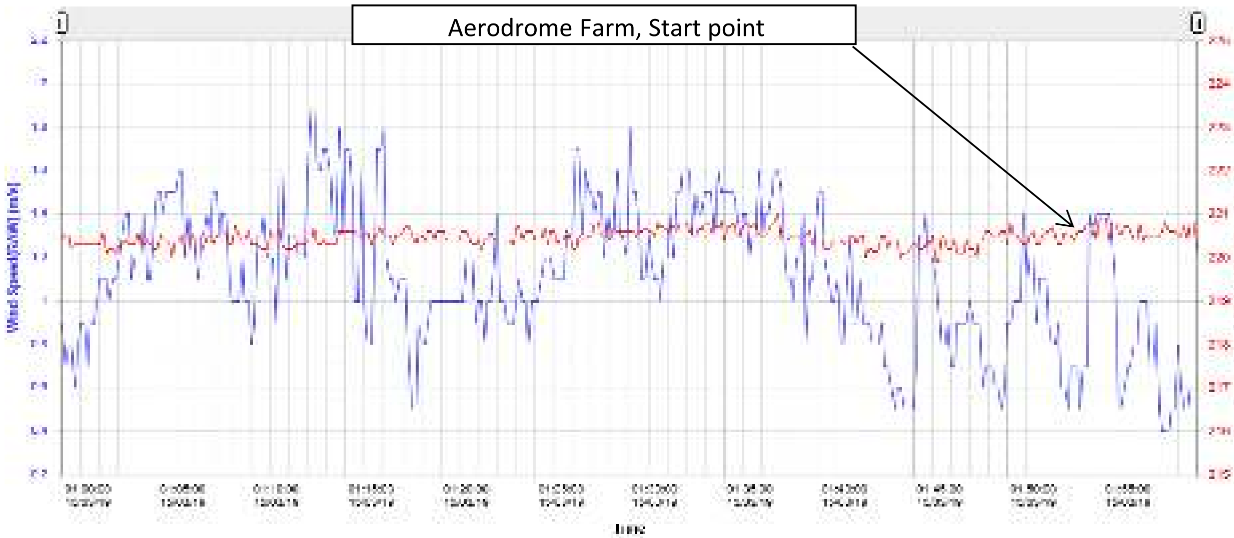
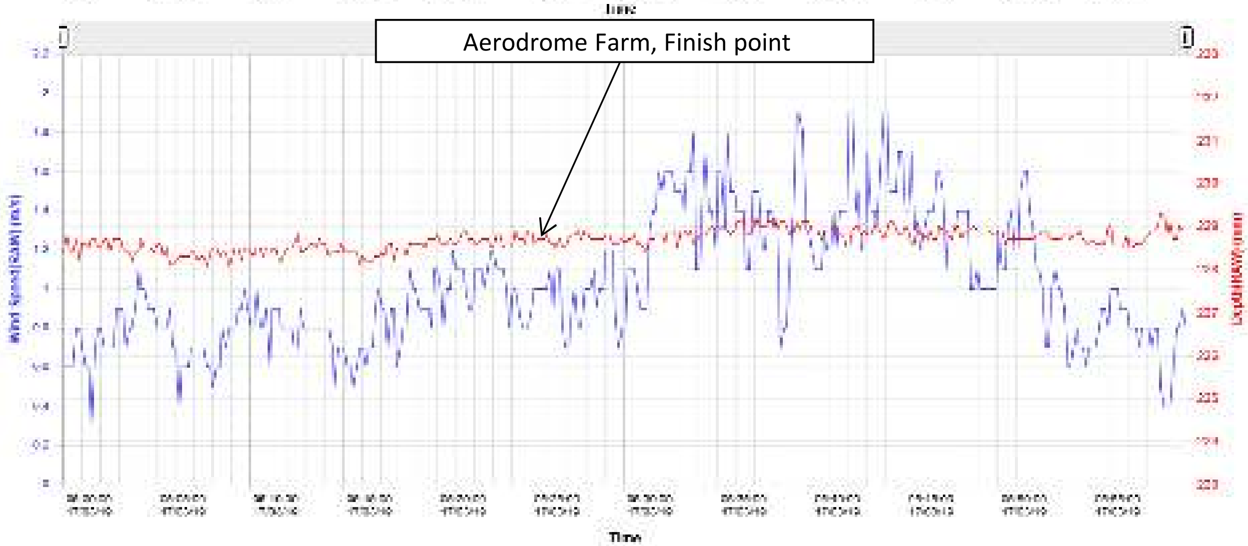
Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz


Aerodrome Farm, Wind and Depth


Aerodrome Farm, Evaporation and Depth


Aerodrome Farm, Start point


Aerodrome Farm, Finish point
Time

4 April 2019

John Scandrett
Dairy Green Ltd.
10 Kinloch Street
PO Box 5003
Waikiwi
INVERCARGILL

RE: Aerodrome Farm sluge beds Drop Test, 301219 March 2019

Dear John

At your request, we have reviewed the data collected for the above test. From this we confirm that:

1. The raw data collected via our Neon data collection system is as you have stated.

2. There were no significant complicating factors during the test.

3. Your conclusion that leakage from the pond complies with the Council's effluent discharge rule appears to be correct.

Yours faithfully

Jeremy Bulleid
NIWA Instrument Systems

Dairy Green Ltd
Practical Engineering Solutions
Consents, Effluent, Stock water, Irrigation
Design through to Installation

EFFLUENT POND VISUAL INSPECTION

Aerodrome Farm Ltd

95 Aerodrome Road

Lorneville

May 2019

Discharge consent 301219

J SCANDRETT
DAIRY GREEN LTD

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843
Phone Invercargill 03 215 4381,
Email: scandrettrural@xtra.co.nz

Visual Pond Inspection

Introduction

This report is to satisfy the permitted activity status described in Environment Southland's decision version of the Water and Land Plan, Rule 32 D, clause (a) (2), which states for existing agricultural effluent storage facilities, "certified by a Suitably Qualified Person in accordance with Appendix P within the last three years as: (a), having no visible cracks, holes or defects that would allow effluent to leak from the effluent storage facility".

Methodology

The methodology used is aimed at detecting obvious physical defects that are causing or could cause leakage.
It involves a physical inspection of the lining material above the liquid height, the crest and external batters, if any. It also considers the likely failure mode for the type of containment structure being inspected. If there is a drop test report available, it will be assumed that this report confirms the performance of the pond batters and floor surfaces below liquid level since these surfaces cannot be observed unless the pond is empty.

A visual inspection cannot record faults that are not observable which could include unsatisfactory material below the liquid level or underneath a synthetic liner or in the core of the bank. It doesn't include an assessment of bank performance in an earthquake or calculated internal and external batter performance under the normal range of operating conditions that a pond has to perform under.

POND

The pond for Aerodrome Farm Ltd is located south of the dairy shed which is accessed off Aerodrome Road and was inspected by request on the 7 May 2019 with details recorded as follows:

Observations

The pond is square shaped and there are two sludge beds situated to north of the pond. Effluent is pumped from between the sludge beds' weeping walls into the storage pond at the north east corner.
The pond bank inside top dimension are approx. 38.5 m wide x 39.5 m long.
The pump shed sits at the east end of the sludge beds. No seepages were identified around the outside of the pond banks. The pond has a clay liner, the same lining material was also used for bank construction.

Figure 1. Aerial view showing the layout of the pond and sludge beds and their location relative to the dairy shed.

Soils

Topoclimate records the predominant soil in the area of the pond as a Waikiwi silt. This soil type is formed from a deep deposit of loess. The topsoil was stripped from the pond site and subsoil used for pond bank construction purposes.

Banks

The pond banks were formed from local material with cut to fill to balance bank height with the excavated material. The material is predominantly silt, pond bank crest widths are 3.6 m or more.

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Phone Invercargill 03 215 4381,
Email: dairygreenltd@xtra.co.nz

The pond is built on a site that gently slopes to the south east. Consequently the south bank has the greatest height. The banks were constructed by fill placement and compaction. The banks appear to be stable and had a good grass cover on their crests and external batter, although the crests and north batter slope have recently been sprayed.

Batters
The pond batter slope looks to be 2H:1V for the internal batters. They look to be stable at this slope. There was no sign of batter instability or slumping. There was some erosion from wave action of the east internal batter at freeboard height.
The external batter slopes on the east, south and west sides are grazed as the fence is on the crest for these sides.

Liner
The pond has been lined with material from insitu and the same material has been used for bank construction.

Photographs of the banks are appended.

Comments

The pond internal bank batters appear to meet the condition of having no visible cracks, holes or defects that would allow effluent to leak from them within the limits of the inspection. There were no visible issues with bank stability and the bank crests and outside batters have a good cover of grass providing erosion protection. The pond passed a drop test carried out from 25th to 28th January 2019.

SLUDGE BEDS

The sludge beds were inspected at the same time as the pond was inspected. The sludge bed banks are constructed of subsoil and the crest width is 3.6m or more. The bank crests are stable and are covered in grass. The two sludge beds are formed from one long sludge bed orientated east – west, with weeping walls at the west and east ends and 2 parallel walls approx. 1m apart in the centre. These effectively petition the single sludge bed into two individual beds for management purposes. The weeping walls were of post and timber and concrete construction. There was no visible displacement of the posts and timber, for any of the four weeping walls.

The east sludge bed had been cleaned prior to inspection and the internal batters had been scraped clean other than for the north end. The internal batters were stable with no indication of slumping.

The west sludge bed had also been cleaned prior to a drop test being done but had been in recent use so the internal surfaces weren't visible. The operative volume of the sludge beds is below ground level so the upper batters were visible. There is no reason to believe the western bed isn't performing as well as the eastern bed.

Batters
The batter slope is 1H:1V for the internal batters. There was no sign of batter slumping or instability for either sludge bed.

Liner
The sludge beds were lined with subsoil, the material appeared to be stable with no indication of slaking or erosion.

Comments

The sludge beds appear to meet the condition of having no visible cracks, holes or defects that would allow effluent to leak from them. No defects that would allow leakage were observed during the sludge bed inspection within the limits of inspection. Both sludge beds were drop tested jointly between the 15^{th} and 17^{th} March 2019 and met the Appendix P leakage requirement.
Photographs of the sludge beds are appended after the pond photographs.

J S Scandrett
Dairy Green Ltd

POND PHOTOGRAPHS

West Bank

The west bank internal batter and crest (view looking south)

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843
Phone Invercargill 03 215 4381,
Email: dairygreenltd@xtra.co.nz

East Bank

The east bank of the pond (view looking south)

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843
Phone Invercargill 03 215 4381,
Email: dairygreenltd@xtra.co.nz

North Bank

The north bank batter slope and bank crest (view looking west)

South Bank

The south bank internal batter slope and bank crest (view looking west)

SLUDGE BEDS PHOTOGRAPHS

East Bed

The east bed with the south batter slope visible.

The east bed with the north batter slope visible.

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843
Phone Invercargill 03 215 4381,
Email: dairygreenltd@xtra.co.nz

The central weeping walls.

The western sludge bed.

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843
Phone Invercargill 03 215 4381,
Email: dairygreenltd@xtra.co.nz

Attachment C: Piobiare Homestead Limited Effluent Storage

Dairy Green Ltd
Practical Engineering Solutions
Consents, Effluent, Stock water, Irrigation
Design through to Installation
Irrigation NZ Accredited Designer

27 February 2019

Nelson Pyper
1011 Lochiel Branxholme Road
RD 4
Invercargill 9874

Dear Nelson

Drop Test Results: Wintering Shed Effluent Pond, 23 - 25 February 2019.

1. Background
The discharge consent for the property is 300998-V1.

As required by Environment Southland, to confirm your effluent pond is not leaking, a drop down test was carried out between the 23 - 25 February 2019.

Site and Set Up
The farm is located at 939 Lochiel-Branxholme Road, Branxholme.

Effluent flows by gravity from the winter barn to a stone trap and pump sump. It is then pumped to a screw press. The solids are separated and the liquid effluent flows by gravity in to a clay lined storage pond.
The pond has been emptied in the last 12 months, it did not require desludging. There was no crust on the pond and the surface was not frozen during testing.

The pond was isolated by not allowing any inflow and by not pumping out during the test period.

The dimensions of the storage pond at the water level during the test period were:
North 42.3m
East 42.2m
South 42.7m
West 42.5m

The dimensions of the storage pond at the top bank level during the test period were:
North 42.8m
East 42.7m

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843
Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz

South 43.2m
West 43.0m

The total pond catchment area was 2.4% greater than the wetted area during the test.

The maximum design depth for the pond is 2.3m including 0.5m of freeboard. At the time of the test the liquid level was 0.5 below design height, i.e.100% full.

Below is an aerial photo that shows the pond and winter barn. The laser drop test unit was installed at the north side of the pond, as marked.

3. Test Methodology

You were notified when the test was to be run and confirmation was received that there would be no liquid inflow or outflow during the test period.
The monitoring equipment was set up at the pond by Evan Sanderson, as described below. The NIWA Neon website was checked to confirm that data was being recorded and sent to the website.

3.1. Water Level Monitoring Unit

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843
Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz

A laser distance measuring unit was set up vertically over the pond surface. A reflective disc was placed on the pond surface to ensure constant, repeatable readings.
The laser was set up within a PVC pipe which acts as a stilling well.
Distance readings to the pond surface were taken at 10 second time intervals and sent to NIWA's Neon logging system.

3.2. Meteorological Station

A Vaisala weather station orientated to the North was also set up and the data it collected sent to NIWA's Neon system at 10 second intervals. It measured:

- Air Temperature
- Wind speed
- Wind direction
- Rainfall

3.3 Evaporation Loss Monitoring

To record evaporation in real time a 10 litre bucket (evaporation pan) with a diameter of 250mm was suspended from a strain gauge. The bucket was rinsed and then filled with 9.0L of effluent, it was situated on the pond bank.

4. Results Recording

Recording of results was carried out to comply with the Appendix P of the Environment Southland Land and Water Plan, recording details are summarized below:

- The minimum test period has to be 48 hours.

- Readings are to be taken every 10 seconds.

- For maximum accuracy the wind velocity has to be less than 1.0m/sec. This limit has been set because wind at the test site has been observed to have two affects, the first being to cause waves and the second to push water to one side of the pond from the other, (a seiche effect). The accuracy of the laser distance recorder is such it will detect changes as small as 0.2mm. To accurately determine the true pond level requires calm conditions at the start and end of the test period.

- When a period of 48 hours or more has elapsed the information is down loaded and the results interpreted.

- The GPS location of the pond and equipment set up is recorded. For this test the equipment was located at **E**1238434, **N**4864360, at the north side of the pond.

Laser at the north side of the pond.

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843
Phone 03 215 4381, Fax 03 215 4391
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5. Results Summary

The results for the test are summarised in Table 1 and discussed below.

The plot of wind speed and pond height shows that at times wind caused waves on the pond surface. However a period was identified at the start and end of the test period when the pond surface was stable and accurate height readings were established.

The start time was assumed to be at 06:20:50 hours on the 23 February 2019.
The distance from the laser to the reflective disc on the pond surface was 265.4mm and the wind speed 0.5m/sec.

The finish time was assumed to be at 06:30:40 hours on the 25 February 2019.
The distance reading was 273.4mm and the wind speed 0.8m/sec.

The total time elapsed was 48 hours and 09 minutes, 50 seconds.

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The laser measured a change in distance to the pond surface of a 8.0mm increase. Therefore the pond surface fell 8.0mm over the test period.

The total rainfall recorded by the evaporation bucket during the test period was 0.9mm. Correcting the rainfall depth for the 2.4% larger pond catchment has no practical effect because the additional catchment at 2.4% is so small. 0.9mm is used for the calculations regarding changes to the pond height.

The change in level in the evaporation bucket on site for the test period was calculated as 5.9mm decrease in level. This is the net result of rainfall less evaporation, evaporation must have been 0.9mm + 5.9 mm = 6.8mm.

During the test period the pond should have risen 0.9mm due to rainfall and fallen 6.8mm due to evaporation, a net change of 5.9mm decrease. The change in pond height was a decrease of 8.0mm. This is close to the expected result, the difference of 2.1mm is leakage.

TABLE 1 : DROP TEST RESULTS SUMMARY, Mr Nelson Pyper

Start Time	23 February, 06:20:50
Finish Time	25 February, 06:30:40
Total Time	48 hrs, 09 minutes, 50 seconds
Start Depth (mm)	265.4
Finish depth (mm)	273.4
Change in depth (mm)	-8.0
Rainfall (mm)	+0.9
Evaporation (mm)	-6.8
Net Change in Depth After	
Rain and Evaporation (mm)	-2.1
Net Change per 24 Hours (mm)	-1.0
Pond Level, % of Design Depth	100
Net Change if Pond at 75% of	
Design Height. (mm/24hrs)	-0.75

Conclusion

The pond complies with the requirement of the Environment Southland Land and Water Regional Plan for effluent discharge (Rule 35 b. iii.), with a leakage rate of less than 1.8mm / day. The pond is suitable for storing effluent as the infiltration rate from the pond is less than 1.8mm per 24 hours.

Yours faithfully

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843
Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz

JOHN SCANDRETT
Agricultural & Engineering Consultant

Appended
Depth and wind speed graph for the test period.
Depth and rainfall graph for the test period.
Depth and wind speed for the start of the test period.
Depth and wind speed for the end of the test period.

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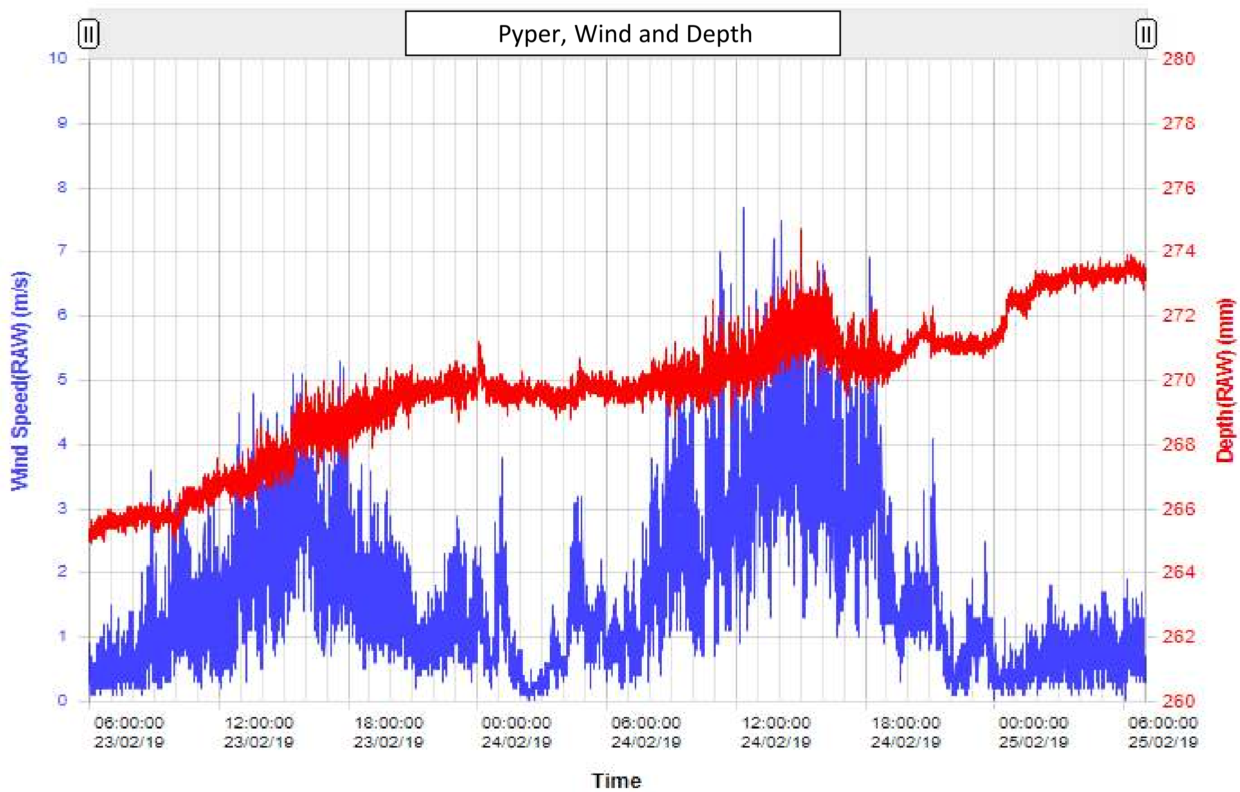
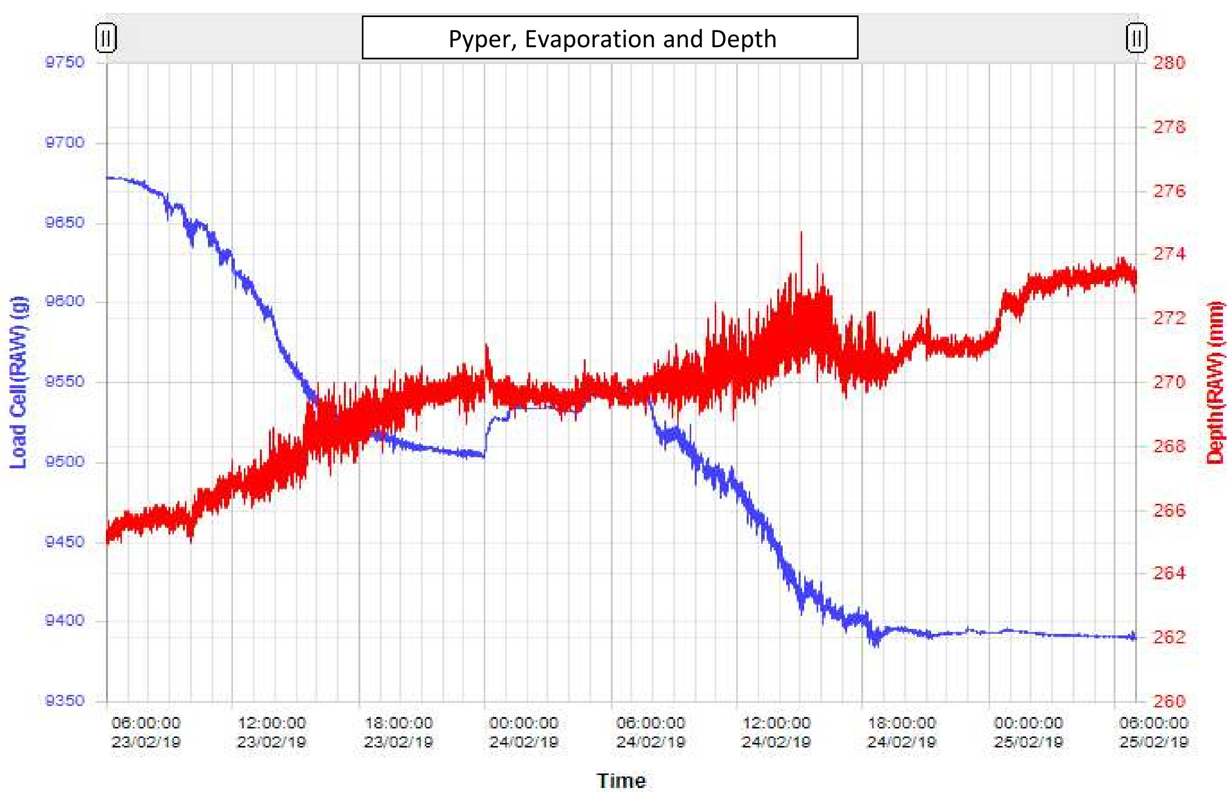
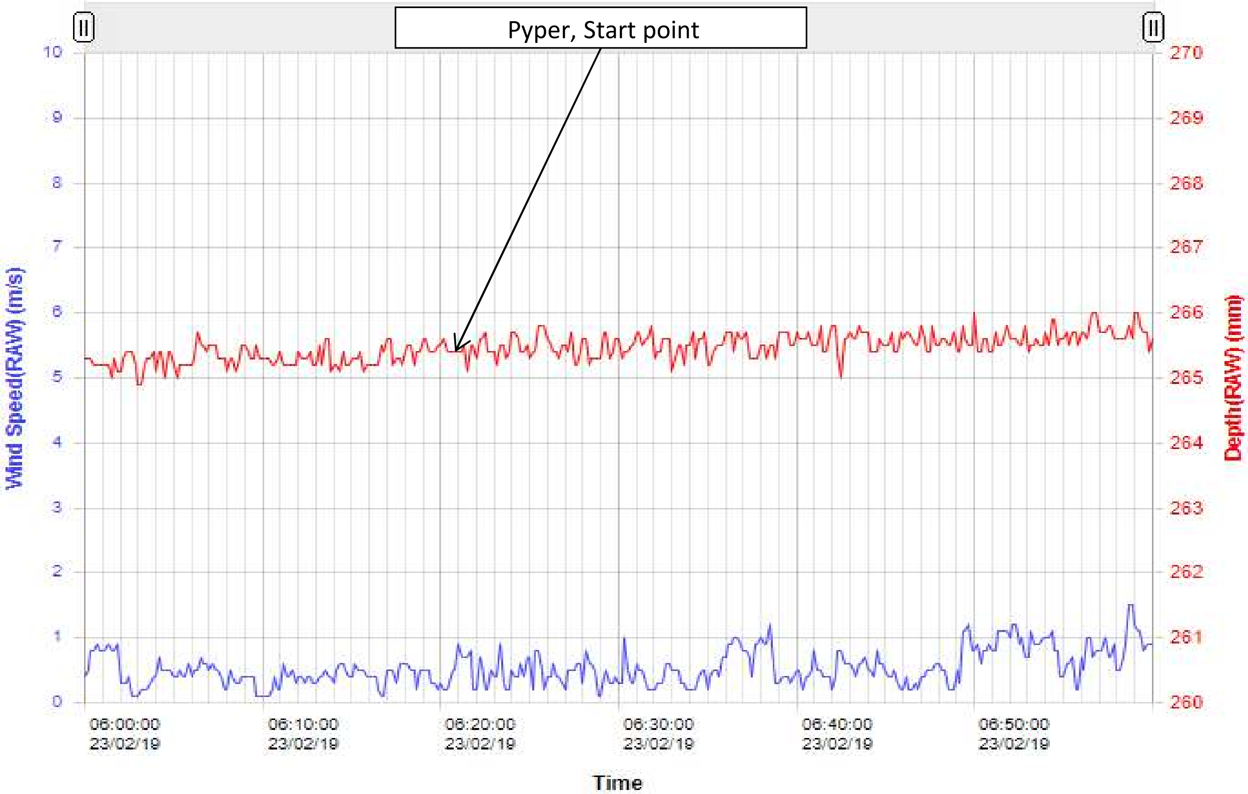
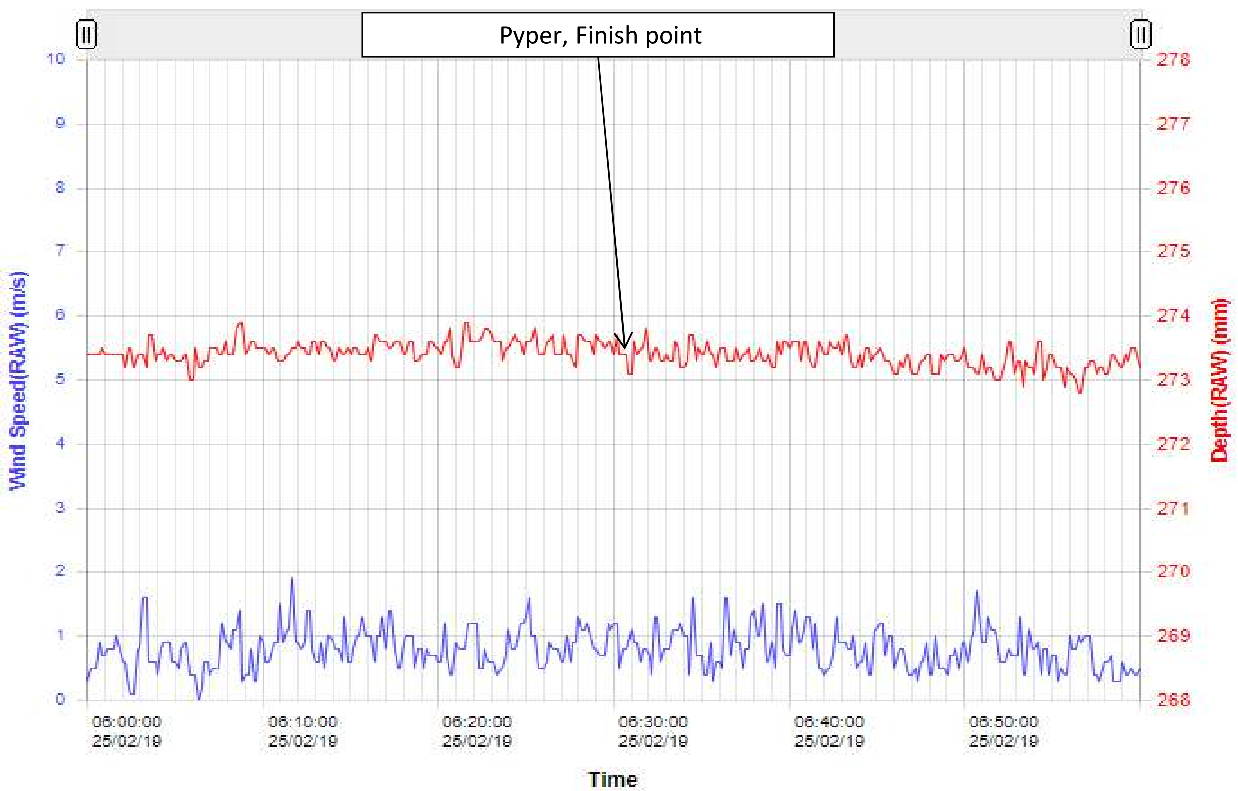
Phone 03 215 4381, Fax 03 215 4391
Email: scandrettrural@xtra.co.nz


Pyper, Wind and Depth
Wind Speed(RAW) (m/s)
Depth(RAW) (mm)
10
9
8
7
6
5
4
3
2
1
0
280
278
276
274
272
270
268
266
264
262
260
06:00:00 23/02/19
12:00:00 23/02/19
18:00:00 23/02/19
00:00:00 24/02/19
06:00:00 24/02/19
12:00:00 24/02/19
18:00:00 24/02/19
00:00:00 25/02/19
06:00:00 25/02/19
Time


Pyper, Evaporation and Depth
Load Cell(RAW) (g)
Depth(RAW) (mm)
9750
9700
9650
9600
9550
9500
9450
9400
9350
280
278
276
274
272
270
268
266
264
262
260
06:00:00 23/02/19
12:00:00 23/02/19
18:00:00 23/02/19
00:00:00 24/02/19
06:00:00 24/02/19
12:00:00 24/02/19
18:00:00 24/02/19
00:00:00 25/02/19
06:00:00 25/02/19
Time


Pyper, Start point
Wind Speed(RAW) (m/s)
Depth(RAW) (mm)
06:00:00 23/02/19
06:10:00 23/02/19
06:20:00 23/02/19
06:30:00 23/02/19
06:40:00 23/02/19
06:50:00 23/02/19
Time


Pyper, Finish point
Wind Speed(RAW) (m/s)
Depth(RAW) (mm)
06:00:00 25/02/19
06:10:00 25/02/19
06:20:00 25/02/19
06:30:00 25/02/19
06:40:00 25/02/19
06:50:00 25/02/19
Time

2 April 2019

John Scandrett
Dairy Green Ltd.
10 Kinloch Street
PO Box 5003
Waikiwi
INVERCARGILL

RE: Nelson Pyper Drop Test, 300998-V1 January/February 2019

Dear John

At your request, we have reviewed the data collected for the above test. From this we confirm that:

1. The raw data collected via our Neon data collection system is as you have stated.
2. There were no significant complicating factors during the test.
3. Your conclusion that leakage from the pond complies with the Council's effluent discharge rule appears to be correct.

Yours faithfully

Jeremy Bulleid
NIWA Instrument Systems

Dairy Green Ltd
Practical Engineering Solutions
Consents, Effluent, Stock water, Irrigation
Design through to Installation

EFFLUENT POND
and
PUMP SUMP

VISUAL INSPECTION

For

Mr. Nelson Pyper

1011 Lochiel Branxholme Road

May 2019

Discharge consent Auth 300998 – V1

J SCANDRETT
DAIRY GREEN LTD

10 Kinloch Street, PO Box 5003, Waikiwi, Invercargill 9843
Phone Invercargill 03 215 4381,
Email: scandrettrural@xtra.co.nz

Visual Pond Inspection

Introduction

This report is to satisfy the permitted activity status described in Environment Southland's decision version of the Water and Land Plan, Rule 32 D, clause (a) (2), which states for existing agricultural effluent storage facilities, "certified by a Suitably Qualified Person in accordance with Appendix P within the last three years as: (a), having no visible cracks, holes or defects that would allow effluent to leak from the effluent storage facility".

Methodology

The methodology used is aimed at detecting obvious physical defects that are causing or could cause leakage.
It involves a physical inspection of the lining material above the liquid height, the crest and external batters, if any. It also considers the likely failure mode for the type of containment structure being inspected. If there is a drop test report available, it will be assumed that this report confirms the performance of the pond batters and floor surfaces below liquid level since these surfaces cannot be observed unless the pond is empty.

A visual inspection cannot record faults that are not observable which could include unsatisfactory material below the liquid level or underneath a synthetic liner or in the core of the bank. It doesn't include an assessment of bank performance in an earthquake or calculated internal and external batter performance under the normal range of operating conditions that a pond has to perform under.

POND

The pond for Nelson Pyper is located South of the wintering shed which is accessed off Lochiel Branxholme Road and was inspected by request on the 8 May 2019 with details recorded as follows:

Observations

The pond is square shaped with inside top bank dimensions of 42.5m x 42.5m. Effluent is pumped from a pump sump at the west end of the wintering shed up into a mechanical separator where liquid is separated and flows by gravity to the effluent pond.
The effluent irrigation pump shed sits on the bank crest in the north west corner of the pond. No seepages were identified around the outside of the pond banks. The pond has a clay liner, the same lining material was also used for bank construction.

Figure 1. Aerial view showing the layout of the pond and its location relative to the wintering shed and solids separator pump sump.

Soils
Topoclimate records the predominant soil in the area of the pond as an Edendale silt type, a deep loessial soil. The topsoil was stripped from the pond site and subsoil used for pond bank construction purposes.

Banks
The pond banks were formed from local material with cut to fill to balance bank height with the excavated material. The material is predominantly silt, pond bank crest widths are 3.6 m plus.

The pond is built on a relatively flat site. Consequently the banks have been constructed by fill placement and compaction. The banks appear to be stable and have a good grass cover on their crests and external batters.

Batters
The pond batter slope looks to be 2H:1V for the internal batters. They look to be stable at this slope. There was no sign of batter instability or slumping and minimal erosion from wave action. There was a layer of dried organic material coating the internal batter, protecting it from wave erosion. There was a greater layer of material where the inlet pipe to the pond discharged.

Liner
The pond has been lined with material from insitu and the same material has been used for bank construction.

Photographs of the banks are appended.

Comments

The pond internal bank batters appear to meet the condition of having no visible cracks, holes or defects that would allow effluent to leak from them within the limits of the inspection. There were no visible issues with bank stability and the bank crests and outside batters have a good cover of grass providing erosion protection.

The pond passed a drop test conducted from 23 – 25 February 2019.

PUMP SUMP

Dung and urine that collects in the wintering shed is scraped to an external collection channel across the end of the shed and then flows by gravity to a Hynds Mega Pond concrete pump sump.

Observations

The pump sump is formed from 8 vertical concrete panels butted together to form an octagonal shape. Each panel is 3.6m wide and the sump approx. 8.9m in diameter. The pond is approx. 1.9m deep although the range in working depth from pump cut in to cut out is in the order of 0.4m with a residual depth of 0.37m at pump cut out.

For a freestanding pond the concrete panels would normally be under tension from the fluid inside the pond, however the panels are mostly below ground level in this installation, so would in fact be in compression from the loading of compacted backfill around the outside of the pond.

The panels are made from high strength concrete, there were 2 fine cracks in the freeboard space, these will have no effect on the structure's performance. The bottom of the panels are bedded in the concrete floor and the joins between the panels are keyed from moving by the use of high strength grout and they are also bolted together on the outside to manage the tension forces. The joins are further sealed by a swellable mastic, inside and out. Only the inner mastic was visible due to the pond being largely below ground level.

All 8 mastic joins were in place. One of the grout joins would benefit from being topped up as it was approx. 6cm below panel height. It appears it was constructed this way. Topping it up would prevent potential frost damage to the mastic, there are no concerns about effluent leakage from the structure though.

Comments

The concrete internal surfaces appear to meet the condition of having no visible cracks, holes or defects that would allow effluent to leak from them within the limits of the inspection, as the floor was not visible. The floor is made from thick reinforced concrete and there are no concerns about its performance, considering its design.

Photos of the structure are appended.

J S Scandrett
Dairy Green Ltd

POND PHOTOGRAPHS

West Bank

The west bank internal batter and crest (view looking south)

East Bank

The east bank of the pond (view looking south)

North Bank
The north bank batter slope and bank crest (view looking east)

South Bank
The south bank internal batter slope and bank crest (view looking west)

PUMP SUMP PHOTOGRAPHS

Northern section

Southern Section

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Email: dairygreenltd@xtra.co.nz

Western Section

Grout joint that should be topped up

Attachment D: Effluent Storage Calculations for Aerodrome and Piobiare

Dairy Effluent Storage Calculator
Summary Report

Regional authority: Environment Southland Regional Council
Authorised agent: RES Rural Environmental Solutions- DC
Client: LAN022 Aerodrome Farm Ltd
Program version: 1.50
Report date: Tuesday, 5 February 2019
General description:

4. RES Base Calculation with an estimated calving pad.

850 Cows, high and low risk soils, NO roof diversion, yard diversion when cows are dried off, Silage Pad, calving pad, 50 lt/cow/day wash down, 2 sets of low rate pods (20m3/hr for 4 hours per day in winter and 8 hours per day in summer), existing pond, application all year round, 3 days emergency storage.

The pad has not been designed at the time RES prepared this calcualtion, RES has used the DairyNZ recommendation of 10m2 per cow (recommenation is 8-10m2 per cow) as the base input for the calvign pad.

All information entered and assumptions made in this report are based upon information gathered from management and staff while onsite. Please check that all information and assumptions made in this report are correct.

Under the management system parameters described in this report and on the balance of probability, it is 90% likely that 1,940m³ of liquid effluent storage will be adequate for storage in any one year.

Based on the pond dimensions of 44m x 43m x 3.5 m, with a 2:1 batter, you currently have 3,816m³ which is approximately 99% probability that you will have sufficient storage in any one year.

Good management is essential for liquid effluent storage of this size.

Under the management system parameters described in this report, approximately 250m³ of solids storage is required each year, if the solids pond is emptied around October and March each season.

Based on the solids storage dimensions of 60m x 8m x 1.2 m, with a 1:1 batter, you currently have approximately 342.5m³ of solids storage capacity.

Good management is essential for solids storage this size.

Climate

Rainfall site: Woodlands Garvie Rd
Mean annual rainfall: 1031 mm/year

Effluent Block

Area of low risk soil: 135.0 hectares
Minimum area of high risk soil: 0.0 hectares
Surplus area of high risk soil: 22.0 hectares

Wash Water

Yard wash:

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

Month	Number of Cows	Hours in Yard	Wash Volume (cubic metres)
January	850	6.0	42.5
February	850	6.0	42.5

March	850	6.0	42.5
April	850	6.0	42.5
May	850	6.0	42.5
June	0	0.0	0.0
July	0	0.0	0.0
August	850	6.0	42.5
September	850	6.0	42.5
October	850	6.0	42.5
November	850	6.0	42.5
December	850	6.0	42.5

Animal shelter wash:

Month	Number of Cows	Hours in Shelter	Wash Volume (cubic metres)
January	0	0.0	0.0
February	0	0.0	0.0
March	0	0.0	0.0
April	0	0.0	0.0
May	0	0.0	0.0
June	0	0.0	0.0
July	120	24.0	0.0
August	120	24.0	0.0
September	120	24.0	0.0
October	120	24.0	0.0
November	0	0.0	0.0
December	0	0.0	0.0

Irrigation

Winter-spring depth:	4 mm
Spring-autumn depth:	8 mm
Winter-spring volume:	80 cubic metres
Spring-autumn volume:	160 cubic metres
Irrigate all year?	Yes

Catchments

Yard Area:	1484 square metres
Diverted?	Yes
- diversion start:	01 June
- diversion end:	31 July
Shed Roof Area:	342 square metres
Diverted?	No
Feedpad Area:	0 square metres
Covered?	No
Diverted?	No
Animal Shelter Area:	1200 square metres
Covered?	No
Diverted?	No
Other Areas:	621 square metres

Storage

Pond/s present?	Yes
No. of ponds:	1 pond/s
Includes irregular ponds?	No

Pond 1

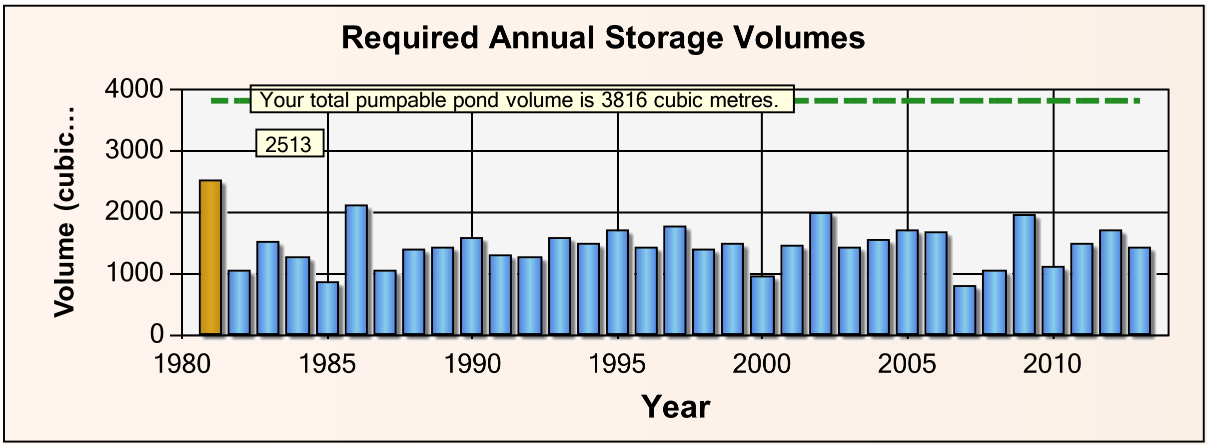
- total volume:	4719 cubic metres
- pumpable volume:	3816 cubic metres
- surface area:	1892 square metres
- width:	43.0 metres
- length:	44.0 metres
- batter:	2.0:1
- total height:	3.5 metres
- pumped?	Yes
Tank/s present?	No
Emergency storage period:	3 days

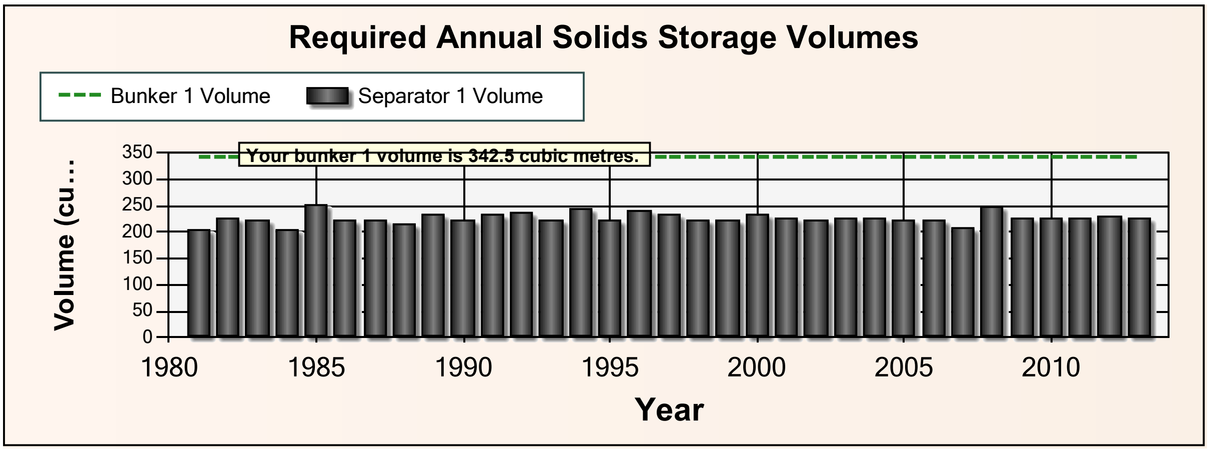
Solids Separation

Solids separator/s present?	Yes	
No. of separators:	1 separator/s	
Separator 1		
- dry matter:	20 %	
- source/s:	Yard	
- separation starts:	01 August	
- separation ends:	31 July	
- bunker surface area:	480.0 square metres	
- bunker volume:	342.5 cubic metres	
- minimum SWD:	10 mm	
- minimum 4 day SWD excess:	10 mm	
- bunker emptied on these dates:	05 March	10 October

Outputs

Maximum required storage pond volume:	2513 cubic metres
90 % probability storage pond volume:	1940 cubic metres
Maximum required solids bunker volume:	250.7 cubic metres
During the period from:	01 July 1980
To:	30 June 2013




Required Annual Solids Storage Volumes
Bunker 1 Volume
Separator 1 Volume
Your bunker 1 volume is 342.5 cubic metres.
Volume (cu...
350
300
250
200
150
100
50
0
1980
1985
1990
1995
2000
2005
2010
Year

Dairy Green Ltd

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PIOBIARE WINTERING SHED EFFLUENT CALCULATIONS

For

Mr. Nelson Pyper

1011 Lochiel Branxholme Road

May 2019

Discharge consent Auth 300998 – V1

J SCANDRETT

DAIRY GREEN LTD

Piobiare Wintering Shed Effluent Loading

Assumptions

Information provided by Nelson Pyper is as follows:

Allow for 440 cows to be in the shed from 15 May to 15 August in any one year.

The feeding allowance is 12kgDM/hd/day.

Allow for 200 r2yr heifers to be in the shed for 14 days in the autumn.

Allow for 200 1yr old calves to be in the shed for 21 days in the spring, after the cows have gone.

For simplicity I have allowed the heifers to have the same feeding allowance as the cows and the calves 8kgDM/hd/day.

The NZAEI waste manual records an allowance of 40kg dung and urine for a 500kg cow fed a harvested ration. I will assume 75% digestibility for the feed and 25% DM for the separated solid.

The effluent is pumped through a mechanical screw press separator, the expected liquid flow to the effluent pond will be 28L/cow/day, worst case.

There will also be the volume of rainfall that falls on the pond. The original consent application in 2011 used 4 months rainfall of 610m^3 as an allowance.

Loadings

Cows

440 x 28L x 92 days = 1,133m^3.

Heifers

200 x 28L x 14 days = 78m^3.

Calves

200 x 18.5L x 21 days = 78m^3.

Rainfall on pond

Allowance = 610m^3.

Total Loading = 1,899m^3.

Attachment E: Water Quality Technical Comment

AERODROME EXPANSION TECHNICIAL WATER QUALITY ASSESSMENT

Date:	2 May 2019	File Ref:	18250
To:	Zoe McCormack, Senior Planner		
From:	Mike Freeman, Senior Scientist/Planner		
Subject:	**Water quality effects assessment for Aerodrome Farm Ltd dairy expansion & Piobiare Wintering Activities**		

1. Background

Aerodrome Farm Limited (the applicant) owns an existing dairy farm located approximately 2 km north of Invercargill.

The applicant proposes to increase the size of the dairy platform from 266.8 ha to 315 ha and increase peak milked cow numbers from 800 (consented) to 850. Currently, the new land is primarily operated as a sheep farm, with a rotational vegetable crop.

The purpose of this report is to provide information on existing water quality in the vicinity of the proposed expansion in the context of relevant water quality standards and guidelines, to indicate the likely effects of the proposal on existing water quality and to identify if any mitigation may be needed to assist in achieving water quality objectives where water quality guidelines/standards are not being achieved.

This report contributes to the Assessment of Environmental Effects that accompanies the resource consent applications associated with the proposed development.

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2. Soil and physiographic environment

The soils and physiographic zones have been described in detail in the main AEE together with the implications for contaminant loss and are not repeated here.

3. Receiving water bodies

The Aerodrome property (existing dairy and proposed dairy) is spread across the upper catchment of the Waikiwi Stream and Myross Bush Creek that feed the main Waikiwi Stream that subsequently feeds into the Oreti River as indicated in the following figure. There is a long-term water quality monitoring site for the Waikiwi Stream downstream of the property at North Street.

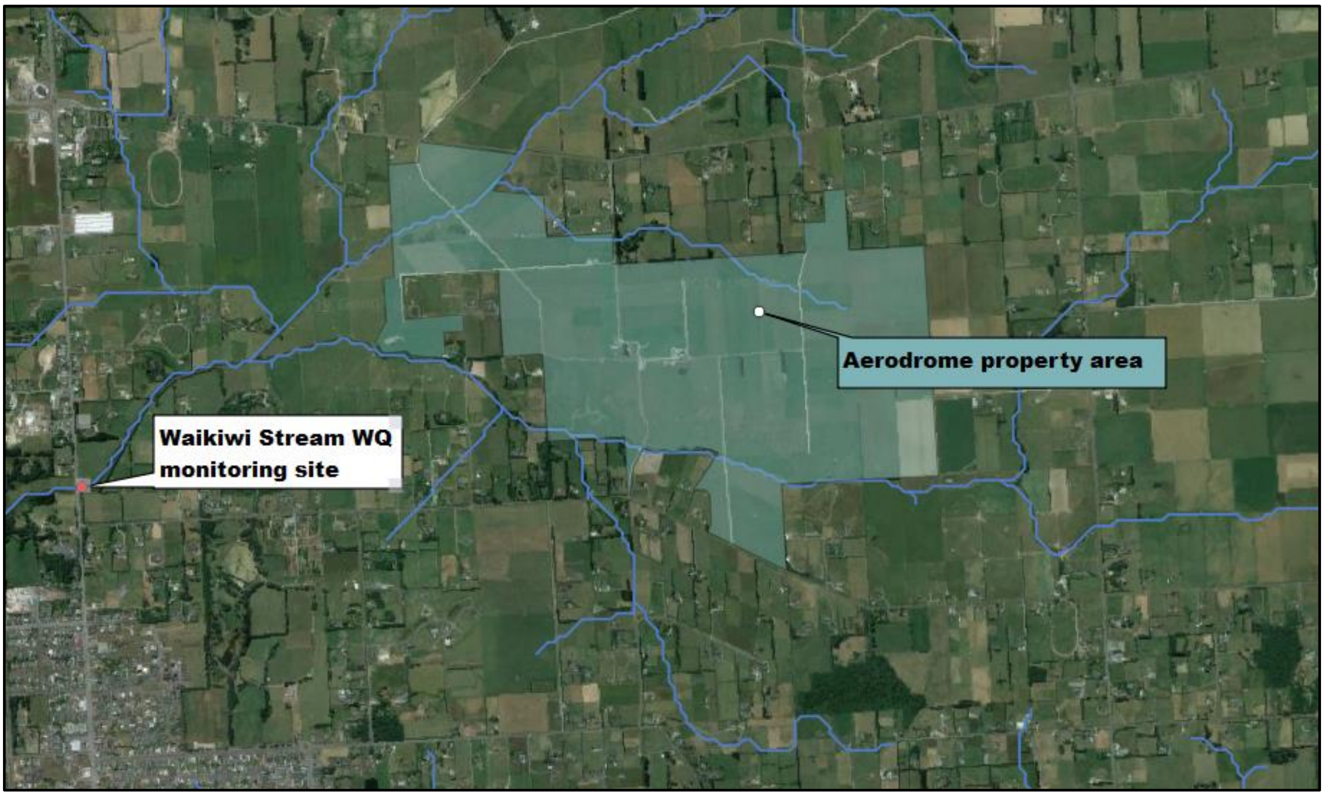

Figure 1: Location of Aerodrome property and catchment above Waikiwi Stream monitoring site

The overall catchment area for the Waikiwi Stream upstream of the North Street monitoring site is approximately 118 km^2 (NIWA, REC 2018). The land use in the catchment is predominantly sheep and beef, dairying and grain growing. The soils in the catchment are mainly silty loam soils that are well drained but also provide for significant run-off during rainfall events. The implications of the soils in the catchment for the loss of contaminants to water are explained in relation to the Aerodrome property in the AEE. Those conclusions also apply generally to the majority of the catchment.

The Piobiare Homestead block is identified on Beacon as contained in the Makarewa River catchment, but topographical information and NIWA/MfE river flow data indicates that surface drains flow through from the property to the Tomoporakau Creek that flows into the Makarewa River which feeds into the Oreti River. As indicated in the following figure.

There is a long-term water quality monitoring site for the Makarewa River at Wallacetown. While this site is upstream from the location of the confluence of the Tomoporakau Creek and the Makarewa River it is the only site in this general area and has been included in this assessment as an indicator of surface water quality in the general vicinity of the Piobiare Homestead block.

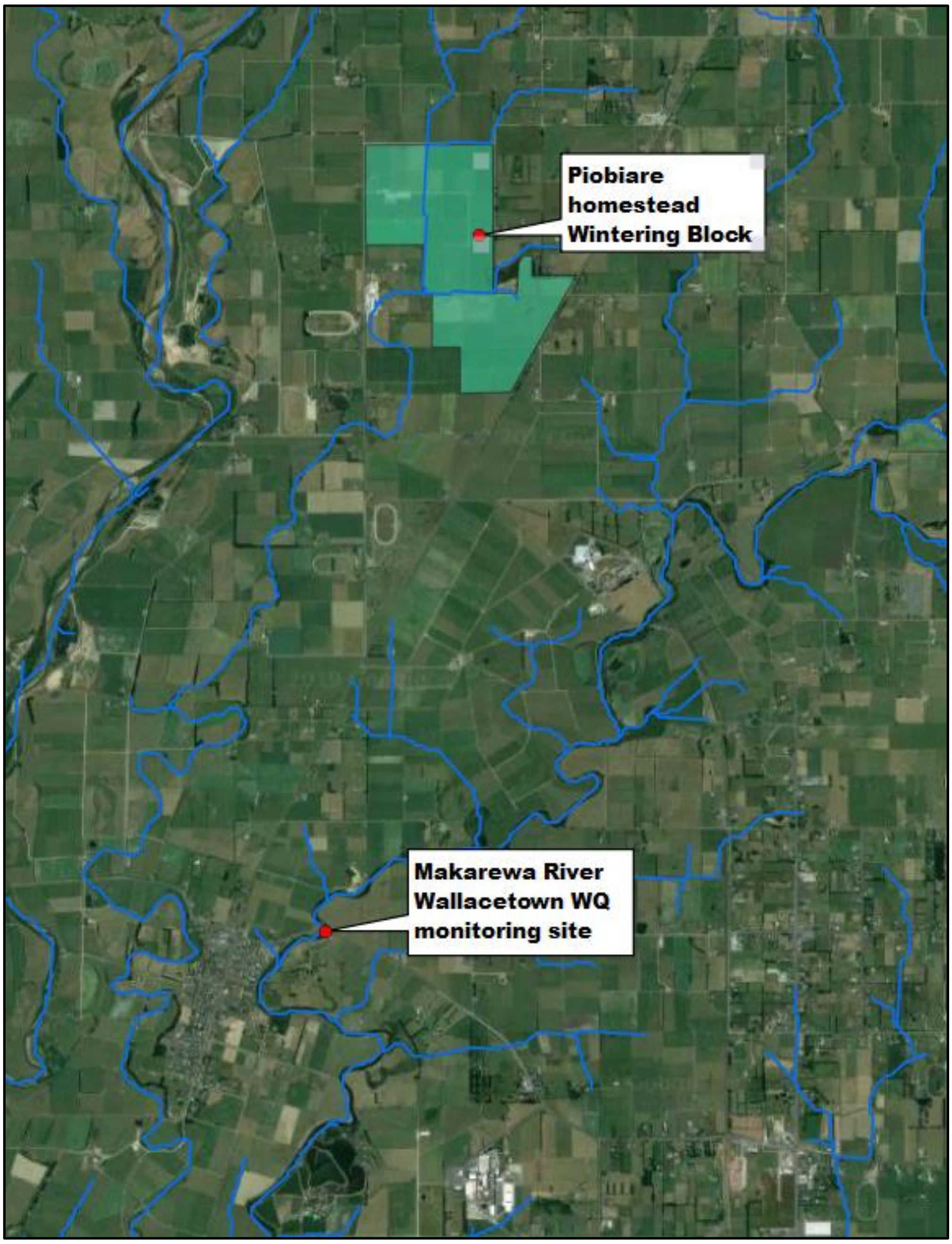

Figure 2: Location of the Piobiare Homestead block showing the headwaters of the Tomoporakau Creek and the Makarewa River

The Aerodrome property is underlain by groundwater that is part of the Waihopai groundwater management zone (as specified in the PSWLP), and the Piobiare Homestead block is in the Lower Oreti groundwater management zone. There does not appear to be any specific technical reports on groundwater hydrogeology in either area. However, information used to inform the PSWLP process (LWP 2017[1]) strongly indicates that the groundwater in both these areas is primarily recharged via rainfall, groundwater discharge is primarily to drains and streams in the area, and the general direction of groundwater flow is south westerly for both properties.

4. Statutory water quality objectives and standards

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

Under the SRWP and the PSWLP, surface water bodies on the properties appear[2] to be classified as lowland hard and lowland soft bed (Aerodrome) and spring-fed (Piobiare) streams. Table 1 summarises the values associated with these water body types as specified in the SRWP. The PSWLP does not establish values for rivers and streams. However, the relevant regional objectives in the PSWLP are also provided in Table 1.

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

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

Table 1: Summary of key regional plan surface water values & objectives for water in the two locations

Regional Plan	*Classification*	*Values/objectives specified in the relevant plan*
Southland Regional Water Plan 2010 Objective 3	Lowland soft & hard bed	- Bathing in those sites where bathing is popular; - Trout where present, otherwise native fish; - Stock drinking water; - Ngāi Tahu cultural values, including mahinga kai; - Natural character including aesthetics.
Proposed Southland Water and Land Plan Objectives 3, 6, 7, & 8	Lowland soft; lowland hard bed (Aerodrome) Spring fed (Piobiare)	3 The mauri (inherent health) of waterbodies provide for te hauora o te tangta (health of the people), te hauora o te taiao (health of the environment) and te hauora o te wai (health of the waterbody) 6 There is no reduction in the quality of freshwater and water in estuaries and coastal lagoons by, (a) maintaining the quality of water in waterbodies, estuaries and coastal lagoons, where the water quality is not degraded; and

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

[2] It is difficult to find an explicit linkage from all the PSWLP Appendix E water quality standards to the maps contained in the separate Maps volume of the PSWLP.

Regional Plan	Classification	Values/objectives specified in the relevant plan
		(b) improving the quality of water in waterbodies, estuaries and coastal lagoons, that have been degraded by human activities. 7 Any further over-allocation of freshwater (water quality and quantity) is avoided and any existing over-allocation is phased out in accordance with freshwater objectives, freshwater quality limits and timeframes established under Freshwater Management Unit processes. 8 (a) The quality of groundwater that meets both the Drinking Water Standards for New Zealand 2005 (revised 2008) and any freshwater objectives, including for connected surface waterbodies, established under Freshwater Management Unit processes is maintained; and (b) The quality of groundwater that does not meet Objective 8(a) because of the effects of land use or discharge activities is progressively improved so that: (1) groundwater (excluding aquifers where the ambient water quality is naturally less than the Drinking Water Standards for New Zealand 2005 (revised 2008)) meets the Drinking Water Standards for New Zealand 2005 (revised 2008); and (2) groundwater meets any freshwater objectives and freshwater quality limits established under Freshwater Management Unit processes

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

The detailed policy assessment is contained in the AEE.

5. Existing water quality in the vicinity and downstream of the properties

5.1 Surface water quality

The following tables and figures provide summary information on the quality of surface water and groundwater in the vicinity of the proposed dairy expansion and associated wintering activities at Piobiare. This water quality information is compared to the most relevant guidelines, specifically the National Objective Framework (NOF) attributes (e.g., *E. coli*, clarity (black disc), dissolved reactive phosphorus, ammonia, etc.) contained within the National Policy Statement Freshwater Management (2017), the PSWLP Appendix E Water Quality 'Standards' (referenced primarily via Policy 16 of the PSWLP), and the Australia New Zealand Environment and Conservation Council (ANZECC) water quality 'trigger values'[3].

The stream definitions (Spring-fed and Lowland Hard Bed) noted earlier provide direction for both the PSWLP water quality standards and also provide some indication of the likely natural background water quality.

[3] Water quality that exceeds an ANZECC trigger value indicates marginal water quality for supporting ecosystem health If the median value of a water quality variable for a particular site exceeds the trigger value, then it is intended to 'trigger' an investigation response to identify the cause and significance of the degraded water quality. (Hart, B.T., Maher, B., & Lawrence, I. (1999) New generation water quality guidelines for ecosystem protection. Freshwater biology 41: 347-359).

Table 2: Summary of State and Trend at the Waikiwi Stream North Road Monitoring Site

Primary WQ indicators	State	National Objective Framework (NOF) Band Annual Median (2008 – 2017) PSWLP Maximum (2018)	Trend identified by LAWA	PSWLP water quality standard (Lowland Hard Bed), ANZECC[∞] trigger values and comments
E. Coli	In the worst 25% of all lowland rural sites	E – For more than 30% of the time, estimated risk is >5% and average infection risk is >7% 5-year median = **495 n/100ml** Maximum = **1,300 cfu/100ml**	Likely Improving	≤1,000/100ml Faecal coliforms[#] *Comment - Highly unlikely to meet standard*
Clarity (Black Disc)	In the worst 50% of all lowland rural sites	No NOF attribute set 5-year median = **1.085 metres**	Not Assessed	≥ 1.6 m when flow below median flow, *Comment - Unlikely to meet standard (flows not measured)*
Total Oxidised N	In the worst 25% of all lowland rural sites	C – Growth effects on up to 20% of species (mainly sensitive species such as fish). No acute effects. 5-year median = **2.65 g/m^3** Maximum = **5.1 g/m^3**	Likely Improving	≤0.444 g/m^3 (ANZECC, 2000)* *Comment - Significantly greater than this trigger value*
Ammoniacal N	In the worst 25% of all lowland rural sites	A – 99% species protection level. No observed effect on any species tested. 5-year median = **0.019 g/m^3** Maximum = **0.07 g/m^3**	Not Assessed	<2.5-0.9 (pH 6.0-8.0) *Comment - Meets standard*
Dissolved Reactive P	In the best 50% of all lowland rural sites	No NOF attribute set 5-year median = **0.011 g/m^3** Maximum = **0.01 g/m^3**	Indeterminate	≤0.01 g/m^3 (ANZECC, 2000)* *Comment - Just greater than this trigger value*
Macroinvertebrate Community Index	Poor	MCI less than 80. Stream in poor ecological condition.	Likely Improving	>90 *Comment - Doesn't meet standard*
Appendix E PSWLP Water Quality stds.		**Observed WQ range 2018(one year of records)**		**PSWLP water quality standard (Lowland Hard Bed)**
Temperature		4 – 17.3 °C		≤23°C
pH		6.4 – 7.6		6.5 – 9.0 *Comment - Doesn't meet standard. Possible natural cause.*
Sediment cover		Not sampled/assessed by ES		
Dissolved oxygen		44% - 151%		> 80 % sat. *Comment - Doesn't meet standard*
Bacterial/fungal slime		Not sampled/assessed by ES		
Filamentous algae		Not sampled/assessed by ES		
Fish		Not sampled/assessed by ES		

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

Table 3: Summary of State and Trend at the Makarewa River Wallacetown Monitoring Site (The site is close to the Piobiare Block but not in the primary downstream catchment area)

Primary WQ indicators	State	National Objective Framework (NOF) Band Annual Median (2008 – 2017) PSWLP Maximum (2009 - 2018)	Trend identified by LAWA	PSWLP water quality standard (Lowland Soft Bed) & ANZECC∞ trigger values and comments
E. Coli	In the worst 25% of all lowland rural sites	E – For more than 30% of the time, estimated risk is >5% and average infection risk is >7% 5-year median = **335 n/100ml** Maximum = **14,000 cfu/100ml**	Indeterminate	≤1,000/100ml Faecal coliforms# Comment - Highly unlikely to meet standard
Clarity (Black Disc)	In the worst 50% of all lowland rural sites	No NOF attribute set 5-year median = **0.84 metres**	Not Assessed	≥ 1.3 m when flow below median flow, Comment - Unlikely to meet standard
Total Oxidised N	In the worst 25% of all lowland rural sites	B – Some growth effects on up to 5% of species. 5-year median = **0.895 g/m³** Maximum = **4.18 g/m³**	Very likely Improving	≤0.444 g/m³ (ANZECC, 2000)* Comment - Greater than this trigger value
Ammoniacal N	In the worst 25% of all lowland rural sites	B – 95% species protection level: Starts impacting occasionally on the 5% most sensitive species. 5-year median = **0.0495 g/m³** Maximum = **0.36 g/m³**	Likely improving	<2.5-0.9 (pH 6.0-8.0) Comment - Meets standard
Dissolved Reactive P	In the best 50% of all lowland rural sites	No NOF attribute set 5-year median = **0.019 g/m³** Maximum = **0.10 g/m³**	Indeterminate	≤0.01 g/m3 (ANZECC, 2000)* Comment - Greater than this trigger value
Macroinvertebrate Community Index	Fair	5-year median = 87. Indicative of only fair water quality and/or habitat condition.	Likely Improving	>90 Comment - Doesn't meet standard
Appendix E PSWLP Water Quality stds.		**Observed WQ 2018 (one year of records)**		**PSWLP water quality standard (Lowland Soft Bed)**
Temperature		2 – 20.5°C		≤23°C Comment – Meets standard
pH		6.7 – 7.8		6.5 – 9.0 Comment - Meets standard
Sediment cover		Not sampled/assessed by ES		
Dissolved oxygen		63% - 125%		> 80 % sat. Comment - Doesn't meet standard
Bacterial/fungal slime		Not sampled/assessed by ES		
Filamentous algae		Not sampled/assessed by ES		
Fish		Not sampled/assessed by ES		

∞Australian and New Zealand Environment and Conservation Council, 2000, Australian and New Zealand guidelines for fresh and marine water quality.

PSWLP standard is ≤1,000 faecal coliforms/100 ml. However, *E. coli* is monitored. *E coli* are a subset of faecal coliforms.

* ANZECC trigger values for investigation. These have no legal status in NZ and are included as a reference point only.

These data indicate that water quality in the Waikiwi Stream is significantly degraded, does not appear to be consistent with all of the objectives identified in relevant regional plans and does not meet all the relevant numerical standards or guidelines. It is not possible to provide a comprehensive interpretation of water quality in the context of the PSWLP water quality standards because not all the water quality standards are monitored and determining compliance with the water clarity standard requires concurrent flow gauging which is not undertaken by Environment Southland.

The four most significant water quality related issues in Waikiwi Stream appear to be:

1. Poor ecological status of the macroinvertebrate community;
2. High concentrations of faecal indicator microorganisms;
3. Raised nutrient concentrations leading to plant growth in the stream and further downstream; and
4. Apparent poor water clarity.

The poor macroinvertebrate community index (MCI) is normally the result of significant stressors on the macroinvertebrate community. This is most commonly the result of fine sediment being deposited on the stream bed and/or by 'swamping' the habitat with plant growth. However, there are a range of additional factors that could contribute to a low MCI, for example, bed stability, dissolved oxygen, temperature, etc. The apparent poor water clarity may be indicative of raised suspended solids in the water column that could impact the macroinvertebrate community. However, the poor water clarity may also indicate discolouration of the water column which is quite possible given the presence of peat soils in parts of the catchment (such as Ottway soils on Aerodrome).

The relatively wide range of pH values are relatively unusual and may reflect the impact of significant periphyton and macrophyte growths. It is also possible that the poor ecological status of the macroinvertebrate community may in part be contributed to by high pH values.

While nitrate nitrogen concentrations in the Waikiwi Stream have been rated as 'B' under the NOF attribute, this value has been set on the basis of nitrate toxicity rather than for nitrogen (N) as a nutrient. In the context of nitrate N as a nutrient both it and DRP concentrations are relatively high (using ANZECC triggers as a guide). This has the potential to accelerate the growth of macrophytes, periphyton and, lower down in the catchment, in the New River Estuary, phytoplankton and macroalgae. It has not been possible to provide a more definitive assessment of the status of periphyton in the Waikiwi Stream because this has not been monitored.

The relatively frequent high concentrations of faecal indicator microorganisms mean that this location would generally not be suitable for swimming or other similar water contact recreation (i.e., LAWA explanation is that this means that "for more than 30% of the time, estimated risk is >5% and average infection risk is >7%") and would also generally have implications for microbiological quality further downstream.

A visual inspection carried out by Landpro staff upstream of the water quality monitoring site in early March 2019 indicated that much of the Waikiwi Stream in this area has a pebbly substrate with significant macrophyte and periphyton growth.

The LAWA water quality monitoring information only goes up to December 2017. Additional information was provided separately from Environment Southland in an Excel file (included in Table 2 & 3). A comprehensive statistical comparison of this dataset with the LAWA statistical summaries has not been undertaken but a review of median values for the 2018 monitoring period indicated that it is unlikely that there are significant changes from the summary data reported in tables 2 and 3.

The water quality information for the Makarewa River at the Wallacetown site (Table 2) are provided to give an indication of what surface water quality could be in the surface waters that receive run-off/drainage from the Piobiare property. In summary, the quality of the Makarewa River in this location appears to have slightly better quality than the Waikiwi Stream but otherwise has similar issues. While there is no long-term water quality monitoring data for the Tomoporakau Creek downstream of the property, some limited water quality investigations undertaken as part of investigations into land management practices at the former Southland Demonstration Farm in 2012[4] and 2016[5] indicate that average nitrate nitrogen and dissolved reactive phosphorus concentrations are significantly higher (~5 g NO_3-N /m^3 and ~0.03 g/m^3 respectively) in this creek compared to concentrations in the Waikiwi Stream.

[4] https://www.massey.ac.nz/~flrc/workshops/14/Manuscripts/Paper_Cameron_2014.pdf
[5] http://flrc.massey.ac.nz/workshops/16/Manuscripts/Paper_Jackson_2016.pdf

Figure 1:View of Waikiwi Stream looking downstream at the western end of the Aerodrome property

Figure 2: View of Stream bed of Waikiwi Stream at western end of Aerodrome Property

Figure 3: View of Tomopokorau Stream from middle of Piobiare property looking upstream

Figure 4: View of Myross Creek looking downstream at southern end of Aerodrome Property

While these descriptions indicate the specific water quality issues that exist in the Waikiwi Stream and the slightly better water quality in the Makarewa River, both water bodies have a significant number of water quality variables where the data reported by LAWA indicate a recent trend of improving quality, specifically *E. coli*, total oxidised nitrogen and MCI for the Waikiwi Stream, and total oxidised nitrogen and MCI for the Makarewa River. I have not attempted to undertake a review of recent statistical trends. This would be a significant technical task and would not provide any further essential information. However, some of the recent data indicate that some of the reported LAWA trends are likely to be revised.

5.2 Groundwater Quality

The results of Environment Southland's survey of regional nitrate nitrogen concentrations are provided as a layer within the Beacon public GIS system (Figure 5) and indicates that the Aerodrome property is in an area where the underlying unconfined groundwater was likely to have been primarily between 3.5 – 8.5 mg/l of nitrate nitrogen between 2007 – 2012, or indicative of moderate to high land use impacts. The Piobiare property is identified in a location with slightly better groundwater quality i.e., indicative of "minor to moderate land use impacts". However, the amount of information that supports this contour map may not always sufficient to justify making significant conclusions about the differences in groundwater quality in different locations.

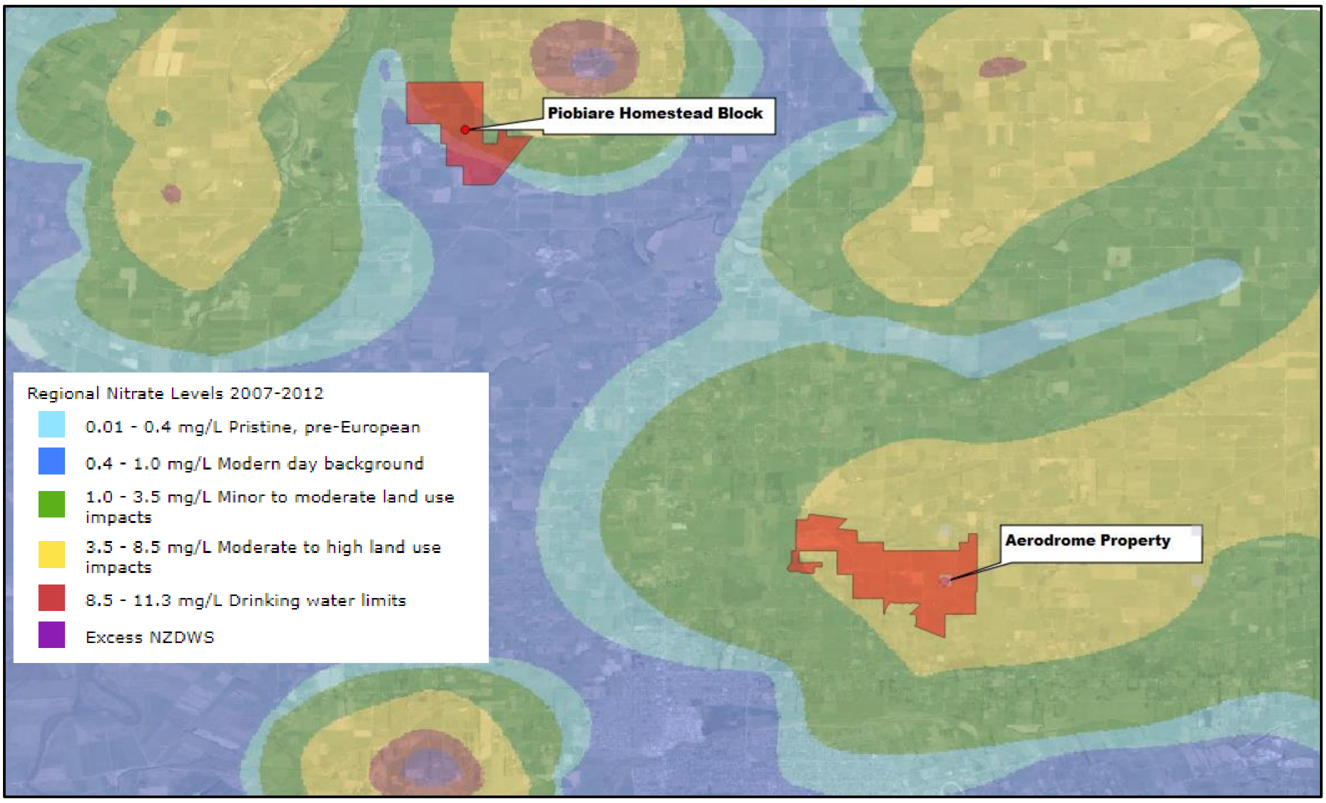

Figure 5: Environment Southland groundwater nitrate nitrogen contour estimates for the period 2007 – 2012 with location of properties overlaid

Interpretation of this data should be done with great care because there are a limited number of results that have been used as the basis for developing these groundwater quality contours, and the source data includes results from a very wide range of bores. Some of these bores are relatively shallow (<10 m depth) and may represent a significant proportion of drainage water quality rather than being representative of unconfined saturated groundwater in the area (majority of water supply bores in the area are between 10 – 20 m depth). It is also not clear what extent of wellhead protection exists for these bores, so for example, it is possible that some of these bores do not have adequate well head protection and some surface water with contaminants can move down the bore casing. In addition, there is some indication from the reported measurements of water levels that some bores in this area may be tapping a lower confined or semi-confined aquifer that may be separated in part from the overlying unconfined groundwater.

Some more recent groundwater quality data has been obtained from Environment Southland and while very little recent groundwater nitrate nitrogen data is available the highest nitrate nitrogen results for groundwater samples taken from each bore post 2012 is indicated for both property areas in the following two figures.

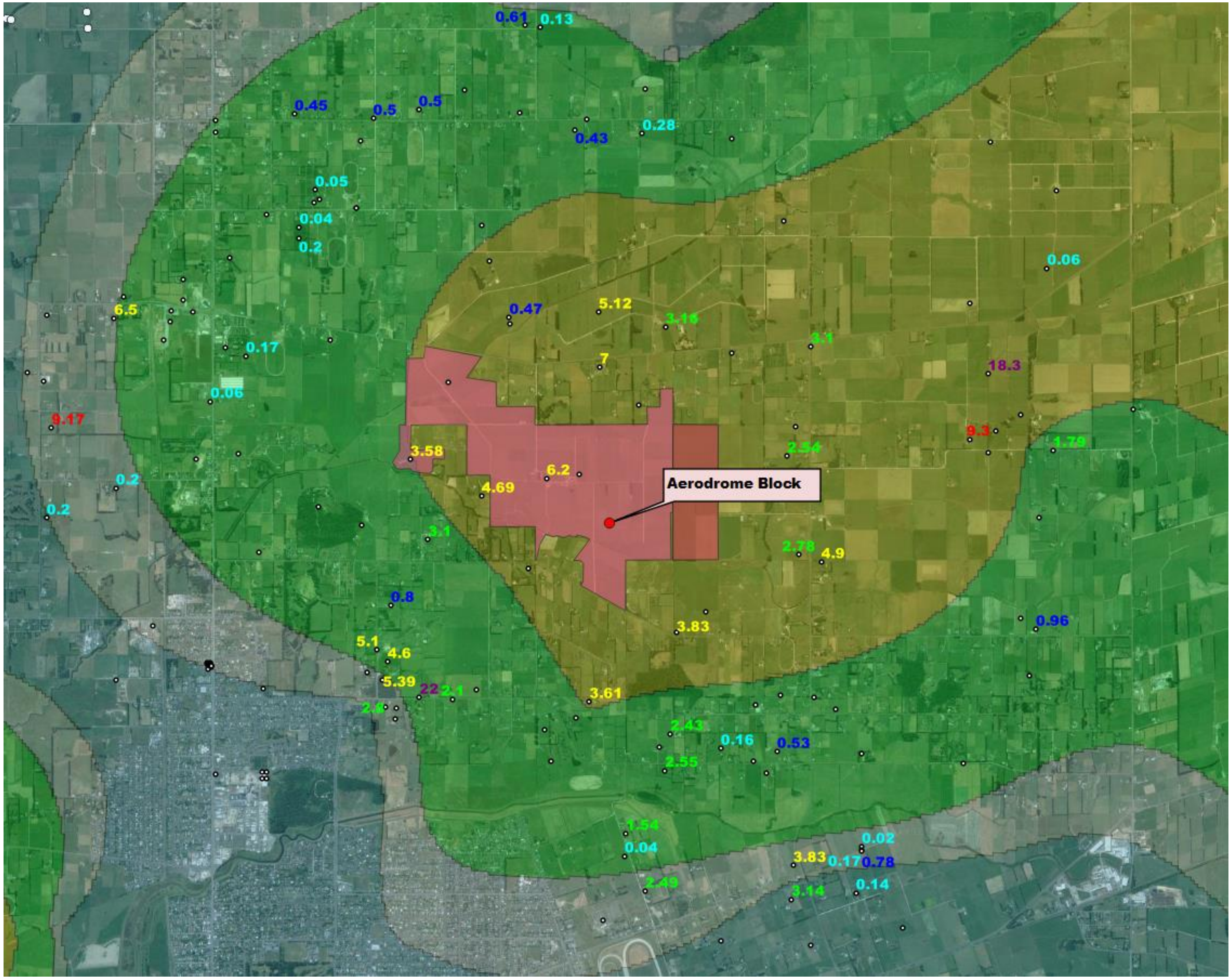

Figure 6: Maximum nitrate nitrogen concentrations (g/m^3) found in groundwater from bores in the general Aerodrome property area, 2013-2018 overlaid on top of the 2007-2012 groundwater quality survey results (colour coding is the same as used by ES in Figure 5)

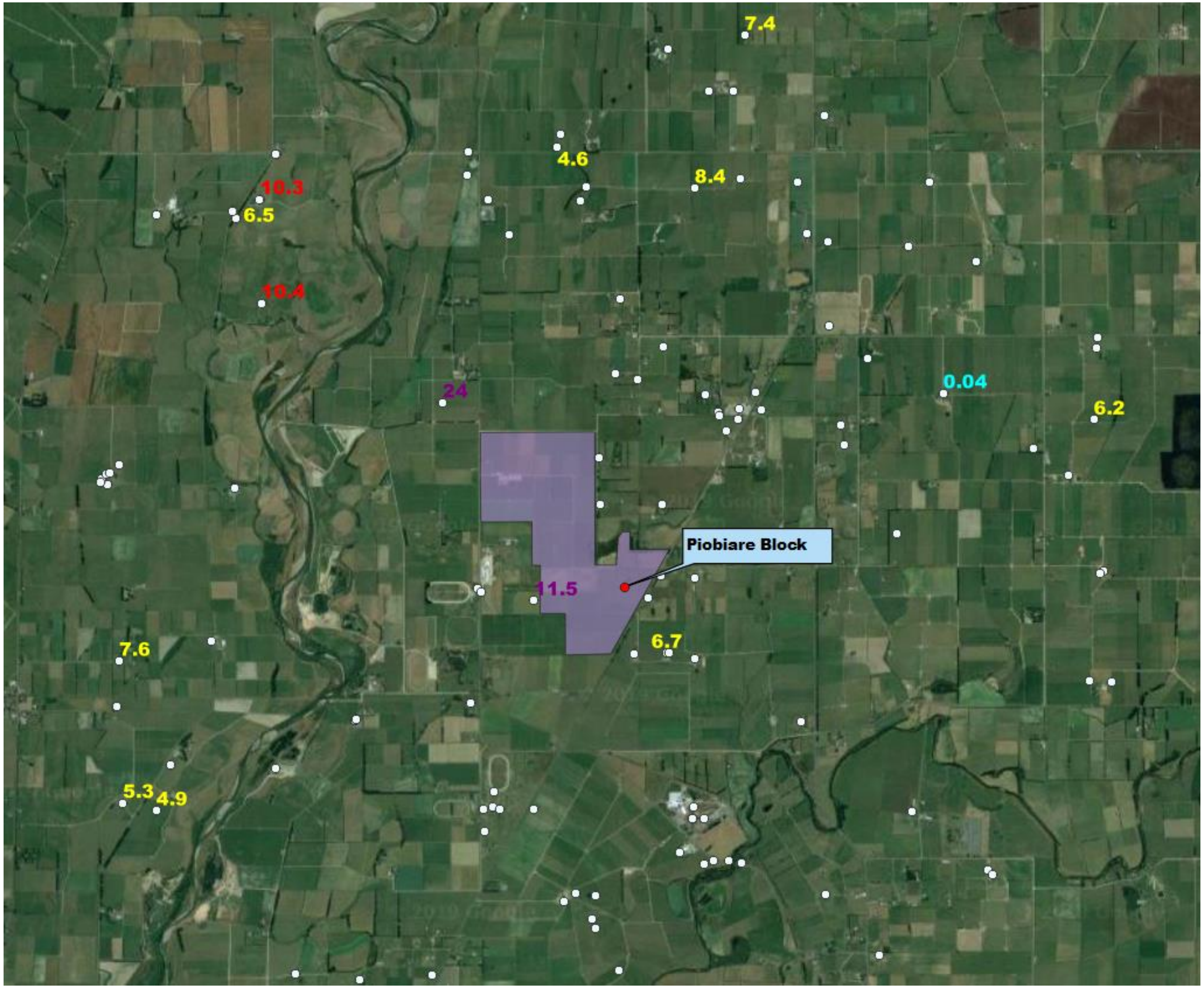

Figure 7: Maximum nitrate nitrogen concentrations (g/m^3) found in groundwater from bores in the general Piobiare property area, 2013-2018 overlaid on top of the 2007-2012 groundwater quality survey results (colour coding is the same as used by ES in Figure 5)

In the context of the highlighted interpretation issues it is difficult to be more definitive than to conclude that groundwater nitrate nitrogen concentrations in the general area of Aerodrome range indicate the relatively intensive land use in the area. Nitrate nitrogen concentrations are commonly between 2 – 8 g/m^3 but with examples of locations with higher values, occasionally exceeding the drinking water standard of 11.3 g/m^3.

In addition to the data interpretation issues identified above, neither the contour diagram nor the compilation of more recent groundwater quality data in Figure 6 indicate what trends if any exist in the Aerodrome area. There are only two bores in the Aerodrome property area that have had nitrate nitrogen monitored over a significant period of time, E46/0097 (2000 – 2018) and E46/0456 (2004 – 2016), approximately 500 m and 3 km respectively in a general upgradient (north east) direction from the property. Nitrate nitrogen concentrations of groundwater from these bores is illustrated in the following figures.

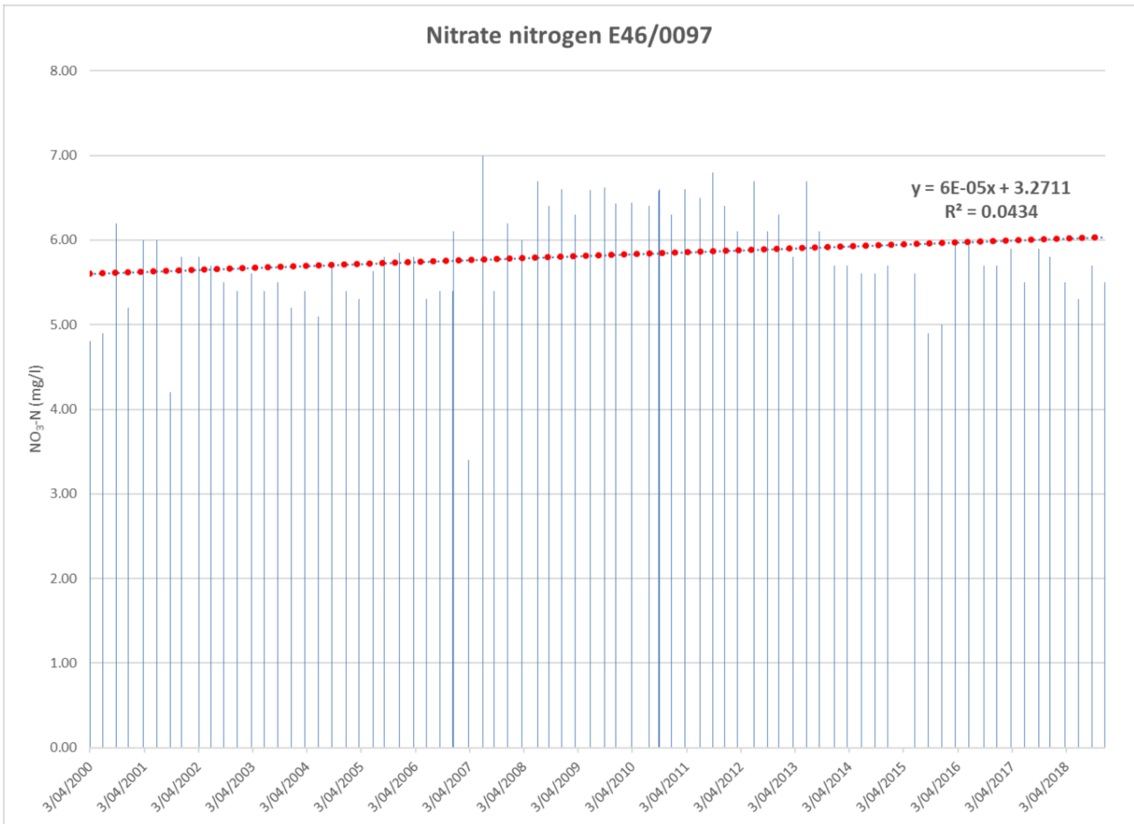

Figure 8: Nitrate nitrogen concentrations in groundwater from bore E46/0097, 2000-2018

Bore E46/0097 is the closest bore to the Aerodrome property (500 m upgradient of proposed property boundary) with long-term groundwater quality data. The results indicate that it is possible that there has been a small increase in concentrations over the past 18 years upgradient of the property. However, the R^2 value is extremely low (0.0434) which means that there is a very low confidence that there has been a real increase in nitrate nitrogen over this time period at this location.

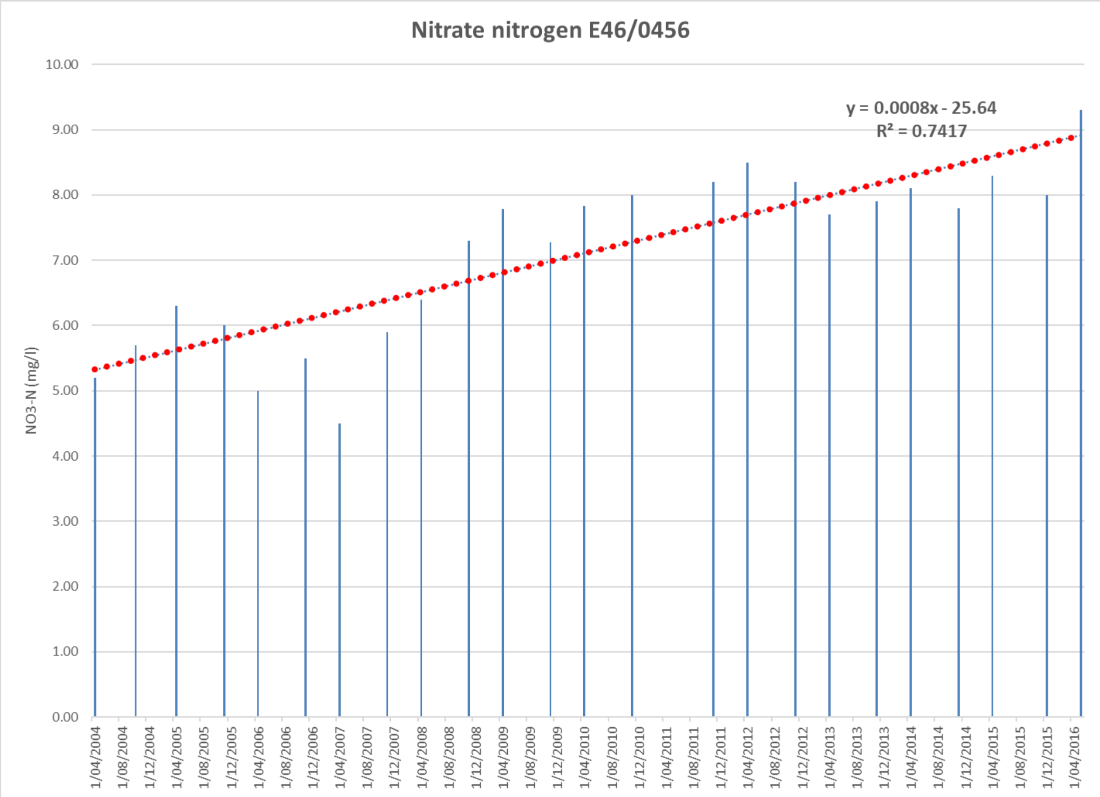

Figure 9: Nitrate nitrogen concentrations in groundwater from bore E46/0456, 2000-2018

Bore E46/0456 is approximately 3 km upgradient of the Aerodrome property and indicates that there was a significant trend of increasing nitrate nitrogen in groundwater at this location. The R^2 value of 0.7417 is relatively high and indicates that there is a high confidence level that this reflects a real trend.

Groundwater nitrate nitrogen concentrations in the Piobiare Block area appear to cover a wider range as indicated in Figure 7 with some groundwater nitrate nitrogen results greater than 10 g/m^3 and one bore (E46/0105) with groundwater with apparently high results over 20 g/m3.

Trends in groundwater nitrate nitrogen concentrations in the Piobiare area appear to be generally increasing with some locations not increasing. There is more long-term data for this area, and this is illustrated in the following figures.

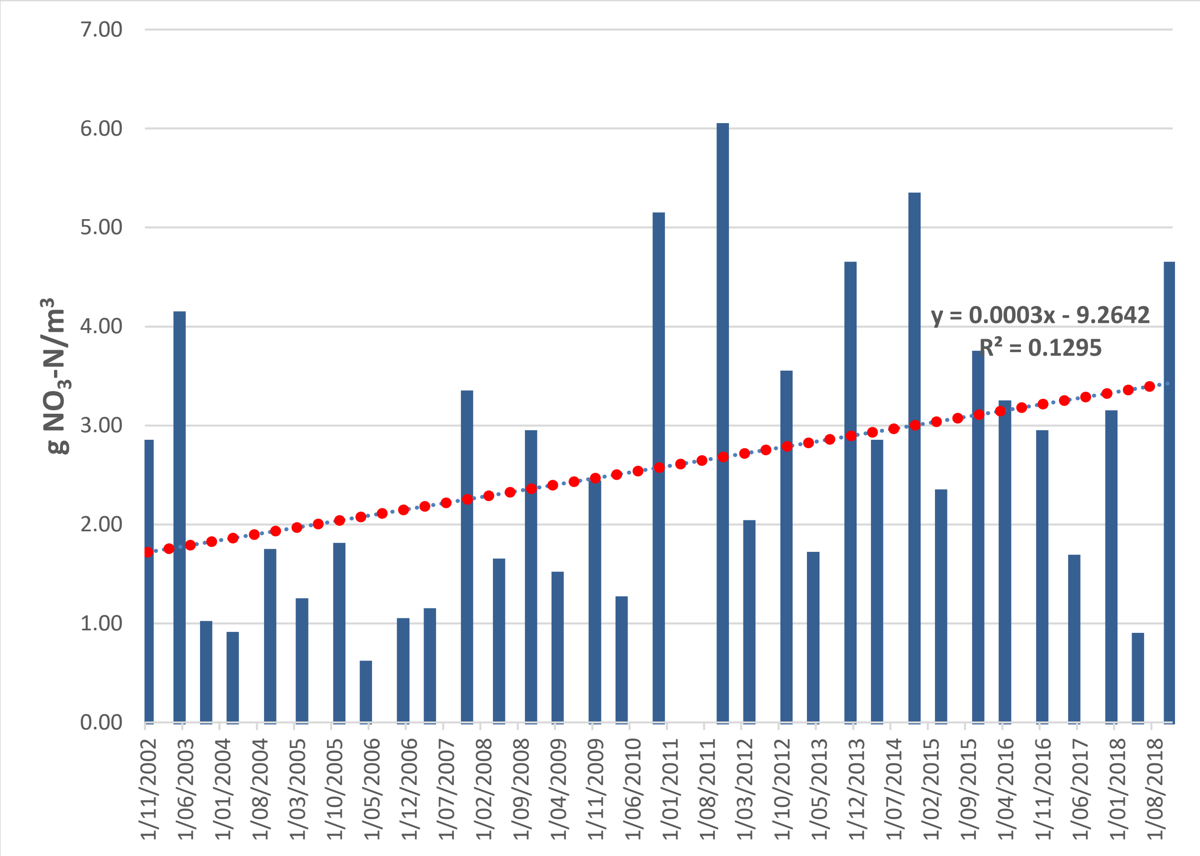

Figure 10: Nitrate nitrogen concentrations in groundwater from bore E46/0446, 2002-2018 (Yellow 5.3 on Figure 7)

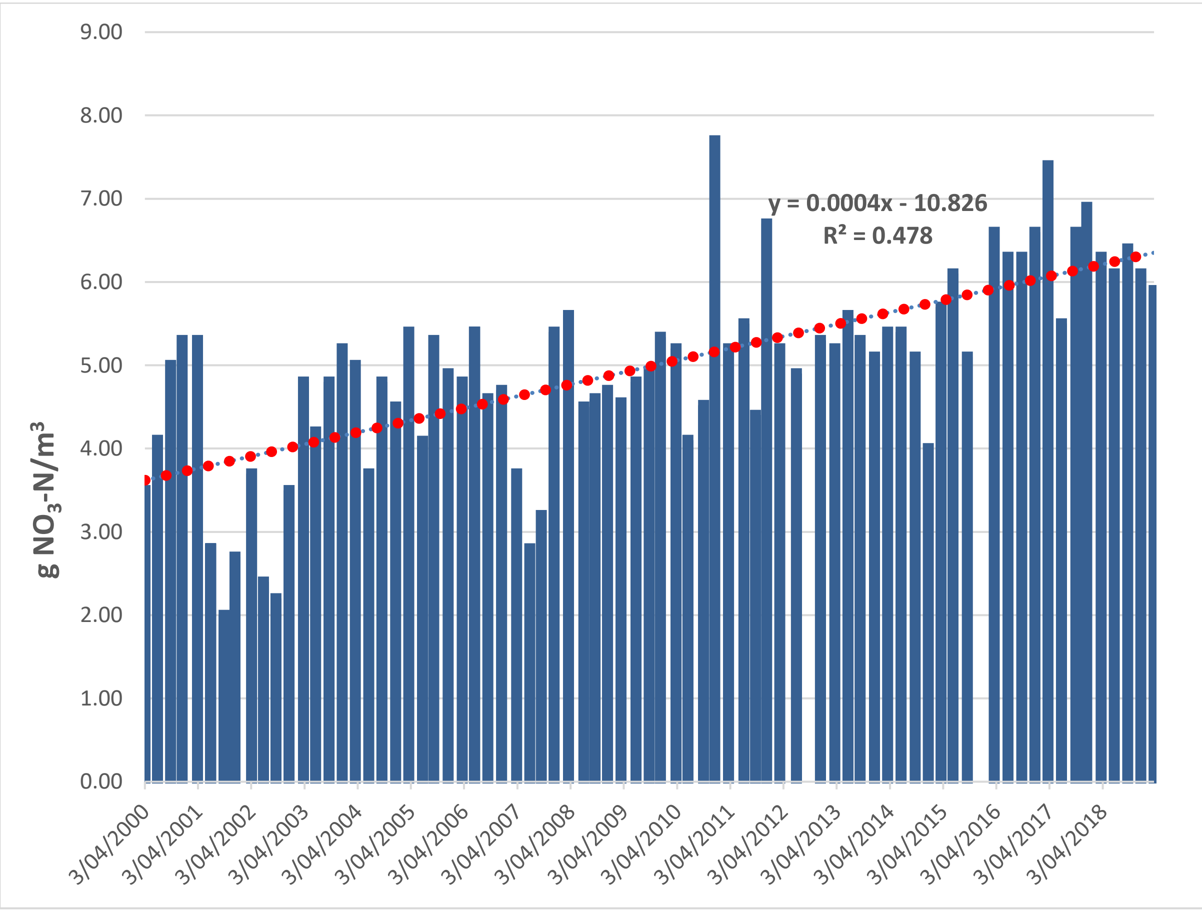

Figure 11: Nitrate nitrogen concentrations in groundwater from bore E46/0099, 2000-2018 (Yellow 7.4 on Figure 7)

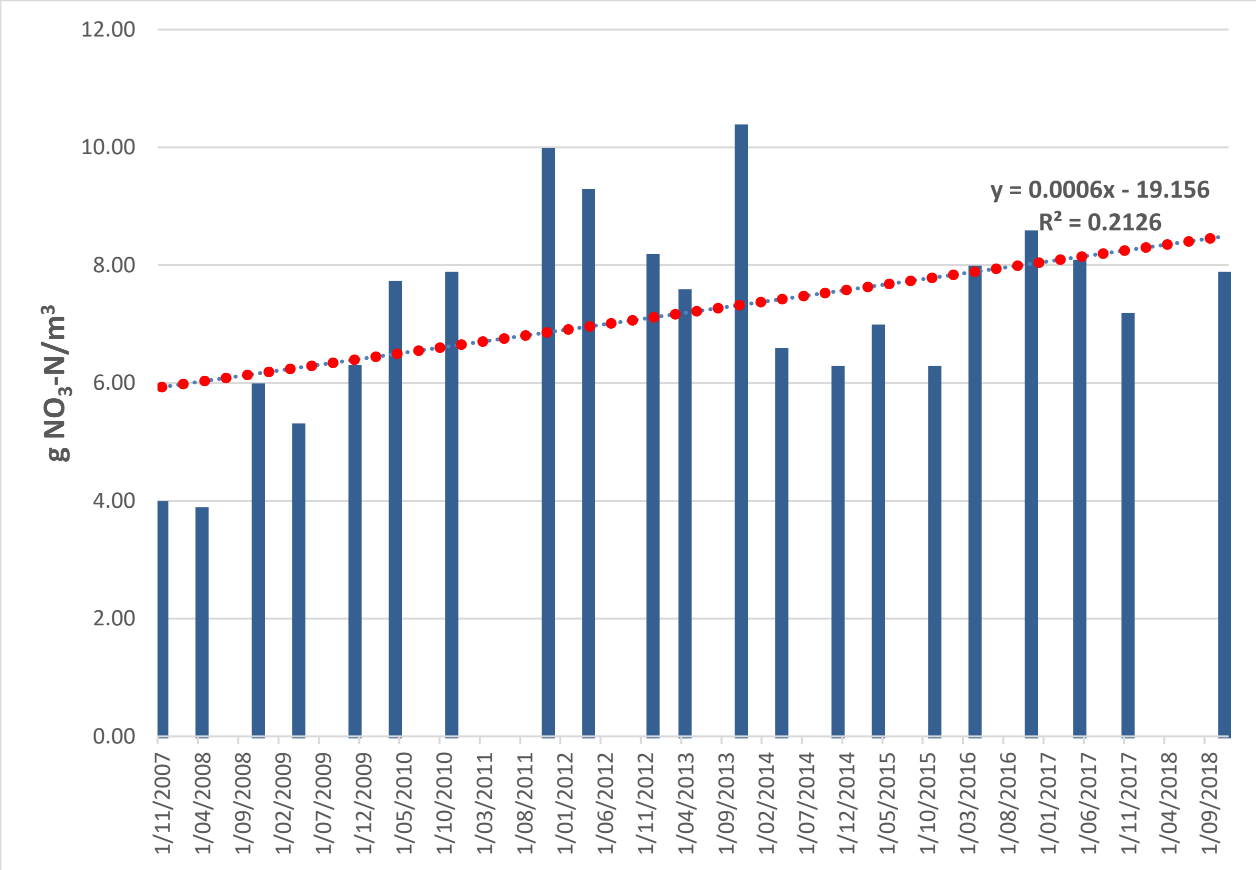

Figure 12: Nitrate nitrogen concentrations in groundwater from bore E46/0165, 2007-2018 (Red 10.3 on Figure 7)

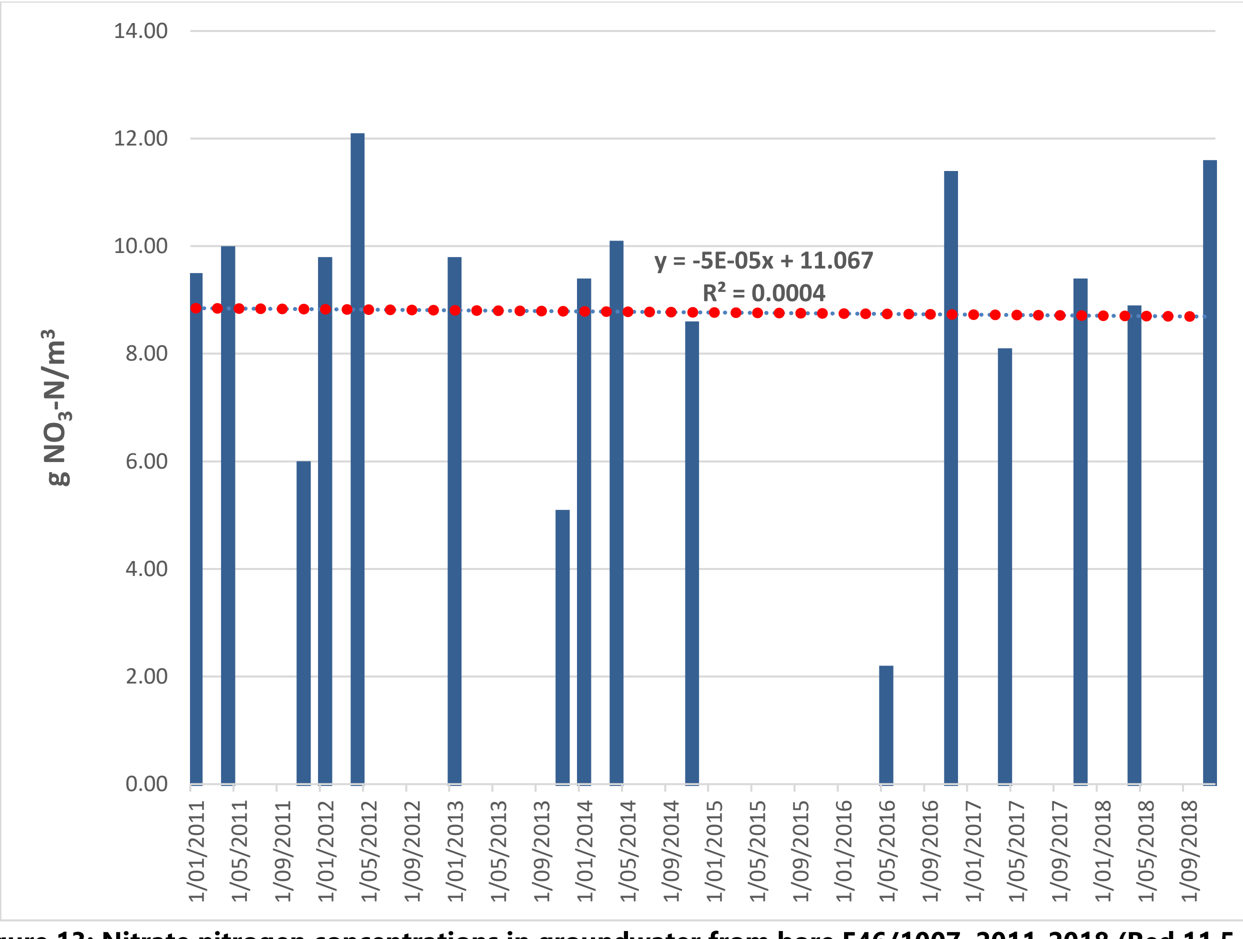

Figure 13: Nitrate nitrogen concentrations in groundwater from bore E46/1007, 2011-2018 (Red 11.5 on Figure 7)

In general, the groundwater quality data reflects the predominant rural land use in the catchment contributing to nitrate nitrogen leaching through to groundwater. The broader general issue is the discharge of groundwater with elevated nitrate nitrogen concentrations to surface waters rather than as a significant issue for the use of groundwater as a source of drinking water (drinking water nitrate nitrogen standard (maximum acceptable value) is 11.3 g/m^3), i.e., the contribution of nitrogen to surface waters contributes to plant growth in streams, and the subsequent rivers, and at the bottom of the catchment in the New River Estuary. However, in the Piobiare area concentrations of nitrate nitrogen in some locations are significantly higher and do not meet the drinking water standard of 11.3 g NO_3/m^3.

5.3 New River Estuary water quality

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

Table 4: Summary of intertidal opportunistic macroalgal cover, New River Estuary, February 2018[7]

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

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

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

the 2001-2018 period strongly indicates a significant decline from a 'good' state to a 'poor' state. The upper estuary has been particularly adversely affected by eutrophication. The Wriggle report concluded that "Ecological condition has consistently declined since monitoring commenced in 2001, and particularly since 2007", and the estuary is "...exhibiting significant problems associated with excessive nutrient fuelled macroalgal growth...".

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

Table 5: Summary of estimated N and P loads to eight Southland catchments

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

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

Table 6: Estimated reductions in the agricultural source loads under three levels of mitigation for all dairy farms in each Southland catchment

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

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

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

Table 7: Description of mitigations assumed to apply under each mitigation level

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

The proposal would provide for all the relevant mitigation measures suggested by the Aqualinc report. It has not been possible to determine exactly what stocking rate was envisaged in the Aqualinc report or the NZIER report that it was partly based. However, the proposed stocking rate of 2.7 is reduced from the original stocking rate of 3.0 and appears highly likely to line up with what was anticipated in the Aqualinc/NZIER reports.

As a proportion of the estimated catchment loads, the overall loads from both properties combined is understandably extremely small. On a modelled catchment source load basis, the overall loads (see Section 8) would amount to approximately 0.3% and 0.2% (both current and proposed) of the modelled catchment loads. While this calculation is useful to get a broad appreciation of the potential scale of the overall contributions to N and P catchment loads, it can’t be used in any meaningful way to estimate contributions to concentrations in either the Waikiwi Stream/Makarewa River or the New River Estuary because of the complex hydrogeological, physical, chemical and biological processes that operate in the catchments. However, it does highlight the importance of targeted catchment wide implementation of contaminant loss measures to address water quality issues.

6. Implications of water quality for targeting of mitigation

The water quality results indicate that priorities for contaminant loss mitigation should be faecal indicator organisms, nitrogen (N), phosphorus (P) and sediment. This is largely reflected in the assessment of the physiographic zones (see main AEE) that indicate risks from both artificial drainage and surface runoff because of the generally heavy soils in both areas.

The primary contribution to the observed water quality issues presented earlier in this report will be from land use activities further upstream in the catchment for both properties, with only a tiny contribution from the individual properties.

7. Contaminant loss mitigation proposals

Existing good management practices

The AEE outlines and illustrates the existing good management practices and additional mitigation that are currently being implemented on both of these properties. These include existing fencing of all waterways and extensive riparian plantings. Some of these are assumed in the Overseer modelling. However, many practices, such as the existing riparian plantings will not be accounted for in the Overseer modelling and therefore the estimates of P loss from Overseer modelling alone are highly likely to over-estimate the actual amounts lost to water.

We do not have enough information about other properties in the catchment to comment on the relative contributions, but if other similar properties in these catchments are not implementing the same range of mitigation measures as the applicant, they will be contributing proportionally more contaminants particularly sediment, P and faecal indicator organism to surface waters.

There does not appear to be any published information available on overall land management practices or contaminant loads from properties in these catchments. However, our anecdotal knowledge indicates that this property has more good management practices implemented than is commonly found on dairy and sheep and beef farms in Southland.

The detailed good management practices and additional mitigation proposed are included in the AEE and its attachments.

8. Estimates of N and P losses before and after development

The following table provides a summary of current and proposed N and P losses to water, based on a combined three-year average of inputs for the current dairy farm system and proposal (new cows and new dairy land) at Aerodrome. The Overseer modelling has been undertaken by Mark Crawford and reviewed by Tim Lissaman/Arron Hunter (all CNMA qualified), Ravensdown.

Nutrient losses are also shown for the current and proposed wintering and grazing operation at Piobiare Homestead Ltd. The N and P losses from the farm systems have been modelled using Overseer Nutrient Budgets (v6.3.1), which indicate that both N and P losses are predicted to decrease slightly following the proposed farm system changes.

Table 9: Summary of N & P property losses to water for Aerodrome Farm Ltd and Piobiare

Nutrient Losses	Combined Current Farm System (3 Year Average)	Proposed Farm System	Difference
Aerodrome Farm Limited			
N Loss from the root zone	48 kg N/ha/year or; 14,961 kg N/year	47 kg N/ha/year or; 14,727 kg N/year.	***-1 kg*** N/ha/year ***- 234 kg*** N/year
P Loss from the root zone	225 kg P/year 0.7 kg P/ha/year or;	224 kg P/year 0.7 kg P/ha/year or;	***-1 kg*** P/ha/year ***0.0 kg*** P/ha/year
Piobiare Homestead Limited			
N Loss from the root zone	4,699 kg N/year or 28 kg N/ha/year	4,385 kg N/year or 27 kg N/ha/year	***- 284 kg*** N/ha/year ***- 1 kg*** N/ha/year
P Loss from the root zone	121 kg P/year or 0.7 kg P/ha/year	118 kg P/year or 0.7 kg P/ha/year	***- 3 kg*** P/ha/year ***0.0 kg*** P/ha/yea

All modelling of long-term annual average estimates of N and P loss to water involve uncertainties, i.e., limitations in parts of the modelling process that is a result of incomplete knowledge. Uncertainty is the most relevant term to use for annual average estimates of N and P loss from a whole farm system[9]. However, the uncertainties involved in Overseer modelling are not currently able to be quantified. They are probably greater than 30% for both N and P modelling[10].

There are two significant implications of this:

- The estimated differences between the current and proposed farm system nutrient loss estimates is significantly less than the likely uncertainties involved in Overseer modelling.
- Overseer modelling should be considered in conjunction with the specific farm systems and mitigation measures that are proposed. to provide a reasonable level of certainty about the relativities of nutrient loss estimates.

This means that while there may be a relatively high level of uncertainty about nutrient loss estimates, if there are clear, measurable and verifiable changes to a farm system there will be a high level of certainty about the relative changes to long-tern annual average nutrient loss estimates[11]. Therefore, provided that assurance is provided that the farm system changes have occurred there will be a high level of certainty there will be relative reduction in long-term annual average N and P losses to water.

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[9] Shepherd M *et al* (2013) Overseer: accuracy, precision, error and uncertainty, FLRC workshop proceedings
[10] Wheeler D & Shepherd M (2013) Overseer: Answers to commonly asked questions, RE500/2012/027
[11] Freeman, M, Robson, M, Lilburne L, McCallum-Clark, M, Cooke, A, & McNae, D. (2016) Using OVERSEER in regulation - technical resources and guidance for the appropriate and consistent use of OVERSEER by regional councils, August 2016. Report prepared by Freeman Environmental Ltd for the OVERSEER Guidance Project Board.

A critical consideration in the context of the application of Overseer under the PSWLP policy framework is that Overseer is not being used to assess compliance with a catchment-based N loss property target. Overseer is being used to establish a comparative baseline for one farm system. Many of the concerns about uncertainties involved in Overseer estimates are focused particularly on the former situation, not this situation. Where the reference point is one existing property, particularly one that is located in a situation that is similar to those used to calibrate key components (or sub-models) of Overseer, the uncertainties are significantly reduced. Indeed, comparisons of modelled and measured nitrate losses for dairy farms in Southland found:

> "Given the inherent uncertainty associated with measuring and modelling N leaching, there was good agreement between Overseer estimates and measured values reported for 3 key experimental sites in Southland.
>
> Estimates of drainage volumes, based on annual rainfall inputs to the model also agreed reasonably well with those derived from a daily soil water balance model.
>
> The agreement between measured and modelled values indicates that the Overseer model is performing well for this combination of soil-climate-management factors."

This investigation was done with Overseer version 6.1 in 2013 prior to a major change to the hydrological model that would likely have significantly improved drainage estimates.

Therefore, given that the Overseer N and P loss estimates are being used to compare losses for one property on a relative and not absolute basis, there will be a very low level of uncertainty about the extent to which estimated reductions or increases reflect real reductions or increases.

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

It is very difficult to develop quantitative estimates of the loss of faecal indicator organisms or sediment loss. There are no equivalent readily available farm-scale models that can be used. Some sediment loss models such as SedNetNZ, NZeem and HEL have been tested and applied in New Zealand[12]. However, none are currently widely used in RM planning or regulatory processes. One common current approach[13] is to use Overseer modelled P loss as a surrogate for both. This is because a key component of Overseer P loss modelling is based on an assessment of soil loss which will include faecal indicator organisms as well as sediment. Therefore, a combination

[12] Palmer D, Dymond J & Basher L (2013) Assessing erosion in the Waipa catchment using the New Zealand Empirical Erosion Model (NZeem®), Highly Erodible Land (HEL), and SedNetNZ models David Palmer, John Dymond, and Les Basher, Landcare Research Report LCR1685.

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

of the Overseer modelled P loss indicating a very small reduction in P loss and the broader good management practices and additional mitigation being proposed and outlined in the AEE, provide a very strong indication that there is highly likely to be small reductions in both sediment and faecal indicator loss to water from the development.

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

Table 10 below summarises the proposed good management practices and additional mitigations which will result in less phosphorus, and generally less sediment and microbiological contaminant loss to water. The table also summarises whether or not they are modelled in Overseer and which practices the applicant will undertake to further minimise P (beyond that modelled by Overseer) and generally sediment and faecal indicator organism loss on farm under the proposed dairy expansion. With the adoption of these measures, losses of these three contaminants will be further reduced.

Table 10: Mitigation proposed that will reduce P losses to water

Phosphorus Loss Mitigation	Rewarded in Overseer?	Proposed to be implemented
Fencing Streams	*Yes*	✓
Appropriate fertiliser rates	*Yes*	✓
Avoiding high risk times for fertiliser application	*Yes*	✓
Change fertiliser type	*Yes*	✓ *(low solubility P fertiliser)*
Targeting optimum Olsen P (30-35)	*Yes*	✓
Precision fertiliser placement	*Partially – through lower application rates*	✓
Culverts and bridges	*No*	✓
Managing track runoff	*No*	✓
Shifting break fences strategically	*No*	✓
Filter areas downstream of unfenced waterways	*Partially – only if wetland able to be captured*	
Uncultivated ephemeral stream margins	*No*	✓ *(grass buffer strips/uncultivated ephemeral stream margins – increased sizing for CSAs)*
Erosion control plantings	*No*	✓ *(riparian planting maintained)*
Spread fertiliser evenly	*No – assumed already*	✓

10. Conclusions on the effects of the proposal on water quality

Local and cumulative surface water quality

The information outlined above on the quality of surface water downstream of these two properties combined with the estimates of the current and likely futures losses of sediment, faecal indicator organisms, N and P from the properties provide strong evidence for concluding that there would be a real but extremely small overall improvement in local surface water quality. I have not attempted to quantify these changes because they are unlikely to be measurable with the current Environment Southland surface water quality monitoring programmes. However, if other properties in both catchments implemented equivalent good management practices there would be significant and measurable improvements particularly for the surface water quality variables that currently do not comply with the relevant standards or guideline trigger values. The nature of the water quality issues, particularly in Waikiwi Stream such as deposition of sediment in slow flowing reaches (which may take many years to move downstream) means that some water quality improvements would take a long time to be realised.

Local and cumulative groundwater quality

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

New River Estuary quality

The key water quality issues in the New River Estuary appear to be sediment and nutrient loading. Contaminant losses from these two properties will be making an almost negligible contribution (<0.4%) to these loadings. The good management practices and additional mitigations that will be implemented will reduce this contribution by a tiny amount. By itself this would be insignificant but combined with similar initiatives across the whole New River Estuary catchment would result in significant reductions in the nutrient and sediment loadings to the estuary which has the potential to contribute to a significant improvement to the eutrophication and sedimentation issues in the estuary.

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Senior Scientist/Planner

Landpro Limited

3 May 2019

Attachment F: Nutrient Budget Farm Scenario Reports

OVERSEER Nutrient Budget review

For: Environment Southland – Aerodrome Farm Ltd

Prepared by: Nicky Watt, CNMA

Introduction

1. Regarding the consent application for Aerodrome Farm Ltd, I have reviewed the following OVERSEER ® Nutrient Budget (OVERSEER) files:
   a) New Block
   b) Ovr-Aerodrome Farm Ltd proposal -15-18 readjcownos-copy 3- copy1
   c) Ovr-Aerodrome Farm Ltd current 2015-18/19 – copy2 adinos

2. Along with the files I have reviewed the following accompany report:
   - Farm Scenario Plan -A plan to cover the Current 3 Year Averaged Farm System and the Proposed Farm System Nutrient Budgets after an adjacent property purchase -Prepared by Mark Crawford

3. I have completed a robustness check on the files for sensibility based on data available and checked to ensure the modelling aligns with the OVERSEER Best Practice Data Input Standards for v6.3.0.The 'New Block' has the farms location as 'By nearest town' where the proposed models have 'By Region'. Changing to 'By region' increases the N loss in the New Block from 29 kgN/ha (1387 kg) to 31 kgN/ha (1481 kg). The current and proposed blocks have not had their soils updated to the latest version (all v6.2.2) however updating these did not have an effect on N loss. The new block has not been identified in the Proposed model. To be able to make comparisons of the change in farm systems the new block needs to be shown in the blocking.

4. It must be assumed that the information provided in the OVERSEER files that the current farming system as modelled is a viable farming system, using actual stock and fertiliser inputs. Therefore, the actual and proposed scenario is also assumed to be appropriate for the location and climate.

5. A 'sensibility test' has been undertaken on the Aerodrome Farm Ltd nutrient budgets with the following five output screens from OVERSEER forming the basis of the determination of the robustness of the nutrient budget:
   a) Is the nutrient loss consistent with what you would expect for an operation of this type and soils in this location?
   b) Does the summary of inputs and outputs make sense? Especially clover fixation and change in block pools?
   c) Check the 'Other values' block reports for rainfall, drainage, and PAW
   d) Select the Scenario reports other values and check the production and stocking rate
   e) Select the pasture production in the scenario report and check pasture growth.

6. Answers to each of these five points will be provided further in this report and then a final determination of the robustness of the nutrient loss to water will be provided at the end of this report.

OVERSEER AUDIT

Appropriateness of the Overseer inputs

1. The three XML files stated in paragraph 1 of this report have been reviewed for consistency between the files and appropriateness of the inputs regarding the farming systems and the Overseer Best Practice Data Input Standard (BPDIS).

2. I concur that there is no deviation from the BPDIS.

3. The New Block model has a total area of 47.8 ha (47.7 ha effective) and the Current model has a total area of 266.8 ha (250.6 ha effective) and the Proposed model has a total area of 314.6 ha (298.3 ha effective) which consists of the Current overseer models for the existing dairy farm and the New Block. There is decrease in the peak stocking rate from Current model at 3.2 cows/ha to 3.0 in the Proposed model.

4. Reviewing the NZ Dairy statistics against the Current and Proposed models, shows the average milk solids production on this property (424 kgMS/cow currently and 454 kgMS/cow proposed) is greater than the Southland regional average of 408 kg MS/cow. The stocking rate at 3.2 and 3.0 cows/ha is higher for the Current and Proposed models, respectively, when compared to the Southland average for the 2017/2018 season of 2.64 cows/ha. The Proposed model per cow production is 6.6% higher than the Current model and the per hectare production is proposed to increase from 1302 kgMS/ha to 1357 kgMS/ha (a 4% increase). Lactation length has remained the same.

Table 1: Summary of Production and stocking rate

	New Block[1]	Current[2]	Proposed[3]
Total Ha	47.8	266.8	314.6
Effective Area (ha)	47.7	250.6	298.3
KgMS	-	326180	390000
MS kg/ha grazed	-	1302	1357
MS kg MS/cow	-	424	454
Dairy RSU	-	6881	8006
Lactation Length	-	284	284
Cows/ha	-	3.2	3.0
Cows October	-	780	870
Cows June	-	4	4
Cows July	-	137	140
Replacement RSU	-	47	54
Sheep RSU	660	-	-
Beef RSU	-	119	54
N lost kg/ha/yr	29	50	47

[1]New Block
[2]Current model
[3]Ovr-Aerodrome Farm Ltd proposal -15-18 readjcownos-copy3-copy1 -Proposed Dairy Farm

5. The total crop area for the New Block model was 15.6 ha and 8 ha in the Current model and 7.2 ha in the Proposed model (see table 2 below).

Table 2: Crop Details

	New Block	Current	Proposed
Dairy Fodder Ha	-	8	7.2
Dairy Fodder Yield (tDM/ha)	-	25-28	
Dairy Oats Ha	-	-	4.6 (part FB rotation)
Dairy Kale Yield (tDM/ha)	12	-	1
New Block Potato rotation	7.8	-	-
New Block Potato Yield (tDM/ha)	50	-	-
New Block Swede rotation Ha	7.8	-	-
Sheep Swede Yield (tDM/ha)	13.5	-	-

6. Supplements imported have changed to meet cow demand (see Table 3). Pasture silage has been made where there was a surplus of pasture.

Table 3: Supplements imported and Harvested

	New Block	Current	Current +NB	Proposed
Supplements Imported (tDM)	0	384	384	383
Supplements Imported (tDM/ha)	0	1.53	1.29	1.28
Total Area (ha)	47.8	266.8	314.6	314.6
Effective Area (ha)	47.7	250.6	298.3	298.3
Peak Cows/ha	-	3.2	3.0	3.0
N Fertiliser applied (kgN/ha)	28	204	177	195
Pasture Growth Dairy with Effluent (TDM/ha)	-	17.16	16.50	16.97
Pasture Growth Dairy (TDM/ha)	-	17.16	16.50	16.97
Pasture Growth Sheep Dryland (TDM/ha)	12.95	-	-	-
Silage Harvested to storage (tDM) -Dairy	-	68	68	122
Silage Harvested for feeding on swede (tDM) - Sheep	24	-	24	-

7. The Proposed Overseer model shows the pasture production as 16.97 tDM/ha for non-effluent/effluent land. If the Current and New Block pasture production figures are combined the pasture production is 16.5 tDM/ha. The N used in the Proposed model was 195 kgN/ha and the average N applied to Current and New Block models is 177 kgN/ha. The supplement used in the Current + New Block Models was 1.29 tDM/ha and the Proposed is predicting using 1.28 tDM/ha. Based on this information, the Proposed models increase in pasture harvested is justified by the increase in N fertilizer applied, increase in per cow and per hectare milk production, similar supplement imported per ha and reduction in stocking rate (see Tables 1 & 3 above).

8. The Current Model N loss was 50 kgN/ha. The N loss of the New Block Model was 29 kgN/ha. The Proposed Model shows a N Loss of 47 kgN/ha and it is unknow what the change in N loss is for the New Block as it was not clearly identified (See table 4a below). When the New Block Model was included in the calculations for Current and Proposed (as in Table 4b below) the Current + NB N loss was 47 kgN/ha which is the same as the proposed model. The Current Model P loss was 0.8 kgP/ha and the P loss of the New Block Model was 0.3 kgP/ha. The Proposed Model shows a P Loss of 0.7 kgN/ha and it is unknow what the change in P loss is for the New Block as it was not clearly identified (See table 4a below). When the New Block Model was included in the calculations for Current and Proposed (as in Table 4b below) the Current + NB N loss and the proposed model were the same at 0.7 kgP/ha. It must be assumed that the information provided in the Current Model farming system

is modelled as a viable farming system, using actual stock and fertiliser inputs. Therefore, the Proposed scenario is also assumed to be appropriate for the location and climate.

Overseer Outputs

Table 4a: OVERSEER outputs

Overseer v6.3.0	New Block	Current	Proposed
N lost to water kg/ha/yr	29	50	47
Total N lost kg/farm	1387	13280	14714
P lost kg/ha/yr	0.3	0.8	0.7
Total P lost kg/farm	15	211	225
Other sources – N	14	519	600
Other sources – P	4	123	141

Table 4b: Adding new Block to current compared to proposed

Overseer v6.3.0	Current + NB	Proposed + NB
N lost to water kg/ha/yr	47	47
Total N lost kg/farm	14667	14714
P lost kg/ha/yr	0.7	0.7
Total P lost kg/farm	226	225

Change in block pools

9. Overall there is no significant difference in the change in block pool values between the Current and the Proposed scenario for N. Only change in block pool values for P is in the Proposed Model (P levels being maintained).

10. It appears N is potentially being immobilized; this is observed with a positive value in the Organic pool for N. This value remains reasonably constant in Current and Proposed models. The reverse is the case for the New Block due to the low amount of N fertilizer applied.

11. Slightly above maintenance P was applied to the New Block and Current Models and at maintenance requirements for the Proposed model which is seen by the respective slight increase and decrease in Inorganic Soil Pool levels.

Table 5: Change in block pool (N)

	New Block	Current	Proposed
Plant Material	7	4	2
Organic Pool	-16	91	90
Inorganic Material	0	0	0
Inorganic Soil Pool	9	2	2

Table 6: Change in block pool (P)

	New Block	Current	Proposed
Plant Material	1	0	0
Organic Pool	0	10	11
Inorganic Material	2	4	4
Inorganic Soil Pool	28	25	1

Rain/clover N Fixation

12. The Biological fixation for the combined Current and New Block Models compared to the Proposed Model at 88 or a 15% increase in fixation (see table 7 below).

13. Average N added to the proposed scenario is 9% more than the average of 177kg N/ha/yr for the New Block and Current Models combined.

14. The increase in biological fixation is mostly due to the decrease in N applied from Effluent to the Proposed model (see Table 8 below). This is deemed to be an acceptable variance and within the limitations of the model due to the proposed increase in area effluent will be applied and decrease in stocking rate.

Table 7: Biological fixation

	New Block	Current	Current+NB	Proposed
Biological Fixation	71	75	74	88
Average N applied to whole farm kg/ha/yr	28	204	177	195

15. It is not known if the decrease in N applied and increase in biological fixation will be able to maintain the pasture production modelled.

Pasture Production

16. The effluent N inputs will decrease from the Current Model to the Proposed Model by 19.4% due to the increase in area effluent will be applied (see table 8 below).

17. Fertiliser inputs of N are the same for effluent and non-effluent area in the Current Model. The N applied to the effluent blocks in the Proposed Model are 23 kgN/ha less than the non-effluent areas.

18. Pond solids are applied to the non-tiled, non-effluent areas only in both Current and Proposed Models (except Otwy_3a Non-Effluent block which has no solids applied). Liquid effluent is only applied to the effluent block in all models using a low application method.

19. Long term pasture growth in Southland between 1979 and 2012 indicated that average pasture growth for newer pastures was 12.7T DM/ha/yr. Average growth data for Edendale, from Dairy NZ data sheets, showed 13.3 tDM/ha (adding 195 kgN/ha of nitrogen at a 10:1 response will give pasture growth of 15.3 tDM/ha). The pasture production on this property, for dryland, is higher than the long-term growth. The annual pasture growth for the Current Model at 17.16 tDM/ha is 17% and 11% higher than the Southland average and Edendale respectively. The New Block Model at 12.95 tDM/ha is than the Edendale and Southland long term pasture growth.

20. The proposed pasture production is very similar to the Current Model pasture production.

21. The animal distribution is modelled the same in all scenarios.

Table 8: Pasture production and N inputs (fertiliser and effluent)

	New Block	Current	Proposed
Effluent Area (ha)*	-	112	152
Pasture Growth (tDM/ha/yr)			
Effluent		17.16	16.97
Non-Effluent	12.95	17.16	16.97
N Fertiliser inputs (kg/ha/yr)			
Effluent		225	201
Non-Effluent	28	225	224
N Effluent Inputs (kg/ha/yr)			
Effluent		94	56
Non-effluent (includes solids)		0 or 15**	0 or 16**
Total N Inputs (kgN/ha/yr)			
Effluent		319	257
Non-Effluent	28	225 or 240	224 or 240

**Effluent area is area that receives liquid effluent*

***Solids added to all the non-tiled blocks except to Otwy_3a Non-Effluent block (no tiles)*

Mitigations Modelled

22. As described in the Farm Scenario Plan of the Aerodrome Farm Ltd summarized on page 30, there are several mitigation measures to mitigate N loss that have been included in the proposed scenario. The below table details if the mitigation measures have been included in the proposed scenario and if they are accurately modelled.

Table 9: Mitigation option for proposed

Contain all increased stock within landholding (added dry cows and replacements to Piobiare (support block)	Can't check this as do not have the support block model
Effluent Mitigation (Increased Effluent area and targeted applications) – Avoid liquid applications in September/April and May to tiled areas, N reduced to Effluent areas (Dec/Jan)	Yes. Effluent area has increased from 112 ha in Current Model to 152 ha in Proposed Model. N Fertiliser is 201 kgN/ha on the effluent areas versus 224 kgN/ha on the non-effluent area or 37 kgN/ha to 25 kgN/ha for December and January. Liquid effluent is not applied to tiled areas April to September.
After cropping regime (Only dry cows on crop over spring and catch crop added)	Yes. Only dry cows on crop and forage oats added after crop grazed by milking cows in the Autumn.
Installation of wetland (a planned area captures an additional 57ha)	Yes, wetland area added, model indicates 76 ha as the catchment area not 57 ha indicated (19 ha in Current Model)
Calving Pad (reduce risk of pugging in spring and autumn)	Yes, calving pad added with stock on it for 100% of the cows in July and 29% in August.

23. Most of the mitigation measures are robust, however there are a few areas in the modelling that may need to be addressed.

24. It is important that these mitigation measures are measured and monitored as if they are not adhered to the N loss reductions proposed may not occur.

CONCLUDING COMMENTS

Determination of the robustness of the nutrient loss to water

25. The questions below were described at Paragraph five of this report. Whilst these have been answered throughput this report, this section summarizes the answer to each question to make an overall conclusion about the robustness of the nutrient budgets.

Is the N loss consistent with what you would expect for an operation of this type and soils in this location?

26. Based on my experience, the N loss estimates are reasonably consistent with an operation of this scale and soil types present.

Does the summary of inputs and outputs make sense? Especially clover fixation and change in block pools?

27. Overall there is no significant difference in the change in block pool values between the Current and the proposed scenario for N. Only change in block pool values for P is in the Proposed Model (P levels being maintained).

28. There is a 15% increase in biological fixation in the Proposed model and a 9% increase in N Fertiliser applied. The increase in biological fixation is mostly due to the decrease in N applied from Effluent in the Proposed model. This is deemed to be an acceptable variance and within the limitations of the model due to the proposed increase in area effluent will be applied and decrease in stocking rate. Clover and pasture inputs are similar for Current and Proposed Models.

29. It is not apparent from reviewing the Overseer technical manuals or the nutrient budgets if the difference in pasture production and N fertiliser use accounts for all the increase in biological fixation.

Check the 'Other values' block reports for rainfall, drainage, and PAW

30. The rainfall and soil information have been entered based on protocols for the location and soil type selected.

Production and stocking rate

31. Based on my experience as well as reviewing NZ Dairy statistics for the Current and Proposed stocking rate is higher than the Southland Region average in the 2017/2018 season. The Current and Proposed Models milk production per cow is higher than the Southland Region average in the 2017/2018 season

32. The average milk solids production per cow on this property for the Current Model is 424 kg MS/cow/year which is higher than the Southland regional

average of 408kg MS/cow. The target of 454 kgMS/cow is a 6.6% increase over the Current Model and if not achieved is likely to result in a lowered N loss.

33. The stocking rate at 3.0 cows/ha for the Current + New Block Models and 3.0 cows/ha for the proposed model are higher than the Southland average for the 2017/2018 season of 2.64 cows/ha.

34. It is assumed that since the Current Model is based on year end information that it represents viable production and stocking rate.

Select the pasture production in the scenario report and check pasture growth.

35. A detailed explanation of the pasture production has been outlined in the above sections.

36. The Proposed model pasture production of 16.97 tDM/ha is higher than the Current and New Block models pasture production figures of 16.5 tDM/ha. The N used in the Proposed model was higher at 195 kgN/ha compared to the average N applied to Current and New Block models of 177 kgN/ha. The supplement used in the Current + New Block Models was 1.29 tDM/ha and the Proposed model is predicting using 1.28 tDM/ha. Based on this information, the Proposed models increase in pasture harvested id justified by the increase in N fertilizer applied, increase in per cow and per hectare milk production, similar supplement imported per ha and reduction in stocking.

37. Long term pasture growth in Southland between 1979 and 2012 indicated that average pasture growth for newer pastures was 12.7T DM/ha/yr. Average growth data for Edendale, from Dairy NZ data sheets, showed 13.3 tDM/ha (adding 195 kgN/ha of nitrogen at a 10:1 response will give pasture growth of 15.3 tDM/ha). The pasture production on this property, for dryland, is higher than the long-term growth. The annual pasture growth for the Current Model at 17.16 tDM/ha is 17% and 11% higher than the Southland average and Edendale respectively. The New Block Model at 12.95 tDM/ha is than the Edendale and Southland long term pasture growth.

38. I have assumed an adequate level of robustness around the Current Model of actual Overseer Modelling as it is based on an actual farming system, and with that, I have assumed actual stock and fertilizer inputs used.

39. The data input protocols have been followed for all scenarios with no deviations. This leads to a high level of robustness for the relevant input data for example, climate, soils, and pasture type.

40. Based on the concerns raised regarding some of the inputs and outputs in the Overseer models, I consider that the robustness of the nutrient loss estimates for the Proposed scenario are **medium,** this is due to the robustness of the nutrient loss estimates for the actual scenarios is **medium**.

41. The area of concern in all the New Block model is: The ‘New Block’ has the farms location as ‘By nearest town’ where the proposed models have ‘By

Region'. Changing to 'By region' increases the N loss in the New Block from 29 kgN/ha (1387 kg) to 31 kgN/ha (1481 kg).

42. The area of concern in the current and proposed models is: The current and proposed blocks have not had their soils updated to the latest version (all v6.2.2) however updating these did not influence N loss.

43. The area of concern in the proposed model is: The new block has not been identified in the proposed model. To be able to make comparisons of the change in farm systems the new block needs to be shown in the blocking. Also, the wetland area of 76ha is in the Proposed model and the report indicates 57 ha (minor issue and does change the N loss/ha only total N)

44. It is vital that the proposed changes to the future farm system are effectively measured and monitored as if these are not adhered to then the reductions in N loss proposed may not occur.

References:

New Zealand Dairy Statistics 2017/2018. Produced by LIC and DairyNZ 2018.
https://www.dairynz.co.nz/media/5790451/nz-dairy-statistics-2017-18.pdf
Overseer Definition of Terms, previously Technical Note 6. May 2016
Overseer Technical Manual – Characteristics of Pasture, April 2015

Smith. L. C. 2012. Proceedings of the New Zealand Grassland Association 74: 147-152 (2012) *Long Term pasture growth patterns for Southland New Zealand: 1978-2012*. www.grassland.org.nz/publications/nzgrassland_publication_2284.pdf

https://www.dairynz.co.nz/media/5790163/average-pasture-growth-data-south-island-2018.pdf (Edendale)

OVERSEER Nutrient Budget review

For: Environment Southland – Piobiare Homestead Ltd

Prepared by: Nicky Watt, CNMA

Introduction

1. Regarding the consent application for Piobiare Homestead Ltd, 939 Lochiel Branxholme Road, Invercargill. I have reviewed the following OVERSEER ® Nutrient Budget (OVERSEER) files:
   a) PIOBIARE HOMESTEAD LTD c/-N&R PYPER – adj-copy 1
   b) PIOBIARE HOMESTEAD LTD c/-N&R PYPER – proposed1 -copy 1- copy 1

2. Along with the files I have reviewed the following accompanying report:
   - Farm Scenario Plan -2015/18 Averaged Nutrient Budget & Report - Prepared by Mark Crawford, Senior Farm Environmental Consultant

3. I have completed a robustness check on the files for sensibility based on data available and checked to ensure the modelling aligns with the OVERSEER Best Practice Data Input Standards for v6.3.0.

4. It must be assumed that the information provided in the OVERSEER files that the current farming system as modelled is a viable farming system, using actual stock and fertiliser inputs. Therefore, the actual and proposed scenario is also assumed to be appropriate for the location and climate.

5. A 'sensibility test' has been undertaken on the Piobiare Homestead Ltd nutrient budgets with the following five output screens from OVERSEER forming the basis of the determination of the robustness of the nutrient budget:
   a) Is the nutrient loss consistent with what you would expect for an operation of this type and soils in this location?
   b) Does the summary of inputs and outputs make sense? Especially clover fixation and change in block pools?
   c) Check the 'Other values' block reports for rainfall, drainage, and PAW
   d) Select the Scenario reports other values and check the production and stocking rate
   e) Select the pasture production in the scenario report and check pasture growth.

6. Answers to each of these five points will be provided further in this report and then a final determination of the robustness of the nutrient loss to water will be provided at the end of this report.

OVERSEER AUDIT

Appropriateness of the Overseer inputs

1. The two XML files stated in paragraph 1 of this report have been reviewed for consistency between the files and appropriateness of the inputs regarding the farming systems and the Overseer Best Practice Data Input Standard (BPDIS).

2. I concur that there is no deviation from the BPDIS.

3. The Current and Proposed models have a total area of 165.1 ha (160.2 ha effective). There is increase in the Current Model Beef RSU from 2570 (2.9 cattle/ha) to 2644 (3.0 cattle/ha) in the Proposed model.

4. The cattle equivalent stocking rate at 2.9 and 3.0 cows/ha is higher for the Current and Proposed models, respectively, when compared to the Southland average for the 2017/2018 season of 2.64 cows/ha. The Proposed model stocking rate is 3.3% higher than the Current model.

Table 1: Summary of Production and stocking rate

	Current[1]	Proposed[2]
Total Ha	165.1	165.1
Effective Area (ha)	160.2	160.2
Sheep RSU	12	12
Beef RSU	2570	2644
*Cattle Equivalent Stocking Rate/ha	2.9	3.0
N lost kg/ha/yr	28	27

[1] PIOBIARE HOMESTEAD LTD c/-N&R PYPER – adj-copy 1
[2] PIOBIARE HOMESTEAD LTD c/-N&R PYPER – proposed1 -copy 1- copy 1
*Assuming 5.5 SU/ha, to compare to dairy stocking rate/ha

5. The total crop area for the Current model was 17.6 ha fodder beet and 8.8 ha new grass and 18 ha fodder beet and 9 ha new grass in the Proposed model (see table 2 below). This is an increase of 2.2% increase in crops in the Proposed Model.

Table 2: Crop Details

	Current	Proposed
Fodder Ha	17.6	18.0
Fodder Yield (tDM/ha)	25	25
New Grass Ha	8.8	9

6. The wintering barn is used to stand off more animals over time in the Proposed Model compared to the Current Model (see Figures 1 & 2 below).

Figure 1: Current Model Wintering Barn

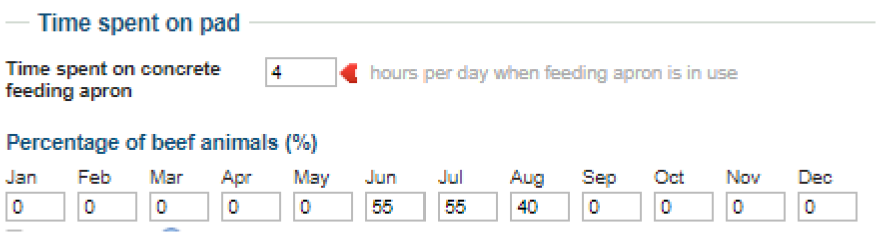
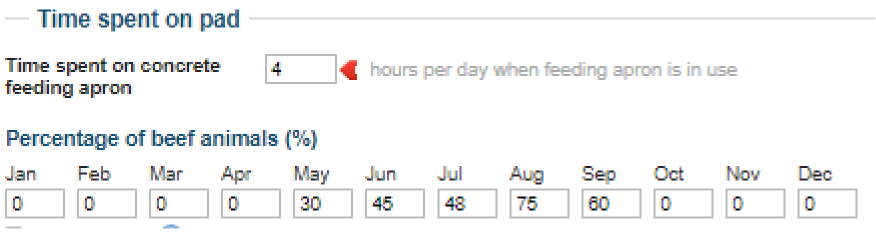


Figure 2: Proposed Model Wintering Barn



Time spent on pad

Time spent on concrete feeding apron: 4 hours per day when feeding apron is in use

Percentage of beef animals (%)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	0	30	45	48	75	60	0	0	0

7. Supplements imported have changed to meet cow demand (see Table 3). Pasture silage has been made where there was a surplus of pasture.

Table 3: Supplements imported and Harvested

	Current	Proposed
Supplements Imported (tDM)	535	592
Supplements Imported (tDM/ha)	3.34	3.70
Total Area (ha)	165.1	165.1
Effective Area (ha)	160.2	160.2
Cattle Equivalent Stocking Rate/ha	2.9	3.0
N Fertiliser applied (kgN/ha)	139	138
Pasture Growth with Effluent (TDM/ha)	12.78	11.81
Pasture Growth (TDM/ha)	12.78	11.81
Pasture Growth Lease (tDM/ha)	11.51	10.63
Pasture Growth Average for Non-Effluent Areas (tDM/ha)	11.91	10.97
Silage Harvested to storage (tDM)	592	592

8. The Proposed Overseer model shows the pasture production as 11.81 tDM/ha for effluent land and an average of 10.63 tDM/ha for non-effluent land. The Current Model pasture production is 12.78 tDM/ha effluent land and 11.91 tDM/ha for non-effluent land. The N used in the Proposed model was 138 kgN/ha and the N applied to Current model was 139 kgN/ha. The supplement used in the Current model was 3.34 tDM/ha and the Proposed is predicting using 3.70 tDM/ha. Based on this information, despite the slight rise in the stocking rate the Proposed model has a decrease in pasture harvested which is justified by the 9.7 % increase in supplement imported and greater number of animals spent on the wintering block (see Tables 1 & 4 above and figures 1 & 2 above).

9. The Current Model N loss was 28 kgN/ha. The Proposed Model shows a N Loss of 27 kgN/ha (See table 4 below). The Current Model P loss was 0.7 kgP/ha and the Proposed Model shows a P Loss of 0.7 kgN/ha. It must be assumed that the information provided in the Current Model farming system is modelled as a viable farming system, using actual stock and fertiliser inputs. Therefore, the Proposed scenario is also assumed to be appropriate for the location and climate.

Overseer Outputs

Table 4: OVERSEER outputs

Overseer v6.3.0	Current	Proposed
N lost to water kg/ha/yr	28	27
Total N lost kg/farm	4698	4383
P lost kg/ha/yr	0.7	0.7
Total P lost kg/farm	121	118
Other sources – N	113	118
Other sources – P	19	19

Change in block pools

10. Overall there is no significant difference in the change in block pool values between the Current and the Proposed scenario for N & P.

11. It appears N is potentially being immobilized; this is observed with a positive value in the Organic pool for N. This value remains reasonably constant in Current and Proposed models.

12. Above maintenance P was applied for both the Proposed and Current Models which is seen by the positive Inorganic Soil Pool levels.

Table 5: Change in block pool (N)

	Current	Proposed
Plant Material	22	13
Organic Pool	48	52
Inorganic Material	0	0
Inorganic Soil Pool	5	5

Table 6: Change in block pool (P)

	Current	Proposed
Plant Material	1	0
Organic Pool	9	9
Inorganic Material	4	4
Inorganic Soil Pool	31	27

Rain/clover N Fixation

13. The Biological fixation for the Proposed Model at 25 is a 16.7% decrease in fixation (see table 7 below).

14. Average N added to the proposed scenario is only slightly lower than the Current Model.

15. The decrease in biological fixation in the Proposed Model is is not from N fertilizer but in part due to extra effluent area and extra effluent produced from the Winter Pad (see Table 8 below) and decrease in pasture production and increase in supplement being imported. This is deemed to be an acceptable variance and within the limitations of the model.

Table 7: Biological fixation

	Current	Proposed
Biological Fixation	30	25
Average N applied to whole farm kg/ha/yr	139	138

16. It is not known if the increase in N applied through effluent and imported supplement and decrease in biological fixation will be able to maintain the pasture production modelled.

Pasture Production

17. The effluent spread area is proposed to increase by 11.8% in the Proposed Model. The total effluent N inputs will increase from the Current Model to the Proposed Model by 10.5% due to the increase in effluent area and similar effluent N/ha applied (see table 8 below).

18. Fertiliser inputs of N differ for effluent and non-effluent area in both Current and Proposed Models. The N applied to the effluent blocks are 15 kgN/ha less than the non-effluent areas.

19. Pond solids and liquid effluent from Wintering Barn are applied to effluent areas only in both Current and Proposed Models. Liquid effluent is applied to the land using <12mm application depth.

20. Long term pasture growth in Southland between 1979 and 2012 indicated that average pasture growth for newer pastures was 12.7T DM/ha/yr. The pasture production on this property is currently like the long-term growth on the effluent areas and 6.2% lower on the non-effluent areas. The annual pasture growth for the Proposed Model at 11.81 tDM/ha is 7% lower for effluent areas and 13.6% lower than the Southland average long-term pasture growth.

21. The Proposed model pasture production is 7.9% lower on the non-effluent blocks and 7.6% lower on the effluent blocks compared to the Current Model pasture production.

22. The animal distribution is modelled the same in all scenarios.

Table 8: Pasture production and N inputs (fertiliser and effluent)

	Current	Proposed
Effluent Area (ha)*	67	76
Total Effluent N (kg/yr)	5226	5776
Pasture Growth (tDM/ha/yr)		
Effluent	12.78	11.81
Non-Effluent	11.91	10.97
N Fertiliser inputs (kg/ha/yr)		
Effluent	141	141
Non-Effluent	155	155
N Effluent Inputs (kg/ha/yr)		
Effluent	78	76
Non-effluent (includes solids)	0	0
Total N Inputs (kgN/ha/yr)		
Effluent	219	217
Non-Effluent	155	155

**Effluent area is area that receives liquid effluent and solids (Paro_4a.1 Effluent/Waiki_30a.1 Effluent/Waiki_30a.1 YG/Paro_4a.1 YG)*

Mitigations Modelled

23. As described in the Farm Scenario Plan of the Piobiare Homestead Ltd summarized on page 22, there are several mitigation measures to mitigate N loss that have been included in the proposed scenario. The below table details if the mitigation measures have been included in the proposed scenario and if they are accurately modelled.

Table 9: Mitigation option for proposed

Aerodrome analysis- Contain all increased stock within landholding (added dry cows and replacements to Piobiare (support block)	As from the Aerodrome Modelling – can confirm extra dry cows and replacements have been added to Piobiare.
The farm has a wintering barn which captures the effluent which is applied to pasture October and November	Yes, both the Current and Proposed models have a winter barn (entered as a covered wintering pad or animal shelter) and effluent is collected and spread in October and November
There will be additional use of the Wintering Barn over May and September	Yes, the barn is being used over May and September, currently only used June/July/August
Little change in N fertilizer applied	Yes, there is a slight decrease in total N applied, no change in N fertilizer applied to each block
Effluent stored and applied at appropriate times and Current area receives 90.7 ha including crops	Yes, effluent is stored and applied at appropriate times, but Current effluent area is 67 ha and Proposed effluent area is 76 ha
Effluent applied to highest risk Paroa soils during highest risk periods could be minimized	Most of the farm receives effluent to the Paroa soils, not sure what the mitigation is?

24. Most of the mitigation measures are robust.

25. It is important that these mitigation measures are measured and monitored as if they are not adhered to the N loss reductions proposed may not occur.

CONCLUDING COMMENTS

Determination of the robustness of the nutrient loss to water

26. The questions below were described at Paragraph five of this report. Whilst these have been answered throughput this report, this section summarizes the answer to each question to make an overall conclusion about the robustness of the nutrient budgets.

Is the N loss consistent with what you would expect for an operation of this type and soils in this location?

27. Based on my experience, the N loss estimates are reasonably consistent with an operation of this scale and soil types present.

Does the summary of inputs and outputs make sense? Especially clover fixation and change in block pools?

28. Overall there is no significant difference in the change in block pool values between the Current and the proposed scenario for N & P.

29. There is a 16.7% decrease in biological fixation in the Proposed model and a small decrease in N Fertiliser applied. The increase in biological fixation is mostly due to the increase in N applied from Effluent in the Proposed model (increased effluent area with similar effluent N applied/ha) and increase in supplements imported. This is deemed to be an acceptable variance and within the limitations of the model. Clover and pasture inputs are similar for Current and Proposed Models.

30. It is not apparent from reviewing the Overseer technical manuals or the nutrient budgets if the difference in pasture production and effluent N accounts for all the increase in biological fixation.

Check the 'Other values' block reports for rainfall, drainage, and PAW

31. The rainfall and soil information have been entered based on protocols for the location and soil type selected.

Production and stocking rate

32. Based on my experience as well as reviewing NZ Dairy statistics for the Current and Proposed stocking rate is higher than the Southland Region average in the 2017/2018 season.

33. The stocking rate at 2.9 cows/ha for the Current model and 3.0 cows/ha for the Proposed model are higher than the Southland average for the 2017/2018 season of 2.64 cows/ha.

34. It is assumed that since the Current Model is based on year end information that it represents viable production and stocking rate.

Select the pasture production in the scenario report and check pasture growth.

35. A detailed explanation of the pasture production has been outlined in the above sections.

36. The Proposed Overseer model pasture production is 7.6% lower for effluent land and an average of 10.7% lower for non-effluent land compared to the Current Model pasture production. The N fertilizer used in the Proposed model is slightly lower than the N applied to Current model. The supplement used in the Proposed model is predicted to be 9.7% more than the Current model. Based on this information, despite the slight rise in the stocking rate, the Proposed model has a decrease in pasture harvested which is justified by the increase in supplement imported and greater number of animals spent on the wintering block.

37. Long term pasture growth in Southland between 1979 and 2012 indicated that average pasture growth for newer pastures was 12.7T DM/ha/yr. The pasture production on this property is currently similar to the long-term growth on the effluent areas and 6.2% lower on the non-effluent areas. The annual pasture growth for the Proposed Model at 11.81 tDM/ha is 7% lower for effluent areas and 13.6% lower than the Southland average long-term pasture growth.

38. I have assumed an adequate level of robustness around the Current Model of actual Overseer Modelling as it is based on an actual farming system, and with that, I have assumed actual stock and fertilizer inputs used.

39. The data input protocols have been followed for all scenarios with no deviations. This leads to a high level of robustness for the relevant input data for example, climate, soils, and pasture type.

40. Based on the concerns raised regarding some of the inputs and outputs in the Overseer models, I consider that the robustness of the nutrient loss estimates for the Proposed scenario are **medium-high,** this is due to the robustness of the nutrient loss estimates for the actual scenarios is **medium-high**.

41. The area of concern in the current and proposed models is: The current and proposed blocks do not have the effluent area in the report matching what was modelled (see page 22 of report on mitigations which indicates Current is 90.7 ha modelled but only 67ha is modelled).

42. It is vital that the proposed changes to the future farm system are effectively measured and monitored as if these are not adhered to then the reductions in N loss proposed may not occur.

References:

New Zealand Dairy Statistics 2017/2018. Produced by LIC and DairyNZ 2018. https://www.dairynz.co.nz/media/5790451/nz-dairy-statistics-2017-18.pdf
Overseer Definition of Terms, previously Technical Note 6. May 2016
Overseer Technical Manual – Characteristics of Pasture, April 2015

Smith. L. C. 2012. Proceedings of the New Zealand Grassland Association 74: 147-152 (2012) *Long Term pasture growth patterns for Southland New Zealand: 1978-2012.* www.grassland.org.nz/publications/nzgrassland_publication_2284.pdf

Farm Scenario Plan

2015/18 Averaged Nutrient Budget & Report

Prepared by Mark Crawford
Senior Farm Environmental Consultant

60827342
Piobiare Homestead Ltd (Runoff)
LOCHIEL-BRANXHOLME ROAD RD 4
INVERCARGILL; 9874
10/07/2019

Reviewed by Arron Hutton (Certified Nutrient Management Adviser)

Executive Summary

Nelson, Roseanne and Chris Pyper have requested an OVERSEER® Nutrient Budget on behalf of Piobiare Homestead Ltd to reflect the current and proposed nutrient losses from their runoff property, in preparation for a change in land use consent involving Aerodrome Dairy Farm. The farm is located at 939 Lochiel Branxholme Road RD 4 Invercargill and is approximately 15 km from the South west Coast. The runoff property has a mixture of dry milking cows wintered and replacement heifers reared from Rising 1 year old through to in calf heifers wintered during June to August and September.

- The average N loss from the root zone from the ***current farm system*** was calculated using OVERSEER® (v6.3) to be **4,699 kg N/year or 28 kg N/ha/year**. The N loss from the root zone from the ***proposed farm system*** was calculated using OVERSEER® (v6.3) to be **4,385 kg N/year or 27 kg N/ha/year**
- The averaged P loss from the root zone from the ***current farm system*** was calculated using OVERSEER® (v6.3) to be **121 kg P/year or 0.7 kg P/ha/year**. The P loss from the root zone from the ***proposed farm system*** was calculated using OVERSEER® (v6.3) to be **118 kg N/year or 0.7 kg N/ha/year**

Key Nitrogen nutrient loss pathways are the N loss from winter grazing of crops, the free draining Waikiwi soils, with the Paroa soils providing a degree of buffering from Nitrogen leaching. Key Phosphate nutrient loss pathways are the P losses from effluent applications and cropping of these heavier silt loams (Paroa). Direct losses to water ways from tile drains are also a major risk to this farm.

Current and proposed key mitigations are;

- the wintering barn and its proposed extended use over the shoulder months in autumn and spring,
- the more than adequate effluent area and storage of effluent which is applied at the most appropriate times when pastures are actively growing,
- the slight reduction in stocking with the proposal, given the move to grazing Aerodrome farms diary stock only and extended use of the barn.

The associated input parameter reports (for the nutrient budget) are available in a separate document upon request.

Overseer nutrient budgets Version 6.3.1 have been used to create the nutrient budgets presented in this report.

Overseer modelling of the current and proposed system has been undertaken in accordance with the Overseer 6.3.1 '*Best Practice Data Input Standards*' and has been reviewed by a Certified Nutrient Management Advisor. The following report summarises the respective Overseer 6.3.1nutrient budgets and key assumptions made

Contents

Important Points to Note

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3. This Plan complies with the industry standard "Code of Practice for Nutrient Management (with emphasis on Fertiliser Use)" (hereafter referred to as 'the code'). The Code can be found on-line in full at: http://www.fertiliser.org.nz/Site/code_of_practice

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……………………………………………………………………….

Mark Crawford

Senior Farm Environment Consultant

Dated: 10th July 2019

General

Aim and Purpose of Farm Scenario Plan

Nelson, Roseanne and Chris Pyper have requested an OVERSEER® Nutrient Budget on behalf of Piobiare Homestead Ltd to reflect the current and proposed nutrient losses from their runoff property, in preparation for a change in land use consent involving Aerodrome Dairy Farm. The farm is located at 939 Lochiel Branxholme Road RD 4 Invercargill and is approximately 15 km from the South west Coast. The total farmed area has been calculated as 165.1 ha, with productive areas forming 156.7 ha. Titled area calculated is 178.26 ha, less 18.51 ha of leased land not farmed, plus 2.6 ha of land is outside of the titled area and has been blocked and identified appropriately as '*FNO'* in OVERSEER® modelling where it is farmed, plus 2.8 ha identified as outside the title area drawn but is owned and farmed. The effective area is of flat topography.

Soil types on the farm are varied and include;

Soil type	Area (ha)	Soil classification	Texture	Drainage status	PAW (0-30 cm)	PAW (0-60 cm)
Paroa_4a.1	96.0	Recent Gley	Silt Loam	Poor draining	99.3	177.7
Waikiwi_30a.1	38.1	Firm Brown	Silt Loam	Well drained	63.8	117.1
Waikiwi_34a.1	29.9	Firm Brown	Silt Loam	Well drained	63.1	112.2
Woodlands_29a.1	1.1	Mottled Brown	Silt Loam	Imperfectly draining	61.1	106.6
Total	165.1					

All soils information taken from Landcare S-Maps.

Property Details

Location/address	939 Lochiel Branxholme Road RD 4 Invercargill 9874
Legal Description	Lot 2 Deposited Plan 429633 and Section 2 Survey Office Plan 385656 and Section 2 Block III New River Hundred and Part Section 3 Block III New River Hundred; Lot 1 Deposited Plan 7084 and Section 30, 39 Block II New River Hundred and Part Section 14-16, 38 Block II New River Hundred
Total area (ha) Titled Area (ha) Leased Area (ha) Non titled farmed (ha)	165.1 (including 2.6 ha on non-titled land) 177.2719 ha titled; 178.26635 ha calculated plus additional 2.8 ha owned 43.27 ha not including 18.51 ha kept by lessor 2.6 ha
Contact details	Nelson & Rosanne & Chris Pyper
Phone	Phone (03) 2217307 Cell (027) 5354005
Farm Type	Dairy Support Runoff

Averaged 2015-18 Farm System Analysis

Description of Current Farm System

The 165.1 ha property is operated as a dairy support runoff, with 654 mixed age cows bought back on farm from the Aerodrome dairy platform from the end of May, with 400 entering the wintering barn and the remainder fed on crop. The cows on crop return back to Aerodrome first, as they transition on crop, whilst the indoor fed cows are sent back as they calve. Cows have been modelled the same as Aerodrome, as Friesian X, with average mob weight of 475 kg. Weaned R1 Replacement dairy heifers (200) are brought from Aerodrome over November and December at 100kg, are wintered twice, with half the in calf heifers going back to Aerodrome in July, the remainder are staggered back from late July. A further mob of replacement heifers (175) are grazed for a dairy farmer for the first winter before being sent back in mid-August. A small mob of dairy cross beef calves are also reared from weaning (100 kg LW) through to slaughter prior to their second winter at between 270 to 300 kg carcass (modelled 285 kg c/c). Notre a small mob of neighbours sheep are used to graze the riparian areas.

Stock Numbers:

Stock class	Start LW	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	End LW
R1 Dairy replacements	100	0	0	0	0	100	151	200	199	199	199	198	198	240
R2 Dairy replacements	240	198	198	197	197	197	197	196	196	196	195	195	195	450
R1 Dairy replacements	100					90	175	175	175	175	175	175	174	240
R2 Dairy replacements	240	174	45											260
Heifers	450	76	10	0	0	0	0	0	0	0	0	0	0	460
Heifers & Cows	455												400	465
Heifers & Cows	465	400	341	73										480
Dairy cows grazing	475	0	0	0	0	0	0	0	0	0	0	0	194	475
Dairy cows grazing	475	176	30	0	0	6	6	0	0	0	0	0	0	475
Weaners	100					12	12	12	12	12	12	12	12	260
Steers	260	12	12	12	12	12	12	12	12	12	12	12		285 c/c
Sheep	60			20	40		40	20		20	40		40	60
Total cows		652	326	17									594	

Climate

Climate data for the property has been sourced from Overseer's Climate Station Tool data and has been entered as annual rainfall: 1110 mm/year, PET: 734 mm/year and average temperature: 10 0^{o}C, based on location at latitude/longitude – 46.2774, 168.3056. Climate data has been modelled as per *Overseer Best Practice Input Data Standards*.

Structures

There is a wintering barn built on the property with a capacity to hold and winter inside 400 animals.

Wintering Barn details

Pad type	Covered animal shelter
Bunker Management	Rubber Mats (modelled no lining material as no other available option)
Bunker Cleaning Management	Scrapping with no water; Solids separated
Concrete feeding Apron present and used	Present and used
Time spent on concrete feed apron	4 hours
Bunker Cleaning Management	Scrapping with no water; Solids separated
Solids separated	Mechanical separation
Average Solid application rate Current system kg N/ha/year	39
Proposed solid application rate kg N/ha/year	38

Feeding Regime: Silage in wintering barn/pad only (% of dry dairy cattle animals per month)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Averaged seasons						50	50	50				
Proposed					30	45	48	75	60			

Effluent management

Effluent management details

Storage type	Holding pond
System	Umbilical cord or Slurry tanker with a dribble bar
Application area, ha	Home block paddocks 1-24 (90 % area applied)
Liquid application depth, mm	Less than 12 mm
Months liquid applied	October through to November after first silage cuts
Solids separated	Mechanical separation
Time in storage	Concrete bunker open, 5 months
Separated solids, months applied	Once a year, October to Effluent block
Pond emptied every year	Every year with liquids
Pond sludge, months applied	October & November
Pond sludge applied on	Effluent Block
Average Liquid application rate Current system kg N/ha/year	41
Proposed liquid application rate kg N/ha/year	39

Irrigation

The property has no irrigation.

Supplements

An estimated 468 Tonnes of silage DM is cut and stored in silage pits (concrete bunkers) and 124 T DM in baleage is cut and used for cattle on crop.

- 468 T DM silage is cut and stored in pits and 411 T DM is fed to cattle from storage on the wintering pad. This was the amount that the model would reported as being fed at very good utilisation, which was used given the concrete indoor feeding bins.
- 100 T DM of baleage is cut and fed from storage to cattle on pastoral blocks, with an added 24 T DM cut, stored and fed to cattle on crop blocks.

Fertiliser

Fertiliser applications have been modelled from Ravensdown sales records and farmer information, and are based on average monthly rates, averaged across the 3 years and the farm blocks. The total fertiliser nitrogen applied is 155 kg N/ha/year and 141 kg N/ha/year for the Non effluent and Effluent farm blocks and 139 kg N/ha/year across all blocks (whole property) on average

Pastoral blocks

Month	Material	NPKS (kg nutrient/ha)
August	Fertiliser product – Urea	12 – 0 – 0 – 0
September	Fertiliser product – Urea	10 - 0 - 0 – 0
October	Fertiliser product – Urea#	5 – 0 – 0 – 0 or 8 – 0 – 0 - 0
October	Fertiliser product – 10 % Potash Superphosphate	0 – 20 – 12 – 25
November	Fertiliser product – Urea#	12 – 0 – 0 – 0 or 20 – 0 – 0 - 0
December	Fertiliser product – Urea	20 – 0 – 0 – 0
December	Fertiliser product – 15 % Potash Superphosphate	0 – 23 – 22 – 28
December	*Fertiliser product – 15 % Sulphur Superphosphate*	*0 – 13– 0 – 22***
January	Fertiliser product – Urea	26 – 0 – 0 – 0
February	Fertiliser product – Urea	15 – 0 – 0 – 0
March	Fertiliser product – Urea	31 – 0 – 0 – 0
April	Fertiliser product – Urea	12 – 0 – 0 – 0
	Total	141-43-35-53 or 155-43-33-53
	Total Effluent Proposal	*141-33-12-47*

Non effluent rates different, tabulated last. ** Proposed rate with added P&K from additional effluent from shed

Soil Test Results

Soil test results presented below are averages of results 2017-2018 between the two blocks, with default values for the riparian edges grazed by sheep.

Blocks	Olsen P	QTK	QT Ca	QT Mg	QT Na	Org S
Effluent Block	37	11	9	16	9	13
Non Effluent & Lease	34	7	10	13	10	12
Riparian block	16	7	7	21	8	7

Pasture Production

The predominant pasture species on the dairy farm is ryegrass/white clover. Annual pasture production has been weighted by relative productivity.

Blocks	Relative productivity	% pasture eaten	Utilisation %	T DM/ha/year
Effluent Non Effluent Home Blocks	1.0	100% dairy grazers	70	12.7
Lease, House Blocks	0.9	100% dairy grazers,	70	11.5
Riparian blocks	0.9	Riparian 100 % sheep only	70	10.8

It should be noted that this estimated pasture production is based on default South Island pasture ME values and may be different to actual ME values and utilisation values on this farm which in turn would influence estimated pasture production.

Crop Rotations

During the 2015-2018 period, 17.6 ha was used for cropping (26.4 ha modelled with rounding error including Young grass crop block) – with fodder beet sown, grazed and cropped twice before being re sown into permanent pasture. The crop blocks modelled were based on the two key soil types pro rata (Paroa_4a.1 and Waikiwi_30a.1 (1st Year crop, 2nd year crop or Fodder beet to Fodder beet and Young grass). Where the block was previously in pasture, conventional cultivation was used in the month of October. Re cropped blocks conventional cultivation occurred in the month of sowing (November). The farm practice in the last three years was to crop the Effluent soils.

Pasture to Fodder Beet: (8.8 ha)

Blocks Paro_4a.1 and Waiki_30a.1 1st Yr FBt were used to model the crop rotation.

- Fodder beet is sown in November after conventional cultivation, grazed in situ in June through to September by the cattle and dairy replacement heifers.
- Sown with a soluble fertiliser mix of NPKS rating (37-28-75-15)as a base and drilled with Crop master DAP (NPKS 30-34-0-2) plus two further applications of Urea at 100 kg/ha are made in December and February.
- Yields are averaged at 26 T DM/ha

Fodder Beet to Fodder Beet: (8.8 ha):

Blocks FB>FB Paro_4a.1, FB>FB Waiki_30a.1, were used to model this crop rotation

- The data entered is the same as for the crop blocks above.

Young Grass: (8.8 ha):

Blocks Waiki_30a.1 YG was used to demonstrate this crop rotation.

Crop blocks were modelled as 6 years in pasture given the 17.6 ha (not counting the Young grass) cropped from the 110.7 ha of home blocks available, with a crop rotation final month being September.

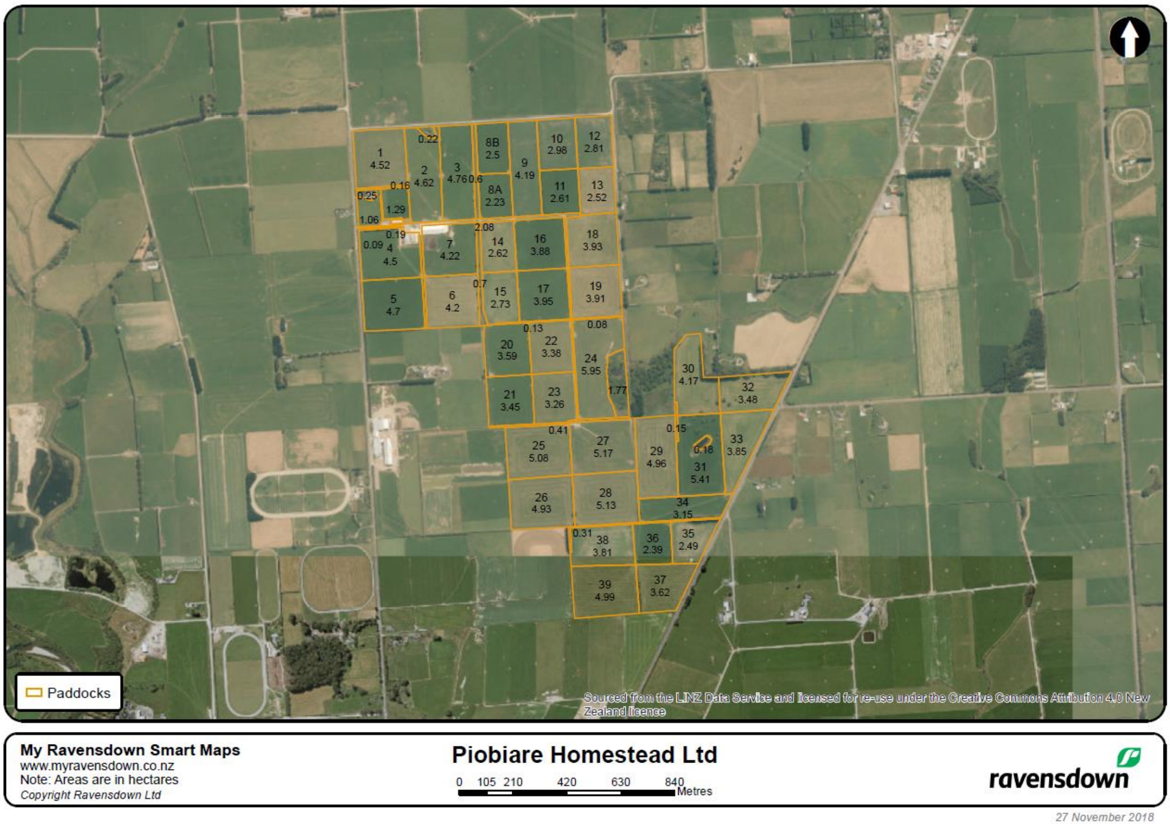
Artificial Drainage

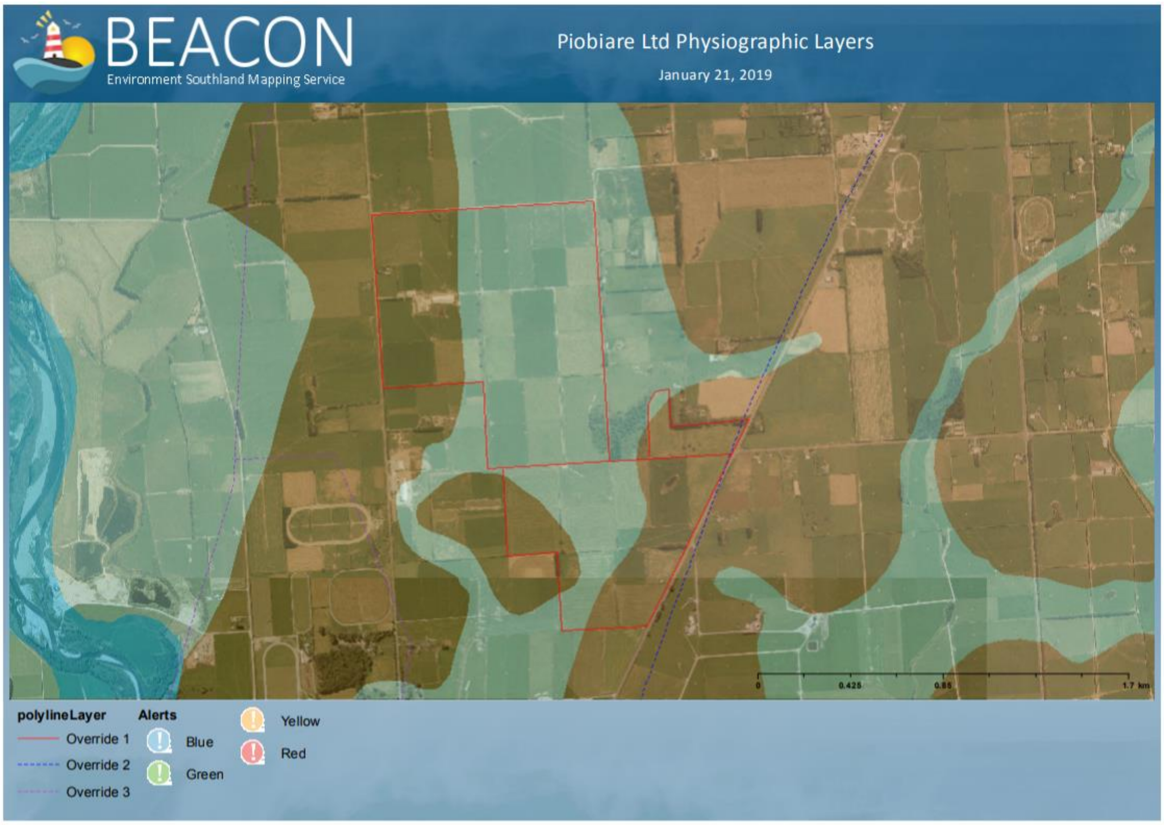
The farm is described by the owner as having tiles throughout the property, with imperfectly and poor draining blocks modelled as mole and tiled for 100 % of block, and the Waikiwi well drained soils at 50 % effectively drained

Management Unit details and Soil Information

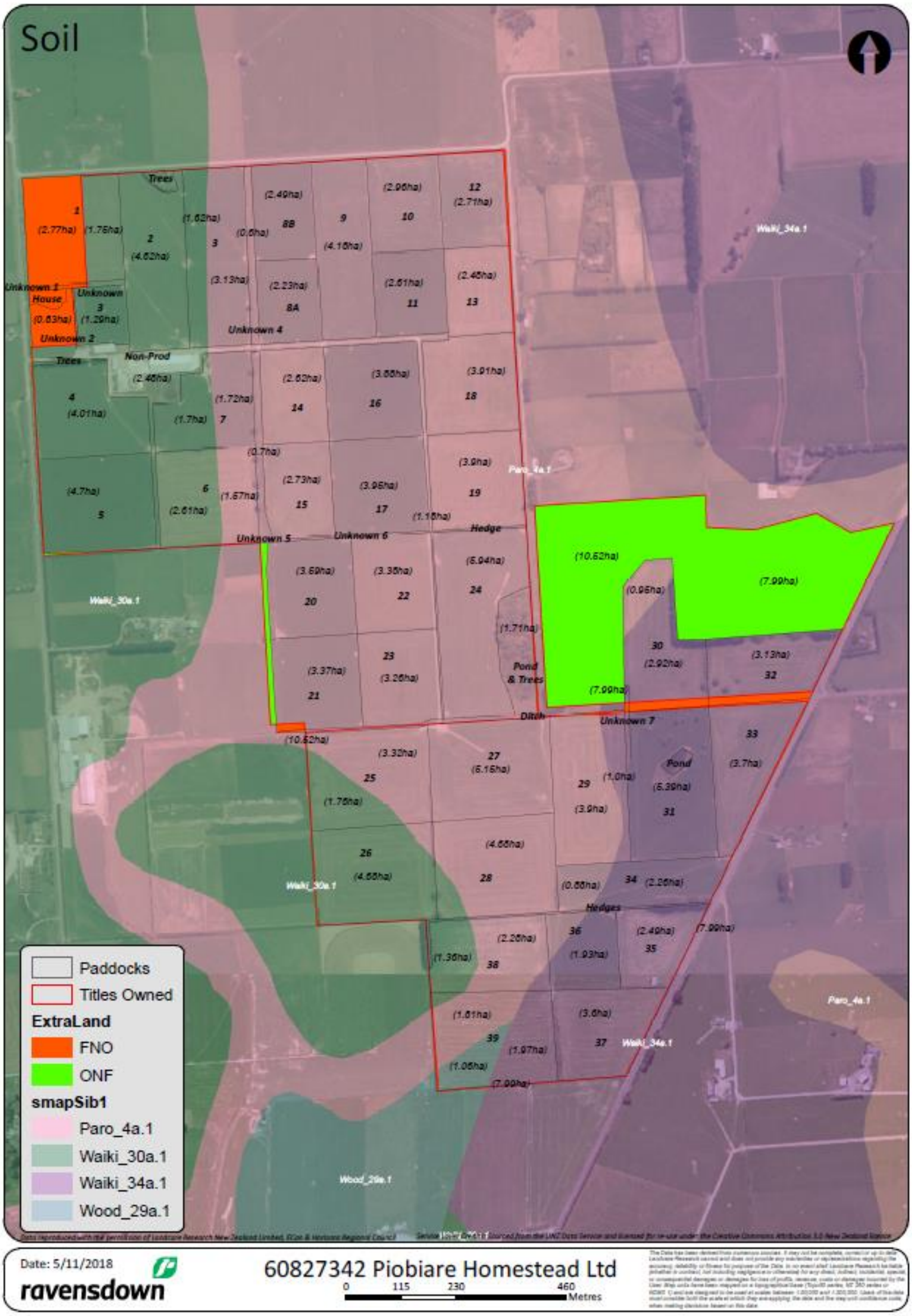
Block Name	Stock	Block Type	Soil Order & Texture	Drainage Class	Effluent	PAW (0-60cm)	Effective Area (ha)
Paro_4a.1 Effluent	Dairy grazers	Pastoral	Recent Gley Silt loam	Poor	Yes	177.7	47.4
Waiki_30a.1 Effluent	Dairy grazers	Pastoral	Firm Brown Silt Loam	Well drained	Yes	117.1	16.8
Paro_4a.1 Non Eff	Dairy grazers	Pastoral	Recent Gley Silt loam	Poor	No	177.7	13.4
Waiki_30a.1 Non Effluent	Dairy grazers	Pastoral	Firm Brown Silt Loam	Well drained	No	117.1	6.9
Paro_4a.1 Non Eff Lease	Dairy grazers	Pastoral	Recent Gley Silt loam	Poor	No	177.7	10.3
Waiki_30a.1 Non Eff Lease	Dairy grazers	Pastoral	Firm Brown Silt Loam	Well drained	No	117.1	1.5
Waiki_34a.1 Non Eff Lease	Dairy grazers	Pastoral	Firm Brown Silt Loam	Well drained	No	112.2	28.6
Wood_29a.1 Non Eff Lease	Dairy grazers	Pastoral	Firm Brown Silt Loam	Imperfect	No	106.6	1.1
Trees and Scrub 1	N/A	Trees and Scrub	Recent Gley Silt loam	Poor	No	177.7	2.5
Riparian 1	N/A	Riparian	Recent Gley Silt loam	Poor	No	177.7	1.1
Waiki_34a.1 Non Eff Lease FNO	Dairy grazers	Pastoral	Firm Brown Silt Loam	Well drained	No	112.2	0.9
Waiki_30a.1 Hse Pdks	Dairy grazers	Pastoral	Firm Brown Silt Loam	Well drained	No	117.7	2.5
Riparain sheep	Sheep	Pastoral	Recent Gley Silt loam	Poor	No	177.7	0.8
Paro_4a.1 FBt>FBt	Dairy grazers	Crop	Recent Gley Silt loam	Poor	No	177.7	6.5
Waiki_30a.1 FBt>FBt	Dairy grazers	Crop	Firm Brown Silt Loam	Well drained	No	117.1	2.3
Paro_4a.1 1st Yr FBt	Dairy grazers	Crop	Recent Gley Silt loam	Poor	No	177.7	6.5
Waiki_30a.1 1st Yr FBt	Dairy grazers	Crop	Firm Brown Silt Loam	Well drained	No	117.1	2.3
Waiki_30a.1 YG	Dairy grazers	Crop	Firm Brown Silt Loam	Well drained	No	117.1	2.3
Paro_4a.1 YG	Dairy grazers	Crop	Recent Gley Silt loam	Poor	No	177.7	6.5
Non-Productive	-	-	-	-	-	-	4.8
Total							**165.1**

Farm Physiographic Land Management Unit Maps

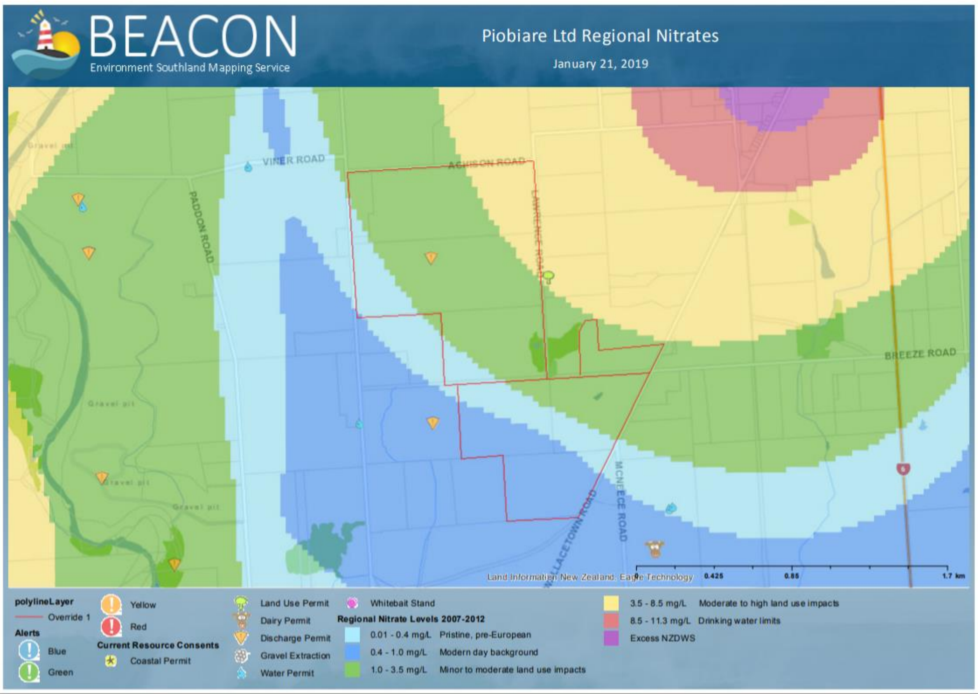




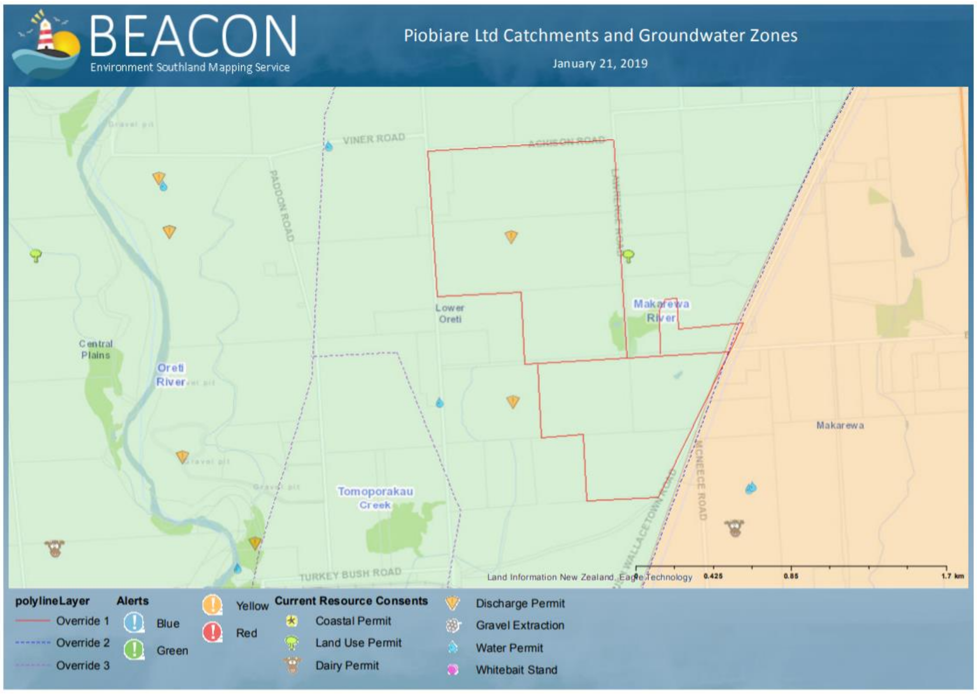
Soil and Slope Maps



Nitrate and Catchment Zone Maps



Farm chiefly lies in nitrate zones which range from pristine pre European to Modern day background to minor to moderate land use impacts.



The farm lies within the Lower Oreti ground water zone, under Alluvial gravels in the Makarewa River sub catchment of the Oreti Catchment

Proposed Farm System Analysis

Description of Proposed Farm System

The farm is proposed to be *used solely for the carrying of the Aerodrome dairy farm increased numbers of wintered dairy cows and young stock*. The effluent area and wintering barn capacity remains the same, with the added ability to use the wintering barn over the May and September periods *for other dry stock*. The cropping area is to remain on the home block still and the effluent block mainly, with the *additional cows and heifers wintered on a slightly increased crop area which is averaged pro rata across the two key soil types*. ***There will be 18 ha of fodder beet grown***.

The 165.1 ha property is operated as a dairy support runoff, with ***670*** mixed age cows bought back on farm from the Aerodrome dairy platform from the end of May, with 400 entering the wintering barn and the remainder ***(270)*** fed on crop. The cows on crop return to Aerodrome firstly as they transition on crop, whilst the indoor fed cows are sent back as they calve. Cows have been modelled to align with the Aerodrome proposal, with higher numbers retained on Piobiare and lower dry cows carried on Aerodrome, as Friesian X with average mob weight of 475 kg. Weaned R1 Replacement dairy heifers ***(225)*** are brought from Aerodrome over November and December at 100kg, are wintered twice with the ***same number*** of in calf heifers going back to Aerodrome in July, the *increased numbers remaining* are staggered back from late July. The same small mob of dairy cross beef calves are also reared from weaning (100 kg LW) through to slaughter prior to their second winter (again modelled 285 kg c/c).

Stock Numbers:

Stock class	Start LW	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	End LW
R1 Dairy replacements	100	0	0	0	0	190	166	225	223	223	223	220	220	240
R2 Dairy replacements	240	220	220	219	219	219	219	218	218	218	215	215	215	450
Heifers	450	93	15	0	0	0	0	0	0	0	0	0	0	460
Heifers & Cows	455												400	465
Heifers & Cows	465	400	315	35										480
Dairy cows grazing	475	0	0	0	0	0	0	0	0	0	0	0	270	475
Dairy cows grazing	475	252	75	0	0	6	6	0	0	0	0	0	0	475
Weaners	100					12	12	12	12	12	12	12	12	260
Steers	260	12	12	12	12	12	12	12	12	12	12	12		285 c/c
Sheep	60			20	40		40	20		20	40		40	60
Total Cows		745	405	35									670	

Structures

There is a wintering barn built on the property with a capacity to hold and winter inside approximately 400 animals. *There will a change in use of this structure with the aim to further mitigate losses on farm by using this over the shoulders of the season (see table on page 8), with an* ***average*** *of 425 cows calculated as wintered over the period June to August, with the rest on crop. The current effluent system is capable of the additional effluent stored.*

In addition the effluent area remains at 90.7 ha, as the cropped area now rotates through some of the non-effluent areas of the home block. (See area differences in Land Management tables)

The management details of the Wintering Barn and Effluent, as well as the feeding regime, remains the same as is as reported in the current farm system table. The changes in the nutrient impacts are also reported in these past sections as well.

Supplements

An estimated 468 Tonnes of silage DM is cut and stored in silage pits (concrete bunkers) and 124 T DM in baleage is cut and used for cattle on crop.

- 468 T DM silage is cut and stored in pits and *468 T DM is fed* to cattle from storage on the wintering pad. This was the amount that the model would report on being fed at very good utilisation, which was used given the concrete indoor feeding bins.
- 100 T DM of baleage is cut and fed to cattle on pastoral blocks, with a further 24 T DM fed to cattle on crop blocks.

Supplementary feed made and fed during the season is similar, given the stocking rates over the total area and time spent on pasture are similar.

Pastoral Stock Unit details:

Stock Class Current System	Revised stock units/ha		Total revised stock units		
	Total farm	Grazed area	Total	Pasture eaten	Time on pasture
Sheep	0.1	0.1	12	12	12
Beef / dairy grazing	15.6	19.7	2,571	1,368	2,571
Total	**15.7**	**19.8**	**2,583**	**1,380**	**2,583**
Stock Class Proposed System	**Revised stock units/ha**		**Total revised stock units**		
	Total farm	**Grazed area**	**Total**	**Pasture eaten**	**Time on pasture**
Sheep	0.1	0.1	12	12	12
Beef / dairy grazing	16.0	20.4	2,651	1,213	2,651
Total	**16.1**	**20.5**	**2,663**	**1,225**	**2,663**

Fertiliser

There are very little change between the two systems modelled. The only modelled change is to reduce the phosphate and potassium on the pastoral effluent blocks by applying 150 kg/ha of 15 % sulphur superphosphate instead of the potassic superphosphate applied previously. The total fertiliser nitrogen applied is 155 and 141 kg N/ha/year for the Non effluent and Effluent farm blocks and 139 kg N/ha across all blocks (whole property) on average

Pasture Production

The predominant pasture species on the dairy farm is ryegrass/white clover. Annual pasture production has been weighted by relative productivity.

Blocks	Relative productivity	% pasture eaten	Utilisation %	T DM/ha/year
Effluent Non Effluent Home Blocks	1.0	100% dairy grazers	70	11.84
Lease, House Blocks	0.9	100% dairy grazers,	70	10.66
Riparian blocks	0.9	Riparian 100 % sheep only	70	10.37

It should be noted that this estimated pasture production is based on default South Island pasture ME values and may be different to actual ME values and utilisation values on this farm which in turn would influence estimated pasture production.

Crop Rotations

For the proposed period, 18.0 ha will be used for cropping – with fodder beet sown, grazed and cropped twice before being re sown into permanent pasture. The crop blocks modelled were based on the two key soil types pro rata (Paroa_4a.1 and Waikiwi_30a.1) on the currently owned farm property (1st Year crop, 2nd year crop or Fodder beet to Fodder beet and Young grass). Where the block was previously in pasture, conventional cultivation was used in the month of October. Re cropped blocks conventional cultivation occurred in the month of sowing (November). The farm practice is still to crop the Effluent soils mostly, ***with some non-effluent area now used but not the leased area***.

Pasture to Fodder Beet: (9.0 ha):

Blocks Paro_4a.1 and Waiki_30a.1 1st Yr FBt were used to model the crop rotation.

- Fodder beet is sown in November after conventional cultivation, grazed in situ in June through to September by the cattle and dairy replacement heifers.
- Sown with a soluble fertiliser mix of NPKS rating (37-28-75-15)as a base and drilled with Crop master DAP (NPKS 30-34-0-2) plus two further applications of Urea at 100 kg/ha are made in December and February.
- Yields are averaged at 26 T DM/ha

Fodder Beet to Fodder Beet: (9.0 ha):

Blocks FB>FB Paro_4a.1, FB>FB Waiki_30a.1, were used to model this crop rotation

- The data entered is the same as for the crop blocks above.

Young Grass: (9.0 ha):

Blocks Waiki_30a.1 YG and Paro_4a.1 were used to demonstrate this crop rotation.

Crop blocks were modelled as 6 years in pasture given the 18.0 ha (not counting the Young grass) cropped from the 101.9 ha modelled from 110.7 ha of home blocks available, with a crop rotation final month being September.

All other factors have remained the same.

Management Unit details and Soil Information: Table 1b

Block Name	Stock	Block Type	Soil Order & Texture	Drainage Class	Effluent	PAW (0-60cm)	Effective Area (ha)
Paro_4a.1 Effluent	Dairy grazers	Pastoral	Recent Gley Silt loam	Poor	Yes	177.7	55.2
Waiki_30a.1 Effluent	Dairy grazers	Pastoral	Firm Brown Silt Loam	Well drained	Yes	117.1	19.7
Paro_4a.1 Non Eff	Dairy grazers	Pastoral	Recent Gley Silt loam	Poor	No	177.7	11.0
Waiki_3oa.1 Non Effluent	Dairy grazers	Pastoral	Firm Brown Silt Loam	Well drained	No	117.1	4.5
Paro_4a.1 Non Eff Lease	Dairy grazers	Pastoral	Recent Gley Silt loam	Poor	No	177.7	8.5
Waiki_30a.1 Non Eff Lease	Dairy grazers	Pastoral	Firm Brown Silt Loam	Well drained	No	117.1	1.5
Waiki_34a.1 Non Eff Lease	Dairy grazers	Pastoral	Firm Brown Silt Loam	Well drained	No	112.2	24.0
Wood_29a.1 Non Eff Lease	Dairy grazers	Pastoral	Firm Brown Silt Loam	Imperfect	No	106.6	1.1
Trees and Scrub 1	N/A	Trees and Scrub	Recent Gley Silt loam	Poor	No	177.7	2.5
Riparian 1	N/A	Riparian	Recent Gley Silt loam	Poor	No	177.7	1.1
Waiki_34a.1 Non Eff Lease FNO	Dairy grazers	Pastoral	Firm Brown Silt Loam	Well drained	No	112.2	0.9
Waiki_30a.1 Hse Pdks	Dairy grazers	Pastoral	Firm Brown Silt Loam	Well drained	No	117.7	2.5
Riparain sheep	Sheep	Pastoral	Recent Gley Silt loam	Poor	No	177.7	0.8
Paro_4a.1 FBt>FBt	Dairy grazers	Crop	Recent Gley Silt loam	Poor	No	177.7	5.3
Waiki_30a.1 FBt>FBt	Dairy grazers	Crop	Firm Brown Silt Loam	Well drained	No	117.1	3.7
Paro_4a.1 1st Yr FBt	Dairy grazers	Crop	Recent Gley Silt loam	Poor	No	177.7	5.3
Waiki_30a.1 1st Yr FBt	Dairy grazers	Crop	Firm Brown Silt Loam	Well drained	No	117.1	3.7
Waiki_30a.1 YG	Dairy grazers	Crop	Firm Brown Silt Loam	Well drained	No	117.1	3.7
Paro_4a.1 YG	Dairy grazers	Crop	Recent Gley Silt loam	Poor	No	177.7	5.3
Non-Productive	-	-	-	-	-	-	4.8
Total							**165.1**

Summary of Current Farm System Scenario: Table 2

	Current scenario	Proposed Scenario
System Type	Dairy support runoff	Dairy support runoff
Total Area (ha)	165.1	165.1
Stocking rate (RSU/ha)*	19.8 /ha grazed 15.7 /ha total farm	20.5 /ha grazed 16.1 /ha total farm
N use (kg N/ha/year)	139 (averaged across the whole farm)	138 (averaged across the whole farm)
Supplements Imported (kg DM/ha/year)	3,585 kg DM/ha/yr. (total farm area), made on and 90 % fed back	3,585 kg DM/ha/yr. (total farm area), made on and all fed back
Pasture production (kg DM/ha/year)**	11,510 to 12,789 (Cattle blocks) 10,829 (Sheep riparian blocks) 8,954 to 9,055 (Young Grass)	10,656 to 11,841 (Cattle blocks) 10,374(Sheep riparian blocks) 8,330 to 8,426 (Young Grass)

*As calculated by OVERSEER and including dairy grazing and replacements**As calculated by OVERSEER with standard default and ME values which are likely to be lower than Southland Otago values.

Summary of Current Whole Farm Nutrient Loss Indicators: Table 3

	Current scenario	Proposed Scenario
Nitrogen leaching loss to water (Total kg N/year)	4,699	4,385
Nitrogen leaching loss to water (kg N/ha/year)	28	27
Phosphorus runoff to water (Total kg P/year)	121	118
Phosphorus runoff to water (kg P/ha/year)	0.7	0.7

Discussion on Whole Farm Nutrient Loss Indicators

From the information provided by Nelson, Roseanne and Chris on behalf of Piobiare Homestead Ltd, information from farm records, and the assumptions listed above, the N loss from the root zone and P loss to second order streams for the current modelled farm system is outlined below.

- The N loss from the root zone from the ***current farm system*** was calculated using OVERSEER® (v6.3) to be **4,699 kg N/year or 28 kg N/ha/year**.
- The N loss from the root zone from the ***proposed farm system*** was calculated using OVERSEER® (v6.3) to be **4,385 kg N/year or 27 kg N/ha/year**
- The P loss from the root zone from the ***current farm system*** was calculated using OVERSEER® (v6.3) to be **121 kg P/year or 0.7 kg P/ha/year**.
- The P loss from the root zone from the ***proposed farm system*** was calculated using OVERSEER® (v6.3) to be **118 kg N/year or 0.7 kg N/ha/year**

The key influences on N loss for the farm systems are discussed below.

- ***Grazing on fodder beet crop***

The concentrations of urinary N on crops deposited with a moderate stocking rate during winter months may result in a high nitrogen load; thereby increasing the risk of N loss, particularly as this farm has some well-drained soils. This process is exacerbated when the crop is grazed over winter and then left fallow over spring, or on soils with less ability to buffer and are easily leached. The urinary N which has been deposited in the soil is not utilised for crop growth and therefore over the high rainfall period, that N is easily leached. This can be demonstrated by the high N loss value for the Waikiwi crop blocks with the rotation of FB to FB, and Pasture to FB, in comparison to the Paroa blocks of the same rotation, with losses being 110 and 94 kg N/ha/year and 82 and 70 kg N/ha/year respectively. In total, the crop blocks and young grass paddocks contribute 1,707 kg N/year or 36.3 % of the total N loss for the current system. This is very similar to the proposed system (1,773 kg N/year and 40.5 % of total N loss/year.

- ***Soil type and Potential Available Water (PAW)***

The soil type has a large impact on N leached. The pastoral blocks with the highest N losses were the Waikiwi_30a.1 soil blocks due to the lower Potential Available Water (PAW) compared to the heavier and slower draining Paroa_4a.1 soils. The Potential Available Water is described as “the amount of water potentially available to plant growth that can be stored in the soil to specific soil depths. Soils with lower PAW are less able to buffer against changes in nitrogen losses to the bottom of the root zone and thus will typically have higher N leaching as there will be more frequent drainage from these soil for a given volume of water applied. In addition these better buffered soils for N leaching are most at risk to sediment loss and overland flow on this farm, as discussed under P losses below.

- ***Pastoral productivity***

The higher the pastoral productivity from pastoral land and the associated higher stocking, the higher the risk of N losses on farms, especially under the climatic, rainfall and evapotranspiration rates for Southland. The current system has a similar stocking per ha on grass (19.8 rsu. /ha grazed) compared to the proposed system (20.5 rsu. /ha grazed) as seen in the table on page 19. This drives the pasture production required at 12,704 kg DM/ha/year and 11,808 kg DM/ha/year respectively as seen in table 2, page 19. This leads to the high amount of urine deposition on pastures from the resulting cattle intakes, resulting in increased risk from N leaching. The results point to a slightly reduced influence from direct losses in the proposal, with the amount of N loss attributed to leaching via tiles decreasing from 19 kg N/ha/year to 17 kg N/ha/year for the proposal, the rest are due to N losses from cropping and effluent applications (other sources) and leaching from urine patches (18 % or 5 kg N/ha/year and 18.5 % or 5 kg N/ha/year respectively for the current and proposed system).

The key influences on P loss for the farm system are discussed below:

The overall P loss risk is low to moderate at 121 kg P/year or 0.7 kg P/ha/year. This is due to the mostly flat topography and soil type. On a kg P/ha/year basis, the majority of the P losses arose from the gleyed soil (Paroa) under cropping or being applied with effluent solids and sludge (9 and 36 kg P/year respectively). These losses can be mitigated with riparian plantings which can remove any sediment before reaching water ways. Reducing stock treading and optimal P levels within these soils are also important factors and are current management practices being used by the current owners. Other sources (19 kg/year) of P loss are lanes and races. Riparian strip planting and vegetation buffer zones again are potential mitigation solutions to reduce this runoff.

The current scenario is rated 7.95, the mid side of category 1 (1 to 12) under the Soil versatility rating system (Landcare Research, 2002), as calculated in the table 4 below. The farm already uses a number of effective Nitrogen mitigation strategies to minimise losses for the proposal culminating in the results above.

Soil Vulnerability Land Management Rating and Physiographic Zones: Table 4

Soil Type (proposal)	Physiographic Zone	Soil Vulnerability	Vulnerability rating	% Farm	Rating score
Paroa_4a.1 aka. Dacre	Gleyed No variant	Moderate	10	58.1	5.81
Waikiwi_30a.1 aka. Edendale	Oxidising No variant	High	1	23.1	0.23
Waikiwi_34a.1	Oxidising Variant artificial drainage	Moderate	10	18.1	1.81
Woodlands_29a.1	Oxidising No variant	Moderate	10	0.7	0.1
Total				**100.0**	**7.95**

The property is situated in the Makarewa River sub catchment, and the Oreti catchment of the proposed Environment Southland Regional Water and Land Plan. It is 58.1% on a Gleyed physiographic zone, with no variants and the remainder is on Oxidising with no variant (23.8 %) and with a variant of artificial drainage (18.1 %). (See map, page 12&13 and table above), meaning the farm must attach significance to these zones in its environmental management. The farm is within zones having influence on nitrate levels within ground water in the range of pristine pre European to moderate to high land use impacts (Environment Southland Beacon map, page 14 of report). Water quality is characterised by alluvial gravels in the Makarewa groundwater management zone and the property is mostly within the Lower Oreti surface water zone. Implications of these environmental characteristics are largely unknown at present but some catchment areas will be required to reduce their impacts. The zonal information would point to the presence of nitrate leaching; and sediment loss as the key risk factors for these zones. An additional key risk factor for all soils is the direct losses of nitrogen through tiles which is the case here.

Mitigations current and modelled:

A summary of current good practice modelled are summarised from the discussions and report;

1. The farm has a wintering barn in which approximately 400 animals are fed in doors and the effluent captured, kept and applied when the pastures are growing (October/November after first cut of silage)
2. There will be additional use of the wintering barn over May and September for the younger stock in the proposal, reducing treading and N leaching losses, as urine is collected and applied at more appropriate times.
3. Given the above, in addition to the change in stock numbers, the stocking intensity is slightly reduced on pasture and there is little need for any additional nitrogen fertiliser from modelling
4. Effluent is stored and able to be applied at appropriate times. As well the area applied is more than adequate, given only 38 ha is required to apply 150 kg of N/ha from all effluent sources, with the current area modelled as 90.7 ha including crops.
5. Effluent applications to the highest risk soil (Paroa) during the highest risk periods could be minimised. This and the created Riparian strips and wetlands would be the activities which would be required to mitigate any overland flows and the direct losses from tile drains.

The associated input parameter reports (for the nutrient budget) are available in a separate document upon request.

Please see information contained in the Appendices for detail relating to nutrient budgets, nitrogen block reports, phosphorus block reports and estimated pasture production for the current situation and scenario modelled.

OVERSEER v6.2.1 onwards has a new irrigation module to better reflect the management practices of irrigators. The Best Practice Data Input Standards give some guidance on what is now required. The model requires more information from users about their irrigation system and how water application decisions are made on farm. The extra data needed includes depth of water per application; return time and depending on how soil water is monitored what are the trigger points and targets (mm deficit). Ideally, this data needs to be actual long-term average data as OVERSEER uses 30-year average climate data. Best estimates of these data will generally generate more drainage, and hence N loss to water, than has been the case with previous OVERSEER versions.

OVERSEER is a continually developing model with several aspects currently being investigated. In particular there are on-going issues in relation to the modelled nitrogen leaching from grazed crop blocks (and possibly forage blocks also) being less than expected. (Please see for more detail).

When future versions of OVERSEER are stipulated for use associated with Regional Council rules, both the current and the proposed farm systems will need to be re-modelled for consistency as the base N lost from the root zone may alter with updated OVERSEER versions.

Appendices

Current Farm System

Whole Farm Nutrient Budget

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	4,699	28
Phosphorus	121	0.7

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	139	47	39	50	87	0	3
Irrigation	0	0	0	0	0	0	0
Supplements	0	0	0	0	0	0	0
Rain/clover fixation	32	0	3	6	4	9	46

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	28	0.7	11	69	54	10	28
As product	11	3	1	1	5	0	0
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	56	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	48	9	5	-16	1	0	0
Inorganic mineral	0	4	-18	0	-2	-3	-3
Inorganic soil pool	5	31	33	0	32	2	25

Current Farm System Nutrient Loss Indicators

P report

Phosphorus summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)
PARO_4A.1 EFFLUENT	36	0.8
PARO_4A.1 NON EFF	10	0.7
PARO_4A.1 NON EFF LSE	8	0.7
RIPARAIN SHEEP	0	0.5
WAIKI_30A.1 EFFLUENT	6	0.4
WAIKI_30A.1 HSE PDKS	1	0.3
WAIKI_30A.1 NON EFF LSE	1	0.3
WAIKI_34A.1 NON EFF LSE	14	0.5
WAIKI_34A.1 NON EFF LSE FNO	0	0.5
WAIKI_30A.1 NON EFF	2	0.3
WOOD_29A.1 NON EFF LSE	1	0.5
PARO_4A.1 1ST YR FBT	8	1.3
PARO_4A.1 FBT>FBT	9	1.3
PARO_4A.1 YG	5	0.7
WAIKI_30A.1 1ST YR FBT	1	0.4
WAIKI_30A.1 FBT>FBT	1	0.4
WAIKI_30A.1 YG	1	0.2

N report

Farm N

Block N

Nitrogen summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)	N IN DRAINAGE (PPM)	N ADDED (KG/HA)	N SURPLUS (KG/HA)
PARO_4A.1 EFFLUENT	1005	21	5	219	139
PARO_4A.1 NON EFF	296	22	5	155	113
PARO_4A.1 NON EFF LSE	204	20	5	155	101
RIPARAIN SHEEP	11	13	3	0	124
WAIKI_30A.1 EFFLUENT	403	24	6	219	141
WAIKI_30A.1 HSE PDKS	52	21	5	141	91
WAIKI_30A.1 NON EFF LSE	32	22	5	155	93
WAIKI_34A.1 NON EFF LSE	649	23	5	155	102
WAIKI_34A.1 NON EFF LSE FNO	19	21	5	155	86
WAIKI_30A.1 NON EFF	171	25	6	155	115
WOOD_29A.1 NON EFF LSE	27	24	6	155	119
PARO_4A.1 1ST YR FBT	457	70	15	159	163
PARO_4A.1 FBT>FBT	532	82	17	159	163
PARO_4A.1 YG	170	26	5	199	66
WAIKI_30A.1 1ST YR FBT	216	94	19	159	163
WAIKI_30A.1 FBT>FBT	253	110	21	159	163
WAIKI_30A.1 YG	79	34	7	199	46

Pasture Production, Effluent and Other Values Reports and Stock number record

Pasture/crops

	PASTURE/CROP	YIELD	GROWTH (KG DM/HA)	INTAKE (KG DM/HA)	REMOVED (KG DM/HA)	UTILISATION (%)	TOTAL RSU
PARO_4A.1 EFFLUENT	Ryegrass/white clover	-	12789	5467	4979	70	9.85
PARO_4A.1 NON EFF	Ryegrass/white clover	-	12789	6393	3657	70	11.51
PARO_4A.1 NON EFF LSE	Ryegrass/white clover	-	11510	5475	3689	70	9.87
RIPARAIN SHEEP	Ryegrass/white clover	-	10829	7580	0	70	13.8
WAIKI_30A.1 EFFLUENT	Ryegrass/white clover	-	12789	5494	4940	70	9.9
WAIKI_30A.1 HSE PDKS	Ryegrass/white clover	-	11475	5233	4000	70	9.44
WAIKI_30A.1 NON EFF LSE	Ryegrass/white clover	-	11510	5257	4000	70	9.47
WAIKI_34A.1 NON EFF LSE	Ryegrass/white clover	-	11510	5463	3706	70	9.84
WAIKI_34A.1 NON EFF LSE FNO	Ryegrass/white clover	-	11510	4946	4444	70	8.92
WAIKI_30A.1 NON EFF	Ryegrass/white clover	-	12789	6416	3623	70	11.58
WOOD_29A.1 NON EFF LSE	Ryegrass/white clover	-	11510	5512	3636	70	9.94
PARO_4A.1 1ST YR FBT	Fodder beets |	25 T DM/Ha	0	0	0	0	0
PARO_4A.1 FBT>FBT	Fodder beets | Fodder beets |	50 T DM/Ha	0	0	0	0	0
PARO_4A.1 YG	Fodder beets | Pasture |	25 T DM/Ha	9055	3970	3385	70	7.17
WAIKI_30A.1 1ST YR FBT	Fodder beets |	25 T DM/Ha	0	0	0	0	0
WAIKI_30A.1 FBT>FBT	Fodder beets | Fodder beets |	50 T DM/Ha	0	0	0	0	0
WAIKI_30A.1 YG	Fodder beets | Pasture |	25 T DM/Ha	8954	3528	3913	70	6.37

Farm details

N: 4699 N/ha: 28 P: 121 P/ha: 0.7 GHG/ha: 9617 NCE: 58%

Total area	165.1 ha
Productive block area	156.60 ha
Nitrogen conversion efficiency (NCE)	58%
N Surplus	72 kg/ha
Region	Southland

GHG: Allocation to wool - breeding mob	0.21	Total liveweight sold (kg/ha grazed)	3551
GHG: Allocation to wool - trading mob	0.01	Percent male beef animals	3
Total liveweight brought (kg/ha grazed)	3237	Beef / dairy grazing stock rate (RSU)	2571
Total liveweight reared (kg/ha grazed)	795	Sheep stock rate (RSU)	12

Effluent report

The report shows rates and target areas for farm liquid effluent only, assuming it is all applied to pastoral blocks. It excludes any farm solid effluent or imported effluent that may be added to effluent blocks. If this occurs, then target areas may need to be increased.

CURRENT AREA RECEIVING LIQUID EFFLUENT	
Total area including crops	67 ha
Pastoral area receiving liquid	58 ha
% of farm pastoral area	44%
Average liquid effluent	38 kg N/ha/yr
Average fertiliser	141 kg N/ha/yr
Average other	38 kg N/ha/yr
AREA OF FARM TO APPLY ALL EFFLUENT TO ACHIEVE RATES OF	
150 kg N/ha/yr - Liquid	20 ha - based on the amount of effluent generated on the the farm and sprayed from sump.
150 kg N/ha/yr - Solid	18 ha
150 kg N/ha/yr - Total	38 ha
Maintenance K	180 ha
100 kg K/ha/yr	81 ha
SOURCE OF N IN EFFLUENT BLOCK(S)	
Effluent from farm dairy	0%
Effluent from Feed pad	0%
Effluent from Standoff pad	0%
Effluent from Uncovered wintering pad/shelter	52%
Solids	48%
Exported	0%

Current		LW	July	August	September	October	Novembe	December	January	February	March	April	May	June	LW
Aerodrome	Milking herd 1	475	0	137	480	577	579	579	578	577	577	557	520	0	475
	Milking herd 2	450	24	180	190	190	190	190	189	189	188	172	164	0	450
	Bulls 1	600	0	0	0	0	6	23	15	0	0	0	0	0	600
	Replacements 1	450	95	0	0	0	0	0	0	0	0	0	0	0	450
	Replacements 2	100	0	0	0	0	0	59	8	8	6	4	4	4	240
	Dairy grazing (milking cows) 1	475	18	146	101	13	0	0	0	0	0	0	0	0	475
	Weaners 1	240	4	4	2	2	2	1	0	0	0	0	0	0	420
	Total Cows		**137**	**463**	**771**	**780**	**769**	**769**	**767**	**766**	**765**	**729**	**684**	**0**	
Piobiare	Dairy grazing (replacements) 1	100	0	0	0	0	100	151	200	199	199	199	198	198	240
	Dairy grazing (replacements) 2	240	198	198	197	197	197	197	196	196	196	195	195	195	450
	Dairy grazing (replacements) 3	100	0	0	0	0	90	175	175	175	175	175	175	174	240
	Dairy grazing (replacements) 4	240	174	45	0	0	0	0	0	0	0	0	0	0	260
	Heifers and cows 1	450	76	10	0	0	0	0	0	0	0	0	0	0	460
	Heifers and cows 2	455	0	0	0	0	0	0	0	0	0	0	0	400	465
	Heifers and cows 3	465	400	286	17	0	0	0	0	0	0	0	0	0	480
	Dairy grazing (milking cows) 1	475	0	0	0	0	0	0	0	0	0	0	0	194	475
	Dairy grazing (milking cows) 2	475	176	30	0	0	0	0	0	0	0	0	0	0	475
	Weaners 1	100						12	12	12	12	12	12	12	260
	Steers	260	12	12	12	12	12	12	12	12	12	12	12		285 c/c
															Average
	Head numbers given		***1032***	***676***	***284***	***251***	***321***	***553***	***553***	***562***	***598***	***550***	***649***	***1088***	***593***
	Total Head		***1036***	***581***	***226***	***209***	***399***	***547***	***595***	***594***	***594***	***593***	***592***	***1173***	***595***
	Total Cows		**652**	**326**	**17**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**594**	
	Total cows incl Aero		**789**	**789**	**788**	**780**									
Proposed		**LW**	**July**	**August**	**September**	**October**	**Novembe**	**December**	**January**	**February**	**March**	**April**	**May**	**June**	**LW**
Aerodrome	Milking herd 1	475	0	201	552	645	645	645	645	645	645	590	480	0	475
	Milking herd 2	450	27	215	210	205	205	205	205	205	205	185	185	0	450
	Bulls 1	600	0	0	0	0	0	25	25	0	0	0	0	0	600
	Replacements 1	450	95	0	0	0	0	0	0	0	0	0	0	0	450
	Replacements 2	100	0	0	0	0	0	59	8	8	6	4	4	4	240
	Dairy grazing (milking cows) 1	475	13	64	83	12	0	0	0	0	0	0	0	0	475
	Weaners 1	240	4	4	2	2	2	1	0	0	0	0	0	0	420
	Total Cows		**135**	**480**	**845**	**862**	**850**	**850**	**850**	**850**	**850**	**775**	**665**	**0**	
Piobiare	Dairy grazing (replacements) 1	100	0	0	0	0	0	190	225	223	223	223	220	220	240
	Dairy grazing (replacements) 2	240	220	220	219	219	219	219	219	219	215	215	215	215	450
	Heifers and cows 1	450	93	0	0	0	0	0	0	0	0	0	0	0	460
	Heifers and cows 2	455	0	0	0	0	0	0	0	0	0	0	0	400	465
	Heifers and cows 3	465	400	315	25	0	0	0	0	0	0	0	0	0	480
	Dairy grazing (milking cows) 1	475	0	0	0	0	0	0	0	0	0	0	0	265	475
	Dairy grazing (milking cows) 2	475	252	85	0	0	0	0	0	0	0	0	0	0	475
	Weaners 1	100						8	8	8	8	8	8	8	260
	Steers	260	8	8	8	8	8	8	8	8	8	8	8		285 c/c
	Bull calves	100						28	28	28	28	28	28	28	250
	R 1 Bulls	250	28	28	28	28	28	28	28	25	25	25	25	25	470
	R 2 Bulls	470	25	25	25	25	25								300 c/c
															Average
	Total Head		***1026***	***681***	***305***	***280***	***280***	***481***	***516***	***511***	***507***	***507***	***504***	***1161***	***563***
	Total Head incl Aero		***1165***	***1165***	***1152***	***1144***	***1132***	***1416***	***1399***	***1369***	***1363***	***1286***	***1173***	***1165***	***1244***
	Total Cows		**745**	**400**	**25**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**665**	
	Total cows incl Aero		**880**	**880**	**870**	**862**	**850**	**850**	**850**	**850**	**850**	**775**	**665**		

Current System Parameter Report

This is available upon request as a separate document.

Proposed Farm System

Whole Farm Nutrient Budget

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	4,385	27
Phosphorus	118	0.7

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	138	42	28	46	75	0	3
Irrigation	0	0	0	0	0	0	0
Supplements	0	0	0	0	0	0	0
Rain/clover fixation	27	0	3	6	4	9	46

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	27	0.7	11	67	53	10	28
As product	11	3	1	1	5	0	0
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	56	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	53	9	5	-17	1	0	0
Inorganic mineral	0	4	-21	0	-2	-3	-3
Inorganic soil pool	5	27	33	0	23	3	24

Proposed Farm System Nutrient Loss Indicators

P report

Phosphorus summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)
PARO_4A.1 EFFLUENT	41	0.7
PARO_4A.1 NON EFF	8	0.7
PARO_4A.1 NON EFF LSE	6	0.7
RIPARAIN SHEEP	0	0.5
WAIKI_30A.1 EFFLUENT	7	0.3
WAIKI_30A.1 HSE PDKS	1	0.3
WAIKI_30A.1 NON EFF LSE	1	0.3
WAIKI_34A.1 NON EFF LSE	11	0.5
WAIKI_34A.1 NON EFF LSE FNO	0	0.5
WAIKI_30A.1 NON EFF	2	0.3
WOOD_29A.1 NON EFF LSE	1	0.5
PARO_4A.1 1ST YR FBT	7	1.3
PARO_4A.1 FBT>FBT	7	1.3
PARO_4A.1 YG	4	0.7
WAIKI_30A.1 1ST YR FBT	2	0.4
WAIKI_30A.1 FBT>FBT	2	0.4
WAIKI_30A.1 YG	1	0.2

N report

Farm N

Block N

Nitrogen summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)	N IN DRAINAGE (PPM)	N ADDED (KG/HA)	N SURPLUS (KG/HA)
PARO_4A.1 EFFLUENT	974	18	4	217	123
PARO_4A.1 NON EFF	193	18	4	155	92
PARO_4A.1 NON EFF LSE	133	16	4	155	81
RIPARAIN SHEEP	10	13	3	0	119
WAIKI_30A.1 EFFLUENT	559	28	7	217	215
WAIKI_30A.1 HSE PDKS	44	17	4	141	84
WAIKI_30A.1 NON EFF LSE	27	18	4	155	85
WAIKI_34A.1 NON EFF LSE	425	18	4	155	83
WAIKI_34A.1 NON EFF LSE FNO	16	18	4	155	78
WAIKI_30A.1 NON EFF	78	17	4	155	75
WOOD_29A.1 NON EFF LSE	23	21	5	155	116
PARO_4A.1 1ST YR FBT	363	68	14	159	163
PARO_4A.1 FBT>FBT	423	80	16	159	163
PARO_4A.1 YG	126	24	5	197	50
WAIKI_30A.1 1ST YR FBT	339	92	18	159	163
WAIKI_30A.1 FBT>FBT	397	107	21	159	163
WAIKI_30A.1 YG	126	34	7	197	80

Pasture Production, Effluent and Other Values Reports

Pasture/crops

	PASTURE/CROP	YIELD	GROWTH (KG DM/HA)	INTAKE (KG DM/HA)	REMOVED (KG DM/HA)	UTILISATION (%)	TOTAL RSU
PARO_4A.1 EFFLUENT	Ryegrass/white clover	-	11841	4560	5326	70	8.2
PARO_4A.1 NON EFF	Ryegrass/white clover	-	11840	5170	4455	70	9.31
PARO_4A.1 NON EFF LSE	Ryegrass/white clover	-	10656	4330	4471	70	7.8
RIPARAIN SHEEP	Ryegrass/white clover	-	10374	7262	0	70	13.22
WAIKI_30A.1 EFFLUENT	Ryegrass/white clover	-	11840	7400	1269	70	13.31
WAIKI_30A.1 HSE PDKS	Ryegrass/white clover	-	10634	4643	4000	70	8.36
WAIKI_30A.1 NON EFF LSE	Ryegrass/white clover	-	10656	4659	4000	70	8.38
WAIKI_34A.1 NON EFF LSE	Ryegrass/white clover	-	10656	4368	4417	70	7.86
WAIKI_34A.1 NON EFF LSE FNO	Ryegrass/white clover	-	10656	4348	4444	70	7.82
WAIKI_30A.1 NON EFF	Ryegrass/white clover	-	11841	4400	5556	70	7.91
WOOD_29A.1 NON EFF LSE	Ryegrass/white clover	-	10656	4914	3636	70	8.84
PARO_4A.1 1ST YR FBT	Fodder beets |	25 T DM/Ha	0	0	0	0	0
PARO_4A.1 FBT>FBT	Fodder beets | Fodder beets |	50 T DM/Ha	0	0	0	0	0
PARO_4A.1 YG	Fodder beets | Pasture |	25 T DM/Ha	8426	3256	3774	70	5.85
WAIKI_30A.1 1ST YR FBT	Fodder beets |	25 T DM/Ha	0	0	0	0	0
WAIKI_30A.1 FBT>FBT	Fodder beets | Fodder beets |	50 T DM/Ha	0	0	0	0	0
WAIKI_30A.1 YG	Fodder beets | Pasture |	25 T DM/Ha	8330	3750	2973	70	6.74

Farm details

N: 4385 N/ha: 27 P: 118 P/ha: 0.7 GHG/ha: 9680 NCE: 60%

Total area	165.1 ha
Productive block area	156.70 ha
Nitrogen conversion efficiency (NCE)	60%
N Surplus	67 kg/ha
Region	Southland

GHG: Allocation to wool - breeding mob	0.21	Total liveweight sold (kg/ha grazed)	3944
GHG: Allocation to wool - trading mob	0.01	Percent male beef animals	12
Total liveweight brought (kg/ha grazed)	3652	Beef / dairy grazing stock rate (RSU)	2651
Total liveweight reared (kg/ha grazed)	784	Sheep stock rate (RSU)	12

Effluent report

The report shows rates and target areas for farm liquid effluent only, assuming it is all applied to pastoral blocks. It excludes any farm solid effluent or imported effluent that may be added to effluent blocks. If this occurs, then target areas may need to be increased.

CURRENT AREA RECEIVING LIQUID EFFLUENT	
Total area including crops	76 ha
Pastoral area receiving liquid	67 ha
% of farm pastoral area	52%
Average liquid effluent	38 kg N/ha/yr
Average fertiliser	141 kg N/ha/yr
Average other	37 kg N/ha/yr
AREA OF FARM TO APPLY ALL EFFLUENT TO ACHIEVE RATES OF	
150 kg N/ha/yr - Liquid	22 ha - based on the amount of effluent generated on the the farm and sprayed from sump.
150 kg N/ha/yr - Solid	21 ha
150 kg N/ha/yr - Total	43 ha
Maintenance K	188 ha
100 kg K/ha/yr	92 ha
SOURCE OF N IN EFFLUENT BLOCK(S)	
Effluent from farm dairy	0%
Effluent from Feed pad	0%
Effluent from Standoff pad	0%
Effluent from Uncovered wintering pad/shelter	51%
Solids	49%
Exported	0%

Proposed System Parameter Report

This is available upon request as a separate document ravensdown

Addendum:

Current Dairy System and Proposed System N & P Block Report comparison

Current	Area	Total N los	N lost to water	N in drainage	Added N **	Total P lost	P lost to water	Proposed		Total N lost	N lost to water	N in drainage	Added N **	Total P lost	P lost to water	N loss diffce	P loss diffce	N loss diffce	P loss diffce	N in Drge diffce
		kg N/yr	kg N/ha/yr	ppm	kg N/ha/yr	kg P/yr	kg P/ha/yr			kg N/yr	kg N/ha/yr	ppm	kg N/ha/yr	kg P/yr	kg P/ha/yr	kg N/yr	kg P/yr	kg N/ha/yr	kg P/ha/yr	ppm
Paro_4a.1 Effluent	47.4	1005	21	4.9	219	36	0.8	Paro_4a.1 Effluent	55.2	974	18	4	217	41	0.7	31	-5	3	0.1	0.9
Waiki_30a.1 Effluent	16.8	403	24	5.5	219	6	0.4	Waiki_30a.1 Effluent	19.7	559	28	6.5	217	7	0.3	-156	-1	-4	0.1	-1
Paro_4a.1 Non Eff	13.4	296	22	5.2	155	10	0.7	Paro_4a.1 Non Eff	11	193	18	4.2	155	8	0.7	103	2	4	0	1
Waiki_3oa.1 Non Eff	6.9	171	25	5.7	155	2	0.3	Waiki_3oa.1 Non Eff	4.5	78	17	4	155	2	0.3	93	0	8	0	1.7
Paro_4a.1 Non Eff Lse	10.3	204	20	4.7	155	8	0.7	Paro_4a.1 Non Eff Lse	8.5	133	16	3.7	155	6	0.7	71	2	4	0	1
Waiki_30a.1 Non Eff Lse	1.5	32	22	5	155	1	0.3	Waiki_30a.1 Non Eff Lse	1.5	27	18	4.2	155	1	0.3	5	0	4	0	0.8
Waiki_34a.1 Non Eff Lse	28.6	648	23	5.2	155	14	0.5	Waiki_34a.1 Non Eff Lse	24	425	18	4	155	11	0.5	223	3	5	0	1.2
Wood_29a.1 Non Eff Lse	1.1	27	24	5.5	155	1	0.5	Wood_29a.1 Non Eff Lse	1.1	23	21	4.7	155	1	0.5	4	0	3	0	0.8
Trees and Scrub 1	2.5	8	3	N/A		0	0.1	Trees and Scrub 1	2.5	8	3	N/A		0	0.1	0	0	0	0	0
Riparian 1	1.1	3	3	N/A		0	0.1	Riparian 1	1.1	3	3	N/A		0	0.1	0	0	0	0	0
Waiki_34a.1 Non Eff Lse FNO	0.9	19	21	4.8	155	0	0.5	Waiki_34a.1 Non Eff Lse FNO	0.9	16	18	4	155	0	0.5	3	0	3	0	0.8
Waiki_30a.1 Hse Pdks	2.5	52	21	4.8	141	1	0.3	Waiki_30a.1 Hse Pdks	2.5	44	17	4	141	1	0.3	8	0	4	0	0.8
Riparain sheep	0.8	11	13	3.2	0	0	0.5	Riparain sheep	0.8	10	13	3.1	0	0	0.5	1	0	0	0	0.1
Paro_4a.1 FBt>FBt	6.5	532	82	16.6	159	9	1.3	Paro_4a.1 FBt>FBt	5.3	423	80	16.1	159	7	1.3	109	2	2	0	0.5
Waiki_30a.1 FBt>FBt	2.3	253	110	21.4	159	1	0.4	Waiki_30a.1 FBt>FBt	3.7	397	107	20.9	159	2	0.4	-144	-1	3	0	0.5
Paro_4a.1 1st Yr FBt	6.5	457	70	14.6	159	8	1.3	Paro_4a.1 1st Yr FBt	5.3	363	68	14.2	159	7	1.3	94	1	2	0	0.4
Waiki_30a.1 1st Yr FBt	2.3	216	94	18.5	159	1	0.4	Waiki_30a.1 1st Yr FBt	3.7	339	91	18	159	2	0.4	-123	-1	3	0	0.5
Waiki_30a.1 YG	2.3	79	34	6.8	199	1	0.2	Waiki_30a.1 YG	3.7	126	34	6.7	197	1	0.2	-47	0	0	0	0.1
Paro_4a.1 YG	6.5	170	26	5.4	199	5	0.7	Paro_4a.1 YG	5.3	125	24	4.8	197	4	0.7	45	1	2	0	0.6
Non prodcutive/Other source	4.9	113				19		Other sources	4.8	118				18		-5	1	0	0	0
Whole farm/Total	165.1	4,698	28			121	0.7	Whole farm/Total	165.1	4,383	27			118	0.7	315	4	1.91	0.02	10.7
		4,699								4,384						315	3	1.00	0.00	

NOTE: The green coloured combined N & P blocks are lower in the proposed when compared to the current. The orange coloured blocks are higher in total N & P loss. White cells are no change. There are rounding differences which mean the sum total of the blocks can differ from Overseer reported values. The 0.1 ha non-productive difference between scenarios has been taken up by averaging areas in the crop blocks, but in no way affects the results at all. Commentary as to why these differences are lower are contained in the report. The Yellow cells totals row shows the overall difference between the sum totals as opposed to the total reported figures in green above, both are showing the overall reduction by these amounts and are as reported and confirmed in the main body of the report.

Farm Scenario Plan

A Plan to cover the Current 3 Year Averaged Farm system and the Proposed Farm System Nutrient Budgets after an adjacent property purchase.

Prepared by Mark Crawford

Farm Environmental Consultant

Certified Nutrient Management Adviser

60822552
AERODROME FARM LTD C/- P W MOYNIHAN
46 ALBERT STREET
GLADSTONE, INVERCARGILL 9810
10/07/19
Reviewed by Tim Lissaman CNMA

Executive Summary

Peter Moynihan on behalf of Aerodrome Farm Ltd has requested OVERSEER® Nutrient Budgets (OVERSEER) to reflect the current and proposed nutrient losses from their dairy farm as a part of an application for land use consent, given the farm area has increased with the purchase of an adjoining block which will be converted to dairying. The farm is at 95 Aerodrome Road, Myross Bush, on the outskirts of Invercargill city and 15 km to the south west coast. The proposal will be a dryland dairy farm, calving 885 cows and peak milking 850 cows.

Combined Current Farm Systems

- The N loss from the root zone from the farm system modelled was calculated from OVERSEER® (v6.3.1) values above to be **48 kg N/ha/year or 14,961 kg N/year.**
- The P loss risk from the farm system modelled was calculated from OVERSEER® (v6.3.1) values above to be **0.7 kg P/ha/year or 225 kg P/year.**

Proposed Farm System

- The N loss from the root zone from the farm system modelled was calculated using OVERSEER® (v6.3.1) to be **47 kg N/ha/year or 14,727 kg N/year.**
- The P loss risk from the farm system modelled was calculated using OVERSEER® (v6.3.1) to be **0.7 kg P/ha/year or 224 kg P/year.**

The higher productivity and urine patch deposition on an oxidising soil plus soils and crops are key risk factors. The farm is in a zone with medium to high land use impact on nitrate levels and the physiographic zones point to leaching to ground water, overland flow and artificial drains as being risk factors. The overall proposed farm system will decrease this risk, given the additional stocking for the proposal has been contained on the run off land holding with its mitigations of grazing only the dairy farm's livestock and further utilising the wintering barn available, and not elsewhere. Thus the overall pastoral stocking rate has been reduced between the current and proposed systems for this land holding.

For Aerodrome farm with the proposed mitigations of the winter/calving pad and reduced stocking overall plus the slightly reduced cropping area, the increase in the losses on the current sheep farm are managed to within the total losses of the proposed system. In addition, the wetlands and riparian strips in place are being enhanced with the additional land to be added to the platform, which will; mitigate the predicted N loss under the proposed scenario. The focus in reducing effluent applications to tiled areas at high risk times, plus ensuring more solid applications are targeted to the non-effluent areas, use of the new calving pad and differential effluent block nitrogen applications are recommended.

Contents

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3. This Plan complies with the industry standard “Code of Practice for Nutrient Management (with emphasis on Fertiliser Use)” (hereafter referred to as ‘the code’). The Code can be found on-line in full at: http://www.fertiliser.org.nz/Site/code_of_practice

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Mark Crawford

Farm Environmental Consultant

Dated 10th July 2019

General

Aim and Purpose of Farm Scenario Plan

Peter Moynihan on behalf of Aerodrome Farm Ltd has requested an OVERSEER® Nutrient Budget (OVERSEER) to reflect the current nutrient losses from their dairy farm and proposed nutrient losses as a part of aa application for land use consent given the farm area has increased by the purchase of an additional 47.54 ha of adjoining land which will be converted to dairying. The farm is at 95 Aerodrome Road, Lorneville, on the outskirts of Invercargill city and 15 km from the south west coast. The property is a dryland dairy farm, milking 769 cows (peak).

The total titled area of the current property is 261.8253 ha, however the GIS map with paddock areas calculates to 266.8 ha due to paper roads and such. The additional area is 47.8 ha GIS, including 0.1 ha non titled. The effective area proposed is calculated at 298.3 ha. In addition there is 2.4 ha of riparian area, 3.4 ha of ponds and wetlands and 10.2 ha non-effective area, comprising of sheds, lanes and yards. It is of flat to gentle rolling topography (modelled flat) with minor tributaries of the Makarewa river (Waikiwi and Myross Bush Streams) flowing through the farm.

Soil types on the farm are varied and include; mostly Waikiwi Silt Loam (Brown, well drained, PAW(plant available water) to 60 cm of 112.2 mm), Woodlands Silt Loam (Brown, Imperfectly drained, PAW 106.6 mm), Paroa Silt Loam Clay (Gley, Poorly drained, PAW 177.7 mm) and small areas of Waimairi peat loam (Peaty Gley, poorly drained, PAW 207 mm) and Otway peats (Organic soil, poorly drained, PAW 172.5 mm).

Overseer modelling of the current system has been undertaken in accordance with the Overseer 6.3.1 “best practice data input standards” and has been reviewed by a certified nutrient management advisor.
The following report summarises the respective Overseer 6.3.1 nutrient budgets and key assumptions made.

Property Details

Location/address	95 Aerodrome Road, Lorneville, Invercargill	Area (ha)
Legal Description Titled area	Lot 2 Deposited Plan 375267, Lot 6 Deposited Plan 403135 and Section 33 Block IV Invercargill Hundred, Lot 2 Deposited Plan 449748 and Section 1-3 Block IX Invercargill Hundred, Lot 1 Deposited Plan 387607, Lot 2 Deposited Plan 451891, 375267 and 444882 plus Lot 3 Deposited Plan 307719 and part Lot 11 Deposited Plan 428750	261.8253 & 47.5 ha
Total area (ha)	314.7 ha	266.8 ha & 47.8 ha
Made up by Non titled (ha)	5.7 ha of road reserve and paper roads	5.6 ha & 0.1 ha
Owners	Aerodrome Farm Ltd	
Contact details	Peter Moynihan	
Phone	Mobile (027) 4328599/phone (03) 2141699	
Farm Type	Seasonal supply Dairy farm and Silage block (effective)	

Farm System Analysis

Climate

Climate data for the property has been sourced from Overseer's Climate Station Tool data and has been entered as rainfall –1124 mm/year, PET – 755 mm/year and average temperature – 10°C, based on location at latitude/longitude -46.35700, 168.38520. Climate data has been modelled as per Overseer BPDIS

Description of 3 year averaged (2016-18) Farm System

The 266.8 ha property is operated as a Dryland dairy farm, calving 780 cows and peak milking 769 (475 kg LW) crossbred cows. First year heifers included in the above figures (190) are modelled slightly lighter at approximately 450 kg LW. Milk production aimed for is averaged at 326,180 kg MS/year. Cow numbers are shown in the table below. All cows were wintered off-farm for June with First calving Heifers back in the month of July (mean calving date 15th August), whilst the mixed age cows mean calving date is 20th August. The Mixed age Cows are staggered back from winter grazing from late July and given so few, numbers are modelled from August (137) with all cows back on farm by early September.

The dry-off date is the 30th of May for the cows and first calving heifers. All replacements are grazed off-farm until they return as in calf R2 heifers in July. Cows are milked once a day at dry off and all calves are fed colostrum and waste milk.

Chaser bulls are brought onto the farm over the October to January period. They have been modelled as Jersey bulls at 600kgLW.

Stock class	Start LW (kg)	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	End LW (kg)
Milking Herd (1)	475	0	137	480	577	579	579	578	577	577	557	520	0	475
Dry Cows	475	18	146	101	13	0	0	0	0	0	0	0	0	475
Replacements	450	24	180	190	190	190	190	189	189	188	172	164	0	450
Replacements	weaned						59	8	8	6	4	4	4	240
Replacements	450	95												450
Weaners	240	4	4	2	2	2	1							420
Bulls	600					6	23	15						600
Total Cows		137	463	771	780	769	769	767	766	765	729	684		

Supplements

Supplementary feed imported onto the property and to be fed during the season is as follows:

- 96 T DM PKE (Palm Kernel Extract) and 8 T DM Brewers Grain - fed in the milking shed over period September October and some in May, with a small % cows (10%) fed over January to April
- 211 T DM Pasture silage (Good Quality) imported and used over the season; and fed evenly across pastoral areas, fed mainly in August to October (60 %) and the rest in March to May (40 %)
- 34 T DM pasture baleage purchased and fed out on crop.
- 33 T DM baleage and 33 T DM of silage made from the silage block and stored and fed out in the following year to dairy cows evenly across pastoral blocks.
- 2 T DM barley straw fed to dairy cows at drying off.

Structures

There are currently no structures available on this farm, with cows wintered on crop.

Milk Shed feeding

Grain feeding is made available to cows during the spring (September and October) and autumn (May), with a small % of cows fed over the January to April period.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
% of milking cows	10	10	10	10	100	-	-	0	100	100	0	0

Fertiliser

Fertiliser applications have been modelled from Ravensdown sales records and farmer information, and are based from proof of placement maps and averaged monthly rates across blocks. Ammo 36 is generally applied over August and September to the whole farm, and in some cases Cropmaster Dap also. Urea is then applied from October through to March behind the cows at differing rates, mostly 55 kg/ha. Autumn applications finish in April. All dairy blocks receive the same Nitrogen applications, with the Silage blocks receiving pre and post-harvest in the months of November, December and January. Where a mix of fertiliser has been applied in month, a soluble fertiliser has been modelled to reflect the NPKS rates applied. Maintenance fertiliser is applied on the dairy pastoral blocks in December. Note also that December fertiliser is not modelled in the first year pasture in crop blocks, and also in reporting year of the new grass blocks. The Effluent area receives Superphosphate at 300 kg/ha, while the non-effluent area receives 400 kg/ha 15% Potash Super. The total fertiliser nitrogen applied is 204 kg N/ha/year for farm blocks.

Non Effluent and Effluent blocks:

Month	Fertiliser	NPKS nutrient rating (kg/ha)
August	Soluble fertiliser modelled	16-8-0-2
September	Soluble fertiliser modelled	20-8-0-2
October	Urea	25-0-0-0
November	Urea	25-0-0-0
December	Urea	37-0-0-0
January	Urea	37-0-0-0
February	Urea	25-0-0-0
March	Urea	28-0-0-0
August	Soluble fertiliser modelled	12-9-0-1
December (Non Effluent only)	15 % Potassic Superphosphate	0-31-30-38
December (Effluent only)	Superphosphate	0-27-0-38

Silage blocks:

Month	Fertiliser	NPKS nutrient rating (kg/ha)
November	Soluble fertiliser modelled	24-21-0-26
December	Soluble fertiliser modelled	24-21-28-7
January	Urea	30-0-0-0
January	Potassium Chloride	0-0-35-0

Soil Test Results

Taken from 2015 and 2016 soil tests for the various areas in table below;

Soil tests	Olsen P	QTK	QT Ca	QT Mg	QT Na	Org S
Waikiwi Effluent	36	8	8	21	9	15
Waikiwi Effluent tiled	38	9	8	21	11	16
Waikiwi Non-Effluent	34	5	8	17	9	14
Waikiwi Non Effluent tiled	42	7	8	18	10	16
Paroa Non Effluent	31	6	10	18	8	12
Woodlands Non Effluent and Effluent	32	6	8	14	8	16
Waimairi and Otway Non Effluent	25	4	8	18	8	15

Pasture Production

The predominant pasture species on the dairy farm is ryegrass/white clover. Annual pasture production has been weighted by relative productivity as no differences between blocks:

Block	Relative productivity	T DM/ha/year
Dairy pastoral areas	No differences	14.9 - 17.2

It should be noted that this estimated pasture production is based on default South Island pasture ME values and may be different to actual ME values and utilisation values on this farm which in turn would influence estimated pasture production.

Fodder Cropping

A cropping cycle of Pasture to two years in Fodder beet before being re sown into pasture is practiced. Crop information entered is;

- Fodder beet is sown in November after conventional cultivation, 8 ha in total, however 3 ha is grazed in autumn by the dairy cows (2 hours on crop in April and 4 hours in May), while the other 5 ha is grazed in situ in July, August and September by the dry dairy cows (50 %) and dairy replacement heifers (50 %) in July, dry cows in August (100 %) and dry cows (20 %) and milking cows (80 %) in September.
- Sown with a soluble fertiliser mix of NPKS rating (51-35-50-26) and Cropmaster borated DAP at 180 kg/ha with a further applications of Urea at 150 kg/ha are made in January with 50 kg/ha of Potassium chloride.
- Yields are averaged at 28 T DM/ha, with a reduction to 25T DM/ha for the autumn grazed crops
- The farm practice is to crop the Waikiwi soils mostly with a little amount on the Woodlands soils, which has not been modelled due to the areas involved (less than a 1 ha block area).

Farm Block	Area	Block history & % area	Sown	Yield T DM/ha	Cultivation
Fodder Beet April-May					
Waiki_34a.1 Past>FBt	1.5	10 & 2 %	November	25	Conventional
Waiki_34a.1 FBt>FBt	1.5	10 & 2 %	November	25	Conventional
Fodder Beet July-September					
Waiki_34a.1 Past>FBt	2.5	10 & 3 %	November	28	Conventional
Waiki_34a.1 FBt>FBt	2.5	10 & 3 %	November	28	Conventional

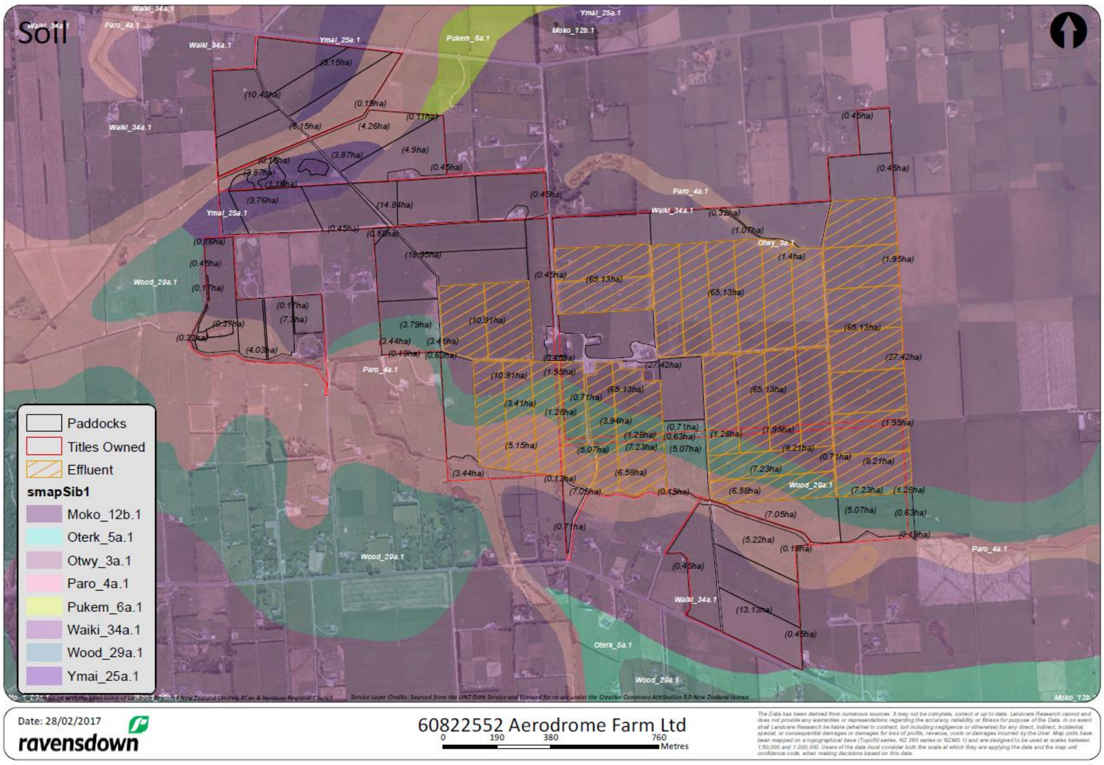
Effluent

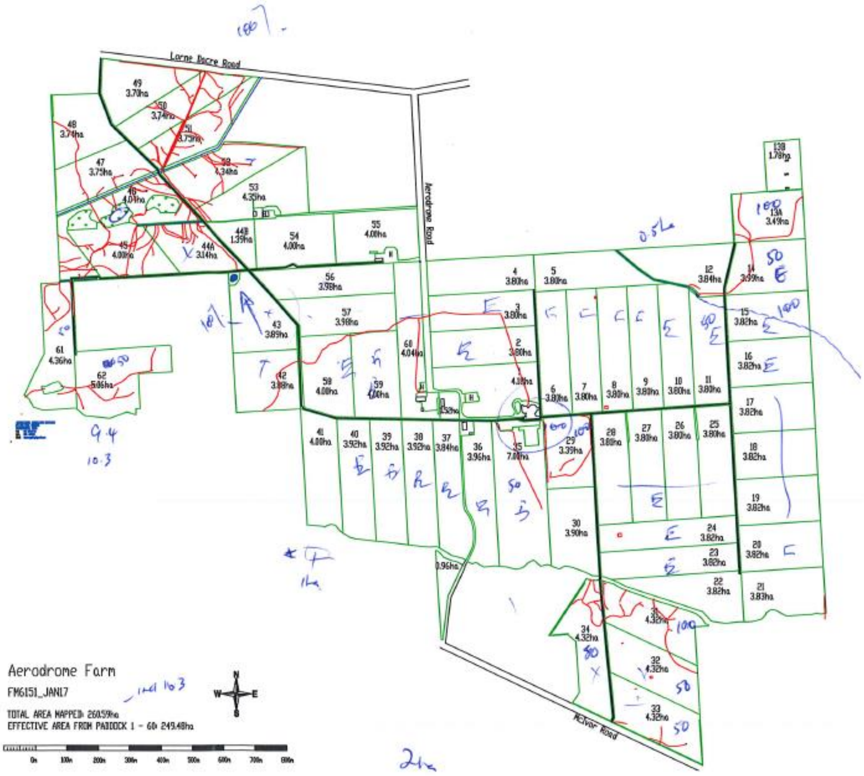
Effluent has been modelled as using Overseer default values, and calculated as applying 32 kg N/ha/year (liquid) plus 61 kg N/ha/year (solids) over 112 ha (pastoral area of 108 ha plus young grass blocks of 4 ha, which apply slightly less effluent as young grass blocks due to the difference in the months of effluent applications). Currently, the effluent system has effluent going into a stone trap and then into two sludge beds/weeping walls separating solids with liquid effluent pumped into a storage pond. This allows effluent to be stored and only applied at appropriate times giving the system more flexibility. Liquid effluent is sprayed during the months of September to April inclusive, using a low application method. Sludge from the pond is modelled to be spread on the effluent blocks in January every 5 years, given there has been little need to de sludge the pond; with all other solids (separated solids) been modelled to be spread over effluent and non-effluent blocks in February. The peaty soils (Ymai_25a.1 and Otwy_3a.1) and the non-effluent tiled areas (Waiki_34a.1, Wood_29a.1 and Paroa_4a.1) surrounding the stream areas plus the silage block do not have any solid effluent applied to them.

Management Unit details and Soil Information: Table 1

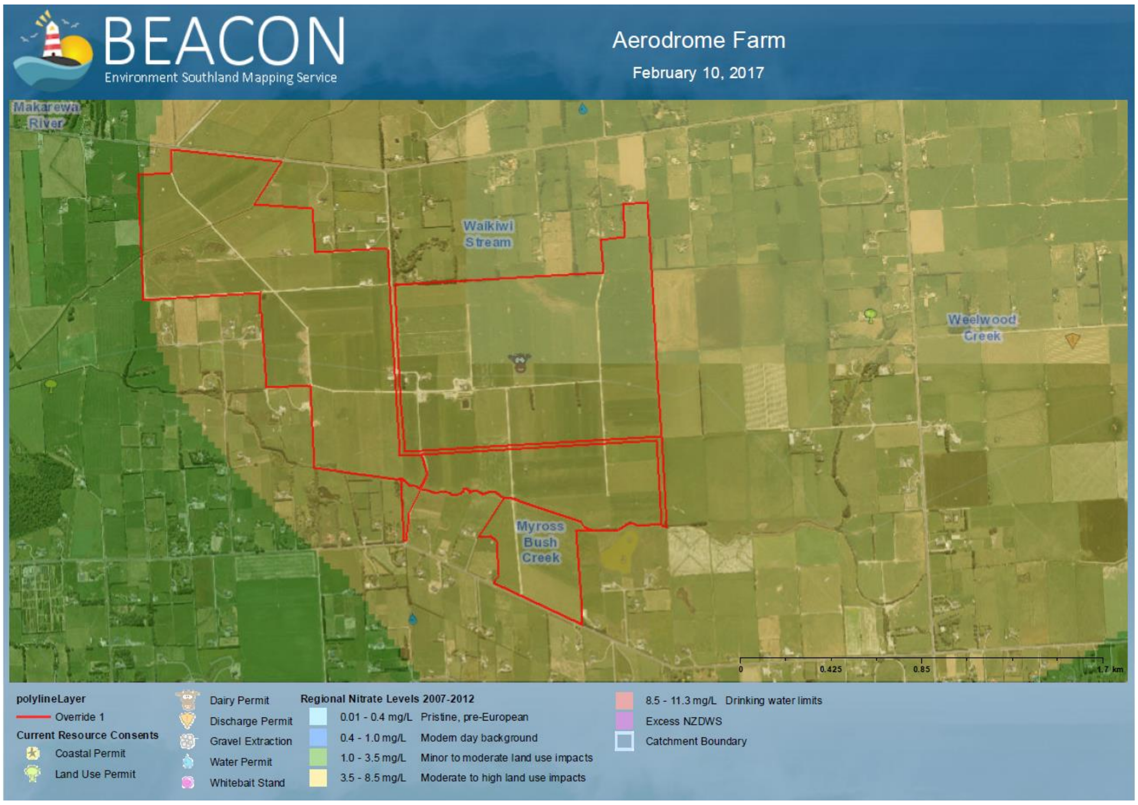
Block Name	Stock	Block Type	Soil Order	Drainage Class	Effluent	PAW (0-60cm)	Effective Area (ha)
Paro_4a.1 Non Effluent	Dairy	Pastoral	Recent Gley	Poor	Solid	177.7	20.6
Paro_4a.1 Non Eff Tiled	Dairy	Pastoral	Recent Gley	Poor	n/a	177.7	12.4
Wood_29a.1 Non Effluent	Dairy	Pastoral	Brown	Imperfect	Solid	106.6	8.6
Wood_29a.1 Effluent	Dairy	Pastoral	Brown	Imperfect	Liquid & sludge & solid	106.6	14.3
Wood_29a.1 Non Eff Tiled	Dairy	Pastoral	Brown	Imperfect	n/a	106.6	1.4
Waiki_34a.1 Effluent	Dairy	Pastoral	Brown	Well drained	Liquid & sludge & solid	112.2	78.6
Waiki_34a.1 Eff Tiled	Dairy	Pastoral	Brown	Well drained	Liquid & sludge & solid	112.2	11.6
Waiki_34a.1 Non Effluent	Dairy	Pastoral	Brown	Well drained	Solid	112.2	53.2
Waiki_34a.1 Non Eff Tiled	Dairy	Pastoral	Brown	Well drained	n/a	112.2	11.3
Ymai_25a.1 Non Eff Tiled	Dairy	Pastoral	Peaty Gley	Poor	n/a	207.0	10.6
Otwy_3a.1 Non Effluent	Dairy	Pastoral	Organic	Poor	n/a	172.5	2.3
Waiki_34a.1 Past to FB	Dairy	Pastoral	Brown	Well drained	n/a	112.2	1.5
Waiki_34a.1 FB FB	Dairy	Pastoral	Brown	Well drained	n/a	112.2	1.5
Waiki_34a.1 Past to FB (2)	Dairy	Pastoral	Brown	Well drained	n/a	112.2	2.5
Waiki_34a.1 FB FB (2)	Dairy	Pastoral	Brown	Well drained	n/a	112.2	2.5
Wood_29a.1 Non Eff NT	Dairy	Pastoral	Brown	Imperfect	Solid	106.6	1
Wood_29a.1 Eff NT	Dairy	Pastoral	Brown	Imperfect	Liquid & sludge & solid	106.6	1.3
Waiki_30a.1 Eff NT	Dairy	Pastoral	Brown	Well drained	Liquid & sludge & solid	112.2	1.9
Waiki_30a.1 Silage Blk	Dry stock	Pastoral	Brown	Well drained	n/a	112.2	3
Paro_4a.1 Silage blk	Dry stock	Pastoral	Recent Gley	Poor	n/a	177.7	2.4
Waiki_30a.1 Silage blk Tiled	Dry stock	Pastoral	Brown	Well drained	n/a	112.2	2.7
Paroa_4a.1 Slge NT	Dry stock	Pastoral	Recent Gley	Poor	n/a	177.7	1.4
Waiki_34a.1 YG	Dairy	Pastoral	Brown	Well drained	Liquid & sludge & solid	112.2	4.0
Wetland	N/A	Wetland					3.4
Riparian	N/A	Riparian					2.4
Non-Productive area							10.4
Total							**266.8**

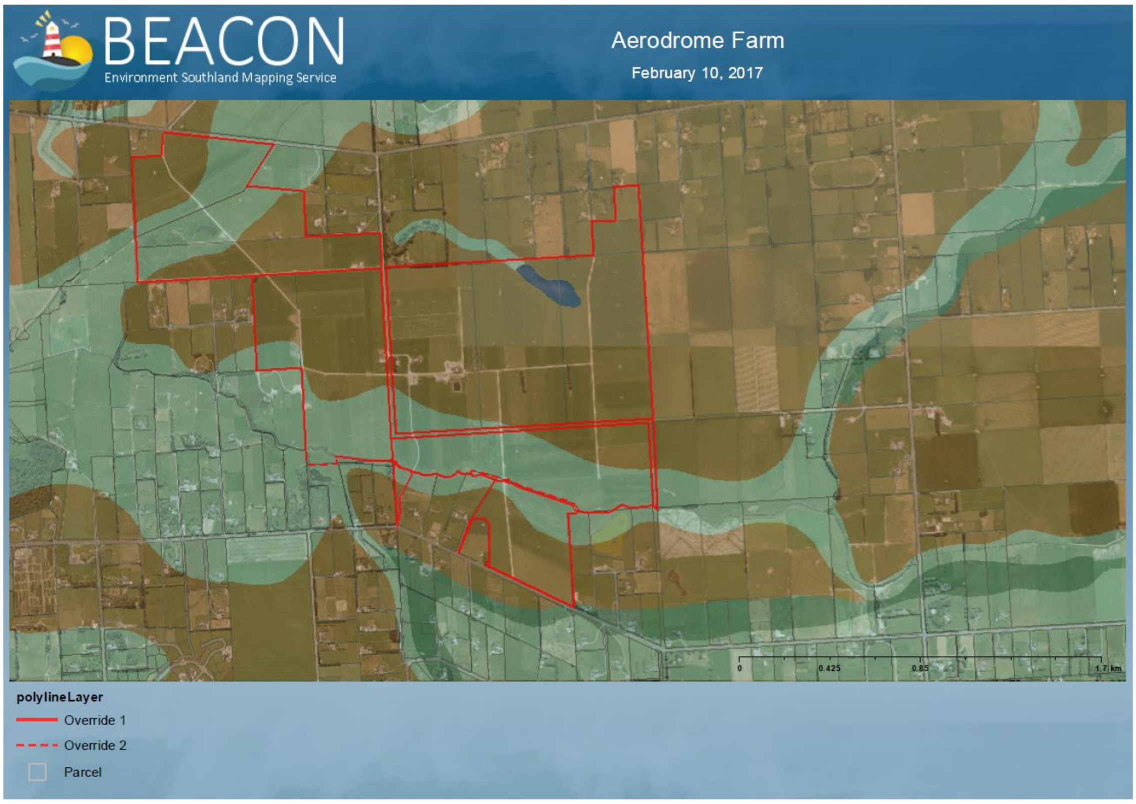
Land Management Unit Map and Farm Map





Nitrate Levels and Physiographic Zonal Environment Southland Beacon Maps





Nutrient related resource Consents held by the Landowner

Resource Consent No.	Condition No.	Condition Text	Resource consent expiry date
301219,03012200, 30021	4 6 7	(i) Maximum depth of application of 25 mm, at an instantaneous rate not exceeding 10 mm/hour (ii) Maximum loading rate of nitrogen shall not exceed 150 kg of Nitrogen/ha from dairy shed effluent Shall not exceed 800 cows At least 3,815 m^3 of effluent storage (93 days)	

Current Sheep Farm System Analysis

Description of Current Farm System

The farm dairy platform will be increased by 47.8 ha after including the purchased sheep block next door and subject to consent. A conversation was had with the original owner by Mr Moynihan to confirm figures to enable a Nutrient budget to be completed for this property, with the resulting data used and modelled for this sheep farm.

The total titled area of the property is 47.54 ha, with an additional 0.3 ha calculated GIS area (farmed boundary). In this figure there is 0.1 ha of non-titled area. The effective farmed area is calculated at 47.8 ha. It is of flat to gently rolling topography (modelled flat).

Soil types on the farm are the same as the dairy platform which are; mostly Waikiwi Silt Loam (Brown, well drained, PAW (plant available water) to 60 cm of 112.2 mm) 42.4 ha, Woodlands Silt Loam (Brown, Imperfectly drained, PAW 106.6 mm), 5.4 ha, and a very small area of Paroa Silt Loam Clay (Gley, Poorly drained, PAW 177.7 mm) 0.1 ha.

The 47.8 ha property was operated as a dryland sheep farm in combination with a larger sheep unit, with an area cropped for winter feed and additional paddocks leased for vegetable cropping. It is understood from the planner an average representation of the crops and sheep numbers over the past 3 years would be sufficient for Environment Southland. Sheep numbers modelled were lambing 580 mixed age (M.A.) ewes (Romney based) with animals destocked after weaning. Data entered is as follows;

- Mean lambing date is the 15th September for the main mob, with weaning finished by the 8th of December. Lambing rate is 150 % STS (survival to sale), ewes mating weight is 65 kg LW, with weaning weights at 35 kg LW average.
- No ewe lambs kept as replacements, as all lambs are sold to works from the property.
- 7 Terminal breeding rams (100 kg LW) and 1,880 kg/year wool shorn and sold on average.

- All lambs sold to works at 18 kg carcass; with 100 left on-farm by the end of January (12 %) and 20 % sold off mothers at weaning (170).

	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	LW (kg)
M.A Ewes	580	575	570	565	565	560	0	0	580	580	580	580	65
Rams								7	7	7			100
Works Lambs	0	0	0	0	0	650	350	100	0				18 c/c

Supplements

There is no Supplementary feed imported onto the property, however, 24 T DM baleage is made and used as follows:

- 24 T DM Baleage used over the following season on swede crop block.

Fodder and Arable Cropping

There is a paddock of swedes each year, which is then sown into barley and autumn wheat before being sown back into permanent pasture. This rotation is 7.8 ha in total, with a further paddock leased and sown into potatoes and carrots, represented by a crop rotation of potatoes followed by carrots before being sown into permanent pasture (7.8 ha). Detail is as follows;

- Swedes sown in December, conventionally cultivated with 300 kg/ha of borated Cropmaster DAP with two further urea applications of 100 kg/ha made in January and March. Grazed in situ by sheep in June to August period.
- Barley sown in October, sown with 250 kg/ha of Serpentine superphosphate and 300 kg/ha of borated Cropmaster DAP with no further fertiliser applications. Crop is harvested in March and residue is baled and exported off the farm block.
- Autumn Wheat sown in April, minimum tilled and sown with no fertiliser. An application of the same barley mix is made in October with no further fertiliser applications. The crop is harvested in January, with the stubble ploughed (Retained) and pasture is sown in February with 250 kg/ha of Serpentine superphosphate.
- Potatoes are modelled as medium, sown in September with 2 T of Superphosphate, 600 kg/ha of Potassium sulphate and 800 kg/ha of NItrophoska 12-10-10 as base and starter fertilisers, followed by two applications of Urea in October and November at 200 kg/ha. The crop is harvested in April and left fallow until sown in carrots.

- Carrots are sown in October, conventionally cultivated, sown with 700 kg/ha of 30 % Potassium superphosphate with no further fertiliser applications. The crop is harvested in March and sown back into permanent pasture in autumn.

Farm Block	Area	Block history & % area	Sown	Yield T DM/ha	Cultivation	Crop Residual
Swede rotation						
Waiki_34a.1 Past>Sw	2.6	4 & 5.5 %	December	13.5	Conventional	
Waiki_34a.1 Sw>Barley	2.6	4 & 5.5 %	October	8.0	Conventional	Removed
Waiki_34a.1 Barley>Past	2.6	4 & 5.5 %	April	14.0	Minimum till	Retained
Potato rotation						
Waiki_34a.1 Past>Potato	2.6	4 & 5.5 %	As below			
Waiki_34a.1 Potato>Carrot	2.6	4 & 5.5 %	September	50	Conventional	Retained
Waiki_34a.1 Carrot>Past.	2.6	4 & 5.5 %	October	50	Conventional	Retained

Fertiliser

All pastoral blocks plus the Young grass paddock after the autumn wheat receive a dressing of 250 kg/ha of Serpentine superphosphate in February, or when sown into pasture after cropping.

Pasture Production

The predominant pasture species on the sheep farm is ryegrass/white clover. Annual pasture production has been weighted as no difference between blocks:

Block	Relative productivity	T DM/ha/year
Waiki_34a.1 Pasture	1.0	13.1
Young grass	1.0	1.6, 2.4 & 4.9 – 10.5

It should be noted that this estimated pasture production is based on default South Island pasture ME values and may be different to actual ME values and utilisation values on this farm which in turn would influence estimated pasture production.

Management Unit details and Soil Information: Table 1b

Block Name	Stock	Block Type	Soil Order	Texture	Drainage Class	PAW (0-60cm)	Effective Area (ha)
Waiki_34a.1 Pasture	Sheep	Pastoral	Brown	Silt loam	Well drained	112.2	26.8
Wood_29a.1	Sheep	Pastoral	Brown	Silt loam	Imperfect	106.6	5.3
Waiki_34a.1 Past>Sw	Sheep	Crop	Brown	Silt loam	Well drained	112.2	2.6
Waiki_34a.1 Sw>Barley	Sheep	Crop	Recent	Silt loam	Well drained	112.2	2.6
Waiki_34a.1 Brly>AWht>Past	Sheep	Crop	Brown	Silt loam	Well drained	112.2	2.6
Waiki_34a.1 Past>Potatoes	Sheep	Crop	Brown	Silt loam	Well drained	112.2	2.6
Waiki_34a.1 Potatoes>Carrot	Sheep	Crop	Brown	Silt loam	Well drained	112.2	2.6
Paroa_4a.1	Sheep	Pastoral	Recent Gley	Silt loam	Poor	177.7	0.1
Waiki_34a.1 Carrot>Past	Sheep	Crop	Brown	Silt loam	Well drained	112.2	2.6
Non-Productive area							0.1
Total							**47.8**

*PAW Landcare S maps calculated

Proposed Farm System Analysis

Description of Proposed Farm System

The farm dairy platform will be increased by including the 47.8 ha of the purchased sheep block. The effluent area is increased and cattle numbers are increased to 850 peak milking in November and December, thus reducing the milking stocking rate over the overall property. The soils are the same on the additional block as noted in the description of the new block and become dairy pastoral paddocks. There will be 7.2 ha of fodder beet grown, with a catch crop sown after the autumn grazed fodder beet. In addition a calving/winter pad will be built to accommodate cows over the spring/autumn periods to mainly stand off and be fed when conditions are wet.

The 315.8 ha (total) property will be operated as a dryland dairy farm, calving 880 cows (862 modelled in Overseer with 880 cows when combined with Piobiare numbers in proposal)and peak milking 850 (475 & 450 kg LW) Friesian cross cows. Milk production aimed for is at 390,000 kg MS/year (459 kg MS/peak cow), higher than averaged given that the operation is now achieving 428 kg MS/peak cow. Cow numbers are shown in the table below. The additional cows are wintered on-the run off (Piobiare) with the same number of First calving Heifers back in the month of July (mean calving date 15th August), whilst the mixed age cows mean calving date is 20th August. The Mixed age Cows are staggered back from winter grazing from late July, with all cows back on farm by early September. It was modelled that the run off would carry the additional replacements and cows, with Aerodrome farm reducing the dry stock numbers from the past averaged numbers, given the proximity and the ability of Piobiare to enable this. This is a good management practice in ensuring a higher number of dry animals are kept at Piobiare and the more efficient milking animal is grazed only on Aerodrome.

The dry-off date remains the 30th of May for the cows and first calving heifers. All replacements, are grazed off-farm until they return as in calf R2 heifers in July. The additional heifers are managed on the Run off block. Cows are milked once a day at dry off and all calves are fed colostrum and waste milk.

Chaser bulls are brought onto the farm over the October to January period. They have been modelled as Jersey bulls at 600kg LW and numbers increased slightly to reflect the higher cow numbers.

	LW start (kg)	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	LW end (kg)
Dairy cows	475		201	552	645	645	645	645	645	645	590	565		475
First calving heifers	450	27	215	210	205	205	205	205	205	205	185	185		450
Dairy grazers (milking cows)	475	13	64	83	12							0	0	475
Dairy grazers (replacements)	100						59	8	8	6	4	4	4	240
Dairy grazers (replacements)	240	4	4	2	2	2	1							420
Dairy grazers (replacements)	450	95												450
Bulls	600					0	25	25						600
Total cows		140	480	845	870	850	850	846	842	797	797	749		

Supplements

Supplementary feed imported onto the property and to be fed during the season has slightly changed and is as follows:

- 96 T DM PKE (Palm Kernel Extract) and 8 T DM Brewers Grain - fed in the milking shed over period September October and some in May, with a small % cows (10%) fed over January to April
- 59 T DM Pasture silage (Good Quality) imported and used over the season; and fed evenly across pastoral areas, fed mainly in August to October (60 %) and the rest in March to May (40 %)
- 96 T DM Pasture silage (good quality) imported and fed onto wintering/calving pad over July to September

- 52 T DM baleage and 70 T DM of silage made from the silage block and stored and fed out in the following year to dairy cows (20 T DM baleage and 70 T DM silage) respectively, evenly across pastoral blocks, plus 26 T DM baleage fed on the calving/winter pad and with 6 T DM fed out on crop.
- 2 T DM barley straw fed to dairy cows at drying off

Because of the slightly reduced stocking rate given the larger area, but with the calving winter pad used for feeding, imported supplementary feed has reduced to the above amounts, with an increase in silage and baleage made from the silage block to equate pastoral productivity and given it is now only wintering young replacements, with a greater portion of dry cattle are on the fodder beet over September.

Structures

There will be a calving winter pad built, with the ability to fed silage, modelled as an uncovered wintering pad with a concrete feed apron and effluent treated the same as dairy effluent. Feeding is the wintering pad only reducing the need to feed milking cows on crop and the % milking cows estimated to be fed is;

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
% of milking cows	0	0	0	0	0	0	100	29	10	0	0	0

Milk Shed feeding

PKE and Grain feeding is the same as the current system to cows during the spring (September and October) and autumn (May), with a small % of cows fed over the January to April period.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
% of milking cows	10	10	10	10	100	-	-	0	100	100	0	0

Fertiliser

There is little change between the two systems modelled, a slight reduction in Phosphate fertiliser (no longer capital P applied) and a decrease in Effluent nitrogen fertiliser applied to account for the N in effluent liquid. Rates are below. The total fertiliser nitrogen applied is 224 kg N/ha/year for the Non effluent and 201 kg N/ha/year for Effluent farm blocks and 195 kg N/ha across all blocks (whole property) on average. The silage blocks have the same fertiliser as before. It was decided not to alter nitrogen rates with the slight reduction in pastoral productivity, to reflect the times when these rates could be used given climatic variability.

Non Effluent and Effluent blocks:

Month	Fertiliser	NPKS nutrient rating (kg/ha)
August	Ammo 36	18-0-0-5
September	Ammo 36	18-0-0-5
October	Urea	25-0-0-0
November	Urea	25-0-0-0
December*	Urea	37-0-0-0 - Effluent 25-0-0-0
January*	Urea	37-0-0-0 - Effluent 25-0-0-0
February	Urea	25-0-0-0
March	Urea	28-0-0-0
August	Urea	12-0-0-0
December (Non Effluent only)	15 % Potassic Superphosphate	0-31-30-38
December (Effluent only)	Superphosphate	0-27-0-38

Silage blocks:

Month	Fertiliser	NPKS nutrient rating (kg/ha)
November	Soluble fertiliser modelled	24-21-0-26
December	Soluble fertiliser modelled	24-21-28-7
January	Urea	30-0-0-0
January	Potassium Chloride	0-0-35-0

Pasture Production

The predominant pasture species on the dairy farm is ryegrass/white clover. Annual pasture production has been weighted by relative productivity as no differences between blocks:

Block	Relative productivity	T DM/ha/year
Dairy pastoral areas	No differences	14.98 – 16.98

It should be noted that this estimated pasture production is based on default South Island pasture ME values and may be different to actual ME values and utilisation values on this farm which in turn would influence estimated pasture production

It should also be noted that the additional cropping block with young pasture underestimates pastoral productivity and increases pasture production by default on the rest of the dairy pastoral blocks.

Fodder Cropping

This remains similar in area between the two systems modelled (current and proposed). The cropping area is now 7.2 ha, with the utilisation of the crop still over the April and May (2.3 ha) plus the July to September period (1.3 ha) for the milking cows and replacements plus dry cattle respectively. The milking cows no longer are fed in late winter spring on crop. This is in response to the availability of the winter/calving pad. It is the same cropping cycle of Pasture to two years in Fodder beet before being re sown into pasture, however a catch crop is modelled for the autumn grazed fodder beet to reduce N losses. Crop information entered is;

- Fodder beet is sown in November after conventional cultivation, 7.2 ha in total, however 4.6 ha is grazed 2 and 4 hourly in April and May respectively by the dairy cows, while the other 2.6 ha is grazed in situ in July, August and September by the dry cattle only now.
- Sown with a soluble fertiliser mix of NPKS rating (51-35-50-26) and Cropmaster borated DAP at 180 kg/ha with a further applications of Urea at 100 kg/ha are made in January, for the first year crops (as per research advice) and 150 kg/ha for the second year crops, with 50 kg/ha of Potassium chloride.
- Yields are averaged at 26 T DM/ha and 23 T DM/ha for the autumn grazed crops, slightly reduced from the 3 year average used in the current system, more of a longer term average.
- Forage Oats are cultivated in, after autumn grazing without any fertiliser and grazed in September or October period by dairy cows before either being sown back into fodder beet or permanent pasture.
- The farm practice is to crop the Waikiwi soils mostly with a little amount on the Woodlands soils, which has not been modelled due to the areas involved being less than 1 ha.

Farm Block	Area	Block history & % area	Sown	Yield T DM/ha	Cultivation
Fodder Beet April-May					
Waiki_34a.1 Past>FBt	2.3	10 & 3 %	November	23	Conventional
Waiki_34a.1 FBt>FBt	2.3	10 & 3 %	November	23	Conventional
Oats Grazed Sept or Oct					
Waiki_34a.1 Past>FBt & FBt>FBt	4.6	10 & 3 %	June	1	Conventional
Fodder Beet July-September					
Waiki_34a.1 Past>FBt	1.3	10 & 2 %	November	26	Conventional
Waiki_34a.1 FBt>FBt	1.3	10 & 2 %	November	26	Conventional

Effluent

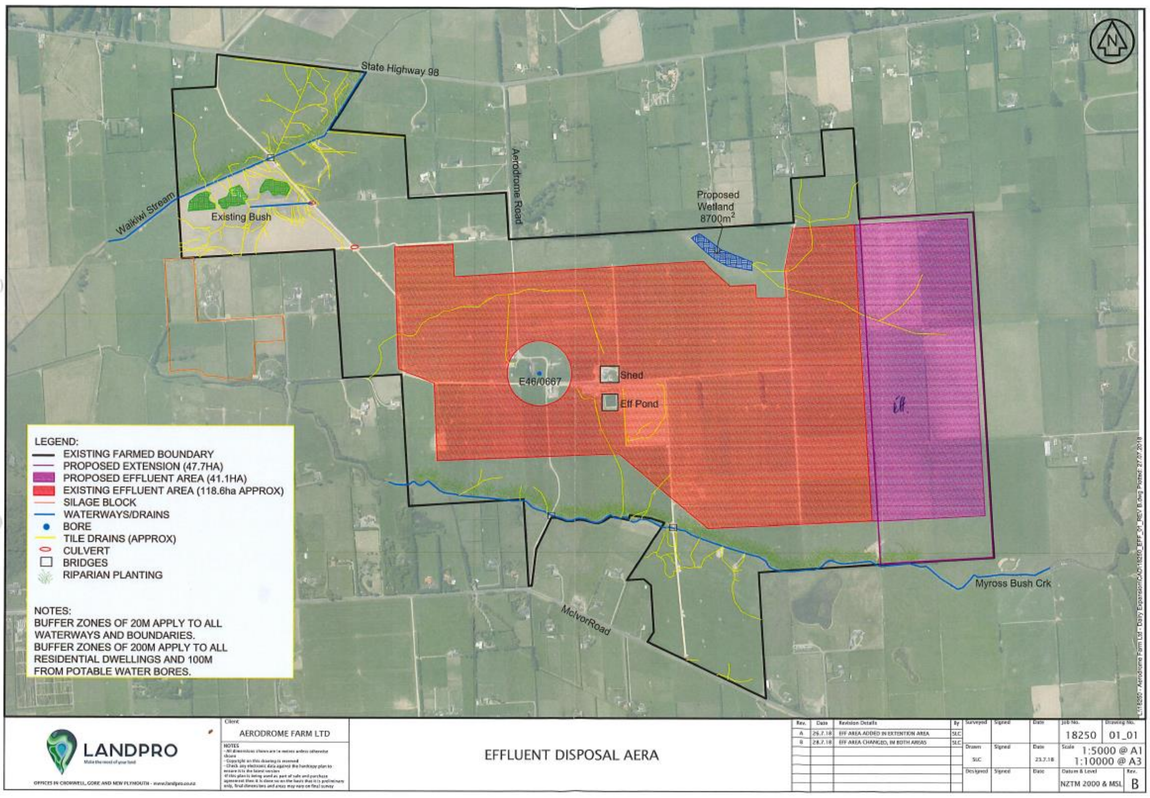
Effluent has been modelled as using Overseer default values, and calculated as applying 31 kg N/ha/year (liquid) plus 25 kg N/ha/year (solids) over 152 ha (149 ha pastoral plus young grass blocks which total 49 kg N/ha from effluent which is less than the 57 kg N/ha on effluent blocks due to the different months of effluent applications) plus 25 kg N/ha/year (solids) applied from pond sludge to the Non effluent areas yearly now instead of 5 yearly to encompass good management practices. The effluent system remains the same as what was detailed in the "current" farm system analysis. In addition the non-effluent Waikiwi blocks (including tiled areas) now receives all the solids from the calving pad, which totals to an additional 11 kg N/ha/year. The same peaty soils and the non-effluent tiled areas surrounding the stream areas still do not have any solid effluent applied to them

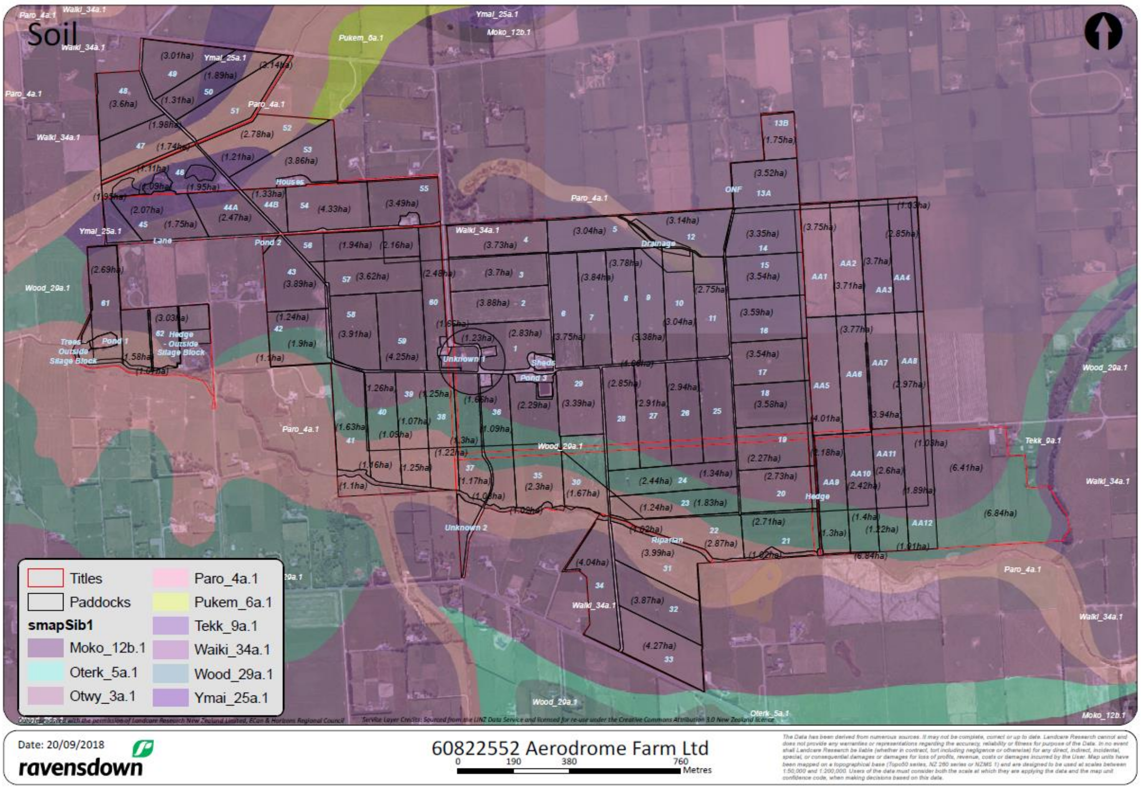
All other factors have remained the same.

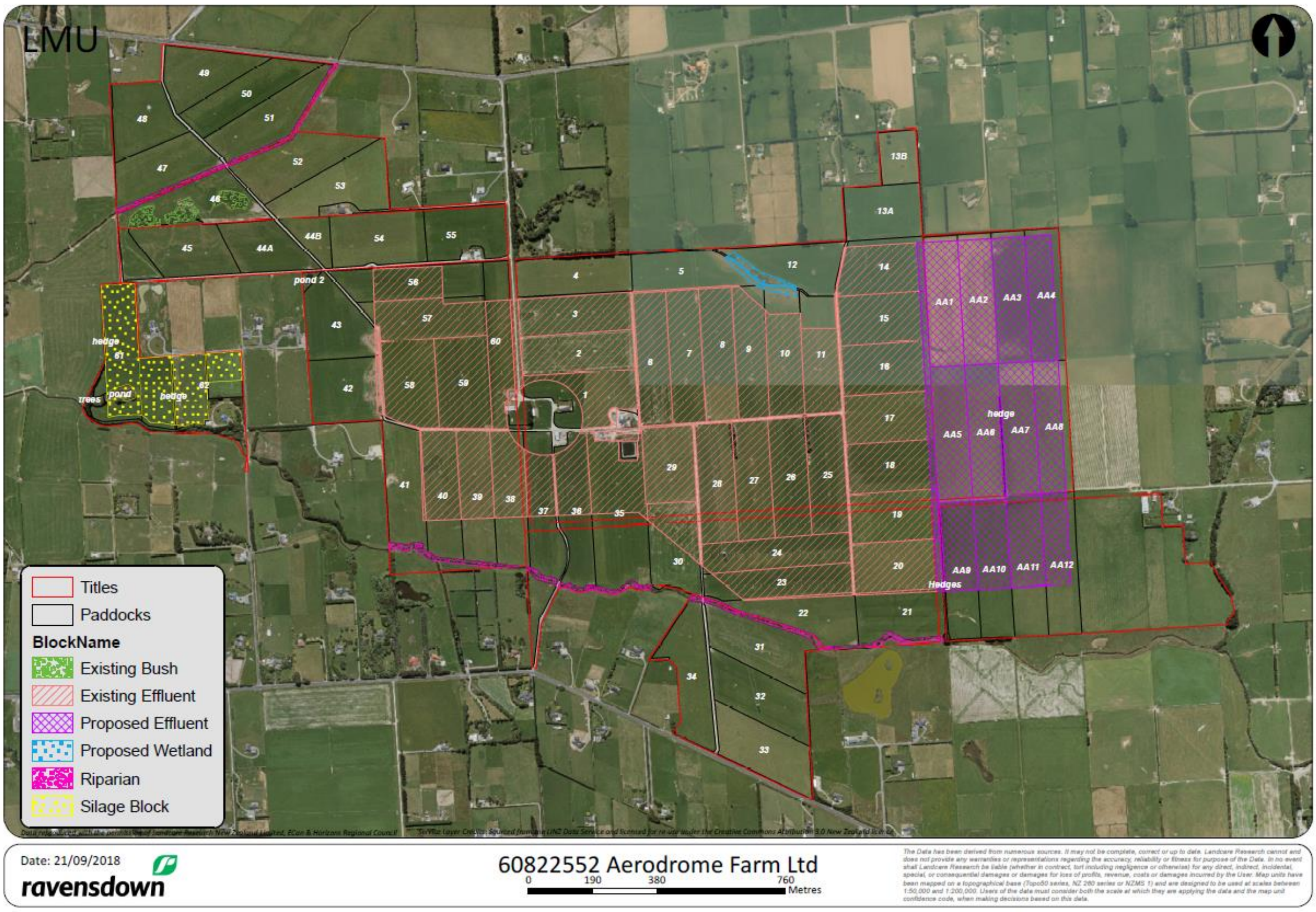
Management Unit details and Soil Information: Table 1b

Block Name	Stock	Block Type	Soil Order	Drainage Class	Effluent	PAW (0-60cm)	Effective Area (ha)
Paro_4a.1 Non Effluent	Dairy	Pastoral	Recent Gley	Poor	Solid	177.7	20.7
Paro_4a.1 Non Eff Tiled	Dairy	Pastoral	Recent Gley	Poor	n/a	177.7	12.4
Wood_29a.1 Non Effluent	Dairy	Pastoral	Brown	Imperfect	Solid	106.6	13.5
Wood_29a.1 Effluent	Dairy	Pastoral	Brown	Imperfect	Liquid & sludge & solid	106.6	14.6
Wood_29a.1 Non Eff Tiled	Dairy	Pastoral	Brown	Imperfect	n/a	106.6	1.4
Waiki_34a.1 Effluent	Dairy	Pastoral	Brown	Well drained	Liquid & sludge & solid	112.2	119.1
Waiki_34a.1 Eff Tiled	Dairy	Pastoral	Brown	Well drained	Liquid & sludge & solid	112.2	11.6
Waiki_34a.1 Non Effluent	Dairy	Pastoral	Brown	Well drained	Solid & Pad solid	112.2	56.2
Waiki_34a.1 Non Eff Tiled	Dairy	Pastoral	Brown	Well drained	Pad solid	112.2	11.3
Ymai_25a.1 Non Eff Tiled	Dairy	Pastoral	Peaty Gley	Poor	n/a	207.0	10.6
Otwy_3a.1 Non Effluent	Dairy	Pastoral	Organic	Poor	n/a	172.5	2.3
Waiki_34a.1 Past to FB	Dairy	Pastoral	Brown	Well drained	n/a	112.2	1.3
Waiki_34a.1 FB FB	Dairy	Pastoral	Brown	Well drained	n/a	112.2	1.3
Waiki_34a.1 Past to FB (3)	Dairy	Pastoral	Brown	Well drained	n/a	112.2	2.3
Waiki_34a.1 FB FB (3)	Dairy	Pastoral	Brown	Well drained	n/a	112.2	2.3
Wood_29a.1 Non Eff NT	Dairy	Pastoral	Brown	Imperfect	Solid	106.6	1
Wood_29a.1 Eff NT	Dairy	Pastoral	Brown	Imperfect	Liquid & sludge & solid	106.6	1.3
Waiki_30a.1 Eff NT	Dairy	Pastoral	Brown	Well drained	Liquid & sludge & solid	112.2	2.0
Waiki_30a.1 Silage Blk	Dry stock	Pastoral	Brown	Well drained	n/a	112.2	3.0
Paro_4a.1 Silage blk	Dry stock	Pastoral	Recent Gley	Poor	n/a	177.7	2.4
Waiki_30a.1 Silage blk Tiled	Dry stock	Pastoral	Brown	Well drained	n/a	112.2	2.7
Paroa_4a.1 Slge NT	Dry stock	Pastoral	Recent Gley	Poor	n/a	177.7	1.4
Waiki_34a.1 YG	Dairy	Pastoral	Brown	Well drained	Liquid & sludge & solid	112.2	1.3
Waiki_34a.1 YG	Dairy	Pastoral	Brown	Well drained	Liquid & sludge & solid	112.2	2.3
Wetland	N/A	Wetland					3.5
Riparian	N/A	Riparian					2.4
Non-Productive area							10.4
Total							**314.6**

Land Management Unit and Soils Map (Proposed)






LMU
Titles
Paddocks
BlockName
Existing Bush
Existing Effluent
Proposed Effluent
Proposed Wetland
Riparian
Silage Block
Date: 21/09/2018
ravensdown
60822552 Aerodrome Farm Ltd
0 190 380 760
Metres

Summary of Current and Proposed Farm System Scenario: Table 2

	Current 3 Year Average	Current 3 Year Average Sheep	Proposed Dairy
System Type	Seasonal dairy Supply	Sheep and Arable crop	Seasonal dairy Supply
Total Area (ha)	266.8	47.8	314.6
Effluent area (ha)#	111.7 ha including young grass area receiving liquids and sludge/solids and some non-effluent area (83.0 ha) receiving pond solids	N/A	152 ha including young grass area receiving liquids and sludge/solids, non-effluent (82.0 ha) receiving pond solids and 63.1 ha wintering pad solids
Stocking rate (s.u/ha)	7,047 s.u* or 29.5 s.u/ha grazed and 26.4/ha total (2.9 cows/ha total)	660 s.u or 20.6/ha grazed and 13.8/ha total	8,124 s.u or 28.3/ha grazed and 25.8/ha total. (2.8 cows/ha total)
N use (kg N/ha/year)	204 across the whole farm	28	195
Production (kg MS/ha grazed)	1367/ha grazed (1223/ha total)	808 kg LW sold/ha	1357/ha grazed; (1240/ha total)
Supplements Imported (kg DM/ha/year)	351 T DM in total or 1,504/ ha platform	N/A	261 T DM in total or 927/ ha platform
Wintering system	Off farm	On farm on crop	Off farm
Pasture production(kg DM/ha/year) - Platform Pastures - Silage block	 17,173 14,940 to 15,003**	 13,084	 16,981 14,952 to 14,994**

*As calculated by OVERSEER and including bulls and replacement heifers. # As calculated by OVERSEER

**As calculated by OVERSEER with standard default and ME values which are likely to be lower than Southland values.

Summary of Baseline Whole Farm Nutrient Loss Indicators: Table 3

	Current average Dairy Farm	Sheep Farm	Combined current	Proposed scenario
Nitrogen leaching loss to water (Total kg N) Less N removed in wetlands**	13,482 13,297	1,479	14,961 14,776	14,727 14,235
Nitrogen leaching loss to water (kg N/ha) Less N removed in wetlands	51 50	31	48 47	47 45
Phosphorus runoff to water (Total kg P)	210	15	225	224
Phosphorus runoff to water (kg P/ha)	0.8	0.3	0.7	0.7

* Note well; Wetlands are not considered best practice in Overseer BPDIS, but were allowed in previous versions. They have been included here as a guide only to the value of wetlands in reducing nutrient losses from this farm, given its current systems recognised wetland features by Environment Southland land officers and the intended additional created wetland.

Discussion on Whole Farm Nutrient Loss Indicators

From the information provided by Peter Moynihan, farm records, and the assumptions listed above, the N loss from the root zone and P loss to second order streams for the farm system is outlined below.

Current Farm System

- The N loss from the root zone from the farm system modelled was calculated using OVERSEER® (v6.3.1) to be **51 kg N/ha/year or 13,482 kg N/year.**
- The P loss risk from the farm system modelled was calculated using OVERSEER® (v6.3.1) to be **0.8 kg P/ha/year or 210 kg P/year.**

New Block (Sheep Farm) System

- The N loss from the root zone from the farm system modelled was calculated using OVERSEER® (v6.3.1) to be **31 kg N/ha/year or 1,479 kg N/year.**
- The P loss risk from the farm system modelled was calculated using OVERSEER® (v6.3.1) to be **0.3 kg P/ha/year or 15 kg P/year.**

Combined Current Farm Systems

- The N loss from the root zone from the farm system modelled was calculated from OVERSEER® (v6.3.1) values above to be **48 kg N/ha/year or 14,961 kg N/year.**
- The P loss risk from the farm system modelled was calculated from OVERSEER® (v6.3.1) values above to be **0.7 kg P/ha/year or 225 kg P/year.**

Proposed Farm System

- The N loss from the root zone from the farm system modelled was calculated using OVERSEER® (v6.3.1) to be **47 kg N/ha/year or 14,727 kg N/year.**
- The P loss risk from the farm system modelled was calculated using OVERSEER® (v6.3.1) to be **0.7 kg P/ha/year or 224 kg P/year.**

Key factors influencing Nutrient Loss include:

- Soil type and Profile Available Water (PAW) plus drainage.

  The soil type has a large impact on N leached. The soils on the property are mostly well drained silt loams. Plant Available Water (PAW) values would be considered 'high' ranging between 106.6 mm and 207.0 mm (0-60cm). The Plant Available Water is described as "the amount of water potentially available to plant growth that can be stored in the soil to specific soil depths". It therefore makes sense that the soils with high PAW will have lower N leaching as there will be less drainage from these soils. Soils with lower PAW are less able to buffer against changes in nitrogen losses to the bottom of the root zone (from stocking rates, crop yields, irrigation volumes) as the soils have larger pores and are flushed frequently as compared to a poorer draining soil with a higher PAW (see N report in Appendix where under the current farming system the Woodlands and Waikiwi soils lose 51 and 48 kg N/ha/year respectively compared to the Waimairi and Paroa soils, losing 39 and 38 kg N/ha/year respectively).

  These heavier soils are often tile drained (artificially drained) to remove water from the profile and enable higher productivity. The risk is that these drains also provide a conduit to nutrient flows and effluent discharges direct to water ways. Ensuring the nutrients are captured by plant growth and minimising effluent applications when soil PAW are near capacity will reduce this.

- Pastoral productivity
  The higher the pastoral productivity from dairy land and the associated higher stocking, the higher the risk of N losses on dairy farms, especially under the climatic, rainfall and evapotranspiration rates for Southland. The overall N loss for the proposed system has slightly lower production per ha (1357 kg MS/ha grazed when compared to the current dairy system) at a similar stocking rate of 2.8 cows/ha total (cf. to 2.73 cows/ha & 1056 kg MS/ha, NZ Southland Dairy statistics 2015-16) with 927 kg DM/ha of supplement imported, and consequently the slightly lower pasture production required at 16,981 kg DM/ha/year (compared to 17,173 kg DM/ha/year) as seen in table 2, page 25 above. This leads to a lower amount of urine deposition on pastures from the resulting cow intakes, resulting in reduced risk from N leaching when compared to the current system.
- Cropping
  The crop blocks for the current farming system which contribute 1,228 kg N/ha or 102 kg N/ha/year on average (9.1 % of total N losses and yet accounts for 3.0 % of the total land area). (Figures as in Block Nitrogen report, pages 34 to 36 & 40). It is the higher concentration of stock in a smaller area and thus the greater urine deposition which leads to this increased risk of losses. This is also exacerbated by these crops being grazed at a time when drainage events are most likely to occur.

- Effluent Management
  The effluent areas have a higher N loss than the non-effluent areas, and this can be noted in the N report (see Appendix) where one can see the effect on N loss of blocks with the same soil type, with either effluent applied or not applied being the varying factor. The solid effluent is currently being applied over this area as well and also on some of the non-effluent area (barring tiled areas). Targeting all solid applications to the non-effluent areas would reduce the nutrient load on these effluent blocks, with a reduced application on Effluent blocks to account for the nitrogen in the liquid effluent also helping.

The riparian blocks, tree block and non-productive areas offset these N losses to an extent.

The other environmental risk indices are the proposed P losses to surface water at 0.7 kg P/ha/year as seen in the Phosphate reports page 33 & 39 which are low risk in their impact. The P risk is mostly influenced by losses from other sources (141 kg or 62.2 % of total of 225 kg, refer Phosphorous block reports, page 33 & 39) which is run off from tracks and yards into drains and ditches from the farm. Riparian strip planting and vegetation buffer zones can reduce this and is being currently practiced now. Olsen P levels are within the optimum agronomic ranges, and the topography where the majority of the fertiliser is applied is flat, which also helps to minimise P losses. Superphosphate applications are also modelled at a maintenance applications for the proposal compared to the capital applications that had occurred within the 3 year current averaged budget. Effluent storage and low volume applications (which is in place) will help to mitigate this risk also.

Comparative environmental effects between the current and proposed farming systems:

- Farming intensity has reduced overall, with the emphasis on containing the additional stock on the run off area. Pastoral losses from the increased platform area are at a lower level (47 kg N/ha/year versus 51 kg N/ha/year), with dairy pastoral losses reduced across the original dairy platform, and this and the decrease in the total losses from the crop blocks compensates for the increased intensity on the 47.8 ha new block. The combined losses from the current systems thus is 234 kg N/year higher than the proposed total kg N/year of 14,727 but one should also note that the additional wetland has helped further the difference to 523 kg N/year between the current and proposed scenario (14,776 and 14,235 respectively)
- The crop area is slightly reduced, with the crops being grazed at a similar time but with the use of catch crops, thus helping reduced losses from this area of the farm. In addition the stock type's grazing for the proposal have changed (dairy replacements and dry cattle for spring), as opposed to a portion of dairy milking cows in the current system. The crop losses reduce from 1,228 kg N/year to 1,140 kg N/year under the proposal, but the per ha losses increase from 77 kg N/ha/year to 105 kg N/ha/year, given the greater grazing of dairy cows and lower yield on the autumn grazed blocks.

- The proposed mitigation of the winter/calving pad and spreading the effluent yearly all have helped reduce the environmental impacts from the increase in dairy numbers.
- Additional mitigations included in modelling have been to reduce Nitrogen applications on the effluent block by 36 kg N/ha over December and January, reduce liquid effluent applications on tiled areas to only October to March, reduce first year urea rates on crop as per latest research showing rates of greater than 50 kg N/ha on first year fodder beet crops does not show any increased yield) and all pad solids are applied to the Waikiwi non effluent areas only.

The proposed scenario is rated 11.2, the low side of category 2 under the Soil versatility rating system (Landcare Research, 2002), as calculated in the table 4 below (page 29) and using the Environment Southland Beacon mapping system. The farm already uses a number of effective Nitrogen mitigation strategies to minimise losses for the proposal culminating in the results above. As modelled, the farm uses and/or has;

- All water ways are fenced and adequate Riparian strips in place plus wetlands.
- The effluent system is a holding pond, with adequate storage and with effluent pumped by a low volume spray system with application depths less than 10 mm during the application months. The area is more than adequate when compared to effluent nutrients supplied, with 71 ha required for the standard effluent application of 150 kg/ha for this number of cows including solids, compared to the current 152 ha (effluent report pages 38 & 41).
- The N fertiliser use is moderate to high at 195 kg N/ha/year on average across all blocks, but no Nitrogen is applied in May.
- The farm winters all of its cows off farm, and a calving/winter pad will be built to mitigate crop and pastoral N losses when conditions are extreme
- Cropping and effluent applications are targeted to the freer draining soils and not on the lower lying tiled areas of the farm

Soil Vulnerability Land Management Rating: Table 4

Soil Type/Farm blocks	Soil Vulnerability	Vulnerability rating	% Farm	Rating score
Paroa_4a.1	Moderate	10	12.49	1.25
Waiki_34a.1	Moderate	10	72.10	7.21
Wood_29a.1	Moderate	10	10.20	1.02
Ymai_25a.1	Limited	30	4.42	1.33
Otwy_3a.1	Unsuitable	50	0.79	0.40
Total			**100.0**	**11.21**

The property is situated in the Myross Bush and Waikiwi stream sub catchments, and the Oreti catchment of the proposed Environment Southland Regional Water Plan. It is 17.7 % on a gley soil physiographic zone, and 82.3 % on an oxidising physiographic zone (see map, page 13), meaning the farm must attach significance to both zones in its environmental management. The farm is within a moderate to high environmental impact for nitrate levels (3.5 to 8.5 ppm). Water quality is mostly lowland hard bed. Implications of this information are unknown at present but some catchment areas will be required to reduce their impacts. The zonal information would point to the presence of nitrate leaching; overland flow and losses of nitrogen through tiles as the key risk factors. Spreading effluent applications according to soil profile and tile drainage, plus cropping only on the non-tiled oxidising areas are also beneficial activities to help spread the risk. A created calving/feed pad and reduced cropping has helped in reducing Nitrogen losses as well. This and the created Riparian strips and wetlands would be the activities which would be required to mitigate any overland flows.

Summary of Mitigations:

Mitigations modelled:	Reason/Rationale:	Effect:
1. Contain all increased stock within landholding (Added dry cows and replacements to Piobiare)	Ensure any additional losses are within proposed land holding. Additional cows and R 1 and R 2 replacements all wintered on Piobiare, with stock being kept on this block until required by Aerodrome, reducing the other stock on the dairy platform when compared to previous years	All additional losses to the increased calving numbers are controlled on the proposed land holding, and not exported elsewhere.
2. Effluent mitigations (increased area and targeted applications)	Ensure effluent only applied to appropriate areas and spread as widely as possible, with Nitrogen applications taking into account the additional effluent nutrients.	Avoid liquid applications in September and April May to tiled areas. Spread sludge from weeping wall beds every year, and target solids only to Woodland and Waikiwi soils, with all pad solids applied to the Waikiwi non effluent blocks only. Effluent spread little and often reduces the risk of losses. Reduce Nitrogen applications by 24 kg N/ha/year over December January period on Effluent spray blocks.
3. Alter cropping regime	With the winter/calving pad, only dry cattle required to be grazed on crop over spring, and a catch crop reduces losses and provides additional grazing in September for diary cows.	Reduced area of crop in fallow over winter after being grazed, reduces autumn Nitrogen losses from urine in milking dairy cows leads to reduced risk of N and P losses. Less cropping area also means less losses.
4. Installation of wetland	A planned area captures estimated additional 57 ha	Increased ability to capture and filter nutrients from this area and reduces overall risk of N and P losses on farm.
5. Calving pad	With additional milking cows an ability to reduce risk of pugging to pastures over spring and at autumn is required.	The risk of pugging reduces infiltration of soils and increases overland flow of nutrients. Also nutrients are held and spread onto soil by effluent applications when pastures more able to receive the nutrients and thus lowers risk of losses.

Please see information contained in the Appendices for detail relating to nutrient budgets, nitrogen block reports, phosphorus block reports and estimated pasture production for the current situation and scenario modelled.

OVERSEER v6.2.1 onwards has a new irrigation module to better reflect the management practices of irrigators. The Best Practice Data Input Standards give some guidance on what is now required. The model requires more information from users about their irrigation system and how water application decisions are made on farm. The extra data needed includes depth of water per application; return time and depending on how soil water is monitored what are the trigger points and targets (mm deficit). Ideally, this data needs to be actual long term average data as OVERSEER uses 30 year average climate data. Best estimates of these data will generally generate more drainage, and hence N loss to water, than has been the case with previous OVERSEER versions.

OVERSEER is a continually developing model with several aspects currently being investigated. In particular there are on-going issues in relation to the modelled nitrogen leaching from grazed crop blocks (and possibly forage blocks also) being less than expected. (Please see www.overseer.org.nz/OVERSEERModel/bugs.aspx for more detail).

When future versions of OVERSEER are stipulated for use associated with Regional Council rules both the current and the proposed farm systems will need to be re-modelled for consistency as the base N lost from the root zone may alter with updated OVERSEER versions.

Appendices

Current farm System Whole Farm Nutrient Budget

Current Dairy Farm

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	13,482	51
Phosphorus	210	0.8

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	204	50	18	37	55	0	1
Irrigation	0	0	0	0	0	0	0
Supplements	32	4	24	3	4	2	2
Rain/clover fixation	77	0	3	6	4	9	47

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	51	0.8	11	61	55	6	21
As product	83	14	20	4	18	2	6
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	83	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	91	10	-6	-19	0	-1	-1
Inorganic mineral	0	4	-19	0	-2	-2	-3
Inorganic soil pool	2	25	38	0	-8	6	26

Current Sheep Farm

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	1,479	31
Phosphorus	15	0.3

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	28	41	24	41	68	12	0
Irrigation	0	0	0	0	0	0	0
Supplements	0	0	0	0	0	0	0
Rain/clover fixation	73	0	3	6	4	9	47

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	31	0.3	8	54	36	5	22
As product	34	8	28	3	3	2	1
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	35	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	-15	1	1	-12	0	0	0
Inorganic mineral	0	2	-27	0	-2	-3	-3
Inorganic soil pool	8	29	6	0	32	15	26

Current Farm System Nutrient Loss Indicators

P report

Block P

Phosphorus summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)
OTWY_3A.1 NON EFFLUENT	3	1.4
PARO_4A.1 NON EFF TILED	8	0.7
PARO_4A.1 NON EFFLUENT	14	0.7
PARO_4A.1 SILAGE BLK	1	0.6
PAROA_4A.1 SLGE NT	1	0.6
WAIKI_34A.1 EFF NT	0	0.2
WAIKI_34A.1 EFF TILED	5	0.4
WAIKI_34A.1 EFFLUENT	18	0.2
WAIKI_34A.1 NON EFF TILED	4	0.4
WAIKI_34A.1 NON EFFLUENT	12	0.2
WAIKI_34A.1 SILAGE BLK	1	0.2
WAIKI_34A.1 SILAGE BLK TILED	1	0.3
WOOD_29A.1 EFF NT	0	0.2
WOOD_29A.1 EFFLUENT	3	0.2
WOOD_29A.1 NON EFF NT	0	0.2
WOOD_29A.1 NON EFF TILED	1	0.4
WOOD_29A.1 NON EFFLUENT	2	0.2
YMAI_25A.1 NON EFF TILED	7	0.6
WAIKI_34A.1 FB FB	1	0.4
WAIKI_34A.1 FB FB (2)	1	0.4
WAIKI_34A.1 PAST TO FB	1	0.4
WAIKI_34A.1 PAST TO FB (2)	1	0.4
WAIKI_34A.1 YG	0	0.2
WAIKI_34A.1 YG	1	0.2

Current Sheep Farm

Phosphorus summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)
PAROA_4A.1	0	0.3
WAIKI_34A.1 PASTURE	3	0.1
WOOD_29A.1	1	0.1
WAIKI_34A.1 BRLY>AWHT>PAST	1	0.2
WAIKI_34A.1 CARROT>PAST	1	0.3
WAIKI_34A.1 PAST>SW	1	0.5
WAIKI_34A.1 POTATOES>CARROT	1	0.4
WAIKI_34A.1 SW>BARLEY	1	0.3
WAIKI_34A.1PAST>POTATOES	3	1.1

N report

Farm N

Current Sheep Farm

Block N

Nitrogen summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)	N IN DRAINAGE (PPM)	N ADDED (KG/HA)	N SURPLUS (KG/HA)
OTWY_3A.1 NON EFFLUENT	91	40	10	225	204
PARO_4A.1 NON EFF TILED	460	37	9	225	200
PARO_4A.1 NON EFFLUENT	784	38	9	241	212
PARO_4A.1 SILAGE BLK	31	13	3	78	54
PAROA_4A.1 SLGE NT	20	14	3	78	73
WAIKI_34A.1 EFF NT	109	57	13	319	274
WAIKI_34A.1 EFF TILED	664	57	13	319	274
WAIKI_34A.1 EFFLUENT	4495	57	13	319	274
WAIKI_34A.1 NON EFF TILED	523	46	11	225	205
WAIKI_34A.1 NON EFFLUENT	2547	48	11	241	216
WAIKI_34A.1 SILAGE BLK	42	14	3	78	40
WAIKI_34A.1 SILAGE BLK TILED	44	16	4	78	62
WOOD_29A.1 EFF NT	78	60	14	319	276
WOOD_29A.1 EFFLUENT	862	60	14	319	276
WOOD_29A.1 NON EFF NT	51	51	12	241	219
WOOD_29A.1 NON EFF TILED	69	49	11	225	207
WOOD_29A.1 NON EFFLUENT	436	51	12	241	219
YMAI_25A.1 NON EFF TILED	412	39	9	225	203
WAIKI_34A.1 FB FB	240	160	30	150	128
WAIKI_34A.1 FB FB (2)	332	133	26	150	70
WAIKI_34A.1 PAST TO FB	181	121	23	150	128
WAIKI_34A.1 PAST TO FB (2)	235	94	19	150	70
WAIKI_34A.1 YG	84	56	12	311	203
WAIKI_34A.1 YG	156	62	14	311	203

Current Sheep Farm

Nitrogen summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)	N IN DRAINAGE (PPM)	N ADDED (KG/HA)	N SURPLUS (KG/HA)
PAROA_4A.1	1	10	2	0	88
WAIKI_34A.1 PASTURE	290	11	3	0	80
WOOD_29A.1	60	12	3	0	88
WAIKI_34A.1 BRLY>AWHT>PAST	21	8	2	0	-161
WAIKI_34A.1 CARROT>PAST	62	24	5	0	-60
WAIKI_34A.1 PAST>SW	235	90	18	194	330
WAIKI_34A.1 POTATOES>CARROT	423	163	29	92	-107
WAIKI_34A.1 SW>BARLEY	258	99	17	35	-46
WAIKI_34A.1PAST>POTATOES	115	44	10	188	217

Current System Pasture Production, Other Values and Effluent Report

Pasture/crops

	PASTURE/CROP	YIELD	GROWTH (KG DM/HA)	INTAKE (KG DM/HA)	REMOVED (KG DM/HA)	UTILISATION (%)	TOTAL RSU
OTWY_3A.1 NON EFFLUENT	Ryegrass/white clover	-	17173	14597	0	85	26.27
PARO_4A.1 NON EFF TILED	Ryegrass/white clover	-	17173	14597	0	85	26.27
PARO_4A.1 NON EFFLUENT	Ryegrass/white clover	-	17173	14597	0	85	26.27
PARO_4A.1 SILAGE BLK	Ryegrass/white clover	-	14989	5652	7083	71	10.09
PAROA_4A.1 SLGE NT	Ryegrass/white clover	-	15029	6660	5714	71	11.88
WAIKI_34A.1 EFF NT	Ryegrass/white clover	-	17169	14542	0	85	26.19
WAIKI_34A.1 EFF TILED	Ryegrass/white clover	-	17169	14542	0	85	26.19
WAIKI_34A.1 EFFLUENT	Ryegrass/white clover	-	17169	14542	0	85	26.17
WAIKI_34A.1 NON EFF TILED	Ryegrass/white clover	-	17169	14542	0	85	26.19
WAIKI_34A.1 NON EFFLUENT	Ryegrass/white clover	-	17169	14542	0	85	26.17
WAIKI_34A.1 SILAGE BLK	Ryegrass/white clover	-	14940	4724	8333	71	8.43
WAIKI_34A.1 SILAGE BLK TILED	Ryegrass/white clover	-	15003	5960	6667	71	10.66
WOOD_29A.1 EFF NT	Ryegrass/white clover	-	17169	14542	0	85	26.19
WOOD_29A.1 EFFLUENT	Ryegrass/white clover	-	17169	14542	0	85	26.19
WOOD_29A.1 NON EFF NT	Ryegrass/white clover	-	17169	14542	0	85	26.19
WOOD_29A.1 NON EFF TILED	Ryegrass/white clover	-	17169	14542	0	85	26.19
WOOD_29A.1 NON EFFLUENT	Ryegrass/white clover	-	17169	14542	0	85	26.19
YMAI_25A.1 NON EFF TILED	Ryegrass/white clover	-	17173	14597	0	85	26.27
WAIKI_34A.1 FB FB	Fodder beets | Fodder beets | Pasture |	50 T DM/Ha	0	0	0	0	0
WAIKI_34A.1 FB FB (2)	Fodder beets | Fodder beets | Pasture |	56 T DM/Ha	0	0	0	0	0
WAIKI_34A.1 PAST TO FB	Fodder beets |	25 T DM/Ha	0	0	0	0	0
WAIKI_34A.1 PAST TO FB (2)	Fodder beets |	28 T DM/Ha	0	0	0	0	0
WAIKI_34A.1 YG	Fodder beets | Pasture |	28 T DM/Ha	15951	13558	0	85	24.51
WAIKI_34A.1 YG	Fodder beets | Pasture |	28 T DM/Ha	15951	13558	0	85	24.51

Current Sheep Farm

Pasture/crops

	PASTURE/CROP	YIELD	GROWTH (KG DM/HA)	INTAKE (KG DM/HA)	REMOVED (KG DM/HA)	UTILISATION (%)	TOTAL RSU
PAROA_4A.1	Ryegrass/white clover	-	13084	9159	0	70	16.57
WAIKI_34A.1 PASTURE	Ryegrass/white clover	-	13084	8636	746	70	15.63
WOOD_29A.1	Ryegrass/white clover	-	13084	9159	0	70	16.57
WAIKI_34A.1 BRLY>AWHT>PAST	Barley (spring) | Wheat (autumn) | Pasture |	22 T DM/Ha	4922	3445	0	70	6.34
WAIKI_34A.1 CARROT>PAST	Potato (medium) | Carrots | Pasture |	100 T DM/Ha	2418	1692	0	70	3.12
WAIKI_34A.1 PAST>SW	Swedes | Barley (spring) |	22 T DM/Ha	1637	608	769	70	1.06
WAIKI_34A.1 POTATOES>CARROT	Potato (medium) | Carrots |	100 T DM/Ha	0	0	0	0	0
WAIKI_34A.1 SW>BARLEY	Swedes | Barley (spring) | Wheat (autumn) |	35 T DM/Ha	0	0	0	0	0
WAIKI_34A.1PAST>POTATOES	Potato (medium) |	50 T DM/Ha	10473	6792	769	70	12.13

ravensdown

Current Dairy Farm

Farm details

N: 13297 N/ha: 50 P: 210 P/ha: 0.8 GHG/ha: 13727 NCE: 28%

Total area	266.8 ha
Productive block area	250.60 ha
Nitrogen conversion efficiency (NCE)	28%
N Surplus	225 kg/ha
Region	Southland

GHG: Allocation to milk	0.81
Total liveweight brought (kg/ha grazed)	597
Total liveweight reared (kg/ha grazed)	64
Total liveweight sold (kg/ha grazed)	655
Default calving date	06 August
Milk production per cow (kg milk solids / cow)	424.2
Milk solids (kg/ha grazed)	1367
Milking herd size (peak cows/ha grazed)	3.2
Percent male beef animals	3
Beef / dairy grazing stock rate (RSU)	119
Dairy stock rate (RSU)	6881
Dairy replacements stock rate (RSU)	47
Wetlands: average contribution of N outside farm (%)	-164
Wetlands: average efficiency (%)	51
Wetlands: % farm leach N removed (%)	1
Wetlands: % farm leach N thru wetland removed (%)	21

Effluent report

The report shows rates and target areas for farm liquid effluent only, assuming it is all applied to pastoral blocks. It excludes any farm solid effluent or imported effluent that may be added to effluent blocks. If this occurs, then target areas may need to be increased.

CURRENT AREA RECEIVING LIQUID EFFLUENT	
Total area including crops	112 ha
Pastoral area receiving liquid	108 ha
% of farm pastoral area	45%
Average liquid effluent	32 kg N/ha/yr
Average fertiliser	225 kg N/ha/yr
Average other	61 kg N/ha/yr
AREA OF FARM TO APPLY ALL EFFLUENT TO ACHIEVE RATES OF	
150 kg N/ha/yr - Liquid	24 ha - based on the amount of effluent generated on the the farm and sprayed from sump.
150 kg N/ha/yr - Solid	54 ha
150 kg N/ha/yr - Total	79 ha
Maintenance K	1575 ha
100 kg K/ha/yr	97 ha
Maintenance K Warning	* Average K maintenance rates were less than 20 kg K/ha/yr - use with caution.
SOURCE OF N IN EFFLUENT BLOCK(S)	
Effluent from farm dairy	53%
Effluent from Feed pad	0%
Effluent from Standoff pad	0%
Effluent from Uncovered wintering pad/shelter	0%
Solids	47%
Exported	0%

Current Sheep Farm

Farm details

N: 1479 N/ha: 31 P: 15 P/ha: 0.3 GHG/ha: 5463 NCE: 33%

Total area	47.8 ha
Productive block area	47.70 ha
Nitrogen conversion efficiency (NCE)	33%
N Surplus	67 kg/ha
Region	Southland

GHG: Allocation to wool - breeding mob	0.75
GHG: Allocation to wool - trading mob	0.01
Total liveweight brought (kg/ha grazed)	755
Total liveweight reared (kg/ha grazed)	77
Total liveweight sold (kg/ha grazed)	808
Sheep stock rate (RSU)	660

Current System Parameter Report

Presented as a pdf document upon request

Proposed farm System Whole Farm Nutrient Budget

Farm nutrient budget

LOSSES FROM ROOT ZONE

	TOTAL LOSS (KG/YR)	LOSS PER HA (KG/YR)
Nitrogen	14,727	47
Phosphorus	224	0.7

NUTRIENTS ADDED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Fertiliser, lime and other	195	28	16	41	56	0	0
Irrigation	0	0	0	0	0	0	0
Supplements	21	3	15	2	2	2	1
Rain/clover fixation	90	0	3	6	4	9	47

NUTRIENTS REMOVED (KG/HA/YR)	N	P	K	S	CA	MG	NA
Leached from root zone	47	0.7	11	62	52	6	21
As product	84	14	20	5	18	2	6
Transfer	0	0	0	0	0	0	0
Effluent exported	0	0	0	0	0	0	0
To atmosphere	82	0	0	0	0	0	0

CHANGE IN POOLS (KG/HA/YR)	N	P	K	S	CA	MG	NA
Organic pool	90	11	3	-17	1	0	0
Inorganic mineral	0	4	-22	0	-2	-3	-3
Inorganic soil pool	2	1	22	0	-6	5	24

Proposed Farm System Nutrient Loss Indicators

P report

Block P

Phosphorus summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)
OTWY_3A.1 NON EFFLUENT	3	1.1
PARO_4A.1 NON EFF TILED	7	0.6
PARO_4A.1 NON EFFLUENT	12	0.6
PARO_4A.1 SILAGE BLK	1	0.6
PAROA_4A.1 SLGE NT	1	0.6
WAIKI_34A.1 EFF NT	0	0.2
WAIKI_34A.1 EFF TILED	5	0.4
WAIKI_34A.1 EFFLUENT	23	0.2
WAIKI_34A.1 NON EFF TILED	4	0.3
WAIKI_34A.1 NON EFFLUENT	10	0.2
WAIKI_34A.1 SILAGE BLK	1	0.2
WAIKI_34A.1 SILAGE BLK TILED	1	0.3
WOOD_29A.1 EFF NT	0	0.2
WOOD_29A.1 EFFLUENT	3	0.2
WOOD_29A.1 NON EFF NT	0	0.2
WOOD_29A.1 NON EFF TILED	1	0.4
WOOD_29A.1 NON EFFLUENT	2	0.2
YMAI_25A.1 NON EFF TILED	6	0.6
WAIKI_34A.1 FB FB (2)	0	0.4
WAIKI_34A.1 FBT>FBT (3)	1	0.3
WAIKI_34A.1 PAST TO FB (2)	1	0.4
WAIKI_34A.1 PAST>FBT(3)	1	0.3
WAIKI_34A.1 YG	0	0.2
WAIKI_34A.1 YG	0	0.2

N report

Farm N

Block N

Nitrogen summary

	TOTAL LOSS (KG)	LOSS PER HA (KG/HA)	N IN DRAINAGE (PPM)	N ADDED (KG/HA)	N SURPLUS (KG/HA)
OTWY_3A.1 NON EFFLUENT	88	38	9	224	193
PARO_4A.1 NON EFF TILED	443	36	9	224	190
PARO_4A.1 NON EFFLUENT	760	37	9	240	202
PARO_4A.1 SILAGE BLK	15	6	2	78	-21
PAROA_4A.1 SLGE NT	9	6	2	78	-31
WAIKI_34A.1 EFF NT	97	49	11	258	225
WAIKI_34A.1 EFF TILED	556	48	11	250	220
WAIKI_34A.1 EFFLUENT	5805	49	11	258	225
WAIKI_34A.1 NON EFF TILED	515	46	11	236	203
WAIKI_34A.1 NON EFFLUENT	2652	47	11	252	215
WAIKI_34A.1 SILAGE BLK	20	7	2	78	-29
WAIKI_34A.1 SILAGE BLK TILED	18	7	2	78	-29
WOOD_29A.1 EFF NT	67	52	12	258	227
WOOD_29A.1 EFFLUENT	754	52	12	258	228
WOOD_29A.1 NON EFF NT	49	49	11	240	208
WOOD_29A.1 NON EFF TILED	66	47	11	224	196
WOOD_29A.1 NON EFFLUENT	659	49	11	240	208
YMAI_25A.1 NON EFF TILED	396	37	9	224	192
WAIKI_34A.1 FB FB (2)	192	148	29	150	166
WAIKI_34A.1 FBT>FBT (3)	371	162	32	150	5
WAIKI_34A.1 PAST TO FB (2)	130	100	20	127	143
WAIKI_34A.1 PAST>FBT(3)	278	121	24	127	-17
WAIKI_34A.1 YG	102	45	10	250	128
WAIKI_34A.1 YG	67	51	11	250	128

Proposed System Pasture Production, Other Values and Effluent Report

Farm details

N: 14235 N/ha: 45 P: 224 P/ha: 0.7 GHG/ha: 13107 NCE: 30%

Total area	314.6 ha
Productive block area	298.30 ha
Nitrogen conversion efficiency (NCE)	30%
N Surplus	216 kg/ha
Region	Southland

GHG: Allocation to milk	0.83	Beef / dairy grazing stock rate (RSU)	64
Total liveweight brought (kg/ha grazed)	421	Dairy stock rate (RSU)	8006
Total liveweight reared (kg/ha grazed)	59	Dairy replacements stock rate (RSU)	54
Total liveweight sold (kg/ha grazed)	470	Wetlands: average contribution of N outside farm (%)	-49
Default calving date	06 August	Wetlands: average efficiency (%)	45
Milk production per cow (kg milk solids / cow)	453.5	Wetlands: % farm leach N removed (%)	3
Milk solids (kg/ha grazed)	1357	Wetlands: % farm leach N thru wetland removed (%)	31
Milking herd size (peak cows/ha grazed)	3.0		

Pasture/crops

	PASTURE/CROP	YIELD	GROWTH (KG DM/HA)	INTAKE (KG DM/HA)	REMOVED (KG DM/HA)	UTILISATION (%)	TOTAL RSU
OTWY_3A.1 NON EFFLUENT	Ryegrass/white clover	-	16981	14433	0	85	26
PARO_4A.1 NON EFF TILED	Ryegrass/white clover	-	16981	14433	0	85	26
PARO_4A.1 NON EFFLUENT	Ryegrass/white clover	-	16981	14433	0	85	26
PARO_4A.1 SILAGE BLK	Ryegrass/white clover	-	14861	1712	12500	72	3.06
PAROA_4A.1 SLGE NT	Ryegrass/white clover	-	14952	1518	12857	72	2.72
WAIKI_34A.1 EFF NT	Ryegrass/white clover	-	16981	14383	0	85	25.89
WAIKI_34A.1 EFF TILED	Ryegrass/white clover	-	16981	14408	0	85	25.96
WAIKI_34A.1 EFFLUENT	Ryegrass/white clover	-	16981	14408	0	85	25.96
WAIKI_34A.1 NON EFF TILED	Ryegrass/white clover	-	16981	14408	0	85	25.96
WAIKI_34A.1 NON EFFLUENT	Ryegrass/white clover	-	16981	14408	0	85	25.96
WAIKI_34A.1 SILAGE BLK	Ryegrass/white clover	-	14994	1445	13000	72	2.58
WAIKI_34A.1 SILAGE BLK TILED	Ryegrass/white clover	-	14982	1464	12963	72	2.62
WOOD_29A.1 EFF NT	Ryegrass/white clover	-	16981	14383	0	85	25.89
WOOD_29A.1 EFFLUENT	Ryegrass/white clover	-	16981	14408	0	85	25.96
WOOD_29A.1 NON EFF NT	Ryegrass/white clover	-	16981	14383	0	85	25.89
WOOD_29A.1 NON EFF TILED	Ryegrass/white clover	-	16981	14408	0	85	25.96
WOOD_29A.1 NON EFFLUENT	Ryegrass/white clover	-	16981	14408	0	85	25.96
YMAI_25A.1 NON EFF TILED	Ryegrass/white clover	-	16981	14433	0	85	26
WAIKI_34A.1 FB FB (2)	Fodder beets | Fodder beets | Pasture |	52 T DM/Ha	0	0	0	0	0
WAIKI_34A.1 FBT>FBT (3)	Fodder beets | Forage oats (autumn) | Fodder beets | Forage oats (autumn) | Pasture |	48 T DM/Ha	0	0	0	0	0
WAIKI_34A.1 PAST TO FB (2)	Fodder beets |	26 T DM/Ha	0	0	0	0	0
WAIKI_34A.1 PAST>FBT(3)	Fodder beets | Forage oats (autumn) |	24 T DM/Ha	0	0	0	0	0
WAIKI_34A.1 YG	Fodder beets | Forage oats (autumn) | Pasture |	24 T DM/Ha	15750	13388	0	85	24.21
WAIKI_34A.1 YG	Fodder beets | Pasture |	26 T DM/Ha	15750	13388	0	85	24.21

Effluent report

The report shows rates and target areas for farm liquid effluent only, assuming it is all applied to pastoral blocks. It excludes any farm solid effluent or imported effluent that may be added to effluent blocks. If this occurs, then target areas may need to be increased.

CURRENT AREA RECEIVING LIQUID EFFLUENT	
Total area including crops	152 ha
Pastoral area receiving liquid	149 ha
% of farm pastoral area	52%
Average liquid effluent	31 kg N/ha/yr
Average fertiliser	201 kg N/ha/yr
Average other	25 kg N/ha/yr
AREA OF FARM TO APPLY ALL EFFLUENT TO ACHIEVE RATES OF	
150 kg N/ha/yr - Liquid	32 ha - based on the amount of effluent generated on the the farm and sprayed from sump.
150 kg N/ha/yr - Solid	40 ha
150 kg N/ha/yr - Total	71 ha
Maintenance K	710 ha
100 kg K/ha/yr	107 ha
Maintenance K Warning	* Average K maintenance rates were less than 20 kg K/ha/yr - use with caution.
SOURCE OF N IN EFFLUENT BLOCK(S)	
Effluent from farm dairy	61%
Effluent from Feed pad	0%
Effluent from Standoff pad	0%
Effluent from Uncovered wintering pad/shelter	6%
Solids	33%
Exported	0%

Proposed System Parameter Report

Presented as a pdf document upon request.

Addendum:

Current Dairy System, combined with Sheep System and Proposed System N Block Report comparison

Current Situation				Current situation					Combined situation		Proposed Situation				
Current Overseer blocks	**area**	**N loss**	**P loss**	**Sheep Overseer Blks**	**area**	**N loss**	**P loss**		**N loss**	**P loss**	**Proposed Overseer Blks**	**area**	**N loss**	**P loss**	**N loss dffce**
Paro_4a.1 Non Effluent	20.6	784	14	Paroa_4a.1	0.1	1	0	20.6+0.1=20.7	**785**	**14**	Paro_4a.1 Non Effluent	20.7	760	12	25
Paro_4a.1 Non Eff Tiled	12.4	460	8						**460**	**8**	Paro_4a.1 Non Eff Tiled	12.4	443	7	17
Wood_29a.1 Non Effluent	8.6	436	2	Wood_29a.1	4.9	57	0.9	8.6+4.9=13.5	**493**	**2.9**	Wood_29a.1 Non Effluent	13.5	659	2	-166
Wood_29a.1 Effluent	14.3	862	3	Wood_29a.1	0.3	3	0.1	14.3+0.3=14.6	**865**	**3.1**	Wood_29a.1 Effluent	14.6	754	3	111
Wood_29a.1 Non Eff Tiled	1.4	69	1						**69**	**1**	Wood_29a.1 Non Eff Tiled	1.4	66	1	3
Waiki_34a.1 Effluent	78.6	4495	18	Waiki_34a.1	38.6	1278	10	78.6+38.6+1.9=119.1	**5773**	**28**	Waiki_34a.1 Effluent	119.1	5805	23	-32
Waiki_34a.1 Eff Tiled	11.6	664	5						**664**	**5**	Waiki_34a.1 Eff Tiled	11.6	556	5	108
Waiki_34a.1 Non Effluent	53.2	2547	12	Waiki_34a.1	3.8	126	1	53.2+3=56.2	**2673**	**13**	Waiki_34a.1 Non Effluent	56.2	2652	10	21
Waiki_34a.1 Non Eff Tiled	11.3	523	4						**523**	**4**	Waiki_34a.1 Non Eff Tiled	11.3	515	4	8
Wetland 2	3.4	10	0					3.4+0.1=3.5	**10**	**0**	Wetland 2	3.5	10	0	0
Riparian 1	2.4	7	0						**7**	**0**	Riparian 1	2.4	7	0	0
Ymai_25a.1 Non Eff Tiled	10.6	412	7						**412**	**7**	Ymai_25a.1 Non Eff Tiled	10.6	396	6	16
Otwy_3a.1 Non Effluent	2.3	91	3						**91**	**3**	Otwy_3a.1 Non Effluent	2.3	88	3	3
Waiki_34a.1 Past to FB	1.5	181	1					1.3-1.5=(0.2)	**181**	**1**	Waiki_34a.1 Past to FB (2)	1.3	130	1	51
Waiki_34a.1 FB FB	1.5	240	1					1.3-1.5=(0.2)	**240**	**1**	Waiki_34a.1 FB FB (2)	1.3	192	0	48
Waiki_34a.1 Past to FB (2)	2.5	235	1					2.3-2.5=(0.2)	**235**	**1**	Waiki_34a.1 Past>FBt(3)	2.3	49	0	186
Waiki_34a.1 FB FB (2)	2.5	332	1					2.3-2.5=(0.2)	**332**	**1**	Waiki_34a.1 FBt>FBt (3)	2.3	67	0	265
Wood_29a.1 Non Eff NT	1	51	0						**51**	**0**	Wood_29a.1 Non Eff NT	1	97	0	-46
Wood_29a.1 Eff NT	1.3	78	0						**78**	**0**	Wood_29a.1 Eff NT	1.3	20	1	58
Waiki_34a.1 Eff NT	1.9	109	0					1.9+0.1=2.0	**109**	**0**	Waiki_34a.1 Eff NT	2	15	1	94
Waiki_34a.1 Silage Blk	3	42	1						**42**	**1**	Waiki_34a.1 Silage Blk	3	18	1	24
Paro_4a.1 Silage blk	2.4	31	1						**31**	**1**	Paro_4a.1 Silage blk	2.4	9	1	22
Waiki_34a.1 Silage blk Tiled	2.7	44	1						**44**	**1**	Waiki_34a.1 Silage blk Tiled	2.7	278	1	-234
Paroa_4a.1 Slge NT	1.4	20	1						**20**	**1**	Paroa_4a.1 Slge NT	1.4	371	1	-351
Waiki_34a.1 YG	1.5	84	0					1.3-1.5=(0.2)	**84**	**0**	Waiki_34a.1 YG	1.3	102	0	-18
Waiki_34a.1 YG	2.5	156	1					2.3-2.5=(0.2)	**156**	**1**	Waiki_34a.1 YG	2.3	67	0	89
Other sources	10.4	519	123	Other	0.1	14	4		**533**	**127**	Other sources	10.4	601	141	-68
Total Overseer reported	266.8	13482	210	Total	47.8	1479	15	Changes =47.8	**14961**	**225**	Total	314.6	14727	224	234
Total Sum of Blocks		13482	209			1479	16		**14961**	**225**			14727	224	234

NOTE: The green coloured combined N & P blocks are lower than the proposed. The orange coloured blocks are higher in total N & P loss. White cells are no change. There are rounding differences which mean the sum total of the blocks can differ from Overseer reported values. The 0.1 ha other for the sheep has been taken up by wetland, but in no way affects the results at all. Commentary as to why these differences are lower are contained in the report. The yellow cells show the overall difference between the sum totals as opposed t the total reported figures in green above, both are showing the overall reduction by these amounts and are as reported and confirmed in the main body of the report.

Attachment G: FEMPs

Aerodrome Farm Limited

Farm Environmental Management Plan; and

Collected Agricultural Effluent Management Plan

June 2019

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FARM ENVIRONMENTAL MANAGEMENT PLAN

A: PROPERTY OVERVIEW

Contact Person(s)	Aerodrome Farm Limited (Owner)	**Plan Prepared By**	Landpro Ltd
Contact Phone	Peter Moynihan – 0274328599 (owner) Name – Number (Farm Manager)	**Date**	2 August 2019
Email Address	Peter.moynihan@westpac.co.nz	**Date of Next Review**	2 August 2020
Physical Address	95 Aerodrome Road, Invercargill		
Consent Numbers and Expiry Dates	TBC		
Farm Descriptions			
Farm Area	315 ha		
Legal Descriptions	Lot 2 DP 444882, Lot 1 DP 387607, Lot 3 DP 307719, Lot 2 DP 500581, Lot 6 DP 403135, Section 33 BLK IV Invercargill Hundred, Lot 2 DP 375267, Sections 1, 2, 3 & 4 BLK IX Invercargill Hundred, Lot 2 DP 449748 and Lot 2 DP 451891.		
Peak Milked Herd Size	850 cows		
Discharge Permit Overview	Discharge of effluent generated at the dairy shed, silage pad, standoff/calving pad to a total area of 159.7 ha via low rate pod system.		
Water Permit Overview	Daily volume of 102 m^3/day Yearly volume 31,312 m^3/year		

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. The FEMP also includes requirements as set out in relevant conditions for the Management Plan and Collected Agricultural Effluent Management Plan, under Land Use Consent AUTH-2019XXXX-0X and Discharge Permit AUTH-2019XXXX-0X respectively.

Objectives of this plan:

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

This will be achieved through;

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

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

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

B: SITE PLANS

This FEMP contains a Farm Plan Map (Appendix A) which identifies key features of the subject property, including critical source areas, waterways, fencing, winter grazing etc. The map was prepared by Landpro Ltd to be in accordance with Part B(3) of Appendix N of the proposed Southland Water and Land Plan, 2018, and also satisfies Condition X of Land Use Consent AUTH-2019XXXX-0X (Management Plan requirements) and Condition X of Discharge Permit AUTH-2019XXXX-0X (CAEMP requirements). This Map is designed to be easily used in conjunction with this FEMP report, to provide all farm staff with a visual map of the critical source areas, winter grazing areas, and infrastructure on-farm.

The following table can be used as a reference point for locating these features. The information in the attached Map was obtained from the consent holder. The attached Map shows the location of the dairy farm and the locations of significant infrastructure, including dairy sheds, effluent storage ponds and silage stacks.

<table>
<tr><th>KEY FEATURES</th><th>PLAN(S) WHERE KEY FEATURES ARE MAPPED</th></tr>
<tr><td>Site boundary</td><td>All site plans in this FEMP</td></tr>
<tr><td>Physiographic zones, variants and soil types</td><td>Figure 1: Physiographic Plan
Figure 2: Soil map</td></tr>
<tr><td>Lakes, rivers, streams ponds, artificial watercourses, modified watercourses and natural wetlands</td><td rowspan="2">Appendix A: Existing waterways and critical source areas shown on the Farm Environmental Management Plan Map</td></tr>
<tr><td>Other critical source areas (gullies, swales etc)</td></tr>
<tr><td>Land with a slope greater than 20 degrees</td><td>N/A</td></tr>
<tr><td>Existing and proposed riparian vegetation and fences (or other stock exclusion methods) adjacent to waterbodies</td><td>Appendix A: Riparian vegetation, 3m-20m grass buffer zones and fencing along waterways shown on the Farm Environmental Management Plan Map</td></tr>
<tr><td>Places where stock access or cross water bodies (including bridges, culverts and fords)</td><td>Appendix A: Bridges shown on the Farm Environmental Management Plan Map</td></tr>
</table>

Known subsurface drainage system(s) and the location of drain outlets	Appendix A: Tile Drainage shown as critical source areas on the Farm Map and Effluent Disposal Plan
All land that may be cultivated over the next 12 months	Appendix A: Cultivation for the 2019/2020 Dairy Season shown on the Farm Map Environmental Management Plan Map
All land that may be intensively winter grazed over the next 12 months	Appendix A: Winter grazing on crop during July, August and September shown on the Farm Map.

C: PHYSIOGRAPHIC ZONES AND KEY CONTAMINANT PATHWAYS

This section of the FEMP documents the physiographic zones and key contaminant pathways present across the property.

The following physiographic plan shows the spatial distribution of the physiographic zones across all three farms according to the Environment Southland Proposed Water and Land Plan 2018 (PSWLP) as mapped by Beacon Mapping Service. The mapping system also details the key contaminant pathways present for each physiographic zone and any variants for the location (i.e.: the Gleyed zone has artificial drainage and Overland Flow pathways and the Oxidising zone has artificial and deep drainage pathways).

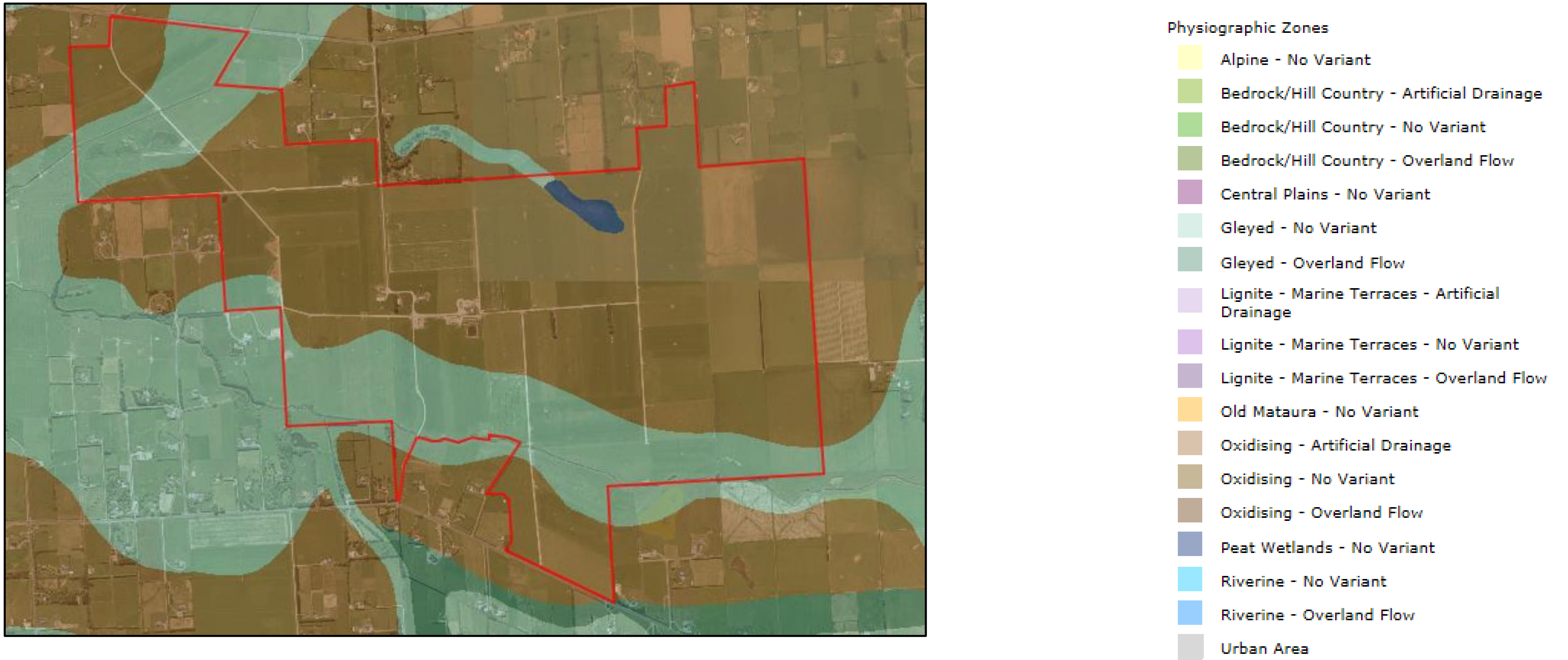


Figure 1: Physiographic Zones across Aerodrome

D: SOIL MAPS

This section of the FEMP documents the soil types present across all three properties. The soil map below shows the spatial distribution of the soil types across the entire property according to the Environment Southland Beacon Mapping Service.

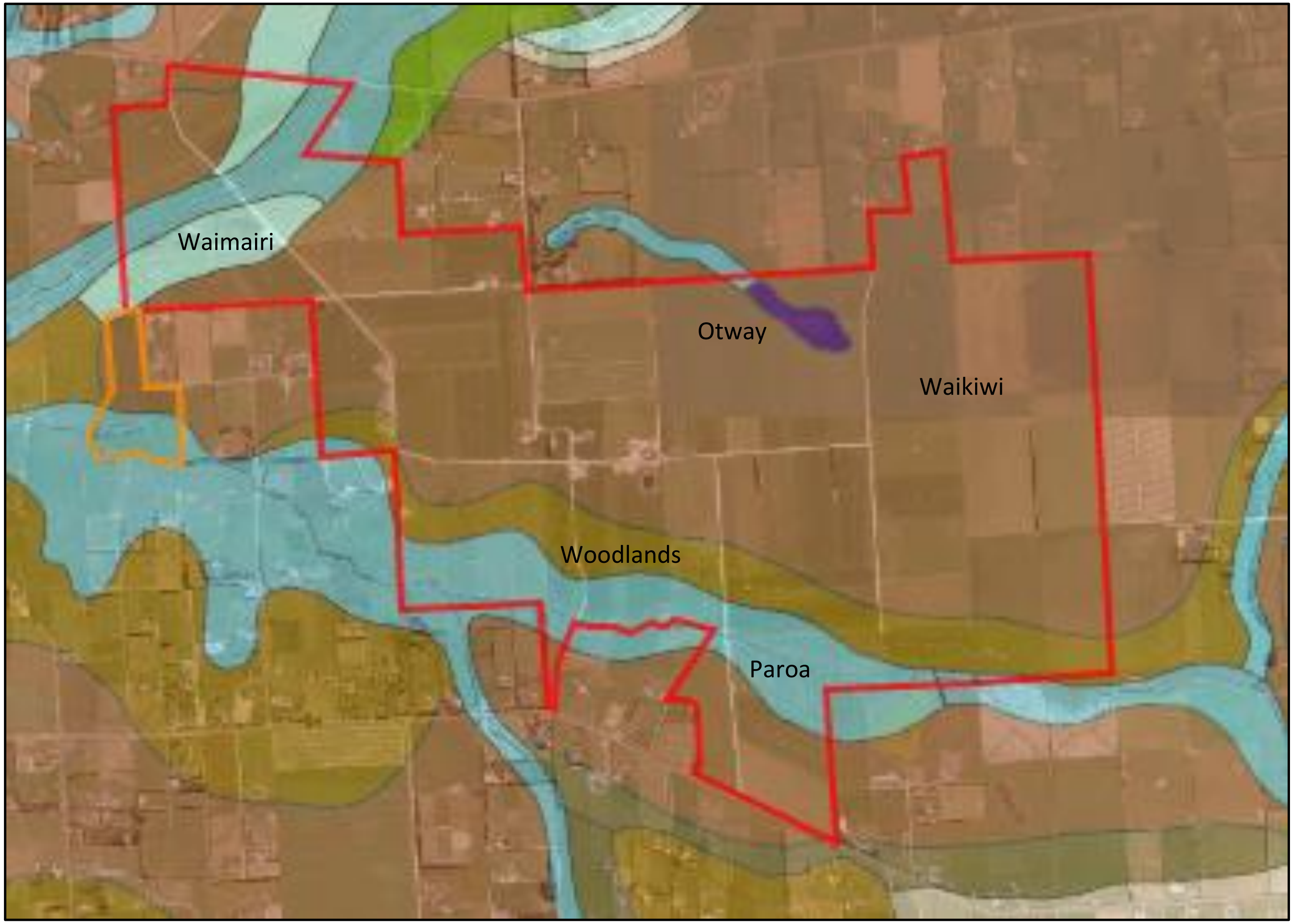


Figure 2: Soils across Aerodrome Farm Limited (Source: ES GIS Beacon)

E: GOOD MANAGEMENT PRACTICES – GENERAL

Mitigation	Good Management Practice	Review notes
Protect soil structure (will also help with P and N loss)	Use of feed pads and standoff pads during the shoulder seasons (between 1 July to 31 September)	
	Re-sow bare soils as soon as possible including oats catch crop	
	Use of selective grazing to avoid grazing very wet paddocks and open the breaks up to avoid pugging and treading damage.	
Manage Critical Source Areas (CSA)	Avoid working CSAs and their margins	
	Leave grassed areas (or native vegetation) around CSAs especially when grazing winter forage crop and/or graze as "last bite". Grazing direction should be down the slope or towards CSA.	
	All riparian margins to be fenced and left to establish with grasses to enable filtration of contaminants that may be transported via overland flow processes.	
Additional P loss reduction	Reduce use of P fertiliser where Olsen P values are above agronomic optimum. Maintain Olsen P levels at optimum levels.	
	Reduce the risk of run-off to laneways and other sources by ensuring crossings are adequately maintained and maintain gradients of laneways to direct runoff to pasture.	
	Use nutrient budgeting to manage nutrient inputs and outputs	

Mitigation	Good Management Practice	Review notes
Reduce accumulation of N in the soil	Time N fertilizer application to meet crop and pasture demand using split applications and avoid high risk times of the year, i.e. when soil temperature is low or during drought periods	
Avoid preferential flow of FDE through soil profile and artificial drains	Defer effluent application when soil conditions are unsuitable especially when applying effluent to high risk paddocks	
	Apply effluent at low rates and depths and utilize entire effluent discharge area	

F: RIPARIAN MANAGEMENT

Aerodrome is located within the Waikiwi Stream and Myross Creek catchment and is located within the Makarewa River Surface Water Management Zone. The figure below shows the specific catchment boundaries underlying Aerodrome.

Figure 3: Catchment boundaries within each farm area (Source: ES Beacon).

All waterways are already fenced to exclude stock as required by the supplier. All riparian margins are left to establish with grasses and native vegetation in the first instance or as a minimum.

Wetland construction will begin within 12 months of any Land Use Consent for farming activities. Continual riparian planting will occur over time, and management of existing riparian areas including weed management.

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.* Appendix A maps the waterways present on the property, any stock crossings and/or CSA's for riparian management. All crop paddocks will have at least a 5 m buffer hot wire fence from any waterbodies.

G: INTENSIVE WINTER GRAZING

Intensive winter grazing is defined in the PSWLP as the *"Grazing of stock between May and September (inclusive) on forage crops (including brassica, beet and root vegetable crops), excluding pasture and cereal crops.*

For the 2020 season, intensive winter grazing is proposed to occur on the platform, and crop areas (consisting of fodder beet) are shown in the attached Plan. Cows are winter grazed off-farm in June/July and are break-fed on fodder beet crop when they return to the property prior to calving during the shoulder season (July, August and September). To ensure cows are transitioned properly onto fodder beet, cows are taken off the crop paddock for approximately 4 hours each day and fed other supplements (silage) on the Calving pad.

The applicant adopts the following good management practices for all intensive winter grazing activity.

Mitigation	Good Management Practice	Review notes
Protect soil structure and reduce N and P loss from intensive winter grazing activities	Grazing direction top of slope to bottom of slope. Use break or block feeding. The consent holder ensures a 'last bite' of 5-20m is left at the base of the slope, or alongside any waterways/other critical source areas. Some crop paddocks (to be grazed in 2019) identified in Appendix A have grass buffer zones of up to 30 metres, which is over and above good practice.	
	Back fencing to prevent stock from entering previously grazed areas.	
	Use of portable water troughs to prevent stock from accessing waterways for stock drinking when not on/off grazing.	

	Cows are taken off the crop area for approximately 4 hours per day and provided supplementary feed on the calving pad. This is to reduce wastage and pugging on the crop paddock.	

H: NUTRIENT MANAGEMENT

Nutrient management is a key component of ensuring good on-farm environmental practice. The farm utilises nutrient budgeting through their supplier (Ravensdown) with nutrient budgets modelled in 2019 as part of the farming consent application process.

To ensure the FEMP meets requirements under Appendix N of the PSWLP, the applicant will provide an updated nutrient budget in due course, which uses the latest version of the OVERSEER model in accordance with the OVERSEER Best Practice Data Input Standards. Any resulting nutrient budgets will be reviewed and updated as required especially if farm system changes are proposed, but not less than on an annual basis. Any budget reviews are guided by a fertiliser representative and nutrient management advisor. Nutrient Budgets will be stored in OVERSEER®FM and available upon request.

Regular soil tests will be undertaken to establish the nutrient status of the soils. Soils should be at nutrient levels which avoid any adverse effects on the environment but maintain good pasture production and animal health, by ensuring that the soils are suitable for optimal plant nutrient uptake.

Areas which are receiving FDE will be carefully managed to ensure nitrogen loadings are at acceptable levels and are compliant with conditions imposed by resource consents. The annual effluent nitrogen loading rate shall not exceed 150kg/N/ha. Effluent will be applied utilising low-rate application. Effluent management is discussed in Section I.

The table below describes the good management practices which will be adopted in relation to nutrient management.

Mitigation	Good Management Practice	Review notes
Minimise nutrient losses from farming activities to ground and surface water by utilising nutrient budgeting	Whole farm nutrient modelling using the latest OVERSEER budget (or equivalent model) prepared by a suitably qualified person	
	Whole farm nutrient budget reviewed annually and updated in accordance with significant farm system changes	
	Minimise N losses by using soil testing to guide fertiliser recommendations and match fertiliser application with plant and animal requirements.	

	Use of a fertiliser representative to advise on fertiliser type, timing and application rates. The Consent Holder uses representatives from Ravensdown.	
	No P application between May to September (over and above GMP)	
	Crop rotations adjusted to maximise the use of residual N in the soil	
	Stock winter grazing practices adjusted to minimise nutrient losses	

The following table sets out the evidence which needs to be collected for nutrient budgeting purposes:

Record	Nature of information/person	Collated (Y or N)
Production	Fonterra App, dockets	
Soil test results	Lab results, fertiliser rep (ravensdown)	
Fertiliser application records	Fertilizer rep (ravensdown)	
Proof of placement	Farm Manager (irrigator run sheets)	
Effluent application records	Farm Manager	
Crop rotation records	Farm map with total hectares	
Stock numbers	Culling timeframes Young stock grazed on farm Breeding bulls (to be kept by farm owner)	
Record of supplements purchased	Invoices (to be kept by farm owner)	
Records of supplements made on farm	Invoices (to be kept by farm owner)	
Farm map/effective hectares	Farm Manager/Owner	

I: FARM DAIRY EFFLUENT – COLLECTED AGRICULTURAL EFFLUENT PLAN

This section 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. This section is also designed to meet the requirements of the Collected Agricultural Effluent Management Plan, in accordance with Condition X of Discharge Permit AUTH-2019XXXX-0X.

	Aerodrome Farm Limited
Total effluent discharge area:	159.7 ha
Effluent Collection	Dairy shed, standoff/calving pad, silage pad
Effluent Collection from feed pad	Collection and discharge to land of liquid/slurry effluent from a new calving pad from up to 120 cows to be primarily used July – September and outside of these times during adverse weather conditions
Available storage volume:	3,816 m^3 in the pond and 342.5 m^3 in the sludge beds.
Effluent application method:	Pods, slurry tanker and umbilical
Maximum application rate and depth of application:	• Umbilical: Maximum depth per application of 10 mm; • Slurry tanker: 5mm maximum depth per application; • Low rate pods: Maximum application rate 10mm/hr and 12 mm depth per application (for pods applying FDE in Category A and D soil risk zones) and 10 mm/hr rate and 10 mm depth per application (for pods applying FDE in Category C soil risk zones); and • No high rate application methods on Category C land as shown within Attachment A scheme plans.
In the event of an emergency or effluent spillage	Contact Environment Southland immediately. 03 2115 115

Summary of the On-site Effluent Management System:

Agricultural effluent is collected from the dairy shed, new calving pad (to be constructed) and silage pad. Effluent is then gravity fed via into a sludge bed/weeping wall treatment system. Liquid effluent is gravity fed directly from the weeping wall into the effluent storage pond.

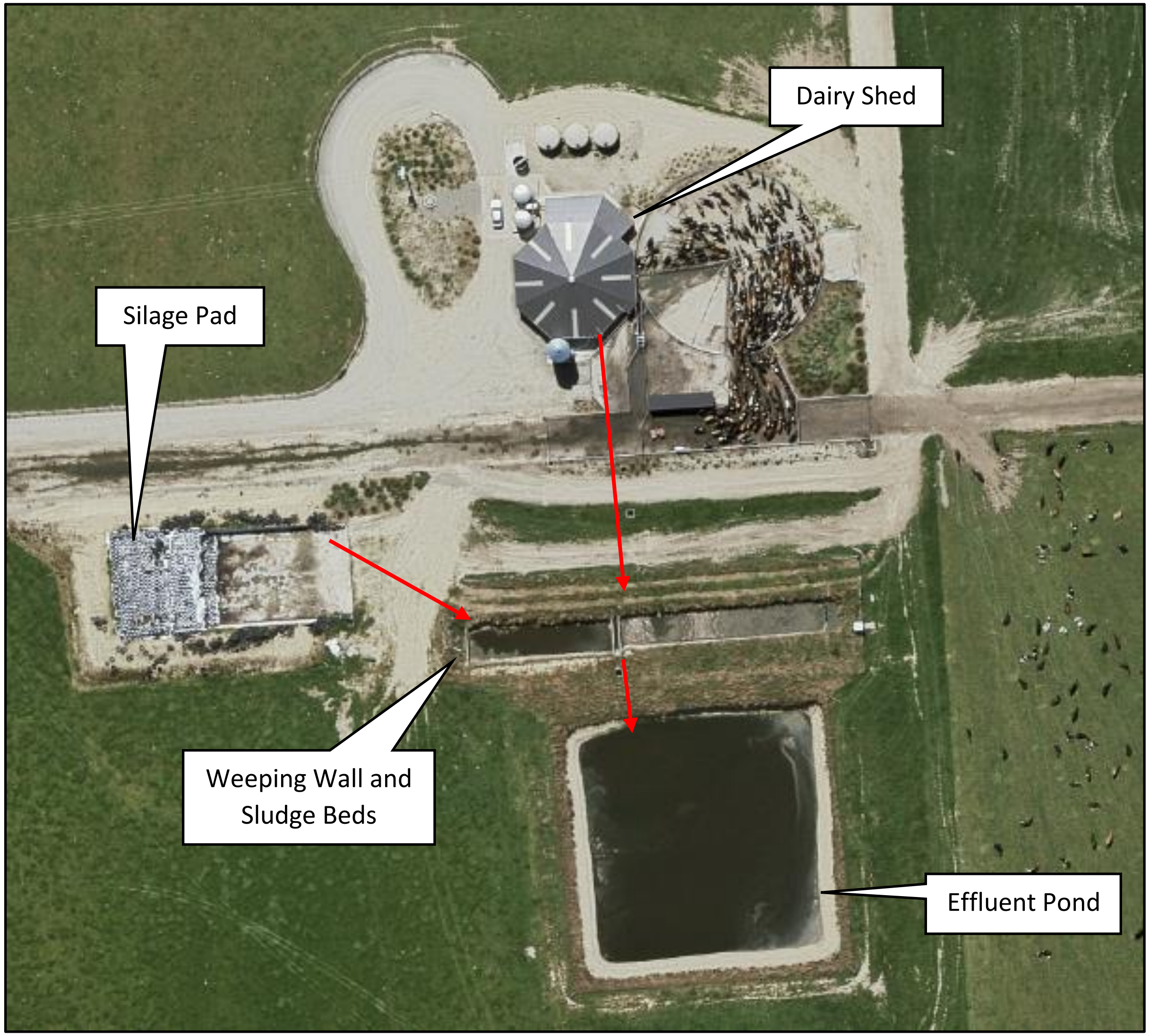


Figure 4: Overview of layout showing dairy shed and effluent treatment system (Source: ES Beacon).

Effluent is applied to land all year-round using low rate pods at a maximum application rate of 10mm/hr with a maximum combined application depth of 12 mm.

The current effluent storage pond and sludge beds meet the storage requirements for both solid and liquid effluent according to the Dairy Effluent Storage Calculator. Consent conditions require this storage volume to be provided on site at all times.

Farm Dairy Effluent Good Management Practices

The following table presents the good management practices which will be adopted on site to avoid or mitigate effects on the environment, specifically from the effluent discharge activity. These practices detail how effluent will be managed when soils are at or above field capacity.

Mitigation	Good Management Practice	Monitoring
Reduction in effluent generation	• Treat the herd gently to avoid increased effluent generated in the dairy shed	N/A
Effluent applied only when soil conditions are appropriate	• Sufficient storage is provided so that when soils are at or above field capacity and/or during adverse weather conditions, effluent can be contained in the effluent storage pond until conditions are suitable for application; • Monitoring of soil moisture using Environment Southland GIS(Beacon) website; • Paddocks will be visually inspected before effluent application to check that soil water deficit exists; • Low rate application will be preferentially used during higher risk periods of the year • Slurry effluent applied to paddocks low in potash (K levels lower than 6-10) and with low Olsen P levels (P levels lower than 25).	N/A

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 1 plan attached to the discharge permit; • Low rate effluent discharge will avoid ponding and/or runoff; • Effluent will not be discharged onto any land areas that have been grazed within the previous 5 days; • Effluent discharge will be to the entire effluent discharge area; and • The standoff/calving pad shall be used during the shoulder seasons (July – September) for appropriate effluent management during adverse weather conditions.	Record irrigation dates, times and areas in the Fonterra Dairy Diary
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 • Mapping of tile drains, as provided in the attached Plan.	N/A
Efficient and effective collection, storage and delivery of effluent from 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; and • Failsafe systems will be kept in place and maintained in good working order, i.e. automatic alarm or shut off system.	Record all repairs and maintenance (invoices, cash manager) 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 of 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; and • Observation of buffers to dwellings not located on the property (200 m) and property boundaries (20 m)	Complaints received by Environment Southland

Operating Procedures for the Effluent Structures

On a monthly basis, checks are undertaken of the components of the effluent management system for all three farms. The details of the monthly checks are recorded and filed for future reference. If there are any matters that require follow up work, then this is noted and should be followed up immediately. An example of the monthly check sheet is included below, and these are kept in the dairy shed. This check sheet is used in conjunction with the effluent orientation and training sheet attached in Appendix B.

Dairy Shed Effluent Monthly Check Sheet

<table>
<tr><th>Task</th><th>Month Done? (Y/N)</th><th>Any further action required?</th></tr>
<tr><td>Check weeping walls are clear of blockages and weeping is occurring. Check inlet pipe and record when beds need to be cleaned out again.</td><td><table><tr><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td><td>J</td><td>F</td><td>M</td><td>A</td><td>M</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td><td></td></tr>
<tr><td>Check all inlet and outlet pipes to storage pond to ensure they are free of debris to prevent blockages. Check height of pond and let manager know if pond is approaching capacity.</td><td><table><tr><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td><td>J</td><td>F</td><td>M</td><td>A</td><td>M</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td><td></td></tr>
</table>

Check effluent nozzles are clear and in good working order	J J A S O N D J F M A M	
Check effluent irrigator pipe is in good working order and does not have any leaks	J J A S O N D J F M A M	
Check well-head(s) remain capped and in good condition. Check stormwater diversion	J J A S O N D J F M A M	

J: OPERATIONAL MANAGEMENT PLAN

Procedure	Effluent Management	Any further action required?
Operational Procedures	• Cowshed effluent enters the effluent system via gravity to the weeping wall and then to the effluent storage pond; • Effluent is pumped direct to farm from the pond if weather and ground conditions allow; • If conditions are not suitable then effluent will remain in the pond; • Effluent from the standoff/calving pad areas will gravity to the above-mentioned pond; • The main methods for effluent irrigation will be by low rate K-line pods; • The effluent discharge permit is proposed to be amended to allow for the use of slurry tankers and umbilical system, contractors will be used for these methods; • Slurry tankers and/or umbilical systems will be used for spreading of the effluent from the weeping wall and feed pad/standoff pad, and de-sludging of effluent pond. The weeping wall needing to be done once a year; • Details of the procedures for the maintenance, moving of the irrigators and pumping requirements are available at the cowshed and detailed training will be provided to any staff required to do this including training and understanding of the requirements of the conditions of the discharge permit; • All application of effluent is to be recorded using a Dairy Diary or notebook; and • Effluent is only to be applied to the areas designated as effluent areas on the farm map as per the discharge permit Appendix 1 Plan.	
Emergency Procedures	• Contact Environment Southland immediately if the effluent pond has become significantly damaged; and • Begin contingency planning to store and discharge effluent in the interim, tidy up the site, and repair any infrastructure.	

Drop Test Procedures	• Drop tests will not be required.	
Monitoring Devices	• All irrigators have fail-safe devices attached and have low pressure shut off system. • The pond can be easily seen from the dairy shed and laneway. Ensure the grass embankments around the pond are 'weed free' so as to easily see the pond from the afar.	

K: COMPLIANCE AND REPORTING

This section sets out the records which are required to be kept that 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.

Record	Location of Records	Date of most recent version
Nutrient budget		
Fertiliser application records		
Soil sampling results		
Water meter certification		
Water abstraction records		
Effluent system training record		
Effluent system monthly maintenance checks		
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 Permit, 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 water take records as specified in the Water Permit to ES by 31 May each year

L: ANNUAL REVIEW AND AUDIT OF FEMP

This FEMP shall be reviewed on an annual basis as a minimum. 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(s) 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 listed above shall be submitted to the consent authority each year including an updated version of the FEMP if any amendments made
- Updated maps of winter crop paddocks and CSA's if applicable

M: 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

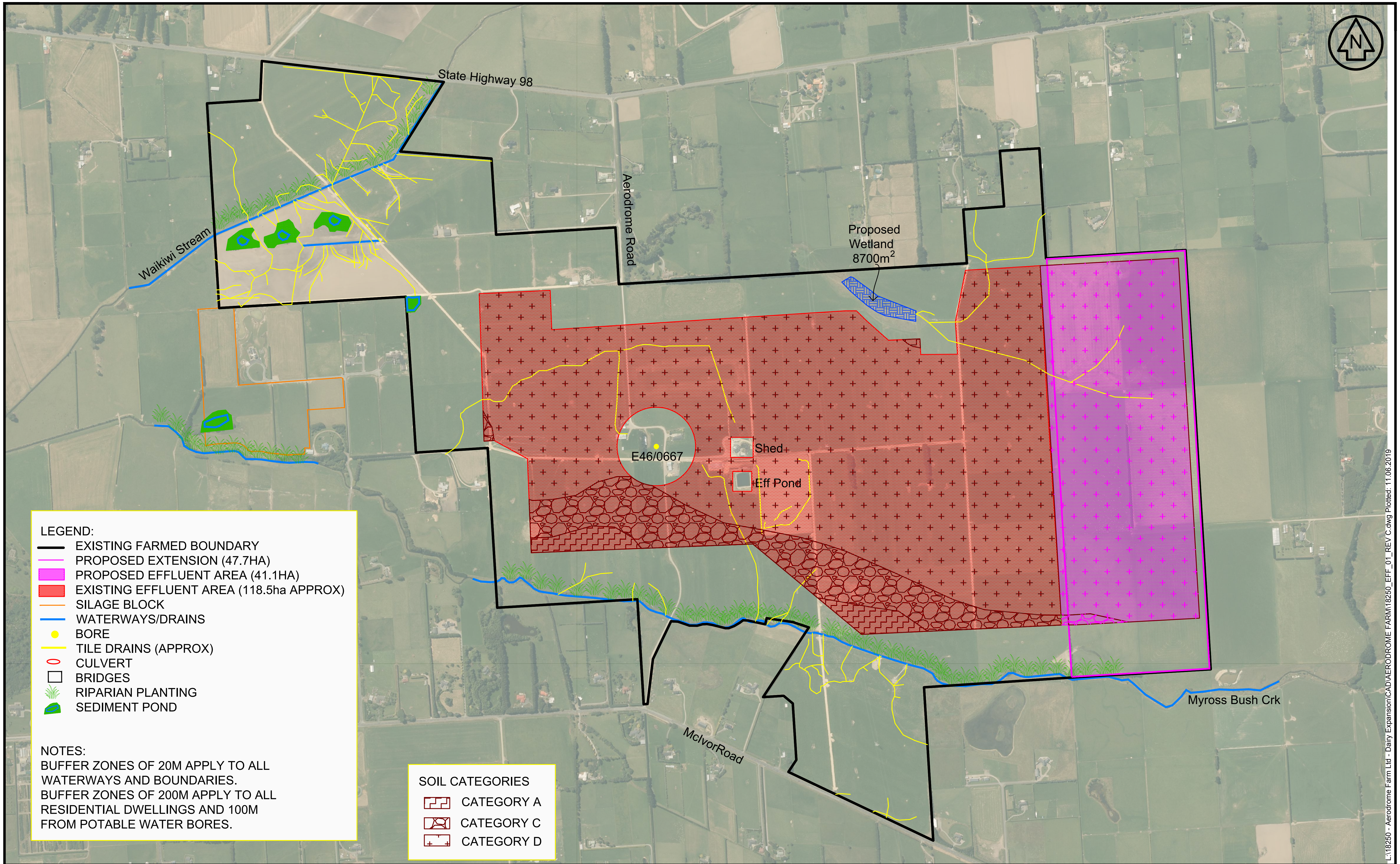
Dairy NZ – Land management on Canterbury Dairy Farms – Managing land to reduce sediment and phosphorous loss

Environment Southland Factsheet – Critical Source Areas

Environment Canterbury – Information Sheet for Farmers on OVERSEER®

Sustainable Dairying: Water Accord

Attachment A – Farm Plan Map



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Client

AERODROME FARM LTD

NOTES
- All dimensions shown are in metres unless otherwise shown
- Copyright on this drawing is reserved
- Check any electronic data against the hardcopy plan to ensure it is the latest version
-If this plan is being used as part of sale and purchase agreement then it is done so on the basis that it is preliminary only, final dimensions and areas may vary on final survey

EFFLUENT DISPOSAL AERA

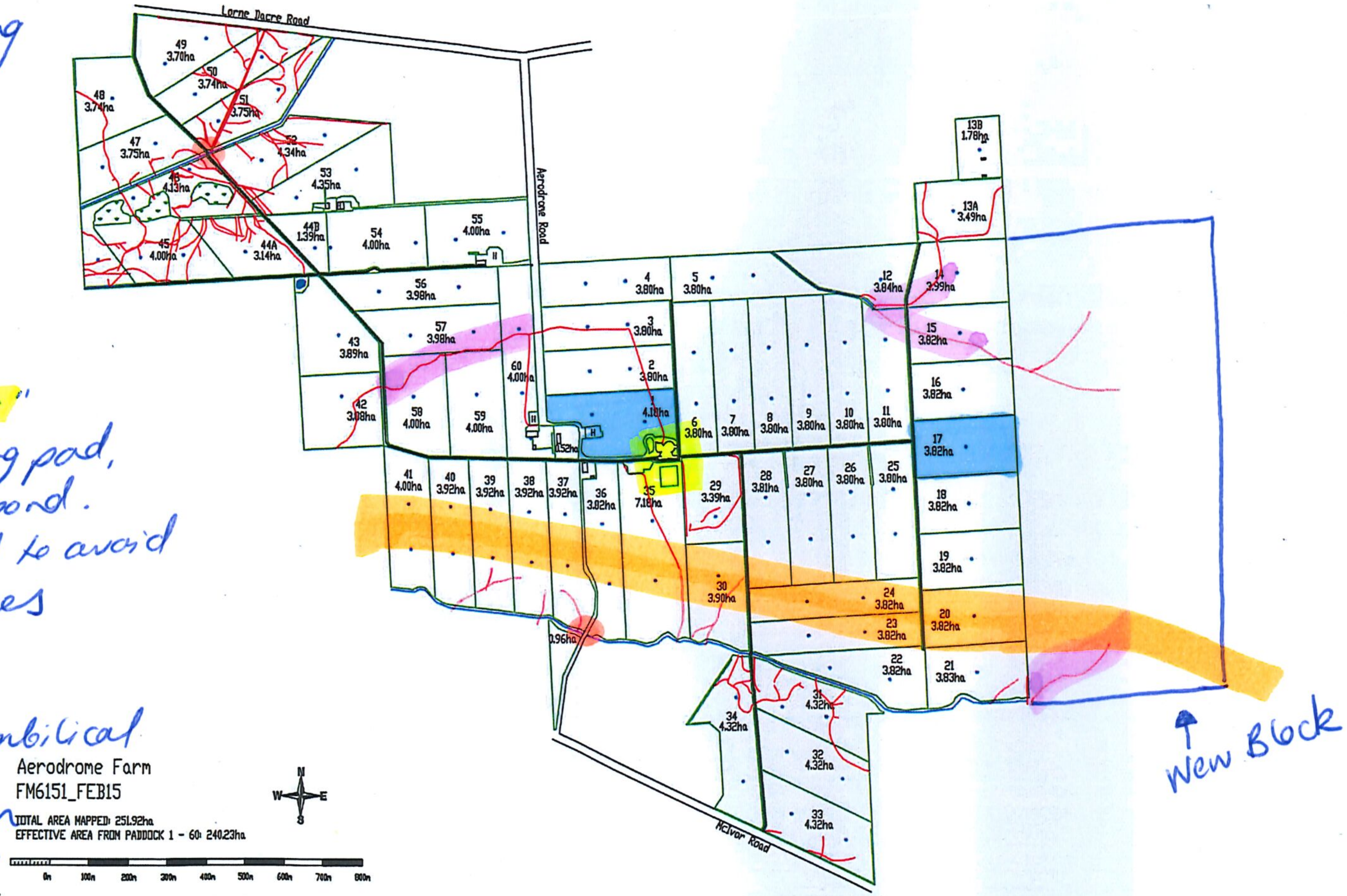
Rev.	Date	Revision Details	By
A	26.7.18	EFF AREA ADDED IN EXTENTION AREA	SLC
B	28.7.18	EFF AREA CHANGED, IN BOTH AREAS	SLC
C	23.5.19	SOIL CATEGORIES ADDED	SLC

Surveyed	Signed	Date	Job No.	Drawing No.
			18250	01_01
Drawn: SLC	Signed	Date: 23.7.18	Scale: 1:5000 @ A1, 1:10000 @ A3	
Designed	Signed	Date	Datum & Level: NZTM 2000 & MSL	Rev. B

Riparian Planting plan.

Critical source Areas.

- swales.
  overland flowrisk
  - "last bite" grazing
- crossings
  - manage/avoid effluent runoff to creeks.
- tile drains
- nutrient "hot spots"
  - dairy shed, calving pad, weeping wall + pond.
  - collect all effluent to avoid direct discharges
- slopingland
  - avoid effluent umbilical application.
  - manage cultivation and overland flow risk
- Planned 2020 intensive winter grazing areas. (subject to consent)



Appendix B: Critical Source Areas Management

Hot spots

- Ensure silage stacks are at least 50 metres from waterways, with no discharge directly to ground water or within 20 metres of a waterbody.
- Recycle plastic waste from the farm.
- Ensure any offal holes or rubbish pits are at least 50 metres from a waterway and there is no seepage to groundwater.
- Septic tanks should be regularly emptied and well maintained.

Erosion control

- Plant trees on slopes where there is the greatest risk of erosion.
- Retain vegetation cover in gullies to reduce erosion and provide filtering of any runoff.
- Avoid cultivation of areas susceptible to erosion, like riparian margins and steep slopes.

Bank Slumping

- Plant appropriate plants in riparian margins that will help stabilise banks.
- Keep fencing well back from waterways so that bank erosion is reduced, and streams can naturally meander.

Paddock selection for wintering

- Identify winter grazing paddocks early.
- Ideally select paddocks further away from waterways.
- Look for areas at lower risk of pugging and compaction.
- Avoid steep slopes.
- Identify critical source areas and leave these in grass.
- Select paddocks where you can manage sediment loss.

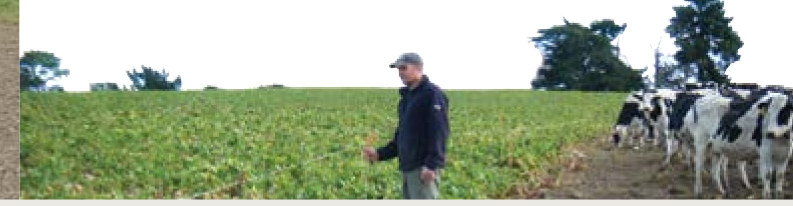
Critical Source Areas

Critical source areas are low-lying parts of farms such as gullies and swales where runoff accumulates. Often these areas have been tiled in the past.

- Runoff from critical sources areas can carry sediment and nutrients to waterways.
- Where possible keep critical source areas uncultivated and ungrazed.
- By managing these areas we can greatly reduce the loss of sediment and nutrients from farms.

Winter intensive grazing

- Work out an access and grazing strategy before putting up fences, thinking about the location of stock water sources and using temporary water troughs if necessary.
- Put supplementary feed out before winter grazing starts.
- Strategically graze paddocks from the top to the bottom or towards the critical source area.
- Back fence stock to prevent them entering previously grazed areas.
- Keep the soil on the paddock.
- Retain a buffer zone along any riparian areas.
- Graze critical source areas last and only if conditions allow.
- Sediment loss can be reduced by up to 90% by adopting strategic grazing methods.



Good Management Practices

SOUTHLAND'S FARMER DRIVEN COMMUNITY CATCHMENT GROUPS

Good management practices are practices which help manage farm resources while minimising environmental risk.

There are many positive outcomes from adopting good management practices on farm, for example:

- Water quality will be maintained and/or improved.
- Complying with national and local regulations.
- Looking after your natural resources.
- Meeting consumer expectations.
- Profitable farming due to improvements in soil management, pasture growth and quality, and animal health.

The sections included in this poster are recommended practices for reducing the potential for our actions to impact on water quality.

These good management practices can be tailored to each farm through a Farm Environment Management Plan.

Southland's farmer driven community Catchment Groups are great places to talk to other farmers about good management practices, and how you can work together to improve water quality in your catchment.

Resources:

Dairy NZ (2016) *Good Management Practices* (Report DNZ40-040) https://www.dairynz.co.nz/media/4106341/Good_management_practices_April_2016.pdf

Dairy NZ (2017) *Wintering on Crops in the South Island* (Report DNZ40-023, Version 2 – January 2017). https://www.dairynz.co.nz/media/5786508/wintering-on-crops-in-the-south-island.pdf

Beef + Lamb New Zealand – Environment home page https://beeflambnz.com/compliance/environment

Beef + Lamb New Zealand – All you need to know about good practice for winter grazing of crops https://beeflambnz.com/wintergrazing

Environment Southland – *Proposed Southland Water and Land Plan* (Decisions Version, 4 April 2018) www.es.govt.nz/document-library/plans-policies-and-strategies/regional-plans/proposed-southland-water-and-land-plan/Pages/default.aspx

Environment Southland – *Farmers' Rough Guide to Environment Southland's Rules* www.es.govt.nz/rough-guide

Environment Southland – *Good management practice* factsheets: www.es.govt.nz/gmp

The Deer Industry Environmental Management Code of Practice https://deernz.org/sites/dinz/files/Deer_EMCoP_Apr%202018_web_interactive.pdf

Project website: www.landcare.org.nz/SouthlandCatchmentGroups

Facebook page: www.facebook.com/Southlandcatchmentgroups

Stock Management

- Fence all stock out of waterways where possible.
- Feed supplements and locate water troughs away from waterways and critical source areas.
- Avoid pugging and soil compaction.
- Ensure deer wallows do not run into waterways.
- *Refer to Southland's Water & Land Plan Rule 70 'Stock exclusion from waterbodies' for different stock class exclusion dates.*

Effluent Management

- Make sure effluent is not applied directly to, or within 50 metres of a waterway.
- Use low rate effluent applicators, over a large area to capture the benefits of the nutrients.
- Ensure there is no ponding or runoff.
- Have sufficient effluent storage.
- Check the Southland Water & Land Plan to see if you need a consent.
- Check your pond does not leak by getting a drop test done.
- Avoid irrigating over tile drains.

Infrastructure

- Regularly used stock crossings over waterways should have either a culvert or bridge in place.
- Manage farm tracks, lanes, gateways, water troughs, self-feeding areas, stock camps, wallows and other sources of run-off to minimise risks to water quality.
- Maintain races and lanes so that effluent goes into a paddock and not a waterway, e.g., installing cut–outs on tracks, and installing sediment traps.
- Ensure all effluent run-off is collected from stock handling facilities.
- Ensure all crossings have a lip or bund on the edge so stock waste and mud cannot enter a waterway.

Fertiliser Application

- Only apply when conditions are suitable i.e. avoid times when soil temperature is too low.
- Don't apply when heavy rain is forecast.
- Have an OVERSEER nutrient budget prepared for the property.
- Keep a buffer around waterways.
- Avoid application to critical sources areas where practical.
- Only apply fertiliser that can be used by the crop or pasture (test soils to check nutrient status).
- Little and often is better than lots now and then.

Biodiversity

- Understand the values of your native area before you change anything. High Value Area surveys can be done at no cost to the landowner.
- Manage or retire wetlands, bogs and swampy areas.
- Protecting native bush can help preserve streams and improve water quality, e.g., QEII covenants.
- Funding is available from Environment Southland for protecting these areas through weed and animal pest control, and fencing.

Riparian Management

- Keep riparian margins wide enough to filter sediment from any run-off.
- Prioritise areas to protect through fencing and planting.
- Consult your local nursery or Environment Southland for advice on the best species to plant in your area.
- Plant trees for shade on north side of streams. This slows down plant growth in the waterway (stopping them becoming choked), but also has the benefit of reducing instream temperature for aquatic life.
- Long grass can be a very effective filter.

Appendix C: Effluent Management

Effluent Orientation and Training Record

Season___/___

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

Trainer signature			
Employee signature			
Date			

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

Irrigator run sheet

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

Date	Paddock	Run	Name	Comments

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

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

Smart Water Use in the Farm Dairy

Milk cooling

Use source water from Tank 1.

Aim for the recommended ratio of 2½ water: 1 milk

For example,

2.5 litres (water) x peak daily litres (milk) ÷ 1,000 = m^3/day water use

To measure milk cooling efficiency

Measure exit flow into a 200 litre drum during milking.
Flow rate in litres/min x total daily milking time (clock this) ÷ 1,000 = m^3/day water use

Alternatively, install a meter on the line delivering water to the plate cooler

Efficiency options

Things to consider if improved cooling efficiency is warranted:

- use of correct flow rates
- optimal plate spacing to increase flow
- pre-cool water source
- ice banks/heat exchangers (can be costly).

Return milk cooling water to Tank 2 for use in yard wash down.

Ensure adequate storage space remains to take all milk cooling water (use float ball or probes).

Capture roof water for reuse or at least exclude it from the yard to prevent increasing effluent volumes.

Yard wash down

To measure yard wash down water use

Follow the steps and calculations in the accompanying *Worksheet* to estimate water use.

Efficiency options

For manual yard washing, here are some ways to improve water-use efficiency.

- Pre-wet the yard on warm, sunny days with a yard hose or sprinkler.
- Use a scraper or a chain (inside an old yard hose) on the backing gate to break up dung before hosing.
- Wash the yard after each milking.
- Work actively and close to the effluent.
- Hose the yard with high water volume under low pressure.
- Include a timer setting on the yard wash down pump (set a time standard for wash down and train staff to achieve it).
- Consider capturing excess cooler water (that would otherwise go to waste) in tipper drums for yard wash.
- Flood wash with water recycled from the effluent pond (refer to conditions of use from your milk processor).

Plant/vat wash

Use water from Tank 1.

To track plant/vat water use

Wash tubs and hot water cylinders use set amounts of water. Refer to washing routine instructions supplied by the detergent companies.

Efficiency options

Here are some steps you can take to reduce plant/vat wash water use:

- Seek advice from your detergent rep on litres required for hot/cold wash options.
- Refill tanks/cylinder with automatic shut-off (to avoid overflows). Use a toilet cistern and trough floats as proven refill/shut-off options.
- Consider heat exchange or pre-heating to improve energy efficiency.

Milking routines

Procedures and practices during milking affect water-use efficiency. Below are some ways to cut water use.

- Pre wet bail and yard.
- Minimise sprinkler/spray washing.
- Hose little and often (as required) in pit area.
- Put cups on dry, clean udders (see DairyNZ's SmartSAMM – www.smartsamm.co.nz).
- Implement a calm, consistent routine to reduce stress in animals and, in turn, effluent in the dairy (see DairyNZ's Milksmart – www.milksmart.co.nz).
- Maintain the dairy (paint/surfaces) to minimise the need for continual wetting.
- For rotaries, use air jet or other methods instead of water to back cows off.

Efficiency options

Here are a few more tips for efficient water use and to reduce water loss.

- Ensure high standard of water quality (if treatment is required).
- Do regular checks for pump pressure, line restrictions and possible leaks.
- Reduce the number of hand-held hoses in use throughout the dairy.

As a measure of efficiency, yard wash water use should not exceed milk cooling water.

Piobiare Homestead Limited

Farm Environmental Management Plan; and

Collected Agricultural Effluent Management Plan

June 2019

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FARM ENVIRONMENTAL MANAGEMENT PLAN

A: PROPERTY OVERVIEW

Contact Person(s)	Piobiare Homestead Limited (Owner)	Plan Prepared By	Landpro Ltd
Contact Phone	Nelson Pyper 03 221 7307 (owner)	Date	2 August 2019
Email Address	rosenel@xtra.co.nz	Date of Next Review	2 August 2020
Physical Address	939 Lochiel Branxholme Road, Branxholme		
Consent Numbers and Expiry Dates	TBC		
Farm Descriptions			
Farm Area	165.1 ha		
Legal Descriptions	Lot 1 DP 12462, Lots 1 & 2 DP 429633, Section 2 and Part Section 3 Block III New River HD, Section 2 Survey Office Plan 385656, Lots 1-3 DP 517446, Lot 1 Deposited Plan 7084		
Peak Wintering numbers	885 milking cows and 220 young stock		
Discharge Permit Overview	Discharge of effluent generated at the wintering barn, silage pad, to a total area of 94 ha.		

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. The FEMP also includes requirements as set out in relevant conditions for the Management Plan and Collected Agricultural Effluent Management Plan, under Land Use Consent AUTH-2019XXXX-0X and Discharge Permit AUTH-2019XXXX-0X respectively.

Objectives of this plan:

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

- Take all practicable steps to minimise the risk of harm to significant vegetation and/or wildlife habitat.

This will be achieved through;

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

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

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

B: SITE PLANS

This FEMP contains a Farm Plan Map (Appendix A) which identifies key features of the subject property, including critical source areas, waterways, fencing, winter grazing etc. The map was prepared by Landpro Ltd to be in accordance with Part B(3) of Appendix N of the proposed Southland Water and Land Plan, 2018, and also satisfies Condition X of Land Use Consent AUTH-2019XXXX-0X (Management Plan requirements) and Condition X of Discharge Permit AUTH-2019XXXX-0X (CAEMP requirements). This Map is designed to be easily used in conjunction with this FEMP report, to provide all farm staff with a visual map of the critical source areas, winter grazing areas, and infrastructure on-farm.

The following table can be used as a reference point for locating these features. The information in the attached Map was obtained from the consent holder. The attached Map shows the location of the dairy farm and the locations of significant infrastructure, including dairy sheds, effluent storage ponds and silage stacks.

KEY FEATURES	PLAN(S) WHERE KEY FEATURES ARE MAPPED
Site boundary	All site plans in this FEMP
Physiographic zones, variants and soil types	Figure 1: Physiographic Plan Figure 2: Soil map
Lakes, rivers, streams ponds, artificial watercourses, modified watercourses and natural wetlands	Appendix A: Existing waterways and critical source areas shown on the Farm Map
Other critical source areas (gullies, swales etc)	
Land with a slope greater than 20 degrees	N/A
Existing and proposed riparian vegetation and fences (or other stock exclusion methods) adjacent to waterbodies	Appendix A: Riparian vegetation, 3m-20m grass buffer zones and fencing along waterways shown on the Farm Environmental Management Plan Map
Places where stock access or cross water bodies (including bridges, culverts and fords)	Appendix A: Crossings shown on the Farm Map

Known subsurface drainage system(s) and the location of drain outlets	Unknown, to be mapped.
All land that may be cultivated over the next 12 months	Appendix A: Cultivation for the 2020 winter shown on the Farm Map
All land that may be intensively winter grazed over the next 12 months	Appendix A: Winter grazing on crop shown on the Farm Map.

C: PHYSIOGRAPHIC ZONES AND KEY CONTAMINANT PATHWAYS

This section of the FEMP documents the physiographic zones and key contaminant pathways present across the property.

The following physiographic plan shows the spatial distribution of the physiographic zones across all three farms according to the Environment Southland Proposed Water and Land Plan 2018 (PSWLP) as mapped by Beacon Mapping Service. The mapping system also details the key contaminant pathways present for each physiographic zone and any variants for the location (i.e.: the Gleyed zone has artificial drainage and Overland Flow pathways and the Oxidising zone has artificial and deep drainage pathways).

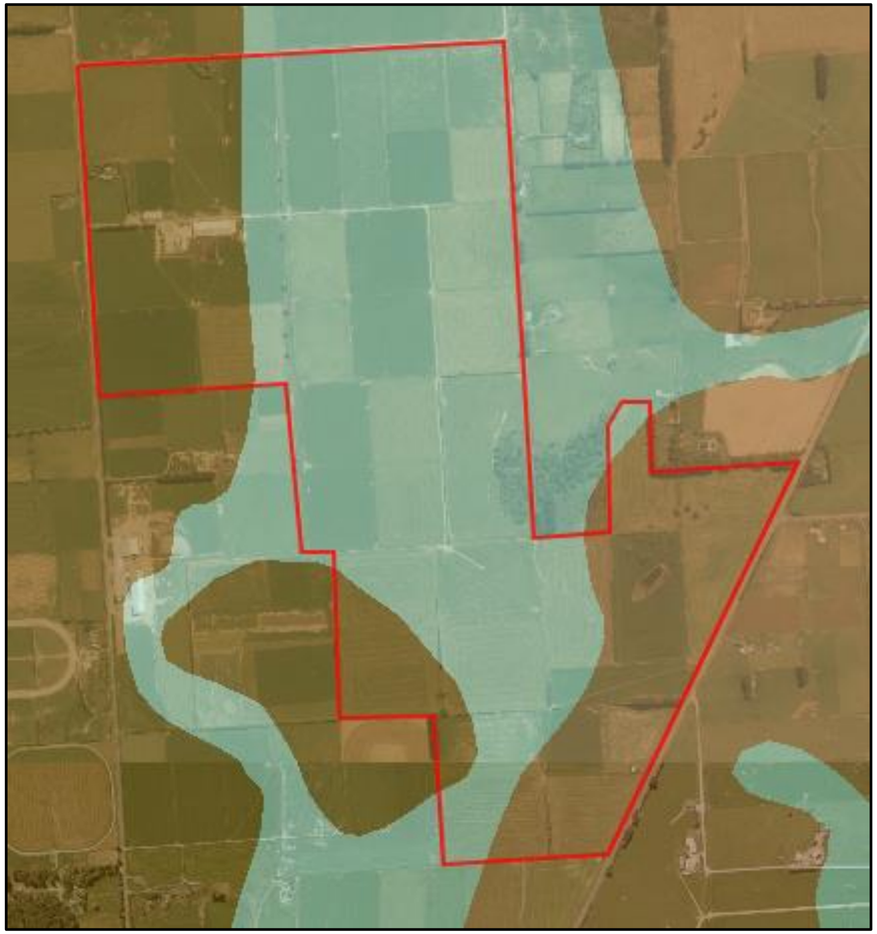

Figure 1: Physiographic Zones across Piobiare

D: SOIL MAPS

This section of the FEMP documents the soil types present across all three properties. The soil map below shows the spatial distribution of the soil types across the entire property according to the Environment Southland Beacon Mapping Service.

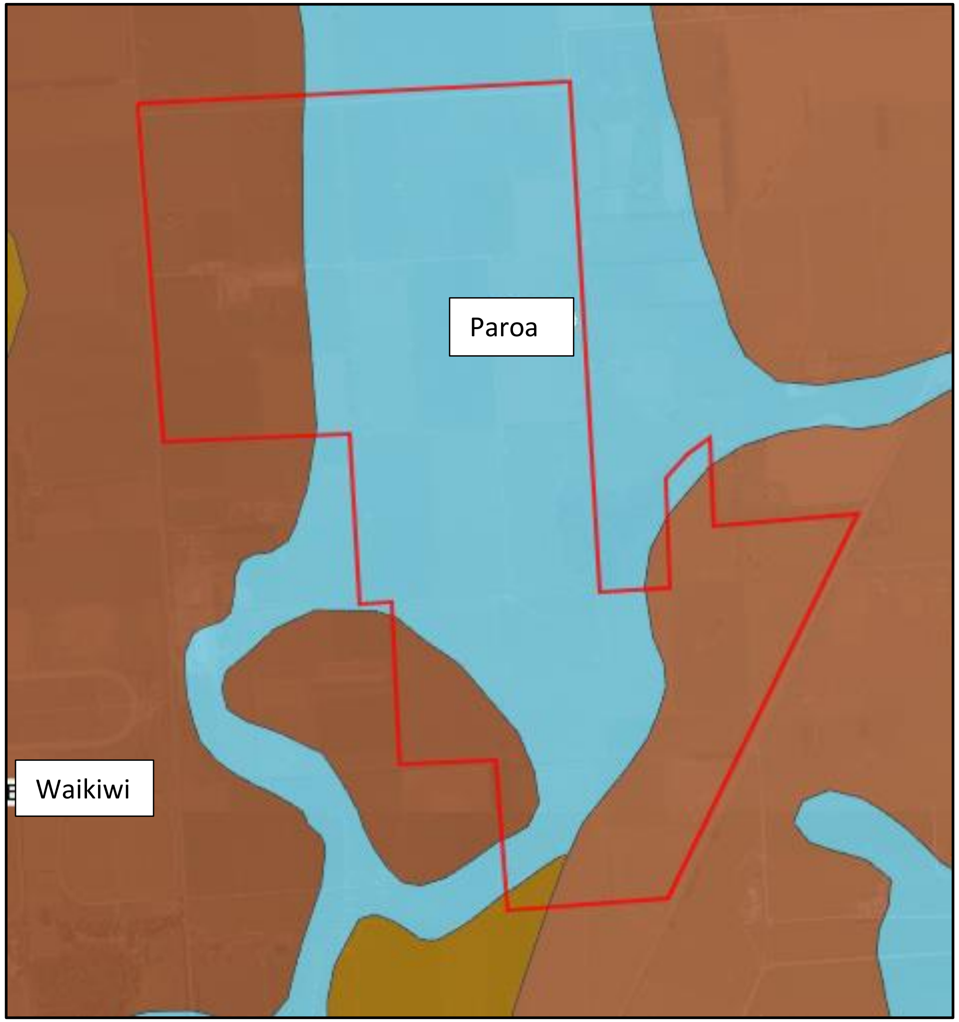

Figure 2: Soils across Piobiare (Source: Smaps)

E: GOOD MANAGEMENT PRACTICES – GENERAL

Mitigation	Good Management Practice	Review notes
Protect soil structure (will also help with P and N loss)	Use of wintering barn between 1 May and 30 September	
	Re-sow bare soils as soon as possible	
	Use of selective grazing to avoid grazing very wet paddocks and open the breaks up to avoid pugging and treading damage.	
Manage Critical Source Areas (CSA)	Avoid working CSAs and their margins	
	Leave grassed areas (or native vegetation) around CSAs especially when grazing winter forage crop and/or graze as "last bite". Grazing direction should be down the slope or towards CSA.	
	All riparian margins fenced and left to establish with grasses to enable filtration of contaminants that may be transported via overland flow processes.	
Additional P loss reduction	Reduce use of P fertiliser where Olsen P values are above agronomic optimum. Maintain Olsen P levels at optimum levels.	
	Reduce the risk of run-off to laneways and other sources by ensuring crossings are adequately maintained and maintain gradients of laneways to direct runoff to pasture.	
Reduce accumulation of N in the soil	Use nutrient budgeting to manage nutrient inputs and outputs	
	Time N fertilizer application to meet crop and pasture demand using split applications and avoid high risk times of the year, i.e. when soil temperature is low or during drought periods	

Mitigation	Good Management Practice	Review notes
Avoid preferential flow of FDE through soil profile and artificial drains	Defer effluent application when soil conditions are unsuitable especially when applying effluent to high risk paddocks	
	Apply effluent at low depths and utilize entire effluent discharge area	

F: RIPARIAN MANAGEMENT

Piobiare is located within the Tomopokorau Creek catchment and is located within the Lower Oreti Surface Water Management Zone.

All waterways are already fenced to exclude stock as required by the supplier. All riparian margins are left to establish with grasses and native vegetation in the first instance or as a minimum.

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.* Appendix A maps the waterways present on the property, any stock crossings and/or CSA's for riparian management. All crop paddocks will have at least a 5 m buffer hot wire fence from any waterbodies.

G: INTENSIVE WINTER GRAZING

Intensive winter grazing is defined in the PSWLP as the *"Grazing of stock between May and September (inclusive) on forage crops (including brassica, beet and root vegetable crops), excluding pasture and cereal crops.*

For the 2020 season, intensive winter grazing is proposed to occur on the home block, and crop areas (consisting of fodder beet) are shown in the attached Plan.

The applicant adopts the following good management practices for all intensive winter grazing activity.

Mitigation	Good Management Practice	Review notes
Protect soil structure and reduce N and P loss from intensive winter grazing activities	Grazing direction top of slope to bottom of slope. Use break or block feeding. The consent holder ensures a 'last bite' of 5-20m is left at the base of the slope, or alongside any waterways/other critical source areas. Some crop paddocks (to be grazed in 2020) identified in Appendix A have grass buffer zones of up to 30 metres, which is over and above good practice.	
	Back fencing to prevent stock from entering previously grazed areas.	

H: NUTRIENT MANAGEMENT

Nutrient management is a key component of ensuring good on-farm environmental practice. The farm utilises nutrient budgeting through their supplier (Ravensdown) with nutrient budgets modelled in 2019 as part of the farming consent application process.

To ensure the FEMP meets requirements under Appendix N of the PSWLP, the applicant will provide an updated nutrient budget in due course, which uses the latest version of the OVERSEER model in accordance with the OVERSEER Best Practice Data Input Standards. Any resulting nutrient budgets will be reviewed and updated as required especially if farm system changes are proposed, but not less than on an annual basis. Any budget reviews are guided by a fertiliser representative and nutrient management advisor. Nutrient Budgets will be stored in OVERSEER®FM and available upon request.

Regular soil tests will be undertaken to establish the nutrient status of the soils. Soils should be at nutrient levels which avoid any adverse effects on the environment but maintain good pasture production and animal health, by ensuring that the soils are suitable for optimal plant nutrient uptake.

Areas which are receiving FDE will be carefully managed to ensure nitrogen loadings are at acceptable levels and are compliant with conditions imposed by resource consents. The annual effluent nitrogen loading rate shall not exceed 150kg/N/ha. Effluent will be applied utilising low-rate application. Effluent management is discussed in Section I.

The table below describes the good management practices which will be adopted in relation to nutrient management.

Mitigation	Good Management Practice	Review notes
Minimise nutrient losses from farming activities to ground and surface water by utilising nutrient budgeting	Whole farm nutrient modelling using the latest OVERSEER budget (or equivalent model) prepared by a suitably qualified person	
	Whole farm nutrient budget reviewed annually and updated in accordance with significant farm system changes	
	Minimise N losses by using soil testing to guide fertiliser recommendations and match fertiliser application with plant and animal requirements.	

	Use of a fertiliser representative to advise on fertiliser type, timing and application rates. The Consent Holder uses representatives from Ravensdown.	
	Limit P application in winter	
	Crop rotations adjusted to maximise the use of residual N in the soil	
	Stock winter grazing practices adjusted to minimise nutrient losses	

The following table sets out the evidence which needs to be collected for nutrient budgeting purposes:

Record	Nature of information/person	Collated (Y or N)
Production	Fonterra App, dockets	
Soil test results	Lab results, fertiliser rep (ravensdown)	
Fertiliser application records	Fertilizer rep (ravensdown)	
Proof of placement	Farm Manager (irrigator run sheets)	
Effluent application records	Farm Manager	
Crop rotation records	Farm map with total hectares	
Stock numbers	Culling timeframes Young stock grazed on farm Breeding bulls (to be kept by farm owner)	
Record of supplements purchased	Invoices (to be kept by farm owner)	
Records of supplements made on farm	Invoices (to be kept by farm owner)	
Farm map/effective hectares	Farm Manager/Owner	

I: FARM DAIRY EFFLUENT – COLLECTED AGRICULTURAL EFFLUENT PLAN

This section 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. This section is also designed to meet the requirements of the Collected Agricultural Effluent Management Plan, in accordance with Condition X of Discharge Permit AUTH-2019XXXX-0X.

	Piobiare Limited
Total effluent discharge area:	94 ha
Effluent Collection	Wintering barn, silage pad
Available storage volume:	2,945 m^3 in the pond and 102.4 m^3 in the bunkers
Effluent application method:	Pods, slurry tanker and umbilical
Maximum application rate and depth of application:	• Umbilical: Maximum depth per application of 10 mm; • Slurry tanker: 5mm maximum depth per application; and • Low rate pods: Maximum application rate 10mm/hr and 12 mm depth per application (for pods applying FDE in Category A and D soil risk zones).
In the event of an emergency or effluent spillage	Contact Environment Southland immediately. 03 2115 115

Summary of the On-site Effluent Management System:

Agricultural effluent is collected from the dairy shed, new calving pad (to be constructed) and silage pad. Effluent is then gravity fed via into a sludge bed/weeping wall treatment system. Liquid effluent is gravity fed directly from the weeping wall into the effluent storage pond.

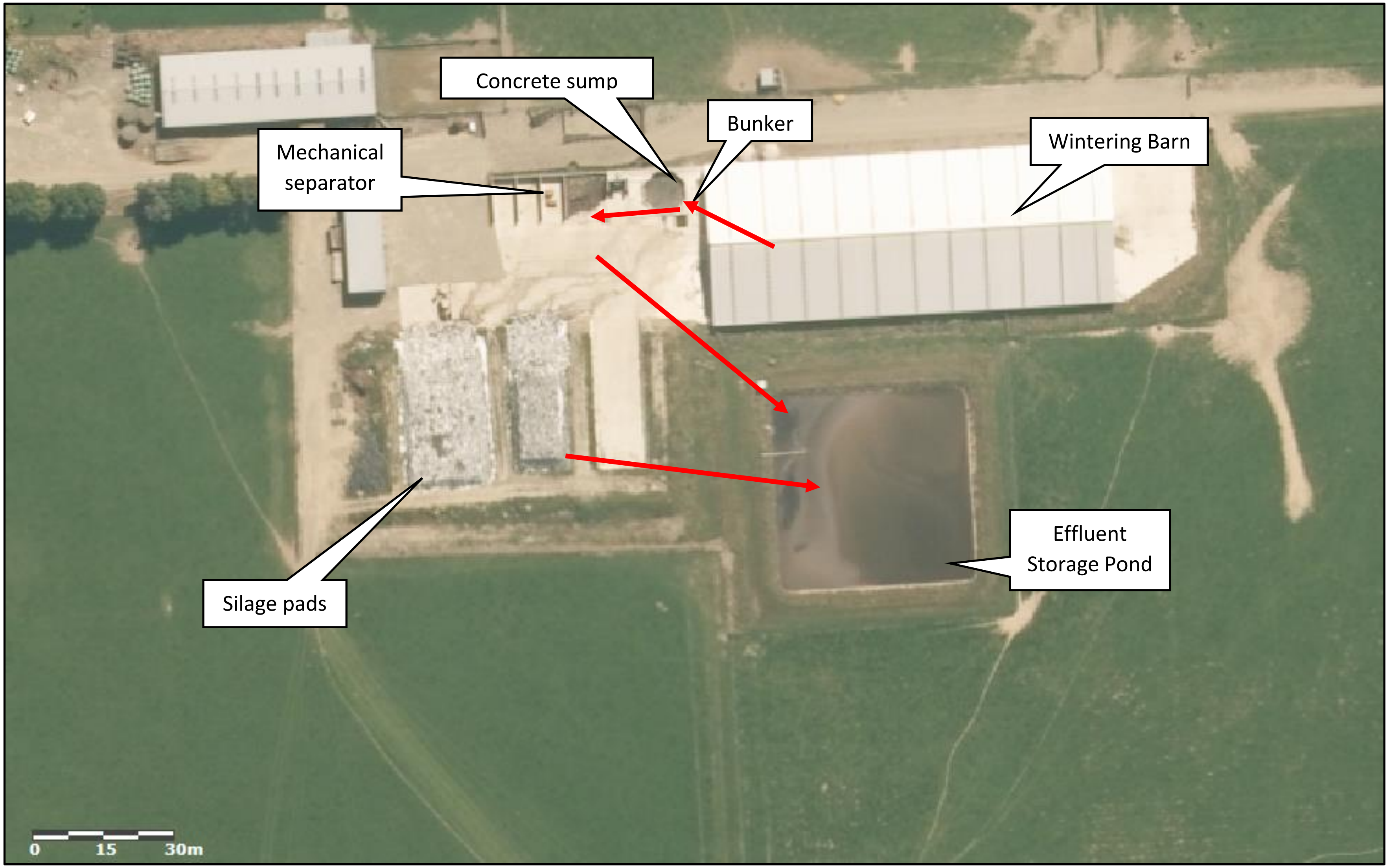

Figure 3: Overview of layout showing dairy shed and effluent treatment system at Piobiare Homestead (Source: ES Beacon).

Effluent is applied to land all year-round using low rate pods at a maximum application rate of 10mm/hr with a maximum combined application depth of 12 mm.

The current effluent storage pond and sludge beds meet the storage requirements for both solid and liquid effluent according to the Dairy Effluent Storage Calculator. Consent conditions require this storage volume to be provided on site at all times.

Farm Dairy Effluent Good Management Practices

The following table presents the good management practices which will be adopted on site to avoid or mitigate effects on the environment, specifically from the effluent discharge activity. These practices detail how effluent will be managed when soils are at or above field capacity.

Mitigation	Good Management Practice	Monitoring
Reduction in effluent generation	• Treat the herd gently to avoid increased effluent generated in the barn	N/A
Effluent applied only when soil conditions are appropriate	• Sufficient storage is provided so that when soils are at or above field capacity and/or during adverse weather conditions, effluent can be contained in the effluent storage pond until conditions are suitable for application; • Monitoring of soil moisture using Environment Southland GIS(Beacon) website; • Paddocks will be visually inspected before effluent application to check that soil water deficit exists; • Low rate application will be preferentially used during higher risk periods of the year • Slurry effluent applied to paddocks low in potash (K levels lower than 6-10) and with low Olsen P levels (P levels lower than 25).	N/A

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 1 plan attached to the discharge permit; • Low rate effluent discharge will avoid ponding and/or runoff; • Effluent will not be discharged onto any land areas that have been grazed within the previous 5 days; • Effluent discharge will be to the entire effluent discharge area; and • Wintering barn shall be used May to September and for appropriate effluent management during adverse weather conditions.	Record irrigation dates, times and areas in the Fonterra Dairy Diary
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; • Mapping of major tile drains, to be complete.	N/A
Efficient and effective collection, storage and delivery of effluent from 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; and • Failsafe systems will be kept in place and maintained in good working order, i.e. automatic alarm or shut off system (when utilising pods only).	Record all repairs and maintenance (invoices) 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 of 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; and • Observation of buffers to dwellings not located on the property (200 m) and property boundaries (20 m)	Complaints received by Environment Southland

Operating Procedures for the Effluent Structures

On a monthly basis, checks are undertaken of the components of the effluent management system for all three farms. The details of the monthly checks are recorded and filed for future reference. If there are any matters that require follow up work, then this is noted and should be followed up immediately. An example of the monthly check sheet is included below, and these are kept in the dairy shed. This check sheet is used in conjunction with the effluent orientation and training sheet attached in Appendix B.

Dairy Shed Effluent Monthly Check Sheet

<table>
<tr><th>Task</th><th>Month Done? (Y/N)</th><th>Any further action required?</th></tr>
<tr><td>Check mechanical separator clear of blockages. Check inlet pipe and bunker and concrete sump.</td><td><table><tr><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td><td>J</td><td>F</td><td>M</td><td>A</td><td>M</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td><td></td></tr>
<tr><td>Check all inlet and outlet pipes to storage pond to ensure they are free of debris to prevent blockages. Check height of pond and let manager know if pond is approaching capacity.</td><td><table><tr><td>J</td><td>J</td><td>A</td><td>S</td><td>O</td><td>N</td><td>D</td><td>J</td><td>F</td><td>M</td><td>A</td><td>M</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td><td></td></tr>
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Check effluent nozzles are clear and in good working order	J J A S O N D J F M A M	
Check effluent irrigator pipe is in good working order and does not have any leaks	J J A S O N D J F M A M	
Check well-head(s) remain capped and in good condition. Check stormwater diversion	J J A S O N D J F M A M	

J: OPERATIONAL MANAGEMENT PLAN

Procedure	Effluent Management	Any further action required?
Operational Procedures	• Wintering barn effluent enters the effluent system via to bunkers and mechanical separator, and then to the effluent storage pond; • Effluent is pumped direct to farm from the pond if weather and ground conditions allow; • If conditions are not suitable then effluent will remain in the pond; • Slurry tankers and/or umbilical systems will be used for spreading of the effluent from pond; • Details of the procedures for the maintenance, moving of the irrigators and pumping requirements are available at the farm office and detailed training will be provided to any staff required to do this including training and understanding of the requirements of the conditions of the discharge permit; • All application of effluent is to be recorded using a Dairy Diary or notebook; and • Effluent is only to be applied to the areas designated as effluent areas on the farm map as per the discharge permit Appendix 1 Plan.	
Emergency Procedures	• Contact Environment Southland immediately if the effluent pond has become significantly damaged; and • Begin contingency planning to store and discharge effluent in the interim, tidy up the site, and repair any infrastructure.	
Drop Test Procedures	• Drop tests will not be required.	
Monitoring Devices	• All pod irrigators have fail-safe devices attached and have low pressure shut off system. • The pond can be easily seen from the dairy shed and laneway. Ensure the grass embankments around the pond are 'weed free' so as to easily see the pond from the afar.	

K: COMPLIANCE AND REPORTING

This section sets out the records which are required to be kept that 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.

Record	Location of Records	Date of most recent version
Nutrient budget		
Fertiliser application records		
Soil sampling results		
Water meter certification		
Water abstraction records		
Effluent system training record		
Effluent system monthly maintenance checks		
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 Permit, 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 water take records as specified in the Water Permit to ES by 31 May each year

L: ANNUAL REVIEW AND AUDIT OF FEMP

This FEMP shall be reviewed on an annual basis as a minimum. 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(s) 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 listed above shall be submitted to the consent authority each year including an updated version of the FEMP if any amendments made
- Updated maps of winter crop paddocks and CSA's if applicable

M: 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

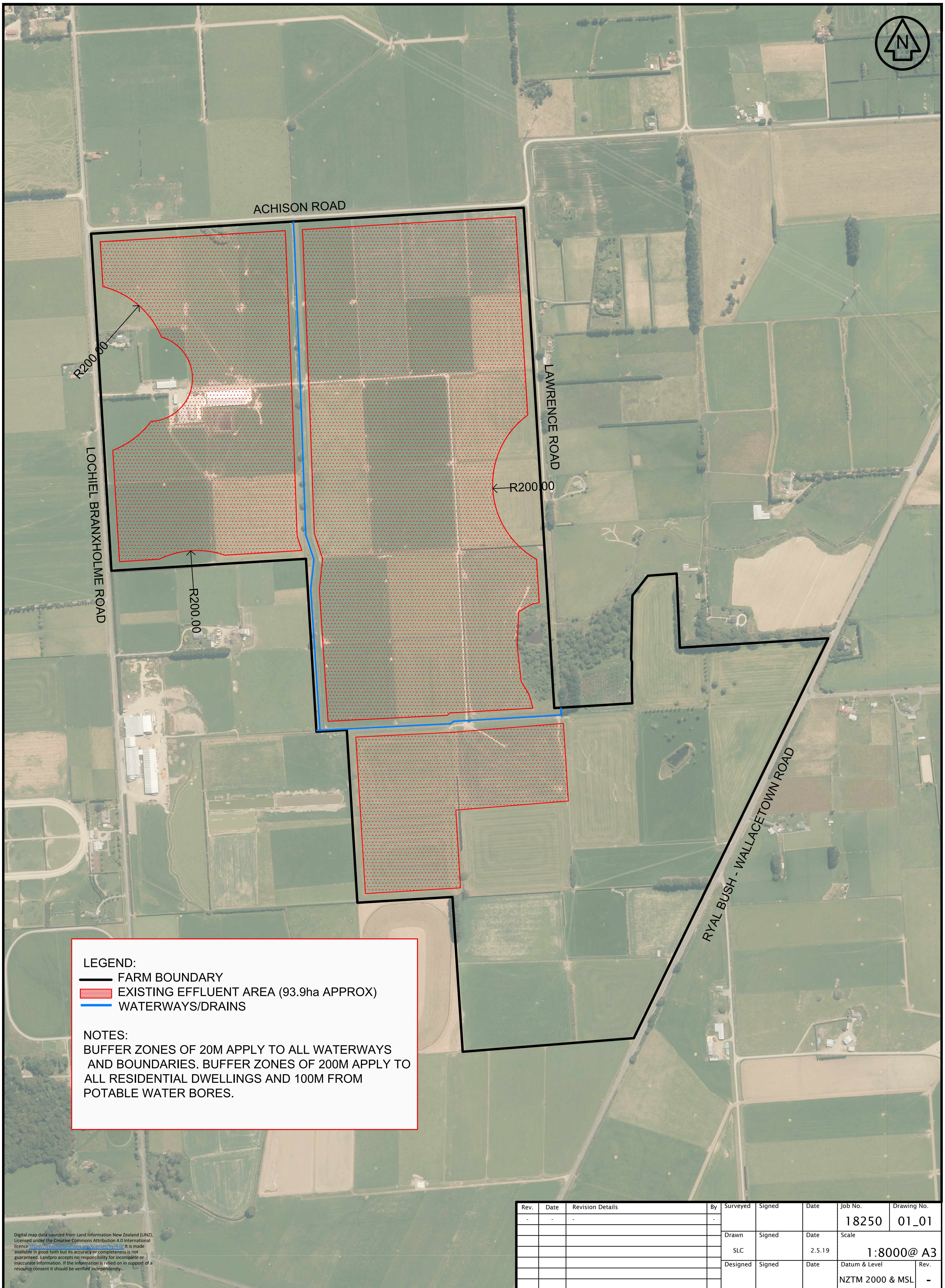
Dairy NZ – Land management on Canterbury Dairy Farms – Managing land to reduce sediment and phosphorous loss

Environment Southland Factsheet – Critical Source Areas

Environment Canterbury – Information Sheet for Farmers on OVERSEER®

Sustainable Dairying: Water Accord

Attachment A – Farm Plan Map



Rev.	Date	Revision Details	By
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			NZTM 2000 & MSL	-

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NOTES
- All dimensions shown are in metres unless otherwise shown
- Copyright on this drawing is reserved
- Check any electronic data against the hardcopy plan to ensure it is the latest version
-If this plan is being used as part of sale and purchase agreement then it is done so on the basis that it is preliminary only, final dimensions and areas may vary on final survey

PIOBIARE HOMESTEAD LTD
EFFLUENT DISPOSAL AREA

L:\18250 - Aerodrome Farm Ltd - Dairy Expansion\CAD\WINTERING BLOCK\18250_02_WINTERING BLOCK_EFF.dwg Plotted: 02.05.2019

Appendix B: Critical Source Areas Management

Hot spots

- Ensure silage stacks are at least 50 metres from waterways, with no discharge directly to ground water or within 20 metres of a waterbody.
- Recycle plastic waste from the farm.
- Ensure any offal holes or rubbish pits are at least 50 metres from a waterway and there is no seepage to groundwater.
- Septic tanks should be regularly emptied and well maintained.

Erosion control

- Plant trees on slopes where there is the greatest risk of erosion.
- Retain vegetation cover in gullies to reduce erosion and provide filtering of any runoff.
- Avoid cultivation of areas susceptible to erosion, like riparian margins and steep slopes.

Bank Slumping

- Plant appropriate plants in riparian margins that will help stabilise banks.
- Keep fencing well back from waterways so that bank erosion is reduced, and streams can naturally meander.

Paddock selection for wintering

- Identify winter grazing paddocks early.
- Ideally select paddocks further away from waterways.
- Look for areas at lower risk of pugging and compaction.
- Avoid steep slopes.
- Identify critical source areas and leave these in grass.
- Select paddocks where you can manage sediment loss.

Critical Source Areas

Critical source areas are low-lying parts of farms such as gullies and swales where runoff accumulates. Often these areas have been tiled in the past.

- Runoff from critical sources areas can carry sediment and nutrients to waterways.
- Where possible keep critical source areas uncultivated and ungrazed.
- By managing these areas we can greatly reduce the loss of sediment and nutrients from farms.

Winter intensive grazing

- Work out an access and grazing strategy before putting up fences, thinking about the location of stock water sources and using temporary water troughs if necessary.
- Put supplementary feed out before winter grazing starts.
- Strategically graze paddocks from the top to the bottom or towards the critical source area.
- Back fence stock to prevent them entering previously grazed areas.
- Keep the soil on the paddock.
- Retain a buffer zone along any riparian areas.
- Graze critical source areas last and only if conditions allow.
- Sediment loss can be reduced by up to 90% by adopting strategic grazing methods.

Good Management Practices

SOUTHLAND'S FARMER DRIVEN COMMUNITY CATCHMENT GROUPS

Good management practices are practices which help manage farm resources while minimising environmental risk.

There are many positive outcomes from adopting good management practices on farm, for example:

- Water quality will be maintained and/or improved.
- Complying with national and local regulations.
- Looking after your natural resources.
- Meeting comsumer expectations.
- Profitable farming due to improvements in soil management, pasture growth and quality, and animal health.

The sections included in this poster are recommended practices for reducing the potential for our actions to impact on water quality.

These good management practices can be tailored to each farm through a Farm Environment Management Plan.

Southland's farmer driven community Catchment Groups are great places to talk to other farmers about good management practices, and how you can work together to improve water quality in your catchment.

Resources:

Dairy NZ (2016) *Good Management Practices* (Report DNZ40-040) https://www.dairynz.co.nz/media/4106341/Good_management_practices_April_2016.pdf

Dairy NZ (2017) *Wintering on Crops in the South Island* (Report DNZ40-023, Version 2 – January 2017). https://www.dairynz.co.nz/media/5786508/wintering-on-crops-in-the-south-island.pdf

Beef + Lamb New Zealand – Environment home page https://beeflambnz.com/compliance/environment

Beef + Lamb New Zealand – All you need to know about good practice for winter grazing of crops https://beeflambnz.com/wintergrazing

Environment Southland – *Proposed Southland Water and Land Plan* (Decisions Version, 4 April 2018) www.es.govt.nz/document-library/plans-policies-and-strategies/regional-plans/proposed-southland-water-and-land-plan/Pages/default.aspx

Environment Southland – *Farmers' Rough Guide to Environment Southland's Rules* www.es.govt.nz/rough-guide

Environment Southland – *Good management practice* factsheets: www.es.govt.nz/gmp

The Deer Industry Environmental Management Code of Practice https://deernz.org/sites/dinz/files/Deer_EMCoP_Apr%202018_web_interactive.pdf

Project website: www.landcare.org.nz/SouthlandCatchmentGroups

Facebook page: www.facebook.com/Southlandcatchmentgroups

Stock Management

- Fence all stock out of waterways where possible.
- Feed supplements and locate water troughs away from waterways and critical source areas.
- Avoid pugging and soil compaction.
- Ensure deer wallows do not run into waterways.
- *Refer to Southland's Water & Land Plan Rule 70 'Stock exclusion from waterbodies' for different stock class exclusion dates.*

Effluent Management

- Make sure effluent is not applied directly to, or within 50 metres of a waterway.
- Use low rate effluent applicators, over a large area to capture the benefits of the nutrients.
- Ensure there is no ponding or runoff.
- Have sufficient effluent storage.
- Check the Southland Water & Land Plan to see if you need a consent.
- Check your pond does not leak by getting a drop test done.
- Avoid irrigating over tile drains.

Infrastructure

- Regularly used stock crossings over waterways should have either a culvert or bridge in place.
- Manage farm tracks, lanes, gateways, water troughs, self-feeding areas, stock camps, wallows and other sources of run-off to minimise risks to water quality.
- Maintain races and lanes so that effluent goes into a paddock and not a waterway, e.g., installing cut–outs on tracks, and installing sediment traps.
- Ensure all effluent run-off is collected from stock handling facilities.
- Ensure all crossings have a lip or bund on the edge so stock waste and mud cannot enter a waterway.

Fertiliser Application

- Only apply when conditions are suitable i.e. avoid times when soil temperature is too low.
- Don't apply when heavy rain is forecast.
- Have an OVERSEER nutrient budget prepared for the property.
- Keep a buffer around waterways.
- Avoid application to critical sources areas where practical.
- Only apply fertiliser that can be used by the crop or pasture (test soils to check nutrient status).
- Little and often is better than lots now and then.

Biodiversity

- Understand the values of your native area before you change anything. High Value Area surveys can be done at no cost to the landowner.
- Manage or retire wetlands, bogs and swampy areas.
- Protecting native bush can help preserve streams and improve water quality, e.g., QEII covenants.
- Funding is available from Environment Southland for protecting these areas through weed and animal pest control, and fencing.

Riparian Management

- Keep riparian margins wide enough to filter sediment from any run-off.
- Prioritise areas to protect through fencing and planting.
- Consult your local nursery or Environment Southland for advice on the best species to plant in your area.
- Plant trees for shade on north side of streams. This slows down plant growth in the waterway (stopping them becoming choked), but also has the benefit of reducing instream temperature for aquatic life.
- Long grass can be a very effective filter.

Appendix C: Effluent Management

Effluent Orientation and Training Record

Season___/___

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

Trainer signature			
Employee signature			
Date			

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

Irrigator run sheet

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

Date	Paddock	Run	Name	Comments

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

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

Smart Water Use in the Farm Dairy

Milk cooling

Use source water from Tank 1.

Aim for the recommended ratio of 2½ water: 1 milk

For example,

2.5 litres (water) x peak daily litres (milk) ÷ 1,000 = m^3/day water use

To measure milk cooling efficiency
Measure exit flow into a 200 litre drum during milking.
Flow rate in litres/min x total daily milking time (clock this) ÷ 1,000 = m^3/day water use

Alternatively, install a meter on the line delivering water to the plate cooler

Efficiency options

Things to consider if improved cooling efficiency is warranted:

- use of correct flow rates
- optimal plate spacing to increase flow
- pre-cool water source
- ice banks/heat exchangers (can be costly).

Return milk cooling water to Tank 2 for use in yard wash down.

Ensure adequate storage space remains to take all milk cooling water (use float ball or probes).

Capture roof water for reuse or at least exclude it from the yard to prevent increasing effluent volumes.

Yard wash down

To measure yard wash down water use
Follow the steps and calculations in the accompanying *Worksheet* to estimate water use.

Efficiency options

For manual yard washing, here are some ways to improve water-use efficiency.

- Pre-wet the yard on warm, sunny days with a yard hose or sprinkler.
- Use a scraper or a chain (inside an old yard hose) on the backing gate to break up dung before hosing.
- Wash the yard after each milking.
- Work actively and close to the effluent.
- Hose the yard with high water volume under low pressure.
- Include a timer setting on the yard wash down pump (set a time standard for wash down and train staff to achieve it).
- Consider capturing excess cooler water (that would otherwise go to waste) in tipper drums for yard wash.
- Flood wash with water recycled from the effluent pond (refer to conditions of use from your milk processor).

Plant/vat wash

Use water from Tank 1.

To track plant/vat water use
Wash tubs and hot water cylinders use set amounts of water. Refer to washing routine instructions supplied by the detergent companies.

Efficiency options

Here are some steps you can take to reduce plant/vat wash water use:

- Seek advice from your detergent rep on litres required for hot/cold wash options.
- Refill tanks/cylinder with automatic shut-off (to avoid overflows). Use a toilet cistern and trough floats as proven refill/shut-off options.
- Consider heat exchange or pre-heating to improve energy efficiency.

Milking routines

Procedures and practices during milking affect water-use efficiency. Below are some ways to cut water use.

- Pre wet bail and yard.
- Minimise sprinkler/spray washing.
- Hose little and often (as required) in pit area.
- Put cups on dry, clean udders (see DairyNZ's SmartSAMM – www.smartsamm.co.nz).
- Implement a calm, consistent routine to reduce stress in animals and, in turn, effluent in the dairy (see DairyNZ's Milksmart – www.milksmart.co.nz).
- Maintain the dairy (paint/surfaces) to minimise the need for continual wetting.
- For rotaries, use air jet or other methods instead of water to back cows off.

Efficiency options

Here are a few more tips for efficient water use and to reduce water loss.

- Ensure high standard of water quality (if treatment is required).
- Do regular checks for pump pressure, line restrictions and possible leaks.
- Reduce the number of hand-held hoses in use throughout the dairy.

As a measure of efficiency, yard wash water use should not exceed milk cooling water.

Attachment H: Signed Lessors Approval

environment SOUTHLAND

Cnr North Road and Price Street
(Private Bag 90116)
Invercargill

Telephone (03) 211 5115
Fax No. (03) 211 5252
Southland Freephone No. 0800 76 88 45

To: Environment Southland
Private Bag 90116
Invercargill 9840

WRITTEN APPROVAL FORM

Affected person's written approval to an activity that is the subject of a resource consent application

To be completed by the person requesting approval

Applicant: Nelson Pyper on behalf of Piobiare Homestead Limited

Application Number: ____________ Officer in Charge: ____________

Type of Resource Consent: Land Use Consent

Proposed Activity(ies): To undertake farming activity including, winter grazing and young stock grazing

Location: 939 Lochiel Branxholme Road, Lochiel

To be completed by the person giving approval:

Name: A C & LJ Roxburgh

and/or Organisation: ____________

Street/Road Address: 256 ROYAL BUSH - WALLACETOWN ROAD, SOUTHLAND.

*I am the owner/~~occupier~~ of the following property and have authority to sign on behalf of all other owners/~~occupiers~~ of the property: ____________ *Delete if not applicable

I/~~we~~ have studied the application for resource consent and give my/~~our~~ written approval to the proposed activity/activities.

In signing this written approval, I/~~we~~ understand that the consent authority must decide that I/~~we am~~/are no longer an affected person(s), and the consent authority must not have regard to any adverse effects on me/~~us~~.

[signature] 16/5/2019 ____________ __/__/__
(Signature) (Date) (Signature) (Date)

Notes: If you do not understand this form and/or any details regarding the application for resource consent, then you should not provide your written approval.

Guidelines for Affected Parties

Why has your written approval been requested?

If you have been asked to sign this form, it will be because someone is proposing an activity that requires a resource consent and you have been identified as an affected party. You may have been deemed an affected party simply because you are a neighbour.

What should you do?

1. Study the application for resource consent for the proposed activities. This should help you understand any potential effects.

2. If you are happy with the proposal and wish to give your approval, you may do so by signing the written approval form.

Any questions regarding the proposed activity(ies) should be addressed to the applicant in the first instance. Discussing the proposal may assist with resolving any issues of concern. If you continue to be concerned with the proposal, you do not have to sign the form, however it is important that you let Environment Southland and the applicant know you will not be giving your approval and why.

If the application is notified, your written approval does not constitute a submission as required under Section 96 of the Resource Management Act 1991.

Note:

- By signing the written approval form you still retain the right to contact Environment Southland or lodge a complaint if you become concerned that the applicant is not complying with the requirements of their resource consent.
- This approval may be withdrawn in writing up to the time that the application is considered and determined.

For further assistance contact Environment Southland's Consents Team on **03 211 5115 or 0800 76 88 45**

Rev.	Date	Revision Details	By
-	-	-	-

Surveyed	Signed	Date	Job No.	Drawing No.
			18250	01_01
Drawn	Signed	Date	Scale	
SLC		2.5.19	1:8000@ A3	
Designed	Signed	Date	Datum & Level	Rev.
			NZTM 2000 & MSL	-

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Client
PIOBIARE HOMESTEAD LTD

NOTES
- All dimensions shown are in metres unless otherwise shown.
- Copyright on this drawing is reserved.
- Check any electronic data against the Landpro plan to ensure it is the latest version.
- If this plan is being used as part of sale and purchase agreement then it is done so on the basis that it is preliminary only. Final dimensions and areas may vary subject to survey.

PIOBIARE HOMESTEAD LTD
EFFLUENT DISPOSAL AREA

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