Overseer Modelling Report

For: Environment Southland

Schrader Main Ltd

Prepared by: Nicole Phillips

Date: April 2017

Peer Reviewed by: Keri Johnston

Introduction

1. My name is Nicole Irene Phillips and I am an Environmental Consultant with Irricon Resource Solutions Limited. I hold a BSc from Lincoln University. I have been an Environmental Consultant for seven years providing nutrient budget, Farm Environment Plans and other consultancy services to clients predominantly throughout Canterbury and Otago.

2. I hold the Advanced Sustainable Nutrient Management qualification and am a Certified Nutrient Management Advisor. I am also a member of the OVERSEER Working Group (OWG); a group of professionals discussing issues arising when using OVERSEER in regional council planning frameworks. The OWG has members from regional councils throughout the country along with representatives from fertiliser companies, OVERSEER Management Services Ltd and industry groups.

3. This report has been peer reviewed by Keri Joy Johnston, also of Irricon Resource Solutions Limited. Ms. Johnston is a Natural Resources Engineer with 15 years' experience in water quantity and water quality management. She is a Professional Member of IPENZ and a Chartered Professional Engineer.

4. The specifics of the review of the Schrader Mains Ltd consent application have been provided in the Short Form Agreement. I have included this in Appendix One. This report will endeavor to answer the questions posed in the Short Form Agreement.

OVERSEER files

5. XML OVERSEER ® Nutrient Budget (OVERSEER) files have been provided by Environment Southland. The OVERSEER files that have been audited are:

a. Schrader Current farm – v6.2.3
b. Schrader Conversion proposal – v6.2.3 – FINAL
c. Schrader – Specialist Grazing – v6.2.3

6. These files were provided via email from Danielle Petricevich, Consents Officer on the 28 March 2017.

7. Ms. Hunters report "Schrader Specialist Grazier Proposal" dated 17 November 2016 (pages 100-105 of application document) explains the *existing operation (2015/2016 season) and a specialist grazing operation (status quo).* It is assumed from this statement that the specialist grazing operation is the current land use for the 2016/2017 year. The current farm model as described above is assumed to be for the 2015/2016 year.

OVERSEER AUDIT

Appropriateness of the OVERSEER inputs

8. The three XML files stated in paragraph 5 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).

9. Attachment B of the Conversion Environmental Management Plan includes a brief report by Ms. Miranda Hunter who completed the OVERSEER Nutrient Budget modelling for this property.

10. The report of Ms. Hunter dated 5th December 2016 notes on page 1 that the OVERSEER Best Practice Data Input Standards, November 2016 have been used to prepare the nutrient budgets and that no deviation from the protocols were made during the modelling assumptions.

11. I concur that no deviation from the protocols has occurred.

OVERSEER Inputs

12. A summary of the soil information used in the modelling is as follows:
    - The soil information used has been obtained from SMAP. Soil moisture values have been used in the modelling which is the most accurate soil information available.
    - The soil information is the same in both scenarios.
    - The soil information and characteristics modelled are consistent with the soil reports generated from SMAP.
    - Reviewing SMAP maps shows that the correct soils have been used in the OVERSEER modelling.

13. Climate information has been obtained using longitude and latitude and the NIWA climate station data tool. This is the most appropriate way to determine climate data and fits with the protocol.

14. Animal distribution has been modelled as there being no difference between blocks in the current and proposed scenario. Although there is a higher rate of N inputs on the effluent block, the difference in pasture productivity this would provide is unknown. Therefore I agree with the approach of not differentiating between the blocks.

15. All other inputs have been reviewed and comments are provided further in this report where there are areas of concern. All other inputs are consistent between the scenarios.

OVERSEER Outputs

16. OVERSEER outputs for all three models are as follows:

OVERSEER v6.2.3	Current	Conversion Scenario	Specialist Grazing Scenario
N lost to water kg/ha/yr	40	25	45
Total N lost kg/farm	4,388	2,803	5,023
P lost kg/ha/yr	0.4	0.7	0.5
Total P lost kg/farm	47	78	52

17. Based on my experience as well as reviewing the NZ Dairy statistics for the 2013/2014 season, the stocking rate and milk solid production in the proposed scenario are considered to be reasonable for the location and climate.

18. It must be assumed that the information provided in the application that the current farming system as modelled is a viable farming system, using actual stock and fertiliser inputs. Therefore the current scenario is also assumed to be appropriate for the location and climate.

19. The robustness of the OVERSEER nutrient loss to water estimates must be determined by reviewing both the inputs and outputs. Appendix Four of the *Canterbury Farm Environment Plan (FEP) Certified Auditor Manual* outlines an assessment of Nutrient Budget robustness.

20. A 'sensibility test' has been undertaken on the Schrader Main Ltd nutrient budgets with the following five output screens from OVERSEER forming the basis of the determination of the robustness of the nutrient budget:
    I. Is the nutrient loss consistent with what you would expect for an operation of this type and soils in this location?
    II. Does the summary of inputs and outputs make sense? Especially clover fixation and change in block pools?
    III. Check the 'Other values' block reports for rainfall, drainage, field capacity and PAW
    IV. Select the Scenario reports other values and check the production and stocking rate
    V. Select the pasture production in the scenario report and check pasture growth and utilization. Is it consistent with what you would expect for a farm of this type in this location?

21. Answers to each of these five questions will be provided further in this report and then a final determination of the robustness of the nutrient lost to water will be provided at the conclusion of this report.

Rain/clover N Fixation

22. There is a reasonable difference in the level of clover N fixation estimated between the current and proposed scenarios. The specialist grazing scenario has not been included in the following comments.

23. The proposed scenario shows an average whole farm biological fixation of 112kg N/ha/yr, whilst the current scenario shows a value of 70kg. This is shown in Figures One and Two below.

Figure One: Current Scenario

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	144	14	11	6	12	0	0
Rain/clover N fixation	**72**	**0**	**3**	**6**	**4**	**8**	**44**
Rainfall	2	0	3	6	4	8	44
Biological fixation	70	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements	7	1	9	1	2	1	1

Figure Two: Proposed Scenario

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	130	18	0	21	43	0	0
Rain/clover N fixation	**114**	**0**	**3**	**6**	**4**	**8**	**44**
Rainfall	2	0	3	6	4	8	44
Biological fixation	112	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0	0
Supplements	33	6	41	5	10	3	3

24. Pasture species and clover levels have the same inputs in both OVERSEER models, indicting no change in pasture species or composition e.g. no increase in clover content.

25. The OVERSEER Technical Manual – Characteristics of Pasture, April 2015 indicates that biological N fixation is based on total pasture production and includes the fertiliser induced reduction in N fixation.

26. The pasture production and average fertiliser inputs on pasture are very similar between the two scenarios.

Pasture production

27. The pasture production estimates for the files I have reviewed are:
    - Current – 14.9T DM/ha/yr
    - Proposed – 15.0T DM/ha/yr
    - Specialist Grazing scenario – 14.9T

28. The average Nitrogen fertiliser application rates are very similar across all the scenarios with between 155-160kg N being applied to pasture blocks.

29. "Long Term pasture growth patterns for Southland New Zealand: 1978-2012" by L. C Smith concluded that long term pasture production with newer ryegrass based pasture at Woodlands was 12.7t DM/ha/year. It has been assumed that the pasture type in both the current and proposed scenarios is newer ryegrass based pasture.

30. If we assume, based on research, that for every 1kg of N fertiliser applied, the average pasture response is 12kg DM (Shepherd & Lucci 2011), then 159kg N applied to the pasture blocks in the current scenario would produce an additional 1.9T DM above natural growth (12.7t). The pasture production for the current scenario can be crudely calculated as 14.6T DM/ha/yr, which is a close fit for the Overseer estimated pasture production for the current scenario at 14.9t.

31. The proposed scenario has similar results indicating that the level of N inputs are sufficient to grown the pasture estimated to be required.

Change in block pools

32. The P inputs are less than maintenance requirements for both the current and proposed scenario indicating that the Olsen P level will continue to reduce over time.

33. It is difficult to determine without a history of soil test information if the Olsen P levels have been maintained over the years, or have seen a decline from far higher Olsen P levels in the past.

34. The lower than maintenance fertiliser use could indicate either; a desire by the applicant to reduce Olsen P levels over time or underestimation of the current P fertiliser inputs.

35. This is further emphasized in the inorganic soil pool values which show a negative value for P in the nutrient budget reports for all pastoral blocks, both current and proposed. The comments section of the block reports indicates a reduction in Olsen P values for all blocks.

36. The current scenario sees a decrease of 7 units in the Olsen P test on the Woodlands soil due to only 6kg P being applied in fertiliser and compared to a maintenance requirement of 37kg P. The Dacre soils are similar with 6kg P being applied and a maintenance requirement of 37kg P.

37. The proposed scenario sees a higher P input on farm with 20kg P from fertiliser being applied to the non-effluent blocks and a 1 or 2 unit decrease in the Olsen P test.

38. If P fertiliser was matched to maintenance requirements in the current scenario then the P loss could be higher than has been modelled. This is the same for the proposed scenario.

39. This creates some uncertainty over the P loss estimates in both the current and proposed scenarios, as an increase in P fertiliser inputs to match maintenance requirements will increase the P lost to water estimates.

40. The percentage increase in P loss with a potential increase in P fertiliser inputs is unknown unless further modelling is undertaken.

Effluent

41. The effluent area in OVERSEER has been modelled as 26ha on Woodlands soils. The application states that up to 93ha land may be used to apply effluent.

42. Using the minimum area that will be used to discharge effluent on farm within OVERSEER is common practice as it indicates a 'worst case' scenario.

43. Spreading the effluent over a larger area when appropriate will help to reduce the N loading from fertiliser.

44. Solid effluent has been modelled as not being separated, which is consistent with the system design described in the application.

45. Effluent application – low application method has been modeled in the proposed scenario. This assumes a low rate of effluent application is always occurring when effluent is applied.

46. The application on page 32 indicates that the proposed effluent application method can achieve depths of application as shallow as 2mm-10mm. The application states that during the wetter parts of the season the effluent system can be pulsed to apply effluent at a rate of 2mm/hr which will avoid over application and the potential for discharge via overland flow or artificial drainage.

47. The application indicates on page 16 that the effluent system will run for around 10 hours per day with a maximum application depth of 20mm, based on applying 2mm depth per hour.

48. OVERSEER requires an application depth to be used when modelling liquid effluent application, rather than an application rate.

49. Although this system uses a low application method to apply the effluent the application depth could be up to 20mm/day based on the information contained within the application.

50. By changing the liquid effluent application to an application depth of between 12-24mm would more closely align with the application. This would likely only have a small impact on the N loss across the whole farm.

Additional comments on the OVERSEER Modelling

51. No feed pad has been modelled in OVERSEER, yet the application indicates a concrete feed pad will be utilized in the shoulders of the season.

52. It is not clear from the application why the feed pad has not been modelled in OVERSEER. I have assumed that the reasoning for this is that the application states that the feed pad will only be used in wet periods and not necessarily for a specified time each day. If my reasoning is correct, then I agree with this approach.

53. It is noted that if the feed pad is to be used extensively and the effluent dealt with in the same manner as the dairy shed effluent, then the N applied from effluent may exceed the 150kg limit proposed in the consent conditions on the 26ha minimum effluent area modelled within OVERSEER. Careful management of the effluent discharge area will be required.

N Loss outputs

54. N loss to water within the OVERSEER model is apportioned to several different inputs based on the farm system. These inputs are outlined below:
    - Leaching – urine patches
    - Leaching – other
    - Runoff
    - Direct (animals and drains)
    - Direct pond discharge
    - Borderdyke outwash
    - Septic tank outflow

55. For the proposed scenario, the largest proportion of the N loss is attributed to Leaching – other (includes fertiliser and effluent) and Direct (animals, drains) due to the mole/tile drains. Figure Three below shows the breakdown of the N losses to water.

56. Leaching other and Direct losses account for 56% of the total losses and leaching from urine patches for the remaining N losses.

57. Any increase in N inputs from sources other than stock could have an impact on the total farm losses.

Figure Three: Proposed scenario Nutrient Loss summary

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	130	18	0	21	43	0	0
Rain/clover N fixation	114	0	3	6	4	8	44
Irrigation	0	0	0	0	0	0	0
Supplements	33	6	41	5	10	3	3
Nutrients removed							
As products	76	13	18	4	16	2	5
Exported effluent	0	0	0	0	0	0	0
As supplements and crop residues	0	0	0	0	0	0	0
To atmosphere	95	0	0	0	0	0	0
To water	**25**	**0.7**	**11**	**36**	**42**	**12**	**30**
Leaching - urine patches	11	0.0	4	0	9	0	0
Leaching - other	6	0.4	3	31	19	8	21
Runoff	0	0.2	0	0	0	0	0
Direct (animals, drains)	8	0.1	3	5	14	4	9
Direct pond discharge	0	0.0	0	0	0	0	0
Border dyke outwash	0	0.0	0	0	0	0	0
Septic tank outflow	0	0.0	0	0	0	0	0

CONCLUDING COMMENTS

Determination of the robustness of the nutrient loss to water estimates

58. The questions below were described at Paragraph 19 of this report. Whilst these have been answered throughput this report, this section summarises 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?

59. Based on my experience, the N loss estimates are reasonably consistent with an operation of this scale.

Does the summary of inputs and outputs make sense? Especially clover fixation and change in block pools?

60. Detailed information has been provided on clover fixation and the change in block soil pools earlier in this report.

61. The soil block pools show a decrease in P, indicating a reduction in the Olsen P value will occur over time as less than maintenance fertiliser requirements are modelled as applied.

62. Clover/biological fixation is different between the files. Biological N fixation is based on total pasture production and includes the fertiliser induced reduction in N fixation.

63. The proposed scenario has a similar level of N fertiliser applied and pasture production but a higher biological fixation.

64. The pasture production is very likely to be achieved with the proposed N fertiliser inputs.

Check the 'Other values' block reports for rainfall, drainage, and PAW

65. The rainfall and soil information have been entered based on BPDIS for the location and soil type selected.

66. These two values contribute to the drainage calculations determined by OVERSEER.

Select the Scenario reports other values and check the production data and stocking rate

67. Based on my experience as well as reviewing NZ Dairy statistics for the 2013/2014 season the stocking rate and milk solid production are appropriate for the location and climate.

Select the pasture production in the scenario report and check pasture growth.

68. The pasture production across the three farm systems modelled is very similar. Nitrogen fertiliser use is also very similar. I am confident that the pasture production in the proposed scenario can be achieved.

69. I have assumed an adequate level of robustness around the current model as it is based on an actual farming system, and with that, I have assumed actual stock and fertiliser inputs have been used.

70. The BPDIS have been followed for both of the scenarios with no deviations. This leads to a high level of robustness for the relevant input data for example, climate, soils, and pasture type.

71. 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,** whilst the robustness of the nutrient loss estimates for the current scenario is **medium-high**.

72. The primary reasons for the **medium** robustness grading for the proposed scenario are:
    - a difference in the biological N fixation between the scenarios
    - The N loss from "leaching other" and "direct from drains" (due to the mole/tile drains) accounts for 56% of the total N lost to water estimate, so any increase in N inputs could have a significant impact on the N lost to water.

- Less than maintenance P requirements have been used in both the current and proposed scenarios.

Viable farming systems

73. It has been assumed that the current scenario represents an actual farming system and actual inputs have been used to generate the nutrient budget. It is therefore considered to represent a viable long-term farming system.

74. Although the above issues have been identified and a **medium** robustness rating has been given to the outputs for the proposed scenario, I am confident that overall the modelled N outputs from the proposed scenario will be less than the current farming system, primarily due to the removal of stock off farm in the June and July period and the significant reduction in fodder crop grown on farm and do represent a viable long term farming system, with mitigation measures in place.

Mitigation Measures

75. The scope of works contained within the short form agreement has the following requirement:

a. *To audit the mitigation measures to ensure the appropriateness and adequacy of mitigation measures in reducing contaminant losses and to ensure that the mitigation measures represent realistic, viable long-term mitigation measures for this proposal.*

76. It is almost impossible to quantify the appropriateness and adequacy of the mitigation measures in reducing contaminant losses. Comment will be made on whether the mitigation measures are appropriate for the location and are likely to have an impact on reducing contaminant losses.

77. It will be important for Environment Southland to be aware of the GMP's and additional mitigation measures that are being implemented on farm.

78. There are several mitigation measures and good management practices (GMP) described throughout the consent application and associated Appendices.

79. The GMP's; although they work as mitigation measures to reduce contaminant losses these have been looked at as the required practices on farm and mitigation measures that go beyond GMP have been more closely addressed in this section.

80. The "Industry-agreed Good Management Practices relating to water Quality" April 2015, Canterbury Matrix of Good Management (MGM) Project has been referred to in providing comments on the mitigation practices included in the application.

81. The MGM Project was a collaboration between several Primary Industry partners and Environment Canterbury to define what GMP looks like on

farm in relation to water quality. Prior to this project there were no commonly agreed definitions of GMP.

82. Although the MGM Project was designed for Canterbury, the GMP's outlined in the report are applicable to most areas within New Zealand.

83. Although these GMP's are seen as minimum on farm practices, they provide a useful reference point in providing comments on the measures included in the application.

84. Table 9 of the application sets out a Summary of proposed mitigation measures. The mitigation measures are summarized into the method and purpose. This table is included in Appendix Two.

85. The table below details the mitigation measure and then a comment is provided as to the appropriateness and adequacy of the mitigation measure.

Mitigation Measure from Table 9 of the consent application	Comments
Stocking rate	A proposed overall stocking rate that is within the South Island average. All stock removed from farm in June and July and a reduction in fodder crop area from 20ha to 2ha. The removal of stock in June and July and a reduction in fodder crop area are a key driver of the decrease in N loss. Appropriate and adequate as a mitigation measure. Changing economic drivers e.g. milk price can change the viability of this mitigation measure.
Effluent storage	Will ensure deferred application can occur. Appropriate and adequate long term mitigation measure for this climate and soil types.
Irrigation system	Low application rate system proposed. Appropriate and adequate long term mitigation measure for this climate and soil types.
Buffer zones	Buffer zones between waterways and effluent discharge areas meet pSWLP requirements and are therefore defined as an appropriate and adequate long term mitigation measure for this application.
Riparian buffers and planting	The application details the riparian planting that is already in place and confirms that no additional planting is proposed at this point. Please see comments in paragraph 89 below. Separation distances to waterways from grazing areas are approximately 2-3m Pasture buffer strips will be maintained between crop areas and waterways and swales.

	Proposed Southland Water and Land Plan (pSWLP) Rule 25 has a setback of 3m from a waterbody for cultivation on sloping ground. Long term mitigation measure.
Stock Exclusion from Streams	All stock are excluded from waterways. Appropriate and adequate long term mitigation measure
Nutrient Management Plan	The management of amount and timing of fertiliser inputs and FDE is very important to minimize the risk of losses. Appropriate and adequate long term mitigation measure
Wintering of stock	All stock are proposed to be removed off farm in June and July and a reduction in fodder crop area from 20ha to 2ha. Please see comment in Paragraph 85 below. pSWLP has a permitted activity limit of 50ha within a single land holding within this physiographic zone.
Tile Drains	Careful management of the tile drains and associated areas will be an important part of minimizing the risk of N leaching.

86. One of the most important mitigation measures is the removal of all stock off farm during June and July and a maximum of 2ha of crop to be planted for grazing in August and September. The removal of stock off farm in June and July is a significant driver in the reduction of N loss under the proposed scenario. The losses from the 20ha of winter grazed kale in the current modelling equates to almost half of the total farm N loss from the property and 20% of the P loss from the property.

87. If this mitigation measure was to alter in any way (e.g. a change back to wintering stock on farm due to economic drivers) then this would impact on the N and P loss from the proposed scenario.

88. A concrete standoff/feed pad is proposed to be used in wet periods on the farm, primarily in the shoulders of the season to keep stock off paddocks. This will help to reduce instances of soil damage but will also help to reduce the potential of contaminants entering waterways, via overland flow or artificial drainage. A feed pad is an adequate long term mitigation measure that is very appropriate for this climate and soil types.

89. Pages 52 and 53 of the application provides an assessment against the Proposed Southland Water and Land Plan. This section also includes mention of several mitigation measures that go beyond GMP that will be investigated for use by the applicant.

90. These include: tile drain amendments and edge of field mitigations (including sediment traps and the development of constructed wetlands).

91. No detail can be found in the application on the criteria for when these mitigation measures may be investigated by the applicant or at what point these additional mitigation measures would be implemented.

92. E.4 Riparian Planting section of the FEP indicates that no additional riparian planting can be undertaken on the property. The section details that the margins of McMillian Creek on the western side have been planted but the eastern bank has not due to regular cleaning carried out by Environment Southland.

93. Having not visited the property it is not acceptable to comment on whether additional planning could occur.

94. The inclusion of water quality monitoring as part of the Farm Environment Plan (FEP) is a good measure to help quantify if the GMP and mitigation measures implemented on farm are achieving the purpose of reducing contaminant loss.

95. The inclusion of an audit and annual review section in the FEP is important in verifying if the GMP and mitigation measures are in place on farm and therefore allowing some context to be placed on the water quality sampling results.

96. The removal of stock off farm in June and July and the reduction in fodder crop area, along with timing of fertiliser and FDE inputs are a quantifiable mitigation measure. This means that these practices can be modelled in OVERSEER and the difference in N loss from the changing farm practices can be calculated.

97. OVERSEER is models nutrient losses below the root zone and not what enters the receiving environment and therefore cannot be used to quantify the effects of the modelled outputs on water quality, it does provide the best available method to quantify nutrient loss due to farm system changes, especially for Nitrogen.

98. For this reason, the removal of stock from farm in June and July and the reduction in fodder crop area, along with nutrient management are, in my opinion the mitigation measures of most importance in this application.

References:

Canterbury Farm Environment Plan (FEP) Certified Auditor Manual, February 2016. Provided by Environment Canterbury.

Industry Agreed Good Management Practices relating to water quality. Canterbury Matrix of Good Management Project. 9 April 2015. http://www.canterburywater.farm/gmp

New Zealand Dairy Statistics 2013-2014. Produced by LIC and DairyNZ 2014. Website:www.licnz.com/viewobj.cfm/dairy_statistics_2013_2014_web.pdf?file_name=dairy_statistics_2013_2014_web.pdf&objID=3

OVERSEER Definition of Terms, previously Technical Note 6.
OVERSEER Technical Manual – Characteristics of Pasture, April 2015

Shepherd, M & Lucci, G. 2011. *Fertiliser advice – What progress can we make?* Presented at Fertiliser and Lime Research Centre (FLRC) Workshops 2011.

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

Appendix One: Excerpt from the short form agreement, signed 29/03/2017

PROGRAMME FOR THE SERVICES:

1. Undertake a review of the Schrader Mains Ltd consent application, this review is specific to the OVERSEER Nutrient Budgets and mitigations measures proposed in the application, specifically:
    a. To audit the OVERSEER Nutrient Budgets provided to ensure that the inputs are appropriate and consistent with the Best Practice Guide, with each other and the application; and to ensure that the budgets represent realistic, viable long-term farming systems and to evaluate the overall robustness of the outputs (nutrient losses) provided though the budgets.
    b. To audit the mitigation measures to ensure the appropriateness and adequacy of mitigation measures in reducing contaminant losses and to ensure that the mitigation measures represent realistic, viable long-term mitigation measures for this proposal.

Appendix Two: Table 9 from consent application

Table 9: Summary of Proposed Mitigation Methods

Mitigation Method	Purpose
Stocking Rate	Appropriate stocking rates on the property prevents excessive N and P losses, soil degradation and sufficient feed for stock. The property proposes a low stocking rate of 2.97 cows/ha which is within the South Island average[22].
Effluent Storage	Appropriately sized effluent storage enables for deferred application. Effluent will be discharged when there is a soil moisture deficit. This prevents runoff and ponding which may affect water quality.
Irrigation System	Low rate irrigation system (in this case a Larall Smart Hydrant System) are more efficient at applying effluent to land in Southland conditions. FDE discharge is guided by the effluent management section of the FMP which outlines the maximum rates and depths of application of effluent ensuring that these rates and depths are low and applications are timed when soils are suitable to receive effluent.
Buffer Zones	The proposed buffer zones of effluent application to surface waterways, abstraction points and key sensitive areas such as dwellings will avoid potential effects on these areas.
Riparian Buffers and Planting	Acts as a buffer to prevent N, P and sediment runoff into waterways. Riparian planting is proposed to occur in accordance with any required Riparian plan.
Stock Exclusion from Streams	All stock are excluded from waterways via the installation of culverts, and fencing of waterways. This provision protect habitat and prevents stock losses.
Nutrient Management Plan	Sets out quantities, frequency and timing of nutrient inputs including FDE. Furthermore, the application of fertiliser at appropriate times and appropriate quantities as advised by fertiliser experts and indicated by frequent soil tests.
Wintering of Stock	Careful consideration regarding wintering practices has been undertaken, and it has been decided that all stock are to be wintered off the property, which will result in a reduced stocking rate over the winter months from what is currently occurring on the property.
Tile Drains	Grazing and cropping of critical source areas will be restricted to protect wet soils. Low application depths of effluent will also be employed to ensure that nutrients get taken up prior to entering the tile drain network.

New Zealand Dairy Statistics 2013-14, 2014. Web. 4 December 2015.

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