

Joint DairyNZ and Fonterra Submission on the Proposed Plan Change 10 to the Bay of Plenty Land and Water Regional Plan

To: Bay of Plenty Regional Council

Joint Submitters: DairyNZ and Fonterra Co-operative Group Limited

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We confirm that we are authorised on behalf of DairyNZ and Fonterra to make this submission.

DairyNZ and Fonterra wish to be heard in support of this submission.

If other parties make similar submissions, DairyNZ and Fonterra will consider presenting a joint case with those parties at the hearing.

DairyNZ and Fonterra will not gain a trade competition advantage through this submission.

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1. Background information on the submitters

About DairyNZ

DairyNZ is the industry good organisation representing New Zealand's dairy farmers. Funded by a levy on milk solids and through government investment, our purpose is to secure and enhance the profitability, sustainability and competitiveness of New Zealand farming. DairyNZ's work includes research and development to create practical on-farm tools, leading on-farm adoption of best practice farming, promoting careers in dairying, and advocating for farmers with central and regional government.

DairyNZ recognises that beyond supporting the economic well-being of New Zealand's urban and rural communities, the dairy sector must responsibly manage its environmental footprint. The Strategy for Sustainable Dairy Farming 2013-2020 ("Making Dairy Farming Work for Everyone") signals the intent of dairy farming to be a part of New Zealand's future for the long term. DairyNZ supports the development of a resource management system that achieves the sustainable management of natural and physical resources in an efficient and equitable way.

About Fonterra

Fonterra is a global, co-operatively-owned dairy nutrition company. It is owned by more than 10,500 farmers and their families who together produce approximately 22 billion litres of milk each year. With this milk Fonterra produces more than two million tonnes of dairy ingredients, specialty ingredients and consumer products each year, with 95 per cent of these exported to millions of consumers in approximately 140 countries around the world. The key components of Fonterra's success include a healthy environment in which to produce milk, access to robust energy and transport infrastructure and an efficient and effective regulatory setting.

2. Scope and nature of submission

DairyNZ and Fonterra recognise that the proposals outlined in Plan Change 10 (PC 10) are intended to give effect to the Council's obligations under the Resource Management Act, and reflect the outcome of an intensive program of stakeholder consultations on strategies to optimise the sustainable management of the Rotorua Te Arawa Lakes catchment – a catchment that is of immense cultural, social, and economic significance to the local Bay of Plenty community and New Zealanders nationwide.

We also recognise that this Plan synthesises a complex body of national and regional resource management policy requirements. Consequently a number of issues, such as the Lake Rotorua annual catchment loads and reduction targets (and associated sector contributions) are not open for submission. Our key objective in preparing this submission is to ensure that the Council delivers on its commitment to adopt an evidence-based planning approach that utilises fully integrated adaptive management techniques.

Our policy positions are built on expert technical analysis of regional and farm-scale economic data, farm systems knowledge, farmer behaviour, water quality science and aquatic ecology. We have applied this approach to the development of this submission.

3. Overview of key submission points

DairyNZ and Fonterra appreciate the opportunity to submit on PC 10. The key issues that we wish to comment on relate to:

- The need for PC 10 to provide maximum flexibility for the Council to re-calibrate its approach in response to the outcomes of regular science and policy reviews. This is particularly important in view of Lake Rotorua's unique geophysical conditions, and recent trends in lake water quality and Trophic Level Index (TLI) state;
- The Council develops a clear strategy for managing multiple catchment attributes and water quality variables over time. Our key concern is that the PC 10 is almost exclusively focussed on the managed reduction of Nitrogen loss whereas the latest scientific evidence indicates that Phosphorous has more significant and enduring impacts on Lake health;
- The proposed resource consenting requirements are modified to provide farming businesses with higher levels of investment confidence and flexibility (including alternate consenting pathways) to maximise the Bay of Plenty's regional social, economic and cultural wellbeing in accordance with the Resource Management Act's broader policy objectives, and to ensure that lake restoration targets are met in the most effective way over the long-term;
- Schedule LR Five (relating to the Use of Overseer and Reference Files) is modified to require Overseer and Reference files to be prepared in accordance with best practice data input standard to ensure consistency nationally, and that progress towards achieving Managed Reduction Targets is measured in a robust and consistent manner;
- Discrepancies exist between the reference farms and current farm systems in the catchment, especially for dairy farms with crops, and OVERSEER Reference Files outputs are therefore not representative of the present situation. The consequence of this is that changes in OVERSEER version number may lead to an inaccurate recalculation and in turn an underestimation of the Nitrogen Discharge Allowance reduction targets for actual farms, as well as failure to account for differences in the impact of OVERSEER changes between farms, and
- Schedule LR Six (relating to Nitrogen Management Plan requirements) and relevant rules are modified so there is a greater emphasis on managing outcomes rather than inputs. Additional information outlining the Council's proposed auditing regime, particularly where plans are prepared as part of an industry environmental management program, will also engender higher levels of public trust and confidence in the proposed arrangements.

Finally, while we have not included significant commentary on these remaining items, we would also like to take this opportunity to note that:

- The achievement of the Council's objectives is contingent on the implementation of various measures (including gorse control, engineering solutions and land-use change incentives) which are not managed through PC 10. It is obviously important that additional information on the implementation program is made available as soon as possible, and
- The Council has also identified the potential need for further changes to the Plan to fully implement the National Policy Statement. We fully support the Council's intention to undertake continual change through an adaptive management process and address these changes using collaborative processes.

4. Detailed analysis and commentary

4.1 Adaptive Management Approach and the current state of scientific knowledge

DairyNZ and Fonterra welcome PC 10's commitment to adopting an adaptive management approach that recognises the inherent challenges associated with the effective management of bio-physical resources. These challenges arise because of the dynamic nature of the bio-physical environment, and the inherent uncertainty associated with predicting how the natural resource system will respond to management interventions. It is therefore essential that adaptive management approaches incorporate regular reviews to assess the extent to which resource management interventions are fulfilling their stated objectives. Accessing robust, evidence-based scientific data is a key part of this review process. In view of the above, it is important to outline the current state of our scientific knowledge regarding the factors that are impacting on the Lake Rotorua catchment.

Lake Rotorua water quality is eutrophic due to current and historical nutrient loading to the lake from point and diffuse sources, including wastewater discharges and landuse. Elevated in-lake concentrations of nitrogen (N) and phosphorus (P) have led to increases in algal biomass (chlorophyll-a) and frequent cyanobacteria blooms in some years. Legacy nutrient loads have been retained in the lake sediments and are released back into the overlying water column under certain environmental conditions. Internal nutrient loading is currently perceived to be a main driver of algal dynamics in the lake and release from internal stores is the primary mechanism for supply of phosphorus during critical periods for algal growth.

The Lakes Rotorua and Rotoiti Action Plan (BOPRC, 2009) sets out management actions to restore Lake Rotorua to a community-desired water quality state similar to the condition of the Lake as it was in the 1960's. This aspiration has been translated into an equivalent scientific target using the Trophic Level Index (TLI), an overall measure of lake water quality condition based on total nitrogen (TN), total phosphorus (TP) and chlorophyll-a concentrations, and water column transparency (secchi disk). For Lake Rotorua the TLI target has been set to 4.2, which is indicative of a eutrophic system, but at the same time is considered realistic given the geophysical characteristics of the lake and its long history of landuse activity in the catchment.

There has been a consistent improving trend in lake TLI since 2003. The greatest improvements in were observed between 2010 and 2012, when the lake reached its TLI target of 4.2 before stabilising at or around the TLI target through to 2014. These trends coincide with low level alum dosing in the Utuhina (beginning 2006) and Puarenga (beginning 2010) Streams. Alum is believed to be locking up internal lake P loads, hence the accelerated improvement to water quality since greater alum dosing in 2011. Other processes also appear to be important as improving water quality trends commenced three years prior to alum dosing. Lake TLI increased in 2016, likely due to prolonged periods of thermal stratification over the summer months.

The improvements in lake TLI strongly indicate that algal growth in Lake Rotorua is primarily limited by P availability, due to the greater relative reduction in P and Chlorophyll-a concentration compared to N. This is a divergence from the previous consensus that N was the most important limiting factor, as reflected in the current rules framework. Trend analysis of inflow water quality indicates that levels of nitrate in the inflow streams are increasing, as are levels of nitrate in the lake outflow. However, there does not appear to have been any adverse effects of this increasing nitrate trend on algal biomass, which has significantly reduced in line with significant reductions in TP.

These results suggest that the sustainable loads of N and P required to achieve a TLI of 4.2 in the long-term are uncertain and need revision to take account of the new information on P-limitation and the effects of alum-dosing on internal P-loads. This is especially important given the significant

financial cost and uncertainty to individual landowners and the community, including through the use of government funding, to mitigate N as the primary means to achieve the lake TLI target. While it is recognised that continued alum dosing poses a significant challenge as a long term management strategy for the lake, an understanding of attainable reductions in catchment P loading from all sources, including land management practices and urban storm water management, is considered important to determine the best solution for the long term management of the lake. A study by the University of Waikato (Tempero et. al. 2016) estimates that the external P load from anthropogenic sources represents 48% of the total catchment load (or 22% of the total DRP load) to the lake. This suggests that a significant proportion of the total anthropogenic P inputs could potentially be managed but further work is required to assess this more fully.

By contrast there are a number of scientific uncertainties associated with the calculation of anthropogenic N losses using the Rotan catchment model. Knowledge about catchment and in-stream attenuation processes is almost non-existent and is a major gap, with ROTAN assuming 0% attenuation between the root zone and the lake. A more detailed understanding of attenuation processes and how these vary spatially throughout the catchment is considered important especially when assigning property-scale nutrient reduction targets and targeting certain areas for incentivised management. For instance N loss attenuation from the root zone is variable but often cited at 50% removal.

We value the Council's intent to regularly review and publish the science used to derive the limits set out on the RPS and Regional Water and Land Plan every five years and respond to any recommendations made through subsequent community consultation and adaptive management. It is our understanding that the first major review of catchment and lake water quality science will be completed in 2017. We fully support this approach and wish to seek assurance that this occurs, and that this and every subsequent review will address the scientific and policy aspects currently proposed in the methods or if there is a more cost effective or efficient way of meeting the 2032 targets.

Recommendations:

1. Provide certainty in the Plan that the first major review of the lake and catchment water quality science will be carried out in 2017, and that the results of this review will form the basis for an adaptive management approach if the findings suggest that the NDA targets and associated rules framework are unlikely to meet the 2032 lake targets.
2. Clarify in the Plan that each scientific review will assess all scientific and policy aspects listed in method LR M2 (a-e).
3. Clarify that the review will include peer review from independent scientists.

4.2 Resource Consent Requirements

DairyNZ and Fonterra support the proposal that all dairy farms in the Rotorua Lake surface water catchment should be required to meet their 2022 Nitrogen Discharge Allowance. We also note that analysis of current OVERSEER N loss estimates against the provisional Nitrogen Discharge Allowances for five Rotorua catchment dairy farms suggests many farms are already meeting their 2022 PNDA targets (Appendix A).

However, due to the uncertainty around what the long-term sustainable nitrogen and phosphorus loads to the lake to achieve and maintain a TLI target of 4.2 should be (see Section 4.1), as well as the significant financial cost to farm businesses and the community if the current Nitrogen Discharge Allowance outcomes do not achieve the intended outcomes (see Appendices 1 and 2) we recommend that the PC 10 should be modified to include new Permitted and Controlled Activity Rules. These rules will enable the Council to achieve its 2022 reduction targets, while providing the opportunity for its post-2022 targets to be re-evaluated and set in an evidence-based manner, utilising the outcome of the forthcoming science reviews and NPS-FM collaborative processes.

The proposed new rules are outlined in detail in Section 5 of this submission and a high-level summary is provided below:

Permitted Activity Rule (for the period 2017-2022)

We recommend that the Plan should provide for a Permitted Activity rule for all properties/farming enterprises that are 40 hectares or more in effective area through to 30 June 2022 provided that:

- a) A 2032 Nitrogen Discharge Allowance and relevant Managed Reduction Targets have been determined for the land in accordance with Schedule LR One and Policy LR P8;
- b) A properly certified Nitrogen Management Plan documenting farm management actions required to meet the 2022 Nitrogen Discharge Allowance target (prepared in accordance with an amended Schedule LR Six) has been provided;
- c) The Regional Council has approved the 2032 Nitrogen Discharge Allowance and Managed Reduction Targets for the land in accordance with Schedule LR One and Policy LR P8;
- d) An annual OVERSEER file, demonstrating that on a 3-year rolling output average basis the property is on a trajectory to achieve its 2022 Managed Reduction Target, has been supplied.

Under this approach farms over 40 hectares with streamlined reporting requirements, will migrate to Rule 8 in July 2017 (with additional actions and reporting conditions) and then to Rule 9, a controlled consent, in 2022. A property greater than 40 hectares that cannot meet the Permitted Activity rule from July 2017 must apply for a consent under Rule 9.

We recommend that the farm Nutrient Management Plan provides the evidence that farmers are intending and on track to meet the 2022 Nitrogen Discharge Allowance targets rather than the compliance tool.

In addition, catchment Dairy farmers and Industry partners will continue to work together to develop voluntary management actions for mitigating environmental risks associated with critical source areas, including for phosphorus and sediment, which are currently not addressed in the NMP and NDS targets.

Controlled Activity Rule (for the period 2022 to 2032)

The new Controlled Activity Rule has been designed to align with and expand the scope of PC 10, Rule 8. It would apply to all properties greater than 10 hectares that: (i) do not meet the relevant Permitted Activity conditions from July 2017, and (ii) use land for farming activities and do not meet the Permitted Activity rules beyond July 2022. The following conditions would apply only if after the 2017 Science review there is community agreement that the 2032 Nitrogen Discharge Allowance targets still represent the most cost effective and efficient way of meeting the desired long-term outcomes for the Lake:

- a) A 2032 Nitrogen Discharge Allowance and relevant Managed Reduction Targets have been determined for the land in accordance with Schedule LR One and Policy LR P8; and
- b) A properly certified Nitrogen Management Plan has been prepared in accordance with Schedule LR Six.

This approach combines key aspects of the Nitrogen Management Planning approach (especially as they relate to identifying possible pathways to achieve the required Managed Reduction Targets) with robust annual OVERSEER processes that allow for the creation of rolling output averages. This will provide farmers with greater flexibility to manage their farm systems in response to the actual economic, climatic and social condition challenges they face in any given production year. It will also create strong incentives for farmers to continue developing and applying innovative management solutions.

We are confident that, by allowing farmers to have a Permitted Activity option which is accompanied by a framework of action/reporting requirements that are commensurate with the scale of the activity, the Council can achieve its stated 2022 nutrient reduction targets. In the meantime, as noted above, the forthcoming science reviews and NPS-FM collaborative processes will inform the content of the consents required to achieve the Council's longer term targets. Our proposed approach is consistent with the PC, Rule 10 which allows for the transfer of nitrogen loss entitlements as a controlled activity from 1 July 2022.

Recommendations:

1. We support the requirement for all dairy farms in the Rotorua Lake surface water to meet their 2022 Nitrogen Discharge Allowance.
2. A new Permitted Activity Rule (for the period 2017-2022) should be introduced based on the following controls:
 - (i) 2032 Nitrogen Discharge Allowance and relevant Managed Reduction Targets have been determined for the land in accordance with Schedule LR One and Policy LR P8;
 - (ii) A properly certified Nitrogen Management Plan (prepared in accordance with Schedule LR Six) has been provided;
 - (iii) The Regional Council has approved the 2032 Nitrogen Discharge Allowance and Managed Reduction Targets for the land in accordance with Schedule LR One and Policy LR P8, and
 - (iv) An annual OVERSEER file demonstrating that, on a 3 year rolling output average basis the property is on a trajectory to achieve the 2022 Managed Reduction Target, has been supplied.
3. A new Controlled Activity Rule (for the period 2022 to 2032) should be introduced based on the following controls:
 - (i) There is community agreement that the 2032 Nitrogen Discharge Allowance targets still represent the most cost effective and efficient way of meeting the desired long-term outcomes for the Lake following completion of the 2017 lake and catchment science review.
 - (ii) A 2032 Nitrogen Discharge Allowance and relevant Managed Reduction Targets have been determined for the land in accordance with Schedule LR One and Policy LR P8; and
 - (iii) A properly certified Nitrogen Management Plan has been prepared in accordance with Schedule LR Six.

4.3 Schedule LR Five: Use of OVERSEER and Reference Files

Schedule LR Five outlines the methodological approach relating to the use of OVERSEER and how different version changes in software are dealt with. We support the intention of providing a practical methodology in which progressive improvements in OVERSEER can be incorporated and taken into consideration in the rules framework while still meeting the requirements for compliance. We do, however, hold several concerns with respect to how the initial reference files have been set up, particularly in terms of the farm system they represent and the implications of this for underestimating the true level of mitigation that may be required by individual landowners to meet the prescribed 2032 Nitrogen Discharge Allowance targets.

The reference files applied represent a prediction of what the average farm system is expected to look like in order to meet the 2032 Nitrogen Discharge Allowance targets, based on average geophysical conditions in the catchment. These files deliberately avoid the inclusion of some farm system components that have historically delivered the greatest variance in nitrogen leaching estimates, for example cropping and irrigation. As a result there are several discrepancies between the reference farms and current farm systems in the catchment, especially for dairy farms with crops, and OVERSEER Reference Files outputs may not be representative of the present situation.

The consequence of this is that changes in OVERSEER version number may lead to an inaccurate recalculation and in turn an underestimation of the Nitrogen Discharge Allowance reduction targets for actual farms, as well as failure to account for differences in the impact of OVERSEER changes between farms. For example the recent change in OVERSEER version from V.6.2.0 to V.6.2.1 resulted in an N leaching reduction of approximately -10% for the reference farms. In reality, for farms with crops, the actual change in leaching was closer to +3%. In this situation individual farms will need to mitigate by an amount equivalent to the Nitrogen Discharge Allowance target plus the difference between the reference file and their current OVERSEER file, which in this case is more. This demonstrates that while the reference files may represent a perceived average future situation, they do not reflect current farming practice, and the true impact on individual businesses. This also means that some farms could technically become non-compliant following changes in OVERSEER version number.

An additional concern is that any approach utilising OVERSEER should be undertaken based on OVERSEER and Reference Files prepared in accordance with best practice data input standards to ensure consistency of approach. While we believe the effect of applying the BOP OVERSEER protocol as opposed to the National best practice standards is small, in principle for confidence, consistency and reproducibility the national Overseer best practice standards should be applied.

Recommendations:

1. The Reference Files, including how dairy farm systems are represented and the impact of the observed differences with actual farm systems when applied to recalculate Nitrogen Discharge Allowance targets following changes on OVERSEER, are reviewed to provide certainty that the proposed methodology is robust and fit for purpose. This review should take place after the next OVERSEER version is released (expected May 2016) and before the Plan becomes operative.
2. Schedule LR Five is amended to incorporate any changes as a result of Recommendation (1).
3. Subsequent review of the Reference Files and associated methodology for recalculating the Nitrogen Discharge Allowance levels are carried following further significant changes in OVERSEER, to ensure similar issues which may arise are identified and can be dealt with quickly.
4. Where possible actual farm systems should be applied in the reference file methodology.
5. A fair alternative rules framework should be developed to manage situations where current farm systems are still not represented by the Reference Files.
6. Schedule LR Five is amended to include a specific requirement that OVERSEER and Reference Files should be prepared in accordance with nationally-agreed best practice data input standards to ensure consistency of approach.

4.4 Schedule LR Six: Nitrogen Management Plan requirements

As part of our submission development process DairyNZ and Fonterra consulted with dairy farmers based in the Rotorua Lakes catchment. There was widespread concern that the Nitrogen Management Plan (NMP) Requirements, contained in Schedule LR Six, would result in the introduction of an input management regime that will significantly reduce their ability to manage their farm systems in a flexible manner in response to seasonal factors (such as climate, disease, consumer demand) which are outside their direct control. In addition, these new plan requirements could dilute farm owner control and transfer management accountability to professional advisors thereby reducing incentives for continued farm-system innovation. Finally, there were also concerns regarding the accuracy, relevance and feasibility of including mitigation options up to 2032 (as required by Schedule LR Six 5(ii)) given the need for NMPs to be living documents. It is obviously important that these concerns are addressed.

We have also noted that, while Schedule 6 appears to open a gateway for Industry Audited Self-Management by enabling NMPs to be prepared “ as part of an industry environment management programme”, there are some noticeable omissions in relation to how this approach will work in the Bay of Plenty context. In particular, there is no guidance on how related audit and reporting requirements will work in practice.

The requirements of the Nitrogen Management Plan includes the need for detail on effluent management (5.c). This information is already described as part of a farm’s dairy effluent consent.

We do not see value in duplicating this information here unless it is Councils intent to manage the effluent consent through a single Farm Nutrient Management Plan document.

Recommendations:

1. Schedule 6 should be modified so that it has a stronger focus on managing outcomes, rather than inputs.
2. Additional information regarding the audit and reporting requirements that will support the effective implementation of Nitrogen Management Plans should be provided as soon as possible.
3. Schedule 6 (5) should be modified to exclude information on effluent management.

5. Comments on specific Plan Change 10 Provisions

Our comments on specific PC 10 Provisions are outlined in the following table:

Number	Page	Provision	Support/Oppose	Comments	Relief Sought
LR M2	8	Regional Council will review and publish the science that determined the limits set in the RPS and the Regional Water and Land Plan for Lake Rotorua on a five yearly basis. These reviews may include:	Support with amendment	<p>We consider regular review of and publication of the science including the actions documented in LR M2 to be essential for an adaptive management approach to be effective. The Plan should provide greater certainty that these reviews will occur.</p> <p>The Plan also needs to specify that a full science review will be undertaken in 2017 before consents (LR R9) become operative</p>	<p>Regional Council will review and publish the science that determined the limits set in the RPS and the Regional Water and Land Plan for Lake Rotorua on a five yearly basis.</p> <p>The next full science review will be completed in 2017</p> <p>The science review is undertaken by independent scientists.</p> <p>These reviews may <u>will</u> include:</p>
LR R1	12	Permitted – 30 June 2017, the use of land for farming activities on properties/farming enterprises in the Lake Rotorua groundwater catchment	Support	All farming activities remaining PA with a 'hold the line' condition until 30 June 2017 is practical to allow time for understanding and implementing the more complex regulation around working toward the MRT / NDA targets on individual farms.	N/A
LR R2	12	Permitted –From 1 July 2017, the use of land for plantation forestry or bush/scrub	Support in part	<p>DairyNZ/Fonterra suggests the appropriateness of introducing more prescriptive management of forestry harvest practices for this catchment should be considered to ensure that pulses of sediment / P do not undermine the efforts of other land users.</p> <p>Dairy NZ/Fonterra agree with the clarification in the advice note that trees / scrub can be considered as a block within a property.</p>	Reference the requirement to comply with sediment loss rules or if they are inadequate for the specific risk in this catchment add to the conditions in this rule.

LR R3	12	Permitted- From 1 July 2017, the use of land for farming activities on properties/farming enterprise 5 hectares or less in area	Support	DairyNZ / Fonterra support the approach of applying less prescriptive rules to properties where the property scale and the land use is less likely to result in contaminant loss to water.	N/A
LR R4	12	Permitted – From 1 July 2017, the use of land for farming activities on properties/farming enterprise greater than 5 hectares in area and up to and including 10 hectares in effective area	Support	DairyNZ / Fonterra support the approach of applying less prescriptive rules to properties where the land use activity is less likely to result in contaminant loss to water.	N/A
LR R5	13	Permitted- From 1 July 2017 until 30 June 2022, the use of land for farming activities on properties/farming enterprise greater than 10 hectares in effective area and less than 40 hectares in effective area or that are not permitted under Rule LR R3 or LR R4	Support	While smaller properties (<40ha) carrying out the same or similar activities as larger properties should be managed to the same standard DairyNZ / Fonterra recognise the practical implementation issues that the council will have to manage and therefore support the lesser reporting requirements for these properties that apply until 2022, at which time they become fully aligned with the requirements applying to the larger properties.	N/A
LR R6	14	Permitted –From 1 July 2017 until 30 June 2022, the use of land for farming activities on	Support	This rule allows more time for property owners who may not have realised that the Rotorua nutrient rules would impact their business, to work with the council before the full rule regime applies to them in 2022.	N/A

		properties/farming enterprise not previously managed by Rules 11 to 11F		DairyNZ / Fonterra support this as a pragmatic and reasonable approach.	
LR R7	14	Permitted – From 1 July 2017, the use of land for low intensity farming activities on properties/ farming enterprises	Support	DairyNZ / Fonterra support the idea of applying less prescriptive rules to properties where the land use activity is less likely to result in contaminant loss to water. We also note and support the recognition in this Rule that provision of an Overseer file that may describe different actions from those in the ‘commencement’ file, prepared by a suitably qualified and experienced person that demonstrates the properties ongoing compliance with a nitrogen loss number, is appropriate.	N/A
LR R8	15	Controlled – the use of land for farming activities on properties/ farming enterprise less than 4- hectares in effective area or that were not previously managed by Rule 11 to 11F that do not meet permitted activity conditions	New PA rule (aligns with PC 10 - rule 9)	<p>Permitted rule that aligns with PC 10 - rule 9 which set out a controlled activity beyond 1 July 2017 in the notified version.</p> <p>By providing for a permitted activity rule for all properties > 40ha through to 2022, with clear conditions that require achievement of 2022 MRT for compliance and full reporting obligations, the council can achieve the same enforceable trajectory through to 2022 while enabling science review processes, and potentially NPS-FM collaborative processes to inform the content of consents that will ensure the appropriate longer term targets can be achieved as efficiently as possible.</p> <p>Under this approach for farms over 40ha Rule 1 with lesser reporting requirements, moves to Rule 8 in July 2017 with additional</p>	<p><u>Controlled – From 1 July 2017, Permitted – from 1 July 2017 until 30 June 2022,</u> the use of land for farming activities on properties/farming enterprises that are 40 hectares or more in effective area The use of land for farming activities on properties/farming enterprises in the Lake Rotorua groundwater catchment where:</p> <ul style="list-style-type: none"> • The property/farming enterprise is 40 hectares or more in effective area and • The activity does not comply with the permitted activity conditions in Rule LR R7, <p>is a controlled activity from 1 July 2017 <u>permitted activity until 30 June 2022</u> subject to the following conditions:</p> <p>(a) A 2032 Nitrogen Discharge Allowance and relevant Managed Reduction Targets have been determined for the land in accordance with Schedule LR One and Policy</p>

				<p>actions and reporting conditions and then to Rule 9, a controlled consent in 2022.</p> <p>A property >40ha that cannot meet the Permitted rule from July 2017 must apply for a consent under rule 9.</p>	<p>LR P8; and</p> <p>(b) A Nitrogen Management Plan has been prepared for the property/farming enterprise by a suitably qualified and experienced person and that person has certified that the Nitrogen Management Plan has been prepared in accordance with Schedule LR Six.</p> <p>Bay of Plenty Regional Council reserves control over the following:</p> <p>(i) The (c) Regional Council approval of the 2032 Nitrogen Discharge Allowance and Managed Reduction Targets for the land subject to the application, set in accordance with Schedule LR One and Policy LR P8.</p> <p>(ii) (d) The submission of an annual OVERSEER® file prepared by a suitably qualified and experienced person, demonstrating implementation of the Nitrogen Management Plan, that on a 3 year rolling output average basis the property is on a trajectory consistent with meeting the 2022 MRT.</p> <p>(iii) The requirement for written landowner approval of any proposed nitrogen loss mitigations to be undertaken on their land.</p> <p>(iv) The form of (e) Provision of information and documentation to support the OVERSEER® file, including data inputs and protocols.</p> <p>(v) Circumstances that may require a review of a Nitrogen Management Plan or consent conditions including a change to property size, the sale or disposal of land, permanent removal of Nitrogen Discharge Allowance from the catchment, changes in lease arrangements, significant farm system changes and subdivision.</p> <p>(vi) (f) Implementation of the Nitrogen Management Plan, or actions that will have an equivalent or greater N loss benefit as calculated / modelled through Overseer being used as set out in condition (b) above, so as</p>
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					including the mitigations and methodology to be used to meet the Managed Reduction Targets. (vii) (g) Self-monitoring, record keeping, information provision and site access requirements to demonstrate on-going compliance with the <u>2022 Managed Reduction trajectory and targets</u> . Nitrogen Management Plan.
LR R9	14	Controlled – From 1 July 2017, the use of land for farming activities on properties/farming enterprise that are 40 hectares or more in effective area	New Rule (aligns with and expands scope of PC 10 Rule 8)	<p>New Controlled Activity Rule to align with what was rule 8 in notified PC 10 but that would now cover all properties > 10ha that:</p> <ul style="list-style-type: none"> (i) Do not meet the relevant PA conditions from July 2017 (ii) Use land for farming activities and do not meet the PA rules beyond July 2022. <p>Using the Farm Plan to provide guidance and to identify possible pathways to achieve the required reductions while using robust annual Overseer processes to allow for the creation of rolling output averages allows for flexibility on the farm to respond to actual conditions (economic, climatic, social) in a production year and also to look for and to apply innovative and most efficient solutions as they might become available.</p> <p>Clause (v) may provide for this to some extent, however without any definition of ‘significant’ there is a risk that farms could effectively be breaching a consent by responding to current conditions even though they remain on track to achieve the MRT.</p>	<p>Controlled – The use of land for farming activities on properties/farming enterprises less than 40 hectares in effective area that do not meet permitted activity conditions, (including all farming properties beyond July 2022 not allowed for in Rules LR R2, LR R3, LR R4 and LR R7) or that were not previously managed by Rule 11 to 11F that do not meet permitted activity conditions</p> <p>The use of land for farming activities on properties/farming enterprises in the Lake Rotorua groundwater catchment where:</p> <ul style="list-style-type: none"> • The property/farming enterprise is less than 40 hectares in effective area or was not previously managed by Rule 11 to 11F; and • The activity does not comply with permitted activity conditions in Part LR, <p>is a controlled activity from 1 July 2022 subject to the following conditions:</p> <ul style="list-style-type: none"> (a) A 2032 Nitrogen Discharge Allowance and relevant Managed Reduction Targets have been determined for the land in accordance with Schedule LR One and Policy LR P8; and (b) A Nitrogen Management Plan has been prepared for the property/farming enterprise by a suitably qualified and experienced person and that person has certified that the Nitrogen Management Plan has been prepared in accordance with Schedule LR Six.

				<p>As written there is no clarity about how the 'significant' qualification in (v) is to be applied to the apparently black and white Plan compliance provisions in (ii), (iii), (vi) and (vii).</p> <p>Allowing for all farms to have a permitted activity option, with a hierarchy of action / reporting requirements commensurate with the scale of the activity, the council can achieve the same enforceable trajectory through to 2022 while enabling science review processes, and potentially NPS-FM collaborative processes to inform the content of consents that will ensure the appropriate longer term targets can be achieved as efficiently as possible. This timeframe is also consistent with LR R10 which allows for transfer of nitrogen loss entitlements as a controlled activity from 1 July 2022.</p>	<p>Bay of Plenty Regional Council reserves control over the following:</p> <p>(i) The approval of the 2032 Nitrogen Discharge Allowance and Managed Reduction Targets for the land subject to the application, set in accordance with Schedule LR One and Policy LR P8.</p> <p>(ii) The submission of an annual OVERSEER® file, prepared by a suitably qualified and experienced person, demonstrating <u>implementation of the Nitrogen Management Plan that on a 3 year rolling output average basis the property is on a trajectory consistent with meeting the 2027 MRT.</u></p> <p>(iii) The requirement for written landowner approval of any proposed nitrogen loss mitigations to be undertaken on their land.</p> <p>(iv) The form of information and documentation to support the OVERSEER® file including data inputs and protocols.</p> <p>(v) Circumstances that may require a review of a Nitrogen Management Plan or consent conditions including a change to property size, the sale or disposal of land, permanent removal of Nitrogen Discharge Allowance from the catchment, changes in lease arrangements, significant farm system changes and subdivision.</p> <p>(vi) <u>Implementation of the Nitrogen Management Plan, or actions that will have an equivalent or greater N loss benefit as calculated / modelled through Overseer being used as set out in clause (ii) above, so as including the mitigations and methodology to be used</u> to meet the Managed Reduction Targets.</p> <p>(vii) Self-monitoring, record keeping, information provision and site access requirements to demonstrate on-going compliance with the <u>trajectory toward the MRT on a rolling output average basis as calculated</u></p>
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					from the annual Overseer file monitoring requirement. <u>Nitrogen Management Plan</u>
LR R10	17	Controlled – From 1 July 2022, the transfer of nitrogen loss entitlement between properties/farming enterprises	Support in part	While DairyNZ / Fonterra support most of the Rule that describes transfer of nitrogen loss entitlements, as elsewhere in the Plan we believe the focus (and council controls) should be on showing compliance with the nitrogen loss trajectory to achieve the MRT and toward the NDA rather than effectively an input control approach through implementing specific actions in the Farm Plan. Input controls are an inflexible and inefficient mechanism to manage effects when there is a credible output monitoring mechanism available.	<p>Controlled.....</p> <p>(ii) The submission of an annual OVERSEER® file, prepared by a suitably qualified and experienced person, demonstrating on-going compliance with the <u>trajectory toward the MRT and NDA on a rolling output average basis as calculated from the annual Overseer file monitoring requirement. implementation of the Nitrogen Management Plan.</u></p> <p>(iii) The requirement for written landowner approval of any proposed nitrogen loss mitigations to be undertaken on their land.</p> <p>(iv) The form of information and documentation to support the OVERSEER® file. This includes data inputs used for the OVERSEER® file and the application of the Lake Rotorua Groundwater Catchment Nitrogen Protocols published by the Regional Council.</p> <p>v) Circumstances that may require a review of a Nitrogen Management Plan or consent conditions including a change to property size, the sale or disposal of land, changes in lease arrangements, significant farm system changes and subdivision.</p> <p>(vi) Implementation of the Nitrogen Management Plan, <u>or actions that will have an equivalent or greater N loss benefit as calculated / modelled through Overseer being used as set out in (ii) above, so as including the mitigations and methodology to be used to meet the Managed Reduction Targets and Nitrogen Discharge Allowance.</u></p> <p>(vii) Self-monitoring, record keeping, information</p>

					<p>provision and site access requirements to demonstrate on-going compliance with the <u>trajectory toward the MRT on a rolling output average basis as calculated from the annual Overseer file monitoring requirement.</u></p> <p>Nitrogen Management Plan.</p> <p>Applications for controlled activities under this rule do not require the written approval of affected persons and shall not be publicly notified except where the Regional Council considers special circumstances exist in accordance with Section 94C of the A</p>
LR 11	18	Controlled – the use of land for farming activities on properties/farming enterprise that cannot be readily modelled by OVERSEER	Support in part	DairyNZ and Fonterra support this rule but believe that the council should clarify the intended meaning of the subjective “readily”. (more than the advice note “equal effort” approach). If one sector or enterprise type identifies that Overseer does not “readily” model an activity type there is scope for inequitable outcomes between sectors dependant on how the council decides to apportion a reduction estimate, in the absence of Overseer, to an action described in a Farm Plan	Limit the application of this rule to enterprises / activities that are not recognised in Overseer <u>or</u> are exceptional in complexity.
Table LR 7	24		Support	This table specifies managed reduction targets for 2022, 2027 and 2032 whereas the PNDA files being provided to farmers provide the targets as 2017-2022, 2022-2027, 2027-2032 and >2032. This is causing confusion (i.e. is the 2022 target 2017-2022 or 2022 - 2027?)	Suggest a consistent description of the targets between the plan and farm PNDA documents.
Schedule LR 6	32	5 (a) A description of how each of the following	Support with amendment	We support only if after the 2017 Science review there is community agreement that the 2032 NDA targets still represent the	A description of how each of the following management objectives, where relevant, will be met. (a) <i>Nitrogen management</i> : To minimise nitrogen losses

	<p>management objectives, where relevant, will be met.</p> <p>(a) <i>Nitrogen management</i>: To minimise nitrogen losses and achieve the Nitrogen Discharge Allowance allocated to the property/farming enterprise by 2032. The Nitrogen Management Plan must include:</p>		<p>most cost effective and efficient way of meeting the desired long-term outcomes for the Lake:</p>	<p>and achieve the Nitrogen Discharge Allowance allocated to the property/farming enterprise by 2022 2032. The Nitrogen Management Plan must include:</p> <p>i) A nitrogen budget for the property/farming enterprise that matches the current system or use of the system.</p> <p>(ii) A pathway, including a schedule of mitigation actions, that demonstrates managed reduction to achieve the Managed Reduction Targets and the 2022 2032 Nitrogen Discharge Allowance in accordance with LR P8.</p> <p>(iii) The specific data and records that will be kept to measure compliance with specific targets and mitigation actions defined in 5(a)ii.</p> <p>(iv) A description of any specific risks</p>
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Appendix A: Review of current Overseer losses against PNDA targets (6 farms)

Current OVERSEER N loss estimates were compared to the provisional Nitrogen Discharge Allowances for five Rotorua dairy farms to assess where farms currently sit with respect to their 2001-2003 benchmark and 2017, 2022, 2027 and 2032 targets. OVERSEER files were provided by Perrin Ag Consultants and represent the current situation as best as possible (2015-2016, based on 2012-2013 data). The BOPRC provisional PNDA targets for each farm were provided by each landowner. All OVERSEER outputs represent Version 6.2.1.

This analysis suggests that four of the five farms have current OVERSEER losses below their 2001-2003 benchmark value and are already meeting their 2017 and 2022 PNDA targets (Figure A1). One of these farms is also meeting its 2027 PNDA target. OVERSEER output for one farm is currently above its benchmark value and not meeting any of the PNDA targets.

Following discussions with the landowners and farm consultant it is believed the current OVERSEER files are representative of the average farm situation, and are not impacted by milk prices. Therefore the OVERSEER outputs are not considered to be abnormally low due to changes undertaken to the farm system in response to the current economic situation. Instead the reductions in nitrogen losses since the benchmark period are more likely to reflect a response to high urea prices, a move away from forage crops due to variability and uncertainty in weather patterns, and small reductions in stocking rate together with slight increases in per cow production.

All OVERSEER values reflect the total farm enterprise and therefore include losses from associated runoff blocks situated elsewhere in the catchment were applicable. This lumping of OVERSEER output at the enterprise scale together with significant changes in OVERSEER software and OVERSEER files being created for different purposes by different agencies has led to much confusion amongst landowners when different files for the same property are compared.

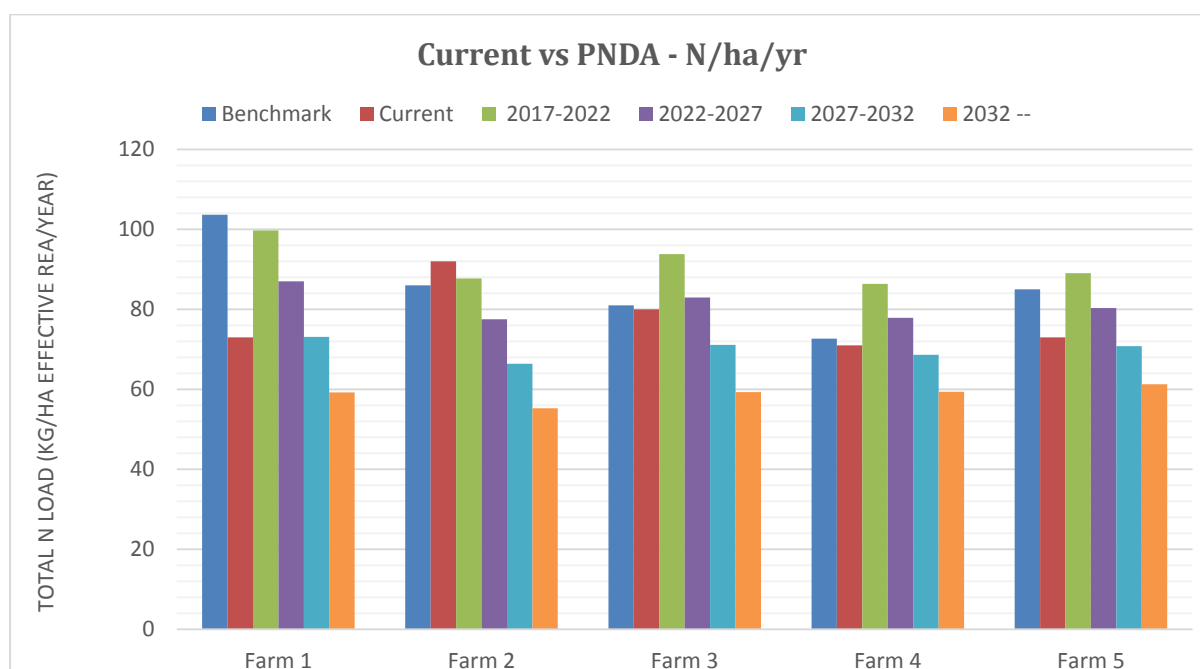


Fig. A.1: Comparison between OVERSEER benchmark and current nitrogen losses (kg/ha/yr) against the provisional 2017 (2017-2022), 2022 (2022-2027), 2027 (2027-2022) and 2032 (>2032) PNDA targets for five Rotorua catchment dairy farms.

Appendix B: Farm system and economic implications for meeting the PNDA targets for dairy farms

B.1 Introduction:

Farm system modelling was undertaken on three representative Rotorua catchment dairy farms to (a) assess which mitigation strategies and farm system changes would be required to meet the provisional NDA targets for 2022, 2027 and 2032, (b) evaluate the impacts of implementation on farm operating profit and business viability and (c) compare the types of modelled mitigation actions against the actions recommended by the associated farm Nutrient Management Plan where available. The modelling approach applied utilised OVERSEER (V.6.2.1) to quantify farm nitrogen losses to the root zone and the FARMAX to simulate farm economics and the feasibility of mitigations for the farm system. A description of the three model case study farms is provided in Table B.1.

Table B.1: Summary of case study farm characteristics (from PNDAs) and PNDA targets based on total enterprise area (in kg N/ha per year and total kg N/year).

Case study	Timeframes	PNDA (kg N/ha/y)	PNDA (kg N/y)	Total reduction to 2032 (%)
Farm 1 (area 276 ha)	2017-2022	93.4	25780	
	2022-2027	81.5	22505	
	2027-2032	68.6	18927	
	2032 --	55.6	15349	-40%
Farm 2 (area 250 ha)	Start Point	83.4	20853	
	2022-2027	73.7	18440	
	2027-2032	63.2	15804	
	2032 --	52.7	13168	-37%
Farm 3 (area 230 ha)	2017-2022	82.6	19016	
	2022-2027	73.1	16834	
	2027-2032	62.7	14451	
	2032 --	52.4	12067	-37%

B.2 Approach:

Modelling was undertaken based on the availability of existing data. Paired OVERSEER and Farmax files representing the most recent situation were supplied by Perrin Ag Consultants. The provisional NDA targets (based on OVERSEER 6.2.1) were provided by the landowners. Where applicable the Farmax or Overseer files were amended to ensure consistency in terms of the input information provided to both models (e.g. block areas, stocking rates, production rates). A number of key assumptions were made in the modelling approach:

- Modelling is based on default financials not actual farm financials.
- Production per cow is allowed to increase slightly per year to account for genetic gain in line with increases in the last 10 years.
- Farmer production possibility frontier is held constant (farmer skill).
- Operating profit and interest were considered. No other costs were considered, for example tax or rent.

- Modelling is based on a \$6.00 milk price and the Farmax expenses (e.g. nitrogen costs and grazing costs) based on that provided by the farm consultant.
- The year modelled represents the long-term steady state of the farm. E.g. overseer assumes 10 year average climate data.
- Flow on effects to the wider economy were not considered. For example if all farmers increase wintering off then the price of this is likely to change. These factors were not accounted for in the modelling.
- Following consultation with the landowners and farm consultant it was assumed that current farm state (OVERSEER below benchmark for most farms) represents a realistic long term starting point before further mitigation as opposed to a short term situation in which changes to the farm system have been temporarily in response to the low milk pay-outs (e.g. cull early, reduced imported feed etc., resulting in reduced nutrient losses but may not be seen as a intended long term change).

B.3 Key findings:

The key findings of this analysis are:

1. Two of the three case study farms are already meeting their 2017 and 2022 PNDA targets and therefore further mitigation to achieve this target is not required on these properties.
 - a. One of these farms is also already meeting its 2027 PNDA target.
2. One farm is presently not meeting its 2017 target and therefore mitigation will be required to reach all future PNDA targets.
3. The level of mitigation required to meet the targets not already met is dependent on the current OVERSER starting point, and is therefore farm specific. In general:
 - a. To meet the 2022 and 2027 targets requires small changes on the farm system, for example changing effluent solid application, increasing standoff pad times, changing high risk fertiliser applications and small reductions in stocking rate to match feed supplies. The economic impacts of these changes is also farm specific and for this analysis ranged from **-2% to -5%** (operating profit only, excluding interest).
 - b. To achieve the 2027 PNDA targets requires medium system changes, including reductions in fertiliser, slight decreases in stocking rate and changes in supplementary feeding practices. The economic impact of these changes is also farm specific and for this analysis ranged from **-2% to -16%** (operating profit only, excluding interest).
 - c. To achieve the target for 2032 and beyond significant system changes to all farms, for example through changes in wintering and young stock practices, removing cropping, reducing fertiliser applications and reducing stock numbers. This has significant impacts on farm operating profit, ranging from **-8% to -22%** for the three case study farms. When interest is included (operating profit minus interest payments) this changes to a reduction between 15% and 38% for the three case study farms.
4. Interest is a significant expense and the farms need to be able to pay this from operating profit in order to remain viable farm businesses.
5. The viability of the business after mitigation needs to be considered better, especially for the >2027 scenarios. This includes the ability to make enough of a profit to meet debt and tax

obligations etc. This also needs to be considered in relation to land value, return on investment and ability to maintain equity.

6. Due to the significant variability in farm system, financial management and geophysical conditions (soil type, rainfall) between individual dairy farm businesses in the catchment, and is uncertain how representative the three model case study farms are of other farms.
7. The bundles of mitigation strategies required to meet the 2027 and 2032 targets are similar to those actions specified in the Nutrient Management Plan available for one farm (Farm 3).
8. These results highlight the importance of farm businesses requiring certainty that the proposed PNDA targets from 2027 represent the most cost effective management strategy in order to meet the lake TLI targets.

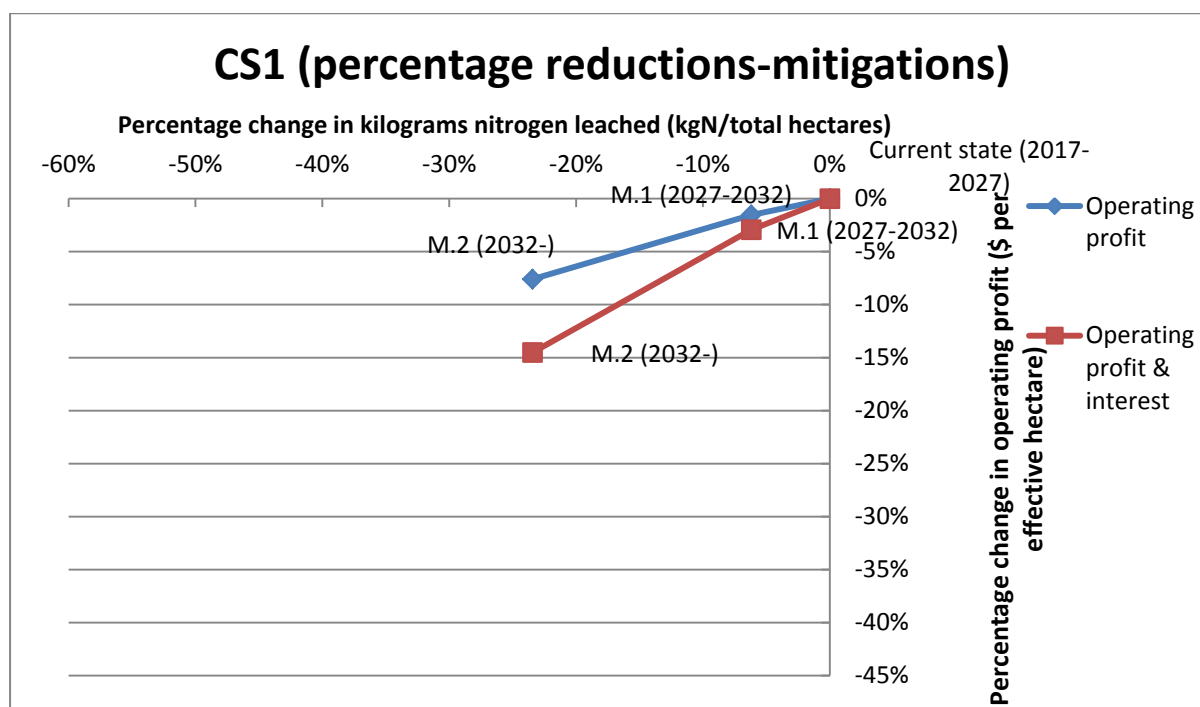
The results of the modelling for each individual case study farm are provided in the following Section, including:

- A summary of the key findings for each farm
- Mitigation strategies and farm system changes required to achieve each PNDA target
- Cost-abatement curves providing the % reduction in farm operating profit for each PNDA target and the impact of interest on this calculation
- A summary of the N and P reductions achieved for each PNDA model scenario

B.4 Findings individual case study farms

Farm 1:

- Minor system changes are required to achieve the 2022-2027 target (e.g. change solid effluent application, shift high risk nitrogen applications and increase stand-off pad usage, some reductions in nitrogen applications, reduce stocking rates and reducing cropping rates), this reduced operating profit (after interest) by 3%.
- To meet the beyond 2032 target significant system changes were made (e.g. changing wintering and young stock practices, remove cropping, reduce fertiliser applications and reduce stock numbers), this reduced operating profit (after interest) by 15%.
- While this farm is currently compliant and able to meet the 2022-2027 target with only minor impacts on operating profit, achieving the target beyond 2027 becomes significantly harder with changes to how the farm system is set up and reductions in operating profit.



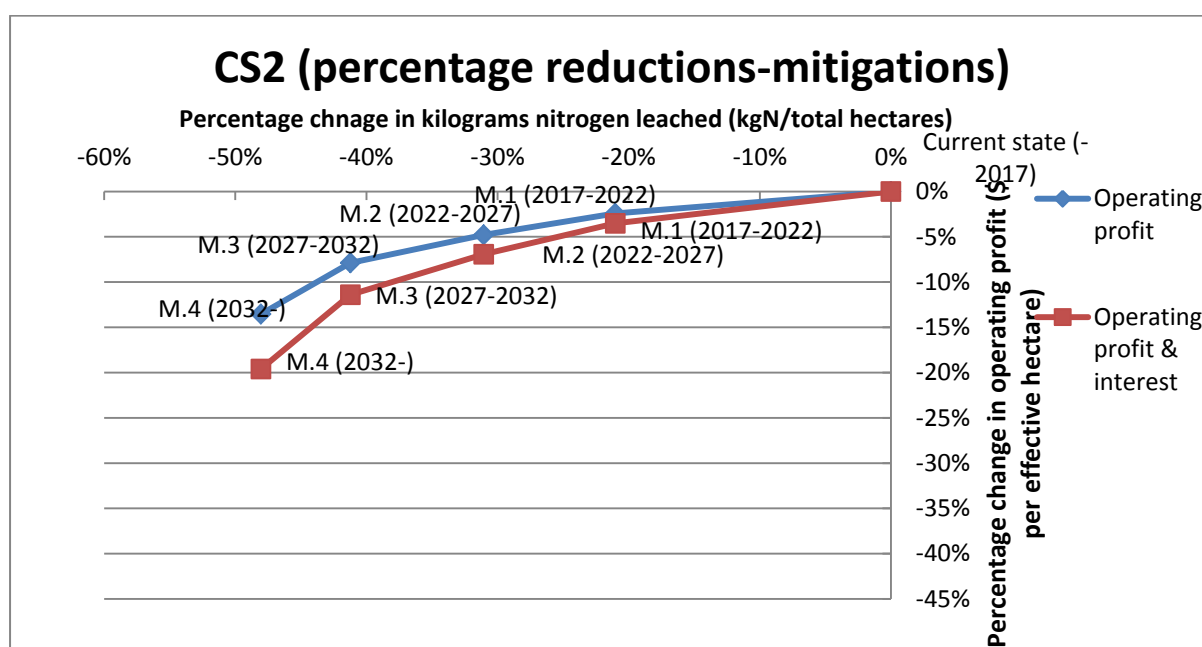
Scenario	Time period	Mitigation
Current State	now-2027	No mitigation is needed until 2027 however an assumption was made that cows will have a \$10 gain in BW each year throughout the scenarios and a support block was added to the farm.
M.1	2027-2032	Increased usage of the wintering pad by standing off 14% of the cows in April, May (6 hours) and June for 14 hours. Reduced nitrogen fertiliser use by removing May application (14kgN/ha) on all blocks. Then reduced stocking rate to match feed supply, peak cows milked reduced by 10 cows. Imported PKE reduced from 350tDM to 337tDM.
M.2	2032-onwards	In addition to 2027-2032, grazed off 1 year old heifers and increased number of cows grazing off from 166 to 262. Cows sent off for grazing by 21 May instead of 1 June. Removed all winter crops from the farm, made silage from the removed winter crop area to feed dry cows in winter. Grass to grass regrassing was assumed on area equivalent to the removed crop. Reduced nitrogen fertiliser by reducing September application from 28-15kgN/ha, removed March application 32kgN/ha on the support block and also removed December nitrogen application 14kgN/ha on the milking platform.

Scenario	Time period	Nitrogen leaching (kg N/ total ha)	Phosphorus loss (kg P/ total farm)	Nitrogen target (kg N/ total ha)	Operating profit (\$/ effective hectare)*	Operating profit after interest (\$/ effective hectare)*
Current State	now-2027	73	488	93.4	2,144	1,123
M.1	2027-2032	68	488	68.6	2,111	1,090
M.2	2032- onwards	56	476	55.6	1,981	960

*Economic impacts are calculated from the default financials specified in the Farmax model and not the actual farms financial information

Results Case study 2

- To meet the 2017-2022 target requires a move away from cropping to imported feed, as well as a reduction in fertiliser application. This reduced operating profit (after interest) by 4%.
- To meet the 2022-2027 target requires additional mitigation through further reduction in fertiliser use, reducing stocking rates to match feed supplies and stopping imported baleage. This reduced operating profit (after interest) by 7%.
- To meet the 2027-2032 target requires further reductions in crops (turnips). This reduced operating profit (after interest) by 11%.
- To meet the >2032 target requires further fertiliser reductions (March and August), further stock reductions, increasing effluent area and early culling. This reduced operating profit (after interest) by 20%.



Scenario	Time period	Mitigation
Current State	now-2017	No mitigation is needed until 2017 however an assumption was made that cows will have a \$10 gain in BW each year throughout the scenarios and a support block was added to the farm.
M.1	2017-2022	Stop growing Maize silage and instead import. To maintain pasture covers, since 11.8 ha is not in crop, reduce a May nitrogen fertiliser to 20kgN/ha on all blocks with the exception of the drystock block, remove November 28kgN/ha application from all blocks, reduce March nitrogen from 32-15kgN/ha on Home, Unsworth and Fredrickson block. Regrass 11.8 ha, grass to grass.
M.2	2022-2027	In addition to 2017-2022 remove May nitrogen fertiliser application on all on all blocks. Then reduce stocking rate to match feed supply. Delay bringing replacements back on platform, consider bringing them back on 10th of July. Since heifers replacements are now off farm, May, June to 10th of July, to manage pasture covers at the same level as the current state file reduce August nitrogen

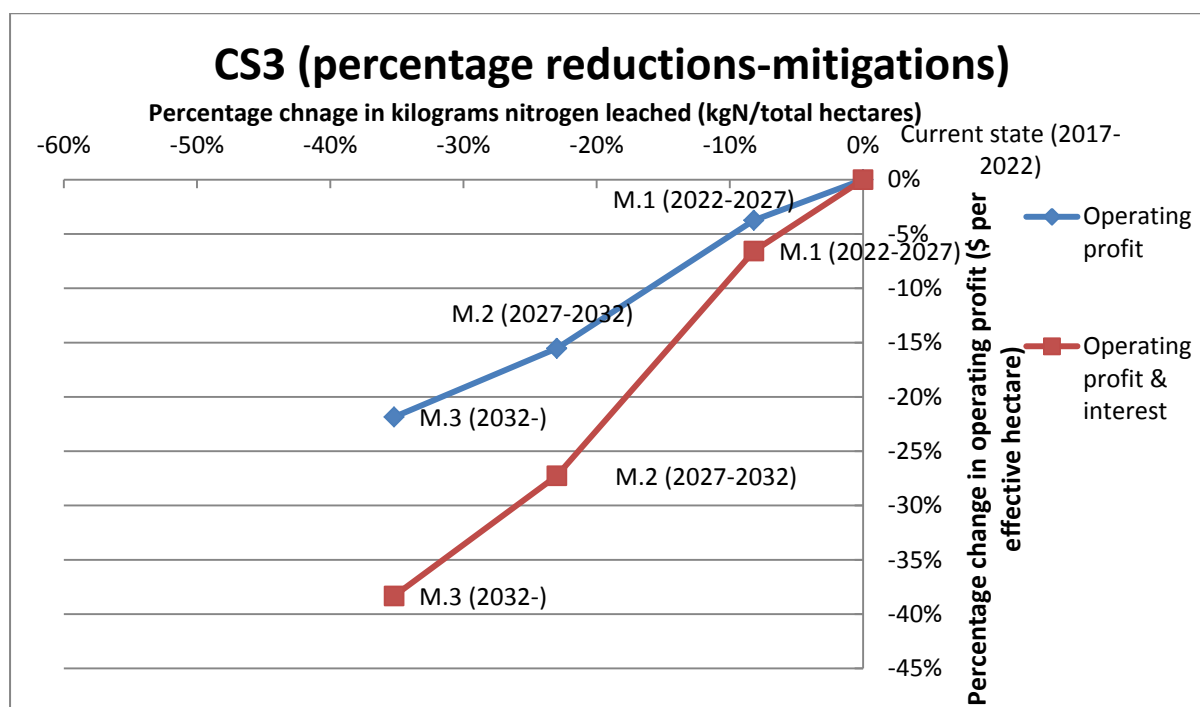
		fertiliser from 28kgN/ha to 15kgN/ha. Stop importing baleage.
M.3	2027-2032	In addition to 2022-2027 remove turnips crop and import extra 64tDM of Maize silage, regrass 14ha that was meant for turnips, grass to grass.
M.4	2032-onwards	In addition to 2027-2032 remove March and August nitrogen fertiliser applications on all blocks. Then reduce stocking rate to match feed supply. Consider early culling, all empties sold by 16th of February. Increase effluent area by 36ha, home block now an effluent block, cost of increasing effluent area, \$12000 for a new pump, \$15/meter for the pipes(estimated 1km worth of pipes) a total capital cost of \$27 000 including installation cost. Added annual cost to the farm will include interest (8%) from the borrowing to meet this, depreciation assuming the pump and pipes will have 6 year life span with no salvage value and for simplicity repair and maintenance will remain the same as in the base file. Added annual costs \$5535, included on Farmax as other expenses. Maize silage reduced from 364tDM to 217tDM.

Scenario	Time period	Nitrogen leaching (kg N/ total ha)	Phosphorus loss (kg P/ total farm)	Nitrogen target (kg N/ total ha)	Operating profit (\$/ effective hectare)*	Operating profit after interest (\$/ effective hectare)*
Current	now-2017	106	652	NA	3,302	2,281
M.1	2017-2022	83	652	83.4	3,222	2,201
M.2	2022-2027	73	652	73.7	3,144	2,213
M.3	2027-2032	62	652	63.2	3,042	2,021
M.4	2032- onwards	55	640	52.7	2,855	1,834

*Economic impacts are calculated from the default financials specified in the Farmax model and not the actual farms financial information

Results Case study 3

- Farm is meeting its targets to 2022
- Farm is slightly (+7kgN/ha) above their targets for 2027 (total hectares).
- To meet the 2022-2027 target some minor system changes are required (e.g. reduce PKE imports, shift high risk nitrogen applications, slightly reduce stocking rate and increase stand-off pad usage) and this reduced operating profit (after interest) by 7%.
- To meet 2027-2032 targets fertiliser use and stocking rate were decreased further. This reduced operating profit (after interest) by 27%.
- To meet the beyond 2032 target significant system changes are required (e.g. changing wintering and young stock practices, remove cropping, reduce fertiliser applications and reduce stock numbers), this reduced operating profit (after interest) by 38%, a significant reduction.
- To meet the 2027-2032 target will reduce operating profit. To meet the 2032 and beyond target it becomes harder with changes to the farm system and significant reductions in operating profit.



Scenario	Time period	Mitigation
Current State	now-2022	No mitigation is needed until 2022 however an assumption was made that cows will have a \$10 gain in BW each year throughout the scenarios and a support block was added to the farm.
M.1	2022-2027	Effluent solids from wintering pad and effluent pond are spread to non-effluent block rather than being spread on effluent block as they are currently. July nitrogen fertiliser (18kgN/ha) on the effluent block was shifted to August. Wintering pad use was increased by standing off 35% of the milking cows for 6 hours in April and May. Nitrogen fertiliser application was reduced by removing the March (34kgN/ha) application on the non-effluent block. Then peak cows milked was reduced by 14 to match feed supply. Summer crop area was reduced by 0.6ha.
M.2	2027-2032	In addition to 2022-2027, nitrogen fertiliser application was reduced by removing the August application on the non-effluent block, reducing the September application from 38-25kgN/ha, November from 38-25kgN/ha and January from 32-18kgN/ha. Then peak cows milked were reduced by 19 to match feed supply. Consider early culling of all empties sold by 15 February. Summer crop area was reduced from 14.4ha to 6.3ha. Added 8.13 ha of regrassing, grass to grass to compensate for the reduced crop to grass regrassing.
M.3	2032-onwards	In addition to 2027-2032, nitrogen fertiliser application was reduced by removing effluent block August application (18kgN/ha) and the September application (25kgN/ha) on the non-effluent block. Heifers were kept off farm and returned on 1 June, 31 May is selected on Farmax to balance the cow numbers. Grazed off 232 mixed age cows as of 15 May, 2 days after dry off (13 May), cows returned on farm 15 July two weeks before the start of calving to comply with animal welfare standards. Since cows are being grazed off earlier and starting pasture covers are high, pasture to feed dry cows was utilised and pasture silage was removed from dry cows' diet. Transferred pasture silage that was being fed to the dry cows to summer feeding and removed the turnips crop. Removed turnip crop had an impact on production.

Scenario	Time period	Nitrogen leaching (kg N/ total ha)	Phosphorus loss (kg P/ total farm)	Nitrogen target (kg N/ total ha)	Operating profit (\$/ effective hectare)*	Operating profit after interest (\$/ effective hectare)*
Current	now-2012	79	358	82.6	2,375	1,354
M.1	2022-2027	73	355	73.1	2,286	1,265
M.2	2027-2032	61	344	62.7	2,006	985
M.3	2032- onwards	51	338	52.4	1,856	835

*Economic impacts are calculated from the default financials specified in the Farmax model and not the actual farms financial information

SUBMISSION ENDS