Module 7: Nutrient Management within the Lake Rotorua catchment

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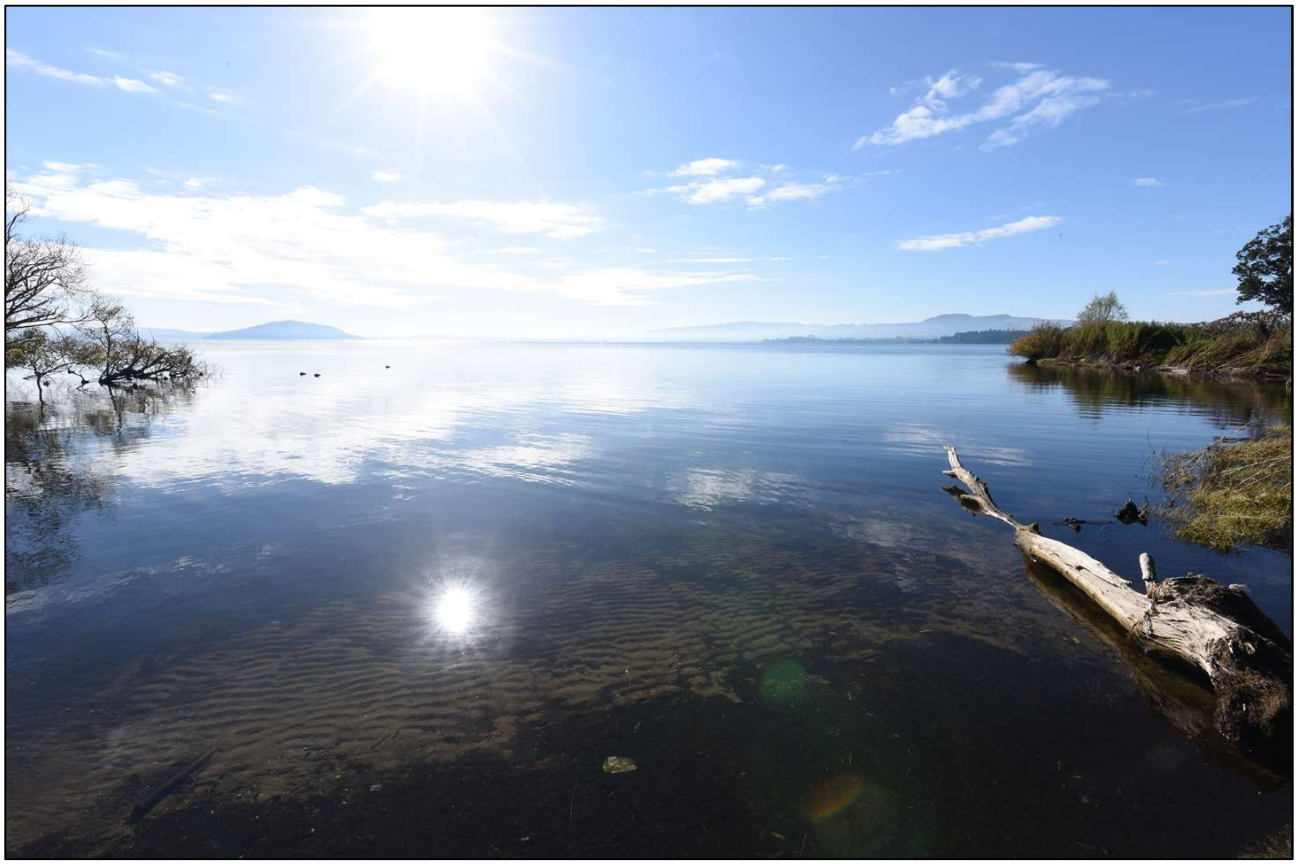


Executive summary

The Lake Rotorua Nutrient Rules (LRNR) require the Bay of Plenty Regional Council Toi Moana to undertake a five-yearly science review of water quality as agreed with key stakeholders. This report focuses on the collection and the presentation of nutrient loss data that has been gathered during the implementation of the LRNR up to the 30 June 2022. The presentation of nutrient loss data in this report will allow comparisons to be made in the 2027 and 2032 science reviews so that progress towards the sustainable nitrogen target can be assessed.

The recommendations of Modules 4 and 10 from the 2017 science review are discussed in Section 2. The recommendations from these modules influenced the implementation of LRNR.

Progress towards the sustainable nitrogen targets

This section reports on the progress made towards reducing nitrogen loss from rural land within the Lake Rotorua catchment. Significant progress has been made by landowners in reducing nitrogen leaching rates from farms. While the LRNR have not required any reductions, analysis of the collected data reveals that farmers have already voluntarily reduced nitrogen loss. Permanent nitrogen reduction through the incentives programme has achieved 30% of the incentives target.

Management on farm to reduce phosphorus loss

Farmers are required to manage farms in a way that mitigates against phosphorus loss from farms in the catchment. The focus has been on cost effective approaches that make sense both to Regional Council staff and farmers. A collaborative approach has been used when coming up with mitigations on farm.

Comparison between sub-catchments

Working with farmers to implement the LRNR has allowed us to gain an understanding of the challenges within different sub-catchments. This section of the report provides an analysis in comparing environmental data collected through the monitoring process and through our environmental funding programmes.

Recommendations from this module:

- Assess the impact of the updated S-map data on nitrogen allocations.
- Assess the new climate data and the effects on nitrogen allocations.
- Engage in new science to improve OverseerFM modelling in the Lake Rotorua catchment.
- Monitor and map gorse growth in the Lake Rotorua catchment area.
- Conduct a physical assessment of the efficacy of wetlands for assisting towards the engineering nitrogen targets.

Site report as:

Kusabs, S. Fraser, S. MacCormick, P. *Module 7: Nutrient Management within the Lake Rotorua catchment*. Bay of Plenty Regional Council Report. 40 p. plus appendices.

Contents

1 Introduction

1.1 Purpose of this report, and who should read it

The purpose of this report is to discuss the monitoring methodology that has been used to keep track of nutrient loss from farms and will present all sources of nutrient reductions across the Rotorua Catchment between 2017 and 2022. The Lake Rotorua Nutrient Rules (LRNR) require the Bay of Plenty Regional Council (Toi Moana) to undertake a five-yearly science review of water quality as agreed with key stakeholders.

This report is intended for key stakeholders, the Lake Rotorua Primary Producers Collective and Lakes Water Quality Society. It is also to inform on progress to our Rotorua Te Arawa Lakes Programme partners, Te Arawa Lakes Trust and the Rotorua Lakes Council.

1.2 Focus of this report

Toi Moana (in this report, also 'we','our','us') is responsible for working with our partners under the Rotorua Te Arawa Lakes Programme to improve water quality in the region. Lake Rotorua has had many years of declining water quality through receiving excess nutrients from the surrounding land use. A target sustainable nitrogen load of 435 tonnes was set in 2010 after scientific advice and extensive consultation with the community. Toi Moana is working with our partners and landowners to achieve the target through the Integrated Framework. The Integrated Framework involves landowners to reduce nutrient loss through a mix of regulation and incentivised land use change.

The LRNR have been introduced to limit nutrient loss from farms within the catchment. The LRNR now have full legal effect, following the Environment Court decision *Federated Farmers of New Zealand Limited and Ors v Bay of Plenty Regional Council and Ors* (Decision No. [2020] NZEnvC 213) that came into effect in April 2021.

Incentivised land use change has involved agreements for gorse removal and incentives agreements where landowners commit to lower nitrogen leaching activities on their land. We have the responsibility to ensure public investment is secured by monitoring these agreements.

Processes and procedures have been developed to effectively implement and monitor the rules and agreements. The collected data enables us to capture the current state of the catchment and report on progress towards meeting the sustainable nitrogen target.

1.3 Scope of this report

This report has a range of aims:

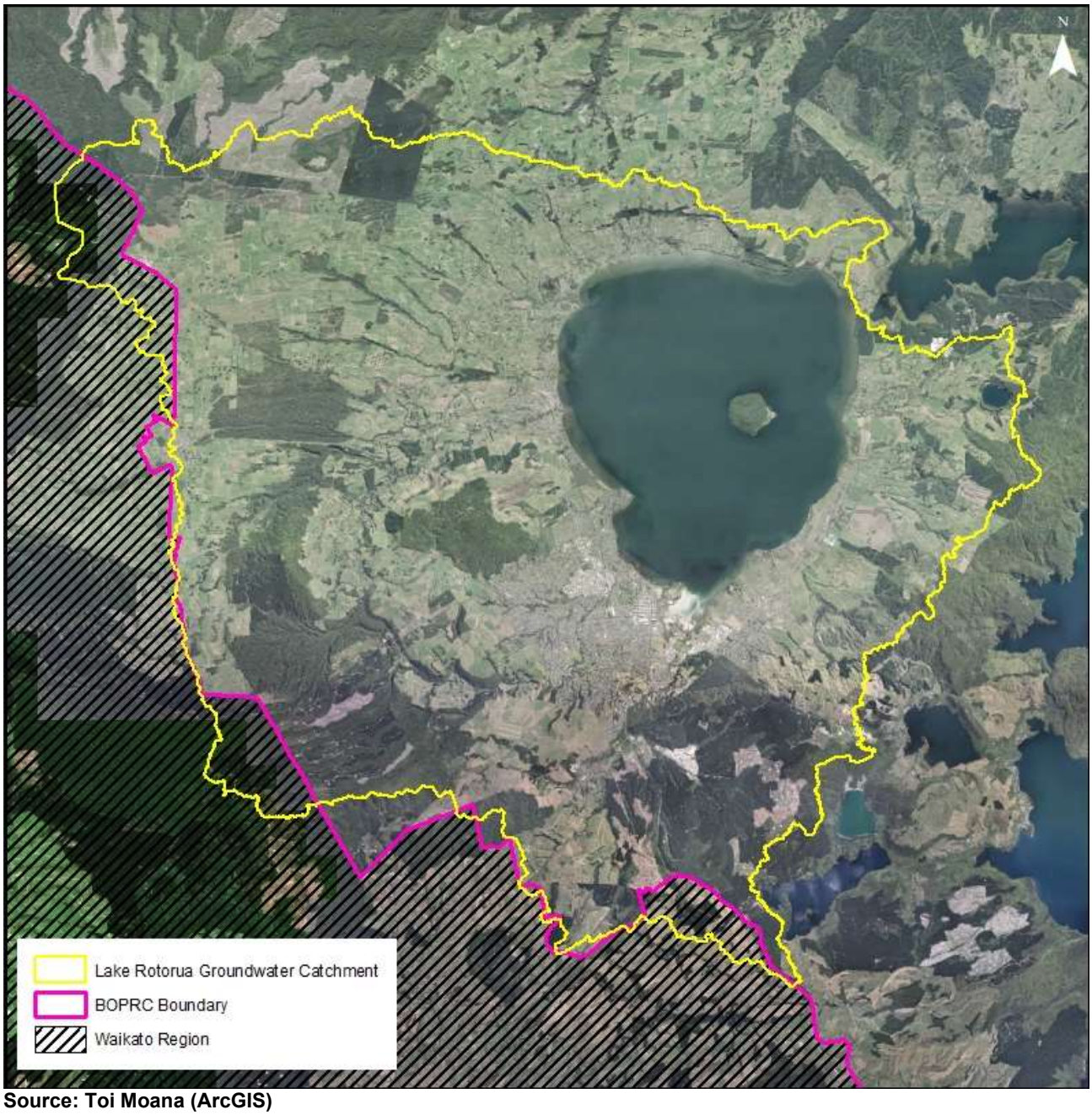
Discuss the terms of reference based on the high-priority recommendations made in Module 4 of the 2017 science review, which was concerned with the methodology used to calculate nitrogen loss.
Discuss the high-priority recommendations made in Module 10 of the 2017 review, which outlined sources of phosphorus and potential mitigation strategies.
Provide an overview of nitrogen loss from rural land use in the Lake Rotorua catchment.
Provide a report on the progress and future opportunities for reducing nitrogen loss from rural land use.
Provide an overview of how phosphorus mitigations are monitored within the Lake Rotorua Nutrient Rules.
Provide a sub-catchment breakdown that shows the different characteristics within the Lake Rotorua catchment.
Find and analyse the gaps within our current monitoring methodology.
Make recommendations for future work needed to improve our knowledge before the next science review in 2027.

1.4 Lake Rotorua catchment area

Lake Rotorua is the second largest lake in the North Island by surface area and covers 81.5 square kilometres. The lake receives water from the surrounding 45,644 hectares (of groundwater catchment). As with other lakes in the region, Lake Rotorua was formed from the crater after a series of violent volcanic eruptions. With an average depth of only 10 metres, the shallow lake allows nutrients and sediment to mix easily through the water column. Too many nutrients can lead to algal blooms and poor water quality.

The lake's water quality is important to the various communities around the lake. In particular, Te Arawa iwi and hapū have a deep spiritual connection to Lake Rotorua. Careful management of the lake's water quality is therefore vital traditionally and for the future wellbeing of all communities who live within the basin (the land where the water empties into the lake). Every New Zealander has a responsibility to work towards improving water quality.

Figure 1 Lake Rotorua catchment and regional boundary affected by the rules



Source: Toi Moana (ArcGIS)

1.5 Structure of this report

This report is divided into seven sections. In this report, ‘we’, 'our' and ‘us’ refers to Toi Moana.

Introduction	**Section 1** The introduction notes the purpose, audience, scope and structure of this report; and shows the Lake Rotorua catchment area.
Recommendations from the 2017 science review	**Section 2** discusses the work undertaken under the recommendations from modules 4 and 10 of the 2017 science review.
Nitrogen accounting — progress towards sustainable nitrogen targets	**Section 3** presents the data of nitrogen accounting to show how we gather and analyse the information already collected. Analysis of the data helps us understand the contributing parameters to nitrogen loss and identify any gaps in our knowledge. Presentation of this data will allow us to show change over time and will help guide and prioritise where further research is needed.
Phosphorus mitigations	**Section 4** discusses the significant progress towards understanding where phosphorus loss occurs at farm scale and the effective ways these sites have been managed. The rural farming community has shown steady progress in managing phosphorus loss from their individual farms.
Understanding the main challenges facing each sub-catchment	**Section 5** focuses on the main challenges facing each sub-catchment. From the information collected, we have a good understanding of the catchment and the various pressures. By breaking down the catchment to a sub-catchment level, we can present the data in a way that helps the rural community better understand their environment. Representatives from the Primary Producers Collective have provided feedback that they would like this breakdown included. We will continue to analyse this information at each science review. This continued analysis will enable us to find changes over time.
Limitations and gaps analysis	**Section 6** discusses gaps in our knowledge and risks to the programme.
Key science review recommendations	**Section 7** presents the recommendations from this report that will guide work to extend our knowledge before the next science review.

Here are some abbreviations commonly used in this report.

CSA	Critical Source Area
NMP	Nutrient Management Plan
LRNR	Lake Rotorua Nutrient Rules
NDMS	Nutrient Data Management System
MRT	Managed Reduction Target
NDA	Nitrogen Discharge Allocation
ROTAN	Rotorua and Taupō Nitrogen
P	Phosphorus

2 Recommendations from the 2017 science review

This section discusses how we have responded to the recommendations made in Module 4 (PC10 Catchment N Accounting) and Module 10 (Land based phosphorus loss and mitigation strategies) from the 2017 science review.

Systems and monitoring methodology for implementing the LRNR were established while consulting the recommendations from these two modules.

2.1 Actions taken after the Module 4 recommendations

Module 4 of the 2017 review had six recommendations: we have prioritised three in our implementation of the LRNR, which are discussed in further detail below. Module 1 of the 2022 science review has covered the other recommendations from Module 4.

> Module 4 (2017) Recommendation: **Define reporting requirements. The reporting requirements determine the information collected and the systems required to manage that information.**

By implementing the LRNR, we have defined what data needs collecting from monitored farms within the Lake Rotorua catchment. Collection of this data enables Toi Moana to track progress towards Lake Rotorua nitrogen (N) targets set through the Integrated Framework using the ROTAN (Rotorua and Taupō Nitrogen) 2011 modelling process.

This report will present the data collected through implementing the LRNR. The following parameters will be reported on:

- Nitrogen loss off farms, revealed from monitoring against the LRNR, shown as modelled losses and geospatial information.
- Nitrogen bought through incentives agreements, shown as modelled gains and geospatial information.
- Gorse agreements, presented as tabular information.
- Phosphorus loss mitigation, shown as geospatial/tabular information.
- Incentivised land use change through environmental programme agreements.

> Module 4 (2017) Recommendation: **Complete development of NDMS (Nutrient Data Management System). The N accounting system must be able to accurately and reliably track changes to allocations arising from N buy outs, trading between properties and shifts within properties.**

The NDMS is a blend of multiple applications (such as GIS), spreadsheets, databases and models (such as OverseerFM). This blend enables reporting of the LRNR allocation accounting and compliance monitoring in the current version of OverseerFM. The NDMS is updated when a new version of Overseer is released.

The aim of the nitrogen accounting system is to track changes accurately and reliably. NDMS captures information for:

- Nitrogen allocations at start point through the managed reduction targets (MRTs) to 2032 nitrogen discharge allocations (NDAs) to meet the Integrated Framework rural land targets.
- Changes to nitrogen allocation through agreements to buy nitrogen from ‘below the line’ nitrogen to the incentives programme.
- Nitrogen outputs for consented farm systems.

- Comparisons between nitrogen allocations of consented farm system and actual year-end farm systems reported.

> Module 4 (2017) Recommendation: **Measure and trace loads from stormwater and sewerage systems to identify areas where N reductions can be made.**

We can identify potential areas for nitrogen reduction by measuring and tracing loads from sewerage systems. All signatories to the Te Arawa Lakes Programme have signed an updated memorandum of understanding about accounting for new reticulated housing from land defined as rural 2001–04.

Landowners can now use a simplified set of subdivision calculators to help them calculate for changes in nitrogen loss due to subdivision of rural land (to rural or urban zoning) and reticulation. Landowners assess the amount of nitrogen they need to carry out their proposed land use, and what portion of that nitrogen they need to set aside for the wastewater treatment plant.

Rotorua Lakes Council and Toi Moana have a mechanism to share information when the Rotorua Lakes Council receives resource consent applications to confirm the calculation for, and number of new connections needed, from the rural area to the wastewater treatment plant.

Rotorua Lakes Council are working through the resource consent application process to ensure Rotorua stormwater is maintained to best practice standards.

2.2 Actions taken after the Module 10 recommendations

Module 10 had 13 recommendations related to managing phosphorus (P) loss from farms. We have prioritised nine in our implementation of the LRNR. These are further detailed below.

> Module 10 (2017) Recommendation: **Improved monitoring data for Olsen P (via soil tests and preferably in a maintained database) for all farms (potentially at block level for use in OVERSEER®).**

Olsen P values are required to be included within consented farm Nutrient Management Plans (NMPs). Olsen P values are commonly used to calculate phosphate fertiliser requirements on pastoral blocks to assist with understanding the plant-available phosphorus in soils. Farmers are required to maintain soil phosphorus fertility within the recommended range described by the Fertiliser Association in its *Fertiliser Use* booklets.

Olsen P values are entered into OverseerFM as farm systems are entered, but we do not maintain a central database. Olsen P actions are captured, monitored and regulated as part of individual consents.

> Module 10 (2017) Recommendation: **Maintain the current soil testing frequency as suggested in the NMP template, with the expectation that soil Olsen P will decrease by 1-2 units per year once the mitigations are implemented.**

Dairy farms are required to test their pastoral blocks every two years and drystock farms every three years, as described within NMPs. Soil Olsen P must stay within the Optimum range, as recommended by the Fertiliser Association. Reduction of Olsen P values is only required when test results indicate the soil fertility is outside the recommended range.

Module 10 (2017) Recommendation: **Ensure good capture (preferably in a maintained database) and monitoring of the state of Farm Dairy Effluent (FDE) storage and land application data.**

Effluent management on farms is monitored by the Toi Moana compliance team when monitoring the dairy effluent consents. Effluent storage and land application records are required to be documented by the consent holders as a condition of the effluent consents. When NMPs are submitted to us the dairy effluent section is assessed to make sure they align with the effluent consent.

Module 10 (2017) Recommendation: **Continue to maintain connections with phosphorus mitigation research and promote and support mitigation research within the Lake Rotorua Catchment, to assess the local applicability of phosphorus mitigations (for example, detention bunds).**

An independent farmer led governance group, the Phosphorus Mitigation Project Inc. (PMP) was established in 2016 to enable and direct continued applied research on detainment bund mitigation performance. Toi Moana was one of nine co-funders supporting the PMP.

The resulting PhD (B Levine 2020) on detainment bund mitigation performance was completed in 2020. The outcome of this is that detainment bunds operated at two trial sites in the Lake Rotorua catchment were shown to mitigate phosphorus and sediment loss from pastoral farm stormwater by approximately 60%.

GIS analysis of Lake Rotorua's catchment have found that there are many sites that are suitable for detainment bunds. To date 33 detainment bunds have been constructed in the Lake Rotorua catchment. These are mitigating the phosphorus and sediment losses from 698 hectares of farmed land.

Module 10 (2018) Recommendation: **Support the development of multiscale spatial approaches to prioritising phosphorus (and nitrogen) mitigation placement to better target phosphorus sources, phosphorus form and phosphorus loss pathways.**

Module 10 (2018) Recommendation: **Develop Council's geospatial database to include implemented phosphorus mitigation actions and phosphorus losses through time.**

Phosphorus mitigation is prioritised by targeting Critical Source Areas (CSAs) of individual farms when the farm NMPs are being developed. As CSAs are identified, they are captured geospatially and are then monitored as part of the process to monitor land use consents. We have developed an effective process to capture CSAs geospatially to allow the effective monitoring of phosphorus mitigation strategies over time. For further analysis of how this process is applied, see Section 4.1.

Module 10 (2018) Recommendation: **Target phosphorus reductions alongside nitrogen reductions (i.e., a dual nutrient reduction approach) given that the phosphorus load target is not achievable through phosphorus "by-catch" associated with nitrogen focussed mitigation alone.**

A mix of approaches are used to target phosphorus reductions that work alongside strategies for reducing nitrogen. Examples of approaches are:

- Good Management Practice, which is expected on-farm with land use consents and defined within the NMP.
- CSA mitigations and management of CSAs, as described above.
- Olsen P monitoring.
- Land use change through the Incentives Programme and environmental programmes.

For more about how these reductions are monitored see Section 4 of this report.

Module 10 (2018) Recommendation: **Build on the existing Nutrient Management Plan template to increase the quantitative and measurable capture of phosphorus nutrient inputs, mitigations and outputs, similar to nitrogen capture.**

Module 10 (2018) Recommendation: **Monitor and report phosphorus mitigation implementation and loss data (initially via nutrient budgets in the NMP) for all farms in the Lake Rotorua Catchment and refine the criteria around the collection, recording, storage of data, as well as NMP implementation monitoring and auditing.**

Module 10 from the 2017 review identified the lack of measurable phosphorus mitigations as a limitation of the NMPs. There is no reliable and cost-effective modelling tool that allows us to quantify the amount of phosphorus being lost off individual farms.

The LRNR do not require us to measure or quantify reduction of phosphorus within NMPs. Phosphorus mitigation strategies are discussed with individual consent holders and included within NMPs. Visual and physical assessment of the CSAs and farm systems are used to monitor and report on progress towards reducing phosphorus loss from farms.

Our focus for monitoring phosphorus loss from farms is by discussing good management practices with landowners and by using visual and geospatial assessments, and assessments to inspect CSAs to check the correct use of mitigation strategies.

Module 10 (2018) Recommendation: **Develop Council's geospatial database to include implemented phosphorus mitigation actions and phosphorus losses through time.**

We have developed an effective process to capture CSAs geospatially to allow the effective monitoring and reporting of phosphorus mitigation strategies over time. For more information on our monitoring process, see Section 4.

3 Nitrogen accounting – progress towards a sustainable nitrogen target

The nitrogen budget and the Integrated Framework reductions for the lake were originally calculated in OVERSEER® v5. The Integrated Framework reductions to achieve the sustainable nitrogen target for Lake Rotorua involves these reductions:

- 140 tonnes from LRNR,
- 100 tonnes from the incentives programme,
- 50 tonnes from engineering solutions, and
- 30 tonnes from gorse.

These reductions are required to achieve the 435 tonnes of nitrogen to achieve the sustainable in lake load by 2032. The reduction in nitrogen to be achieved by 2032 through the LRNR was calculated as a reduction of:

- 35.3% from the 2001–04 dairy sector blocks, and
- 17.2% from the 2001–04 drystock sector blocks.

The nitrogen losses modelled between 2001 and 2004 (the benchmarking period) from the pastoral sector have been updated to OverseerFM v6.4.3 to allow comparison with the nitrogen losses from the monitoring data received in the current version of OverseerFM.

3.1 2021 Nitrogen Losses in the Lake Rotorua catchment

The LRNR are based on the estimated risk of nutrient loss from the farm. A key factor in the potential magnitude of nitrogen loss is the size of the land being used for farming practices (known as ‘effective area’). As part of the LRNR we are required to monitor farm OverseerFM analysis to see how actual year end farm systems compare with the modelled predictive farm systems. Several years of monitoring data have now been gathered for:

- Properties of over 40 hectares effective area that were either assessed as a permitted activity or have a consent (LRR9 and LRR7).
- Properties of less than 40 hectares effective area that have engaged with us (LRR8 and LRR7).
- Properties of any size that have an incentives agreement and are engaging in less intensive farming practices.

Forestry, bush and small lifestyle blocks (up to 10 hectares) are captured within the LRNR under the permitted activity rules. Landowners are permitted as long as they meet the conditions of the permitted activity rules. The majority of the land blocks that fit within the permitted activity rules have not been assessed or monitored as our staff resources have been focused on the larger land parcels. For these properties, geospatial modelling uses the nitrogen allocation for each hectare to estimate nitrogen loss (known as 'scripting'). Properties that fall within the scripted category include:

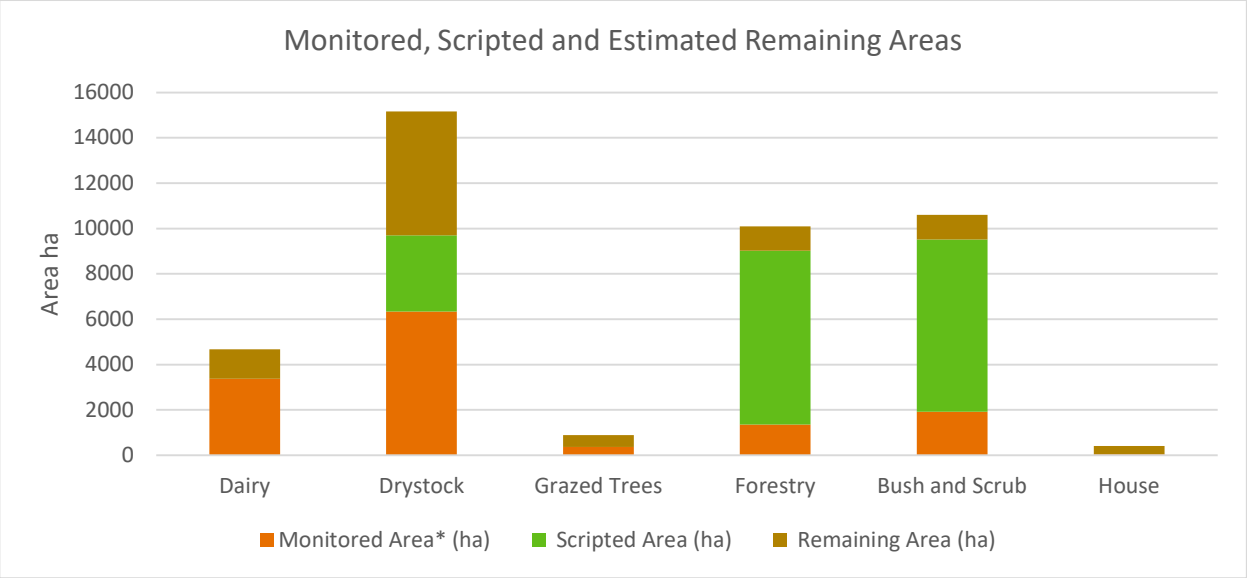
- Forestry and bush (LRR2).
- Properties of less than 5 hectares (LRR3).
- Properties between 5 hectares and 10 hectares (LRR4).

The remaining area of the catchment has either not been assessed as permitted activity or requires a resource consent. The 'remaining area' is split between two categories:

- Properties of over 40 hectares effective area that need a consent or need to be assessed as a permitted activity (LRR9 or LRR7).
- Properties of over 40 hectares effective area that have a consent but have not submitted any monitoring data (LRR9).
- Properties between 10 hectares and 40 hectares that have not been assessed (LRR9 or LRR7).

Figure 2 compares the 'monitored area', 'scripted area' and the 'remaining area' for each land use.

Figure 2 : Monitored area, scripted area and remaining area for each land use



Source: Toi Moana (OverseerFM, ArcGIS)

Table 1 shows a breakdown of the total hectares in the catchment.

Table 1 Breakdown of monitoring status in hectares

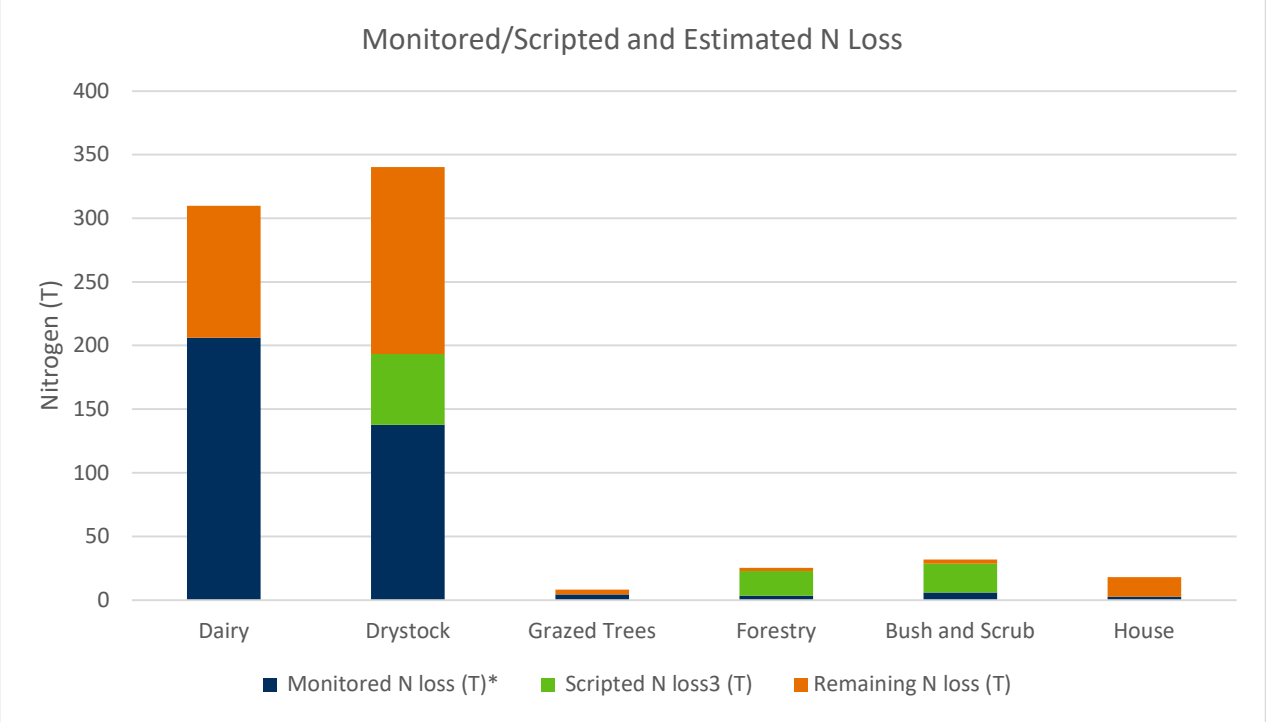
Type of activity	Number of hectares	Comment
Monitored	13,368	
Geospatially scripted	18,608	

'Remaining area' neither monitored nor geospatially scripted	9,918	• May have a recent resource consent, but no monitoring data received to date.
		• The 2022 allocation has been used to estimate the nitrogen loss.
		• Excludes these hectares of areas (that make up the total catchment area of 53,790 hectares):
		  • Lake: 8,144 ha
		  • Reticulated housing in the urban area: 2,723 ha
		  • Urban open space: 520 ha
		  • Roading: 509 ha

Source: Toi moana (ArcGIS)

Figure 3 shows the nitrogen losses for the various areas of land use. The figure includes monitoring data where it exists, estimated nitrogen losses for areas that are 'scripted' and allocation data for the 'remaining area'. The nitrogen losses for the area that is scripted is 57% of the drystock reference file for the effective area – this equates to 16.6 kg N/ha in OverseerFM v6.4.3. Nitrogen losses of 2.5 and 3 kgN/ha have been used for the tree blocks.

Figure 3 Monitored, scripted and estimated nitrogen loss by land use

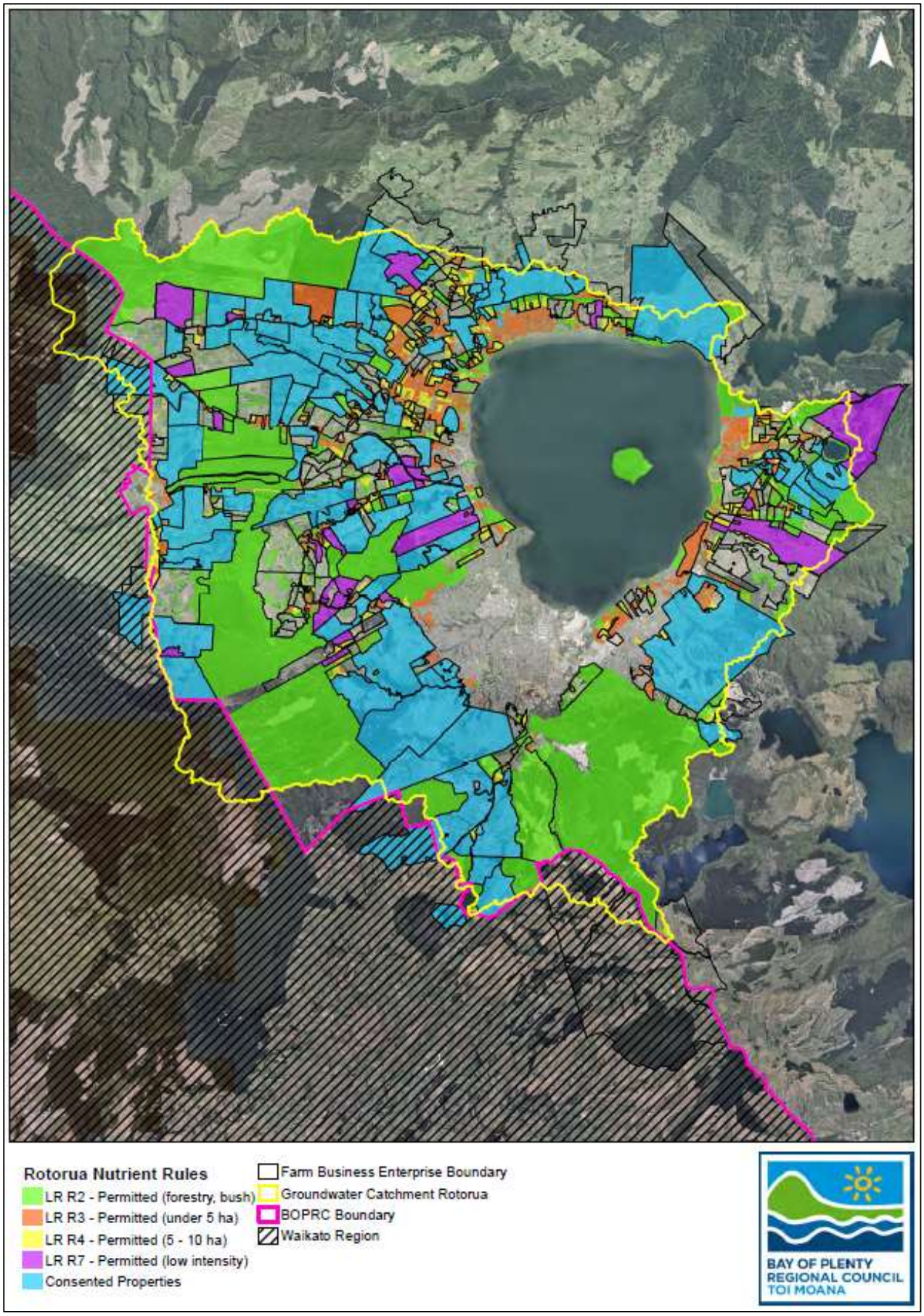


Source: Toi Moana (OverseerFM, ArcGIS)

As we continue to implement the LRNR, farms under 40 hectares effective area will need consent from 1 July 2022 or will be required to apply for permitted activity status.

As more farms become compliant within the LRNR (they meet their start points and provide monitoring data), the scripted assumptions will reduce to allow a more accurate picture of the nitrogen status of the catchment. As identified in the 2017 review, we do not know the actual nitrogen losses from small lifestyle blocks.

Figure 4 Lake Rotorua catchment with assessed properties



Source: Toi Moana (ArcGIS)

3.2 Land use change between the benchmark period (between 2001 and 2004) and the monitoring period (between 2020 and 2021)

Under the LRNR, the first managed reduction target came into effect on 1 July 2022.

Work to date has been ensuring that the farm systems operated by landowners in the Lake Rotorua catchment:

- Have nitrogen losses within their 'start point' or 'benchmark.
- Have a plan that shows how they will meet the reductions required by the rules.

The data collected is ensuring that nitrogen losses from the farm systems have not increased from the benchmark period in the current version of OverseerFM v6.4.3.

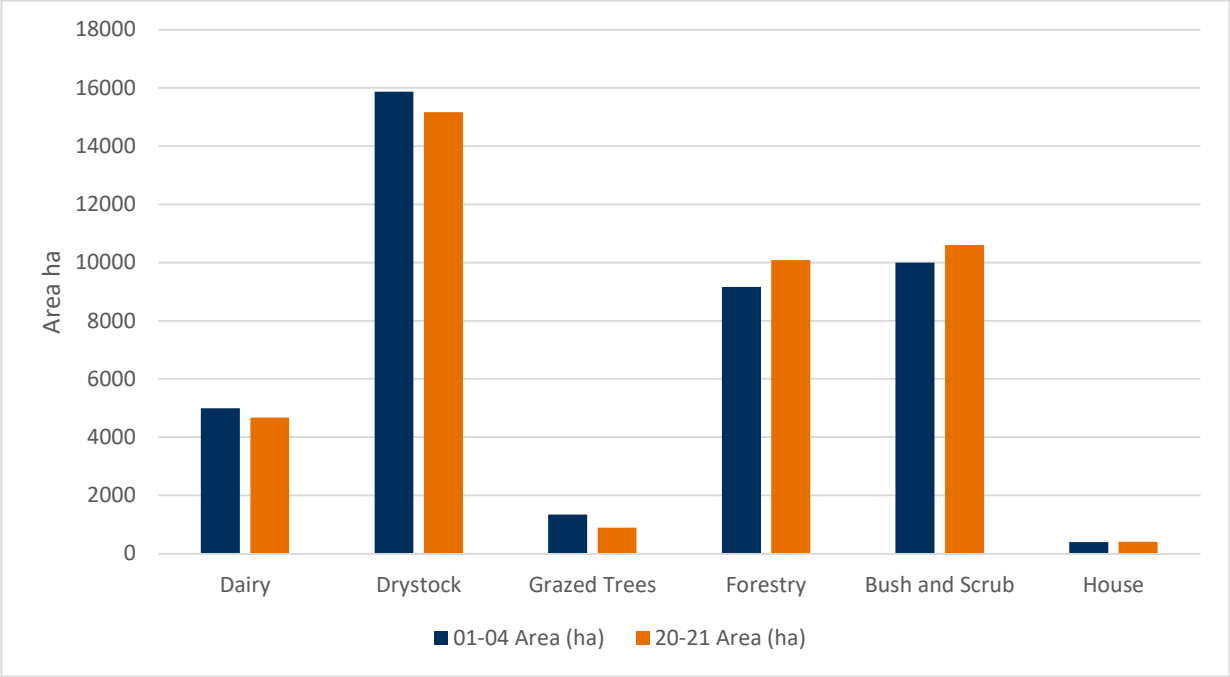
Table 2, and Figures 5 and 6, outline the changes in land use since the benchmark period. The area covered in the 2020 to 2021 monitoring period that we are reporting on is based on monitoring area, scripted area and the benchmark land use area. The nitrogen loss is based on monitoring data, scripted data and the 'Start point' for the balance of the area assuming that farm systems are being run within the rules.

Table 2 Change in land use and nitrogen loss between 2001 and 2004 and between 2020 and 2021 v6.4.3

	2001-2004		2020-2021	
Land use	**Area (ha)**	**Nitrogen (t)**	**Area (ha)**	**Nitrogen (t)**
Dairy	4990	402	**4543**	**309.8**
Drystock	15873	466	**15159**	**340.3**
Grazed Trees	1346	10	**895**	**8.2**
Forestry	9163	23	**10086**	**25.3**
Bush and Scrub	9994	30	**10586**	**31.9**
House	396	27	**272**	**17.9**
Reticulated housing	2589	13	**2723**	**15.9**
Urban Open Space	522	11	**520**	**11.1**
Non-grazed Grass			**13**	**0.0**
Lake or waterway	8145	0	**8144**	**0.0**
Non-productive	237	0.1	**339**	**0.2**
Roading	534	0.3	**509**	**0.3**
Total	**53789**	**982.4**	**53790**	**760.9**

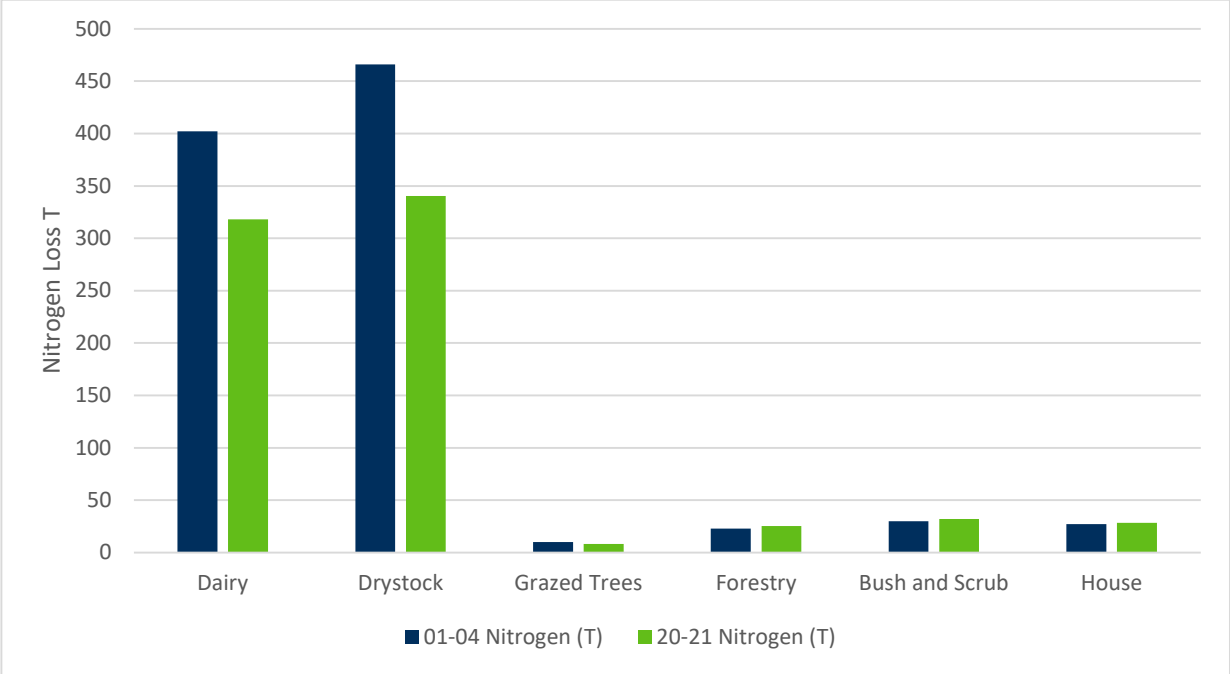
Source: Toi Moana (OverseerFM, ArcGIS)

Figure 5 Change in land use area between the benchmark period and the monitoring period



Source: Toi Moana (OverseerFM, ArcGIS)

Figure 6 Change in nitrogen loss by land use between 2001 and 2004 and 2020 and 2021



Source: Toi Moana (OverseerFM, ArcGIS)

3.3 Tracking towards the sustainable load of 435 tonnes nitrogen in Lake Rotorua

The load to land has reduced from 982 tonnes to 761 tonnes between 2017 and 2022. This is a combined nitrogen loss figure of monitoring farm data and scripting and allocation data as described in the previous section. The load to land includes the nitrogen reductions achieved on farm through the LRNR and the Incentives Programme as at the time of this report.

Farmers have voluntarily made a significant portion of the progress towards the sustainable target described above. Yet this progress should not be viewed as permanent reductions. The LRNR allow landowners who are operating below their 'start point or Managed Reduction Target'(MRT) to increase nitrogen losses up to their limit. Significantly, some landowners are already operating their farm system at their 2032 NDA.

Another reason for the drop to the modelled 761 tonnes is nitrogen leaching figures include the reduction in allocation of nitrogen from non-benchmarked properties as a result of Environment Court Decision *Federated Farmers of New Zealand Limited and Ors v Bay of Plenty Regional Council and Ors* (Decision No. [2020] NZEnvC 213). The purpose of the reduction was primarily to allow for the reallocation of approximately 11 tonnes to Te Ture Whenua Māori Act to low intensity farming. Allocating nitrogen to Te Tura Whenua land, enables landowners to increase production capacity into pastoral land use. The monitoring period data in this report and shown in Table 2 and Figure 6, has included the 53.4T reduction from the reallocation of nitrogen in OverseerFM v6.4.3. By 2032 the net change to nitrogen allocations because of the reallocation will be 28.4T in OverseerFM v6.4.3. A total of 800 ha of Te Ture Whenua land is eligible to apply for consent to increase their nitrogen allocation to convert to low intensity pastoral land use. This could see nitrogen leaching rates increase from these properties.

The reductions that rural landowners need to achieve is ongoing, with the first tier of reductions due from July 2022. Rules for landowners with less than 40 hectares effective land come into effect from July 2022, and work is ongoing to assess these properties. Through this consultation they will understand what their obligations are.

3.4 The target of the 100 tonnes Incentives Programme

The 100 tonnes of nitrogen reduction required by the Incentives Programme was included as part of the Integrated Framework adapted from ROTAN in 2011. There has been land use change on 4626 hectares of land by 24 landowners in the catchment to reach 30% of the incentives target for the Incentives Programme. These figures only include the legal agreements that have been encumbered. There are a number of agreements still being worked through.

These reductions are part of the community contribution, with financial payments made for a permanent reduction to the property NDA. The original date for this programme was 1 July 2022 with all target reductions made. The deadline for reaching the target has been extended to 1 July 2027.

Table 3 shows the difference between land use sectors in the benchmark period between 2001 and 2004 and the new agreed sectors as a result of the incentives programme.

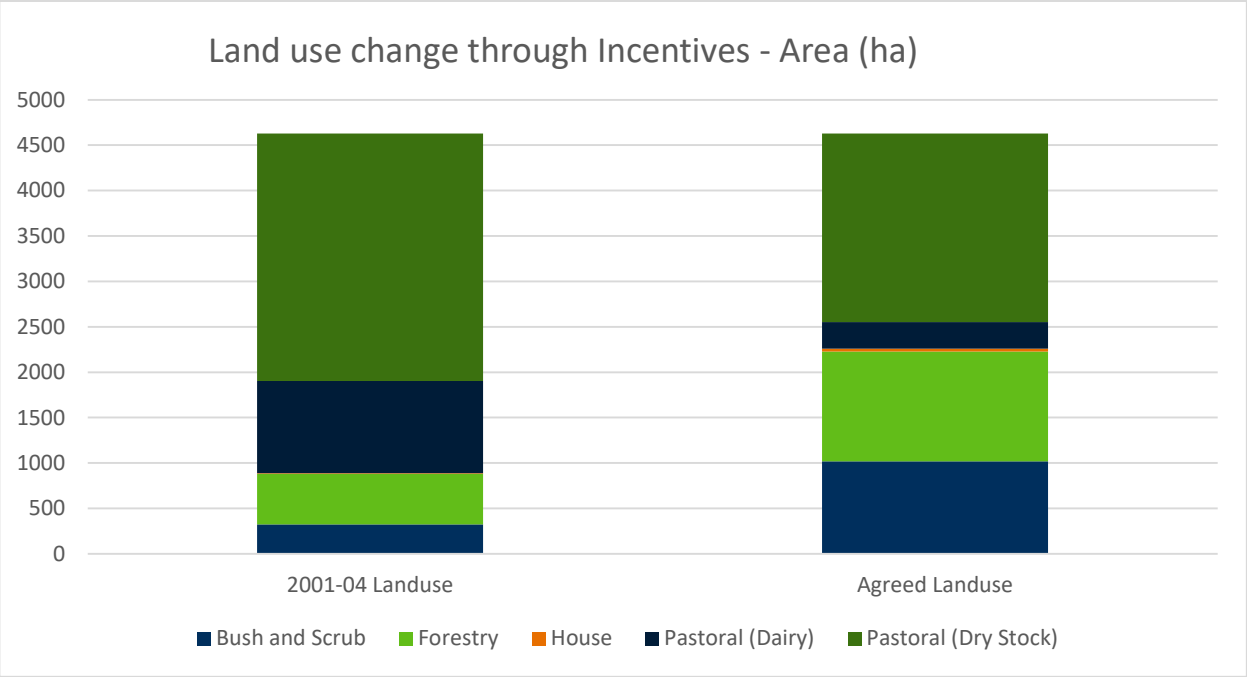
Table 3 Change in area of land use before and after incentives agreements

Land use Sector	2001-04 Land use (ha)	Agreed Land use (ha)
Bush and Scrub	324	1020
Forestry	557	1208
House	7	32
Pastoral (Dairy)	1014	292
Pastoral (Dry Stock)	2723	2074

Source: Toi Moana (OverseerFM, ArcGIS)

Figure 7 shows the difference in hectares undergoing land use change following agreements from the Incentives Programme.

Figure 7 Land use change through incentives



Source: Toi Moana (OverseerFM, ArcGIS)

3.5 Engineering solutions – analysis and future directions

The Integrated Framework sustainable water quality solution for Lake Rotorua was agreed to by all partners of the Te Arawa Lakes Programme and the Stakeholder Advisory Group in approximately 2015. Part of that framework was that 50 tonnes of nitrogen reduction (toward the 320 tonne reduction target) was to be made through engineering solutions. The viable solutions to contribute to the 50 tonne target have evolved over time, at the time of writing this report they are sewerage reticulation and wetlands.

3.5.1 Sewerage Reticulation

The Water Quality Technical Advisory Group has always advised reducing catchment nutrients via sewerage reticulation, where those opportunities are available across the Te Arawa Lakes catchments. Sewerage reticulation reduces nutrients, but also pathogens and thereby provides protection of public health. The programme has delivered widescale reticulation of lakeside communities across its catchments since 2010, and has further reticulation planned.

With the support of funding from the Rotorua Te Arawa Lakes Programme, Rotorua Lakes Council have reticulated 669 lakeside properties in the Lake Rotorua catchment. Out of date onsite effluent disposal systems (present during the benchmarking period 2001-2004), have been replaced with reticulated sewerage connections back to the Rotorua Wastewater Treatment Plant. Having reticulation available in these lakeside communities, also means that new buildings are able to connect, and therefore don't send their wastewater to onsite systems. As a result of reticulation of those lakeside properties in the Lake Rotorua catchment, a net reduction of 7 tonnes of nitrogen to the lake has been achieved. Figure 8 shows the location of the reticulated properties.

Figure 8 Houses in the Lake Rotorua catchment that were reticulated since the benchmarking period

Source: Toi Moana and Rotorua Lakes Council (ArcGIS)

There are some future opportunities that could be pursued in terms of reticulation in the Lake Rotorua catchment. Two examples are:

- A project to require connection of those properties that have reticulation available at their gate but have not connected.
- The reticulation of Mamaku village.

3.5.2 Tikitere De-nitrification Plant and Wetlands

At Tikitere, a geothermal flow releases a high nitrogen concentration to the Waiohewa Stream. It is estimated that 20-30 tonnes of nitrogen in the form of ammonia flows to Lake Rotorua from here. At the time of the commitment to the Integrated Framework, it was expected that around 25 tonnes of the 50 tonne engineering solutions target would be removed by the Tikitere de-nitrification plant. In September 2018 the Rotorua Te Arawa Lakes Programme resolved to discontinue the Tikitere project because of escalating construction costs (around $10 million) and ongoing operational costs in perpetuity to ensure the nitrogen continued to be removed (around $1 million per year). There were also concerns that the technology to be used was not proven on a commercial or large scale, and there was uncertainty around whether the project would deliver the required benefits in terms of nitrogen reduction.

Following the decision to discontinue the Tikitere project we looked back at the options previously investigated in terms of engineering solutions for nutrient removal in the Lake Rotorua catchment. We commissioned Wildlands to review the options for large scale nitrogen reductions in the catchment.

That resulting Wildlands report highlighted wetlands as the most viable option for nitrogen reductions through physical engineering intervention in the catchment. It was noted that the viability of wetlands was enhanced because of the other benefits they would bring, e.g., biodiversity, stormwater retention and amenity benefits – unlike the single benefit that the Tikitere Plant would deliver.

In October 2020, we commissioned Syrinx, a company specialising in green infrastructure solutions to produce a report specifically on wetlands. The scope of the report focused on wetlands and provided some important information to direct future work in this space. Key focus points of the report were to:

- Review work previously undertaken on wetlands in the catchment.
- Propose key sites for constructed wetlands.
- Quantify potential nutrient removal.
- Advise on phases for potential project development.
- Provide indicative construction and monitoring costs.

The Syrinx report identified three priority sites for constructed wetlands, based on the most viable areas to get effective nitrogen removal. The report also identified additional interventions, including rural drain wetlands and paludiculture wetlands. Rural drain wetlands are the restoration of wetlands that have previously been drained for farming activities. Paludiculture wetlands are planted with species that have a commercial or cultural value for harvesting.

Engagement has commenced with landowners and mana whenua of two of the identified priority constructed wetland sites and the owners of two sites suitable for rural drain wetlands. Work with those parties continues, with funding for construction of these available under the Deed of Funding for the Rotorua Te Arawa Lakes Programme from now until 2032. It is estimated that constructed wetlands identified by this report can remove between 18-29 tonnes per year of nitrogen from the catchment; the Syrinx report also estimates that 18 tonnes per year could be removed through

rural drain wetland restoration. The viability of each of these projects is dependant on funding and land availability.

3.6 Gorse agreement analysis

The Lake Rotorua Gorse Programme was expected to reduce the amount of nitrogen leaching to Lake Rotorua by 30 tonnes. The way to achieve this was by converting mature gorse (existing in the benchmarking period), to either forestry, native bush or other land uses where nitrogen leaching is low.

The initial survey of mature gorse stands in the catchment, estimated the Lake Rotorua catchment had approximately 870 hectares of gorse (Hamill et al. 2010). In 2019, this estimate was updated to 1192 hectares after Landcare Research did a flyover survey of flowering gorse in the catchment.

A combination of control methods have been used to control gorse. As of 2019, Gorse Agreements (through the Lake Rotorua Gorse Programme) controlled about 267 hectares of gorse in the catchment. Alternative channels (such as Incentives Agreements, Environmental Programmes and landowner led interventions) have managed to control a further 596 hectares.

An estimated 226 hectares remain as uncontrolled gorse, which has not otherwise been classified. A large extent of this uncontrolled gorse is on land where the landowner does not yet have a consent under the LRNR. When consent is gained, gorse will be controlled as required under their consent conditions. Some of this uncontrolled gorse is within bush blocks and surrounding wetland; this uncontrolled gorse may be addressed through future environmental programmes. The Rotorua Catchment team will continue to look for opportunities to control gorse through available funding avenues.

The total amount of gorse in the catchment will change over time as new growth appears, and mature stands are controlled through the various means described above; intermittent flyovers will help to ensure gorse in the catchment remains well managed.

Table 4 shows how all gorse tracts identified by the 2019 flyover have been managed in collaboration with various landowners. A map of the gorse and how areas have been controlled can be seen in Appendix 1.

Table 4 Management of gorse tracts after collaborating with landowners since 2017

Classification	Area (ha)	%
Gorse Agreements	266.67	22
Incentives Agreements	190.16	16
Plantation Forestry	111.19	09
Environmental Programme	95.39	08
Lake Rotorua Nutrient Consent	161.57	14
Retired independently by landowners	20.56	02
DOC land	17.60	01
Uncontrolled gorse	225.52	19
Paper roads, streams, road verges, rail corridor legal parcels	14.65	01
‘Not gorse’ – misidentified species including broom and brambles (field checked)	88.58	07
TOTAL	**1191.89**	**100**

Source: Toi Moana (ArcGIS)

4 Phosphorus mitigation

Module 10 of the 2017 science review summarised the available research and information on anthropogenic (or human induced) land-based phosphorus losses and mitigation strategies for the Lake Rotorua catchment. This section of the report expands on how the recommendations from that module have been implemented through a regulatory pathway that requires farmers to address phosphorus loss described in their NMPs.

Environment Court decision *Federated Farmers of New Zealand Limited and Ors v Bay of Plenty Regional Council and Ors* (Decision No. [2020] NZEnvC 213) on the rule's framework for Lake Rotorua, included the need for farmers to identify and mitigate phosphorus loss from their farms. This requirement came into force on 15 August 2017. The NMP template was then amended to include:

- The need to identify specific CSAs and describe mitigation strategies to reduce phosphorus loss.
- The requirement to monitor phosphorus fertility levels across individual farms.
- The need to reduce phosphorus loss by following industry good management practices.
- National Environmental Standards for Freshwater Management (NESFM) that were introduced by the Government in 2021.

4.1 Management of Critical Source Areas

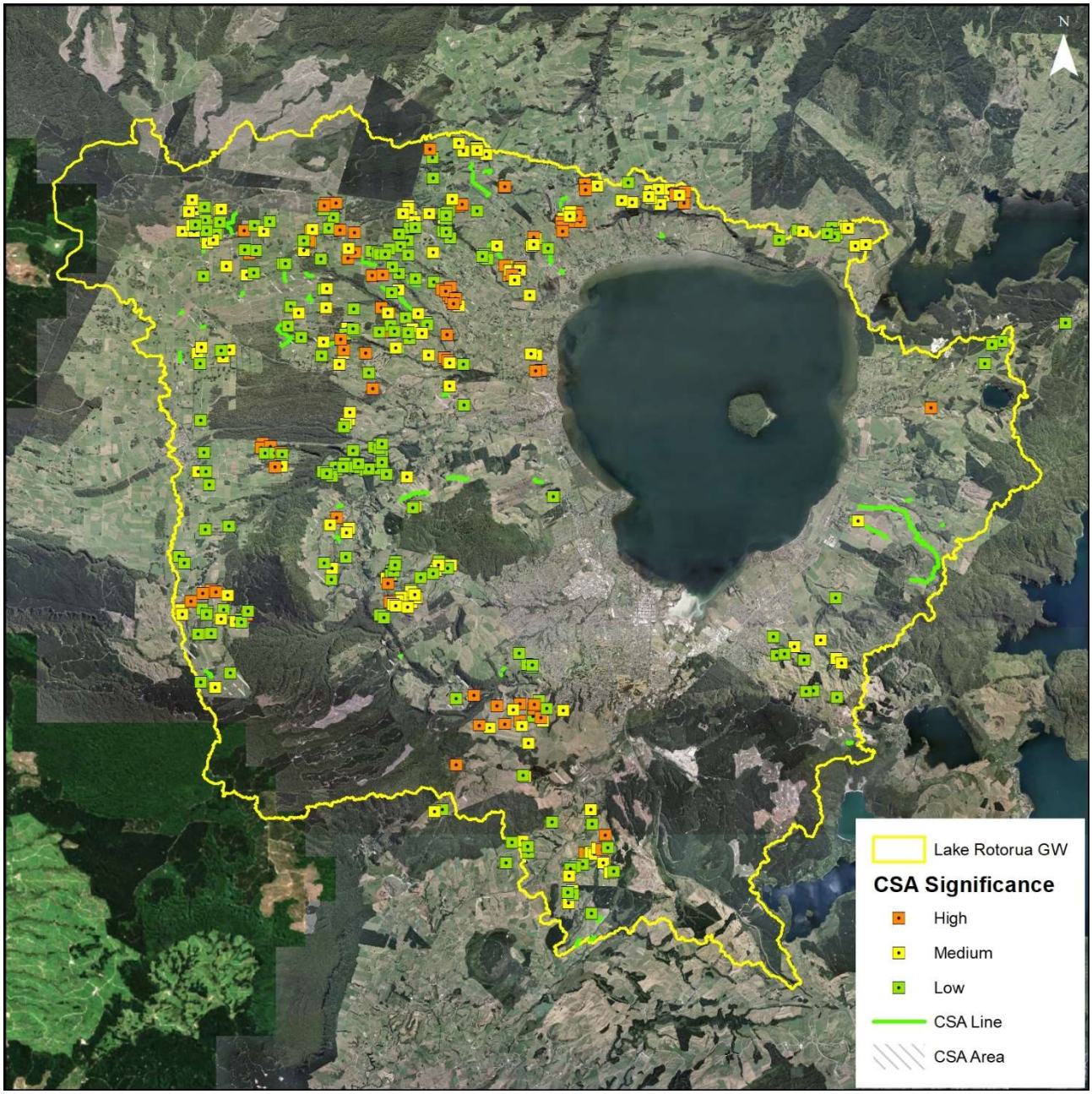
CSAs occur where soil is exposed and sediment and nutrient can be mobilised to enter waterways. Areas where stock are concentrated (such as around gateways and troughs) or soil is exposed (such as after cropping and strip grazing) need to be carefully located and managed. Effective management of these CSAs not only reduces nutrient and sediment loss but has productive benefits for the farm. Loss of topsoil and nutrients from farms is reduced and stock receive health benefits when they are kept away from areas that historically produce mud.

Mitigation measures for CSAs were included in NMPs following the Environment Court decision *Federated Farmers of New Zealand Limited and Ors v Bay of Plenty Regional Council and Ors* (Decision No. [2020] NZEnvC 213).

We supplied maps to landowners that identified steep areas and defined the lower lying routes where rain activated runoff flows in high concentrations. These maps were used to target and prioritise the high risk areas for where CSAs could occur. Land Use Advisor consultants then walked the farm with the farmer to identify problem areas. CSAs on each farm were then identified as part of the NMP development phase.

Each CSA is rated low risk, medium risk or high risk based on how significant the source for nutrient loss is from each site. CSAs managed effectively are rated as completed. An example of this could be where a trough or gate is removed from a flow path and relocated.

Figure 9 CSA distribution in the Lake Rotorua catchment



Source: Toi Moana (ArcGIS)

As identified in Module 10, research by McDowell (2012) found that applying mitigation strategies to target CSAs was 6-7 times more cost-effective than applying the strategies across entire paddocks of the farm. We understand the importance of mitigation strategies to be cost effective for farmers.

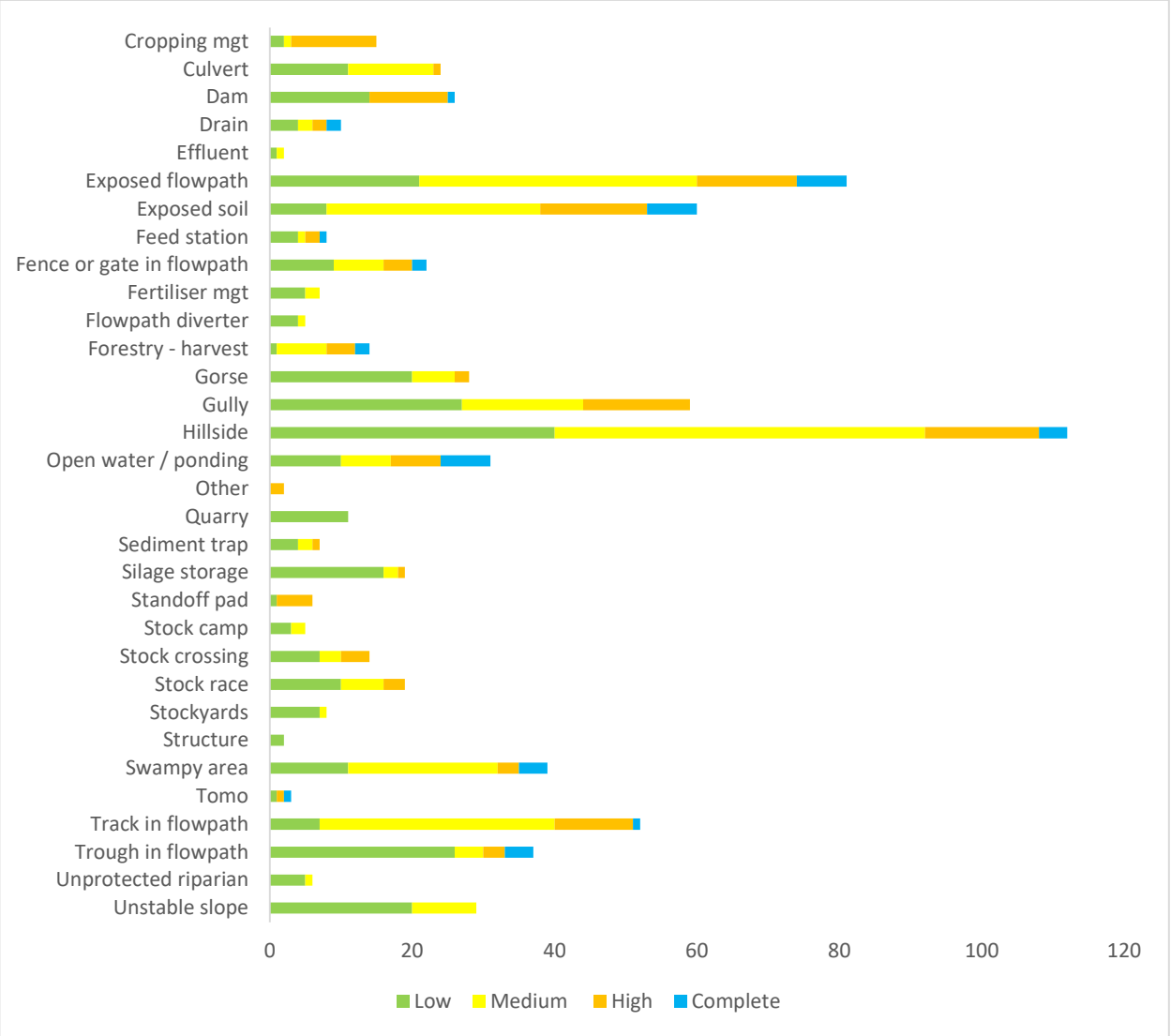
Our approach to date to monitor how CSAs are managed on farm has relied on the farmer taking the lead. Often the farmer has suggested timely mitigation strategies, leading to real progress towards managing CSAs effectively. In several instances we have worked collaboratively with farmers to manage problem areas on the farm (see Photo 1).

Photo 1 Shows the retirement of an ephemeral flow path where the flow path was eroding in many places. The area within the protection area has since been planted with trees.

Photograph: Toi Moana.

Every CSA can be managed differently, and each farmer will have different strategies for how they want to deal with them. It is up to the individual farmer as to what works best on their farm. Our job is to monitor the progress towards reducing phosphorus loss from each CSA and see whether the farmer led intervention is working or not. Geospatial and visual data capture (using photos) help us to track change over time and assess mitigation effectiveness

Figure 10 Distribution of CSA types within the Lake Rotorua catchment



Source: Toi Moana ArcGIS

4.2 The Olsen P section within the NMPs

McDowell (2010) identified that maintaining a balanced phosphorus fertility is a critical means of managing phosphorus loss from agricultural land. It is also one of the most cost-effective strategies: maintaining the inputs of phosphorus to match the farm system outputs will prevent paying for surplus fertiliser.

A section in the NMP refers to monitoring phosphorus fertility through regular Olsen P tests.

- Consent holders must keep Olsen P test results between the recommended range, as described by the Fertiliser Association. If farm Olsen P tests are identified as being too high, then strategies need to be identified to bring the results back within the recommended range.
- Dairy farmers must test soils every two years and drystock farmers every three.

Farmers considered to be compliant through permitted activity rules do not need to test soils for P and are not required to produce an NMP.

4.3 Good Management Practices

The NMP has a table that identifies good management practices on-farm that help to reduce nutrient loss from farms. The reason for good management practices is to manage the farm activities in a way that will prevent CSAs developing on-farm and reduce nutrient loss. The good management practices described in the NMP were developed in line with industry advice. The practices are divided into required and recommended practices. Most management actions described in the table focus on ongoing farm practices that rain and overland water flow paths can affect.

The good management table within the NMP template is available on the Te Arawa Lakes Website. The NMP review every five years can include an update of this section if new national regulations are required to be included.

4.4 National Environmental Standards for Freshwater Management (NESFM) requirements introduced to 2022-2027 NMP template

In 2021, some new regulations were introduced though the NESFM regulations. The NMP review for the 2022 to 2027 period offered an opportunity to include these regulations in the NMP template. The NMP template now gives farmers all the information they need to know to comply with regional and national rules. We have the regulatory responsibility to monitor these national regulations. We and the consent holder can monitor the NESFM regulations more easily when we are on farm assessing the conditions of the land use consent.

5 Understanding the main challenges facing each sub-catchment

The sustainable nitrogen load of 435 tonnes applies to the whole catchment. We are working with individual landowners on a range of regulatory and incentivised programmes to achieve that load. As we work with landowners and collect data, we can break down the characteristics within each sub-catchment to give us a better understanding of the different challenges that exist.

The sub-catchments have different characteristics that potentially impact nutrient loss to the lake. This can be influenced by physical attributes such as size, elevation, location (which influences rainfall), soil types and topography. The different anthropocentric (or human induced) characteristics will also have an influence on nutrient loss, and include land use, population and the mitigations that have been put in place.

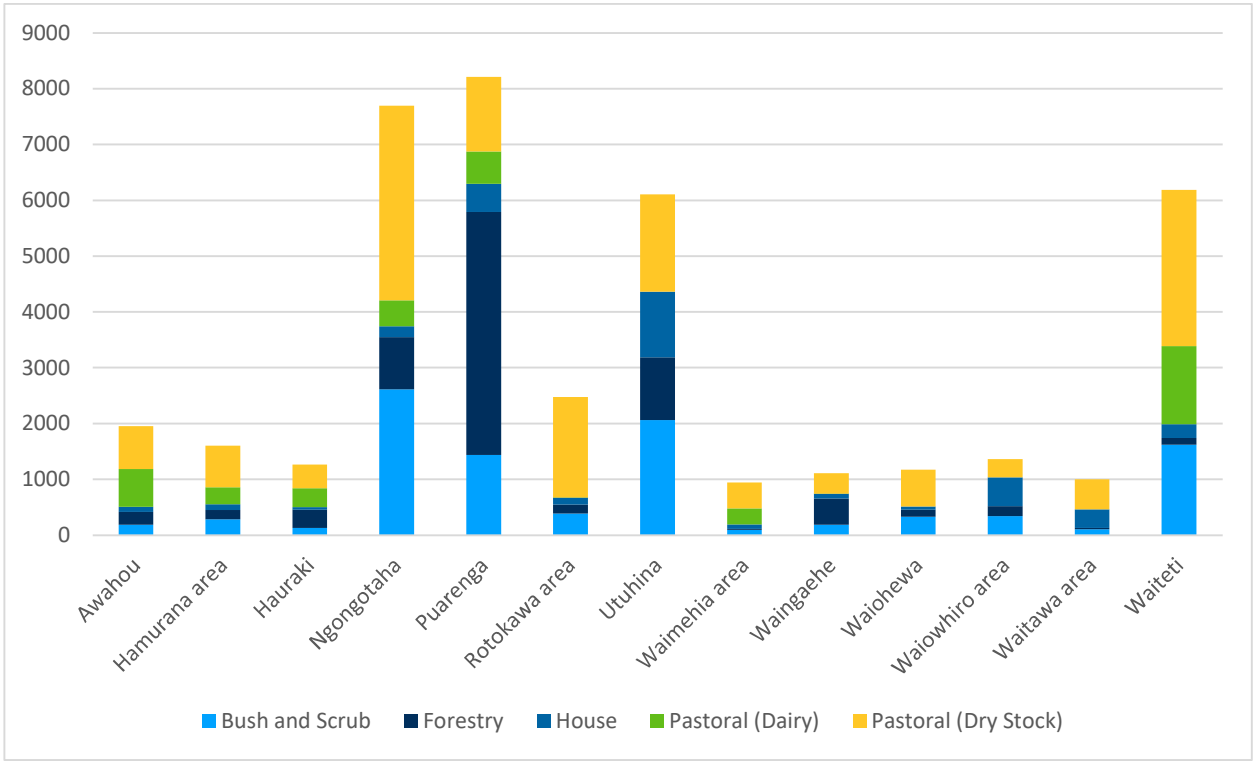
This identification of characteristics may provide opportunities in the future to work at a sub-catchment level to solve some of the issues from the various physical and human influenced characteristics. As the information improves and new mitigations are better understood, reporting on different characteristics may help us prioritise different nutrient reducing strategies. Reporting will also help us to understand changes over time.

5.1 Information about farm systems in sub-catchments

The sub-catchments within Lake Rotorua differ quite markedly in terms of modelled total nitrogen loss. Analysis of farm data for monitoring purposes allows us to break down what the different land uses are in each sub-catchment.

Figure 11 displays the sub-catchment land use area by sector. Once again, the information is obtained from monitoring land use, scripted land use and allocated land use. The sub-catchments are based on surface water catchments and the LRNR data.

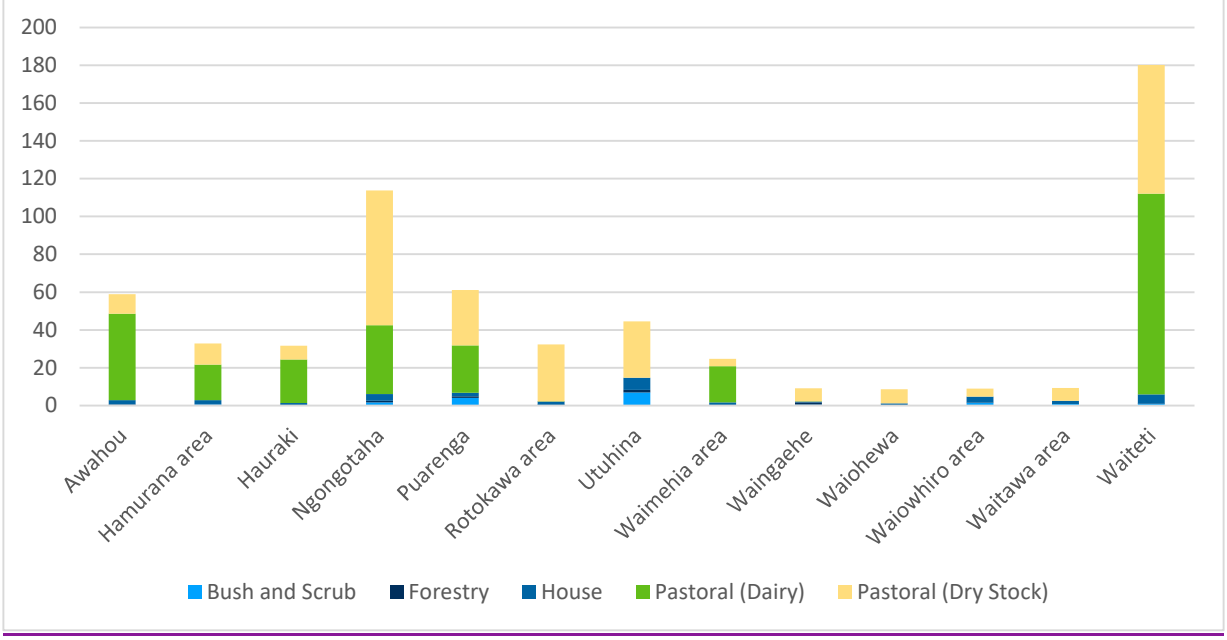
Figure 11 Sub-catchment area (ha) by sector



Source: Toi Moana (ArcGIS)

Figure 12 displays the nitrogen losses (within LRNR area) by sub-catchment and by sector.

Figure 12 Sub-catchment Nitrogen loss (tonnes) by Sector

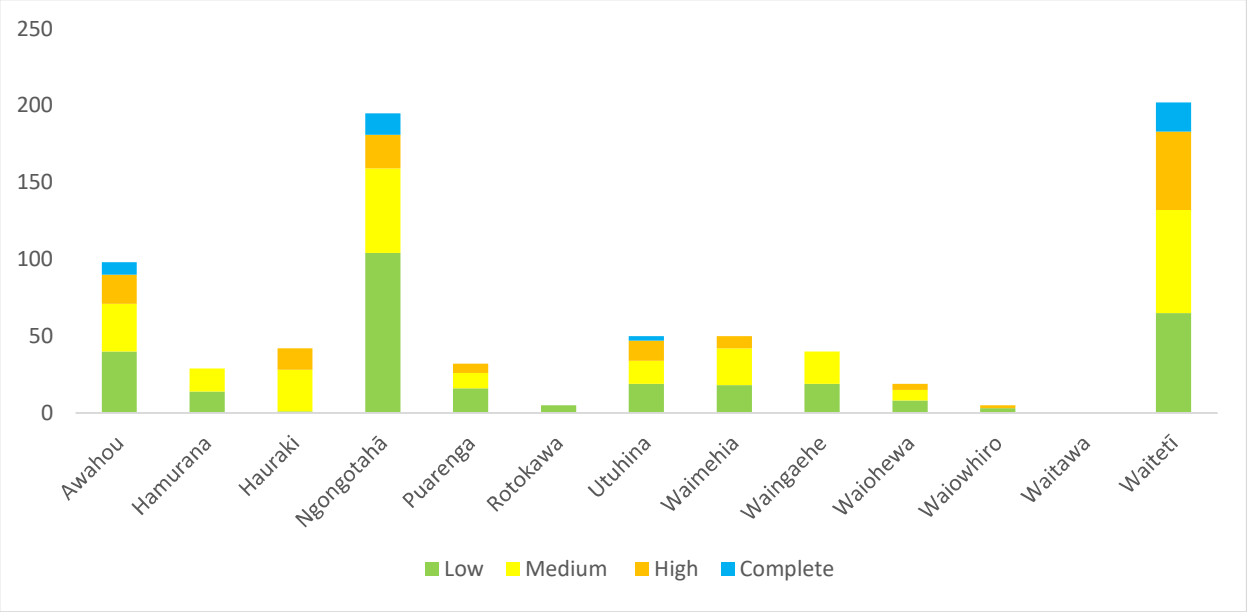


Source: Toi Moana (OverseerFM/Arc GIS)

5.2 Critical source areas – sub-catchment breakdown

Figure 13 shows where the CSAs are concentrated within the Lake Rotorua catchment. This is influenced by the number of consented farms located within the sub-catchments. Some properties do not have consents; CSA numbers will increase when all farms are compliant with the rules. Properties that meet the permitted LRNR conditions are not monitored for CSAs as they are assumed to be well managed.

Figure 13 Critical Source Areas by catchment



Source: Toi Moana (ArcGIS)

5.3 Environmental programmes in the Lake Rotorua catchments

Part of Policy LR P2 of the LRNR requires Toi Moana to use non-regulatory programmes to help manage diffuse and point sources of phosphorus loss. We have noticed wide uptake of Environmental Programmes within Lake Rotorua over the last five years. Most programmes have been aimed at improving water quality and have focused on riparian retirement, wetland restoration and retiring unsuitable grazing land for erosion control. We believe the work undertaken through these agreements will have major benefits for lake water quality immediately and in the years to come. Landowners have especially been motivated to work collaboratively with us to retire their less suitable grazing land and areas that contain CSAs.

Over the past five years, the team's focus has been on the stream catchments identified as having poor water quality (Ngongotahā, Puarenga, Utuhina, Waitetī). Any long-term improvements in the bacterial water quality in these streams will also contribute to Toi Moana's swimmability target noted in the Long-Term Plan.

The Rotorua Land Management team has worked with 44 landowners between 2017 and 2022 on environmental restoration projects on their land. These 44 projects have required 50 kilometres of fencing to enable 157 hectares of land use change from pasture to native forest, and 120 hectares of biodiversity protection. A total of 260,788 native plants have been planted within the catchment through these programmes.

The work we are reporting on here only captures the work where Toi Moana has been a co-funder. There are many other projects throughout the catchment where landowners have independently planted problem areas on their farms and restored wetlands.

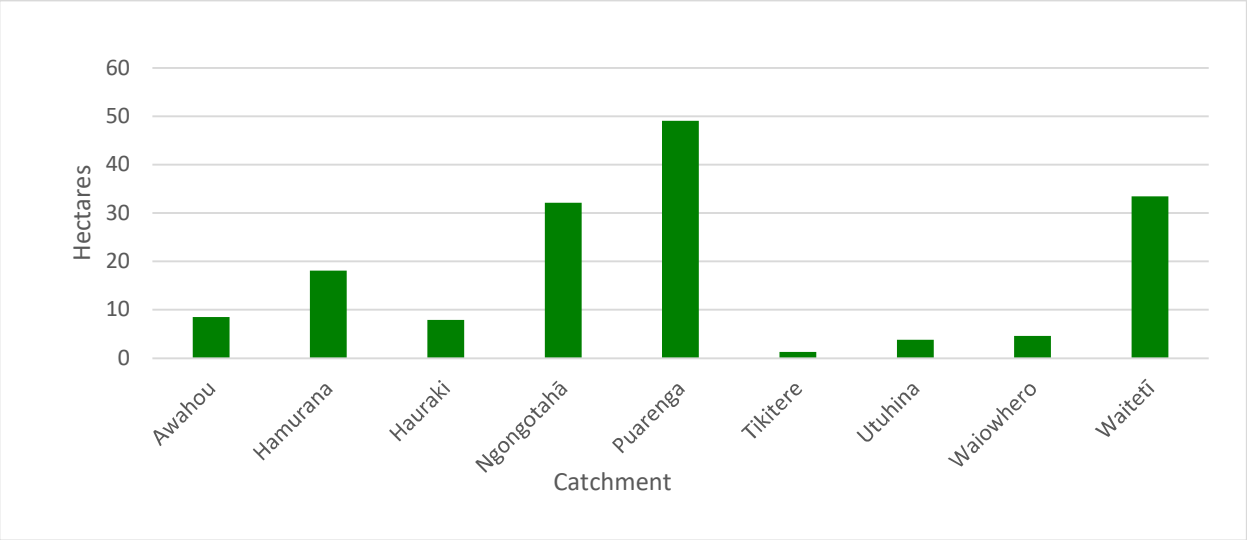
Table 5 shows some of the achievements of that work in the Lake Rotorua catchment, with a focus on those catchments affected by swimmability issues.

Table 5 Work outcomes for work on private land where Toi Moana has been a co-funder

Lake Rotorua catchments	Ngongotahā	Puarenga	Utuhina	Waitetī	Other Catchments	Totals
Native Plants (no)	46,106	57,920	13,750	72,274	70,738	**260,788**
Fencing (km)	7.9	19.5	1.1	18.8	2.7	**50**
Land use Change (ha)	32.1	49	3.8	33.5	40.6	**159**
Restoration Wetland Area (ha)	1	20	0	14	5	**40**
Restoration Biodiversity Area (SNA)	0	84.8	0	34.7	0	**124.5**

Source: Toi Moana (ArcGIS)

Figure 14 Hectares of new protection areas by sub catchment since July 2017



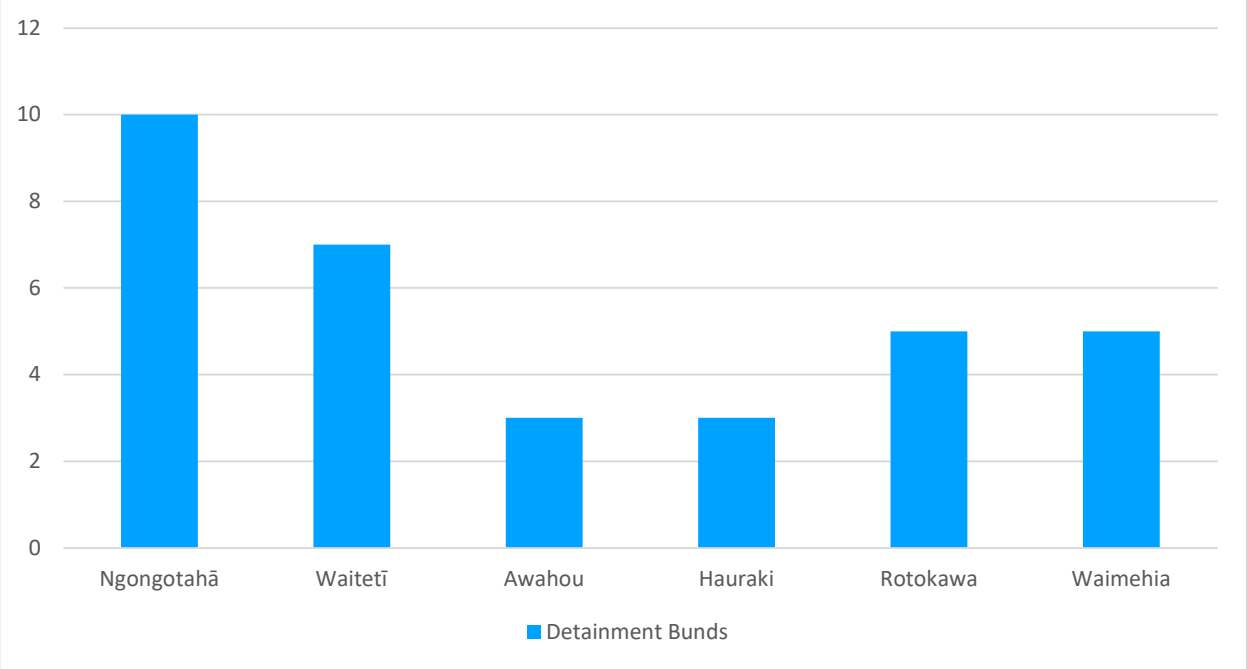
Source: Toi Moana (ArcGIS)

5.3.1 Detainment Bund Construction

The effectiveness of detainment bunds at intercepting and mitigating phosphorus and sediment loss has been shown to be very effective in the Lake Rotorua catchment (Levine, B. 2020). A critical factor in detainment bund effectiveness is the storage capacity to catchment size ratio so not all pastoral landscapes are suitable. Steep and flat topographies have more limited opportunities for application of detainment bunds than rolling landscapes.

To date there have been 33 detainment bunds constructed within the catchment and this mitigates the phosphorus and sediment loss from 698 hectares of farmland. Location of these detainment bunds can be seen in Appendix 2. Geospatial analysis of the catchment has shown that there may be an opportunity to construct more detainment bunds. This is especially the case in the sub-catchments on the west to north-west sides of Lake Rotorua that drain from the Mamaku Plateau.

Figure 15 Detainment Bunds by sub-catchment



Source: Toi Moana (ArcGIS)

6 Limitations and gaps analysis, what are the risks

This section analyses the information we have presented and identifies the potential knowledge gaps and risks. Analysis of those gaps will be important in directing areas where further work is required.

The analysis in this section leads into the key recommendations for focusing further work over the next five years, ready for the next science review.

6.1 Future direction and implications from the Overseer review

In 2018 the Parliamentary Commissioner for the Environment published the report "*Overseer and regulatory oversight: Models, uncertainty and cleaning up our waterways*". One of that report's recommendations was to establish an independent science advisory panel to carry out a rigorous whole-model peer review of OverseerFM. The aim of this was deciding whether OverseerFM is fit for purpose as a regulatory tool. The panel completed the final report in June 2021 and found that, in its current form, OverseerFM was not reliable in estimating total nitrogen loss from farms.

The Government is working with Overseer Ltd to upgrade and develop the next generation of the model. The upgraded OverseerFM model should be an effective tool to help understand and manage nutrient loss from farms.

OverseerFM is an integral part of the LRNR, as it forms the basis for collecting data and has driven the way we report on nitrogen loss in the catchment. The OverseerFM review process has the potential to require adjustments in the way we monitor the LRNR and the systems we have put in place.

The Government response to the Overseer peer review report discussed the way forward for regional councils using OverseerFM in Section 5. Using OverseerFM in catchments with pastoral land use situations on low slope and well drained soils may be appropriate.

Table 6 shows that 83% of pastoral land use is on low slopes.

Figure 16 shows the catchment land use by soil drainage type – 99% of pastoral land sits on soils that are well drained according to S-Map. To maintain consistency across allocation and year-end analyses, this description is based on a soil dataset used for the 2001-04 benchmarking period, and on current OverseerFM block attributes.

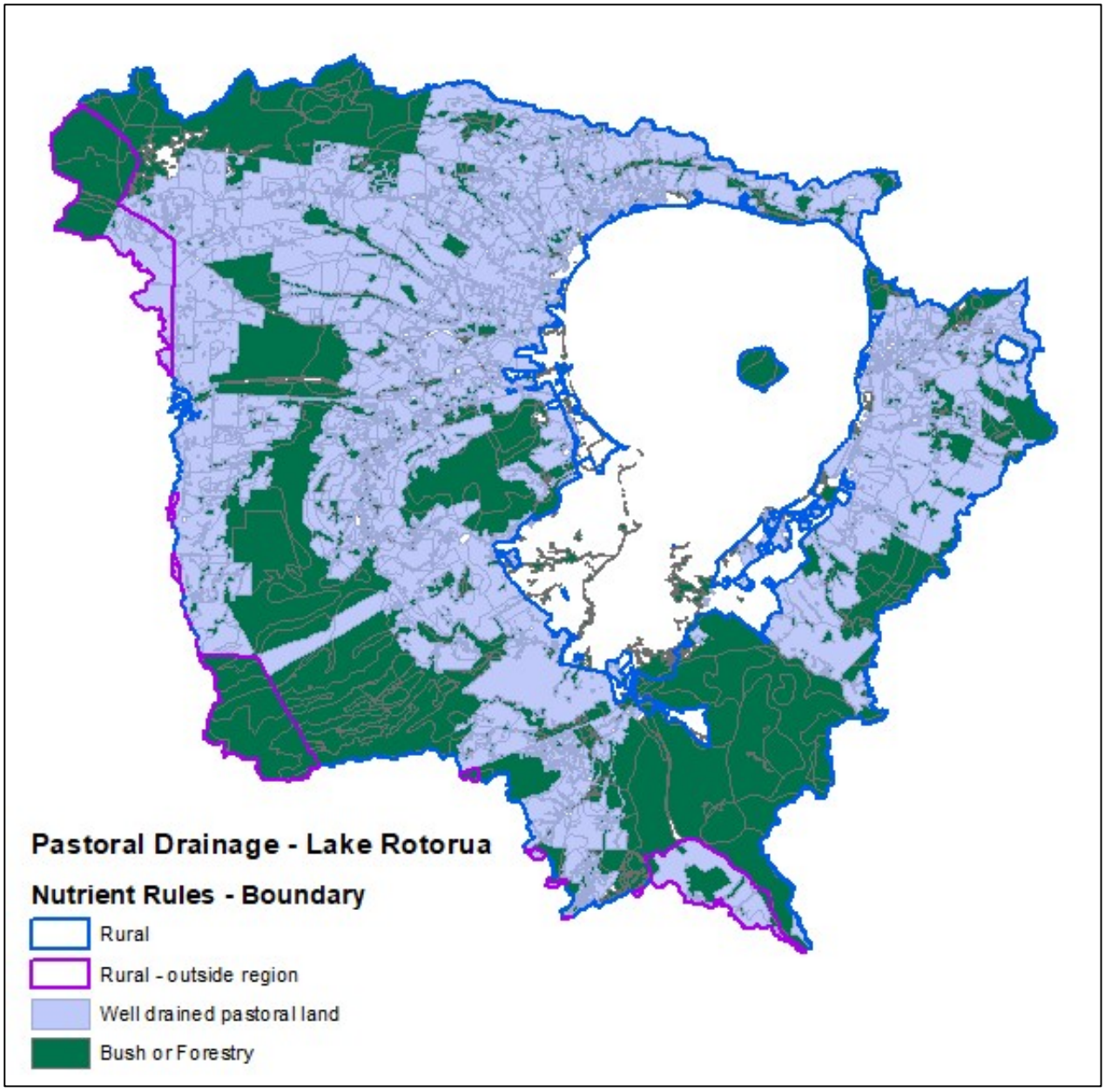
Table 6 Types of slopes in LRNR area of pastoral land use

OverseerFM name	OverseerFM slope	Area ha	Area %
Flat	0 - 7 degrees	6788	**33%**
Rolling	8 - 15 degrees	10506	**50%**
Easy Hill	16 - 25 degrees	3471	17%
Steep Hill	26+ degrees	65	0%
Total		20830	

Source: Toi Moana (Soilmap, Arc GIS)

In October 2022, we expect to see a report from MPI and MfE that will determine how OverseerFM may be used in a regulatory framework. In the meantime, regional councils are continuing to implement plans and monitor consents (as is consistent with regional plans).

Figure 16 Pastoral land use well drained soils – rural area



Source: Toi Moana (Soilmap, Arc GIS)

6.2 New soil data may affect predicted nitrogen leaching and phosphorus loss figures

Soil parameters influence nitrogen leaching and therefore the quality of Lake Rotorua's water. Manaaki Whenua is carrying out a soil mapping project for Toi Moana with help from Central Government funding to improve the soil data in the region and then use that data to update S-map. S-map is a digital map for New Zealand soils. Soil test and mapping is complete for the Mamaku Plateau area of the Lake Rotorua catchment, and updated S-map versions will include analysis of data from that testing and mapping.

Figure 17 Map showing the area of the Lake Rotorua catchment that has been updated

Source: Manaaki Whenua

The purpose of the project was outlined in Manaaki Whenua's milestone report for the 2021 fiscal year:

> *'The study area already has S-map data that is based on legacy work dating back to the 1960's, over time it was re-interpreted and uploaded into S-map. One of the aims of this current soil survey field work was to evaluate the quality of that historical mapping in the context of the new digital data we have available to use (such as LiDAR) and soil landscape characterisation understandings 50 years on.'*

Initial findings indicate:

- Pumice soils mapped on the east side of Mamaku Plateau would now mostly be classified as Allophanic. This is supported by measurements of P-retention, particle size and pH (acidity in water)
- Podzol soils are over-represented and provide an over simplified view of the Mamaku Plateau soils. The podzols are quite weakly expressed and lab data suggests they do not differ much from the Vitric Allophanic soils mapped closer to the lake. Land clearance and land use intensification has led to the disturbance of the top 20-40cm in many places and

evidence of podzolisation has been lost. This is because E horizon and podzolic B horizon development is mostly confined to the Kaharoa and Taupo Pumice tephras that occur in the top 20-30 cm across the Plateau and have been largely modified by forestry and farming. Below these tephras weathered tephras are composed of allophanic soil materials and behave like Allophanic soils.

- Substantially more detailed (finer resolution) mapping can be conducted with the LiDAR data support.

6.3 Compliance with the rules

While a significant portion of the farming community has shown a real willingness to work with us to implement the rules, some farms remain unconsented and therefore remain non-compliant with the LRNR. This undermines the excellent work and leadership shown by most of the rural community in working to improve water quality in the Lake Rotorua catchment.

The collection of data is an integral part of the LRNR. That collection provides an important opportunity to learn about nitrogen loss off farms and requires a collective and ongoing commitment to work with staff from Toi Moana. Non-compliance with the LRNR will therefore require enforcement to uphold the integrity of the significant work already undertaken.

The independent science advisory panel report on Overseer has significantly affected our ability to enforce non-compliance with the LRNR. If we are to take legal action on cases of non-compliance, we will need to have confidence in an upgraded, next-generation model of OverseerFM. If the upgraded, next- generation model does not give us this confidence we may need to redevelop the rules framework.

6.4 National Policy Statement for Freshwater Management – opportunities and implications for NMPs

New regulations are being developed as part of the National Policy Statement for Freshwater Management (NPSFM) to require all farmers to produce farm environment plans to address nutrient loss from farms. Regional councils throughout New Zealand are required to set new regulations to give effect to the national environmental standards for freshwater.

The NMP template has been developed to mitigate both phosphorus and nitrogen loss from farms and sets a high environmental standard for farming. The template has been updated to include the NES regulations so farmers in this catchment can understand their obligations under the rules.

6.5 Auditing gaps

Landowners must keep records if they are to comply with the conditions of the LRNR. At time of writing, individual farm data used to build farm models within OverseerFM has not been audited. We currently rely on the honesty of each farmer that the year-end analysis they submitted is accurate and reflects what happened on their farm. We will work to develop a random auditing system to allow the checking of records against their submitted data.

6.6 Actual losses from smaller lifestyle blocks

Forestry, bush and small lifestyle blocks (up to 10 hectares) are less likely to lose a significant amount of nitrogen from their land. This assumption is based on the permitted land use under the conditions of the permitted activity rules.

No auditing of lifestyle lots up to 10 hectares is planned for the next five year period although we will be responding to complaints and assessing compliance with the conditions of the rules in these cases. We are also planning on engaging with small lifestyle properties to ensure they are aware of their obligations under the LRNR and to encourage good management practices.

7 Key Science Review Report recommendations

This section outlines the work that we will do before the next science review is due in 2027.

7.1 Assess the impact of updated S-map data on nitrogen allocations

The physical attributes of soils have the potential to affect the actual loss of nutrients from farm systems. The project being undertaken by Manaaki Whenua will update the soils in S-map using modern methodology and more accurate measurements. The due date for the project to be completed and S-map updated will be spring of 2024. Once this has been completed, we need to carry out work to help us understand the implications of the changed soil parameters on the nitrogen discharge allocations and how this may affect individual farms within the catchment.

This work will be important to understand before the next MRT period starts in 2027.

7.2 Assess new climate data and effects on nitrogen allocations

The climate data in OverseerFM uses 30 year averages from NIWA and is updated every 10 years. The climate data set has recently been updated and the effect of this needs to be assessed in regard to benchmark, reference files and allocations.

7.3 Engage in new science to improve OverseerFM modelling in the Lake Rotorua catchment

Continue to identify opportunities to improve and support work that will increase knowledge of nutrient loss from farms in the Lake Rotorua catchment. For instance the new initiative for Plantain Potency and Practice Programme – DairyNZ. Find references to recent research on the topic and a link to the DairyNZ website in the Reference section of this report.

7.4 Monitor and map gorse growth in the catchment area

Gorse mapping will be carried out once in the next five years before the next science review. This will be important to help monitor areas where gorse may be increasing so we can work with landowners to ensure it is controlled.

7.5 Conduct a physical assessment of the efficacy of wetlands for assisting towards the engineering nitrogen targets

Significant potential exists in using wetlands to remove nitrogen from groundwater and surface water before it enters the lake. A Toi Moana commissioned report identified suitable sites where wetlands could be constructed in the Lake Rotorua catchment. We expect to progress the design and construction of at least one wetland within the catchment. At that time we will undertake monitoring to test the efficacy of the constructed wetland to remove nitrogen from water.

8 References

Bay of Plenty Regional Council. Nutrient Management Plan templates and user guides. https://www.rotorualakes.co.nz/nutrient-management-plan-

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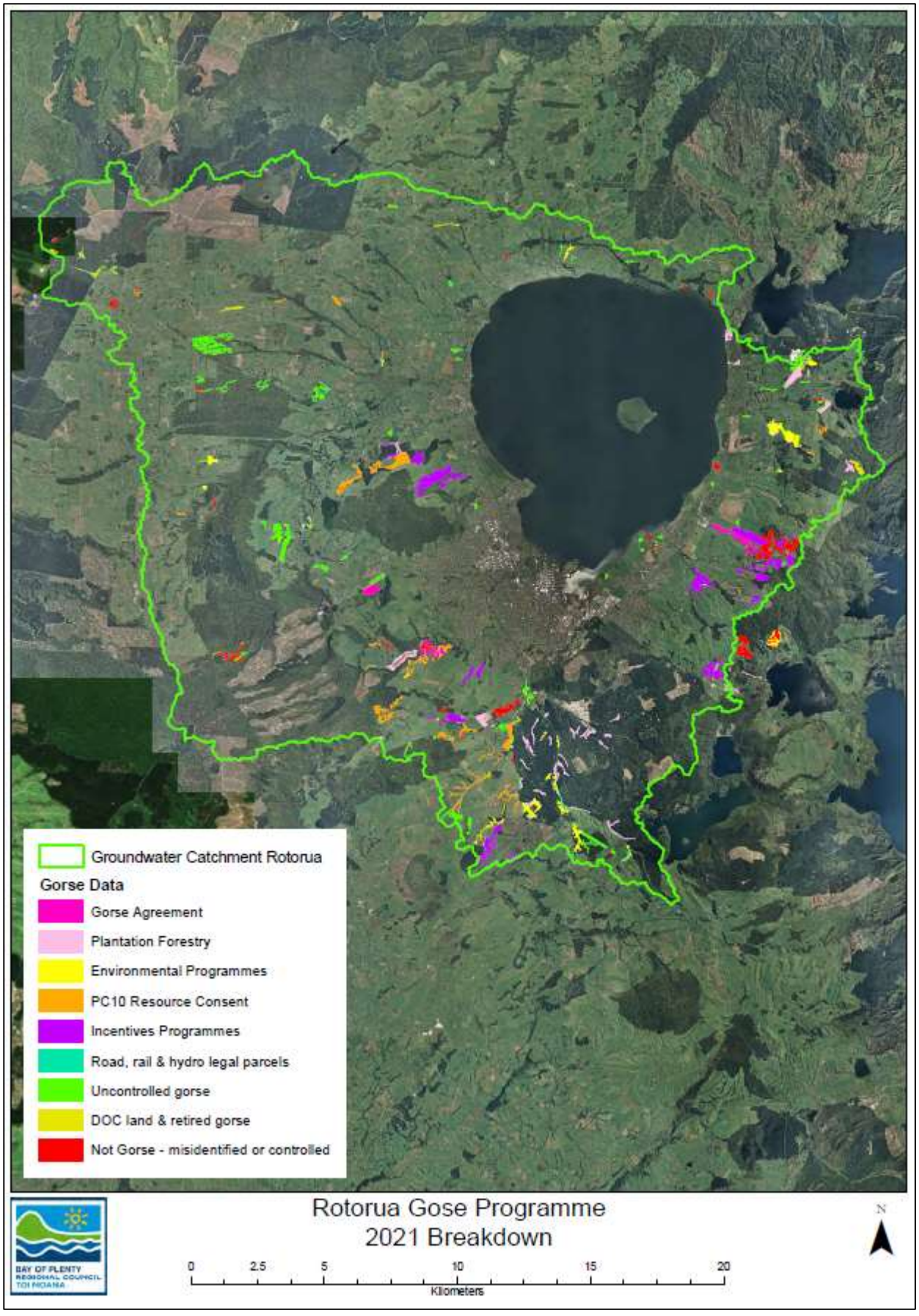
Appendices

Appendix 1 Rotorua gorse programme breakdown (2021)



Source: Toi Moana (ArcGIS)

Appendix 2 Detainment bunds in the Lake Rotorua catchment

Source: Toi Moana (ArcGIS)