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TARAWERA FARM ENVIRONMENTAL PLANS – FARMERS BUILDING ON THE PAST, PREPARING FOR THE FUTURE

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Abstract

The Project Rerewhakaaitu farmer group evolved in the 2000s from a series of projects looking at on-farm nitrogen and phosphorus mitigations. Many mitigations were incorporated into Farm Environment Plans (FEPs) developed by AgResearch.

In 2015 the non-statutory Tarawera Lakes Restoration Plan was developed by Bay of Plenty Regional Council (BORPC) with community input. Agreed actions included FEPs for the inner and outer Tarawera lakes catchments – the latter comprises the contributing catchments of Lake Rerewhakaaitu and five other lakes. The Restoration Plan also flagged the need for improved catchment modelling and potentially land use rules to limit increased nutrient inputs to the Tarawera lakes system.

Project Rerewhakaaitu and BOPRC agreed to base the new FEPs on industry templates and Overseer. Fonterra used its Sustainable Dairy Advisors to develop Tiaki FEPs and Beef and Lamb New Zealand ran two Land and Environment Plan workshops, with one-to-one follow-up by local farm consultants. As participation was voluntary, farmers were given written assurances that individual farm data would remain confidential and only aggregated catchment nutrient data would be published.

48 FEPs were completed by spring of 2018. There are 32 Tiaki FEPs covering 5300 hectares with a combined 1060 on-farm actions. There are 16 LEPs covering 6800 ha. Key averaged effective area Overseer results (v6.3.0) were:

- Dairy (Tiaki): 46-58 kgN/ha/yr and 1.3-2.5 kgP/ha/yr;
- Dairy Support (Tiaki) 34-51 kgN/ha/yr and 1.8-3.8 kgP/ha/yr;
- Drystock (LEPs): 16-32 kgN/ha/yr and 1.1 to 3.9 kgP/ha/yr;
- Drystock P losses appear to correlate with soil type.

While some of the 'outer' Tarawera lakes are meeting their Natural Resources Regional Plan water quality targets (expressed as 3-year average Trophic Level Index or TLI), Lake Tarawera itself is not meeting its 2.6 TLI target. Aggregated nutrient loss data from this FEP project will help inform catchment modelling. This will in turn inform the local community on the complex linkages within the Tarawera lakes system and the need for any land use rules.

Background

The formal trigger for the Tarawera FEP project was the non-statutory Tarawera Lakes Restoration Plan (BOPRC, 2015) and its directive to develop 'environmental management

plans' for farms in the inner and outer Tarawera lake catchments. It is important to see the recent FEP project in the context of ongoing local Rerewhakaaitu farmer leadership on environmental issues, particularly nutrient management. This is illustrated with an abbreviated history of the 'Project Rerewhakaaitu' farmer group:

- **2002-2006:** A Sustainable Farming Fund (SFF) was initiated by farmers with support from Dairy Insight, FertResearch and BOPRC. Bob Parker from Fruition managed the project and facilitated many farmer meetings. AgResearch and others provided science support, including farm Overseer® analyses and N mitigation assessments, improving fertiliser efficiency, grass filter strips (McKergow et al, 2008) and a denitrification trench. An overall summary is provided by Parker et al (2006).
- **2006-2009:** A second SFF project focused on phosphorus loss and critical source areas. Trials included smelter slag phosphate socks, sediment traps and soil Olsen P assessments (see related work by Rajendram et al, 2011). Damaging summer storms highlighted the importance of sediment runoff with high P contents, including from farm races. Longhurst et al (2009) summarise the P mitigation results.
- **2009-2015:** The Project Rerewhakaaitu farmers, with BOPRC support, developed a catchment plan, summarised in Parker et al (2014). Individual farm Nutrient Management Plans (NRMs) were prepared, informed by a 'Farm Enviro Walk' (DairyNZ, 2019). Farms were visited several times by an independent auditor to check progress against NRM actions. Positive results were reported on effluent management (Longhurst et al, 2014), reducing Olsen P levels, farm tracks and overall progress (Hawke et al, 2013). The average aggregated reductions in Overseer-derived nutrient losses (2002/03 cf 2009/10) across participating farmers was 18% for N and 28% for P, with further reductions reported through to 2012/13 (Parker et al, 2014).
- **2015:** The farmers formalised their group as an incorporated society, maintaining the 'Project Rerewhakaaitu' name, and with Chris Sutton as chairman. The group represents the wider Rerewhakaaitu farming community and includes farmers from neighbouring lake catchments and part of the Rangitaiki River catchment. Project Rerewhakaaitu also had input to the Tarawera Lakes Restoration Plan.
- **2016 onwards:** Project Rerewhakaaitu engaged with BOPRC on implementing actions from the Tarawera Lakes Restoration Plan. There have also been initial informal discussions on potential regional plan changes related to implementing the National Policy Statement for Freshwater Management (NPS-FM; MfE, 2017).

In addition to the Project Rerewhakaaitu background given above, it is useful to recap the complex Tarawera lakes catchment hydrology and water quality status. There are seven lakes that contribute surface and/or groundwater flow and nutrients to Lake Tarawera which subsequently discharges via the Tarawera River to the Bay of Plenty, as shown in Figure 1 below. There are multiple geothermal inputs to some lakes, seasonal lake sediment nutrient dynamics and lakeside community wastewater discharges to consider as well. The overall hydrology, groundwater and nitrogen flux for the combined has been summarised (White et al, 2016) and as a simplified schematic in Figure 2 below.

Additional in-lake modelling is underway by University of Waikato as part of the wider Rotorua lakes science programme. It is desirable for the ongoing lake and catchment modelling to be informed by up-to-date assessments of nitrogen (N) and phosphorus (P) nutrient losses.

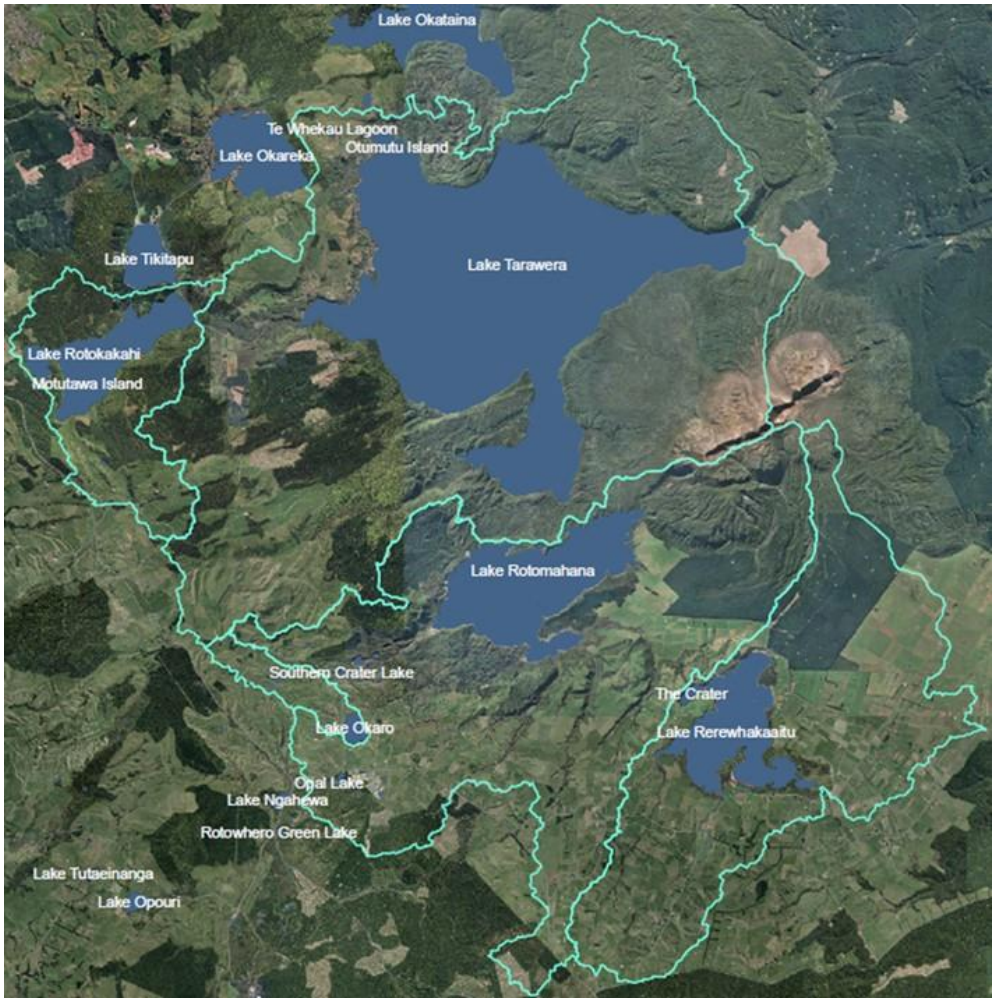

Figure 1: Tarawera lakes catchments

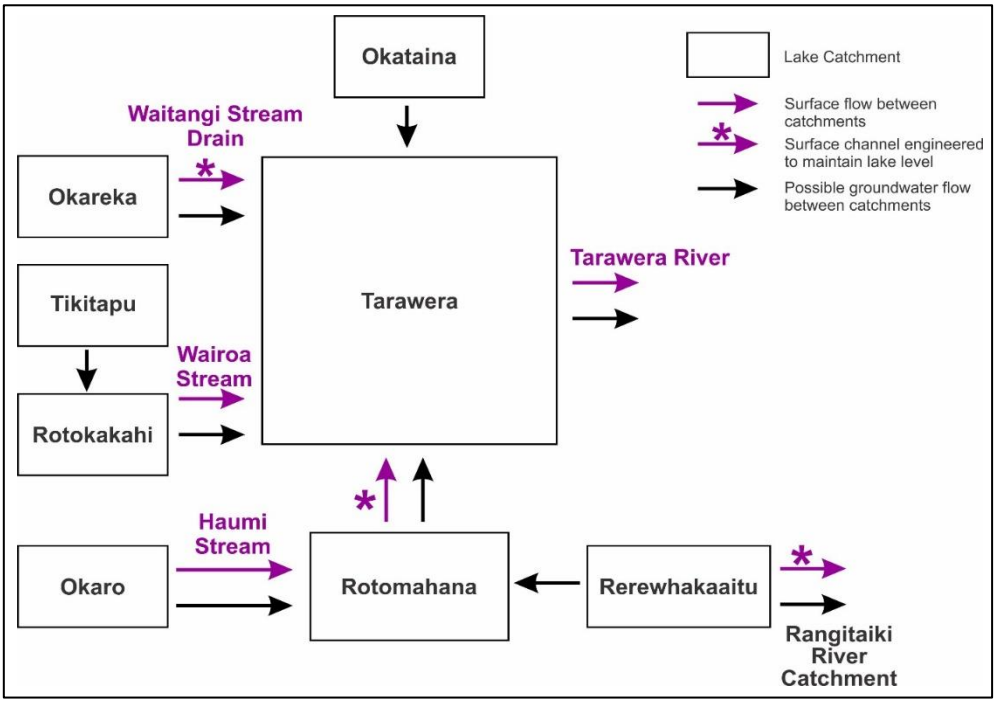

Figure 2: Tarawera lakes hydrology schematic (from White et al, 2016)

Water quality trends in the Tarawera lakes

Lake water quality in New Zealand is commonly assessed and reported using the Trophic Level Index, or TLI (Burns et al, 2000). The TLI combines annualised in-lake concentration data on N, P, chlorophyll-a (an algae metric) and Secchi disc (a clarity metric). BOPRC has set water quality TLI targets for all of the Rotorua lakes, including the eight Tarawera lakes.

Figure 3 below shows that Lake Rerewhakaaitu has been largely meeting its 3.6 TLI target with some fluctuation due to climatic variability. In contract, Figure 4 shows that Lake Tarawera has significantly exceeded its 2.6 TLI target for several years. This highlights the need to improve scientific understanding of catchment and lake nutrient loading and fluxes.

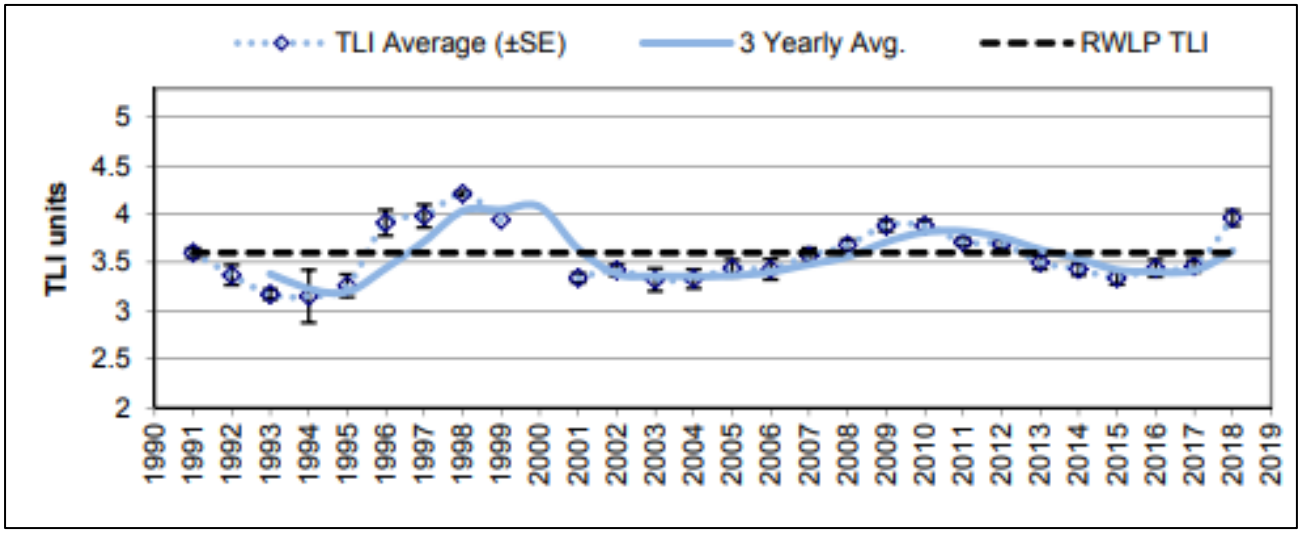

Figure 3: Lake Rerewhakaaitu TLI results

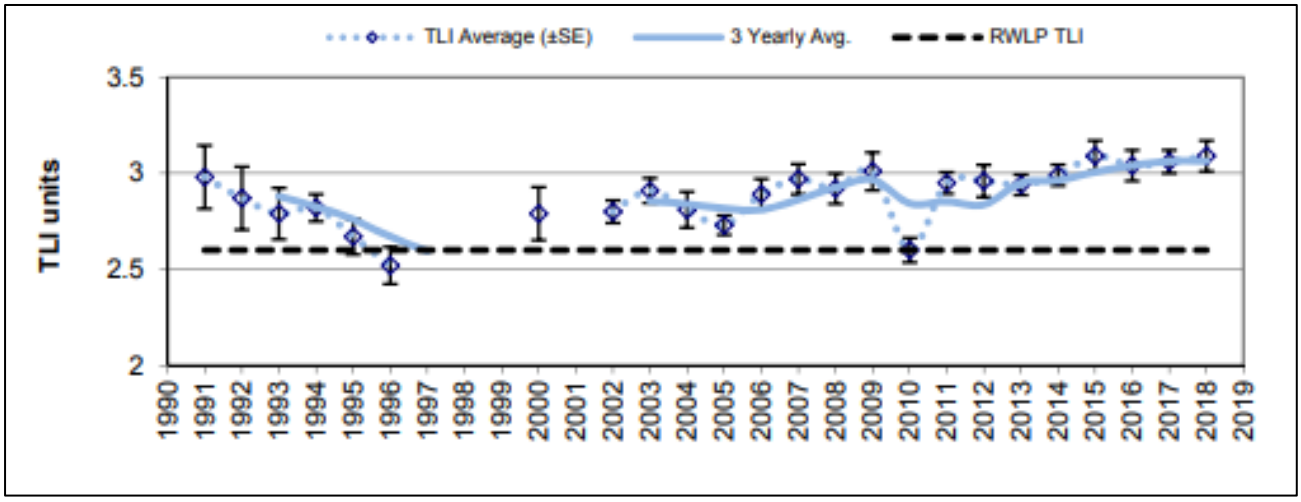

Figure 4: Lake Tarawera TLI results

It is widely acknowledged in the Bay of Plenty and beyond that Project Rerewhakaaitu has achieved practical on-farm progress, especially via voluntary farmer-led initiatives. However, the complexity of the Tarawera lake system the unsatisfactory TLI result for Lake Tarawera itself mean that further action and research is needed.

Tarawera FEP project objectives

To give effect to the 2015 Tarawera Lakes Restoration Plan and address the science needs for catchment modelling, BOPRC allocated a $180,000 to develop approximately 50 voluntary FEPs for pastoral farms in Lakes Rerewhakaaitu, Rotomahana, Rotokakahi, Okaro and Tarawera, plus some Rangitaiki catchment farms that are part of the wider Rerewhakaaitu community. BOPRC contracted Simon Park (from Landconnect Ltd) to manage the FEP project under the direction of Helen Creagh, Rotorua Lakes Catchment Manager.

Discussions with Project Rerewhakaaitu leaders, BOPRC staff, DairyNZ and Beef + Lamb NZ (B+LNZ) resulted in a project plan with three key objectives:

1. Recognise and promote on-farm good nutrient management practices
2. Develop FEPs using industry farm plan templates and Overseer
3. Provide BOPRC with summary nutrient data to support catchment and lake modelling.

Methodology

Prior to the new FEP roll-out, it was agreed with Project Rerewhakaaitu that we would use industry FEP templates. This reflected the growing industry promotion of FEPs within both voluntary and regulatory contexts, and the increased likelihood that farmers would get support in future to their FEPs.

Dairy farmers were projected to use DairyNZ's Sustainable Milk Plan template. This changed in 2017 with the availability of Fonterra's new 'Tiaki Sustainable Dairying Programme' FEP template, in part because all the dairy farmers in the target catchments are Fonterra suppliers. The FEP implementation was based on the following methodology:

- 32 dairy farms worked with Fonterra's Sustainable Dairy Advisers (SDAs) to develop Tiaki FEPs, using existing Fonterra farm data wherever possible. A farm walk enabled SDAs to photograph critical source areas and identify relevant mitigations.
- 22 drystock farmers were identified by Project Rerewhakaaitu and BOPRC staff and were invited to two Land and Environment Plan (LEP) workshops hosted in 2017 by B+LNZ. The initial Level 1 LEP workshop attracted 15 farmers and the subsequent Level 2 workshop attracted 8 farmers, with some farmers attending both. BOPRC then contracted Perrin Ag and AgFirst to do individual follow up with consultants to complete LEP2 farm plans and a current Overseer nutrient budget.
- Quality control on Overseer nutrient budgets was managed as follows:
    - Using Overseer Best Practice Data Input Standards and developing nutrient budgets in the same Overseer version[1]
    - BOPRC staff reviewed ten Overseer files (6 dairy, 4 drystock) for robustness[2]
    - using experienced consultants – Perrin and AgFirst are approved as nutrient advisors implementing Lake Rotorua Plan Change 10. Fonterra has its own internal peer review system for Overseer files.

[1] While the project time period covered both Overseer version 6.2.3 and 6.3.0, all files were converted to version 6.3.0 for data aggregation purposes.

[2] The Overseer file checking was done by meeting the consultant and viewing the relevant farm file on their laptop, without receiving actual farm files or reports.

    - Biophysical attributes for each Overseer block (drystock farms) was provided by BOPRC GIS staff following receipt of block maps from the farm consultants, with ephemeral flow paths mapped. Fonterra used a comparable internal system.
- BOPRC supplied catchment boundary maps.
- Ensuring farmer data confidentiality, with customised approval forms used for both dairy and drystock farmers. This gave confidence to farmers that BOPRC would not have access to individual farm data – only aggregated data.
- Chris Sutton, Simon Park and the consultants encouraged all targeted farmers to participate with follow up phone calls as required.
- Nutrient data aggregation was carried out by Fonterra and B+LNZ for the dairy and drystock farmers respectively. B+LNZ contracted The Catalyst Group to do this work while Fonterra carried out its assessment in-house.
- Fonterra and B+LNZ presented results to Project Rerewhakaaitu farmers in late 2018.

Nutrient loss results – drystock farms

Overseer nutrient loss data was aggregated for 16 farms based on 15 Overseer files, with one farm submitting Overseer output data. Of the five non-participating farms, two are engaging with BOPRC through separate processes and their data may eventually be incorporated i.e. there only three farmers who declined to participate.

The total farm area coverage was about 6800 ha with about 5500 ha effective area. Rainfall was moderate at 1300-1600 mm/year, with a range of flat, rolling and easy hill country and a range of generally well-drained soil types. Farm systems included various combinations of sheep, beef, dairy grazing, deer and fodder crops.

Key results (based on Taylor, 2018) are presented below in Tables 1 and 2, with all N and P loss rates applying to effective area only, Overseer version 6.3.0 and 2016/17 data:

Table 1: Drystock effective area nutrient loss Overseer v6.3.0, aggregated by catchment

Catchment	**annual nutrient loss**	
	nitrogen, kg N/ha/yr	phosphorus, kg P/ha/yr
Tarawera	22	3.7
Rotokakahi	18	3.9
Okaro	23	2.0
Rotomahana	16	1.3
Rerewhakaaitu	32	1.2
Rangitaiki	34	1.1

Table 2: Drystock effective area nutrient loss in Overseer v6.3.0, aggregated by soil order, pasture and fodder crop

Soil Order	pasture		fodder crop		combined	
	kgN/ha/yr	kgP/ha/yr	kgN/ha/yr	kgP/ha/yr	kgN/ha/yr	kgP/ha/yr
Recent (69%)	22	2.2	90	1.5	23	2.2
Allophanic (6%)	18	0.5	-	-	-	-
Pumice (25%)	26	1.6	106	2.4	28	1.7

Please note that the data presented above involves several assumptions and simplifications to enable a timely aggregated approach, including:

- A relatively small total farm dataset
- Basic pro-rating of whole farm losses where a farm straddles a catchment boundary
- Different staff and separate agencies carrying out separate but interdependent functions, in part due to the farm data confidentiality requirements.

Additional observations by B+LNZ (also via Taylor, 2018) include:

- Understanding and managing losses from critical source areas is essential
- 'Non-effective area' can be an unhelpful term as these areas are dominated by bush, forestry and riparian margins and are typically highly valued by farmers as part of the whole farm landscape – they also provide ecosystem services and mitigate nutrient and greenhouse gas emissions
- Although only covering small areas, there were relatively high per hectare N losses from fodder crops
- The differentiation of N and P losses by soil order indicate scope for targeting mitigation effort.

Nutrient loss results – dairy farms

Dairy farm nutrient loss data was aggregated for 32 farms, representing all targeted dairy farms, and a total covered was 5352 hectares. A subset of nutrient loss results for three catchments (3390 ha effective) is summarised in Table 3 below.

Table 3: Dairy and dairy support effective area nutrient loss in Overseer v6.3.0, aggregated by catchment

Catchment	dairy only		dairy support only		combined	
	kgN/ha/yr	kgP/ha/yr	kgN/ha/yr	kgP/ha/yr	kgN/ha/yr	kgP/ha/yr
Rerewhakaaitu	64	1.7	51	3.7	58	1.8
Rotomahana	51	1.3	34	1.8	46	1.3
Rangitaiki	57	2.5	35	3.8	54	2.5

Additional observations by Fonterra (via Kempson, 2018) include:

- Overall N losses ranged from mid-30s to early 90s of N kg/ha/yr, with most in the 40-60 N kg/ha/yr band, indicating many were at or close to what was feasible for the local soils and climate
- Some observed (relatively) higher risk N loss activities related to undersized effluent areas, N fertiliser use in winter and winter cropping and stock management
- Some of the higher P loss risks related to undersized effluent areas and high Olsen P levels with ongoing capital and maintenance fertiliser programme
- Variability in P losses was influenced by slope and a wide range in soil P retention (~20% to 83%)
- Many P mitigating activities (e.g. land management, race maintenance) are unable to modelled in Overseer, while noting the importance of managing critical source areas
- A total of 1060 farmer agreed actions were identified in FEP development, with about 70% timebound and others based upon ongoing management
- There was a good spread of actions across the four key contaminants (N, P, sediment, E. coli), with many actions addressing multiple contaminants.

Discussion on project management
The Tarawera FEP project was perhaps unusual in several respects, including:

- The extensive history of previous Project Rerewhakaaitu farmer-led projects
- The large number of agencies involved, combined with confidentiality undertakings on individual farm data, the arms-length data aggregation process and the voluntary nature of participation
- The relatively large target area covering both dairy and drystock farms.

The above factors meant it was difficult to directly compare nutrient loss results with previous reporting (e.g. Hawke et al, 2013). There was no single 'past and current' database of Overseer files which would have potentially enabled comparisons following migration of older files to the current version (and adjusting for farm boundary and leased land changes).

There were also a number of challenges during the project development and roll-out, some of which caused delays, including competing work demands for key staff from B+LNZ, Fonterra, Perrin Ag and AgFirst, plus changing farmer availability and willingness. There were also some delays due to staff turnover and the distraction of a possible dairy factory liquids irrigation proposal for during 2017.

Discussion on preparing for the future
Both Fonterra and B+LNZ are keen to follow up and support wider Tarawera catchment farmers. Fonterra plans individual follow-ups over the next two years, with upgrades to Tiaki FEPs as needed. BOPRC has assigned a Land Management Officer to liaise with the project farmers with many eligible for incentives to carry out on-farm mitigation works.

There is some uncertainty around the timeframe for NPS-FM implementation, with BOPRC focusing on information gathering during 2019. Therefore it is unclear what shape any new rules may take, while noting that the 2015 Tarawera Lakes Restoration Plan includes Action 5,

which is to 'Develop a rule to limit land-use changes that increase nutrients in the Tarawera System' (BOPRC, 2015).

Project Rerewhakaaitu farmers are likely to consider the possibility of any new rule in the context of current RMA nutrient rule development in the adjoining catchments of Lake Rotorua (Plan Change 10) and Waikato's Wai Ora Healthy Rivers Plan Change 1. The farm nutrient data summaries have been provided to the University of Waikato to support wider Tarawera catchment modelling, which in turn may help inform what further RMA policies are developed through the NPS-FM process.

Conclusions

The industry FEPs are effective tools to engage farmers and focus on pragmatic on-farm mitigation actions, including within a voluntary context such as the Tarawera lakes catchments. These FEPs will assist Project Rerewhakaaitu farmers to continue to improve environmental performance and mitigate nutrient impacts on their local lakes.

The challenge of collating and analysing confidential farm nutrient data should not be underestimated, especially within a voluntary project context.

Ambitious FEP rollout projects inevitably evolve as they progress and it is essential to maintain good communications with the project team and the wider farming community throughout the project implementation. Equally, it is important to maintain momentum and communication with and amongst farmers following FEP development.

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