

BEFORE AN INDEPENDENT HEARING PANEL

IN THE MATTER

Of the Resource Management
Act 1991

**AND IN THE
MATTER**

Of applications to Hawke's Bay
Regional Council for resource
consents to take and use Tranche
2 groundwater

**EVIDENCE OF KATHERINE MCCUSKER
ON BEHALF OF HAWKE'S BAY REGIONAL COUNCIL**

**LAND AND WATER USE EFFECTS
8 AUGUST 2022**

1. QUALIFICATIONS AND EXPERIENCE

- 1.1** My full name is Katherine Ann McCusker.
- 1.2** I am employed as a Farm Environment Consultant with the environmental engineering and science company Pattle Delamore Partners Ltd (PDP).
- 1.3** I hold the qualifications of Bachelor of Agricultural Science and I am a member of the New Zealand Institute of Primary Management. I completed the Massey University Advanced Sustainable Nutrient Management course in 2015. I have over thirty years of experience as a farm consultant and farm environment consultant. Prior to my employment at PDP, my previous roles included environmental change specialist at DairyNZ, environment consultant at The Agribusiness Group and I have held senior policy analyst and project advisor roles at the Ministry of Agriculture and Fisheries (MAF) in the areas of sustainable farming and climate change.
- 1.4** I have particular experience in mitigations for the environmental effects that can arise from the land use change in farming systems.
- 1.5** I have read the Code of Conduct for Expert Witnesses as contained in the Environment Court Practice Note 2014 and have complied with it in preparing this evidence. I confirm that the issues addressed in this evidence are within my area of expertise and I have not omitted material facts known to me that might alter or detract from my evidence.

2. SCOPE OF INVOLVEMENT

- 2.1** I have been engaged by the Hawke's Bay Regional Council (HBRC) to review and advise on the technical material provided in support of the eight revised applications to take and use Tranche 2 groundwater received in August 2021 and the further information received since that time, including information to support the associated land use consent applications.
- 2.2** My role in the technical review of the applications undertaken by PDP has been to review the water demand assessments for the take and use applications, and

potential contaminant changes (including nutrient, sediment and microbes) associated with changed land use under irrigation with the Tranche 2 water, which is covered in the separate land use consent applications required.

2.3 The key documents provided by the applicants that I have reviewed in preparing the evidence include:

(a) The AEE:

(i) Sage Planning HB Ltd, Aqualinc Research Ltd and Bay Geological Services Ltd. Revised Applications for Take, Use and Discharge of Tranche 2 Groundwater Ruataniwha Basin. 19 August 2021.

(b) Further information provided in November 2021:

(i) Various reports on land use information for individual applications.

(c) Further information provided in July 2022:

(i) Allen, J. 2022 Applications for take, use and discharge of Tranche 2 groundwater: combined assessment of environmental and economic impacts. AgFirst Waikato Ltd.

(ii) The applicant's proposed conditions of water use and water take consents (dated 22 July 2022).

2.4 My review of the above information is provided in a memorandum dated 8 August 2022. This is provided as an attachment to this evidence.

2.5 In this evidence I provide a summary of my review of the water demand assessments provided for the proposed take and use of water and comment on the likely effects associated with the required land use consent applications. While this hearing is for the applications to take and use water, the effects associated with the required land use consents are relevant, particularly with respect to whether the land use could occur in a manner that does not result in potential contaminant increases in groundwater and surface water.

2.6 The locations of the eight applicants' properties I have reviewed information for are shown in the figure below, reproduced from the AEE.

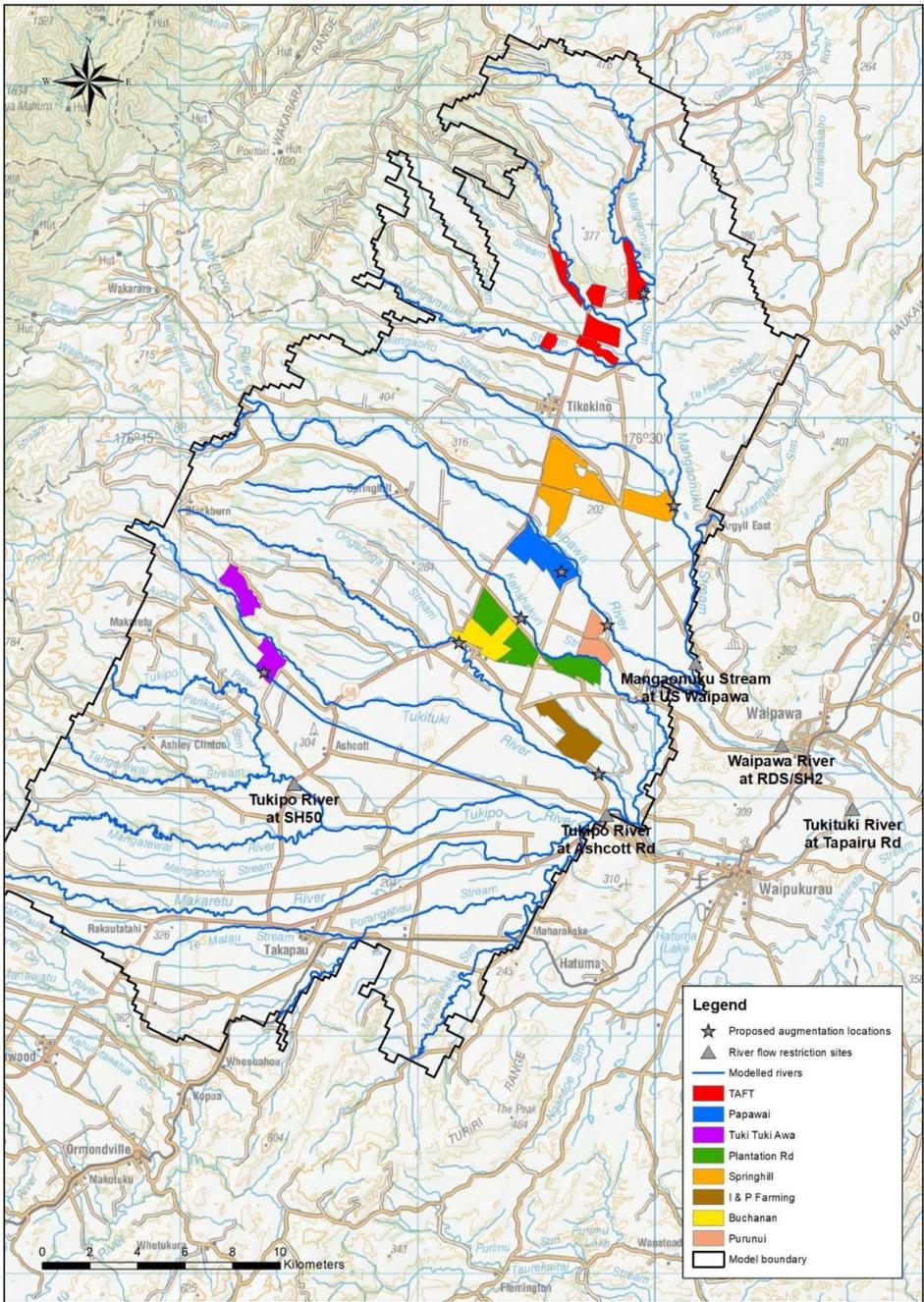


Figure 13: Tranche 2 applicants' farm locations, proposed augmentation discharge locations and key river flow monitoring sites

3. SUMMARY OF EFFECTS

Effects on water quantity and quality related to inefficient use of water

- 3.1** If water is used inefficiently, more water could be abstracted than necessary, leading to an increase in adverse effects. In addition, this could lead to allocation issues if water is allocated but not used. Inefficient use of water can also lead to adverse water quality effects, through increased contaminant leaching or run-off.
- 3.2** Irrigation demand has been modelled by the applicants using Irricalc, which calculates crop water demand and associated irrigation based on climate, soil, crop type and irrigation method. Irrigation demand was based on irrigated pasture which has the highest demand per hectare. The 90th percentile water demand for pasture has been used for all properties to determine the water demand. The applicants have indicated the area under irrigation could increase significantly beyond the area applied for as irrigated pasture if used for other land uses, such as cropping.
- 3.3** Pasture does have a higher water demand than most crops, averaging 5 mm/day or greater in summer. I note most of the applicants plan to have some arable crops in their farming system and they have lower water demand during January and February due to harvesting. Based on the volumes and irrigation areas provided, the average application rates are less than 5 mm/day and I consider the calculated water demand reasonable and within the range expected for irrigated mixed cropping and pastoral farms. If the applicants follow good management irrigation practices, then the water could be used efficiently.
- 3.4** It is important that this requirement of good management irrigation practices is incorporated into FEMPs and consent conditions, including soil moisture monitoring or an alternative approved by the Hawke's Bay Regional Council.

Effects on water quality related to subsequent land use changes

- 3.5** A number of the properties are located in catchments where the instream nitrogen target is already significantly exceeded. An overall decrease in nutrients is required across the Tukituki River and its tributaries in order for the water quality targets in Plan Change 6 to be met by 2030.

- 3.6** Farm system changes enabled by the proposed take and use of the water for irrigation have the potential to result in impacts on water quality. HBRC noted in the 1 October 2021 Section 92 request that land use consent is already required for these properties and they would not likely be granted to allow for any increase in nitrogen loss.
- 3.7** Subsequent information has been provided by the applicants on nutrient and other contaminant losses related to the production land use consents required for the properties. There are some inconsistencies, further information is required in places and details will need to be worked through in the individual land use consent applications, but overall, I consider there is sufficient information to show that the proposed land use with irrigation could be managed to result in either a decrease, or at least no increase, in the discharge of nitrogen, phosphorus, sediment and *E. coli* with appropriate controls.
- 3.8** There is significant uncertainty in estimating contaminant loads from farms. I recognise that the Ministry for Primary Industries commissioned a review into the use of the nutrient management tool Overseer by a Science Advisory Panel (SAP) and the outcome was they did not have confidence in Overseer to estimate whether the volume/rate of nutrient loss was being increased or reduced as a result of on-farm actions or changes in land use. However, even though there is a lack of confidence in Overseer to quantify nutrient losses, there is a body of robust New Zealand science to help identify high risk nutrient loss activities, mitigations and actions that could affect subsequent impacts of these activities on groundwater and surface water quality and how changes in land use activities may alter losses.
- 3.9** In terms of nitrogen, based on the current information provided, I consider that nitrogen losses to groundwater are:
- (a) Likely to remain at a similar level for Papawai Partnership, Tuki Tuki Awa Ltd, I & P Farming Ltd and Buchanan Trust No. 2
 - (b) Likely to decrease for Plantation Road Dairies, Springhill Dairies Partnership and Te Awahohonu Forest Trust (if the 200 ha orchard is developed)

- (c) There is insufficient information to determine this for Purunui Trust (because the baseline or current information is missing and recent Overseer modelling is significantly higher than earlier modelling)

3.10 I am concerned that not having a maximum irrigated area in the proposed use of water consent poses a risk that catchment loads could increase, depending on the land use. Further details and the careful development of consent conditions will be necessary for each individual production land use consent to ensure that contaminants (including nutrients, sediment and microbes) either decrease or, at a minimum, do not increase in the catchments as a result of the land use change. Farm Environment Management Plans (FEMPs), farmer/farm manager training, good record keeping and good nutrient management practices will be required.

3.11 It will be important that appropriate restrictions are also applied to Papawai Partnership's consent to use water, given my understanding that this applicant may not require a land use consent.

4. CONCLUSIONS

4.1 Overall, based on the information provided, I consider the calculated water demand is reasonable for the proposed land use. I also consider that the proposed land use with irrigation could be managed to result in either a decrease or at least no increase in the discharge of nutrients, sediment and *E. coli*. However, this requires a number of controls to be in place to achieve this including appropriate conditions on the land use consents, FEMPs, farmer/farm manager training, good record keeping and good nutrient management practices.

Katherine McCusker



8 August 2022

ATTACHMENT 1 – MEMORANDUM DATED 8 AUGUST 2022



memorandum

TO Paul Barrett FROM Katherine McCusker
Hawke's Bay Regional Council DATE 8 August 2022
RE Review of nutrient loss information for Ruataniwha Tranche 2 groundwater take applicants' properties

1.0 Introduction

Pattle Delamore Partners Limited has been engaged by Hawke's Bay Regional Council to assist with the technical review of a group of applications to take and use Tranche 2 groundwater from the Ruataniwha Basin. These applications propose to take deep groundwater (Tranche 2 groundwater defined in the decision on Plan Change 6 for the HBRC Regional Plan) from bores in the Ruataniwha Basin. The various applications have been lodged individually (since 2014), although an updated assessment of environmental effects was provided in 2021, which superseded and replaced the individual assessments that were lodged by each of the eight applicants. The updated assessment of environmental effects (AEE) was provided to HBRC on 23 August 2021.

PDP had previously reviewed information provided for the individual applications. We subsequently reviewed drafts of the technical reports prepared to support the updated combined AEE and provided comments on these (PDP, 2020 and PDP, 2021a) and the updated AEE (PDP, 2021b). Since that time further information relating to the potential effects of the application has been requested and provided. The application was publicly notified in December 2021 and a number of submissions were received both in support of, and opposing, the application.

Our review of the updated AEE prior to notification was completed in September 2021 and the applicant responded to comments in that review. In addition to the further information provided on the groundwater take and use applications, at the request of HBRC, information was provided on nutrient losses related to production land use consents required for the properties. On 27 July 2022, AgFirst also provided a report 'Applications for take, use and discharge of Tranche 2 groundwater: combined assessment of environmental and economic impacts' for the eight parties that have applied for a groundwater take consent (referred to herein as the AgFirst Report).

This memorandum provides a summary of the proposed use of water and associated nutrient losses for the different land uses proposed. The AgFirst report has been used to update the earlier draft of this memorandum, however we have not had access to the Overseer files or reports to check the changes made.

The eight applicants are now applying to use 8.5 million m³/year of water for irrigation to:

- ∴ Increase security of water supply to continue farming operations;
- ∴ Increase the area of cropping, horticulture and irrigated pasture production for sheep, beef, and dairy support.

There is a discrepancy between the irrigation volumes reported in the AgFirst report, and those modelled in the groundwater modelling report¹. I understand that some of the irrigation volumes sought by the individual applicants have reduced as shown in Table 2 and Table 4 of the AgFirst report, however, the applicants have confirmed to HBRC that the overall total volume of the takes applied for remains the same as the applicants intend for it to be used for other purposes, including potential cultural purposes. Information on that use, and the locations/depths of take for that use, have not yet been provided so the related effects cannot be reviewed or assessed at present.

2.0 Review of information received

In response to the Section 92 request from HBRC, the applicants have provided information on nutrient losses. The information provided is summarised in the following sections of this memorandum. Seven of the eight properties² involved in the applications have at least part of the property located in sub-catchments where dissolved inorganic nitrogen (DIN) concentrations in the waterways are exceeded as set out in the Tukituki Catchment Plan (PC6). Under PC6 rules, those seven properties will require a land use consent.

The first objective in PC6 includes managing the use and development of the land and the discharge of nutrients so that water quality is maintained or enhanced to protect aquatic ecosystems, food gathering, drinking water supplies, recreational use and the mauri of the water. The second objective is, where the first objective is not being met, water quality must not be allowed to degrade further and shall be improved progressively so the first objective is achieved by 2030.

We recognise that the Ministry for Primary Industries commissioned a review into the use of Overseer by a Science Advisory Panel (SAP) and the outcome was they did not have confidence in Overseer to estimate whether the volume/rate of nutrient loss was being increased or reduced as a result of on-farm actions or changes in land use. This review has altered HBRC's approach³ to enforcement of the rules in PC6 for land use in the Tukituki Catchment, that are intended to help achieve the objectives related to maintaining or improving water quality. However, even though there is a lack of confidence in Overseer to quantify nutrient losses, there is a body of robust New Zealand science to help identify high risk nutrient loss activities, mitigations and actions that could affect subsequent impacts of these activities on groundwater and surface water quality and how changes in land use activities may alter losses. Examples of expected nutrient loss under different activities are:

- ∴ sheep production typically has lower nitrogen losses than cattle farming due to the size of the urine patches;
- ∴ summer feed crops typically result in less losses than winter feed crops due to less drainage in summer;
- ∴ if a farm changes from dryland cattle (dairy) grazing and the stocking rate remains the same, irrigation may decrease the nutrient loss if the additional feed grown is exported off farm as the silage/hay exported will remove nutrients;
- ∴ for properties that are changing from a use such as cattle production to vegetable production it is more difficult to quantify the change without the use of a model like Overseer as the losses under vegetable crops vary greatly.

¹ Weir, J., 2022. Ruataniwha Basin Tranche 2 Groundwater Modelling (Revised). 30 June 2022.

² Papawai Partnership are not in a DIN exceeding local catchment as defined by HBRC

³ Hawke's Bay Regional Council Tukituki Catchment Plan (PC6) Procedural Guidelines. A guidance document outlining how the regional council proposes to implement the regulation requirements of the plan. October 2021. Hawke's Bay Regional Council Publication No. 5565

In this memorandum, the mitigations and good practices that can be expected to reduce nutrient loss have been identified for each applicant from the information provided in the AgFirst Report, the AEE, FEMPs and other supporting documents. I have reviewed this information together with the land use/irrigation changes, to inform the likely changes in nutrient loss with the proposed activities.

The information provided in the AgFirst Report indicated that the proposed irrigation areas have increased for TAFT, Plantation Road Dairies, I & P Farming Limited, Buchanan Trust No.2 and Purunui Trust and decreased for Springhill Dairy Partnership, Tukituki Awa Ltd, and Papawai Partnership compared to the previous information provided by the applicants.

In summary my assessment is the nitrogen losses to groundwater are:

- ∴ Likely to remain at a similar level: Papawai, Tukituki Awa, I & P farming, Buchanan Trust No. 2;
- ∴ Likely to decrease: Plantation Road Dairies, Springhill Dairies, TAFT (if the 200ha orchard is developed);
- ∴ Insufficient information to determine: Purunui (baseline or current information is missing and recent Overseer modelling is significantly higher than earlier modelling).

I consider, based on the information provided, that the proposed land use with irrigation could be managed to result in either a decrease or at least no increase in the discharge of nitrogen, phosphorus, sediment and *E. coli* through FEMPs, farmer/farm manager training, good record keeping and good nutrient management practices. Further details and the careful development of consent conditions will be necessary for individual land use consent applications, but this conclusion is relevant to the overall evaluation of the use of Tranche 2 water that has been applied for.

In terms of water demand, the water use efficiency for all eight applicants appears to be within the range expected for irrigated mixed cropping and pastoral farms. I consider that if the applicants follow good management irrigation practices, the water could be used efficiently. It will be important that measures in FEMPs and consent conditions are in place to help ensure this, but this conclusion is relevant to the overall evaluation of the use of Tranche 2 water that has been applied for.

2.1 Te Awahohonu Forest Trust (TAFT) (Gwavas Station)

TAFT's proposed take intended to irrigate 480⁴ ha of pasture, or up to 850 ha of less water-intensive crops or horticulture and provide river augmentation to the Mangaonuku Stream. The AgFirst report indicates an irrigation area of 820 ha as modelled in Overseer. The irrigation volume applied for is 2,841,220 m³/year. The 90th percentile water demand for pasture has been calculated to be approximately 580 mm/year.

The farm is looking to shift from a predominantly winter cropping regime to a summer regime to finish cattle before the second winter. Reducing the number of cattle during winter months and less winter cropping may reduce both the nitrogen loss and reduce the risk of overland flow of phosphorus and sediment to waterways. The AgFirst report indicates the applicant is now planning to also use water for irrigated horticulture.

⁴ There is a discrepancy between the LandVision November 2021 report and the Aqualinc October 2021 memorandum, which indicates 540 ha.

Key points from the information provided are:

Existing System from LandVision November 2021 report

- ∴ 1,600.2 ha, three properties farmed as one, Gwavas Station owned by TAFT Farming Ltd, and lease properties owned by Carola and John Hudson and SL & SM Pearse and JD Parsons;
- ∴ Mangaonuku sub-catchment;
- ∴ 15,015 RSU, Predominant land use is sheep and beef, generally cattle are finished after their second winter due to summer droughts with a 43:57 sheep to cattle ratio;
- ∴ Winter and summer crop to finish lambs and cattle (I note no information has been provided on the area of winter and summer crops);
- ∴ Currently no irrigation;
- ∴ 1 wetland;
- ∴ 32,000 m of streams running through the property,
- ∴ Stock exclusion of cattle from rivers (source FEMP) and 17.6 ha of riparian margins (source Overseer modelling);
- ∴ 9 critical source areas identified and mitigated in FEMP;
- ∴ A Phosphorus Management Plan as part of FEMP is required.

Proposed System from LandVision November 2021 report and updated from the AgFirst Report

- ∴ TAFT is planning to purchase 200 ha of land to develop into an apple orchard in the next 10 to 20 years;
- ∴ The updated Overseer modelling is based on 820 ha of irrigation for horticulture (including 180 ha apple orchard), mixed cropping and sheep and beef finishing (620 ha);
- ∴ On the pastoral land centre pivots and lateral systems with variable rate irrigation and soil moisture monitoring will be used. Irrigation will commence mid-October to end March or April depending on moisture levels;
- ∴ The farm will move to growing grain and finishing livestock;
- ∴ No additional information on the revised farm system has been provided to Hawke's Bay Regional Council.

TAFT's Baseline 2020 year end leaching was updated to 24 kg N/ha (37,850 kg N/ha/yr for around 1600 ha) in the AgFirst Report. The purchased land for the apple orchard would need to have a current N loss of equal or more than 24 kg N/ha to ensure the predicted enterprise nitrogen loss of 22 kg N/ha/yr is met. This property is in the Mangaonuku sub-catchment, in which water quality exceeds the DIN limit in PC6, therefore they require a land consent under PC6.

The updated proposed system has a calculated nitrogen loss of 22 kg N/ha/yr (38,976 kg N/yr over around 1800 ha). This modelling is based on an additional 200 ha of land.

The proposed system as provided in November 2021 by LandVision appears to increase both the area and yields of summer brassica crops. This allows an increase in trading lambs and bull beef to be run on the property. Overall, I consider the proposal could have the following effects:

- ∴ Increased area of bare ground at sowing of the crops and following grazing resulting in increased risk of surface run-off of sediment and phosphorus to waterways. This is mostly likely to occur during heavy rain and storm events in summer and autumn. Summer and autumn are when

dissolved phosphorus would be most detrimental to stream water quality due to warm temperatures and light conditions that help stimulate algal growth;⁵

- ∴ Increased use of nitrogen and phosphate fertiliser to achieve the crop yields. Overseer modelling indicates this would be more than double the pasture blocks. Increased fertiliser rates increase the risk of both nitrogen and phosphorus leaching and phosphorus run off;
- ∴ The proposed system is to run less cattle in winter, reducing the loss of nitrogen, sediment, phosphorus, and *E. coli* over the winter;
- ∴ There is a reduced risk of phosphorus and sediment run off in the summer on the irrigated pasture compared to the unirrigated areas as grass cover will be maintained;
- ∴ A 17% increase in stocking rate is proposed, the *E. coli* load is directly proportional to dry matter intake and stocking rate. As the increase in stock is over the summer there will be differences in die-off rates and drainage rates, however it is highly likely increasing RSU from around 15,000 to 17,700 will increase the *E. coli* load and *E. coli* entering the waterways following heavy rainfall events;
- ∴ TAFT are proposing to reduce the forage crop area and reduce the number of animals wintered on the property as mitigations.

To summarise, I consider the effects of the TAFT proposal on contaminant loads are:

- ∴ It is possible the nutrient losses will remain similar or reduce under the proposed system with irrigation and without the orchard development, however this needs to be confirmed by the applicant;
- ∴ A likely reduction in nitrogen loss per hectare to groundwater across the property if the 200 ha apple orchard is developed of which 180 ha is irrigated. Note the applicant has said this may not occur for another 10 to 20 years;
- ∴ A likely increased risk of phosphorus loss to waterways from summer cropping, which could stimulate algal growth. A likely increase in *E. coli* loss to waterways due to the increase stocking rate of up to 17%. However, this could be managed by having grass buffer strips between any forage crops and waterways, stock exclusion from waterways and riparian planting. It is proposed to reduce the risk of surface run-off and associated contaminants (e.g., *E. coli*, sediment, and phosphorus) by reducing the forage crop and the winter stocking rate.

2.2 Papawai Partnership

Papawai Partnership's property is located at 1041 Highway 50, Ongaonga. The Papawai Partnership comprises 336 ha of which 297.8 ha is owned and 38.2 ha is Hawke's Bay Regional Council land. According to the AgFirst report, Papawai Partnership currently lease Tranche 1 water for irrigation. The applicant seeks to irrigate up to 260 ha in total on their Ongaonga farming unit and the Tranche 2 water will replace the Tranche 1 water that they currently take. They are not planning a farm system change.. The baseline (year ending 2020) Overseer file includes irrigating 259.6 ha. This modelling includes 200 ha of pasture and lucerne, 47 ha of process crops, 22 ha of arable crops and 53 ha of forage green feed. The AEE (August 2021) stated that the irrigation component of the proposed Tranche 2 take will supplement the existing consented take of 608,212 m³ /year from Well Nos. 1859 and 16508 . From 1 July 2025 this will reduce to 557,212 m³ /year. According to the Perrin Ag Consultants February 2021 FEMP, there is currently 260.7 ha under irrigation applying up to 8 mm on average every 3 days. There is 66.8 ha, which is not currently

⁵ McDowell, R. 2012. Challenges and opportunities to decrease phosphorus losses from land to water.

irrigated, however 18.5 ha of this has the set-up for irrigation though no water is currently applied, and it is not clear whether this area will be irrigated in the future.

The property is located within the Waipawa sub-catchment (T1) and is adjacent to the Waipawa River. The applicant has provided a FEMP prepared by Perrin Ag in accordance with Hawke's Bay Regional Council Tukituki Plan Change 6 requirements. The key points from the FEMP are:

- ∴ The whole farm runs a cropping and finishing operation, with some 'one-year' breeding ewes. A mixture of green peas, spring barley and beans was grown in the 2019-20 season as crops for Hawke's Bay processing companies. Approximately one-third of the farm is in crop in any one year;
- ∴ A trading lamb operation runs all year round with total approximately 20,000 lambs purchased in the 2019-20 season, 5,000 transferred in or weaned and 24,000 sold. A small beef cattle operation (approximately 15% of the RSU) is comprised of one and two year beef steers;
- ∴ The property is flat with one small bank in the north-west corner. There are no ephemeral flow paths on the property and no flowing water. Along the northern boundary there is a stop bank, maintained by HBRC to contain the Waipawa River in times of flood;
- ∴ The pivots are designed to 'walk' over the stop banks to irrigate the area of the farm between these banks and the river. The river boundary is fully fenced to ensure no stock can access the river or riparian margin.

The FEMP provided by Perrin Ag, dated 25 February 2021 refers to the use of legacy Overseer v5.4.3 for PC6 compliance and Overseer FM v6.3.5. Due to the limitations of the legacy Overseer model several work arounds were used in the modelling, particularly for the fodder crops and these are described in pages 54 to 57 of the FEMP document. Although these work arounds appear to make sense, they do reduce the confidence in the accuracy of the nitrogen loss figure generated (a loss of 13,379 kg N (40 kg N/ha/yr) (Overseer 6.4.3) for the Year ending 2020). The modelling for the future years' activities (Refer to page 54 of FEMP) with the cropping changes identified below shows a reduction to the N loss for the property to approximately 10,500kg N per year (31 kg N/ha/yr). However, it is not clear from the reporting whether irrigation water has been applied in the modelling to all the blocks labelled as having irrigation.

It appears in the AgFirst Report, that this applicant is expecting no change in the farming system with the addition of Tranche 2 water and therefore have used the same Overseer file for both their baseline and proposed system.

According to Perrin Ag, the farm plans to make the following changes to reduce nutrient losses in future years, but have not provided an Overseer file to model the changes:

- ∴ Remove all fodderbeet and plant swedes;
- ∴ Move barley production to their Otane property where there is more headroom for nitrogen losses. The area that was in barley will go into pasture for lamb finishing which has a lower nitrogen loss;
- ∴ Plan the crop planting rotation using a 'look up table' of expected nitrogen losses for the crops so the farm does not exceed the nitrogen allocation;
- ∴ Reduce phosphorus fertiliser to maintenance levels.

In summary Papawai Partnership are proposing changes to reduce the nitrogen and phosphorus losses. However, the changes proposed of moving barley production, using a 'look up table' and reducing phosphorus fertiliser use are not dependent on Tranche 2 water availability. I recommend soil moisture monitoring is implemented if the Tranche 2 water is available and other mitigations required through the land use consent process.

2.3 Tukituki Awa

Tukituki Awa's application is for a groundwater take to increase the security of irrigation supply to an existing dairy farm, which currently has around 122 ha irrigated (Year ending 2019 Overseer budget) under a surface water abstraction consent from the Tukituki River. The irrigation component of the proposed Tranche 2 take is intended to replace the existing surface supply in periods of low flow. There are no plans to increase the area of irrigation.

This 300 ha dairy and dairy support farm has 34 ha in the Tukipo (exceeds DIN limit in PC6) and 266 ha in the Upper Tukituki Corridor (below DIN limit) sub-catchments. The property is located at 406 Tukituki Road and includes 4.6 ha of council lease.

A FEMP prepared by LandVision Ltd has been supplied (dated November 2021). Key points from this are:

- ∴ The milking platform is predominantly flat over two terraces adjacent to the Tukituki River;
- ∴ The milking platform of 135ha is approximately 90% irrigated with a mix of K-line and Bosch type sprinklers. Soil moisture monitoring has recently been installed;
- ∴ A runoff property is situated on Blackburn Road and is composed of rolling hill country over several terraces adjacent to the Tukituki River;
- ∴ The runoff property includes 30 ha of flats and 114 ha of hills, 38 ha of retired bush and terrace rise. 3.2 km of river frontage is fenced;
- ∴ Milk production of 1,270 kg MS/ha from 366 cows peak milked.

The farm is assessed using the risk Matrix Calculator as having a medium risk due to both the stocking rate and the imported feed and fertiliser. Overseer modelling has been provided by Grant Bickley (a certified nutrient management advisor (CNMA) at LandVision). This appears to have been updated in the AgFirst report resulting in the averaged nitrogen leaching rate across the whole property of 34 kg N/ha.

The applicant has provided the following mitigations to reduce nutrient losses:

- ∴ Reduced nitrogen fertiliser use by 20 tonnes since 2015;
- ∴ Use of maize as a supplementary feed to reduce N loss in urine patches;
- ∴ Riparian planting along the dry creek bed (but failed due to drought);
- ∴ Their P loss risk is associated with sheet erosion from rolling hill country. To manage this, they will only apply maintenance fertilizer and seek to maintain minimum pasture residuals of 1400. This reduces soil disturbance during rainfall.

If increased irrigation water is available, the applicant plans to:

- ∴ Reduce or eliminate 6 ha of summer swedes and move to direct drilled chicory;
- ∴ Reduce the quantity of purchased supplements;
- ∴ Change to more annual grass species and reduce the need for forage crops.

Considering the above mitigations and changes to the farm system, I consider it is likely nitrogen and phosphorus losses will remain the same or reduce if increased irrigation water is available and if there is

no increase in stocking rate. However, the above mitigations should be confirmed (or required through the land use consent process) as the AgFirst report indicates no mitigations will occur.

2.4 Plantation Road Dairies

As described in the information provided by Alastair MacCormick, Perrin Ag Consultants AEE for the production land use consent application (11 April 2022) (referred to as the PRDL-SB AEE), Plantation Road Dairies operate 423.87 ha of support blocks comprising eight owned and nine titles not owned in the vicinity of Whakarara Road and Ongaonga Road. It is not clear at present what areas are present in the Waipawa and Kahahakuri catchments, this may be available in the FEMP.

The application site is currently utilised for dairy support, and mixed cropping. Beef trading and finishing also occurs on the site. One block of 106.3 ha is irrigated under AUTH-120449-03 via a centre pivot. The applicant has applied to split the existing water take with the new owner of the adjacent dairy platform (application no. APP-127488). Their new volume of Tranche 1 ground water for the dairy support block will be 650,000 m³/yr to irrigate 155 ha. The current enterprise consists of 250.8 ha of dryland pasture, 34.5 ha of irrigated pasture, 71.8 ha of irrigated maize and 56.2 ha of dryland maize.

Plantation Dairies originally applied for 2,418,225m³ of water for irrigation to irrigate 459 ha. They have now sold the 465ha dairy farm to Apatu Farms and not renewed the lease on another 180 ha block that they intended to irrigate with Tranche 2 water. The revised Tranche 2 groundwater volume applied for is 1,645,279 m³/year (Table 2 AgFirst Report).

The AgFirst Report includes the 465 ha dairy farm that was recently sold to give a catchment scale impact. The proposed changes are according to the AgFirst report:

- ∴ The addition of 302.2 ha of irrigation on the dairy support block and 30.4 ha of irrigated sheep and beef;
- ∴ A reduction of the irrigated dairy farm of 6 ha;
- ∴ The total increase in irrigation is 326.6 ha based on the Overseer modelling.

The mitigations included in the production land use consent application and the AgFirst Report include: reduced synthetic nitrogen and phosphate fertiliser use, reduced fertiliser use on blocks receiving dairy effluent, exporting supplements and minimising fallow periods between crops.

The nitrogen loss for the planned farm operation was modelled at 33 kg N/ha/year. The PRDL-SB AEE has the modelled nitrogen loss for the support block as 34 kg N/ha/yr for 2019- 20. The AgFirst report provides a nitrogen loss from the dairy farm and support blocks of 39 kg N/ha/yr for the current operation.

The s92 request asked for information on the use of the proposed new irrigation area and to determine whether Regulations 21 and 24 of the NES-FW may apply. It appears from the AgFirst Report the additional irrigation is on dairy support and sheep and beef blocks.

I agree with the applicant that the combination of the proposed changes should not increase nitrogen and phosphorus loss to the environment when the area of irrigation is increased.

2.5 Springhill Dairies (formerly Ingleton Farms)

Springhill Dairies has 349 ha of dairy support, beef and cropping located at 82 Butler Road, Tikokino. Springhill Dairies applied to take up to 1,005,213 m³/year of Tranche 2 groundwater from deep bores located around their property to supplement existing consented takes (with a combined volume of approximately 4,029,077 m³/year) to provide adequate irrigation to 702 ha of pasture and crops. As per the AgFirst report, Springhill have since revised the application volume from their initial 1,005,213 m³ to 850,307 m³ of which 497,652 m³ is for irrigation and 352,655 m³ is for augmentation with an increase in

irrigation area from 65 to 158 ha on part of the property. In the original application it was not clear whether the new irrigation would be developed on the nearby dairy farm in addition to the support property. The AgFirst report indicates all the Tranche 2 water take application will be used for the dairy support, beef and cropping operation.

Information has been provided by the applicant's consultant Colin Tyler, Ravensdown, including a memorandum from Colin Tyler to Paul Barrett, dated 19 November 2021, with expected changes in nutrient loss with use of Tranche 2 water. A FEMP for the dairy and dairy support farm was also previously submitted with an application by Franklin Springhill Trust for a land use consent in 2020 to exceed the land use capability nitrogen leaching rate for a farming enterprise and to farm within a sub-catchment (Mangaonuku) that exceeds the PC6 Dissolved Inorganic Nitrogen (DIN) limit of 0.8mg/L. The AEE for the application was prepared by the applicant's consultant planner Victoria Caseley, also of Ravensdown.

Key points from the AEE and FEMP are:

- ∴ The support block runs to the Mangaonuku Stream which adjoins the eastern boundary and is crossed in a west-east direction by the Mangaoho Stream. To the north and south of this block is farmland;
- ∴ Based on a memorandum from Colin Tyler to Paul Barrett, dated 19 November 2021, it appears Springhill Dairy Partnership plans to increase the irrigated area on the 349 ha dairy support and cropping farm from the current 65 ha to 120 ha with the additional Tranche 2 water sought. The AgFirst Report has a proposed irrigation area of 158 ha;
- ∴ Soil moisture monitoring is installed ensuring that irrigation and effluent discharge only occurs when the soil moisture is below the minimum water holding capacity of the soils, although I note this is not modelled in the Overseer modelling provided in November 2021. A proportion of the pivots also have GPS technology installed enabling accurate applications.

The Overseer calculations carried out in 2020 to support the land use application AEE showed the whole farm nitrogen loss is 43 kg N/ha/yr for the 702 ha property, although that was using OverseerFM Version 6.3.2. The nitrogen loss for the sub catchments for the 469 ha in the Mangaonuku (DIN limited) was 45 kg N/ha/yr and 39 kg N/ha/yr for the 235 ha in the Waipawa.

The memorandum provided by Colin Tyler, Ravensdown, dated 19 November 2021 differs from the Overseer budget provided in the AEE, which, aside from Overseer changes, may be due to this applying to the area of land for which Tranche 2 water is sought. The calculated N loss for the baseline scenario is 33 kg N/ha/yr and 0.3 kg P/ha/yr. The AgFirst Report provides an updated nitrogen loss for the dairy support property of 33 kg N/ha/yr for the baseline and 29 kg N/ha/yr for the proposed 158 ha of irrigation.

An application for consent under the NES FW to increase the area of land used for dairy support purposes has also since been lodged and is currently being assessed by HBRC.

Ravensdown note in the 19 November 2021 memorandum that farm practices that appear to be reducing, or at least stabilising nutrient loss are:

- ∴ Increased area of maize silage being grown and exported due to additional irrigation;
- ∴ Similar amount of N fertiliser applied overall, but less per hectare on the irrigated blocks and a reduction in application in high risk months;
- ∴ A plan to phase out existing lucerne areas;
- ∴ No imported feed;
- ∴ No winter cropping (but no information on whether there is winter cropping in the baseline period).

Ravensdown note there are no planned changes to the stocking rate. The irrigation is expected to provide additional pasture growth limiting the need for additional inputs. In a good pasture growth season, more supplements are to be cut and exported rather than the stocking rate increased.

Ravensdown note other potential mitigations and good practices are planned, in place or possible are:

- ∴ Ongoing GMPs re irrigation practices with soil moisture meters in place and experienced staff to manage the irrigation along with support from irrigation company;
- ∴ Waterway retirement. There is a process to retire approximately 2.5 km of waterway and install reticulated water which is currently not present. An unnamed tributary of the Mangaonuku stream runs through the property. All other existing waterways are fully retired, with potential for small areas of additional planting which may assist eco-system health;
- ∴ Considering adding plantain to the pasture sward;
- ∴ Reduced N fertiliser;
- ∴ No winter crops, all regrassing/summer crops by direct drilling and improved grazing management.

Considering all of the above, I consider it is possible the nitrogen losses could be reduced under the proposed increase in irrigation. As the property has waterways, the reduction in winter crops would reduce phosphorus and sediment loss although it is not clear how much winter cropping occurs.

2.6 I & P Farming (formerly Abernethy Partnership)

I & P Farming's Braemar farm is located at 337 Ongaonga Waipukurau Road, Waipukurau. Braemar is a currently unirrigated, flat 305 ha sheep, beef and cropping operation with a winter animal feeding operation that triggered the requirement for a Feedlot Land Use Resource Consent. A consent application for the land use consent was lodged in November 2021 and covers both the current dryland farming operation and the farm under irrigation if the Tranche 2 water take and use consent is approved.

According to the consent application, the title area on the LINZ database is 303 ha. The area mapped in Overseer FM is 305.1 ha, measured using an aerial image of the farmed area. The difference is due to waterways along the boundaries.

According to the consent application, the property has 75.3 ha in the PC6 Upper Tukituki Corridor catchment (T4) and 230.3 ha in the Kahahakuri sub-catchment (T3). As stated previously, the Kahahakuri sub-catchment exceeds the DIN target for PC6. A FEMP has been prepared by Colin Tyler, Ravensdown and reviewed by Emma Buchanan in November 2021. Table 20 of the AgFirst report now indicates 288 ha will be used for irrigation.

I & P Farming have applied for 916,010 m³/year of Tranche 2 groundwater for irrigation. They are planning to increase the cropping and reduce the number of cattle. I note the applicant is proposing to continue to have winter feeding of crops on the stonier soils and this could result in higher nitrogen losses.

It appears the current nitrogen losses for the property will not significantly change with the irrigation. The four year rolling average for 2018 to 2021 was 21.75 kg N/ha/year of nitrogen loss to water. I note the AgFirst Report has both the baseline and proposed calculated nitrogen loss at 16 kg N/ha/yr, but it is not clear whether this difference is the result of an Overseer version change or the modelling has been updated.

According to the consent application, proposed pivot designs show the irrigation could cover between 220 and 240 ha depending on the layout chosen. A scenario prepared in Overseer assumes irrigation of 181.5 ha, an arbitrary indicative area modelled to illustrate the concept with the drains crossing paddocks removed from the total irrigable area using variable rate irrigation targeted to location and crop needs.

The exact area to be irrigated would be optimised during the design of the system and may not be exactly 181.5ha. Irrigation scheduling would be based on soil moisture monitors installed to trigger irrigation when a minimum soil moisture level is reached, up to a maximum optimum level. As above, the discrepancies in the irrigated area should be confirmed.

The consent application also notes that the proposed stocking policy on the farm would change significantly from that demonstrated in the years 2017-2021, with a reduction in dairy grazing cattle over the year, replaced with lamb trading over winter.

The applicant's proposed mitigations are:

- ✦ Decrease in cattle and increase in trading lambs;
- ✦ Variable rate irrigation and irrigation depth targeted to crop needs;
- ✦ Soil moisture monitoring and irrigation managed to best practice;
- ✦ Drains across irrigated paddocks removed;
- ✦ Continue to manage stocking rates, cropping and fertiliser use to achieve the nitrogen leaching limit;
- ✦ Continue to protect soils from erosion and waterways from stock access;
- ✦ Direct drilling whenever possible;
- ✦ Tracks are cambered and cut-outs are used to direct runoff into paddocks and away from waterways.

The only information provided on water use efficiency is that the applicant has stated they will have variable rate irrigation (VIR) and use soil moisture monitoring with trigger points.

Overall, I consider that, based on the information provided, I & P Farming are likely to be able to manage their activities such that the nitrogen loss does not increase with a change from unirrigated to irrigated farming using Tranche 2 water if the area of winter crops on stonier soils does not increase. No mitigations have been provided by the applicant to reduce additional phosphorus loads to the environment except for stock exclusion from waterways and run off from yards being directed to pasture.

2.7 Buchanan Trust No. 2

Buchanan Trust No. 2 have a farm in the Kahahakuri DIN limited sub-catchment. Under a previous water permit the applicant could take up to 218,420 cubic metres of water within a year to irrigate 69 ha of process crops. A change of consent conditions has recently been granted to increase the irrigation area to total 115 ha and to increase the annual volume of take by 100,000 m³ using Tranche 1 water (Stage 1). Buchanan Trust No 2 have applied to increase the irrigation area to 320 ha (Stage 2) using Tranche 2 water (the AgFirst report indicates a proposed area of 215 ha with Tranche 2 water). According to the AgFirst report, they have also revised the application volume from their initial 1,145,794 m³ to 802,558 m³ of which 550,960 m³ is for irrigation and 251,597 m³ is for augmentation. The Tranche 2 water will replace the leased Tranche 1 water. The leased Tranche1 water will then be available for transfer in the catchment, managed under a consenting process.

The nutrient modelling provided by David Reynolds in support of the Tranche 2 consent application, was up-dated in June and July 2022 so that the irrigation was consistently modelled between the baseline (year end 2021), Stage 1 and Tranche 2 stage. The nutrient modelling for the Tranche 2 irrigation had 206 ha of total irrigation, however the AgFirst Report has 215 ha of total irrigation. There will be an increase in irrigated cropping to 135 ha of beans, peas, radish, corn, carrots and maize silage and the projected

number of bulls wintered will decrease to 110, and lambs will increase to over 3000. In the Overseer modelling provided by David Reynolds there is 60 ha of orchard.

The Baseline has a nitrogen loss of 22 kg N/ha/yr and Tranche 2 with 206 ha of irrigation has nitrogen losses of 23 kg N/ha/yr (Overseer 6.4.3). Note the AgFirst Report provided on 29 July has 215 ha of irrigation, but the Overseer reports and all previous information provided had 206 ha of irrigation. The crop mix includes a significant area of bean, peas, radishes (modelled as ryegrass seed) and sweet corn that all have high nitrogen losses. As the area of these crops is likely to vary each year the nitrogen loss for the property is also likely to vary.

The farm is managing nutrient loss by:

- ∴ Cultivating with strip tilling already used for the sweetcorn, and to be used next season for the maize silage. Direct drilling is used to establish the annual ryegrass;
- ∴ All crops are harvested in the summer or early autumn, outside of periods of concern under the HBRC Risk Matrix;
- ∴ Nitrogen fertiliser is applied in the summer for crops or autumn for the annual grass, also outside of the May-August risk period.

Although the Overseer modelling shows a small increase in nitrogen loss between the baseline and the proposed scenario, it is within the variation that would be expected between seasons for a mixed cropping farm with no changes to the irrigation area.

2.8 Purunui Trust

Purunui Trust originally applied to take Tranche 2 groundwater to irrigate 175 ha of pasture/process crops on their property located at 385 and 375 Swamp Road, Ongaonga, within the Kahahakuri sub-catchment. The AEE for the Revised Tranche 2 Groundwater Applications (Sage Planning, August 2021) describes how Purunui Trust was the last applicant in the queue for Tranche 2 water, therefore the full volume applied for by the Trust is not considered available. The AEE notes how the available volume is adequate to irrigate approximately 62 ha of pasture (assumed), or a larger area of up to 93 ha of less water-intensive crops and/or horticulture, or a mixture of pasture, crops, and horticulture. The AgFirst Report indicates that the irrigation area could be 117 ha. The Purunui Trust land is leased out. At the time the original application was made for Tranche 2 water, the land was leased to Plantation Road Dairies and used for dairy support. Subsequently, a new lessee has taken over the land and plans to run an irrigated sheep, beef and cropping system.

According to the FEMP, Purunui Trust's property is a 180 ha mixed arable enterprise with grain, seed, and processed vegetable production with cattle, and lamb finishing. There is currently no irrigation. A letter from the consultant Emma Buchanan, Soter, dated 19 November 2021, describes how the stocking policy on the farm would change significantly from that demonstrated in the years 2017-2021 with Tranche 2 irrigation with a reduction in dairy grazing cattle over the year, replaced with cropping, and lamb trading over winter. That letter indicates that the proposed irrigation area will be around 63 ha, while the AgFirst Report has the new irrigation area as 117 ha. The irrigation would be used for crop production and lamb finishing.

A FEMP has been provided (dated 26 October 2021) and it includes good management practices for irrigation. Key points from the FEMP are:

- ∴ The farm is flat;
- ∴ There are streams and drains on the property that flow into the Kahahakuri Stream. A programme of fencing and planting has been actioned for all natural dams and streams on the property by the owner to exclude stock;

- ∴ There is 141.6 ha of LUC1 land, 36 ha of LUC2 land and 0.7 ha of LUC 8 lan.

The applicant has provided the following proposed mitigations and good management practices to help reduce nutrient losses, some of which are in place or underway:

- ∴ Decrease in dairy grazers and increase in trading lambs;
- ∴ Variable rate irrigation and irrigation depth targeted to crop needs;
- ∴ Soil moisture monitoring and irrigation managed to best practice;
- ∴ Drains across irrigated paddocks removed;
- ∴ Crops and fertiliser would be targeted to ensure soil structure and health are maintained, and the nitrogen leaching limit is continually achieved based on a four-year rolling average;
- ∴ The use of no tillage and cover crops to reduce soil erosion and improve soil health.

There is no standalone baseline Overseer file for the land as it was previously run with other support blocks and combined into the Overseer file of Plantation Road Dairies. An Overseer modelled scenario with irrigation and an increased cropping and lamb trading policy showed a N loss to water of 22 kg N/ha/year (Overseer v 6.4.3), with 61.2 ha of irrigation and 121 ha of crop was provided on 19 November 2021. The AgFirst report indicates a 29 Kg N/ha/yr loss based on 117 ha of irrigated mixed cropping, this is a significant increase in both nitrogen loss and irrigation area. A decrease in dairy grazers and increase in trading lambs may result in a decrease in nutrient loss from the baseline but the applicant has not provided adequate information to assess this. Based on the information provided, I consider it is possible with irrigation that the property can continue to operate within the losses under the existing /previous land uses but further details will be necessary for a land use consent.

3.0 Water use efficiency

The amount of water used for irrigation impacts nutrient leaching, therefore, a review of the irrigation demand has been undertaken in tandem with the nutrient loss assessments.

Irrigation demand has been modelled using Irricalc, which calculates crop water demand and associated irrigation based on climate, soil, crop type and irrigation method. Irrigation demand was based on irrigated pasture which has the highest demand per hectare. The 90 percentile water demand for pasture has been used for all properties to determine the water demand. However, the proposed irrigated areas may be significantly higher if less water-intensive crops or horticulture is irrigated. The applicants have proposed that the condition of consent is tied to the rate of take of water and not to the area irrigated. This would allow increased water use efficiency through improved irrigation management, improved technology, or a change to a more water efficient crop, however it would also allow for increased areas of irrigation and nutrient loss. The modelling report provided by Aqualinc indicated potentially the area under irrigation could increase significantly beyond the area applied for as irrigated pasture. If the irrigation area is increased there is a risk of higher loss of nitrogen and phosphorus entering the ground and surface water, particularly if the increased irrigation is used for vegetable production or winter forage crops. One of the options for this would be to have in the production land use consents or the water use consent, the maximum area of irrigation and the maximum area of high nitrogen loss crops, including irrigated vegetable and seed crop production and winter forage. We recommend the maximum areas are capped at the same level as those provided in the application and there is also a requirement for soil moisture monitoring or an alternative approved by the Hawke's Bay Regional Council.

In all the nutrient budgets modelled with the proposed irrigation, the irrigation area was lower than the maximum area applied for. The maximum area applied for was 2,555 ha in total from the eight applicants. The AgFirst Report has updated the irrigation areas and the area modelled/provided in the latest information from the applicants totals 1,795 ha of new irrigation. The proposed irrigation areas have

increased in this most recent report for TAFT, Plantation Road Dairies, I & P Farming Limited, Buchanan Trust No.2 and Purunui Trust and decreased for Springhill Dairy Partnership, Tukituki Awa Ltd, and Papawai Partnership. Table 1 below summarises the proposed irrigation area, the maximum and total including the existing irrigation for each applicant.

Table 1: Areas of Irrigation Used to Model Nutrient Loss (ha)

Application Number/s	Applicant Name/s	Maximum Area Applied For	Existing Irrigated Area	Proposed New Irrigation	Proposed Total Irrigation Area Modelled For N loss	Farm Area
WP140512T	Te Awahohonui Forest Trust (TAFT)	850	0	820	820	1600
WP140555Tb	Papawai Partnership	320	260	0	260	336
WP150044T	Tukituki Awa Ltd	136	122		122	300
WP160193T	Plantation Road Dairies	459	521	327	847	1077
WP150016T	Springhill Dairy Partnership ¹	188	65	93	158	349
WP170155T	I&P Farming Limited	310	0	288	288	305
WP170166T	Buchanan Trust No. 2	230	64	150 ²	215	241
APP-125281	Purunui Trust	93	0	117 ³	117	180
	Total	2586	1032	1795	2827	4388

Notes:

1. The AgFirst report provided on 29 July 2022 updated the area to 215 ha of irrigation total
2. Includes the Tranche1 irrigation that is being developed spring 2022
3. The AgFirst report provided on 29 July 2022 updated the area to 117 ha of irrigation

The above table shows that the nutrient loss has been modelled for an irrigated area that is significantly (more than 10%) smaller than the maximum area of irrigation applied for some properties. Those properties have not presented the worst case scenario for nitrogen loss, which would be to have the maximum area of crop modelled.

Having the condition of consent tied to an irrigation area and a maximum area of high nutrient loss activities would help reduce the risk of contaminant loads increasing in waterways. However, I note that water quality targets are not being met for Upper Tukituki Corridor, Mangaonuku, Kahahakuri and Tukipo catchments and further mitigations are going to be required. These could include farmer training in good management practices, a look up table for the different crop nitrogen losses, together with very good record keeping and reporting/monitoring, to help manage the nitrogen loads.

Although Aqualinc have used the same methodology to determine the water required, the water used per hectare per day will vary due to smaller irrigation areas and varying existing water allocations. Pasture does have a higher water demand than most crops, averaging 5 mm/ha/day or greater in summer. I note most of the applicants plan to have some arable crops in their farming system and they have lower water demand during January and February due to harvesting. The table below shows that if we assume the seasonal water available (existing and proposed) is used over 150 days in the period of mid-October to the March, then between 2.2 and 3.49 mm/ha/day would be available. As evapotranspiration rates are

between 3 and 7 mm/ha/day at that time of the year, the farms will still regularly require rainfall to avoid moisture deficits. I consider that if the applicants follow good management irrigation practices, the water could be used efficiently.

AgFirst were engaged by the eight applicants to review the water use requirements and the associated Irricalc and Overseer modelling. Where necessary the Overseer files were updated so that the irrigation water use more closely aligned with the Irricalc calculations.

Table 2: Summary of water take (m³/year) and water use

Application Number/s	Applicant Name/s	Proposed New Irrigation Volume	Existing Irrigation Volume	Total Irrigation Volume	Proposed Total Irrigation Area (ha)	Irrigation Use assumed for 150 days/yr (mm/ha/day)
WP140512T	Te Awahohonu Forest Trust (TAFT)	2,841,220	0	2,841,220	820	2.31
WP140555Tb	Papawai Partnership	1,010,817	-. ³	1,010,817	260	2.59
WP150044T	Tukituki Awa Ltd	607,000	-. ³	607,000	122	3.32
WP160193T	Plantation Road Dairies Support	1,645,279	650,000 ¹	2,295,279	439	3.49
WP150016T	Springhill Dairy Partnership	497,652	145,030	642,682	158	2.71
WP170155T	I&P Farming Limited	916,010	0	916,010	288	2.12
WP170166T	Buchanan Trust No. 2	550,960	218,420 ²	769,380	215	2.39
APP-125281	Purunui Trust	370,321	0	370,321	117	2.11

Notes: Irrigation areas are based on the AgFirst report provided 29 July 2022

1. Application no. APP-127488 will split the existing water take with the new owner of the dairy platform and their new volume of Tranche 1 ground water for the dairy support block will be 650,000 m³/yr for 155 ha of irrigation
2. Water permit AUTH-121586-03 but excludes Tranche 1 water which was granted on 10 June 2022 and will be replaced with Tranche 2 water if this application is successful. There are some discrepancies with the information in Table 12 of the AgFirst report.
3. Assumes all the existing water take is replaced with the Tranche 2 water.

Note that in Table 2 it is assumed that Buchanan Trust No. 2 replaces Tranche 1 water with Tranche 2 and the Tranche 1 water is not included in the water use efficiency calculation.

4.0 Phosphorus, sediment and *E. coli* loss to water

The applicants have identified mitigations and actions to reduce the loss of phosphorus and sediment to waterways, in their FEMPs. Most phosphorus is lost to water when there is runoff/overland flow. There is a risk that, with increased cropping resulting in increased cultivation and periods of bare ground after harvest, more sediment carrying phosphorus could enter the waterways. However, these risks can be reduced by the use of grass buffer strips and riparian planting between crops and waterways, nutrient assessments to optimise the use of fertiliser and good management practices. TAFT, Papawai, Tukituki Awa and Springhill Dairies have all identified a reduction in the area of winter forage crops. TAFT, Plantation Road Dairies, I & P Farming, Buchanan Trust No 2 and Purunui plan to reduce the number of cattle as a mitigation. Both of these mitigations will reduce the risk of pugging/trading damage and sediment carrying phosphorus to waterways.

The reduction in cattle numbers will also reduce the risk of *E. coli* entering either surface or groundwater. Springhill Dairies and Purunui Trust are still in the process of stock excluding all waterways which will contribute to reducing *E. coli* to water.

I consider, based on the information provided, that the proposed land use with irrigation could be managed to result in either a decrease or at least no increase in the discharge of nutrients, sediment, and *E. coli* through appropriate conditions on the land use consents, FEMPs, farmer/farm manager training, good record keeping and good nutrient management practices. Further details and the careful development of consent conditions will be necessary for individual land use consent applications.

5.0 Summary

The information provided in the AgFirst Report indicated that the proposed irrigation areas have increased for TAFT, Plantation Road Dairies, I & P Farming Limited, Buchanan Trust No.2 and Purunui Trust and decreased for Springhill Dairy Partnership, Tukituki Awa Ltd, and Papawai Partnership compared to the previous information provided by the applicants.

In summary my assessment is the nitrogen losses to groundwater are:

- ∴ Likely to remain at a similar level: Papawai, Tukituki Awa, I & P Farming, Buchanan Trust No. 2;
- ∴ Likely to decrease: Plantation Road Dairies, Springhill Dairies, TAFT (if the 200 ha orchard is developed);
- ∴ Insufficient information to determine: Purunui (baseline or current information is missing and recent Overseer modelling is significantly higher than earlier modelling).

The expected nitrogen and phosphorus losses, based on the information I have reviewed, are summarised in Table 3 below.

Table 3: Summary of Nutrient Losses						
Property Name	Land Use Change	Sub Catchment (Red exceeds catchment DIN levels)	Baseline N loss kg N/ha/yr	Proposed N loss /ha/yr	Changes to P and sediment loss	Mitigations Proposed
TAFT	200 ha of orchard, shifting from winter cropping to summer crop with finishing cattle before the second winter	Mangaonuku	24	22	Decrease if mitigations are implemented	Purchase 200 ha of sheep and beef land and convert to orchard, reduce winter cattle numbers
Papawai	Increase in vegetable, arable and feed crops	Waipawa	39	39	No change if well managed	Remove fodder beet and barley production, reduce phosphorus fertiliser use

Table 3: Summary of Nutrient Losses

Property Name	Land Use Change	Sub Catchment (Red exceeds catchment DIN levels)	Baseline N loss kg N/ha/yr	Proposed N loss /ha/yr	Changes to P and sediment loss	Mitigations Proposed
Tukituki Awa	No change in irrigation area, change water source, continue with dairying	Tukipo	34	34	Decrease if reduce forage crops	Reduce nitrogen fertiliser use, reduce forage crops, reduce purchased supplements
		(34 ha)				
		Upper Tukituki Corridor(266 ha)				
Plantation Road Dairies	Dairy support, sheep and beef additional irrigation	Waipawa (TBC)	39 ¹	33	No change	Reduce nitrogen and phosphorus fertiliser, export of supplements
		Kahahakuri (TBC)				
Springhill Dairies	Dairy support, no change to stocking rate, increased supplements sold	Mangaonuku	33	29	Decrease possible	No winter forage crops, reduce nitrogen fertiliser
I & P Farming	A reduction in cattle, replaced with lamb trading over winter.	Kahahakuri (230.3 ha)	16	16	Decrease possible	Decrease in cattle and increase in lambs, direct drilling where possible
		Upper Tukituki Corridor (75.3 ha)				
Buchanan Trust No. 2	Increase in vegetable production and lambs wintered decrease in bulls wintered	Kahahakuri	22	23	Depends on the crop mix, decrease possible	Decrease in bulls wintered
Purunui	A reduction in dairy grazing, replaced with cropping, and lamb trading over winter.	Kahahakuri	Not provided	29	Decrease possible	Decrease in dairy grazers and increase in lambs, use of no tillage and cover crops

Notes

1. Plantation Dairies current nitrogen loss includes the dairy farm and when it is excluded the current N loss is 34 kg N/ha/yr.

Having the condition of consent tied to the rate of water taken and not to the area irrigated poses a high risk that catchment loads could increase, unless the consents cap the nutrients lost to the level provided by the applicant and there is confidence in those numbers. I recommend either the use of Overseer or a look up table for the different crops together with very good record keeping and reporting/monitoring, to help manage the nitrogen loads.

I consider, based on the information provided, that the proposed land use with irrigation could be managed to result in either a decrease or at least no increase in the discharge of nitrogen, phosphorus, sediment, and *E. coli* through appropriate conditions on the land use consents, FEMPs, farmer/farm manager training, good record keeping and good nutrient management practices. Further details and the careful development of consent conditions will be necessary for individual land use consent applications.

The water use efficiency for all eight applicants appears to be within the range expected for irrigated mixed cropping and pastoral farms. I consider that if the applicants follow good management irrigation practices, the water could be used efficiently. This management requirement should be incorporated into FEMPs and consent conditions.

This memorandum has been prepared by Pattle Delamore Partners Limited (PDP) based on information provided by the Hawke's Bay Regional Council others (not directly contracted by PDP for the work). PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the memorandum. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

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