Independent
Agriculture
& Horticulture
Consultant
Network

Applications for take, use and discharge of Tranche 2 groundwater: combined assessment of environmental and economic impacts

Prepared by James Allen
July 2022

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

Plan Change 6 (PC6) to the Hawke's Bay Regional Resource Management Plan became operative on the 1st of October 2015. It set groundwater allocation limits for the Ruataniwha Basin which is located within the Upper Tukituki River Catchment. Included within those limits was an allocation of deep groundwater that PC6 has labelled Tranche 2. In response to the Tranche 2 allocation, eight parties have applied for a groundwater take.

Each of these properties plan to abstract water for agricultural production purposes. The proposed take for agricultural purposes is 8.4 million m^3/yr. In addition to this quantity, a significant part of their total take (4.5 million m^3/yr.) will be used for augmentation back into surface water bodies to support low flow periods. There is also 2.2 million m^3/yr. residual available for any necessary mitigation.

The eight applicants submitted individual applications to the council. In August 2021 a revised combined Assessment of Environmental Effects (AEE) was submitted to the council following council request to show the combined impact of the applications. To support this AgFirst Waikato Ltd (AgFirst) were engaged by the applicant group (in March 2022) to provide an overarching report that outlined the combined water take requirements, nitrogen discharges and other environmental impacts associated with the proposed irrigation and an assessment of the potential economic effect on the farms and community, which is the purpose of this report.

To prepare this report AgFirst reviewed all the of the existing information, particularly around water use requirements and associated IrriCalc and OverseerFM (Overseer) modelling. Where necessary, Overseer files were updated or reworked. It is noted AgFirst is reliant on the provision of accurate information by both the farmer applicant and the nutrient management consultant who prepared the Overseer files.

The analysis was based on the following understanding:

- The eight applicants are applying for the irrigation water for agricultural purposes (8.4 million m^3/yr) to:
    - Increase security of water supply to continue existing farming operations (e.g. replacing leased water with their own consented water).
    - Move to higher value land uses.
- Seven of the eight applicants will also require a land use change consent. The conditions of the consent will require the landowner to ensure that there is no increase in nitrogen discharges as a result of the irrigation.
- For the purpose of this report environmental impact is limited to the nitrogen, phosphorus, sediment, and *E.coli* discharges and greenhouse gases.
- Assessment of likely environmental impacts of irrigation, along with mitigation of effects, is best undertaken using a combination of Overseer modelling in conjunction with industry accepted science and the Hawkes Bay Regional Council (HBRC) two-tiered risk matrix.

The key conclusions from the analysis are as follows:

- Overseer modelling of the proposed irrigation with a combination of land use changes, livestock management changes, and farm management changes indicate that nitrogen losses will not increase as a result of the irrigation.
- Overseer modelling scenarios have been assessed as potentially viable and the resulting outputs credible based on current science and understanding.
- HBRC matrix assessment was conducted, however more emphasis in this report has been put on Overseer model analysis as this is more detailed and accurate than the matrix. The matrix assessment found two farms drop a category, four remain in the same category and two increase a category. This increase in category is caused by increased imported nitrogen for both farms. With irrigation it is possible to increase imported nitrogen application to pastures and crops without increasing loss of nitrogen as, with effective management, irrigation enables increase yield and improved utilisation efficiency (section 6.3, pg. 22). .
- GDP outputs as a result of the irrigation development equate to $5.7 million per annum.
- The aggregated net economic benefit for the eight properties was $4.4 million per annum. This equates to a return of 12% before taxation on the approximately $36 m of capital (irrigation) that will need to be invested.
- An increase in horticultural area provides increased employment opportunities for the region. If 260 hectares of land is converted to horticulture, this could provide additional employment for up to 74 people.
- There is approximately 1.3 million m^3 per annum of potential irrigation water available for mitigation. This would be sufficient to irrigate 217 ha, add $217,317 per year of net benefit, and provide additional employment for 10 people in the community.

2.0 BACKGROUND AND PURPOSE

Plan Change 6 (PC6) to the Hawke's Bay Regional Resource Management Plan became operative on the 1st of October 2015. PC6 set groundwater allocation limits for the Ruataniwha Basin which is located within the Upper Tukituki River Catchment. Included within those limits was an allocation of deep groundwater that PC6 has labelled Tranche 2 (T2).

In response to the T2 allocation eight parties have applied for a groundwater take. These parties are as follows:

Table 1: Applicant details

Applicant	Property location
Te Awahohonu Forest Trust (TAFT)	Gwavas Station - 5740 State Highway 50 and 97 Matheson Road, Tikokino
Springhill Dairies Partnership	Cnr Tikokino and Makaroro Roads, Tikokino
Tuki Tuki Awa Ltd	406 Tukituki Road, Takapau
Plantation Road Dairies	1404 Ongaonga Road, and Wakarara Road, Ongaonga
Papawai Partnership	1041 State Highway 50, Ongaonga
I&P Farming Limited	337 Ongaonga -Waipukurau Road, Ongaonga
Buchanan Trust No. 2	19 Ngaruru Road, Ongaonga
Purunui Trust	385 and 375 Swamp Road, Ongaonga

Each of these properties plan to abstract water for agricultural production purposes. Since the initial application there have been changes to the volumes that applicants are applying for. The proposed take for agricultural purposes was initially 9.6 million m^3/yr. In addition to this quantity, a significant part of their take (5.1 million m^3/yr) was to be used for augmentation back into surface water bodies to support low flow periods. These volumes have changed to 8.4 million m^3/yr for agricultural purposes and 4.5 million m^3/yr for augmentation (see 10.1 Appendix 1: Application areas, volumes and changes throughout application process) and 2 million m^3/yr residual available for mitigation.

The eight applicants submitted individual applications to the council. In August 2021, following council request to show the combined impact of the applications, a revised combined AEE was submitted. . To support this, AgFirst Waikato Ltd (AgFirst) were engaged by the applicant group (in March 2022) to provide an overarching report that outlined the combined water take requirements, nitrogen discharges and other environmental impacts associated with the proposed irrigation and an assessment of the potential economic effect on the farms and community, which is the purpose of this report, i.e.:

1. To review and synthesise the eight applications and associated modelling into an overarching model, providing an overall assessment of the environmental effects that can be expected from the farm systems change.

2. Undertake a high-level analysis of the economic and social impact/benefits of the use of T2 water for irrigation as proposed in the applications.

3.0 METHODOLOGY

AgFirst was engaged by the eight applicants to prepare this report. This project was governed by a smaller committee consisting of the applicants and a resource management planning expert. Our methodology was as follows:

1. Desktop review of all of the relevant background material, i.e. applications, AEE, various correspondence.
2. Review existing Overseer files (these files were created for the applicants land use applications and their baselines). This includes comparison with application volumes.
3. Compare the Overseer files with the individual applications

   Review alignment of irrigation water take volumes requested against proposed water use requirements from the Overseer modelling. IrriCalc data sourced from Aqualinc[1] was used to determine the irrigation volume requirements. To ensure that the Overseer files provided accurately represented the environmental impact of the full volume being applied for by each applicant, each proposed scenario was compared with IrriCalc to seek alignment between Overseer and IrriCalc. The 90th Percentile annual irrigation volume was taken to be the application volume. IrriCalc was calculated based on a given area (by the applicant and optimised by Aqualinc modelling) and based on the use of irrigation for pastoral agriculture. IrriCalc also has the ability to output average annual irrigation volumes (m^3/yr) (as shown in Table 3 pg.9). This volume is what was compared to the irrigation volumes modelled in Overseer proposed scenarios as Overseer is an 'averaging' model. As the input data for the two models and the calculation methods are not identical, AgFirst agreed that the volume of irrigation applied in the Overseer scenario modelling needed to be ± 25% of the IrriCalc average annual irrigation volume.
4. Engagement with the eight farmer applicants and their associated nutrient management experts who have pulled together the relevant consent applications and undertaken Overseer modelling. Full irrigation application scenarios (or future opportunity scenarios) were requested and finalised.
5. A review of the environmental impact of each applicant's current land use and proposed land use was conducted through comparison of Overseer files.
6. Using the Hawkes Bay Regional Council (HBRC) two-tiered matrix (Appendix 2: HBRC risk matrix), an assessment of each applicant's current ranking versus their proposed system was undertaken.
7. Review of proposed farm system changes and associated economic costs and benefits.
8. Compilation of financial impacts at the farm level, and the associated impacts to the wider community.

[1] See Julian Weir's modelling report and evidence.

4.0 LIMITATIONS

There are several limitations to this report. In preparing this report, AgFirst were reliant on:

- The quality of the data provided by the farming applicants.
- The competency of the nutrient management consultants who prepared the Overseer files.
- The assumptions provided by the applicants with regard to their proposed land use once irrigation is secured.
- The assumption that farmers are achieving and will continue to achieve, good farming practices at minimum and are operating efficient irrigation systems.
- The assumption that the proposed farm systems are economically and practically viable.
- The accuracy of Overseer and IrriCalc. As discussed in section 6.0 there are limitations to both Overseer and Irricalc and the ability to compare between the two models.
- AgFirst has not undertaken site visits as the preparation of the Overseer files was done by the various nutrient management consultants.
- AgFirst is reliant on the accuracy of the IrriCalc modelling provided by Aqualinc.

Information received from applicants was reviewed to ensure assumptions were reasonable.

This report should be read with these limitations in mind.

5.0 OVERVIEW OF APPLICANTS – CURRENT & PROPOSED

Eight farming businesses have applied for the groundwater take. The location of the applicants is shown on the following map:

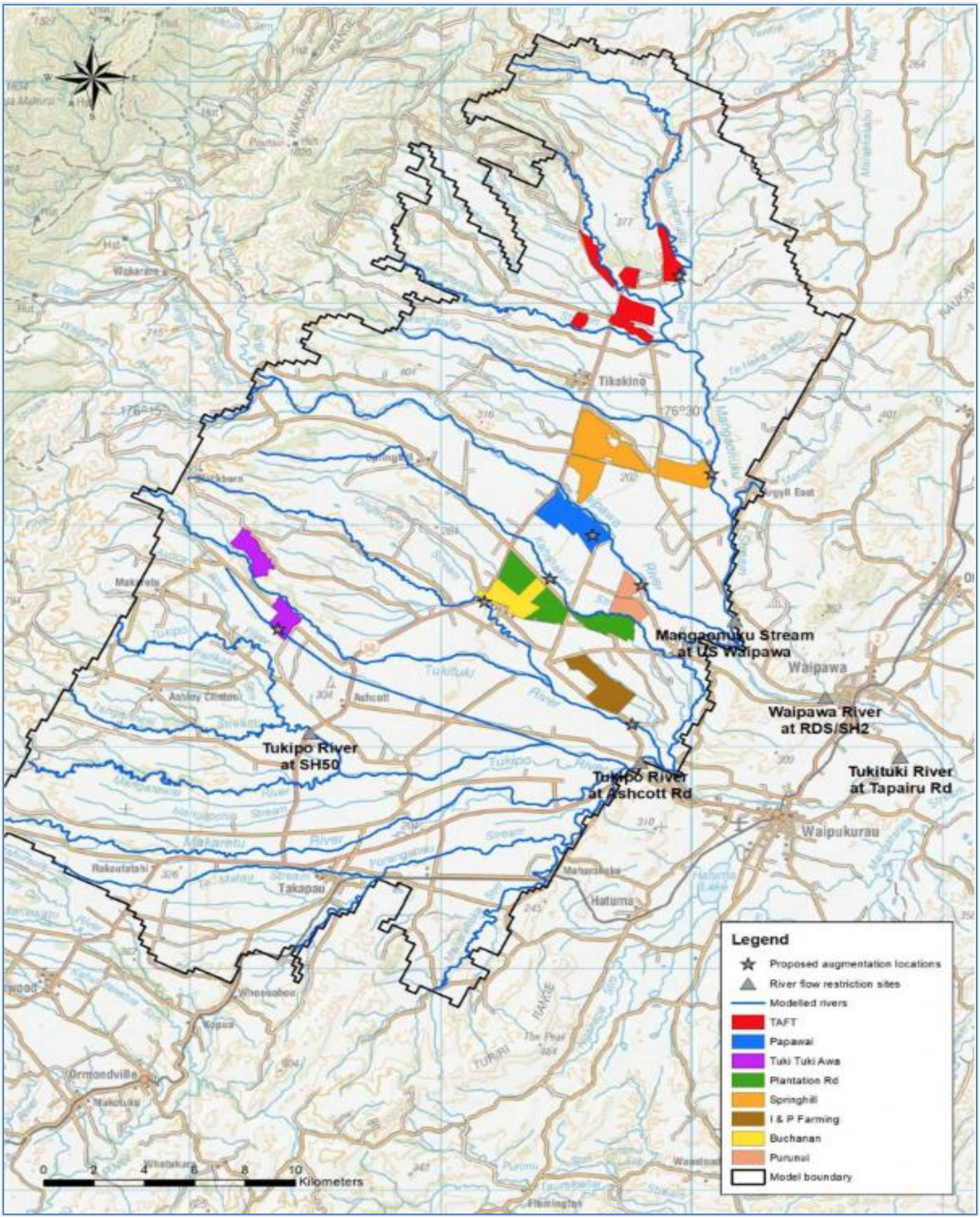

Figure 1: Location of applicants as per lodgement with HBRC (note locations are approximate and some landholdings have changed area since lodgement)

The following table provides a high-level overview of the amount of water that has been applied for, for agricultural use.

Table 2: Applicant proposed water take for Agricultural purposes

Applicant	Initial Tranche 2 ground water volume applied for (m^3/year)	Final Tranche 2 ground water volume applied for (m^3/year)
TAFT	2,841,220	2,841,220
Papawai	1,010,817	1,010,817
Tuki Tuki Awa	678,100	607,000
Plantation Road Dairies	2,418,225	1,645,279
Springhill Dairies Partnership	588,313	497,652
I&P Farming	916,010	916,010
Buchanan	786,594	550,960
Purunui	370,321	370,321
Total take for agricultural purposes	**9,609,600**	**8,439,260**

It is noted that whilst this application is for a groundwater take, 7[2] of the 8 farming applicants will also be required to apply for a land use change consent. Although the land use change consent applications are outside the scope of this report, we are aware that there will need to be alignment between the two consent processes. Thus, we have worked on the principle that the land use change consent will require the landowner to ensure that there is no increase in nitrogen discharge as a result of the irrigation. Whilst the applicants want to retain a degree of flexibility with regard to the ultimate choice in land use, e.g. pastoral versus arable versus horticulture, the applicants are also aware that any land use change cannot increase nitrogen leaching.

AgFirst have reviewed the agricultural irrigation take requests and associated modelling from IrriCalc against the proposed land use modelling that was undertaken via Overseer. This ensures there is consistency between the proposed water take and the proposed water use.

Any environmental impact of the residual water available for mitigation has not been assessed, however the economic potential of using that water for agricultural irrigation has been estimated.

[2] Papawai are not in a DIN exceeding catchment and therefore do not require a land use consent. They are not planning to change their system as a result of the granting of Tranche 2 water, see 0

Papawai Partnership.

Table 3: 90th Percentile and average annual irrigation volumes calculated using IrriCalc and as modelled by Aqualinc.

Applicant	Modelled 90 percentile annual irrigation volumes (m^3/year)	Modelled average annual irrigation volumes (m^3/year)
	(1972-2012)	**(1972-2012)**
TAFT	2,841,220	2,464,700
Papawai	1,010,817	881,400
Tuki Tuki Awa	607,000	503,600
Plantation Rd Dairies	2,418,225	2,031,100
Springhill Dairies	588,313	462,200
I&P Farming	916,010	720,400
Buchanan	786,594	674,700
Purunui	370,321	309,400
Total	**9,538,500**	**8,047,500**

AgFirst has, as stated in the methodology, worked through the process of ensuring the environmental and economic assessment aligns with the water take volume to which the group are applying. Working through this process and taking into consideration land ownership changes, has allowed the numbers in the above table to be refined to the table below. This process has brought about a residual volume that is available for mitigation (Appendix 1: Application areas, volumes and changes throughout application process).

Table 4: Revised IrriCalc application volumes

	Volume total	Augmentation volume	Irrigation 90th percentile volume	Irrigation average volume
TAFT	4,914,920	2,073,700	2,841,220	2,464,700
Papawai	1,475,517	464,700	1,010,817	881,400
Tuki Tuki Awa	636,600	29,600	607,000	503,600
Plantation Rd Dairies	2,552,207	906,928	1,645,279	1,381,892
Springhill Dairies	850,307	352,655	497,652	390,974
I&P Farming	1,200,010	284,000	916,010	720,400
Buchanan	802,558	251,597	550,960	472,586
Purunui	554,921	184,600	370,321	309,400
Total	**12,987,040**	**4,547,780**	**8,439,260**	7,124,951
Residual available for mitigation	2,012,960	701,991	1,310,969	
Total (inc. residual)	**15,000,000**	5,249,771	9,750,229	

The volumes shown in section five for each property are based on the Overseer irrigation volumes, and as such will be different from the volumes shown above. However as previously noted we have ensured there is consistency (+/- 25%) between Overseer and the adjusted IrriCalc volumes which are shown in the 'irrigation average volume column' of Table 4.

5.1 Te Awahohonu Forest Trust (TAFT)

TAFT is the owner of Gwavas Station, a dryland sheep and beef breeding and finishing property. To mitigate the impact of drought it currently grows a large amount of both summer and winter fodder crop. Even with the large amount of cropping, TAFT struggles to finish cattle prior to their second winter. It is also missing an opportunity to improve ewe performance by strategic feeding at critical periods.

In the short term, TAFT has identified the opportunity to use T2 water to finish livestock earlier with less reliance on winter cropping and more reliance on improved pasture species that will perform well under irrigation.

In the short to medium term the farm system at TAFT will move to growing summer grain crops and a significant investment in apples (about 200 ha), along with finishing livestock. TAFT will need to purchase a further 200 ha of land that is suitable for development of an apple orchard. The purchased land will need to have a current N loss equal to or more than 24 kg N/ha to ensure the predicted enterprise N loss of 22 kg N/ha/yr is met.

The net benefit to the catchment will therefore be a reduction, as the forecast for Gwavas including purchased land is 22 kg N/ha/yr.

TAFT has applied for 2,841,220 m^3 of water for irrigation. This is to support TAFT's medium and long term (10 - 20+ year) development plans. TAFT plan to keep optimising their land use over time.

TAFT has modelled Gwavas' current and proposed system in Overseer and the following table shows some key outputs and parameters. The volume of irrigation modelled in this Overseer scenario is 2,288,790 m^3 per year. This is 178,210m^3 less than the average annual volume from IrriCalc. This difference is deemed to be within the range of error between IrriCalc and Overseer (see paragraph 4 in 3.0 Methodology).

Table 5: Te Awahohonu Forest Trust key parameters.

	Current	Proposed
Irrigation area (ha)	0	820
Irrigation volume (m^3/year)	0	2,288,790
Farm system	Sheep and beef breeding and finishing	Horticulture, mixed cropping and sheep and beef finishing
N loss (kg N/ha/yr)	24	22
P loss (kg P/ha/yr)	0.3	0.5
GHG (total eCO2-tonnes/ha/yr)	6,146	7,485
Stock units	15,057	17,677
Crop area (ha)	316.2	187.7
Synthetic N fertiliser applied (kgN)	54,406	63,641
Purchased supplement (tDM)	0	0
N surplus (kgN/ha/yr)	66	71
Environmental mitigations	» Increase land area » Develop apple orchard » Reduction in number of breeding animals » Finish livestock prior to their second winter » Reduce forage crop area	

5.2 Papawai Partnership

Papawai, a mixed cropping and sheep and beef farm, currently leases Tranche 1 water for irrigation. They are not applying for a system change; they are applying for the volume of water that they currently lease, and if successful will replace the lease water with T2 water[3]. They are not planning a system change as a result of T2 water.

This block is not in a nutrient exceeding zone and therefore does not require a land use consent or baseline. No system change is occurring.

The volume of water modelled in Overseer is 972,792 m^3. This is greater than the average irrigation volume calculated by IrriCalc in relation to the volume applied for. The difference of 91,392 m^3 is assumed to be covered by lease water for the purpose of this report. There is therefore no change in environmental impact or economics as a result of this application. The following table shows some key outputs and parameters of the Overseer file produced for this analysis.

Table 6: Papawai Partnership key parameters

	Current	Proposed
Irrigation area (ha)	260	260
Irrigation volume (m^3/yr)	972,792	972,792
Farm system	Sheep,beef and cropping	Sheep,beef and cropping
N loss (kgN/ha/yr)	39	39
P loss (kgP/ha/yr)	0	0
GHG (total eCO2-tonnes/ha/yr)	1,624	1,624
Stock units	3,493	3,493
Crop area (ha)	125.6	125.6
Synthetic N fertiliser applied (kgN)	16,576	16,576
Purchased supplement (tDM)	148t DM (lucerne hay and barley straw)	148t DM (lucerne hay and barley straw)
N surplus (kgN/ha)	61	61
Mitigations	» No change, potential for irrigation infrastructure development due to increased water security as the water is owned as opposed to leased.	

[3] The leased Tranche 1 water is expected to be transferred to another farm. This transfer will be managed through a separate consenting process, during which it is expected that no increase in environmental impact from the current system on the farm the water is transferred to will be accepted. Therefore, this transfer will not cause an increase in environmental impact.

5.3 Tuki Tuki Awa Limited

Tuki Tuki Awa is a 127 ha dairy platform which includes some young stock grazing. The property currently has 122 ha of irrigation (consent WP120320T). This application is not to increase irrigation but to provide water for when the T1 water is restricted. This will provide more security of water supply. Overseer assumes good management practices are achieved and therefore assumes irrigation is applied when required. However, if the river is on flow restrictions, a farm may not actually be applying water when Overseer is assuming it is. Therefore, from the perspective of Overseer modelling, the water applied will not change with the addition of T2 water to this system, but the actual volume applied in practice will increase to correspond with that modelled by Overseer.

The current consent held by Tuki Tuki Awa is for 174,180 m^3 per 28 day period at a rate of no greater than 78 l/s. The volume that has been applied for by Tuki Tuki Awa in their initial T2 application totals 678,100 m^3 and 228,480 m^3 per 28 day period. The IrriCalc modelled 90 percentile annual irrigation requirement is 607,000 m^3. Tuki Tuki Awa have revised their requested volume back to the 90-percentile number of 607,000 m^3 (equivalent to 503,600 m^3 as an average annual volume).

Overseer modelling shows an average annual water use of 398,845 m^3, this is 104,755 m^3 less than the revised IrriCalc average volume modelled. This variation is deemed to be within the margin of error between the two models.

The following table shows some key outputs and parameters from Overseer.

Table 7: Tuki Tuki Awa key parameters

	Current	Proposed
Irrigation area (ha)	122	122
Irrigation volume (m^3/yr)	398,845	398,845
Farm system	Dairy farm	Dairy farm
N loss (kgN/ha/yr)	34	34
P loss (kgP/ha/yr)	1.2	1.2
GHG (total eCO_{2}- tonnes/ha/yr)	1,545	1,545
Stock units	3,582	3,582
Crop area (ha)	6	6
Synthetic N fertiliser applied (kgN) per year	8,090	8,090
Purchased supplement (tDM)	482	482
N surplus (kgN/ha)	178	178
Mitigations	» no mitigations as no associated change	

5.4 Plantation Road Dairies

Plantation Dairies is currently a dairy and dairy support operation with 520.8 ha of the 1,077 ha irrigated. This application is to increase the irrigation area of the dairy support area.

The land use proposed is shown in the table below.

Table 8: Proposed change in land use for Plantation Road Dairies

Land use	Current (ha)	Proposed (ha)
Dryland dairy	51	53[4]
Dryland sheep & beef	3	3
Dryland dairy grazing	469	63
Total Dry	**523**	**119**
Irrigated dairy	415	409[4]
Irrigated sheep & beef	0.3	31
Irrigated dairy grazing	106	408
Total Irrigated	**521**	**847**
TOTAL (effective)	**1,043**	**967**[5]

Plantation Dairies originally applied for 2,418,225 m^3 of water for irrigation. Since this application they have sold some land and not renewed the lease on other land which has had implications for the volume of T2 water now required for irrigation. They therefore applied for more water than they can now use for irrigation. This water has been set aside as residual available for any necessary mitigation purposes.

After removing that volume of water, the average annual volume of irrigation totals 1,381,892 m^3. The water modelled in the Overseer file sourced from T2 water totals 1,050,238 m^3. The difference is therefore 331,654 m^3, which is a difference of 24% between the two models.

Table 9: Plantation Road Dairies key parameters

	Current	Proposed	Difference
Irrigation area(ha)	521	847	327
Irrigation volume (m^3) per year	1,703,328	2,753,566	1,050,238
Farm system	Dairy support	Dairy support	
N loss (kgN/ha/yr)	39	33	-6
P loss (kgP/ha/yr)	0.5	0.6	0.1
GHG (total eCO_2 -tonnes/ha/yr)	16,501	15,875	-626
Stock units	26,518	26,102	-416
Crop area (ha)	214.2	131.5	-83
Synthetic N fertiliser applied (kgN) per year	160,728	100,936	-59,792
Purchased supplement (tDM)	7,792.3	5,400	-2,392
N surplus (kgN/ha/yr)	193	184	-9
Mitigations	» Reduced imported feed » Reduced synthetic N fertiliser		

[4] Land sold with irrigation (kept in analysis to give catchment scale impact).

[5] 180 ha lease removed from modelling and approx. 100 ha land added to model. This land was unirrigated dairy support/cropping land.

5.5 Springhill Dairies

Springhill Dairies is a dairy and drystock operation. This application is only relating to the runoff block, on which they are currently irrigating 65 ha of the total 349 ha. This application is aiming to increase the irrigation area from 65 to 158 ha. The cropping area will be increased and livestock numbers have also slightly increased.

Springhill have revised the requested application volume from their initial 1,005,213 m^3 to 850,307 m^3 of which 497,652 m^3 is for irrigation and 352,655 m^3 is for augmentation.

Springhill are currently applying for change in land use consent to increase the area of dairy grazing from the reference period.

Table 10: Springhill Dairies key parameters

	Current	Proposed
Irrigation area (ha)	65	158
Irrigation volume (m^3)	145,030	442,170
Farm system	Beef and dairy grazing	Beef and dairy grazing
N loss (kgN/ha/yr)	33	29
P loss (kgP/ha/yr)	0.3	0.4
GHG (total eCO_2/tonnes/ha/yr)	1,698	1,749
Stock units	3,544	3,601
Crop area (ha)	121.8	137
Synthetic N fertiliser applied (kgN)	23,278	27,753
Purchased supplement (tDM)	0	0
N surplus (kgN/ha/yr)	59	2
Mitigations	» Removed higher leaching lucerne crop and fodder beet-barley rotation. » Increased crop area	

5.6 I & P Farming

I & P Farming Ltd is currently a mixed cropping and drystock farm with no irrigation. The farm intensively finishes bulls and steers over winter. Stock are kept on a free draining area of the farm and they eat autumn saved pasture and supplementary feed on their break. The system operates under a HBRC feedlot[6] resource consent.

I & P Farming are proposing to add 288 ha of irrigation, increase cropping area and reduce the number of cattle. They intend to continue their intensive winter feeding system, however they will have less livestock on farm over this period and will have a greater proportion of sheep to beef stock.

The difference between the IrriCalc annual average water use and the Overseer modelling is 132,110m^3, this is within the range of error for I & P Farming Ltd.

Table 11: I&P Farming Ltd key parameters

	Current	Proposed
Irrigation area(ha)	0	288
Irrigation volume (m^3)	0	588,290
Farm system	Mixed cropping and sheep and beef finishing	Mixed cropping and sheep and beef finishing
N loss (kgN/ha/yr)	16	16
P loss (kgP/ha/yr)	0.3	0.6
GHG (total eCO_2 - tonnes/ha/yr)	2,614	1,337
Stock units	6,071	2,772
Crop area (ha)	160	240
Synthetic N fertiliser applied (kgN)	16,921	16,082
Purchased supplement (tDM)	0	0
N surplus (kgN/ha/yr)	72	6
Mitigations	» Reduced stocking rate » Reduced synthetic N applied » Increased cropping area » Reduced beef numbers by more than sheep (stock composition change).	

[6] This would not be defined as a feedlot under the NES definition of a 'feedlot'

5.7 Buchanan Trust No. 2

Buchanan Trust currently have 64 ha of irrigation on their dairy and dairy support land. During winter 2022 they are developing their irrigation area to 102 ha using leased Tranche 1 water. The applicant plans to further develop the irrigation to 215 ha. This final development will go ahead with the granting of T2 water. The T2 water will also replace the leased Tranche 1 water (ie. this water will not be used simultaneously but will replace the lease when granted). The replaced leased water will be available for transfer to elsewhere in the catchment where the impact will be managed through the resource consenting process.

Buchanan Trust have revised the application volume from their initial 1,145,794 m^3 to 802,558 m^3 of which 550,960 m^3 is for irrigation and 251,597 m^3 is for augmentation.

This applicant's plan with T2 water is to operate a more effective system, increase crop area and reduce livestock numbers.

Table 12: Buchanan Trust key parameters.

	Current	Proposed
Irrigation area(ha)	64	215
Irrigation volume (m^3)	121,550	480,715
Farm system	Dairy support	Dairy support
N loss (kgN/ha/yr)	22	23[7]
P loss (kgP/ha/yr)	0.4	0.7
GHG (total eCO_2 - tonnes/ha/yr)	1,287	978
Stock units	2,785	1,533
Crop area (ha)	74.8	145.5
Synthetic N fertiliser applied (kgN)	13,308	18,327
Purchased supplement (tDM)	0	0
N surplus (kgN/ha/yr)	73	15
Mitigations	» Reduced stock units » Increased cropping area » Improved irrigation application efficiency	

[7] This increase has been accepted through the consent process relating to the interim development of irrigation with leased Tranche 1 water.

5.8 Purunui Trust

The Purunui Trust land is leased out. At the time of the original application 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.

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 (this file included dairy and dairy support).

The scenario shown is deemed to show a viable farm system that utilises the volume of irrigation that has been applied for. The previous land use was a dairy support platform. Although adding irrigation is generally regarded as an intensification of a system, this farm is simultaneously reducing system intensification by moving away from dairy to a sheep, beef and mixed cropping system. The net impact on the environment as a result of irrigation plus these changes in farm system is expected to be nil. Assumptions made to support this;

- » Stocking rate has reduced as arable cropping is being carried out where it was not previously
- » Livestock intensity has reduced as sheep have been introduced into the system

Table 13: Purunui Farms key parameters.

	Current	**Proposed**
Irrigation area(ha)		117
Irrigation volume (m^3)		272,635
Farm system	Dairy support	Mixed cropping and beef and sheep
N loss (kgN/ha/yr)		29
P loss (kgP/ha/yr)		0.4
GHG (total eCO_2 -tonnes/ha/yr)		810
Stock units		1,272
Crop area (ha)		120.7
Synthetic N fertiliser applied (kgN)		14881
Purchased supplement (tDM)		1
N surplus (kgN/ha/yr)		84
Mitigations	» System change from dairy support to arable cropping,sheep and beef	

6.0 ENVIRONMENTAL ASSESSMENT

6.1 Overseer

The primary modelling tool used to understand the environmental impacts arising from the proposed land use change and irrigation use is OverseerFM v6.4.3 (Overseer). AgFirst is aware of the reports released in 2021 by MPI regarding the use of Overseer, particularly in a regulatory framework. AgFirst is also aware of the fact that the Hawke's Bay Regional Council have released a guideline on how Overseer will be used within the regional council regulatory framework.

The MPI report on Overseer highlighted challenges with regard to using Overseer in a regulatory framework. The Science Advisory Panel (SAP) review of Overseer stated:

"Relative and absolute nitrate loss estimates are unlikely to be reliable. Based on our discussions with regional councils, they considered that, for their application, the accurate prediction of absolute nitrate losses is not essential because regulations rely on relative comparisons of nutrient loss estimates for different management scenarios. However, model accuracy is required to provide confidence in either relative or absolute values. Using relative values will only cancel out model biases in the rare scenario that biases are equal and in the same direction in both management scenarios. However, if the model accuracy is different for the two scenarios then the relative value is not guaranteed to be any more reliable than the absolute value. Overseer is, therefore, unlikely to be a reliable tool for predicting either relative or absolute nutrient loss estimates."[8]

In response to the SAP review, the government responded as follows:

"The Government's response to the Panel's findings will be to put in place one or more of the following options:

(a) The creation of a new risk index tool, potentially using elements of Overseer (including the user interface); and

(b) Development of a next generation Overseer to address the issues raised by the Review Panel and ensure that it is fit for purpose as a tool to use in appropriate regulatory settings; and/or

(c) Greater use of controls on practices and inputs to manage nitrogen loss (including through amendment to the NES-F); and/or

(d) A completely new approach to understanding and managing diffuse nutrient loss risk. This might include, for example:

(i) Near real-time monitoring of water quality at the local scale

(ii) A tool that provides detailed understanding of nutrient loss risk based on the characteristics of land

(iii) A new nutrient loss model."[9]

[8] Overseer Whole-Model Peer Review, p5
[9] Government response to the findings of the Overseer peer review report, p7

The Hawkes Bay Regional council Tukituki Catchment Plans (PC6) procedural guidelines then went on to state: "…*the Government advised the regional sector that regulatory outcomes should not be determined solely based upon nutrient budget outputs from Overseer".* Thus, a combined approach of Overseer modelling to indicate a likely direction of travel with regard to nutrient loss, along with use of risk-based approaches as described by a Farm Environment Management Plan (FEMP), as used in the combined water take consents/land use consents, will provide greater certainty of outcomes. The fact that the council has indicated that the land use consents may be shorter in duration (e.g. five years), also provides the opportunity to realign outcomes with a revised Overseer model (or alternative tool) in due course.

6.2 IrriCalc

IrriCalc, a widely accepted model for determining irrigation requirement, has been used to determine the irrigation requirements of the farm systems. The applicants have applied for the volume calculation to be their 90th percentile irrigation requirement. To ensure that Overseer modelling aligns with the volumes applied for, the average volume requirement has been calculated with IrriCalc and compared to Overseer.

IrriCalc was calculated based on a set area (specified by the applicant and optimised by Aqualinc modelling) and pasture, which requires a high volume of irrigation. To use the same volume of water the Overseer scenarios typically have a larger area of irrigation but lower irrigation requirement land uses (pasture being the highest water using crop). The irrigation areas have therefore not been compared.

As there are significant differences between the calculation methods of the two models, and different input data (weather data, and profile available water) Overseer files have been deemed suitably similar if their modelled average annual irrigation volume is within 25% of the IrriCalc modelled average volume.

The IrriCalc volumes are as follows.

Table 14: 90th percentile and average annual irrigation volumes as calculated using IrriCalc and modelled by Aqualinc

Applicant	**Modelled <u>90 percentile</u> annual irrigation volumes (m^3/year)**	**Modelled <u>average</u> annual irrigation volumes (m^3/year)**
	(1972-2012)	**(1972-2012)**
TAFT	2,841,220	2,464,700
Papawai	1,010,817	881,400
Tuki Tuki Awa	607,000	503,600
Plantation Rd Dairies	2,418,225	2,031,100
Springhill Dairies	588,313	462,200
I&P Farming	916,010	720,400
Buchanan	786,594	674,700
Purunui	370,321	309,400
Total	**9,538,500**	**8,047,500**

6.3 Irrigation – managing and mitigating impacts

Plant growth requires, in the most basic sense, nutrients, sunlight and water. In the Tukituki catchment water is a limiting factor to plant growth over the summer period. Adding irrigation will increase plant yields as sunlight is not limiting, and nutrients can be applied to meet requirements.

Irrigation provides the opportunity to apply the right amount of water when required to increase pasture growth. Increased growth requires more nutrients which are sourced either from existing nutrients in the soil or additional fertiliser. Irrigation water can increase the efficiency of nutrient applications, as the nutrients can be applied with water when they are needed. For example, for every tonne of barley grain produced, an irrigated system requires 7 kg less nitrogen when compared to a dryland barley crop. [10]

A more consistent application of water (via irrigation) reduces the build-up of soil nutrients throughout a summer dry period, as can happen in a dryland farming situation.

With irrigation, summer growth is significantly greater, and therefore available soil nitrogen reserves are being used constantly for growth. Therefore, there are less nutrients readily available to be lost in drainage.

In a cropping system this means nutrient loss is reduced with the addition of irrigation.

In a livestock system however, increased pasture or crop growth means an increased number of animals can be fed as the area is now growing more feed. Feeding more animals leads to more urine patches. These provide high applications of N/ha on a small spot which leads to an increased loss of N.

Options for farmers to add irrigation to a livestock system and reduce nutrient loss are:

(a) Keep the same number of animals, graze less area, and crop the remainder of the area.
(b) Finish beef stock earlier by feeding them better. This means animals don't have to be carried through a second winter when the majority of drainage occurs.

[10] FAR, Irrigation is good for the environment

6.4 Overseer modelling of properties

Overseer assumes good farm management practices are achieved. This environmental assessment therefore assumes that applicants are, and will continue to operate their farms such that good farm management practice is achieved at minimum. This includes efficient and accurate application of irrigation, ensuring there is neither under or over watering occurring.

Each farm has provided a baseline Overseer file and a T2 scenario file. These proposed land use files may not be what the applicants intend to do in the short term but show the long term and full use impact of the water that applicants have applied for. Many applicants intend to take a staged approach to development to support a more manageable outlay of capital.

Each applicant will be required to show no increase in nitrogen through the land use consenting process, which will assess the short-term impact on the environment. This analysis has been undertaken to show the full impact of all irrigation water applied for and that the applicants can viably operate a system utilising the water applied for with no increase in environmental impact.

6.4.1 Nitrogen loss

Overseer files for each of the properties have been created in order to understand the current (baseline) nitrogen leaching values, and the likely nitrogen leaching values after irrigation, assuming changes in land use as described by the applicants. Nitrogen loss is linked to drainage as nitrogen is most typically lost through the profile. The results are shown in the following table.

Table 15: Current and proposed nitrogen leaching

Applicant	Baseline year end	Current (baseline) N leaching kgN/ha/yr	Total (baseline) N leaching kgN/yr	**Current N surplus**[11]	Proposed N leaching kgN/ha/yr	Proposed total N leaching kgN/ yr	**Proposed N surplus**
TAFT	2020	24	37,850	**66**	22	38,976[12]	**71**
Papawai	2020	39	13,267	**61**	39	13,267	**61**
Tuki Tuki Awa	2021	34	4,788	**178**	34	4,788	**178**
Plantation Rd Dairies	2020	42	41,526	**193**	32	32,741	**184**
Springhill Dairies	2020	33	11,385	59	28	10,233	67
I & P Farming	2021	16	4,870	72	16	4,890[13]	**6**
Buchanan	2021	33	8,698	73	33	8,852	**15**
Purunui					29	5,250	**81**
Average		30		100	28		**83**
Total (without Purunui)			**122,384**			**113,747**	

[11] N Surplus is the sum of the nitrogen inputs used for production on the farm (eg fertiliser, imported feed, irrigation water & clover fixation) minus the total nitrogen that is removed from the farm as products (eg meat, wool, milk, crops, exported effluent, supplements sold or stored).

[12] Total increase results from lower per ha loss but an increased area (purchased land is expected to have equal loss/ha and therefore this increase would actually be a reduction in relation to the catchment.

[13] Increase in total but not per hectare a result of rounding, increase so small it within the range of error.

Overall, the applicants have shown that the addition of T2 water to their farms and associated farm system change will enable a reduction in the loss of N.

All properties (aside from TAFT and Springhill[14]) have shown through Overseer, a reduction in N surplus. A reduction in N surplus shows more efficient utilisation of N and supports the reduction in N loss modelled result.
The mitigations contributing to the reduction of N loss that have been enabled through T2 water use include

- » Reduced stocking rate,
- » Increased cropping
- » Finishing of livestock earlier (reduction of heavy livestock carried through winter)
- » More efficient application of synthetic nitrogen (through targeted application with irrigation)
- » Improved irrigation systems (through more secure water source for some farms).

The overall impact on N loss is minor. The net loss across all properties is a slight reduction (8,637kg N/yr). It must be kept in mind that these farms are forecasting a farm system change which in most cases includes a significant change in farm management and skills (pastoral to arable and/or horticulture). The environmental impact of these systems is reliant on the farms performing to the standard that has been modelled and it is therefore important to note that to achieve these outcomes farmers will need to upskill.

6.4.2 Phosphate and sediment loss

Broadly speaking nitrogen loss is associated with leaching through the soil strata into groundwater. Phosphate loss is more typically associated with overland flow which is consistent with sediment loss. For grazed livestock systems there are also often E.coli impacts. Therefore, the loss of P can be associated with the loss of sediment and, for livestock systems, E.coli. If we predict an increase in the loss of P then we can assume the loss of E.coli and sediment also increases. Key drivers of sediment loss include land contour, cultivation processes, time between crops and grazing management, amongst others.

Mitigation options that are available to reduce the loss of sediment when adding irrigation include:

- » Resow crops earlier and therefore reduce the number of days bare soil is exposed. After a summer crop, in a dryland system resowing has to wait until there is rain forecast to ensure the seed gets the water it requires to grow. With irrigation, as soon as that summer crop is removed the next crop can be drilled and established.
- » Finishing beef stock earlier so that they are not carried through a second winter reduces erosion through less pugging. Rising 2-year old beef stock are heavier animals which are significantly more likely to cause pugging damage than younger, lighter cattle or sheep.
- » Direct drilling of new pastures and crops.

[14] Total loss is expected to reduce even though N surplus is predicted to increase.

The Overseer modelling from each of the eight properties indicates the following impact on phosphate loss.

Table 16: Current and Proposed Phosphate Loss

Applicant	Baseline year end	Current (baseline) P loss kg/ha/yr	Total (baseline) P loss kgP/yr	Proposed P loss kgP/ha/yr	Proposed total P loss kg P/yr
Te Awahohonu Forest Trust	2020	0.3	481	0.5	845
Papawai Partnership	2020	0.4	118	0.4	118
Tuki Tuki Awa	2021	1.2	169	1.2	169
Plantation Rd Dairies	2020	0.5	577	0.6	596
Springhill Dairies	2020	0.3	101	0.3	153
I & P Farming	2021	0.3	82	0.6	192
Buchanan	2021	0.4	113	0.6	151
Purunui Trust				0.4	81

In order to mitigate the loss of nitrogen through the profile applicants have looked to increase cropping. This gives them a lower loss of nitrogen under irrigation than their existing livestock systems while still operating a viable system. However, with increased cropping there is increased bare soil and therefore increased loss of sediment. This is represented in Overseer by an increase in the loss of phosphorus (P), as P is lost primarily through loss of sediment.

To mitigate the sediment loss applicants can implement buffer zones, riparian planting and use minimum tillage and direct drilling. The impact of riparian zones and buffer strips is not accounted for in Overseer (where the data was sourced for the above table. It is therefore deemed that even though there appears to be a slight overall increase in the loss of sediment associated with the proposed change in farm systems this increase can be managed to ensure there is a nil impact on the receiving environment. As previously mentioned, mitigation/management options to support this include:

- Riparian planting and buffer zones
- Minimum tillage and direct drilling
- Bunds and/or sediment traps
- Livestock management (especially in extreme weather events).

It should be noted that a weakness of Overseer is that it uses monthly time steps and does not allow the harvesting and planting of a crop within a single month (which is common practice). Overseer therefore assumes the soil is bare for longer than it actually is, and this may increase modelled sediment loss.

6.4.3 Greenhouse gas impacts

Greenhouse gas (GHG) emissions in a pastoral agricultural setting are predominantly methane which is strongly related to dry matter intake by ruminant animals. In other words, if there is an increase in livestock numbers and/or amount eaten per animal, all things being equal GHG emissions will rise. Several of the applicants for the water take are considering a move to arable/horticultural practices and any such move will result in a direct reduction in GHG emissions. Overseer is well recognised as a tool to estimate GHG emissions from a farm setting.

The emissions from the eight properties pre and post conversion irrigation are as follows:

Table 17: Current and proposed GHG emissions (in tCO2e)

Applicant	Baseline year end	Baseline total GHG emissions T/yr	Baseline GHG emissions T/ha/yr	Proposed total GHG emissions T /yr	Proposed GHG emissions T/ha/yr
Te Awahohunu Forest Trust	2020	3,841	6.1	4,156	4.2
Papawai Partnership	2020	1,624	1.6	1,624	1.6
Tuki Tuki Awa	2021	1,545	1.5	1,545	1.5
Plantation Rd Dairies	2020	16,501	12	15,875	16
Springhill Dairies	2020	1,698	1.7	1,717	1.4
I & P Farming	2021	2,614	8.5	1,337	1.3
Buchanan Trust	2021	1,304	4.9	1,261	4.3
Purunui Trust				810	4.5

Overall, this shows that greenhouse gas emissions will be reduced. TAFT shows an overall increase in GHG but a reduction per hectare. This is due to their proposed increase in farm area. If the assumption is made that the GHG emission of the land purchased matches that of the current system, then the overall impact of the proposed system will also be a reduction. Plantation Dairies shows an increase in per hectare emissions but reduction in total emissions. This is driven by the sale of land between the two scenarios. The lease land let go was dryland dairy support land.

Total stock units across the properties (assuming no change in the stock units of Purunui, which are likely to have reduced), reduced from 62,319 RSU's to 60,029 RSU's. This overall reduction of livestock is the main driver of the overall reduction in GHG enabled by the addition of T2 water to these systems.

6.4.4 HBRC Two-Tiered Risk Matrix assessment

Hawkes Bay Regional Council (HBRC) have designed a two-tiered risk matrix system to be used in the place of Overseer in the short term. This process is a simple analysis of the potential environmental impact of a farm. The following table has been created to assess each farms category according to the risk matrix and the category in which the proposed system sits.

Table 18: HBRC matrix assessment by farm

	Current						Proposed						Change in matrix category
	Imported Nitrogen (kg/ha)	RSU[15]/ha	Was fertiliser applied between May and August?	Were forage crops grazed between May and August?	Were arable crops harvested between May and August?	Matrix category	Imported nitrogen (kg/ha)	RSU/ha	Was fertiliser applied between May and August?	Were forage crops grazed between May and August?	Were arable crops harvested between May and August?	Matrix Category	
TAFT	34	9.86	No	Yes	No	M	35	10.61	No	No	No	L	Down
Papawai	49	10.7	Yes	Yes	No	H						H	No change
Tuki Tuki Awa	118	28.17	Yes	No	No	H						H	No change
Plantation Rd Dairies	273	25.42	Yes	No	No	H	222	27.01	Yes	No	No	H	No change
Springhill Dairies	67	10.54	Yes	No	No	M	113	7.1	No	No	No	H	Up
I & P Farming	55	21.18	No	No	No	M	53	9.64	No	No	No	M	No change
Buchanan	50	10.6	No	No	No	L	70	5.86	No	No	No	M	Up
Purunui							83	7.81	Yes	No	No	M	Down

The proposed changes for Springhill and Buchanan move these farms up a category from medium to high and low to medium respectively. This category change for both farms is caused by increased imported nitrogen. With irrigation it is possible to increase imported nitrogen application to pastures and crops without increasing loss of nitrogen as, with effective management. irrigation enables improved utilisation efficiency (section 6.3, pg 22.) .

[15] Revised stock units (taken from Overseer) per effective hectare.

7.0 ECONOMIC ASSESSMENT

To examine the economic impact of the proposed T2 irrigation take, AgFirst assessed the proposed cost of irrigation development, current economic returns and proposed economic returns based on future land use.

7.1 Financial impacts

To understand the likely financial impact of irrigation, AgFirst examined the current and proposed land use for each property. These tables are shown on the following pages. Land use options were then compared using EBIT (earnings before interest and tax) per hectare. The EBIT figures used were a combination of financial impact analysis undertaken by the farm business, and industry averages. The comprehensive analysis undertaken by MRB[16] et al in 2016 examined the likely change in farm level profitability for farms in the Ruataniwha catchment pre and post irrigation. The differential, pre and post irrigation in this report correspond to the values used in the MRB report.

Some of the properties that are applying for consent are proposing to use the T2 water to replace existing T1 water allocation. In these cases, the value of the irrigation has been treated the same as 'new' irrigation – without the security of T2 water allocation the existing investment in irrigation infrastructure could become redundant.

Installing irrigation has a significant capital cost. We have allowed for a capital cost of $15,000 per ha for pastoral irrigation costs and $50,000 per ha for horticultural irrigation, once the land use options were compared (pre and post irrigation), and allowance has been made for both the cost of capital (6%), and depreciation (5%).

1535 ha x $15,000 per ha =	$23,020,500
260 ha x $50,000 per ha =	$13,000,000
Total capital cost to irrigate 1,795 ha =	**$36,020,500**

16 Ruataniwha water storage scheme - review of farm profitability (MRB,2016)

Table 19: Current land use

		Current situation (ha)													
		Dryland							Irrigated						
Name	Farm Size (ha)	S&B	Dairy support	Arable	Dairy	Pip fruit	Forestry	Other	S&B	Dairy support	Arable	Dairy	Pip fruit	Forestry	Other
Te Awahohonu Forest Trust	1,780	1,707					73								
Papawai Partnership	336	61		6				10	140		120				
Tuki Tuki Awa Ltd	140				11			7				122			
Plantation Road Dairies	1,077	3	469		51			34		106		415			
Springhill Dairies Partnership	349		272					13		65					
I&P Farming Limited	305	160		126				18							
Buchanan Trust No. 2	266	187		11				4			64				
Purunui Trust	180		170					10							
Total (ha)	**4,433**	**2,118**	**910**	**143**	**62**	**0**	**73**	**95**	**140**	**171**	**184**	**537**	**0**	**0**	**0**
							Total Dryland (ha)	3402						Total Irrigated (ha)	1,031

Table 20: Proposed land use

		Future use (ha)													
		Dryland							Irrigated						
Name	Farm Size (ha)	S&B	Dairy support	Arable	Dairy	Pip fruit	Forestry	Other	S&B	Dairy support	Arable	Dairy	Pip fruit	Forestry	Other
Te Awahohonu Forest Trust	1780	842					101	18	620				200		
Papawai Partnership	336	61		6					140		120				
Tuki Tuki Awa Ltd	140	0	0	0	11	0	0	7	0	0	0	122	0	0	0
Plantation Road Dairies	1,077[17]	3	145		53			29	31	408		409			
Springhill Dairies Partnership	349		179					13		158					
I&P Farming Limited	305							18	48		240				0
Buchanan Trust No. 2	266	54		11				5	19		136		60		
Purunui Trust	180	42		4				17			117				
Total (ha)	**4,433**	**996**	**305**	**20**	**64**	**0**	**101**	**106**	**857**	**566**	**612**	**531**	**260**	**0**	**0**
						Total Dryland (ha)		1593					Total Irrigated (ha)		2826

Table 21: Change in irrigation areas by land use.

	S&B	Dairy Support	Arable	Dairy	Pip fruit	Forestry	Other
Current (ha)	140	171	184	537	0	0	0
Proposed (ha)	857	566	612	531	260	0	0
Change (ha)	717	395	428	-6	260	0	0

[17] Net change in farm system of 111 ha as described in 5.4 Plantation Road Dairies but for the purpose of the financial analysis this has remained within the analysis as the same land use (dryland dairy support) to enable a more accurate representation of the economic impact for the region.

The aggregated net economic benefit for the eight properties was **$4.4 million per annum** before taxation. This equates to a return on capital (irrigation) invested of **12%**.

Table 22: Financial impact of irrigation

Aggregated farm level impact	Total ($)	$ per ha (total ha)
Existing returns (EBIT)	4,510,338	1,017
Proposed returns (EBIT)	**12,878,294**	**2,914**
Increased profitability due to irrigation	8,367,957	1,897
less cost of capital @ 6%	2,161,230	488
less depreciation @ 5%	1,801,025	406
Net benefit of irrigation	**4,405,702**	**1,003**

This benefit is based on typical management changes expected from a move to an irrigated farming system.

The expectation is that over time the move to irrigation will unlock further opportunities for increased investment in higher value products. For example, whilst the initial transition to irrigation may be to an irrigated arable cropping programme, ultimately the water may be used for higher value horticultural products such as apples.

Whilst this obviously has benefit for the landowner, there is a wider benefit for the community, which is discussed further in the next section.

7.2 Downstream benefits

The water availability and security report by MPI in 2021, stated the following:

"A transition towards land uses that have a higher economic and lower environmental footprint, and improved community resilience, will require increased water security. This will require a strategic response that addresses and integrates approaches that consider the current and future supply, demand, and priorities for the use and protection of freshwater and the resources dependent on it." [18]

The report then goes on to state:

"Based on a technical assessment of water allocation, availability, security, and financial viability2 – Northland, Waikato, Bay of Plenty, Gisborne, Hawke's Bay, Otago, Greater Wellington, Tasman and Manawatū-Whanganui have been identified as having the greatest potential to grow the food and fibre sector by improving water availability and security. However, this growth needs to be carefully considered and placed within the context of Te Mana o te Wai (TMoTW) to incorporate wider community needs and expectations." [18]

This report highlights the importance of water availability in order to transition to land uses that not only improve financial returns but also have a lower environmental impact.

7.2.1 Regional Employment

In general, the irrigation applicants are using the proposed irrigation water to either:

- » improve the security of their existing water take;
- » to improve resilience of their farming operation by protecting against climate uncertainty; or
- » moving to horticultural enterprises, which tend to require increased labour, thus providing additional regional employment.

The Northland irrigation scoping report[19] indicated that a typical dryland sheep and beef property requires one FTE (full time employee) per 150 ha, whereas horticultural crops require one FTE per 2-5 ha. Over time it is expected that the landowners involved in this application will transition to these higher value land uses, which is not possible without the certainty of water supply that irrigation provides.

Over the eight applicants, their current plans include establishment of 260 hectares of horticulture. Using the labour multiplier as described in the previous paragraph, using a conversative estimate of one FTE per 3.5 irrigated hectares, an additional 74 employees would be required. This of course has flow-on benefits for the wider community.

[18] Water Availability and Security in Aotearoa New Zealand Supporting the sustainability, productivity, and resilience of the food and fibre sector MPI Information Paper No: 2021/04

[19] Scoping of Irrigation Scheme Options in Northland

7.2.2 GDP contribution

Undertaking in-depth analysis as to the gross domestic product benefit to the Hawke's Bay region as a result of irrigation is outside the scope of this report. However, three in-depth studies provide an insight as to the value of irrigation to a community:

1. Value of irrigation in New Zealand, NZIER, 2014 report re irrigation benefits;

2. Scoping of irrigation scheme options in New Zealand, 2017; and

3. Economic value of Amuri irrigation, NZIER, 2018.

The NIZER report (using 2011 figures) concluded that there was approximately \$3,000 GDP benefit per irrigated ha, with the majority of the irrigation being used for pastoral irrigation. The Northland study (2017) concluded that there was approximately \$28,000 GDP benefit per irrigated ha, with the majority of the irrigation being used for horticultural irrigation. The proposed irrigated land uses for the eight applicants include a wide mixture of pastoral, arable and horticultural uses. With 1,850 ha likely to be irrigated, if we used the lower value of \$3,000 per ha, and applied a CPI adjustment to this figure, the additional GDP is:

1,795 ha x \$3,159 per ha GDP contribution = **\$5,669,457 per annum**

Value of residual volumes used for agricultural purposes

As part of the irrigation consent application process, the eight farming applicants have refined their application volumes and allocated 1.3 million m^3/yr to be used for any necessary mitigation purposes.

Working on similar application ratios and returns, this quantity of water would be sufficient to irrigate approximately 217 hectares. The proposed land use for this land is obviously unknown. However, if we can assume that there is a mixture of horticultural (14%), arable and irrigated pastoral land use, and similar proportions to the applicants, the financial and labour benefits will be similar. Thus, in broad terms, this would equate to:

Increase in farm gate returns: 217 ha x \$1,003 per ha = **\$217,317** per annum.

Increase in employment: 31 ha horticulture development x 1FTE/3.5 ha = 9 additional FTE plus 1 FTE for the non-horticultural component (total 10 extra employees).

8.0 CONCLUSIONS

- The eight applicants are applying for the irrigation water (8.4 million m^3/yr) to:
  - Increase security of water supply to continue existing farming operations (e.g. replacing leased water with 'owned' water).
  - Move to higher value land uses.
- AgFirst have reviewed the individual applications to ensure the requested water take volumes align with both the IrriCalc and Overseer models.
- The applicants will also require a land use consent. The conditions of the consent will require the landowner to ensure that there is no increased impact on the environment as a result of the irrigation development.
- Assessment of likely environmental impacts of irrigation, along with mitigation of effects, is best undertaken using a combination of Overseer modelling in conjunction with the use of risk-based approaches as described by a Farm Environment Management Plan (FEMP).

The key conclusions are as follows:

- Overseer modelling of the proposed irrigation with a combination of land use changes, livestock management changes, and farm management changes indicate that nitrogen losses will not increase as a result of the irrigation.
- Overseer modelling scenarios have been assessed as potentially viable and the resulting outputs credible based on current science and understanding.
- HBRC matrix assessment was conducted, however more emphasis in this report has been put on Overseer model analysis as this is more detailed and accurate than the matrix. The matrix assessment found two farms drop a category, four remain in the same category and two increase a category. This increase in category for both farms is caused by increased imported nitrogen. With irrigation it is possible to increase imported nitrogen application to pastures and crops without increasing loss of nitrogen as irrigation enables improved utilisation efficiency (section 6.3, pg 22.) with effective management.
- GDP outputs as a result of the irrigation development equate to $5.7 m per annum.
- The aggregated net economic benefit for the eight properties was $4.4 million per annum. This equates to a return of 12% before taxation on the approximately $36m (of capital (irrigation) that will need to be invested).
- An increase in horticulture provides increased employment opportunities for the region. If there 260 hectares of land is converted to horticultural purpose this could provide additional employment for up to 74 people.
- There is approximately 1.3 million m^3 per annum of potential irrigation water available for mitigation. This would be sufficient to irrigate an additional 217 ha, add $217,317 per year of net benefit, and provide additional employment for 10 people in the community.

9.0 REFERENCES

Corong E, Hensen M, Journeaux P; 2014; Value of irrigation in New Zealand An economy-wide assessment to the Ministry for Primary Industries

Clough P; NZIER; 2018; Economic value of Amuri irrigation Assessment of the economic contribution of Amuri Irrigation Company Ltd to its community NZIER report to Amuri Irrigation Company Ltd September 2018

DairyNZ; 2020; Dairy NZ Economic Survey 2019/20

Eaton H, Everest M, Macfarlane A, Nicholls A, Beetham R, Bryant S, Brooks J, Pentreath R; 2016; Ruataniwha water storage scheme - review of farm profitability

FAR;2017; Irrigation is good for the Environment

Frost, L Algeo, S Paine, N Adams, Kel Sanerson, F Stokes, D Morgan, A Gibbs, C Rajanayaka, B Cathcart; 2017; Scoping of Irrigation Scheme Options in Northland, Northland Regional Council

McPhail L; 2021; 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 Hawkes Bay Regional Council Publication No. 5565

MPI, MFE; 2021; Overseer whole-model review, Assessment of the model approach MPI Technical Paper no: 2021/12 Prepared for the Ministry for Primary Industries and the Ministry for the Environment by the Science Advisory Panel ISBN No: 978-1-99-100936-4 (online) ISSN No: 2253-3923 (online)

MPI, MFE; 2021;The Government response to the findings of the Overseer peer review report; Prepared for the Ministry for Primary Industries and the Ministry for the Environment; ISBN: 978-1-99-003369-8.

MPI; 2021; Water Availability and Security in Aotearoa New Zealand Supporting the sustainability, productivity, and resilience of the food and fibre sector MPI Information Paper No: 2021/04 Prepared for Ray Smith, DG Ministry for Primary Industries by the Water Availability and Security Team - Agriculture and Investment Services.

10.0 APPENDICES

10.1 Appendix 1: Application areas, volumes and changes throughout application process

Table 23: Applicants initial application volumes and volumes as at September 21

	Initial application	IrriCalc Sep-21		
	Volume total	Volume total	Irrigation volume	Augmentation volume
TAFT	4,914,920	4,914,920	2,841,220	2,073,700
Papawai	1,475,517	1,475,514	1,010,817	464,700
Tuki Tuki Awa	952,400	707,700	678,100	29,600
Plantation Rd Dairies	3,751,225	3,751,225	2,418,225	1,333,000
Springhill Dairies	1,005,213	1,005,213	588,313	416,900
I&P Farming	1,200,010	1,200,010	916,010	284,000
Buchanan	1,145,794	1,145,794	786,594	359,200
Purunui	554,921	554,921	370,321	184,600
TOTALS	15,000,000	14,755,297	9,609,600	5,145,700

Table 24: Applicants final areas and volumes and the corresponding areas and volumes used in this analysis

	IrriCalc irrigation area[20]	Volume total	Irrigation 90th percentile volume	Augmentation volume	Irrigation average volume	Overseer irrigation area[21]	Overseer irrigation volume
TAFT	490	4,914,920	2,841,220	2,073,700	2,464,700	820	2,288,790
Papawai	181	1,475,517	1,010,817	464,700	881,400	260	972,792
Tuki Tuki Awa	135	636,600	607,000	29,600	503,600	122	398,845
Plantation Rd Dairies	403	2,552,207	1,645,279	906,928	1,381,892	327	1,050,238
Springhill Dairies	123	850,307	497,652	352,655	390,974	93	297,140
I&P Farming	166	1,200,010	916,010	284,000	720,400	288	588,290
Buchanan	131	802,558	550,960	251,597	472,586	151	359,165
Purunui	62	554,921	370,321	184,600	309,400	117	272,635
TOTALS	1691	**12,987,040**	**8,439,260**	**4,547,780**	7,124,952	2176	6,227,895

[20] These areas are based on the assumption that pasture is irrigated. However, larger areas of less intensive crops or horticulture can be irrigated within the same yearly volumes used by pasture, with little-to-no difference in the hydraulic effect.

[21] This is based on the total area of the Overseer blocks proposed to be irrigated with Tranche 2 water.

10.2 Appendix 2: HBRC risk matrix

The follow images are taken from pages 19- 22 of the Hawke's Bay Regional Council Tukituki Catchment Plan (PC6) Procedural Guidelines. These images show the assessment that has been followed to undertake the Two-Tiered Risk Matrix assessment. The information for the assessment was sourced from Overseer.

9. Overseer and alternative Risk Matrix approach

Overseer is the nutrient model used in the Tukituki Catchment Plan to estimate farm leachate concentration. It was developed over a number of years for use by famers to manage nutrients to maximise production and profitability. It is now used as a tool to provide additional data in the management of water quality and is key to a number of the Tukituki Catchment Plan provisions.

In 2018 the government commissioned a science advisory panel (SAP) review of Overseer which concluded Overseer is not to be solely relied upon in a regulatory context, the Council is therefore unable to continue with implementation of the Tukituki Catchment plan as it was proposed in the Tukituki Catchment Plan (PC6) Procedural Guidelines (v3 – March 2021).

Nutrient budgets can continue to be prepared using the latest version of Overseer and published to the council via the Overseer^{FM} platform or applicants can choose to supply information to HBRC as required by Schedule XXI of the Tukituki Catchment Plan.

In light of this, the Council developed an approach with two options.

1. Prepare an Overseer nutrient budget as before or
2. Provide specific alternative information otherwise included in an Overseer budget

In September 2021 this was socialized with the primary industry representative group who collaborated on the original Procedural Guidelines in 2019. Members indicated a preference to work together to further develop the second option

A working group was established with representation from the dairy, sheep and beef, arable and horticulture sectors. At pace, the group collaborated and shared information which allowed Council to develop an alternative risk matrix. Sector wide agreeance on the approach was reached quickly.

Landowners will be required to retain specific farm data, including that set out in Schedule XXI and in consent conditions. This data could be used to assess risk or for input into a future version of Overseer or an alternative tool as is deemed appropriate.

A 'Two-Tiered Risk Matrix' was developed, based off the conversations had with industry and the discussion above around most useful, balanced with ease of data collection across industry indicators of Nitrogen potential loss risk.

19

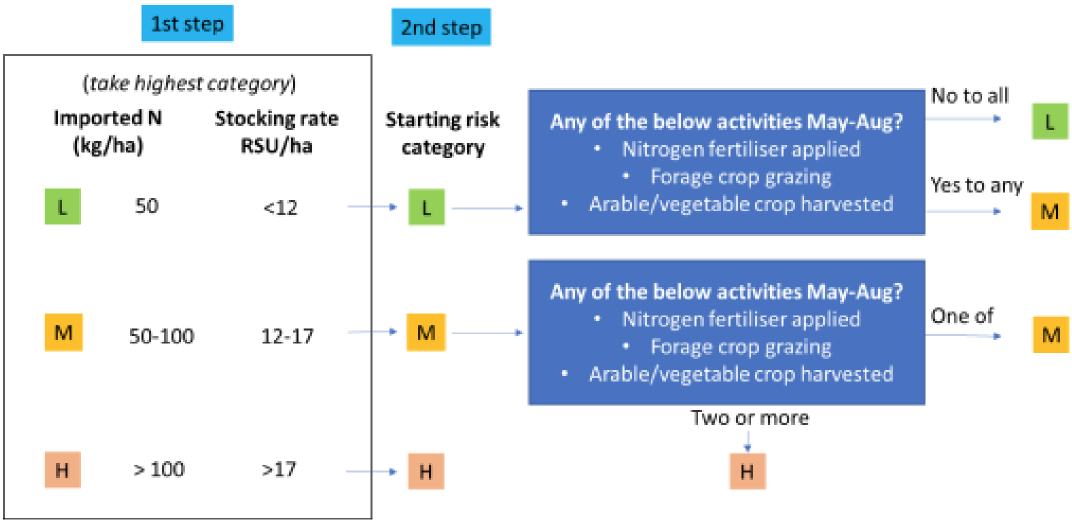

Figure 5 – The 'Two-Tiered Risk Matrix'

Firstly, Imported Nitrogen (in fertiliser and feed, in kg/ha/yr) and stocking rate (in RSU/ha) are checked against the three categories. Whichever of the two is the highest has the initial category applied to it e.g., low, medium or high.

E.g., a farm importing 55kg/N/yr in fertilizer and feed with a stocking rate of 11 RSU/ha would take the imported N as the highest category and be 'medium' for the first step.

If the property comes out 'high' it stays high. If the property comes out low or medium, three key questions are then asked:

1. Do you use any Nitrogen fertiliser between May and August?
2. Do you graze any forage crops by stock between May and August?
3. Do you harvest any arable or vegetable crop between May and August?

Depending on how many of the above questions apply to the farm it may stay in its initial category or move up to a medium or high category.

The matrix will be socialised with the farm plan providers, to be used when updating a landowners FEMP and applying for consent. It is intended that by the provider running through the matrix and having the conversation with the landowner, a part of the FEMP update and the consent application can be structured based off the result of the matrix. Noting this approach is only a *potential* risk of nitrogen leaching from the farm. It does not account for other contaminants that should still be addressed in both the FEMP and consent application.

E.g., if a farm uses winter Nitrogen and has cattle grazing winter forage crops these activities should be discussed in the application, and mitigated/managed appropriately (Intensive Winter grazing modules, timing of fertiliser applications with soil temperature and buffers, etc.)

To determine the data needed in the matrix, either an Overseer file could be used to provide the figures (e.g., RSU/ha) or a calculator that will be supplied by HBRC can be used determine nitrogen content in feed and RSU/ha. Fertiliser nitrogen load per hectare can be determined from fertiliser records.

Property Address:

CALCULATION OF REVISED STOCK UNITS (RSU)

Stock units are a means of calculating stock number equivalents between species and age groups on the basis of feed consumed. 1 RSU is defined as an animal with an intake of 6000 MJME/yr or 550kgDM/yr. Assumptions for conversion ratios are provided in the tables below

Instructions:

1) In the highlighted grey cells enter the tally/ peak number of animals carried in late spring (eg Oct/Nov or 1 month before weaning)
2) Add farm area at the bottom of the table
3) Use revised stock units per Ha (R.S.U./ha) in your reporting

SHEEP	Tally / number	Stock unit conversion	Stock units
Ewes		1	0
Hoggets		0.7	0
Wethers		0.7	0
Rams		0.8	0
Total sheep	0		0

BEEF CATTLE	Tally / number	Stock unit conversion	Stock units
M.A. Cows		5.5	0
Heifers 2.5 Yr		5.5	0

Figure 6: Image of Revised Stock Units (RSU) Calculator

21

CALCULATION OF NITROGEN IN FEED IMPORTED

Nitrogen (N) in feed and N in Fertiliser together make up nitrogen imported to the property. The table below contains the assumptions and a calculator to use to work out N in feed imported.

Instructions:

1) Enter amount of each feed in either grey highlighted column as tonnes or kg DM. Use dry matter % from table below if needed
2) Ensure farm area is entered in blue cell E88
3) Use kgN/ha from feed in your reporting

Agricultural product name	Dry matter %	Nitrogen (N) %	Category	Amount of feed imported (KG Dry Matter)	Nitrogen imported in Feed (kg)	Amount of feed imported (Tonnes DM)	Nitrogen imported in Feed (T)
Apple Pomace	65	1.1	Concentrates		0		0
Apples	18	0.6	By-product		0		0
Bread	63	0.8125	By-product		0		0
Cabbage	9	3.2	By-product		0		0
Carrots	13	1.52	By-product		0		0
Citrus Pulp	20	1.12	By-product		0		0
Copra	88	3.2	By-product		0		0
Fishmeal	88	11.09	By-product		0		0
Grape Marc	38	1.12	By-product		0		0
Grape Pomace	38	1.12	By-product		0		0
Kiwifruit	15	0.8	By-product		0		0
Onions	10	1.6	By-product		0		0

Figure 7: Image of Nitrogen in feed imported (abridged version)

Once a production land use consent has been lodged with a two-tier N risk matrix evaluation the consent team will use the evaluation as part of how they asses the consent.

The level of risk determined from the matrix is a way for the consent team to triage what applications they may need to scrutinise more. The risk level isn't something that would hold landowners to a specific set of mitigations or certain reductions. But it is an indication of how much evidence the consents team will expect to see around efforts taken to minimise nitrogen loss. The risk index is also an indication of how much focus will be placed on different types of properties in future plan iterations. The council would highlight that the more evidence we can collect of progress made towards reducing nitrogen in the next few years will help inform discussions around how restrictive any future regulations may need to be.

<u>Protocol for submitting Overseer nutrient budgets to HBRC</u>

If applicants choose to continue to use Overseer, the regional council requires nutrient budget data to be submitted using the latest version of Overseer.

Contact

James Allen

Agribusiness Consultant
027 474 3093
james.allen@agfirst.co.nz

AgFirst Waikato (2016) Ltd
26D Liverpool Street
PO Box 9078, Hamilton 3240, New Zealand
07 839 2683
waikato@agfirst.co.nz
www.agfirst.co.nz

Disclaimer:

The content of this report is based upon current available information and is only intended for the use of the party named. All due care was exercised by AgFirst Waikato (2016) Ltd in the preparation of this report. Any action in reliance on the accuracy of the information contained in this report is the sole commercial decision of the user of the information and is taken at their own risk. Accordingly, AgFirst Waikato (2016) Ltd disclaims any liability whatsoever in respect of any losses or damages arising out of the use of this information or in respect of any actions taken in reliance upon the validity of the information contained within this report.