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memorandum

TO	Paul Barrett	FROM	Neil Thomas, Laura Drummond, Katherine McCusker, Hilary Lough
	Hawke's Bay Regional Council	DATE	4 November 2022
RE	Review of Ruataniwha Tranche 2 Applicants' Evidence		

1.0 Introduction

The memorandum provides a summary of our comments on the applicants' evidence for the Ruataniwha Tranche 2 groundwater takes, submitted at 5 pm on Monday 31 October 2022. We have outlined our comments under the following main areas:

- Groundwater modelling
- Well interference
- Ecology/surface water effects
- Nutrient loss, water use efficiency and land use

2.0 Groundwater Modelling

This section of this memo has been prepared by Neil Thomas.

Key issues around the groundwater modelling have largely been resolved through further work undertaken by the applicant since our evidence in chief was submitted in August 2022. In addition, joint witness conferencing between Neil Thomas, Julian Weir and Nick Dudley-Ward in September 2022 resulted in a joint witness statement where issues were identified and agreed between the different parties.

A brief summary of our key original concerns around the groundwater modelling are summarised below, together with our current position based on the applicants' evidence and the joint witness conferencing.

- **Issues around the method by which the model was calibrated and how this fed through to uncertainty in the model predictions**. Issues included the volume of groundwater abstraction used in the model and the way in which the model represents observed groundwater levels allowing for that volume of groundwater abstraction.

  These issues have been resolved through the uncertainty quantification undertaken by the applicant, which demonstrates that despite the issues, the range of model predictions fall into a relatively narrow band.

- **Issues around the model calibration to stream flows within the Ruataniwha Basin**. The model was not originally calibrated to streams within the basin and the model did not match observed stream flows in smaller streams and rivers.

  This model has now been calibrated to stream flows within the basin and provides a reasonable match to the observed data for smaller streams and rivers.

- **Issues around using the model for drawdown interference effects and drawdown effects in the shallow strata as well as stream flow effects.**

  This issue is now largely resolved via model uncertainty assessments indicating the potential range of effects that are predicted. These fall into relatively narrow bands and the potential issues around much larger potential drawdown due to the way in which the model was originally calibrated are now resolved.

3.0 Well Interference

This section of this memo has been prepared by Neil Thomas.

Key issues related to well interference are as follows with comments on whether these have been addressed:

- **Methodology: Derivation of the static water level against which the effects of the Tranche 2 pumping effects are assessed**. There were originally issues raised regarding the way in which the static water level was derived, based on any data available and how levels were interpolated across the basin from monitoring points. Issues were also raised around how the existing cumulative effects (i.e. from the Tranche 1 pumping) were accounted for in the estimates of static water levels.

  The evidence provided by Susan Rabbitte addresses some of these issues, but the issue around whether the static water levels used account for the effects of Tranche 1 pumping is still outstanding. The information provided is not clear and it does not obviously demonstrate that the approach taken accounts for the Tranche 1 pumping.

  The applicant should provide more information in this regard, particularly around the contours used, and how they compare to the estimates of Tranche 1 effects derived from the numerical groundwater model. The electronic contour / grid files should be also provided to aid in the review of this, together with maps of modelled drawdown for each model layer and the bores within each of these modelled layers assessed in the drawdown interference assessment.

- **Accounting for range of groundwater level drawdowns predicted by the model uncertainty analysis.** This issue is now covered off and a range of drawdown effects has been provided.

- **Use of March 2011 as a 'worst case scenario'.** Some questions were raised around whether the use of March 2011 represents a worst case scenario in terms of effects from the Tranche 2 takes.

  Further information regarding this issue has been provided (Weir, paras A1 to A11) and broadly, we agree that using the modelled drawdown effects from March 2011 do appear to represent the time of greatest modelled effects. March 2011 appears to be the end of a period of higher simulated pumping, in which case drawdown effects would be greatest.

- **Drawdown interference estimates and effects**. The applicants have provided summaries of the drawdown interference impacts under different scenarios, and identified bores that are flagged, or where the drawdown interference effects are greater than 20%. No further information has been provided regarding these bores and whether the effects are considered as being more or less than minor. Therefore, there is an outstanding issue in terms of the overall impact of the effects of drawdown interference. We also note that the impacts of drawdown interference on the registered drinking water supplies are not provided in Susan Rabbitte's evidence, but these are discussed in Alexandra Johansen's evidence, so it is not possible to cross check the numbers provided. Further justification of the exclusion for some wells from the assessment would also be beneficial.

4.0 Ecology / Effects on Small Streams and Rivers within the Basin

This section of this memo has been prepared by Laura Drummond.

Key issues around potential effects to small streams and rivers in the Ruataniwha Basin remain despite further work undertaken by the applicant since our evidence in chief was submitted in August 2022. This includes an updated scenario of drawdown predictions using 'typical' conditions (March 2021), instead of the previously provided 'worst-case' scenario over 20-years of data. Joint witness conferencing between Laura Drummond and Vaughan Keesing in October 2022 resulted in a joint witness statement (JWS) where issues were identified and agreed between the different parties.

A brief summary of our key original concerns around the ecological effects assessment are summarised below, together with our current position based on the applicant's evidence and the joint witness conferencing.

- Effects could occur to streams and rivers upstream of the augmentation sites, where flow augmentation is delayed through injection of groundwater (proposed at two sites), or where flow augmentation is upstream of dry reaches.

During expert conferencing it was agreed that an Augmentation Management Plan needs to be developed to determine appropriate sites for augmentation discharge. It was agreed that adverse effects could occur if augmentation water is discharged to a dry reach of streambed, as the water is unlikely to travel to the intended watercourse location (river minimum flow site) and could result in unintended impacts such as disruption of species lifecycle patters, loss of connectivity and fish passage. It is still considered likely that drawdown resulting in adverse effects due to lowered water levels or flow could occur upstream of the augmentation sites. There are also still questions regarding lag times of augmented water that will be injected to bores and associated impacts on the intended surface water receiving environment.

- Averaged one-off data used for predicting effects to water levels in smaller streams and wetlands does not account for seasonal variability and worst-case scenarios, and could therefore underestimate adverse effects.

This issue is not resolved. We still consider that this method (one-off water level survey) did not account for seasonal variability and worst-case scenarios of drawdown effects for smaller streams. The time period when water levels were taken (wet summer with previous rainfall) may not have accounted for seasonal low flows. We are therefore still of the opinion that the assessment methodology could have underestimated effects to small streams. Effects on small streams are predicted to include reductions in water levels, flows and available instream habitat, in addition to an increase in the frequency, duration and/or extent of existing seasonal stream drying and connection.

It was agreed in the JWS that the assessments undertaken show reductions in aquatic habitat as a result of predicted drawdown. The significance of instream habitat reductions is uncertain due to the limited baseline data available. In the initial ecological assessment, drawdown predictions were shown to be large across the assessed reach scale habitats (riffle, run, pool), with 27 out of 61 sites that had water present drying and 20 sites showing highly reduced water levels (≥ 50% reduction). Additional groundwater modelling was undertaken, with a 'typical' year (March 2001) being used to determine predicted drawdown, which reduced the predicted drawdowns to 19 out of 61 sites with water present drying, and

10 sites showing highly reduced water levels (≥ 50% reduction). While it is agreed (as per the JWS dated 18 October 2022) that the updated assessment shows a less adverse change than the first 'worst-case' predictions, adverse impacts to aquatic ecology values including water quality, available instream habitat, fish passage and spatial connection, nuisance macrophyte growth, macroinvertebrate communities and fish behaviour/health are still expected to occur based only on 'typical' changes.

Dr Keesing's position is that the aquatic communities present are robust and well adapted to further drying conditions. We consider that while many of these habitats are currently degraded, they have the potential to have higher values (MCI and fish diversity) and that restoration, not further impacts through reduction in habitat availability, is required to improve their condition. In addition, while some sites with simple macroinvertebrate communities may be more resilient to change, fish communities (while mobile) can also be impacted. These small streams act as migration pathways for many diadromous fish (from headwater sites to the coast) and are rearing habitat for juvenile fish that have moved from the main rivers (Tukutuki and Waipawa). Increased intermittence and increased loss of flow connection (as a result of drying of riffle habitats for example) has the potential to impact this behaviour. Recent environmental DNA (eDNA) sampling shows the presence of the At-Risk dwarf galaxias (*Galaxias divergens*) and/or torrentfish (*Cheimarrichthys fosteri*) in many Ruantaniwha Basin waterways including the Waipawa, Tukituki, Tukipo and Kahahakuri. The Kahahakuri Stream in particular has seven fish species recorded, including dwarf galaxias, rainbow trout (*Oncorhynchus mykiss*) brown trout (*Salmo trutta*) and eels (shortfin and longfin). The Kahahakuri Stream is predicted to have increased drying extents and drawdown of assessed habitats by >50%.

There is still disagreement on the level of impact the proposed groundwater takes could have on small streams and rivers not receiving augmentation or above the augmentation sites. We do not agree that the effects will be negligible - minor and consider that the impact could be more than minor, with increased drying of reaches and large reductions of in-stream habitat. In addition, a response as to why 13 m^3/yr instead of 15 m^3/yr was modelled for the updated assessment and if this is consistent with the data used for the original assessment is required.

- Effects could occur as a result of the discharge of deep groundwater to rivers, where groundwater quality has elevated concentrations of some contaminants.

It was agreed in JWS that the quality of groundwater must be confirmed and approved prior to augmentation being trialled or initiated, as there is the potential for contaminants in the deep groundwater. An Augmentation Management Plan is proposed by the applicant. Details of this plan, including parameters, timeframes, triggers and limits are not provided. The Augmentation Management Plan should be reviewed and approved by a Council freshwater ecologist and should be linked to water quality guidelines to ensure no contaminants are discharged via augmentation water.

- Effects to Inglis Bush

It was agreed in the JWS that the area of Inglis Bush walked by Dr Keesing was not a wetland forest, based on the information that was collected, however, additional potential wetland area has been identified since and field confirmation is required. Further site visits are planned prior to the hearing to confirm the presence, condition and potential impacts to springs and wetland habitat within Inglis Bush.

The maps of drawdown provided by the applicant for the top model layer appear to suggest that drawdown effects at the water table will be less than 0.2 m (as per contours). It may also be helpful to see drawdown in deeper model layers because changes in these deeper strata may impact on spring discharge.

- Mitigation and monitoring

We agreed in the JWS statement that riparian planting on its own will not provide ecologically meaningful mitigation for the proposed activity, in addition, this is already being initiated at many farms (stock exclusion, riparian planting).

We disagree that effects will be easy to monitor and reverse, as stated in paragraph 8.32 of Dr Keesing's evidence. There is currently not enough water level data for the small streams assessed to determine historical trends and tease out impacts from Tranche 2 compared to other impacts (land-use, Tranche 1, surface water takes, climate change). Therefore, it is not considered feasible to 'reverse the impacts' by altering the water take if adverse effects are observed. How this would be managed by the applicant is unclear.

5.0 Effects on Rivers that Discharge from the Basin

This section of this memo has been prepared by Laura Drummond and Neil Thomas

- **Augmentation outside of 1 in 10 year dry events.** Although the applicants' pumping may cease where their annual volumes are used up, the depth of the proposed takes mean that effects from pumping will still occur (because of the time lag between pumping ceasing and effects at the surface) but these will not be offset by augmentation where those annual volumes are exhausted.

  The applicant has commented that this could be resolved by removing the annual volume limit on the augmentation takes (Weir, paragraph A22). The applicant has also provided some information regarding how often this could occur (Weir, para A18-A21), based on the last 40 years of climate and river flows. In total, the applicant indicates that augmentation would reach the annual limit on four occasions, but that in these situations, the irrigation seasonal volume would also be reached before the augmentation annual volume limit is reached, or irrigation demand ceases. The applicant notes that this would mean that stream depletion effects would be reducing before the augmentation annual volume is exhausted.

  In general, our opinion is that allowing unlimited augmentation water would not be a suitable solution to this issue, since it would result in further stream depletion and could result in exceedances of the Tranche 2 allocation limits. It is possible that in future, the seasonal allocation limits proposed by the applicant will be exhausted more frequently due to climatic effects. The effect of allowing for unlimited augmentation water has not been modelled by the applicants.

  We also note that whilst the irrigation demand may have reduced by the time the augmentation limit is reached, that does not mean that effects have reduced to the point where the Tranche 2 takes are not the cause of low flow exceedance or exacerbating the impact on low flow condition in rivers and streams during these extreme years. Because the proposed takes are deep, their stream depletion effects (which the augmentation seeks to mitigate) are slow to develop and slow to recover. Our view is that the applicants' comments only partly address this issue and that there are effects that they cannot effectively mitigate, as the application is proposed.

- **Staging of augmentation.** A potential issue was raised where development may not occur concurrently between all the applicants and augmentation may not offset the effects at different stages of development.

  Our view is that the lag time between effects occurring at the surface due to pumping (in the order of 7 years) will largely mitigate this issue. However, this still assumes that development of each property takes place within that timeframe. If greater delays occur for some applicants, or if some applicants are not able to develop to the degree intended (for example if well yields are poor, or well interference effects/drawdown effects are excessive) this issue could still be relevant.

- **Red Bridge flow trigger**. Reducing flow in the Waipawa and Tukituki Rivers will reduce flows at Red Bridge, which could potentially affect some users. Augmentation is only proposed at low flow triggers in the Waipawa and Tukituki Rivers.

  The applicant notes (Weir, para A44) that augmentation will improve flows at Red Bridge on 132 days within the modelled simulation (over 40 years) and will reduce flows below the trigger levels on 6 days. They comment that requiring augmentation when flow triggers at Red Bridge are reached will require additional pumping and overcompensate flow at the low flow sites on the Waipawa and Tukituki Rivers.

  Our position is that, whilst the applicant's comments are reasonable, there are impacts on stream flows downstream of Red Bridge and these impacts should be mitigated. The applicants pumping will influence flow at Red Bridge. At times, this effect will occur when the flow triggers are not breached on the Waipawa and Tukituki Rivers, but the flow triggers are breached at Red Bridge. The most appropriate means of mitigating those effects is to require augmentation at the Red Bridge flow triggers, noting that the Red Bridge minimum flow level increases next year to 5,200 L/s. However, this would need to be accounted for in updated modelling to ensure there is sufficient augmentation volumes.

- **Augmentation site effectiveness.** Some issues were raised around the effectiveness of augmentation into shallow bores and also around augmentation into dry streams.

  The applicant notes that (Weir, para A42) the basin is closed and therefore any water discharged into streams that are dry, or into shallow groundwater, will eventually make its way into the major rivers at the basin outlets (i.e the Waipawa and Tukituki Rivers). Therefore, this augmentation will have positive effects.

  We agree with this comment in general, but note that the aim of the augmentation is to mitigate impacts of the Tranche 2 takes on other users, where the Tranche 2 takes will cause the low flow triggers to be breached more frequently, in addition to providing some environmental benefit below the point of discharge. Discharge into dry streams or into the shallow bores is unlikely to have the rapid effects that are required to increase flows above the low flow triggers. The model does account for losses and gains in streams, but it is not clear whether, in the model, the streams are persistently flowing, in which case the simulated discharge will have a rapid effect on the low flow sites downstream, or whether some of the modelled discharges occur at times when the modelled streams are dry (which will be the case in reality) in which case the effect at the low flow sites would be expected to be slower. Some further information could be provided by the applicant to help cover this issue.

- **Augmentation availability.** During the seasons when augmentation water is not available, drawdown of water levels is likely to occur at all waterways that are hydraulically connected to groundwater (large and small). The magnitude of drawdown impacts is uncertain in larger stream reaches, as this has not been modelled or assessed by the applicant. Due to the high fisheries values of the Waipawa and Tukituki Rivers and their tributaries, there is potential for adverse effects to be more than minor where water levels or flow levels in fish migratory pathways or within spawning habitat is lowered significantly. During these extreme dry events, drawdown could exacerbate natural drying and impact water quality, nuisance periphyton and macrophyte growth, cyanobacteria blooms and fish behaviour/health.

6.0 Nutrient Loss and Water Use Efficiency

This section of this memo has been prepared by Katherine McCusker.

There are no changes to the nutrient loss modelling, irrigation areas or irrigation water use in the applicants' evidence. I note the applicants have used Augmentation Scenario 5 (Table 6, Weir) for the irrigation water volumes, with the total volume taken for irrigation at 8.4 million m^3 and the total when augmentation is included at 13 million m^3. The total nitrogen loss to water as modelled in Overseer remains similar between the current and the proposed scenario at 122,384 kg N/ha/yr (current).

Use of the HBRC 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.

Key issues are:

- The total proposed water take is 15 million m^3 but the nutrient modelling has been based on 13 million m^3 of water use.
- There is 2 million m^3 for cultural and environmental use (Weir). According to the evidence of Mr Allen, 1.3 million m^3 of this water could be used for an additional 217 ha of irrigation, by a Manawhenua entity. At this this stage the Manawhenua entity has not been set up and there is no information on where the land/irrigation would be located or the crops grown. This additional 217ha and 2 million m^3 has not been included in nutrient loss effects.
- I agree with the applicant (evidence of Mr Allen) that specifying crops could be problematic particularly as they are applying for a 20-year consent and over that timeframe crop types could change due to markets, climate change and profitability. If all applicants had a land use consent throughout the duration of the water take and use consent, nutrient loads could be managed through those consents. I note there is only one applicant Papawai that is not in a DIN limiting sub-catchment and they have applied for a land use consent.
- The applicant has suggested the consented area is set as the total area of the land parcels that the applications have applied for as part of this consent. There is a risk if there is no maximum area of irrigation the applicants could decide to irrigate a larger area than they have modelled and shown the effects of. The modelling has been completed to show the water required for 9 years out of 10 for pasture irrigation and if they decided to irrigate a larger area with less reliable water, then they could use their maximum allocation of water more frequently. This could result in greater drawdown in wells and a larger flow depletion impact on surface water. The consented maximum area should be the area provided in the applications.

In terms of land use, there are no additional changes in the evidence provided. The report *Applications for the take, use and discharge of Tranche 2 groundwater: combined assessment of environmental and economic impacts* provided by AgFirst on 29 July 2022 contains the most up to date summary of the proposed land use changes.

7.0 Summary

7.1 Groundwater

The further work undertaken by the applicant has largely addressed our concerns raised in evidence regarding the numerical model used to support the assessments. However, key issues that are outstanding with respect to effects on groundwater include:

- It is not clear that the method to assess **drawdown interference effects** is appropriate and we have concerns regarding the means by which the static water levels have been defined and whether the effect of existing Tranche 1 pumping is accounted for.
- **Augmentation outside 1 in 10 year events**. In our opinion, this issue is still outstanding and it is not clear how the applicants will mitigate their effects in very dry years when augmentation water is exhausted.
- **Red Bridge flow trigger**. Our opinion is that the Tranche 2 takes will impact on the reliability for other users tied to flows at Red Bridge and therefore augmentation should occur to mitigate those effects.
- **Augmentation site effectiveness**. We still have concerns about augmentation discharges into dry reaches of streams and whether those discharges will reach the low flow monitoring sites in time to offset the stream depletion effects of the applicants pumping. Some further information could be provided by the applicant to help cover this issue. We also have similar concerns around the proposed discharges of augmentation water into shallow bores.

7.2 Surface Water

Key issues that are outstanding with respect to effects on surface water include:

- Effects on seasonal low flow levels in the major rivers that discharge from the basin upstream of augmentation sites and effects when augmentation water is not available.
- There is still disagreement on the level of impact the proposed groundwater takes could have on small streams and rivers not receiving augmentation. We do not agree that the effects will be less than minor or minor and consider that the impact could be more than minor, with increased drying of reaches and large reductions of in-stream habitat.
- Potential surface water quality effects as a result of augmentation water quality are proposed to be managed by an Augmentation Management Plan to ensure surface water quality is not impacted. However, this has not been provided for review.
- Further site visits are planned prior to the hearing to confirm the presence, condition and potential impacts to springs and wetland habitat within Inglis Bush.
- Mitigation is not proposed by the applicant for small streams and wetlands. We disagree that effects will be easy to monitor and reverse, as baseline water level data is not available for the small streams and wetlands assessed in order to determine historical trends. Therefore, separating impacts from Tranche 2 compared to other impacts (land-use, Tranche 1, surface water takes, climate change) will be challenging.

7.3 Nutrient Loss and Water Use Efficiency

Comments related to nutrient loss and water use are as follows:

- According to the evidence of Mr Allen, 1.3 million m^3 of water could be used for an additional 217 ha of irrigation, by a Manawhenua entity. The effects of an additional 217 ha has not been assessed.

- There is a risk if there is no maximum area of irrigation the applicants could decide to irrigate a larger area resulting in applicants using their maximum allocation of water more frequently. This could result in greater drawdown in wells and a larger flow depletion impact on surface water. The consented maximum area should be the area provided in the applications.
- If all applicants had a land use consent throughout the duration of the water take and use consent, nutrient loads could be managed through those consents and this could be used to manage changes in crop types over the 20 year duration of the consent.

8.0 Limitations

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