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memorandum

TO	Paul Barrett	FROM	Hilary Lough
	Hawke's Bay Regional Council	DATE	15 December 2020
RE	Ruataniwha Basin Tranche 2 Groundwater Modelling - Preliminary Comments		

1.0 Introduction

Pattle Delamore Partners Limited (PDP) has been engaged by Hawke's Bay Regional Council (HBRC) to review the technical aspects of consent applications from a number of applicants to take Tranche 2 groundwater in the Ruataniwha Basin. "Tranche 2" groundwater is as defined in the decision on HBRC's Plan Change 6. This decision sets out that Tranche 2 groundwater is only available for allocation if accompanied by surface water augmentation to endeavour to mitigate surface water flow depletion.

In 2013, Aqualinc Research Ltd (Aqualinc) developed a three-dimensional numerical flow model of the Ruataniwha basin as part of the Tukituki catchment Plan Change 6 (PC6) hearing. They have recently updated the model to assess the effects of the Tranche 2 groundwater abstractions sought by eight consent applicants and augmentation recharge on groundwater and surface water within the basin. This is documented in Weir (2020), which is referred to in this memo as 'the modelling report'.

We have been provided a copy of this report on 2 December 2020. Due to time constraints with our work commitments prior to Christmas, a full review of the work undertaken and assessment of effects is not possible. However, in this memo we have provided some preliminary comments and questions that would be useful to receive further information on to assist with a more detailed review. Some of these are in line with questions HBRC have already noted from their initial review of the modelling report.

We have also undertaken a brief high level review of the well interference report (Lattey Group, 2020) provided to us on 8 December 2020. That report is based on the results of the modelling described in the modelling report (Weir, 2020) so further information on that is required before a full review can be undertaken of the well interference report. However, we have provided some preliminary comments on the well interference report.

2.0 Preliminary comments and questions on modelling report

Our preliminary comments and questions on the modelling report (Weir, 2020) are as follows:

1. There appears to be little consideration of model uncertainty on the predicted effects on river flows and groundwater levels, or comment on where the model is poorly calibrated, except for some general comments around over-compensation with augmentation to allow for model uncertainty. 30 bores across the basin is not a large number and there are reasonably large model areas in Figure 3 where no observation bores are sited, so there will be some areas where the calibration dataset provides little information to constrain the model parameters. It would be helpful if comments were provided on how the 30 bores were selected, which is less than the total number of HBRC monitoring bores. We recognise that assessing uncertainty can be time

consuming, but often reveals that the predictions are not very certain and can fall into a wide range, so it is important to understand this. In the first instance, some comments on model uncertainty with respect to the impacts on the predicted flow and level changes would be helpful for our review.

2. We acknowledge the pumping test information review (PDP, 2018) has been used to inform the model. In a similar manner, it would be useful to comment on whether the riverbed conductivities are comparable with previous estimates, for example from aquifer tests or concurrent flow gaugings. The report notes the riverbed conductivity values varied between 0.0018 m/day and 5 m/day for each calibration reach. In line with the above comments on uncertainty, uncertainty in the riverbed conductivities on the model results will be important to explore and communicate.

3. The model period is from 1 July 1972 through to 30 June 2012. We appreciate the comments made in the modelling report that, due to the length of time required to generate new model inputs, the model run period was not changed. We agree that the current 40 year model run period incorporates a wide range of climatic variability, as illustrated in Figure 1 which shows the model period covers the full range of annual rainfall observed up to 2019 (except higher rainfalls). However, it would have been useful to have the model period extended to cover the period of water level declines or larger seasonal impacts that have been observed in a number of the observation bores since that time, possibly due to increased abstraction. Based on the R^2 values the model appears relatively well calibrated, but in some of the plots provided, some of the downwards trends in the groundwater levels are not captured even up until 2013. While it is accepted that the forward modelling allows for full irrigation, some further comment on the recent declines and the model's suitability in light of those would be useful.

4. Following on from the above comment, the river flow calibration plots only extend from 1987-1990, which seems very short. Some initial comments on why only this period was included would be helpful. In addition, similar to the hydrographs for different scenarios, it would be helpful to see a comparison between measured flows and simulated flows for different scenarios at the different sites over the full model period, rather than just the low flow statistics shown in the tables, including for very dry years.

5. Following on from the above, comments on the impacts to the full range of flows and associated effects would be helpful, including a consideration of flow variability. For example, will there be long periods where flows are sustained at or just above the augmentation flow thresholds proposed?

6. Effects of climate change are not modelled or discussed. While basing the calibrated model on a timeseries from 1972 to 2013 does incorporate a range of different rainfalls, it is not the same as a long term shift to reduced rainfall or different seasonal rainfall patterns, so some consideration of that effect would be helpful.

7. The groundwater level graphs indicate that groundwater levels were simulated across the 40 year period, but it was not clear to us what the modelled time period was for the depletion effects estimated for each take that have been included in the tables throughout the report. Clarification of this would be helpful. It is important that residual depletion effects from year to year over the consent durations sought are accounted for, together with effects of pumping in dry years/consecutive dry years/climate change scenarios. It would be useful to describe the overall changes that occur, perhaps presented as a water balance, showing how the increased abstractions are balanced by reduced river flows, irrigation return water etc.

8. The proposal to start the 'water year' on 1 October with the 'augmentation year' starting on 1 November in principle seems logical to help ensure water is available for augmentation over the

summer months when the potential for adverse effects is greater, including on other users. It is understood that the intention would still be to use water for augmentation during November (from the previous year), but this should be clarified. We would suggest that it would be best for the water year and augmentation year to align with the same dates, as we would not recommend that the volumes of water for augmentation and irrigation be split, except for there being an upper limit on the volume of water available for irrigation.

9. The effects on flows at five low flow monitoring sites are presented, but no information is given on the modelled changes in the other waterways across the basin. This is important information, including the changes in spring discharges and smaller streams, and should be provided together with information on the implications of those flow changes.

10. While not of relevance to the downstream flow monitoring sites, some information on the implications of the location of the augmentation discharges would be helpful, particularly with respect to the stream/river depletion effects that are modelled to occur upstream of the augmentation sites. There would appear to be the potential for quite significant changes in some of the smaller streams, particularly those that are not receiving augmentation flows.

11. The estimates of flow changes are presented as flows (L/s), but it would also be helpful if these were expressed as % change in average flow/MALF (rather than just the low flow limit).

12. Comments are provided to the effect that it is assumed for model calibration that gains and losses between the basin outlets (the edge of the model) and the flow monitoring sites are negligible. However, within the model extent it is not clear how the augmentation flows were added to the model, for example are the discharges in the stream file or are they simply added to the modelled river flow records assuming no losses between the point of discharge and the flow recorder?

13. Further information on the boundaries used in the model and the method of including the surface water bodies in the model would be helpful for our review.

14. The modelling report comments that a further flow restriction site exists on the Tukituki River at Red Bridge, which is below the model's extent and the flow monitoring sites on the Waipawa at SH2 and Tukituki at Tapairu Road, so those flows sites have been considered to represent Red Bridge. The report notes that, provided the combined 7-day MALF at the SH2 and Tapairu sites are maintained (or improved), then the downstream low flows at Red Bridge will not be adversely affected by the proposed Tranche 2 takes. The minimum flow at Red Bridge will increase in 2023 to 5200 L/s. We suggest that a consideration of the changes in flow at this site is warranted with respect to augmentation requirements, allowing for the increase in minimum flow, to demonstrate this will not alter the augmentation required.

15. The report explains that the irrigation demand simulated using IrriCalc was used to generate a theoretical abstraction record for the proposed Tranche 2 takes. It was not entirely clear if this was how the theoretical abstraction record for the existing takes (over the 6,000 ha currently irrigated) was applied and whether this was applied to the full model or allowed for changes over time. It would be helpful for this to be clarified.

16. We acknowledge the intention for augmentation to occur at higher flows than the minimum flows to help protect reliability for existing abstraction holders (by adding on the equivalent stream depletion effect from the Tranche 2 irrigation and augmentation takes), and for augmentation to occur below these flows regardless of whether abstraction for irrigation is occurring (with the exception of the applicant, Tuki Tuki Awa). To illustrate how this can occur, it would be helpful if a list was provided of the existing consent holders subject to minimum flows together with the size of their takes, the relevant minimum flows and flow sites for those consent holders.

17. The modelled changes in shallow groundwater levels are predicted to lower a maximum of 0.8 m in the vicinity of the Tranche 2 take locations, and less than 0.3 m further afield. It would be useful to consider whether this groundwater level change could impact wetlands. Also, an explanation of why 2001 was chosen for the modelled groundwater level changes should be provided.
18. Some of the contour maps of aquifer properties in Appendix C would benefit from more labels on the scales or alternate scales, to better understand the values used.
19. We have a copy of Weir (2013), however, the text is not recognised in the version we have, which makes searching the document challenging. It would be helpful for our further review of this work if a different copy could be provided.

3.0 Preliminary comments on well interference report

Our preliminary comments on the well interference report (Lattey Group, 2020) are as follows:

1. In general, the use of the numerical modelling results for the assessment is helpful in that it allows for cumulative drawdown interference effects of all proposed pumping, however, the model is developed at a regional scale and may not be representative of local parameters unless there is good calibration there. We recommend that comparison is made of the predictions from the regional scale model with predicted drawdown interference effects using on site specific aquifer test data.
2. Consideration on whether the full effects of the current Tranche 1 abstractions are reflected in the HBRC monitoring well records would also be warranted, including consideration of actual versus consented pumping.
3. The assumption of a seasonal water level variation of 2 m near the bores with the greatest actual recorded groundwater level variations seems too low. Further consideration of this assumption, perhaps with a review of nearby takes to establish that direct interference effects are likely responsible for the large seasonal variations would be helpful.
4. We recommend HBRC consider whether the assessment process, particularly the exclusion of some bores, is in line with HBRC planning provisions.

4.0 Summary

We have undertaken a high level review of the groundwater modelling report (Weir, 2020) that describes the model developed to assess changes to the groundwater and surface water system related to the consent applications to take Tranche 2 groundwater in the Ruataniwha Basin.

In this memo we have provided some preliminary comments and questions that would be useful to receive further information on to assist with a more detailed review. We have also provided preliminary comments on the well interference report (Lattey Group, 2020).

We expect further assessment of all potential effects associated with the proposed activities will be provided by the applicants at a later date, once the modelling has been further reviewed.

5.0 References

Lattey Group. 2020. Ruataniwha Basin Tranche 2 Irrigation Water Permit Consent Application -Assessment of Well Interference Effects

PDP. 2018. Ruataniwha Aquifer Properties Analysis and Mapping. Prepared for Hawke's Bay Regional Council. 14 December 2018

Weir, J. 2020. Ruataniwha Basin: Tranche 2 Groundwater Modelling. 28 October 2020.

Weir, J. 2013. Statement of Evidence of Julian James Weir for Ruataniwha Water Users Group (Groundwater Modelling). Expert evidence presented before a Board of Inquiry for the proposed Tukituki Catchment plan change 6. 7 October 2013.

6.0 Terms and conditions

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Prepared by

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