MEMO

To:	The PPC9 Hearings Panel
From:	Dr Jeff Smith – Manager Science Ellen Robotham – Policy Planner
Date:	24 September 2021
Subject:	**RESPONSE TO THE PANEL'S QUESTIONS REGARDING WATER QUANTITY PROVISIONS AND APPENDIX 11**

Background

On 21 September 2021, the panel produced Minute 10 and an attached memo requesting further information from HBRC officers regarding the interim allocation limit, its scientific reasoning, and its role. These questions are answered below followed by a discussion of the policy implications.

Ms Robotham answered questions 1 and 2, and provided the discussion regarding policy implications. Dr Smith responded to questions 3, 4, and 6. Both authors responded to question 5 with Dr Smith providing response regarding technical matters.

Question 1: How much water is currently allocated from Heretaunga Plains groundwater to each of:

i. Public water supplies

ii. Industrial users

iii. Irrigators?

In answering this question, assumptions have been made to create an estimated annual volume where consents do not currently include them. For example, to estimate an annual allocation for irrigation, the weekly volume allocation for these consents has been multiplied by 120 days to reflect the total potential irrigation season. This leads to a conservatively high total because irrigators do not normally need that total amount in most years.

At the time of writing the Section 32 Report (see page 273), total groundwater allocation was estimated to be between 140 – 180 Mm^3. For the purposes of this memo, HBRC consent staff have rerun the calculation based on current consents as at September 2021. Allocation estimates vary due to differences in method and accounting for double ups where water is shared between consents and multiple points of take.

Use	Estimated annual volume allocation (Mm^3/yr)	Comment
Public water supplies	40.3	This estimate includes the following consent categories: • Recreational Facilities • Domestic • Potable • Recreation
Industrial users	40.2	This category includes the following consent categories:

		• Shingle Washing • Cooling Water • Industry • Non Potable • Potable • Potable - Bottling • Vehicle Wash
Irrigators	82.7	This category includes the following consent categories: • Agriculture • Damfill • Irrigation • Stockyard
Frost protection	0.6	According to the PPC9 definition of Allocation limit for groundwater, frost protection is not included within the interim limit. I have included it here for fullness.
Environmental	1.9	This category includes the following consent categories: • Augmentation / Recharge for a stream and a wetland • Multiple uses (trout hatchery)
Total	**165.7**	

Question 2: In round terms, how much water is proposed to be allocated to each of these three groups of users for the upcoming 10 year period during the consent reviews anticipated by PPC9?

As discussed on page 276 of the Section 32 Report, the consent-by-consent review of all water permits during the term of the plan and according to POL TANK 38 will enable the sum of the individual 'actual and reasonable use' reallocation to be calculated. In lieu of undertaking a consent-by-consent analysis, actual and reasonable use has been estimated to roughly equate to the actual water demand as indicated by abstraction during the highest water use year, i.e. the 2012-13 water year.

Actual abstraction for the 2012-13 water year is discussed in response to Questions 3 and 4, including the expected allocation by sector. Based on this, annual allocation (rounded to whole numbers) for these three groups is estimated to be:

Irrigation	51 Mm^3
Public Water Supply	24 Mm^3
Industry	14 Mm^3

Question 3: Can the Council provide an estimate of the volume of how much water is taken from the aquifer in each water year by permitted activities (such as domestic water supplies)?

The volume abstracted for permitted activities is calculated using methods described by Harper (2016)[1] and Buchanan et al. (2013)[2]. The method for calculating stock drinking water is described in the *Shopping list for Proposed Plan Change 9* document that was delivered to the Hearing Panel on 11 June 2021. Permitted use for domestic water supply was calculated using similar methods: i.e. population (census) data were used to estimate the number of individuals in households that are not connected to reticulated water supply. Previously established estimates of daily consumption were then applied, to arrive at total permitted use. Total permitted domestic water use was then filtered by source, using spatial data to estimate the likelihood of use from surface water or groundwater.

Based on these methods, annual permitted groundwater use has been calculated as:

- Domestic water supplies: 893,663 m^3/year
- Stock drinking water: 512,712 m^3/year
- Dairy shed wash down: 119,446 m^3/year

The total abstraction for permitted use was calculated as **1,525,821 m^3/year**.

This represents less than 2% of the 91 Mm^3 abstraction that occurred in 2012-13. Disaggregated into water use sectors, the abstraction during 2012-13 is:

Irrigation	51.32 Mm^3
Public Water Supply	23.51 Mm^3
Industry	13.66 Mm^3
Frost Protection	1.30 Mm^3
Domestic	0.90 Mm^3
Stock Drinking	0.63 Mm^3

Question 4: Is it correct that the proposed 90M m3/y interim allocation limit is based primarily on the estimated water use during the 2012/2013 water year? If so, what are the 80th and 90th percentile confidence limits of this estimate?

Yes, the interim allocation limit is based on water use for 2012-13. This is a total of all abstractions for that year, and is not an average or other estimate from a sample distribution that is used to generate a parameter for an unknown population. Therefore, it is not possible to generate statistically derived confidence limits for the actual water use in 2012-13.

I note that Mr Shade Smith provided confidence limits for the mean (average) abstraction calculated for the period 2006-2014, and advocated for a 70 Mm^3 interim annual allocation based on those calculations. I accept that confidence limits are appropriate for the calculation of mean abstraction over time. However, groundwater allocation in PPC9 is based on providing greater reliability of supply than that required during an average year. Therefore, abstraction during the dry 2012-13 hydrological year was used as the basis for establishing

[1] Harper S (2016). *Permitted Takes*. Memorandum from Simon Harper to Pawel Rakowski, appended to HBRC technical report number 4997: Heretaunga Aquifer Groundwater Model Development Report, available at https://www.hbrc.govt.nz/documents-and-forms/details/10975

[2] Buchanan F, Waldron R and Johnson K (2013). Estimating Permitted Water Use in Hawke's Bay. HBRC technical report number 4355. Available at https://www.hbrc.govt.nz/documents-and-forms/details/11149

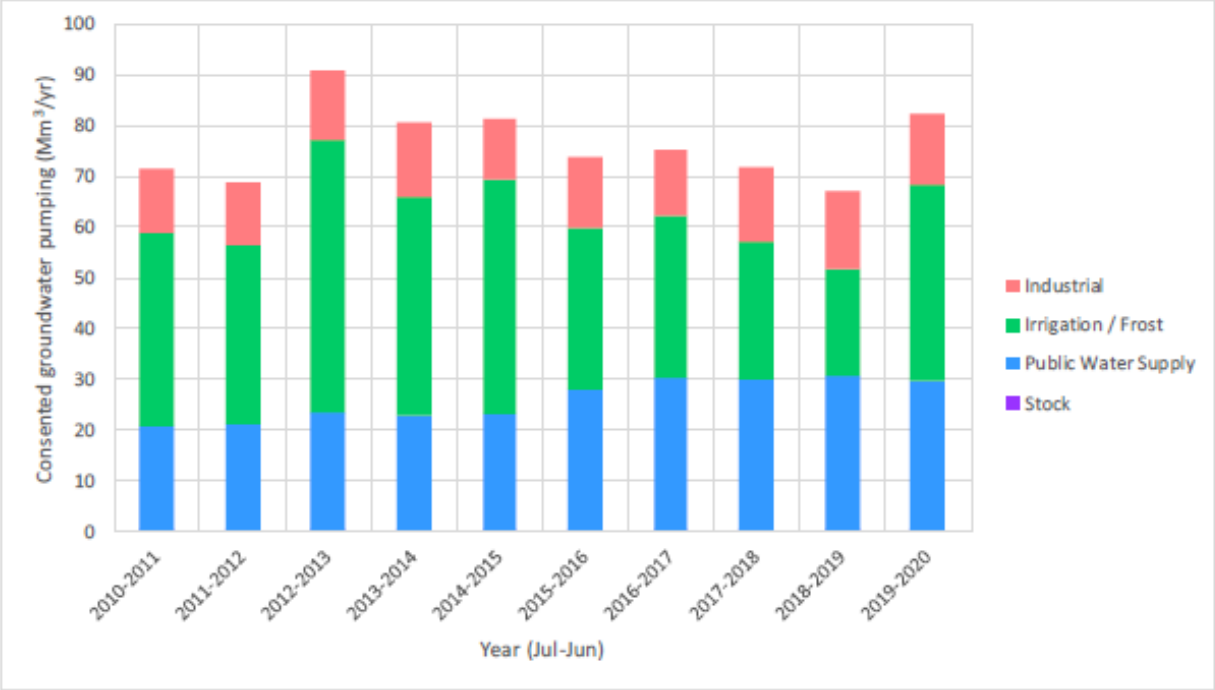
the interim allocation limit; which is much less than the allocation currently consented for abstraction from the Heretaunga aquifer system.

As demonstrated by Dr Kozyniak in her evidence dated 19 May 2021, water use in the 2012-13 year, as a proxy for demand, is likely to represent requirements for providing 95% reliability of supply in accordance with POL TANK 47.

Question 5: The proposed new definition of "actual and reasonable use" includes almost all of the 2020/21 water year, which we understand to be the driest in the recent record. Can an estimate be provided of total water use from the aquifer in this water year please, and if so, what are the 80th and 90th percentile confidence limits of this estimate?

The definition of actual and reasonable use as recommended during closing submissions includes the 10 years preceding 2 May 2020. It does not include the 2020/21 water year.

Mr Waldron provided evidence dated 19 May 2021 which revised total water use estimates provided in the original Appendix 11 and explained how estimates are derived. Total water use was estimated to be 91.1 Mm^3 in 2012-2013 and 82.5 Mm^3 in 2019-2020, as shown in the figure below.



The revised estimate of total consented annual water use from the Heretaunga Plains Aquifer indicates that 2012-2013 and 2019-2020 were years with the highest water use during the ten-year period (2010-2011 to 2019-2020). The 2013-2014 and 2014-2015 years also estimate total water use greater than 80 Mm^3/yr.

There is very high confidence in water use estimates from 2017, because at least 95% of the consented volume of abstraction was metered.

There is also confidence in the 2012-13 groundwater volumes abstracted for public water supplies and industrial use, because those abstractions were metered. While irrigation demand modelling was used to calculate the abstraction during 2012-13, water meter data

were available for 60-70% of the abstracted volume and those data were used to confirm those the modelled estimates.

Furthermore, Dr Kozyniak's statement of reply evidence (dated 19 May 2021) identified that rainfall during the irrigation seasons of 2012-13 and 2019-20 was within the lowest 5th percentile of records, so similar abstraction would be expected for both of those seasons.

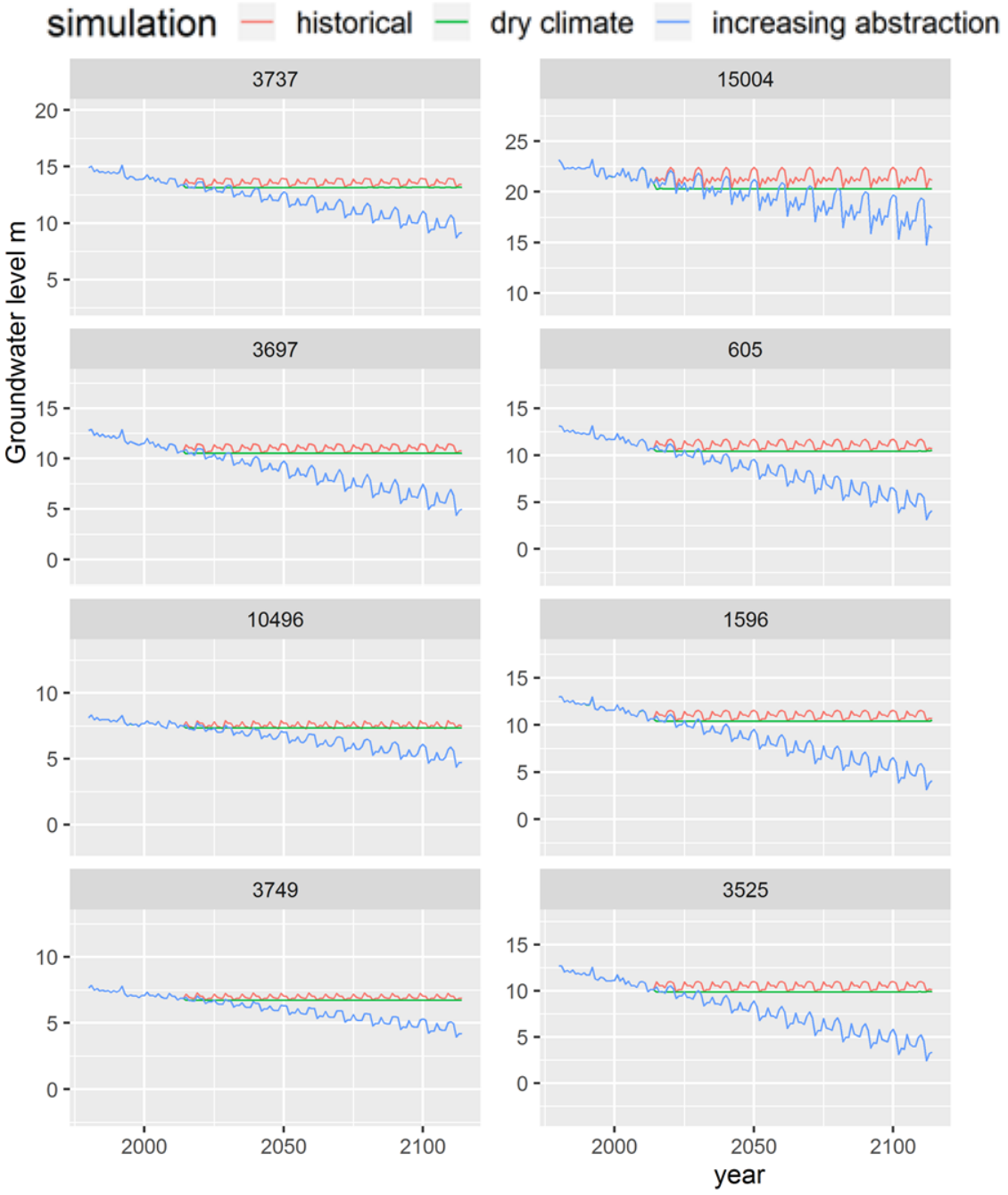
The abstraction calculated for 2012-13 is approximately 10% greater than abstraction during 2019-20. Therefore, in my opinion, the abstraction calculated for 2012-13 might be overestimated by up to 10%, but is unlikely to be an underestimate.

Question 6: How is the proposed 90M m3/y interim allocation limit justified by the current scientific knowledge of the Heretaunga Plains groundwater system? In particular, we cannot reconcile observed gradual declines in seasonal groundwater levels when actual average abstraction was about 15-20 M m3/y less than this, with a groundwater model that essentially says "it seems to be broadly sustainable to take 90M m3/y for each of the next 100 years". On the face of it the science appears to be contradictory, with some support for a hard allocation limit however, the modelling would suggest otherwise.

Declines in groundwater levels have occurred because of increased allocation (and subsequent abstraction) over time.

This question is related to modelling that explored future abstraction scenarios, which is described in pages 55 to 59 of Rakowski's (2018) report[3]. Results for groundwater levels at selected wells are shown in the figure below, with green lines showing results related to this question. The green line (dry climate scenario) lacks seasonal or internannual variation because in each year the same climatic and pumping conditions are repeated.

[3] Rakowski P (2018). Heretaunga Aquifer Groundwater Model: Scenarios Report. HBRC technical report number 5018. Available at https://www.hbrc.govt.nz/documents-and-forms/details/10965



The three scenarios, with interpretation of results are:

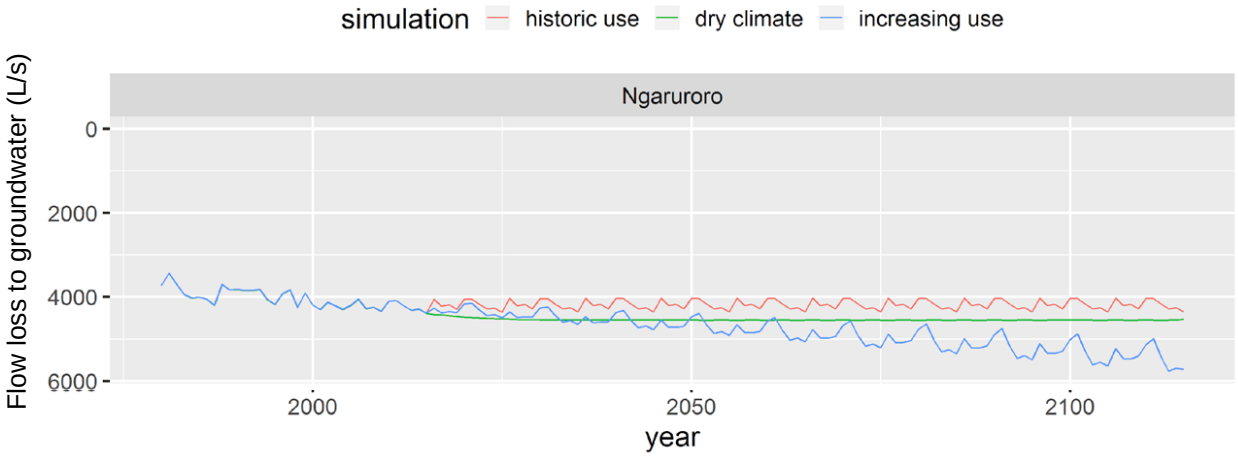
1. Repeated abstraction from 2005-2015 was simulated into the future to explore whether further declines in groundwater might be expected, even though abstraction and allocation are capped. This is shown with red lines in the figure above. The results show that the aquifer system responds relatively quickly and a dynamic equilibrium is achieved rapidly, so further declines would not be expected. This confirms that the aquifer system is not being mined by abstraction and environmental effects would not be expected to intensify further over time, if abstraction was limited to currently consented volumes.

2. Another simulation was used to explore an extreme climate change scenario, with abstraction for the very dry 2012-13 year repeated every year. **This is the scenario referred to in Question 6** and results are shown with green lines in the figure above.

The results show that groundwater levels would remain at low levels, with no seasonal recovery of groundwater levels. However, there is no evidence of a long-term declining trend.

3. The third simulation explored a scenario with abstraction increasing at the same rate that allocation for irrigation was increasing before the interim allocation limit was in place. The rate of increase is approximately 10 Mm^3 per decade and results are shown with the blue line. This demonstrates that further groundwater declines would be expected if allocation and abstraction continued to increase.

Rakowski's (2018) modelling also showed that adverse effects on surface water bodies would be amplified if abstraction was to increase over time; to the point where some streams and rivers would dry out. As an example, the blue line in the figure below shows that if abstraction continued to increase over time, by around 2050 the Ngaruroro River at Fernhill would lose an additional 1,000 L/s of flow which would result in the river ceasing to flow during dry periods (Ngaruroro flows have been as low as 1,000 L/s in the past).



In the figure above, the green line shows that if conditions from 2012-13 were repeated every year, the Ngaruroro flow loss to groundwater would be greater than currently observed. The green line (dry climate scenario) is invariable because in each year the same climatic and pumping conditions are repeated.

Policy Implications

Although it is not numeric, I consider Actual and Reasonable is a hard limit when combined with Schedule 31 and the rule conditions and terms.

Traditionally resources have been allocated using a first-in, first served approach. A limit is identified and applicants can access the resource until that limit is met. In PPC9, the limit appears to have been met already. While groundwater level declines and stream depletion effects are not expected to worsen if existing levels of use are continued, modelling indicates increased use will increase adverse effects.

The full suite of PPC9 provisions intends to look at the problem with a wide-perspective, to halt water use at current levels, apply annual allocation restrictions based on a defined reliability of supply, reduce allocation where possible through a sinking lid approach and avoid any increase of adverse effects, while providing a pathway for further information gathering and reviewing whether a numeric Actual and Reasonable is an appropriate limit.

PPC9 is the first step of an adaptive management pathway that allows Council to take a precautionary approach to water allocation and ensure that we are prioritising the health of the aquifer, as well as the waterbodies and ecosystems that are connected to the aquifer, as requested by tangata whenua submitters. What the interim limit does is identify a point against which to reassess plan provisions.

I consider that to enable Council to effectively implement PPC9 and achieve objectives of avoiding future over-allocation and phasing out over-allocation, consents planners require strong tools to avoid the cumulative adverse effects of groundwater takes across the Heretaunga Plains.

Where the panel considers that uncertainty remains around whether the interim limit should be set at 90Mm^3, the NPSFM2020 directs decision-makers to interpret that information in the way that will best give effect to the NPSFM2020. Clause 1.6 of the NPSFM2020 is copied below (emphasis added).

1) *A requirement in this National Policy Statement to use the best information available at the time is a requirement to use, if practicable, complete and scientifically robust data.*
2) *In the absence of complete and scientifically robust data, the best information may include information obtained from modelling, as well as partial data, local knowledge, and information obtained from other sources, but in this case local authorities must:*
    a) *prefer sources of information that provide the greatest level of certainty; and*
    b) *take all practicable steps to reduce uncertainty (such as through improvements to monitoring or the validation of models used).*
3) *A person who is required to use the best information available at the time:*
    a) *must not delay making decisions solely because of uncertainty about the quality or quantity of the information available; and*
    b) *if the information is uncertain, must interpret it in the way that will best give effect to this National Policy Statement.*

Maintaining an interim limit of 90Mm^3 and a prohibited activity status for Rule 12, gives effect to the hierarchy of obligations by prioritising the health and wellbeing of the aquifer, and connected waterbodies and ecosystems.