# DISCUSSION DOCUMENT AND OPTIONS;

**Part 1; Lowland Stream Flow Enhancement Scheme - further policy development**

**Part 2 High Flow Allocation Regime; Policy and Rules**

**Part 3 River Flow Management Regimes and Water Abstraction**

Report for meeting 38 of the TANK Group March 22 2018 by Jeff Smith, Mary-Anne Baker, Rob Waldron, Thomas Wilding with input to parts 1 and 2 by the Water Augmentation Group.

# Contents

# Part 1; Low Flow Enhancement Policy

1. At TANK meeting 37 (22 February 2018), a management framework that addresses the establishment of allocation limits in the Heretaunga Plains, the allocation of groundwater and a range of other measures to mitigate the stream depletion effects of those groundwater takes was discussed.
2. One of the management solutions was a stream flow enhancement scheme that would aim to maintain flows in the lowland streams from additional groundwater pumping.
3. Concerns were raised about the effectiveness or desirability of flow enhancement from groundwater to remedy or mitigate the effects of groundwater abstraction during periods of low flow. This section provides additional material to address and potentially allay those concerns.
4. Aquifer recharge and flow enhancement solutions are also being developed by other NZ councils and elsewhere around the world. Canterbury[1] and Gisborne[2] are dealing with very similar problems.
5. The following bullet points list some of the concerns raised during TANK meeting 37, along with a further policy drafting proposals.

## Environmental benefits of a lowland stream augmentation scheme

6. Some of the TANK members questioned whether the anticipated environmental benefits are real or likely.
7. The groundwater modelling has considered other options (e.g. Managed Aquifer Recharge) that may be considered for remedying or mitigating stream depletion effects caused by groundwater pumping. Apart from stream augmentation and widespread and significant allocation reductions, no other options have been identified as feasible solutions for maintaining adequate environmental flows in lowland streams. The modelling has demonstrated that it is technically feasible to maintain trigger flows in most Heretaunga lowland streams via augmentation from groundwater.
8. Furthermore, the Twyford augmentation scheme has demonstrated the environmental benefits of augmenting lowland streams to increase flows via the discharge of oxygen enriched groundwater (the resource consent held by Twyford Co-operative Company Limited (TCCL) requires augmentation water to have at least 80% oxygen saturation). (A field trip to the existing stream enhancement scheme at Twyford has been arranged prior to this meeting.)
9. While the oxygen content of groundwater remains relatively stable, the oxygen levels in the Raupare can vary considerably during the day. The TCCL are experimenting with ways of increasing oxygen saturation in the groundwater to help the oxygen levels in the Raupare.
10. For streams struggling to maintain 40% oxygen overnight, this augmentation would improve dissolved oxygen directly and also as a consequence of improved flows. Therefore, the benefits would extend downstream during low flows when oxygen saturation is less than 40%.

[1] https://www.ecan.govt.nz/get-involved/news-and-events/zone-news/ashburton/managed-aquifer-recharge-pilot-achieves-two-out-of-three-goals/
[2] http://www.gdc.govt.nz/about-the-mar-project/

11. Also, augmentation is regarded as a real solution for enhancing lowland stream flows and improving instream habitat in other regions. Environment Canterbury is seeking solutions to very similar issues with lowland streams that are fed by groundwater. For example, significant habitat has been lost from springfed streams in the Selwyn/Waihora Zone as a consequence of declining groundwater discharge to the streams. Targeted Stream Augmentation (TSA) is being trialled in one of those waterways; which involves pumping groundwater, increasing the dissolved oxygen content and discharging the oxygen-enriched water into the stream (**Error! Reference source not found.**). The augmentation trial has shown considerable benefits to instream flows from augmentation (**Error! Reference source not found.**).

12. While the Canterbury work is still in a trial phase, the TCCL project has provided the TANK Group with evidence of a working scheme that has improved flows and ecological habitat in the Heretaunga Plains. The groundwater modelling has also demonstrated how augmentation can provide environmental benefits in other lowland streams including the Irongate, Karamu and Mangateretere streams.

*Figure 1* Discharge point of targeted stream augmentation trial in Boggy Creek, Canterbury. Water is supplied through multiple holes in the PVC pie and discharged on to cobbles to increase the dissolved oxygen content.

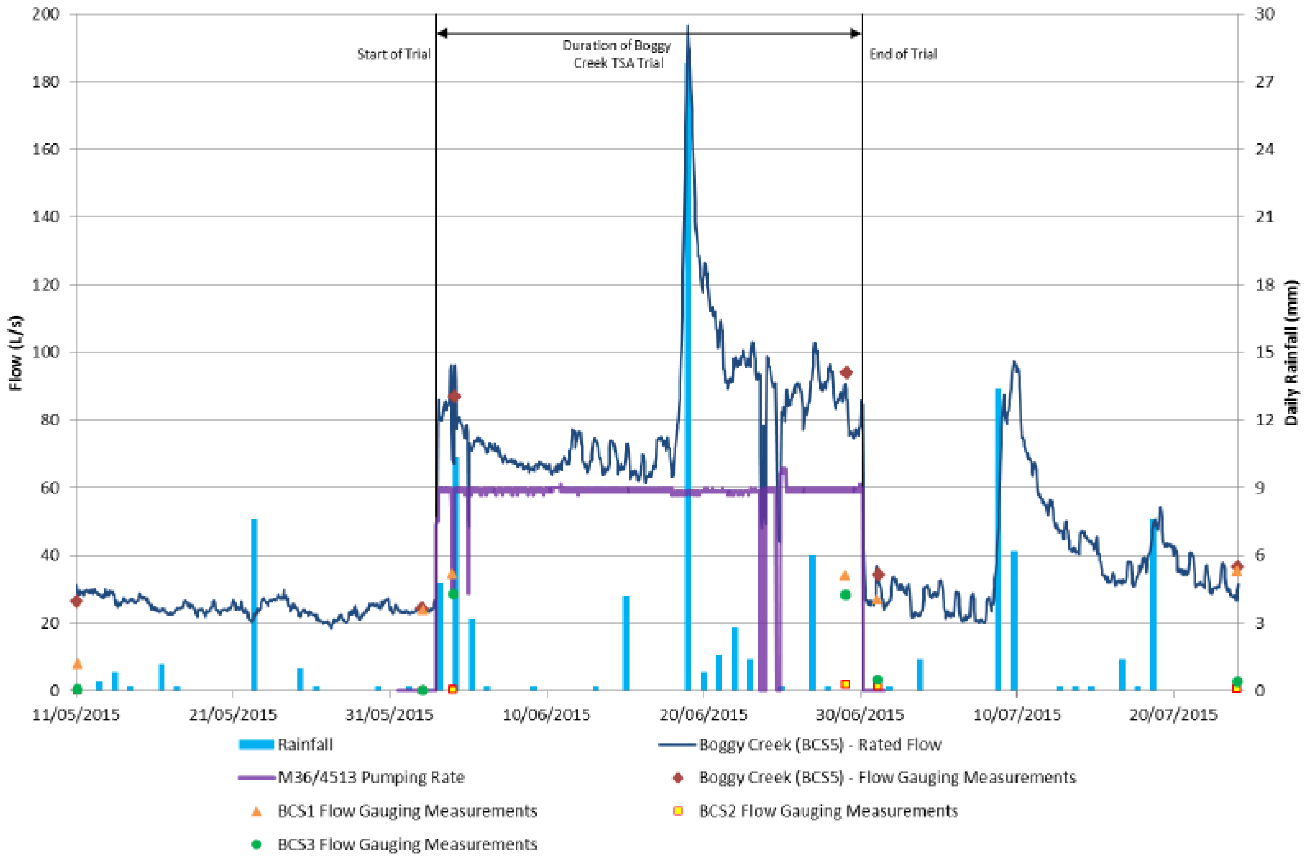


*Figure 2* Stream flow, rainfall and augmentation flow for the Boggy Creek augmentation trial: before, during and after the experiment. The data show that 60 L/s augmentation made a significant difference to flow in the tributary.

## Augmentation is a short-term solution

13. Some TANK Group members consider that this response to groundwater depletion should only be seen as a short term solution while a better management approach is developed to meet freshwater outcomes. They consider that this flow enhancement solution should over time be replaced with better water use, riparian land management and newer technologies that would meet environmental outcomes on a more sustainable basis.

14. This approach could be reflected in policy; that is to revisit the effectiveness of this flow enhancement solution, whether other measures are being developed to deal with the stream depletion issue and their effectiveness. Support for flow enhancement would not be to the detriment of other solutions, nor given priority over them.

## Reduction of pumping would be more effective than augmentation

15. The RMA does not require that all adverse effects be avoided. For some activities, adverse effects cannot be avoided but can be remedied or mitigated. It will be a TANK judgement as to where the balance between avoid (e.g. reduce allocations) remedy (e.g. flow enhancement solutions) or mitigate (e.g riparian planting etc.) will be made.

16. The discussion document for TANK meeting 37 identified that while reductions of groundwater abstraction may provide some benefit to lowland stream flows, this approach would not be an effective solution on its own. **Error! Reference source not found.** (column e) shows augmentation that would be required in addition to 15% reduction of pumping throughout the entire Heretaunga Plains. Apart from the Raupare Stream, substantial augmentation would be necessary in all streams to achieve the minimum flow.

17. This demonstrates that regulation to decrease actual groundwater abstraction by 15% would be entirely inadequate by itself to achieve minimum flows in lowland streams and the Ngaruroro River during prolonged dry periods, such as during the dry 2012-2013 summer.

*Table 1* Change in stream flows expected as a consequence of a 15% decrease in pumping throughout the Heretaunga Plains. Modelling was based on stream flows observed during the dry period 2012-2013.

| STREAM | a) Flow Increase (%) | b) Observed Flow (L/s) | c) Flow Increase (L/s) | d) Minimum Flow (L/s) | e) Flow to Augment (L/s) |
|---|---|---|---|---|---|
| Raupare | 10% | 280 | 28 | 300 | 0 |
| Irongate | 23% | 19 | 4 | 100 | 77 |
| Mangateretere | 46% | 27 | 12 | 100 | 61 |
| Karamu (gains in main stem) | 7.5% | 720 | 54 | 1,100 | 326 |
| Karewarewa | 52% | 4 | 2 | 75 | 69 |
| Ngaruroro | 12% | 1,300 | 156 | 2,400 | 944 |

## Augmentation does not treat the cause of the problem

18. Some TANK members considered this approach to be more of a band-aid solution that does not address the actual cause of the problem. However, while a substantial reduction in total allocations would avoid the problem, this does not address the high value groundwater has for the TANK communities and the substantial adverse impact this remedy would have. However, the effect can be remedied through additional pumping to enhance flows. The RMA allows for actions to be taken that can remedy or mitigate an effect of an activity, if the adverse effects cannot otherwise be avoided.

19. The Twyford Co-operative Company Limited (TCCL) have shown us that augmentation does remedy the effects of groundwater pumping on lowland stream flows. This has provided instream ecological benefits and modelling has demonstrated that it is technically feasible to augment most other Heretaunga lowland streams from groundwater. Furthermore, the TCCL group has developed a sense of responsibility for managing flows in the Raupare Stream. In this way, the TCCL group have been incentivised to implement careful management of the groundwater resource, including reduced abstraction and more efficient water use which is “treating the cause”. In many ways, incentivising this behaviour change is more effective and less costly than regulation, compliance monitoring and enforcement.

20. Development of an augmentation scheme across the Heretaunga Plains might be implemented via similar co-operative groups that are responsible for managing flows in discrete lowland streams. Each co-operative group may then be incentivised to implement careful management of their groundwater resources with the shared objective of ensuring adequate flows in the lowland stream they are responsible for.

21. The involvement of the water users in the design and management also enables more cost effective solutions as they are likely to be more incentivised to contribute to the infrastructure and its operation and in some cases, existing infrastructure may be available for use.

## Further allocation of groundwater for stream augmentation

22. There is concern that additional water is intended to be pumped for the stream enhancement schemes.
23. Augmentation requirements for lowland streams represent a maximum of 2% to 4% of current groundwater utilisation. The modelling was done on the assumption that additional water could be pumped from groundwater sources. If augmentation is achieved from an additional groundwater allocation, it is important to consider that:
    - The requirement for augmentation is driven by the environmental effects caused by widespread pumping of groundwater for human needs. Any allocation for augmentation would be for the purpose of remedying those adverse environmental effects.
    - Augmentation requirements are relatively brief and are not usually sustained for long periods of time
24. Moreover, it is entirely possible that augmentation requirements from groundwater may be met from within the groundwater allocation – not in addition to the allocation. The TCCL scheme has demonstrated that additional allocation is not a requirement for successful flow enhancement schemes.
25. For the Twyford scheme, the irrigators managed collectively with less water to meet the flow needs when the Raupare flow reduced. There was water available either within consented totals as there was at times a gap between what was allocated and what was being used or because of water use efficiency.
26. The WAG group consider that stream enhancement flow could be included within the proposed allocation limit and not provided for as an additional water take.
27. Thinking further about how this could be implemented as a more general approach in the Plan Change –water is allocated as per the current proposals. A proportion of this take will be subject to use for stream flow enhancement if and when this becomes necessary during summer. The amount that needs to be kept aside for the enhancement (when flow enhancement is necessary) will be informed by Pawel's calculator. It remains an incentive for efficient use as the more water used means higher enhancement flow requirements.
28. The portion of the municipal supply used for industrial and commercial use that causes stream depletion effect will also be subject to this requirements.

## Community involvement and management

29. The WAG is seeking further development of a management structure that builds on the learning provided by the Twyford group and that encourages and supports collective management to meet environmental outcomes. As part of this users with higher stream depletion effects for certain streams can be identified and management systems can be established that enable their active involvement.
30. Further work will be done to develop this management framework for the TANK group.

## Management Proposals

31. The WAG group supports the development of policies that are aimed at managing the Heretaunga Plains aquifers. In particular they support development of policies that;

- establish limits for managing water takes
- remedy the stream depletion effects of groundwater takes by flow enhancement,
- take into account the high level of uncertainty around the allocation limit and the actual level of water use.
- Ensure the development of other measures, technology and management responses to meeting the needs of the lowland streams affected by groundwater takes.
- Enable a staged management approach that allows better information to be collected. This includes further reduction of the allocation limit should over-allocation and adverse effects still be an issue.

### Proposal 1;

Policies are according drafted that address the following matters;

(i) Groundwater allocation limit
  - Ensures no more water abstraction from the Heretaunga Plains (at least until the over-allocation issue is more fully understood and addressed)

(ii) Reduction in allocations (based on 2013 land use)
  - Irrigation subject to higher efficiency standards
  - Actual and reasonable use
  - Seasonal allocations limited by a 9 in 10 reliability standard [3]

(iii) Remedy or mitigate stream flow depletion
  - Stream flow enhancement – similar to the Twyford scheme
  - Water required for stream flow enhancement will be part of the allocation for permit holders and contained within the existing allocation limit
  - Riparian land management/wetland development
  - Other technology and methods as they arise or are developed.

(iv) Water user and community involvement in the mitigation measures including in the design and management of the stream flow schemes

(v) An outcomes approach to enhancing river flows that takes into account;
  - Stream depletion effect of the groundwater take,
  - The existing trigger flow
  - dissolved oxygen
  - temperature

(vi) Equitable approach to imposing the costs based on the stream depletion effect and basing this on Pawel's calculator. An exemption is to be provided for the effects of water takes for essential human health and community well-being.

(vii) Adopt a staged approach – and develop a specific review policy

[3] https://www.irrigationnz.co.nz/Attachment?Action=Download&Attachment_id=48
*"The irrigation system will ideally be designed to meet the peak water demand of each crop irrigated within the design area. In practice, the peak demand will normally be based on a likely frequency of demand (i.e. 1-in-10-year mean 7-day demand)".* Where there are no limitations on water use, a system might be able to be designed to deliver maximum amount of water demanded at all times, however, this level of reliability is being reflected in council plans.

# Part 2; High Flow Allocation

1. Due to the Ngaruroro run-of-river[4] allocation for surface water abstraction being exhausted, there is demand for high flow allocation that provides for harvest of water for storage. A high flow allocation has a cease-take trigger flow that ensures low flows in the river are not affected, but this also results in the reliability of supply being much less than a run-of-river allocation. Thus, the purpose of a high flow allocation is to provide water for a storage reservoir, so that water may be released or used later when there is demand or need.

2. Based on a report by MWH (Harkness, 2010[5]) and limited historical demand for high flow allocation, HBRC has adopted a very conservative 2 $m^3$/s high flow allocation for the Ngaruroro River, with a 20 $m^3$/s cease-take trigger flow. Approximately 1 $m^3$/s of the high flow allocation is currently consented. The TANK Group is considering policy that may enable a scheme to abstract from the Ngaruroro River during high flows and store water for augmentation of the river during low flows. If this proposal is implemented, there would be little remaining in the current high flow allocation of 2 $m^3$/s.

3. Pickens (2010[6]) reported that potential new irrigation of the Heretaunga Plains and Ngaruroro river flats may be up to 3,500 ha and this demand could be met with 17.5 million cubic metres ($Mm^3$) of storage. However, even with adequate storage the current (2$m^3$/sec) high flow allocation would be insufficient to meet this demand.

4. This assessment of the irrigable area was a high level screening exercise to provide understanding about the possible scale of future demand and potential storage options. Other reasons for advancing storage proposals include for creation of aquatic habitat, flow enhancement, increasing a reliability of water supply or meeting other water demand such as for urban development, however, none of these are included in this analysis

5. In terms of in-stream values (e.g. aquatic ecology), it is important to ensure that the high flow allocation will not compromise flushing flows that remove periphyton and maintain macroinvertebrate structure. Harkness (2010) modelled several scenarios to determine a high flow allocation for the Ngaruroro River that could be made available without adversely impacting instream ecological requirements. Relevant management objectives prescribed in the Hawke's Bay Regional Resource Management Plan (RRMP) are described by Harkness (2010) and are not repeated here.

6. A key metric used for assessment by Harkness (2010) is the $FRE_3$ statistic, which is the number of times per year when river flow exceeds three times the median flow. $FRE_3$ has been used throughout New Zealand for determining high flow allocations since Clausen & Biggs (1997[7]) identified its close correlation with instream biological values including periphyton flushing.

7. Figure 3 shows simulated flows for December 2019 to June 2020, along with median and 3 times median flows for the Ngaruroro River at Fernhill. During this period, there were three $FRE_3$ events.

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[4] Operating on the flow of the river without modification by upstream storage.

[5] Harkness M. (2010) *Ngaruroro River high flow allocation: June to November period.* Prepared by MWH for HBRC, 25 May 2010. Available at https://www.hbrc.govt.nz/assets/Document-Library/Projects/TANK/TANK-Key-Reports/Ngaruroro-River-High-Flow-Allocation-2010.pdf

[6] Pickens A. (2010) *Ngaruroro water augmentation scheme prefeasibility study – Stage 1 report*. Prepared by Tonkin & Taylor Ltd for HBRC, June 2010.

[7] Clausen B. and Biggs J. B. (1997) *Relationships between benthic biota and hydrological indices in New Zealand streams.* Freshwater Biology, v38, pg 327 – 342.

The cease-take trigger for high flow abstractions (20 m$^3$/s) is also shown and (to protect low flows and reliability of run-of-river takes) high flow abstraction does not occur when river flow is less than 20 m$^3$/s. For comparison, the current cease-take trigger for run-of-river takes (2.4 m$^3$/s) is also shown.

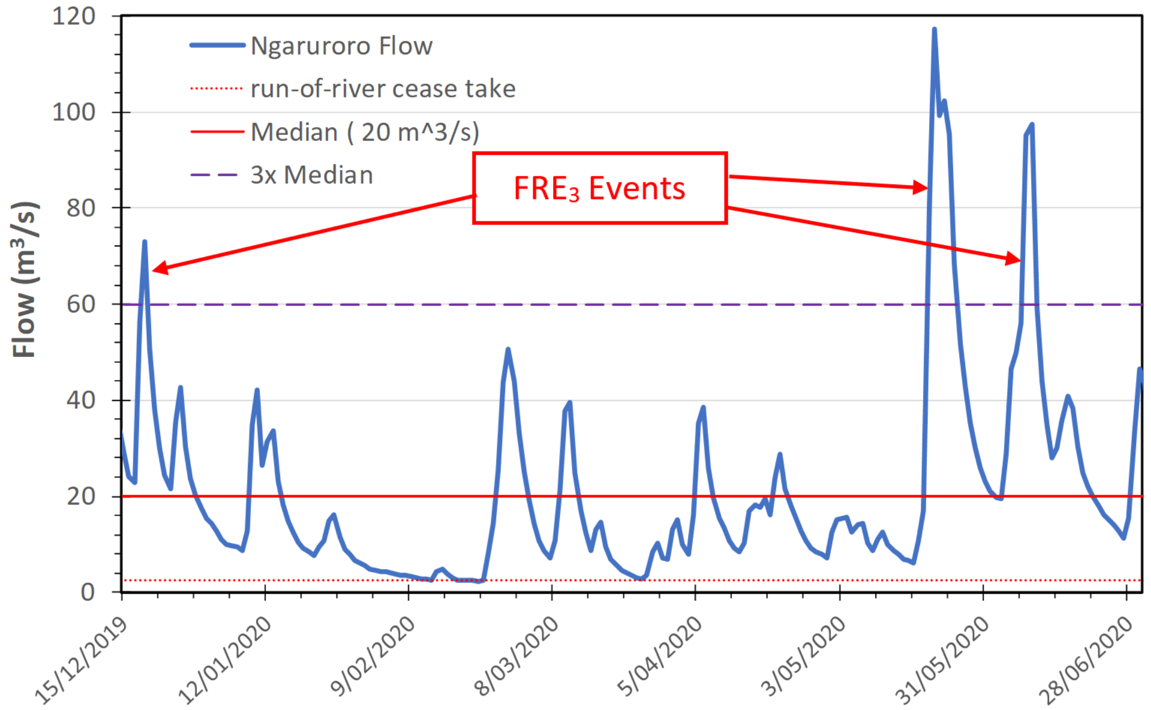



*Figure 3.* Daily mean flows for the Ngaruroro River at Fernhill simulated using the HBRC SOURCE model for December 2019 to June 2020. The cease-take trigger flow for current high flow allocation (20 m$^3$/s) is also shown, along with 3x median flow (60 m$^3$/s) which is used to calculate FRE$_3$.

8. Harkness (2010) considered that, in terms of limiting impact to the aquatic environment, a high flow allocation is acceptable if FRE$_3$ under the altered flow regime would be changed by less than 10% when compared to FRE$_3$ for naturalised flows. The same criterion has been used in analyses here.

9. The modelling by Harkness (2010) assumed flow sharing regimes (where a specified proportion of the flow above the trigger is taken for storage) for all scenarios and that high flow abstraction would be limited to the months June to November. While Harkness (2010) demonstrated that high flow allocations of 2 m$^3$/s and 5 m$^3$/s would not cause significant effects on Ngaruroro River ecology or water quality, HBRC at the time chose to adopt the former allocation option (2 m$^3$/s) with a trigger flow equal to the median (20 m$^3$/s).

10. This evaluation explores high flow allocations without a flow sharing regime and also assumes that abstraction occurs whenever flow in the Ngaruroro River at Fernhill is greater than the 20 m$^3$/s trigger flow (i.e. not limited only to the months June to November).

11. The aims of the analyses that follow are to:

    - identify high flow allocation options with less than 10% change in FRE$_3$ when compared to FRE$_3$ for naturalised flows.; and

- identify a high flow allocation that may be sufficient to meet the irrigation demand for 3,500 ha with 17.5 $Mm^3$ storage as reported by Pickens (2010),

12. Along with the 2 $m^3/s$ current high flow allocation, additional allocations of 2 $m^3/s$, 4 $m^3/s$ and 6 $m^3/s$ were assessed. Thus, $FRE_3$ statistics were calculated for total high flow allocation scenarios of **4 $m^3/s$**, **6 $m^3/s$** and **8 $m^3/s$**.

## $FRE_3$ Analysis

13. Naturalised daily mean flows for the Ngaruroro River at Fernhill were produced using the TANK SOURCE model, for the years simulated between 2015 and 2032. $FRE_3$ statistics were calculated for the naturalised flows, along with $FRE_3$ for the three high flow allocation scenarios (4 $m^3/s$, 6 $m^3/s$ and 8 $m^3/s$).
14. Figure 4 is a snapshot of the impact that high flow allocation is predicted to have on Ngaruroro River flows for the four-week period shown. In this case, the largest allocation scenario (8 $m^3/s$) is plotted for illustration purposes. While flows greater than 20 $m^3/s$ are reduced by the high flow allocation, the flushing flow event that peaked 9 June is not reduced below 3x median flow, so the $FRE_3$ flow threshold is not compromised in this case. The effect of the current 2 $m^3/s$ high flow allocation is also shown in Figure 4.
15. Figure 4 is helpful for demonstrating that: 1) low flows are not affected by high flow allocation; and 2) there are less than minor effects on flushing flow effectiveness during this four-week period. However, to assess the long term effect of high flow allocation on flushing flows, the data in Figure 5 have been assessed against the criterion described in paragraph 8 (i.e. less than 10% change in $FRE_3$ as a consequence of high flow allocation).

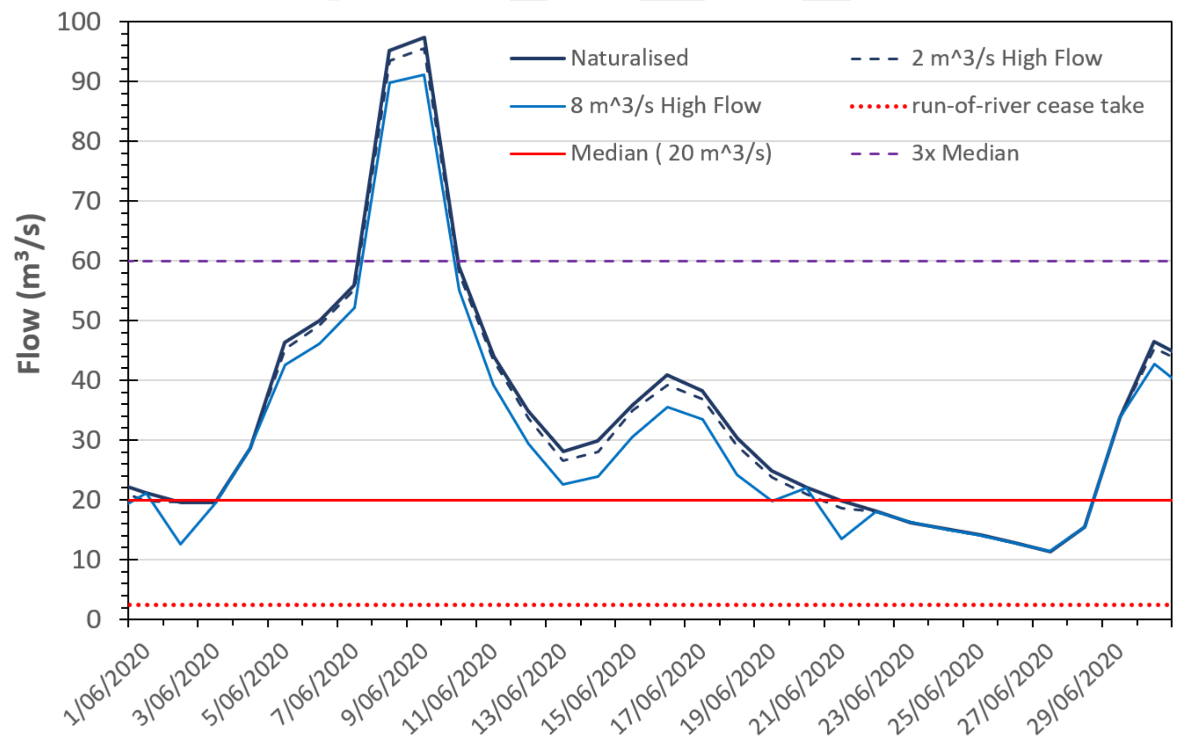



*Figure 4*. Daily mean flows for the Ngaruroro River at Fernhill during one month of the simulation period. Naturalised flows are shown, along with flows simulated for the current high flow allocation (2$m^3/s$) and the 8 $m^3/s$ high flow allocation scenario. The trigger flow 20 $m^3/s$ is also shown, along with 3x median flow (60 $m^3/s$) which is used to calculate $FRE_3$.

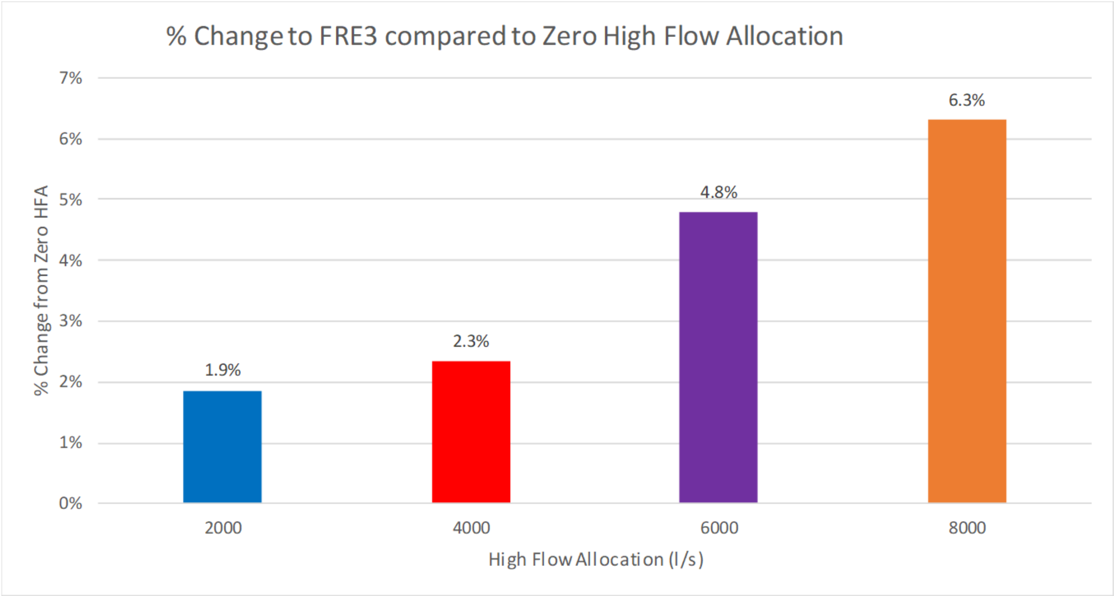



*Figure 5*. Percentage change of average annual $FRE_3$ under high flow allocation scenarios, compared with $FRE_3$ for naturalised flows.

16. Figure 5 shows that there is less than 10% change in $FRE_3$ for all high flow allocation scenarios up to 8 $m^3/s$. Based on the criterion established by Harkness (2010), a high flow allocation up to 8 $m^3/s$ is supported for maintaining ecological instream values of the Ngaruroro River.

## Capacity of High Flow Allocation to Meet Demand

17. The second aim of this analysis was to identify a high flow allocation that may be sufficient to meet the irrigation demand for 3,500 ha with 17.5 $Mm^3$ storage as reported by Pickens (2010). It is very difficult to achieve this via storage and demand modelling, because this is a hypothetical exercise and the location(s) and geometry of future storage are unknown. Furthermore, the location of land that may be irrigated from the storage is unknown and variables including soil properties and climate have a major influence on demand modelling and, consequently, predictions of water released from storage during the irrigation season. Note also that other reasons for developing water storage are not considered in this analysis.

18. Because of the magnitude of required assumptions, a different approach was exercised. For each high flow allocation scenario, the volume of water available during the winter and spring period June to September was calculated for each year of the SOURCE simulation from 2015 to 2032. The assumption is that if 17.5 $Mm^3$ of water was available for harvest during each winter, there would be sufficient to fill the storage required to meet demand for irrigating 3,500 ha.

19. Based on advice from the TANK Water Augmentation Working Group, flows greater than 60 $m^3/s$ are unsuitable for harvesting from the Ngaruroro River due to technical challenges including high sediment load in the river. Therefore, abstraction was assumed to be available only when flow in the Ngaruroro River was less than 60 $m^3/s$ and greater than the 20 $m^3/s$ cease-take trigger.

20. **Assumptions** made in the analysis are:

    - A full 17.5 $Mm^3$ reservoir capacity at the start of an irrigation season would be sufficient to meet demand for 3,500 ha of land;

- The entire allocation (i.e. up to 8 $m^3/s$) is capable of being transported to the storage reservoir(s). In practise, this may present technical challenges but may be achieved if a suitable tributary was available for storage, or if several smaller storage facilities were developed with a combined capacity of 17.5 $Mm^3$;
- Evaporation losses from storage reservoir(s) have not been accounted for, because storage geometry is unknown. Based on potential storage sites identified by Pickens (2010), net evaporation losses may be in the order of 500,000 $m^3$ during irrigation seasons;
- Leakage losses from the storage and distribution infrastructure have not been included. In practise these losses are non-trivial and this uncertainty should be considered when interpreting results.

21. This analysis ignores the existing 2 $m^3/s$ high flow allocation because, if the Ngaruroro River augmentation proposal described in paragraph 2 is adopted, there would be little remaining in the current high flow allocation. Therefore, winter/spring volumes were calculated for <u>additional</u> high flow allocation scenarios of 2 $m^3/s$, 4 $m^3/s$ and 6 $m^3/s$ that may be used for future demand. Results are plotted in Figure 6.

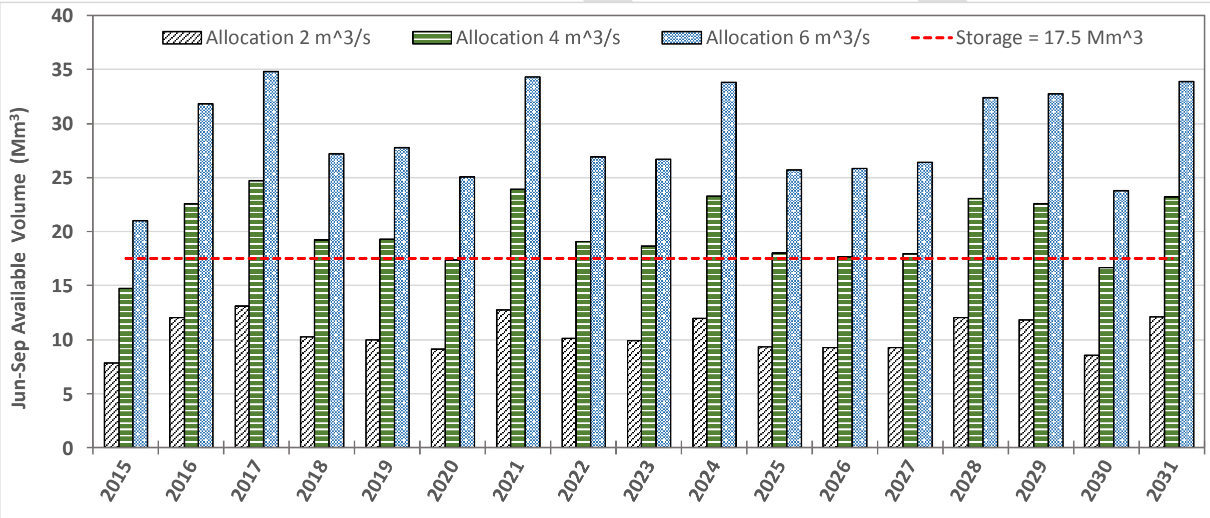



*Figure 6* Annual volumes of water available for harvesting between June and September for SOURCE model simulations to 2032, for additional high flow allocations 2 $m^3/s$, 4 $m^3/s$ and 6 $m^3/s$. The current 2 $m^3/s$ high flow allocation is excluded. The dotted red line indicates the storage capacity reported by Pickens (2010) as sufficient to meet demand for 3,500 ha of irrigation

22. Figure 6 shows that an additional high flow allocation of 2 $m^3/s$ would not be sufficient to satisfy storage capacity. An additional allocation of 4 $m^3/s$ may be sufficient to fill the reservoir capacity during most, but not all, years of the simulation. An additional allocation of 6 $m^3/s$ is predicted to be satisfactory for filling 17.5 $Mm^3$ of storage during all years of the simulation.

23. In summary, a total high flow allocation of 6 $m^3/s$ (including 4 $m^3/s$ for future demand) may be sufficient to provide new irrigation to 3,500 ha in most years. However, there is greater certainty (given the assumptions listed above) of a total high flow allocation of 8 $m^3/s$ (including 6 $m^3/s$ for future demand) providing for future demand to irrigate 3,500 ha. Moreover, a total high flow allocation of 8 $m^3/s$ is the most likely scenario to provide additional volume to store water for environmental purposes, such as augmentation during low flow periods.

## Other important considerations

24. It is important to note that one of the primary reasons for providing a high flow allocation and (cease take) trigger flow in the TANK plan change is to make provision for water harvesting in the future if storage is considered to be a sustainable means to meet additional demand or improving reliability of supply. If the TANK plan fails to make this provision, it will be far more onerous to implement a storage scheme in future. Assessing an application in the absence of any supporting policy or rules is a tougher, more costly and likely much more contentious proposition, then where there are plan provisions that provide scope and guidance to consider such an application. Plan provisions can provide direction in relation to both positive and negative aspects of water harvesting. It also enables the plan to address the need to set limits to protect water body values as required by the NPSFM.

25. Along with demand for irrigation, there may be environmental benefits from harvesting high flows to storage. For example, offline (i.e. non-mainstem) storage may be considered for augmenting the Ngaruroro River in addition to the currently considered augmentation proposal for offsetting the impact of groundwater abstraction. Additional augmentation may be valuable for environmental benefits or to offset the effects of run-of-river abstractions during low flow periods. In addition, harvesting and storage may be required in the future for lowland stream augmentation: particularly for streams with technical challenges to augmentation from groundwater such as the Paritua and Karewarewa.

26. The purpose of this analysis was to identify high flow allocation options that may be sufficient to meet future demand for storage, without the potential for adverse effects from the abstraction itself. Depending on the intended purpose of any future storage scheme, there is also likely to be a need to consider environmental effects from the use of stored water. For example, there may be potential for water quality effects caused by land use change. These other potential environmental effects would require full assessment as part of the resource consenting process.

27. While it is not necessary to speculate on the use of water harvested to storage, or the potential environmental effects of that use, because those issues would be fully assessed when application is made for resource consent, there will be a need to ensure land use change only occurs within the environmental limits established for the relevant water bodies.

28. Similarly, it is important to note that the **provision of a high flow allocation does not allow for the development of any dam or storage** facility. Construction of a storage reservoir is a separate activity to the abstraction of harvesting flow and requires a resource consent in its own right.

29. This analysis has shown that high flow allocations of 6 $m^3/s$ or 8 $m^3/s$, accompanied with storage capacity of 17.5 $Mm^3$, may be sufficient to meet demand for 3,500 ha of new irrigation. There are assumptions and unknown variables in this analysis, particularly regarding locations of storage and irrigation demand, and an allocation of 8 $m^3/s$ would provide greatest certainty for meeting future demand.

30. Because there is less than 10% change in $FRE_3$ for all high flow allocation scenarios, a high flow allocation up to 8 $m^3/s$ could be supported for maintaining ecological instream values of the Ngaruroro River.

## Options for managing high flow allocation

31. The above analysis shows that up to 8 $m^3/s$ can be taken for storage in the Ngaruroro catchment and still meet an environmental threshold for minimising impacts on the range of river flows needed for efficient and effective functioning of the Ngaruroro River related to high flow flushing

effects. This level of allocation results in a change to the $Fre_3$ of much less than the 10% threshold (a 6.9% change).

32. There are still some uncertainties that are not addressed by this analysis and some precaution might still be preferred.

33. The WAG group was not unanimous on this issue with some favouring the upper modelled limit ($8m^3/s$) based on the agreed threshold. Others felt a more staged approach that reflected a more likely rate of uptake of $6m^3/sec$ that could be reviewed later. They considered that the rate of uptake of this amount was uncertain and would probably depend on other decisions about minimum flow triggers and allocation limits.

34. In debating the relative merits of the options, the WAG also considered the possibility that water augmentation proposals be subject to a requirement to release stored water during low flow periods. There wasn't unanimous agreement that this be made a requirement. The consequences of such a requirements could not easily be predicted as the options were likely to be very site specific and depend on things like the size, location and purpose for the water storage. (This suggestion is reflected in the proposed policy however as a consideration).

35. Wider TANK input into the final allocation limit is now being sought.

### Instream Dams and Out of Stream Storage

36. Note that the analysis above addresses abstraction for out-of-stream storage and does not directly or specifically address limits for in-stream dams. However, both means of water storage will need to be guided by the findings of this analysis. The cumulative effect on river hydrology and flow regimes caused through water storage by any means should be covered by water storage policy.

### Damming Prohibitions

37. The WAG group has also considered the high significance of the instream values of these two rivers, including for native fisheries, birds, recreation and in respect of Māori tikanga. They generally agreed to the proposition that the plan includes a prohibition on instream dams on the mainstem of both the Ngaruroro and the Tutaekuri River.

### Future Management of Augmentation Proposals

38. A further consideration, not covered by the WAG in any detail, is the role of Council in providing a leadership in the management of the regions water resources – including where the regional water resources might be increased through water storage.

39. The Council is responsible under the RMA for the management of water, including the management of activities that use, take dam or divert water and the allocation of water. It must ensure that adverse effects of activities on the regions water bodies are properly managed, and take into account the effects of climate change. It must also enable people and communities to meet the their social, economic and cultural well-being, in a way that addresses the needs of future generations. Council also has a range of responsibilities under the Local Government Act for meeting community outcomes including through the preparation of a Long Term Plan.

40. These Acts give the Council long term, community focussed and wide-ranging responsibilities in relation to water management that cannot be met by any other organisation or individual. For these reasons a further policy that commits the Council to an active role in the investigation of the water demand and supply needs and future opportunities is suggested. It further commits Council to active participation and support of the development of such schemes where there is community benefit or where community benefit can be provided.

41. Water allocation policy for high flow allocation will needs take into account both the beneficial effects of water storage as well as the adverse effects. It should introduce limits as to the extent of water storage and measures to mitigate the adverse effects arising from storage structures and their impact on river hydrology and water quality. Furthermore, the creation of water storage and new water use opportunities also has implications for land use change as noted in para 25. Water storage policy will need to ensure these effects are considered at the time a water storage proposal is developed.

42. Note that a property scale nutrient discharge allowance provides a means to manage nutrient loss effects of land use change on water quality. However, the plan change does not currently include a property nutrient allowance, although it is likely that one will need to be developed. A water augmentation proposal will therefore need to address this risk specifically as part of that proposal.

43. The following policy framework is suggested for the TANK group agreement. It has been reviewed by the WAG group at their meeting on the 12 March and (apart from the council role) has wide support from that group with the exception of the actual allocation limit – and whether it should be set at $6m^3$/sec or $8m^3$/sec.

## Proposals - High Flow Allocation

| |
|---|
| **Policy to manage adverse effects** |
| *2a Direction to establish allocation limits for high flow abstraction including a trigger flow for restricting when abstraction occurs as provided in Schedule XX.*<br>*Direction to ensure adverse effects are considered when assessing applications for high flow abstraction including adverse effects on;*<br>*i. the uses and values for any water body identified in Table XX ;*<br>*ii. water levels and flows in affected water bodies, including lakes and wetlands*<br>*iii. water quality, including effects on temperature and management of periphyton in connected water bodies;*<br>*iv. potential changes to water quality arising from subsequent changes to land use activities;*<br>*v. river ecology and aquatic ecosystems, including passage of fish and eels, and riparian habitat;*<br>*vi. groundwater recharge;*<br>*vii. downstream land, property and infrastructure at risk from structural failure;*<br>*viii. other water users;*<br>*ix. downstream river bed stability, including through sediment transfer and management of vegetation in river beds* |
| **Policy to acknowledge benefits;** |
| *2b There are potential benefits of providing for water storage and council will make decisions about new applications on the basis of the extent to which they contribute to or benefit;*<br>*i. water availability or the level to which the security of supply for water users is enhanced.*<br>*ii. aquatic organisms and other instream values listed in Table XX, including as a result of low flow enhancement .*<br>*iii. provided to water flow management and aquatic habitat by the design and management of the water storage structure*<br>*iv. for other water users including recreational and cultural uses and any public health benefits.*<br>*v. community resilience to climate change and beneficial effects on landscapes or tourism, etc* |

| **Policy for Council** | |
|---|---|
| 2c | *The HBRC will carry out further investigation in to the present and potential future regional demand, and current and potential future water supply including for abstractive water uses and environmental enhancement and will explore options in consultation with local authorities, tangag whenua, industry groups and resource users and the wider community* |
| **Policy to manage main stem water storage dams** | |
| 2d | *The HBRC will protect the instream water values and uses identified in Table XX for the Ngaruroro and Tutaekuri Rivers by prohibiting the construction of dams on the mainstem of those rivers.* |

**44. Schedule XX**

| River Name | Flow Management Site | High Flow Trigger | High Flow Allocation |
|---|---|---|---|
| Ngaruroro R | Fernhill | $20m^3$/second<br>(and provide for ongoing operation of current $1m^3$/s high flow take at the current consent takes) | 6 or 8 $m^3$/second* (includes the current $2m^3$/sec allocation) |
| Ngaruroro Tributaries | | Median flow | Proportionally in comparison to contribution to the main stem |
| Tutaekuri | Puketapu | Median flow | No change of more than 10% to $FRE_3$ |

45. Note that the WAG group did not have a unanimous position on this limit. Both meet the requirement not to change the FRE3 by more than 10% (and the two options result in changes of 4.8% and 6.3% respectively)

| High Flow Allocation Limit Options | |
|---|---|
| 2e Allocation limit of $6m^3$/sec | 2f Allocation limit of $8m^3$/sec |
| The smaller limit might be seen as better reflecting the likely rate of uptake for new storage options and be a more conservative approach. It could be accompanied by explanatory text to explain its conservative nature with further plan changes signalled as a means of increasing the limit. | The higher limit enables water storage options to be developed over a longer timeframe and provide more certainty for options that might need longer lead in and development times.<br>It reflects a sustainable environmental limit for high flow allocation. |

# Part 3 Flow Management Scenarios for the Ngaruroro and Tutaekuri

## Summary of environmental information considered for establishing trigger flows

1. The TANK Group will need to set flow management regimes for the Ngaruroro and the Tutaekuri Rivers. The group recognise water as a taonga and wish to ensure the river instream values and the river itself, the awa, is appropriately provided for.

2. The TANK Group also recognises the significant contribution that abstraction of water makes to the economic, social and cultural well-being of its community.

3. The decision about a flow management regime requires a value based judgement to be made about the level of protection for instream values in relation to the demand for abstraction water. The RMA and the NPSFM both require that flow management regimes are established at levels that as a minimum safeguard the life-supporting capacity of air, water, soil, and ecosystems.

4. However, this decision needs to be made in such a way that enables communities to provide for their economic well-being, including productive economic opportunities, in sustainably managing freshwater quantity, within limits. The NPSFM requires that consideration must be given to how communities can be enabled to provide for their economic well-being within limits that are to be set. In particular, the TANK Group must consider;

    - *any choices between the values that the formulation of freshwater objectives and associated limits would require;*
    - *any implications for resource users, people and communities arising from the freshwater objectives and associated limits including implications for actions, investments, ongoing management changes and any social, cultural or economic implications;*

5. This paper summarises the environmental information that has been used to understand the potential impact of different flow management regimes on the instream values of the river. It sits alongside the information on the economic, social and cultural impacts of the flow management regime that will be presented separately.

6. The outcome being sought by this section of the discussion paper is agreement on the range of management scenarios and timeframes that are to be subject to further analysis.

## Critical Values

7. In deciding when to limit water use, an important consideration is the effect of reduced water flow on critical values. Critical values are those values that are most sensitive to reduced flows. The decision on when to limit water use requires a judgement as to how much risk to the desired values is acceptable as a result of water abstraction. There are some tools that assist in making this decision including modelling approaches such as RHYHABSIM.

8. For both the Ngaruroro and the Tutaekuri, the TANK group have identified a range of instream values for the rivers that include;
    - tikanga Māori values including those for cultural practices
    - habitat for native fish and birds
    - recreational activities including trout fishing, swimming and boating
    - trout habitat

## RHYHABSIM

9. Of all of the identified values, the most flow demanding values for each river are torrent fish and trout for the Ngaruroro and Tutaekuri respectively. If these fish are provided for, then other less flow demanding species will consequently also be protected as their flow requirements are less and recreational values can also be accommodated within this ecological flow (although there are no guidelines that enable a quantitative assessment).

10. From a previous presentation (meeting 34) the Group has heard that the levels of habitat protection provided for the different flow regimes are based on calculated relationships between flow and habitat provided by models – and for the two rivers, the RHYHABSIM model has been used.

11. This model predicts how depth and water speed changes in response to less flow. For example, torrentfish like fast and shallow riffles, and RHYHABSIM is used to predict how fast-shallow water areas decrease with flow. RHYHABSIM can also predict changes to deep water, at moderate speeds, and this is where common smelt are often found.

12. The models provide information that helps to understand the extent to which different flow regimes might constrain fish populations. A range of factors other than flow also impact on the health of fishes, including flood disturbance and water quality.

13. The following tables summarise the RHYHABSIM data for the two rivers.

*Table 2; Flow and habitat protection levels for the Ngaruroro River*

| **Ngaruroro River<br>- downstream of Fernhill<br>nat. MALF 4700 L/s *(was 4500)*<br>exist. MALF 3800 L/s** | **Flow for 90% habitat** | **Flow for 80% habitat** | **Flow for 70% habitat** | **Habitat protection at 2400 L/s** |
|---|---|---|---|---|
| **Fast-water fish<br>i.e. torrentfish** | 4400 L/s | 4000 L/s | 3600 L/s | 44% |
| **Moderate-water fish<br>i.e. smelt** | 2700 L/s | 2200 L/s | 1800 L/s | 86% |
| **Slow-water fish<br>i.e. common bully** | 1200 L/s | <1000 L/s | <1000 L/s | 100% |
| **Invertebrates<br>(food producing)** | 4200 L/s | 3700 L/s | 3200 L/s | 47% |

*Table 3; Flow and habitat protection levels for the Tutaekuri River*

| **Tutaekuri River<br>- Puketapu<br>nat. MALF 3900 L/s *(was 3800)*<br>exist. MALF 3500 L/s** | **Flow for 90% habitat** | **Flow for 80% habitat** | **Flow for 70% habitat** | **Habitat protection at 2000 L/s (existing trigger flow)** |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| **Fast-water fish i.e. adult trout** | 3300 L/s (3200) | 2800 L/s (2600) | 2300 L/s (2100) | 65% (68%) |
| **Moderate-water fish i.e. koaro** | 1600 L/s | 1100 L/s | 700 L/s | 100% |
| **Slow-water fish i.e. common bully** | <500 L/s | <500 L/s | <500 L/s | 100% |
| **Invertebrates (food producing)** | 2700 L/s | 2100 L/s | 1600 L/s | 79% |

14. Recent Cawthron research highlighted the invertebrate production at flows greater than the mean annual low flow in providing food for trout populations. However, the reduction in invertebrate habitat at median flows was minor from existing water use (e.g. 2.13 to 2.12 $m^2$/m of habitat for Tutaekuri). In addition to water use representing a smaller proportion of higher river flows, there is currently less water demand for irrigation and other uses at times when moisture levels are sufficient to sustain median river flows. The decline in habitat during low-flow periods was greater, with invertebrate habitat reduced from 5.2 to 4.3 $m^2$/m (habitat at naturalized versus measured MALF, respectively). Given the low-flow period is more critical, both in terms of fish habitat and invertebrate habitat, basing trigger flows on low-flow statistics is appropriate for the Ngaruroro and Tutaekuri.

## Effect on Number of Days Below the Trigger Flow

15. Flows will vary naturally from year to year in response to climate variability, dropping to lower flows in dryer years. Water abstraction will change the frequency at which flows might drop to low flows.

16. In the past, flow thresholds for the Ngaruroro and Tutaekuri were referred to as "minimum flows". The problem with this term is it implies the river flow will always remain above this minimum value, which is not the case. For example, flow in the Ngaruroro River dropped to less than 2,400 L/s, which is the existing "minimum flow" at Fernhill, in 7 years during the 1998 to 2015 period. And flow would have dropped below this level in the absence of water use (estimated 2 years below 2,400 L/s using naturalised flow series 1998-2015).

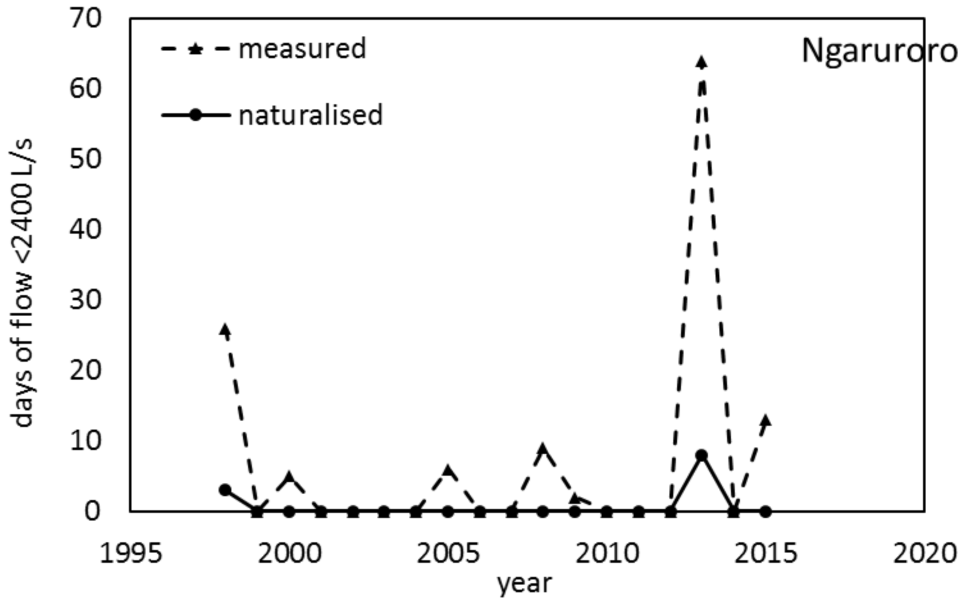
17. A more appropriate term than "minimum flow" is "trigger flow", given it triggers a management response that is intended to slow the rate of flow recession, but not necessarily halt it. For the higher trigger flows under consideration, the rivers would drop below the trigger more often, both under existing water use and in the absence of water use (**Error! Reference source not found.**). The difference is how often the flow drops below the trigger.

*Table 4 The number of water years in which the annual low flow dropped below each flow threshold (7-day mean minimum for the July to June water year). Both measured and naturalised flows are presented for the Ngaruroro at Fernhill (period 1998-2015) and the Tutaekuri at Puketapu (1981-2015). The naturalised flows are the flows estimated to have occurred if there was no water use (based on estimated actual use, rather than allocation). Water year July to June.*

| | **Ngaruroro** | /18 years | | **Tutaekuri** | /33 years |
|---|---|---|---|---|---|
| Flow L/s | measured | naturalised | | measured | naturalised |
| 1000 | 0 | 0 | | 0 | 0 |
| 2000 | 2 | 0 | | **0** | **0** |
| 2400 | **7** | **2** | | 2 | 2 |
| 3000 | 7 | 4 | | 10 | 4 |

| | | | | |
|---|---|---|---|---|
| 3500 | 10 | 7 | 17 | 14 |
| 4000 | 12 | 7 | 23 | 18 |
| 4500 | 13 | 9 | 28 | 25 |
| 5000 | 16 | 13 | 30 | 28 |

18. The duration of low flows also increases with water use, with the Ngaruroro estimated to have spent 7 more days per year below 2,400 L/s as a result of water use (average days/year for 1998-2015). During most years, flow did not fall below 2,400 L/s (11 out of 18 measured years; 16 out of 18 naturalised years). Dry years saw the biggest increase in the duration of low flows, with 64 days below 2,400 L/s in 2013, compared to 8 days below from the naturalised flows (using daily mean flow).



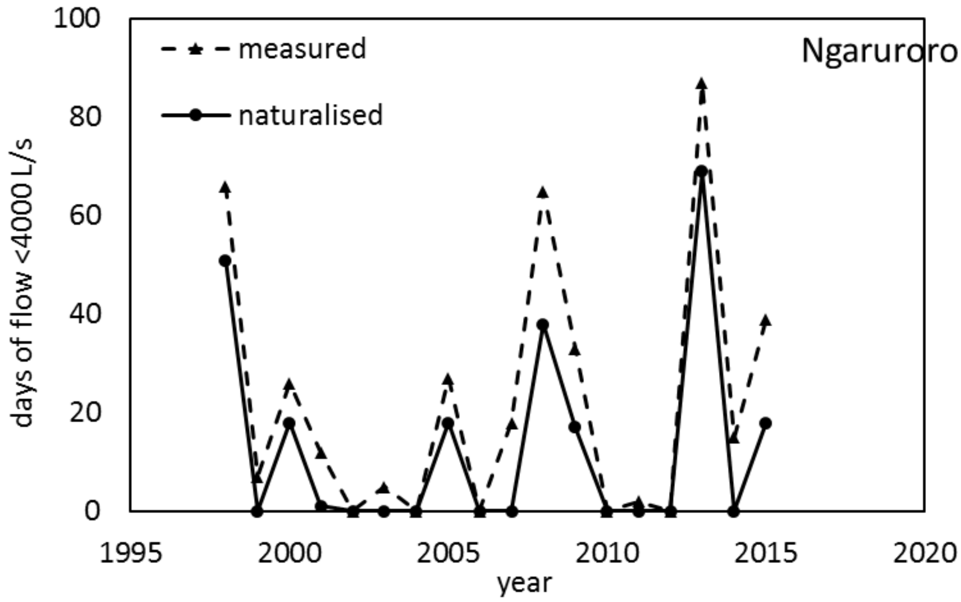




*Figure 7 Water use increases the number of days when flow is below a given threshold. The upper plot shows the number of days when the measured flow dropped below the existing trigger flow (2,400 L/s) for Ngaruroro at Fernhill. The lower plot uses a different threshold of 4,000 L/s (80% protection level for torrentfish).*

19. Trigger flows can be used in a variety of ways including to direct when abstractions must reduce or cease or when flow enhancement is required. They are also be used to calculate the amount of allocatable water so that both security of supply for abstraction is adequate and impact on fish habitat is addressed. The specified trigger flow indicates a flow at which there is a calculated habitat reduction for fish.

## Effect of Flow Triggers on Reliability of Supply

20. This section considers the effect of different flows that trigger day-to-day restrictions on surface takes and groundwater takes in zone 1. This does not apply to groundwater takes outside of zone 1, where the delayed effect on flows diminishes the value of day-to-day restrictions.

21. Different flow management regimes have varying impacts on the security of supply for water abstraction. That is, as a flow trigger is reached, water abstraction is required to stop (or in some circumstances, the amount of water abstraction is reduced) and if the flow trigger is high, restrictions are imposed sooner and water use is stopped or restricted more often.

22. The impact of different flow management regimes on reliability statistics was described at meeting 34. These included, for example, the number of times in all the years being modelled there would be restrictions lasting longer than 3 or 10 days, or the number of days in any year there would be restrictions.

23. The impact on farm income from the different levels of water reliability that are a consequence of the different flow management scenarios are provided in a separate report to this meeting by AgFirst Consultants. In this economic modelling, AgFirst took the flow and restriction data and applied it to actual farm production on a model farm that represented a specific crop and management regime.

24. This analysis shows the economic impacts of changing water reliability of supply at a farm scale. Further work is being undertaken to assess the flow on effects of this change to the wider Hawkes Bay economy and employment. This analysis in being carried out by Nimmo-Bell and Market Economics.

25. Other analysis will be done to assess impacts of the preferred management scenario(s) on the social and cultural well-being of the affected communities.

## Land Use Change

26. As water reliability decreases, and farm income is affected for the different crops grown, land managers could reasonably be expected to begin to change water use behaviour and what is grown and irrigated.

27. Depending on the severity of changes proposed by new policy and the management regime adopted for the allocatable water, the following responses are possible by land managers;

- More efficient water use and adoption of new technology, more targeted water use
- Irrigators and land managers will look for opportunities to access allocated but unused water (through site to site transfers or by permit sharing)
- Different land use mixes would be adopted to manage risk to higher value crops (low value crops could be sacrificed in dry years)

- The higher value crops at most risk from reductions in water reliability will most likely be replaced by lower value crops and the amount of irrigation would reduce (either the irrigated area would reduce or lower water use crops would be grown on the same areas).[8].
- Opportunities for improving security of supply would be advanced

28. The possible development of a threshold to indicate when a crop/land use system will no longer be economic is being considered to assist with assessing the regional impacts of land use changes. For any scenario where outcomes don't meet the threshold, a land use change will be assumed. Further development of a suitable threshold (with the economic modellers, irrigators and primary industry groups through the EAWG ) is required.

29. In reality, a decision to change land use based on security of water supply is difficult to predict as decisions to change can be gradual, especially if the following summers are not particularly dry, or if the change to security of supply is subtle and adaptation reduces severity of impacts. Land use change will also be dependent on the land manager's own situation, their levels of indebtedness and the individual or farm ability to manage this risk.

30. In any case, if reliability of supply is significantly decreased, the area irrigated is likely to decrease at low security of supply, or the area of low value crop that is irrigated might increase. Both scenarios will have a flow on impact to the regional economy. Anecdotally, this is already occurring in Tukituki for surface water users.

31. The impact of reduced irrigation will be covered by the Nimmo-Bell and Market Economic assessments.

## What happens to flows if there is a 10% emergency water take

32. One of the flow regime management options is to allow water abstraction to continue once the trigger flow is reached – but only for emergency end uses. This could include water needed to sustain tree crops to avoid long term economic impacts if tree crops were to be lost to drought. It could also include water needed to maintain water supply for stock drinking water, where use was in excess of permitted quantities. (Note that a decision about the permitted quantity for water take is still to be made. The TANK group has indicated support for reducing the permitted quantity which would have implications for some currently permitted activities).

33. The amount of water for emergency use could be limited to a relatively small amount such as 10% of the allocated total. It is an arbitrary amount, but would reflect the amount needed to keep mature tree crops alive[9].

34. The potential impact of a 10% emergency water take has been modelled on the Ngaruroro and Tutaekuri Rivers. For the purposes of estimating the potential impact, the 10% emergency water take has been modelled to apply to all groundwater abstractions located within the proposed Stream Depletion Zone 1, and all surface water abstractions located upstream of the Ngaruroro at Fernhill and Tutaekuri at Puketapu flow management sites.

35. For each flow management site a 10% emergency water take has been calculated based on combining 10% of the maximum modelled stream depletion effect from groundwater

[8] Need some references for this – including what it currently happening in the Tukituki with the new minimum flows

[9] Check the data used for the tree survival water in Tukitiki

abstractions within the Stream Depletion Zone 1, with 10% of the maximum daily allocation for all upstream surface water abstractions.

36. The 10% emergency water take that has been calculated and modelled at each flow management site is shown in the following table. The breakdown of the groundwater and surface water components that are combined to calculate the 10% emergency water take are also included. The groundwater component is very small when compared to the surface water component.

| Flow Management Site | 10% of Max SD Effect from GW Abstractions in SD Zone 1 (l/s) | 10% of Max Daily Upstream SW Allocation (l/s) | Total 10% Emergency Water Take (ls) |
|---|---|---|---|
| Ngaruroro River at Fernhill | 2 | 161 | 163 |
| Tutaekuri River at Puketapu | 0.01 | 83 | 83 |

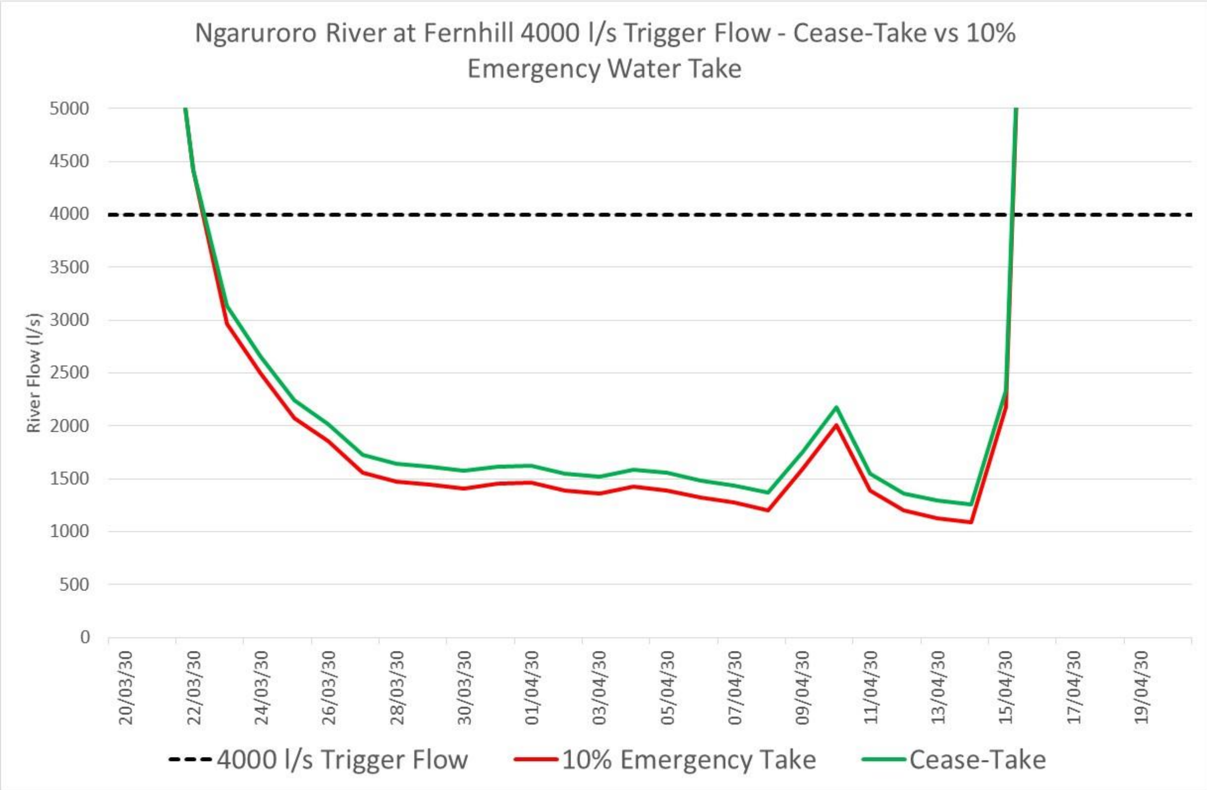
*NB: SD = Stream Depletion, GW = Groundwater, SW = Surface Water*

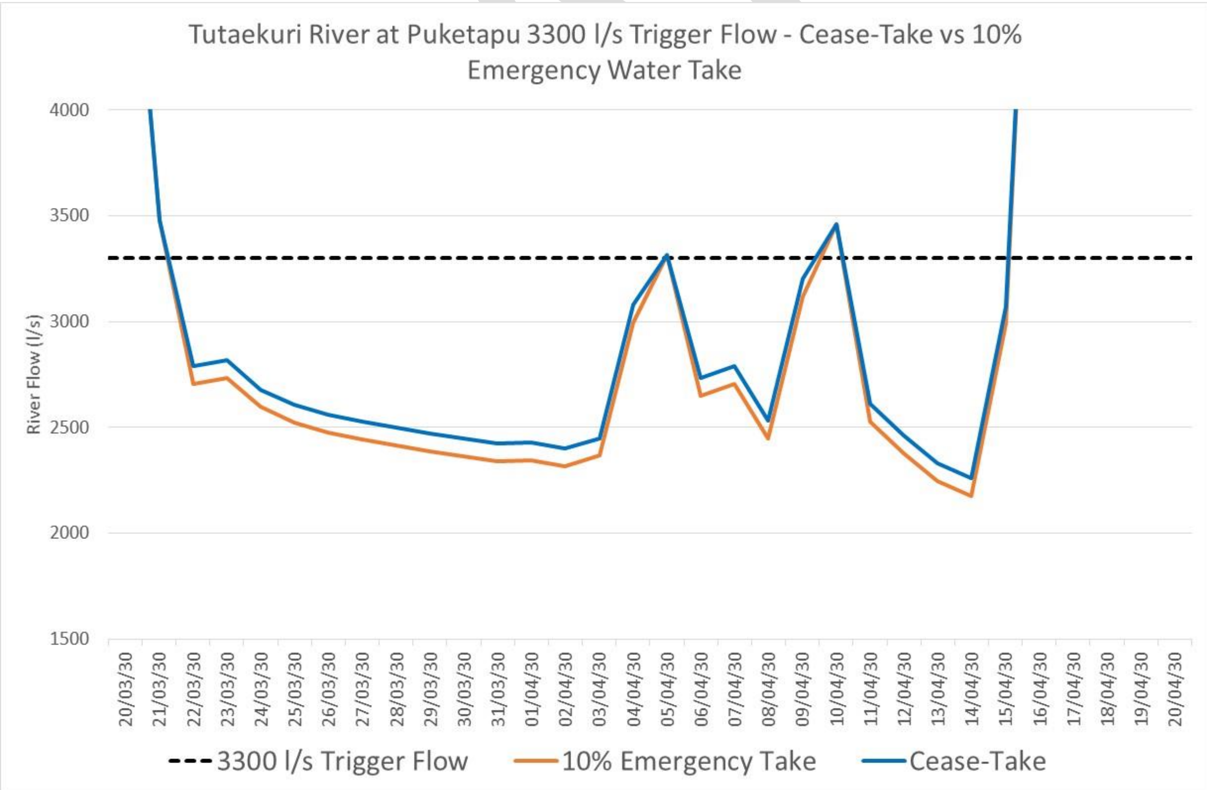
37. The modelled potential impact on river flows resulting from the calculated 10% emergency take is shown in the following table for the different scenario trigger flows at each flow management site. The minimum and maximum percentage change to river flow below each trigger flow is given.

| Flow Management Site | Trigger Flow (l/s) | % Change to River Flow Below Trigger Flow | |
|---|---|---|---|
| | | Min % Change | Max % Change |
| Ngaruroro River at Fernhill | 2400 | -7% | -15% |
| | 3600 | -5% | -15% |
| | 4000 | -4% | -15% |
| Tutaekuri River at Puketapu | 2000 | 0% | 0% |
| | 2500 | -3% | -4% |
| | 3300 | -3% | -4% |

38. For the Ngaruroro River, the maximum modelled impact from a 10% emergency water take is a 15% change to river flows. This 15% change is the same for all modelled trigger flows. For the Tutaekuri River, modelled river flows never go below a 2000 l/s trigger flow, so a 10% emergency water take is never abstracted. River flows are modelled to go below the higher trigger flows of 2500 l/s and 3300 l/s, and a 10% emergency water take would potentially reduce river flow by up to 4%.

39. The following two graphs compare the effect on river flows with a cease-take trigger flow versus a 10% emergency water take occurring when the river at or below the trigger flow. The two graphs show each flow management site separately, using the highest trigger flow and showing a short period of record to highlight the potential effects on river flow.




## Proposal for reducing the number of management scenarios

40. The TANK Group has undertaken to make decisions about flow management regimes that appropriately meet the needs of the wide range of values that these waters have and must do their own analysis to establish their preferred flow management regime in relation to the values

it has identified and adopted for future management, including trigger flows for low and high flow abstractions and allowing for the possibility of emergency water abstraction.

41. The current analysis programme will assess the flow-on economic impact of the preferred management scenarios. We are also doing a separate analysis of the Plan Change effect on social and cultural values.

42. The scenarios currently under consideration are listed in Table 5. Note that the habitat protection levels are provided for torrent fish in relation to the Ngaruroro flows and for trout in the Tutaekuri. Table 1 and 2 above provide additional information about levels of habitat protection for other types of fish.

*Table 5; Overview of management scenarios; (habitat protection in Ngaruroro for torrent fish and Tutaekuri for trout)*

| Case | Scenario | Detail |
|---|---|---|
| Base Case | 1- No Ban<br>Represents Tutaekuri 2,000 l/s | Represents 'current' as best as possible.<br>No annual allocation restriction |
| | 2- Ngaruroro 2,400 l/s | Shuts off irrigation at 2,400 l/s at Fernhill<br>No annual allocation restriction |
| 80 - 90% Habitat Protection | 3- Ngaruroro 4,000 l/s<br>Represents Tutaekuri 3,300 l/s. | Restricted annually to 4 in 5 year allocations |
| 70 - 75% Habitat Protection | 4- Tutaekuri 2,500 l/s (75%) | Restricted annually to 4 in 5 year allocations |
| | 5- Ngaruroro 3,600 l/s | Restricted annually to 4 in 5 year allocations |
| Annual allocation Reductions | 6- Groundwater Zone 2-4 2013 allocation | No bans<br>Restricted annually to 2013 year allocations |
| | 7- Groundwater Zone 2-4 "9 in 10 year" allocation | No bans<br>Restricted annually to "9 in 10 year" allocations |

43. Staff are suggesting a reduction in the number of options for further economic analysis. This will mean a smaller analysis burden and mean that results of the assessments will be available sooner. It serves to narrow the range of options that need to be considered and further debated by TANK.

44. The proposal is that the management scenarios for further testing be reduced to the following;

*Table 6: Management Scenarios for Further Analysis*

| Case | Scenario | Detail |
|---|---|---|
| Base Case | 1- No Ban<br>Represents Tutaekuri 2,000 l/s | Represents 'current' as best as possible.<br>No annual allocation restriction |
| | 2- Ngaruroro 2,400 l/s | No annual allocation restriction |
| 70 - 75% Habitat Protection | 4- Tutaekuri 2,500 l/s (trout) | |
| | 5- Ngaruroro 3,600 l/s (torrentfish) | |
| Annual allocation Reductions | 7- Groundwater Zone 2-4 | No bans<br>Restricted to "9 in 10 year" allocations |

Note that the current flow triggers are 2400l/sec for the Ngaruroro and 2000l/sec for the Tutaekuri.

45. The reason for suggesting a reduction to the number se scenarios is that there are a wide range of values to be considered and there is the potential for very significant impacts as a result of some management combinations that may not meet the needs of all values being considered by the Group.

46. Relevant considerations in making this decision are the;

    - current health of the river and its aquatic ecosystem and its ability to meet existing in-stream values
    - the community need for high levels of protection of instream values balanced with the very high level of social and economic dependence on the abstracted water
    - supporting measures in this plan change to improve aquatic ecosystem health through riparian land management, including through stock access controls and cultivation setbacks and the sediment management objectives
    - supporting measures to be applied through plan implementation that enable a more focused local and catchment scale management and monitoring involvement in meeting freshwater objectives

## Timeframes

47. If changes to the trigger flows are to be made, the Group will need to consider timeframes for how these will be imposed. The economic analysis can take this into account. We previously proposed that new flow and allocation provisions should apply as existing consents expire as would usually happen in the normal course of events. The recommendation also included advancing review of some longer term consents so that all permits would have been reviewed within 10 years (from the operative date of the Plan). Not all Group members entirely agreed with this approach and some were seeking an alternative regime (though no details were provided).

48. Should the Group decide on a significant change to the flow triggers (for example >3000 for the Ngaruroro and >2500 for the Tutaekuri), a longer lead in time could be considered. The new triggers could be phased in over time with a series of smaller flow trigger changes – or the new trigger could be imposed at some time in the future and the current trigger remain in place till then.

49. We need to get some guidance about when a new flow regime (if adopted) would be expected to be in place. Note that there are over 3000 water permits potentially covered by this plan change. About 300 permits are currently linked to a trigger flow.

50. In thinking about a response to this proposal, please consider not only the rate of progress towards better environmental outcomes but also;

    - The administrative and cost burdens on both consent holders and the council
    - The time needed by land managers and water permit holders to plan for different land uses if a significant change to water reliability was made

- The impact on employment and resulting social changes for individuals and their communities

## Allocation methodology

51. There is also some debate necessary about standardising the way water is allocated for irrigation, irrespective of whether it is surface or groundwater. At the moment a lower reliability standard for allocation of water is provided for the same crop/soil for a surface take than for a groundwater take. A surface take gets to meet demand 4 in 5 years where groundwater is provided to meet demand 9 in 10 years.

52. The rationale for this appears to have been part of a historical view about the reliability of surface supplies – mainly in relation to pastoral irrigation. However, there is now a wider range of crops irrigated and an increasing sophistication about how irrigation water is managed as part of overall crop quality and quantity.

53. The problem with a 4 in 5 year standard compared to a 9 in 10 year standard is that it does not recognise that the same crop needs the same amount of water irrespective of the source of the water.

54. The Agfirst analysis also confirms that the 4 in 5 allocation for surface users additionally limits irrigation - more than for the same crop/soil combination where irrigation is by groundwater - when the environmental constraints (allocation limit and flow trigger) are not limiting.

55. The 9 in 10 year allocation has generally been used by councils as a means to ensure water can be more efficiently distributed across more users. If a change is made to increase the reliability standard it means a smaller number of water users get access to water. However, it does recognise crop water demand in a consistent manner across all water users – (although still not so generously that water demand is met all the time). It also reflects the real life, where design of irrigation systems accepts that some risk is still acceptable compared to the cost. The use of the nine in ten water demand is standard practice across most of NZ.

56. The result of a change to allocation from surface supplies is that surface water users may irrigate to meet crop water demand when flows are above trigger flows. This is irrespective of decisions about the trigger flow (which is yet to be confirmed). The allocation limit for surface abstraction will also not be changed.

57. It means irrigation in some years when flows are high will not need to be restricted because of an unnecessarily low constraint on quantity allocated for use. Slightly more water may be allocated to individuals. However, the current actual versus allocated water use are significantly different and the review of permits according to a more stringent actual and reasonable use regime will reduce the gap and enable the impact of a 9 in 10 year allocation to be reduced and accommodated within the limits.

58. Note that the farm scale modelling for this will not be possible within the remaining modelling/time available, although we can provide further analysis about potential effects/impacts considering water allocated against water used and the possible impacts of applying a higher reliability standard.

## Proposals for Further Analysis

| Proposal 3 | |
|---|---|
| 3a | Further economic analysis be carried out to assess the impacts of the reduced number of management scenarios listed in Table 5 |
| 3b | The further economic analysis consider impacts of applying higher flow triggers:<br>(i) within ten years for all permits<br>(ii) new trigger flow applies at <date> (we will be asking TANK members for feedback on what date should apply) |
| 3c | Further analysis to be carried out of the effects of standardising water allocation reliability (irrespective of the water source). |
| 3d | (i) Allow 10% water use to continue after any trigger flow or<br>(ii) Allow 10% water use to continue only where a trigger flow is increased above what applies at present |