Greater Heretaunga and Ahuriri Land and Water Management Collaborative Stakeholder (TANK) Group

Meeting 28: 27 April 2017
Karakia
Karakia

Ko te tumanako
Kia pai tenei rā
Kia tutuki i ngā wawata
Kia tau te rangimarie
I runga i a tatou katoa
Mauriora kia tatou katoa
Āmine
Agenda

9:30am  Notices, meeting record
9:45am  Summary of science from March TANK meeting
10.30am Recap of benefits to river from restricting GW takes
11.00am Raupare flow augmentation scheme
12:00pm GW modelling
  • Stream depleting zones for specific waterways
  • Augmentation
1:00pm  LUNCH
1:30pm  Discussion and direction on groundwater regime
2:30pm  On-farm economic assessment methodology
3:15pm  COFFEE BREAK
3:30pm  Working group updates
4:00pm  CLOSE MEETING
Meeting objectives

1. Agree a management regime for stream depleting groundwater takes for the purpose of further modelling.

2. An understanding of the methodology being used to assess on-farm economic impacts.
Engagement etiquette

• Be an active and respectful participant / listener
• Share air time – have your say and allow others to have theirs
• One conversation at a time
• Ensure your important points are captured
• Please let us know if you need to leave the meeting early
Ground rules for observers

- RPC members are active observers by right (as per ToR)

- Pre-approval for other observers to attend should be sought from Robyn Wynne-Lewis (prior to the day of the meeting)

- TANK members are responsible for introducing observers and should remain together at break out sessions

- Observer’s speaking rights are at the discretion of the facilitator and the observer should defer to the TANK member whenever possible.
Meeting Record – TANK Group 27

- Matters arising
- Action points
## Action points

<table>
<thead>
<tr>
<th>ID</th>
<th>Action item</th>
<th>Person</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.1</td>
<td>HBRC to bring back the new NOF swimmability tables to the TANK Group for consideration</td>
<td>Anna M-S</td>
<td>Date tbc</td>
</tr>
<tr>
<td>27.2</td>
<td>Refer the list of potential guest speakers to the Engagement Working Group for consideration in light of the revised work programme.</td>
<td>Drew</td>
<td>WIP</td>
</tr>
<tr>
<td>27.3</td>
<td>HBRC to add another column in the table of naturalised flows for the Ngaruroro Water User Group who are on water takes subject to low flow bans.</td>
<td>Jeff S</td>
<td>WIP</td>
</tr>
<tr>
<td>27.4</td>
<td>HBRC to consider default policies to manage flow in tributaries to complement what we find for the main stem.</td>
<td>Mary-Anne</td>
<td>WIP</td>
</tr>
<tr>
<td>27.5</td>
<td>Plot rain events upstream of Fernhill and identify whether they are responsible for increased river flow after bans were enforced.</td>
<td>Hydrologists</td>
<td>WIP</td>
</tr>
<tr>
<td>27.6</td>
<td>HBRC to report back to the TANK Group on its current policy on river mouth maintenance (i.e. what triggers opening river mouth using diggers)</td>
<td>Thomas</td>
<td>WIP</td>
</tr>
<tr>
<td>27.7</td>
<td>HBRC to organise an expert to present to the Group on RHYHABSIM and fish habitat levels of protection.</td>
<td>Thomas</td>
<td>Possibly 14 June</td>
</tr>
<tr>
<td>27.8</td>
<td>HBRC to bring back more information on the sustainability of the current level of abstractions, particularly in light of climate change.</td>
<td>Jeff S</td>
<td>WIP</td>
</tr>
<tr>
<td>27.9</td>
<td>HBRC to present the findings from a water aging study of the aquifer.</td>
<td>Iain M</td>
<td>Date tbc</td>
</tr>
</tbody>
</table>
Discussion and Agreement sought from TANK Group

For the purpose of further modelling do you agree/disagree;

Effects of water takes on spring fed streams are best managed by;
- Reducing effects of takes by flow augmentation (i.e not by restrictions on takes)
  because
  - Stream depletion zones for individual streams cannot be determined
  - Zones of pumping impact for individual takes cannot be established
  - Accounting for the cumulative impact of all takes is important
Stream Depletion Modelling: Summary of Science

TANK Collaborative Stakeholder Group Meeting 28

Dr. Jeff Smith
Outline of Presentation:

1. Reason for focus on stream depletion
2. Summary of science to date
3. Introduction to sessions this morning
4. Climate change projections
1. Reason for stream depletion modelling

Stream Depletion modelling
- Allocation?
- Cease take rules?
- Artificial recharge?
- Augmentation?
- Other management?
- Which streams/rivers?

Surface water flow management
- Stream depleting groundwater takes
- Surface water abstractions
- Allocation(s)
- Flow regulation

Groundwater sustainability and allocation
2. Recap of stream depletion modelling
Meeting 26: Stream Depletion Modelling

Heretaunga Plains Stream Depletion Modelling Results

Layer 1 Stream Depletion Effect
- >90% effect after 7 days
- >60% effect after 30 days
- >60% effect after 150 days
- <60% effect after 150 days
- Low Confidence Area

0 1.25 2.5 5 km
Meeting 27: More stream depletion modelling

1. Effectiveness of pumping bans on river flows
2. Other Mitigation options:
   a. Artificial recharge
   b. Stream augmentation
Artificial recharge conclusions

- Relatively small effect, even for a very large scheme
- Beneficial effects quickly dissipate when artificial recharge ceases
Groundwater ban scenario results:

<table>
<thead>
<tr>
<th>Scenario number</th>
<th>Karamu</th>
<th>Ngaruroro</th>
<th>Raupare</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2, 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9, 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>change in flow as % of low flow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10</td>
<td>10</td>
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<tr>
<td></td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

ban zone: 
- zone 1
- zone 1+2
- zone 1+2+3
- zone 1+2+3 + 100%IND
- no pumping
Need to identify zones for individual streams
Meeting 27 – Science shows that:

- Artificial recharge examples were insufficient for mitigating stream depletion
- Pumping restrictions for irrigation takes were somewhat effective, if applied throughout Zones 1, 2 and 3
Reasons for considering lowland streams separately from Ngaruroro and Tutaekuri Rivers:

• augmentation from groundwater is unlikely to be practical for large rivers

• flow requirements for low-gradient streams are based on oxygen availability (c.f. habitat)
Next steps were to:

- identify stream depletion sub-zones for managing individual lowland streams
- Investigate efficacy of augmentation
3. What to expect later this morning

- Intention was to identify stream depletion sub-zones for lowland stream flow management
  - Modelling shows this isn’t realistic
- Most takes have small effects, but the combined stream depletion is large

<table>
<thead>
<tr>
<th>zone</th>
<th>total effect L/s after 150 days of pumping</th>
</tr>
</thead>
<tbody>
<tr>
<td>all zones</td>
<td>2084.7</td>
</tr>
<tr>
<td>Karamu</td>
<td>211.5</td>
</tr>
<tr>
<td>Ngaruroro</td>
<td>1048.7</td>
</tr>
<tr>
<td>Raupare</td>
<td>93.9</td>
</tr>
</tbody>
</table>
3. What to expect later this morning

• Attention turning to managing cumulative stream depletion effects
• Jerf is reporting how the Twyford Irrigators Group uses flow augmentation to mitigate stream depletion in the Raupare Stream
• Pawel – modelling augmentation to mitigate stream depletion throughout the Heretaunga Plains
Heads up – Pawel’s work

1. Stream depletion zones could not be identified

2. Stream Augmentation is a viable option for managing of some streams

3. A tool was developed for this investigation
   - Could be used for managing cumulative impacts of pumping on stream depletion
4. Climate Change Projections

TANK Stakeholder Group has asked:

What does climate change mean for the TANK Plan Change?
4. Climate Change Projections

Need to know for modelling scenario predictions
Climate Change Projections

IPCC (2013) representative concentration pathways (RCPs):

**RCP2.6 = Mitigation.** Assumes international intervention that reduces emissions. CO$_2$ concentrations peak at 440 ppm by the year 2040 and decline thereafter

**RCP4.5 = Stabilisation.** Assumes international management. CO$_2$ concentrations would stabilise to approximately 540 ppm by the year 2100

**RCP6.0 = Stabilisation.** CO$_2$ concentrations 670 ppm by 2100, but not yet stabilised

**RCP8.5 = Business as usual.** Very high CO$_2$ concentrations to 950 ppm by 2100 and increasing thereafter
Climate Change Projections

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**RCP8.5 = Business as usual.** Very high CO$_2$ concentrations to 950 ppm by 2100 and increasing thereafter.
Climate Change Projections

- 16 Global Climate Models (GCMs) available for RCP6.0 scenario
- NIWA has chosen 6 GCMs for downscaling to New Zealand Regional Climate Models (RCMs = 5km grid)
- RCM bias correction by Aqualinc Research for TANK catchments – 26 years (2015 – 2041)
- 2015 – 2041 captures the cycle of this TANK plan change
Three sub-catchment clusters chosen for analysis
Climate Change Projections

• Three sub-catchment clusters chosen for analysis
• Projections reported for **Rainfall** and Potential **Evaporation** (PE) within each cluster
• Comparisons with previous 26 years (1989 – 2015)
Cumulative Rainfall Projections

Cluster 1

Cluster 3

Cluster 9
No statistically significant differences between historic data and climate change projections
Cumulative Evaporation Projections
Annual average **Evaporation Projections**

= statistically significant differences between historic data and climate change projections
ii. Annual precipitation changes are small in many places, partly due to inter-model variability, but also to seasonal compensation, eg, in [Hawke’s Bay, models predict an increase in summer rainfall but a decrease in winter](#).

iii. The largest projected changes in precipitation occur on the West Coast in the winter season.

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**Climate Change Projections for New Zealand**

Atmospheric projections based on simulations undertaken for the IPCC 5th Assessment
Conclusions

• Considerable uncertainty with climate change projections

• Statistically no significant difference between historic 26-year rainfall/evaporation and almost all 26-year climate change projections

• Historic data are considered valid for future scenario modelling within this TANK planning cycle

• Future plan reviews/changes should revisit updated climate change projections
Decision from Group

Do you agree climate change projections are not significant enough to influence decisions for this plan change?
Recap on benefits to river of restricting groundwater takes

Thomas Wilding
**Ngaruroro:**
Little flow recovery from total ban for everyone

Flow recovery as a percent of river flow after 30 days total ban for zone 1, 2, 3, + industrial + municipal.

- 20% recovery at 2300 L/s
- 40% recovery at 1150 L/s
Ngaruroro:
Partial restriction even less effective

Flow recovery as a percent of river flow after 30 days of 25% reduced use for zone 1, 2, 3, + industrial + municipal
Raupare (spring-dominated)
Much greater flow recovery from total ban

Flow recovery as a percent of river flow after 30 days restriction for zone 1, 2, 3, + industrial + municipal
Sort out the spring streams first, then return to Ngaruroro flows

<table>
<thead>
<tr>
<th></th>
<th>Ngaruroro</th>
<th>Spring streams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact on flow</td>
<td>Small</td>
<td>higher</td>
</tr>
<tr>
<td>Consequence</td>
<td>Less habitat for <em>some</em> species</td>
<td>Less oxygen for <em>all</em> species</td>
</tr>
<tr>
<td>Physical validation</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Biological impacts</td>
<td>Unknown</td>
<td>Observed</td>
</tr>
<tr>
<td>Interactions investigated</td>
<td>None</td>
<td>Shade, aquatic plants</td>
</tr>
</tbody>
</table>
We can decide how to achieve limits

AVOID
  e.g. allocation limits, staged reductions

REMEDY
  e.g. flow augmentation (from wells, dams, etc.)

MITIGATE
  e.g. riparian shading
Summary

• Recommend focus on spring-dominated streams – for now.

• Why? Bigger impact on springs and better knowledge of instream consequences.

• We can set draft limits => draft remedies => draft mitigation.
Follow Up Points

Didn’t we already agree to use torrentfish as RHYHABSIM target species for Ngaruroro? - NO
• There was consensus on inanga (lowland trib.) and tuna (upland trib.), but not on torrentfish (Ngaruroro) [URL]
• Perf. measure discussion was broader than flow target

What are the Flow requirements for koura - LOW
• Koura prefer zero velocities. They can tolerate up to 0.4 m/s if provided cover. Therefore flow requirements are less than fast-water fish.

Does river mouth closure restrict fish numbers - UNLIKELY
• Closure does occur, but typically only lasts a few hours (Vince Byrne).
• Not long enough to limit the fish population.
Less flow => less Oxygen

Seasonal plant growth changes the oxygen-flow response

- Awanui Stream – comparing model predictions (black line) to observed oxygen (training circles; validation dots)

Predictions used for limits
We can choose oxygen limits

<table>
<thead>
<tr>
<th>Oxygen attribute</th>
<th>Indicator</th>
<th>Health of adult native fish</th>
<th>Fish survival / aquatic plant health</th>
</tr>
</thead>
<tbody>
<tr>
<td>60%</td>
<td>invertebrate MCI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40%</td>
<td>(velocity 0.04 m/s)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Restriction Regime</th>
<th>Ban or Staged Reduction</th>
</tr>
</thead>
</table>
We can decide where we set flows

Three sites investigated compared to more than 20 existing ban sites
Semi-Confined Global Consent Augmentation of the Raupare

Jurf van Beek
Who is involved?

• 46 Wells measured on WaterSense web tool.
• This is 65% of the land area in the Semi-Confined zone.
• All but 2 people in the Twyford area are in TIG.
Who pays and who benefits?

- Every one who is a member of TIG Pays a per hectare levy
- Everyone benefits
- Not everyone is in the Global Consent
- Working on naturalised flow.
How we augment

Using the daily mean flow from the HBRC website as a trigger

Example of Daily mean flow in January
Augmentation at Bostocks M6
Global Consent conditions

- 80% plus Dissolved Oxygen in the augmented water
- Not to be more than 3 degrees warmer
- Not to damage the stream bed
Raupare flow in January
Daily mean flow in January
Raupare flow 11th January
Raupare mean flow 11th of January
Global use for entire season

45% of total water was used

The highest usage period reached approximately 59.8% of the 28 day limit
January was the highest usage

CURRENT YEAR - MONTHLY VOLUME USED

Max Month: 323643.19 m³
Min Month: 469.88 m³
Monthly Average: 186.61 m³

Dec 2016: 241226.01 m³
Year to date - usage pattern

DAILY VOLUME USED BETWEEN JUL 1, 2016 - APR 23, 2017

Max Day: 16876.38 m³
Min Day: 0 m³
Daily Average: 0 m³
## Warnings

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global 28 Day Limit</td>
<td>475974 m³</td>
</tr>
<tr>
<td>Global 12 Month Limit</td>
<td>1876770 m³</td>
</tr>
<tr>
<td>Usage Warning Threshold</td>
<td>75 %</td>
</tr>
<tr>
<td>High-Usage Warning Threshold</td>
<td>95 %</td>
</tr>
<tr>
<td>False Warning Level</td>
<td>150 %</td>
</tr>
<tr>
<td>Message Archive Age</td>
<td>3 Months</td>
</tr>
<tr>
<td>Rate Calculation Period</td>
<td>1 Hours</td>
</tr>
</tbody>
</table>

[Save Button]
Maximum use guideline

- Maximum Use Guideline: 227695 m³
- Current Usage: 105951 m³
- Remaining: 121744 m³

Guide of max use per grower, group or well.
What about the Un-Confined zone
Global consent
Augmentation to other waterways

- feasibility and potential challenges
- Mangateretere, Karamu, Moteo Valley etc.
Questions?
Stream depletion for individual streams and stream augmentation
Presented by Pawel Rakowski
Outline of the presentation

1. Stream Augmentation scenario
2. Stream depletion zones for individual streams (didn't work)
3. Zones of actual impact of pumping and cumulative impact (didn't work)
4. Possible management of cumulative impact
Stream augmentation

- Pumping groundwater to the streams during dry periods
Stream Augmentation Scenario

- Pumping well in Raupare area
- Pumping rate 150 L/s
- Calculate effect of this additional pumping on stream flow in selected streams including Raupare

**Required augmentation flow to maintain 300L/s stream flow**

- Graph showing Raupare stream flow in dry summer
- Map showing location of pumping well in Raupare area
Stream Augmentation

Effect of stream augmentation pumping with rate of 150 L/s on stream flows

- Stream reduction over time since start of augmentation in days.
Outcome of Augmentation scenario

• Positive effect for the augmented stream
• Small negative effect for other streams
• Negative effect for Ngaruroro river may be acceptable (35 L/s effect for flow of 2000 L/s)
• Potentially a viable mitigation option, if benefit to spring fed streams outweighs negative effect in larger rivers
Stream depletion zone per stream

Purpose:

• Identify which streams are potentially most affected by stream depletion
• Identify protection/ban zones for individual stream
• Which streams should trigger restrictions
Stream depletion zone per stream

Method:

• Test effects of pumping from individual wells on stream flow of selected streams.
• Many thousands of locations tested.
• Result is how much stream flow declines in response to groundwater pumping
• Result as % of pumping rate
• Results are converted to a contour map
• Contour maps can be converted to zones
Stream depletion zones for all streams
Raupare 150 days

Stream flow impact as % of pumping rate
- 0-20%
- 20-40%
Summary of findings:

- Stream depletion zones for spring fed streams (Karamu and Raupare) cannot be established using Tukituki PC6 criteria, because individual effect is too small but...
- The method does not consider cumulative pumping effects
- Cumulative effects can be calculated in a next stage using actual pumping rates
- Cumulative effects can be large, even if individual % of depletion is small
- The actual cumulative effect on the stream, as % of actual stream flow can be large, if flow in the stream is small (e.g. Raupare stream)
Actual pumping impact distribution
Stream depletion zones for individual streams

Actual pumping from groundwater wells

= Actual pumping impact
Actual pumping effect L/s after 150 days on Raupare
Actual pumping impact distribution - findings

- Distribution of actual effects cannot be used to help define zones ... no obvious zones can be seen
- Most takes have very small individual effect
- The combined effect is significant

<table>
<thead>
<tr>
<th>zone</th>
<th>total effect L/s after 150 days of pumping</th>
</tr>
</thead>
<tbody>
<tr>
<td>allzones</td>
<td>2084.7</td>
</tr>
<tr>
<td>Karamu</td>
<td>211.5</td>
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<td>Ngaruroro</td>
<td>1048.7</td>
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<tr>
<td>Raupare</td>
<td>93.9</td>
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</tbody>
</table>
Possible management option

Stream depletion zones for individual streams
Zones of actual pumping effect

Methodology to estimate effect of:
• Combined effect of groundwater abstraction
• Effect of abstraction from individual wells on:
  • Individual streams and rivers

Response functions
Response function

• Sensitivity of stream flows to groundwater pumping
• Established using a model
• Model is no longer required for estimating effects of pumping on streams
• For **individual wells**, the effect of pumping on flow per stream can be calculated
• For **groups of takes** (e.g. irrigation wells), the total cumulative effect on flow in streams can be calculated
• Cumulative effect of all wells
• The calculation could be automated for use by consents officers or the public (e.g. consent applicants), using a web interface
How can this be used for management

e.g. Ngaruroro river flow

- Natural flow (e.g. 1 in 20 years dry year) (e.g. summer 2012/2013)
- Target minimum stream flow (e.g. based on habitat or oxygen etc)
- Target maximum acceptable stream depletion (for all groundwater takes) = target maximum allocation

- Calculate current stream depletion Using response function

- Compare current depletion with target depletion (is there any freeboard)
- Calculate any additional depletion with new wells (e.g. during consenting process)
### Example

<table>
<thead>
<tr>
<th></th>
<th>QminNat</th>
<th>QminAcept</th>
<th>maxAceptDepl</th>
<th>QDeplActual</th>
<th>QDeplFree</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>flows in L/s</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>QminNat</strong></td>
<td>minimum naturalised flow for worst case condition</td>
<td>agreed minimum acceptable flow in the river for worst case condition</td>
<td>calculated maximum stream depletion</td>
<td>calculated current stream depletion</td>
<td>depletion freeboard</td>
</tr>
<tr>
<td><strong>Ngaruroro</strong></td>
<td>2200</td>
<td>1000</td>
<td>1200</td>
<td>1000</td>
<td>200</td>
</tr>
</tbody>
</table>

- Calculation: $Q_{minNat} - Q_{minAcept}$
- Calculation: $max_{AceptDepl} - Q_{DeplActual}$
- Calculation: $max_{AceptDepl} - Q_{DeplActual}$ could be used to see if there is additional water available.

- worst case condition has to be defined
- this has to be agreed
Requirements

• Establishing target maximum
• Decide what kind of conditions (e.g. 1 in 20 years minimum flow)
Summary

1. Stream Augmentation is a viable option for managing of some streams
2. Stream depletion zones for individual stream cannot be established
3. Zones of actual impact of pumping cannot be established
4. Possible management of cumulative impact of pumping on stream depletion
Thank you
TIME FOR LUNCH
Discussion and direction sought on GW regime

Breakout and plenary discussion
Discussion and Agreement sought from TANK Group

For the purpose of further modelling do you agree/disagree;

Effects of water takes on spring fed streams are best managed by;

- Reducing effects of takes by flow augmentation (i.e. not by restrictions on takes)

  because

  - Stream depletion zones for individual streams cannot be determined
  - Zones of pumping impact for individual takes cannot be established
  - Accounting for the cumulative impact of all takes is important
An understanding of the methodology being used to assess on-farm economic impacts

AgFirst

Jonathan Brookes, Leander Archer & Lochie MacGillivray

April 2017
Parts 1a 1b: Determine Heretaunga Plains water allocation and nutrient loss mitigation impacts

Part 2: Determine Pastoral Nutrient loss mitigation impacts

AgFirst into two main teams with QA and environmental support from others when required.

- Parts 1a & 1b managed by AgFirst HB (Horticultural specialists) with some subcontracting.
- Part 2 AgFirst Pastoral (Pastoral specialists)
Concept

1. Build a series of base models that represent agricultural and horticultural systems in the TANK catchment
2. Run various mitigation and water allocation scenarios across the base models to determine the impact variance
3. Scale the base models and scenarios impacts in order to represent the entire catchment impacts in economic and social returns.
Concept continued

4. The base models represent averaged resources and inputs for an a typical farm/orchard/vineyard.
5. The base model farms won’t represent the mitigation impacts on an individual farm, only the region as a whole
Models

1. Pastoral
   Three broad zones (geospatially defined), Sheep and Beef and Dairying

2. Heretaunga
   One zone, Pipfruit, Summer Fruit, Kiwifruit, Grapes and Vegetable crops
Crop budget progress

<table>
<thead>
<tr>
<th>Crop</th>
<th>Data collected from industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipfruit</td>
<td>Yes</td>
</tr>
<tr>
<td>Summerfruit</td>
<td>Yes</td>
</tr>
<tr>
<td>Kiwifruit</td>
<td>No</td>
</tr>
<tr>
<td>Grapes</td>
<td>In progress</td>
</tr>
<tr>
<td>Vegetables: Squash, Onion, Peas &amp; beans/ Sweetcorn, winter pasture</td>
<td>Yes</td>
</tr>
</tbody>
</table>

- Data has mostly been collected
- Next steps are:
  - Combine individual grower data into a ‘model farm’
  - Confirm N and P inputs to each crop (average practice)
  - Send model farm summaries around our grower contributors for feedback
Vegetable Model Farm

This has come out of a long process of consultation and discussion. Crops chosen on land area, sensitivity to curtailments and economic significance including downstream effects (beyond farm gate).

<table>
<thead>
<tr>
<th>Crop</th>
<th>Input (water, nutrient)</th>
<th>On farm Value</th>
<th>Destination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onions</td>
<td>High</td>
<td>High</td>
<td>Export</td>
</tr>
<tr>
<td>Squash</td>
<td>Med</td>
<td>Med</td>
<td>Export</td>
</tr>
<tr>
<td>Peas, Beans and Sweetcorn</td>
<td>Low</td>
<td>Low/Med</td>
<td>Process</td>
</tr>
<tr>
<td>Other</td>
<td>Mod</td>
<td>Mod</td>
<td>Mostly Process</td>
</tr>
</tbody>
</table>

Beetroot, tomatoes, carrots...
### Vegetable Model Farm

<table>
<thead>
<tr>
<th>Model Farm</th>
<th>ha</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onions</td>
<td>31.5</td>
<td>15%</td>
</tr>
<tr>
<td>Squash</td>
<td>63.0</td>
<td>30%</td>
</tr>
<tr>
<td>Peas &amp; Beans</td>
<td>31.5</td>
<td>15%</td>
</tr>
<tr>
<td>*Sweet Corn</td>
<td>31.5</td>
<td>15%</td>
</tr>
<tr>
<td>**Other</td>
<td>52.5</td>
<td>25%</td>
</tr>
<tr>
<td>Total effective</td>
<td>210.0</td>
<td>100%</td>
</tr>
<tr>
<td>Headlands &amp; infrastructure</td>
<td>9</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Total Land area</strong></td>
<td><strong>219</strong></td>
<td></td>
</tr>
</tbody>
</table>

Awaiting one large grower’s information to finalise.

*Uses peas and beans SPASMO modelling
**Not modelled in SPASMO
Climate and Soils

One climate station showing 17 years of climate data will be used. 14 soil types will be modelled for each crop. Soils with similar effects on yield outcomes will be grouped by AgFirst for reporting.
Irrigation management scenarios

The current situation, and two alternative options will be reported on. How we model the current and alternative situations is in discussion. The current concept is to model a range of situations along the continuum of security of supply (high to low). We are looking at data from the 14 current low flow points to find their place on this continuum. Stepwise options will be modelled.
Size and Quality

SPASMO will give us change in dry matter due to water deficits occurring in each scenario. We are now working on how size and quality is affected by levels of water deficit for each modelled crop.
For each crop, year, soil type and irrigation management scenario, we get an EBIT, N and P loss. We then weight these by the soil type and crop proportions of our model farm. The model farm EBIT is then scaled up by multiplying to the total area of that farm type in TANK. We end up with a comparison of how different levels of security of supply impact the economy and nutrients to farm gate.
Putting it all together

Inputs to SPASMO

1 VCSN (Climate Station)  
For 17 years (1998 - 2015)

14 Soil Types for each of:  
Vegetables  
Grapes  
Tree crops and kiwifruit

8 Crops (plus Pasture)  
Pipfruit  
Kiwifruit  
Summerfruit  
Grapes  
Squash  
Onion  
Peas  
Beans  
Pasture as Winter rotation

SPASMO Model

Irrigation Management Scenario  
Days on and off ban/restriction for the 17 years according to a rule  
E.g. 'Ban when Ngauroro reaches X flow rate'

Soil type groupings - low and moderate (and high if necessary) water holding capacities

Output from SPASMO

Water deficits (mm) reached in each situation, weekly.

Change in dry matter for each crop, for each year, for each soil, according to the difference between irrigation required and irrigation applied.

Nutrient outputs (N and P loss to the environment) for each crop, soil, year...
Financial budgets for each crop, looking at 3 year average yield, price and costs. Gathered from growers.

AgFirst budget model

Change in average farm business EBIT for each crop, year and soil grouping for ONE irrigation management scenario

Outputs from AgFirst model

Repeat process for each new irrigation management scenario

All properties on moderate ban scenario e.g. 'current ban A' grouping a representing low flow zones 1-6

All properties on a stepwise reduction scenario e.g. 100% reduces to 80% when river flow reaches level X. 80% reduces to 60% when river flow reaches flow Y...
= 1632 to 2448 budgets. Each one shows one crop on one soil group, in one climate year, on one ‘low flow rule’ and one water allocation. This results in a dry matter production and nutrient output from SPASMO (yield), and then AgFirst must calculate a change in size and include other quality effects to alter $/kg. Adding one more ‘ban scenario’ increases the number of budgets by hundreds. We need to choose these wisely to enable AgFirst to interpret the sheer volume of data.
Pastoral Country update
Pastoral Country Model Summary

Objective

1. Use Overseer to produce nitrogen and phosphorus outputs for the modelled land uses within the Pastoral Country section of the TANK Catchment. At least three scenarios
2. Design a robust model to evaluate the current, (and mitigated) sediment outputs from the Pastoral Country. At least three sediment mitigation scenarios.
Pastoral Zones
A function of natural resources...slope, soil, climate
Sets
Typical farm natural resources
Basic Farm system
Production
Pastoral
Pastoral

Erosion
Pastoral Climate
Pastoral Climatic Zones
Establish Base models

- Five Models
  - Summer Moist (greater than 1200mm rainfall)
  - Summer Dry (< 1200mm, breeder store some finishing)
  - Intensive (finishing farms esp over winter)
  - Scale Restricting Summer Dry/ Intensive (previously referred to as Part Time), <200 ha
  - Dairy
## Pastoral Sheep and Beef Dairying breakdown

<table>
<thead>
<tr>
<th></th>
<th>Summer Moist (S &amp; B)</th>
<th>Summer Dry (S &amp; B)</th>
<th>Scale Restricting (S &amp; B)</th>
<th>Intensive (S &amp; B)</th>
<th>Dairying</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total area (ha)</td>
<td>52,002</td>
<td>52,008</td>
<td>8,243</td>
<td>28,349</td>
<td>7,015</td>
</tr>
<tr>
<td>Number of Farms</td>
<td>103</td>
<td>108</td>
<td>86</td>
<td>61</td>
<td>12</td>
</tr>
<tr>
<td>Average size (total ha)</td>
<td>520</td>
<td>486</td>
<td>108</td>
<td>480</td>
<td>465</td>
</tr>
<tr>
<td>Average size (effective ha)</td>
<td><strong>446</strong></td>
<td><strong>449</strong></td>
<td><strong>97</strong></td>
<td><strong>452</strong></td>
<td><strong>400</strong></td>
</tr>
<tr>
<td>Total sheep</td>
<td>2,880</td>
<td>2,514</td>
<td>412</td>
<td>5,355</td>
<td></td>
</tr>
<tr>
<td>Total cattle</td>
<td>314</td>
<td>321</td>
<td>95</td>
<td>570</td>
<td>1,215</td>
</tr>
</tbody>
</table>
## Pastoral Slope Breakdown

<table>
<thead>
<tr>
<th>Slope Category</th>
<th>Summer Moist (S &amp; B)</th>
<th>Summer Dry (S &amp; B)</th>
<th>Part Time (S &amp; B)</th>
<th>Intensive (S &amp; B)</th>
<th>Dairying</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3 degree slope</td>
<td>7%</td>
<td>8%</td>
<td>18%</td>
<td>70%</td>
<td>24%</td>
</tr>
<tr>
<td>4-7 degree slope</td>
<td>4%</td>
<td>2%</td>
<td>8%</td>
<td>2%</td>
<td>13%</td>
</tr>
<tr>
<td>8-15 degree slope</td>
<td>18%</td>
<td>7%</td>
<td>6%</td>
<td>2%</td>
<td>48%</td>
</tr>
<tr>
<td>16-20 degree slope</td>
<td>25%</td>
<td>22%</td>
<td>26%</td>
<td>4%</td>
<td>12%</td>
</tr>
<tr>
<td>21-25 degree slope</td>
<td>26%</td>
<td>45%</td>
<td>36%</td>
<td>18%</td>
<td>3%</td>
</tr>
<tr>
<td>26-35 degree slope</td>
<td>12%</td>
<td>16%</td>
<td>5%</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>36-42 degree slope</td>
<td>8%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Pastoral Soil Orders

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Summer Moist</th>
<th>Summer Dry</th>
<th>Scale Restricted</th>
<th>Intensive</th>
<th>Dairy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allophanes</td>
<td>33%</td>
<td>6%</td>
<td>2%</td>
<td>1%</td>
<td>44%</td>
</tr>
<tr>
<td>Gleys</td>
<td>8%</td>
<td>11%</td>
<td>12%</td>
<td>45%</td>
<td>4%</td>
</tr>
<tr>
<td>Browns</td>
<td>6%</td>
<td>11%</td>
<td>9%</td>
<td>7%</td>
<td>3%</td>
</tr>
<tr>
<td>Pumice</td>
<td>16%</td>
<td></td>
<td></td>
<td></td>
<td>39%</td>
</tr>
<tr>
<td>Pallic</td>
<td>25%</td>
<td>55%</td>
<td>49%</td>
<td>27%</td>
<td>10%</td>
</tr>
<tr>
<td>Melanic</td>
<td>12%</td>
<td>2%</td>
<td>4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recents</td>
<td>12%</td>
<td>2%</td>
<td>4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic</td>
<td>0%</td>
<td>2%</td>
<td>11%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
Pastoral All models Financial

<table>
<thead>
<tr>
<th>Sheep and Beef</th>
<th>Sheep &amp; Beef Weighted Average</th>
<th>Dairying</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer Moist</td>
<td>Summer Dry</td>
<td>Intensive</td>
</tr>
<tr>
<td>53,512</td>
<td>52,472</td>
<td>29,286</td>
</tr>
<tr>
<td>Number of Farms</td>
<td>103</td>
<td>108</td>
</tr>
<tr>
<td>Total area</td>
<td>520</td>
<td>486</td>
</tr>
<tr>
<td>Effective area</td>
<td>446</td>
<td>449</td>
</tr>
<tr>
<td>Total $</td>
<td>Gross Farm Income</td>
<td>419,266</td>
</tr>
<tr>
<td>Farm Working Expenses</td>
<td>300,989</td>
<td>285,579</td>
</tr>
<tr>
<td>EBIT</td>
<td>118,277</td>
<td>63,160</td>
</tr>
</tbody>
</table>

Total GFI $163 mill pa
EBIT $42 mill pa
Pastoral
Stream and River Orders
Summer Moist Zone
## Stock Proof Fencing in TANK Catchment

### 2nd-6th order Zone Fencing category length %

<table>
<thead>
<tr>
<th>Zone</th>
<th>Fencing category</th>
<th>Through Zone River length (kms)</th>
<th>Category %</th>
<th>Through Farmland only length</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer Moist</td>
<td>Excellent</td>
<td>165</td>
<td>37%</td>
<td>2</td>
<td>2%</td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td>169</td>
<td>38%</td>
<td>15</td>
<td>13%</td>
</tr>
<tr>
<td></td>
<td>Fair</td>
<td>88</td>
<td>20%</td>
<td>65</td>
<td>59%</td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td>28</td>
<td>6%</td>
<td>28</td>
<td>25%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>450</strong></td>
<td><strong>100%</strong></td>
<td><strong>110</strong></td>
<td><strong>100%</strong></td>
</tr>
<tr>
<td>Summer Dry</td>
<td>Excellent</td>
<td>52</td>
<td>15%</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td>109</td>
<td>31%</td>
<td>16</td>
<td>9%</td>
</tr>
<tr>
<td></td>
<td>Fair</td>
<td>100</td>
<td>29%</td>
<td>73</td>
<td>42%</td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td>88</td>
<td>25%</td>
<td>86</td>
<td>49%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>350</strong></td>
<td><strong>100%</strong></td>
<td><strong>176</strong></td>
<td><strong>100%</strong></td>
</tr>
<tr>
<td>HP Intensive</td>
<td>Excellent</td>
<td>177</td>
<td>44%</td>
<td>95</td>
<td>34%</td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td>101</td>
<td>25%</td>
<td>75</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td>Fair</td>
<td>67</td>
<td>17%</td>
<td>62</td>
<td>22%</td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td>55</td>
<td>14%</td>
<td>49</td>
<td>18%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>399</strong></td>
<td><strong>100%</strong></td>
<td><strong>282</strong></td>
<td><strong>100%</strong></td>
</tr>
<tr>
<td><strong>Total river length</strong></td>
<td></td>
<td><strong>1198 kms</strong></td>
<td></td>
<td><strong>568 kms</strong></td>
<td></td>
</tr>
</tbody>
</table>
Pastoral

SEDNET – Summer Moist Erosion on a Total basis
Pastoral
SEDNET – Summer Moist
Erosion on a M2 basis with
Stream overlay
Sednet derived erosion source

<table>
<thead>
<tr>
<th>Erosion source</th>
<th>Percent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landslide</td>
<td>70%</td>
</tr>
<tr>
<td>Earth Flow/ other</td>
<td>1%</td>
</tr>
<tr>
<td>Surface</td>
<td>13%</td>
</tr>
<tr>
<td>Bank</td>
<td>16%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>
Sednet derived benefits of riparian fencing

<table>
<thead>
<tr>
<th>Summer Moist Zone</th>
<th>Total sediment loss</th>
<th>% gain from current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current loss</td>
<td>28,494</td>
<td></td>
</tr>
<tr>
<td>25% increase in riparian fencing</td>
<td>23,146</td>
<td>18.8%</td>
</tr>
<tr>
<td>50% increase in riparian fencing</td>
<td>17,797</td>
<td>37.5%</td>
</tr>
</tbody>
</table>
Fencing Requirement for Summer Moist Model

<table>
<thead>
<tr>
<th>Quality</th>
<th>Length of fenced streams*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>20</td>
</tr>
<tr>
<td>Good</td>
<td>130</td>
</tr>
<tr>
<td>Fair</td>
<td>590</td>
</tr>
<tr>
<td>Poor</td>
<td>250</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>990</strong></td>
</tr>
</tbody>
</table>

* Stream order 2-6
## Nutrient losses to Water from Overseer version 6.2.3

<table>
<thead>
<tr>
<th>Model</th>
<th>N losses to water kgs/ha/yr</th>
<th>P losses to water kgs/ha/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer Moist</td>
<td>14</td>
<td>1.5</td>
</tr>
<tr>
<td>Summer Dry</td>
<td>15</td>
<td>0.9</td>
</tr>
<tr>
<td>Scale Restricting</td>
<td>16</td>
<td>0.7</td>
</tr>
<tr>
<td>HP Intensive</td>
<td>11</td>
<td>0.3</td>
</tr>
<tr>
<td>Dairy</td>
<td>62*</td>
<td>1.9*</td>
</tr>
</tbody>
</table>

* Still to be ground truthed
Verbal updates from Working Groups

- Engagement
- Economic Assessment
- Stormwater
- Wetlands/Lakes
- Mana whenua
Next meeting – 30 May 2017

1. **Clive River management options**

1. **Plan Change Outline** (MAB/Mana Whenua Group)

2. **Possible further GW modelling** (Jeff/Pawel)

3. **Surface water takes**
   - flow management regime options (Jeff/Rob W)
   - Assess outputs according to values/attributes (MAB)
Closing Karakia

Nau mai rā
Te mutu ngā o tatou hui
Kei te tumanako
I runga te rangimarie
I a tatou katoa
Kia pai to koutou haere
Mauriora kia tatou katoa
Āmine