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 GW science
10:30am Water age in drinking water supply wells in Heretaunga aquifer
11:30pm SOURCE model and SW takes
12:30pm LUNCH
1:00pm  Te Tua out-of-stream storage specs and modelling
2:30pm  COFFEE BREAK
2:45pm  Decision-tool showing combinations of options and pros/cons
4:00pm  CLOSE MEETING
Meeting objectives

• Continue focus on GW modelling

• Introduce the SOURCE model and explain how it works in relation to surface water takes

• Consider an out-of-stream storage option for augmenting flows in the Ngaruroro River

• Provide a tool for deciding combinations of possible management solutions for future modelling.
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.
Notices

• Possible dates for additional meeting

OPTIONS:
1. Thursday, 17 August
2. Friday, 18 August

• Agreement to extend meetings to 5pm (if required)

• Any from the floor?
Meeting Record – TANK Group 28

• Matters arising

• Action points
Key question from previous meeting

For the purposes of further modelling do you agree/disagree:

Effects of water takes on spring fed streams are best managed 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.
Does this match your recollection?

Based on the hydrologists recommendation that it may be feasible, the TANK Group agreed to explore rolling out an augmentation scheme across the Heretaunga Plains for widespread takes but noted that a management group (similar to the Twyford scheme) is essential to “lean” on users. The model is not at a scale capable of accounting for observed stream depleting effects from particular takes. One option is to treat these as treated as surface water takes.
### Action points

<table>
<thead>
<tr>
<th>ID</th>
<th>Action item</th>
<th>Person</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.1</td>
<td>HBRC Scientists to consider the list of suggestions from the TANK Group on further modelling and come back with possibilities.</td>
<td>Jeff</td>
<td>Later in meeting</td>
</tr>
<tr>
<td>28.2</td>
<td>HBRC Scientists to come back with more information on GW levels.</td>
<td>Jeff/Pawel</td>
<td>Future meetings</td>
</tr>
</tbody>
</table>
Groundwater Modelling: Summary of Science

TANK Collaborative Stakeholder Group Meeting 29

Dr. Jeff Smith
Outline of Presentation:

1. Summary of modelling to date
2. Responses to questions from previous meeting
3. Introduction to sessions today
4. Looking ahead to next meeting
1. Summary of groundwater 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
Actual pumping impact distribution

- 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>
</tr>
<tr>
<td>Ngaruroro</td>
<td>1048.7</td>
</tr>
<tr>
<td>Raupare</td>
<td>93.9</td>
</tr>
</tbody>
</table>
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

Pumping bans unlikely to be successful
Agreement sought from TANK Group

Effects of water takes on spring fed streams are best managed by flow augmentation from groundwater 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
2. Options raised at previous meeting

- Augmentation from a dam to Ngaruroro, Raupare and Karamu, that shows the quantum of augmentation required
- Flooding Roy’s Hill Maraekakaho river flats to use as a recharge; turn into a wetland for co-benefits of increased flows and habitat
2. Options raised at previous meeting

• Using the aquifer as a ‘bank’ as long as not mining plus possibly artificial recharge

• More attention to “Avoid” options especially:
  ➢ A sliding scale of takes not fully used
  ➢ Protecting groundwater levels – risks of contamination (include domestic wells) and bores running dry.

• Using GW allocation limit to protect GW levels long term
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 levels and allocation

- Allocation?
2. Options raised at previous meeting

- What would it cost to replicate the Twyford Scheme in terms of management/operational costs?
- Methods to make urban (municipal) and industrial more efficient.
- Hydrological modelling cannot completely answer these questions
- Important issues, for consideration later
Further modelling requirements

1. Long term sustainability of pumping in terms of groundwater levels
2. Effects of combined lowland stream augmentation
3. Combined augmentation plus MAR
Modelling since previous meeting

1. Integration with SOURCE model revealed water balance deficit
2. Groundwater discharge to streams was underestimated during winter
3. Groundwater model was recalibrated ...
4. ... then previous scenarios run again, to confirm no substantial changes
Recalibrated groundwater discharge

![Graph showing recalibrated discharge data for Irongate. The graph displays discharge (L/s) over time from 1/04/2011 to 31/03/2014. The data is represented by a blue line, M2 by an orange line, and hpm035 by a green line. The graph highlights fluctuations in discharge over the specified period.]
Re-modelling of previous scenarios

Ngaruroro 150 days

Stream flow impact as % of pumping rate:
- 0-20%
- 20-40%
- 40-60%
- 60-80%
- 80-90%
- 90-100%

New improved model
Re-modelling of previous scenarios

Karamu 150 days

Stream flow impact as % of pumping rate
- 0-20%
- 20-40%
- 40-60%
- 60-80%
- 80-90%
- 90-100%

New improved model
## Water budget comparison (10 year average)

<table>
<thead>
<tr>
<th></th>
<th>New Model</th>
<th>Previous Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drains</td>
<td>-1.4</td>
<td>-6.8</td>
</tr>
<tr>
<td>Offshore Discharge</td>
<td>-30.0</td>
<td>-92.0</td>
</tr>
<tr>
<td>Well pumping</td>
<td>-75.7</td>
<td>-76.3</td>
</tr>
<tr>
<td>Recharge</td>
<td>77.9</td>
<td>79.1</td>
</tr>
<tr>
<td>River leakage</td>
<td>29.1</td>
<td>96.0</td>
</tr>
</tbody>
</table>
Modelling was suspended
3. What to expect later today

- GNS water age and tracer investigation of Heretaunga drinking water supply bores
- Configuring the SOURCE surface water flow model
- Out of stream storage for augmentation of Ngaruroro River during low flow periods
4. Modelling for next meeting

1. Long term sustainability of pumping in terms of groundwater levels
2. Effects of combined lowland stream augmentation
3. Combined augmentation plus MAR
Illustrative description
Questions?
Water Quantity Modelling

TANK Stakeholder Group Meeting 14th June 2017

Rob Waldron
Water Quantity Modelling

- SOURCE model simulates surface water
- MODFLOW simulates groundwater
- Both models interact to simulate the complete system and SW-GW interaction
- SOURCE and MODFLOW model domains overlap
Modelling SW and GW Abstractions

- Approximately 1500 current consented abstractions to be simulated using combination of both models.
Modelling SW and GW Abstractions

MODFLOW Model

- Simulates all groundwater abstractions within the MODFLOW model domain
Modelling SW and GW Abstractions

**SOURCE Model**
- Simulates all SW abstractions within the SOURCE model domain
- Also simulates GW abstractions located outside the MODFLOW model domain
Modelling SW and GW Abstractions

SOURCE Model

- Simulated abstractions located in numerous sub-catchments within the SOURCE model.
Flow Management Sites

Current Flow Management Site Network

- 14 current active minimum flow sites located within the SOURCE model domain.
- Traditional minimum flow sites used to manage the restriction of abstractions
Flow Management Sites

Potential Future Flow Management Site Network

- 10 proposed sites
- Focus on sites for effective management of instream habitat & oxygen requirements
- Sites may be used to trigger:
  - Restrictions
  - Staged reductions
  - Augmentation
  - Artificial recharge
# Current Flow Management Sites

<table>
<thead>
<tr>
<th>Catchment</th>
<th>14 Current Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tutaekuri</td>
<td>Tutaekuri River at Ngaroto</td>
</tr>
<tr>
<td></td>
<td>Tutaekuri River at Puketapu HBRC Site</td>
</tr>
<tr>
<td>Ngaruroro</td>
<td>Maraekakaho Stream D/S Tait Road</td>
</tr>
<tr>
<td></td>
<td>Ngaruroro River at Fernhill</td>
</tr>
<tr>
<td></td>
<td>Ngaruroro River at Whanawhana</td>
</tr>
<tr>
<td></td>
<td>Tutaekuri Waimate Stm at Goods Bridge</td>
</tr>
<tr>
<td>Karamu</td>
<td>Karamu Stream at Floodgates</td>
</tr>
<tr>
<td></td>
<td>Karewarewa Stream at Paki Paki</td>
</tr>
<tr>
<td></td>
<td>Louisa Stream at Te Aute Road</td>
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<tr>
<td></td>
<td>Mangateretere Stream at Napier Road</td>
</tr>
<tr>
<td></td>
<td>Ongaru Drain at Wenley Road</td>
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<tr>
<td></td>
<td>Paritua Stream at Water Wheel</td>
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<tr>
<td></td>
<td>Raupare Drain at Ormond Road</td>
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<tr>
<td></td>
<td>Te Waikaha at Mutiny Road</td>
</tr>
</tbody>
</table>
# Potential Future Flow Management Sites

<table>
<thead>
<tr>
<th>Catchment</th>
<th>10 Proposed Sites</th>
<th>Latest Flow Assessment Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tutaekuri</td>
<td>*Tutaekuri River at Puketapu HBRC Site</td>
<td>Habitat-flow modelling</td>
</tr>
<tr>
<td>Ngaruroro</td>
<td>*Maraekakaho Stream D/S Tait Road</td>
<td>Hydrological/ecological</td>
</tr>
<tr>
<td></td>
<td>*Ngaruroro River at Fernhill</td>
<td>Habitat-flow modelling</td>
</tr>
<tr>
<td></td>
<td>*Tutaekuri Waimate Stm at Goods Bridge</td>
<td>Oxygen-flow modelling</td>
</tr>
<tr>
<td>Karamu</td>
<td>Awanui Stream at Flume</td>
<td>Oxygen-flow modelling</td>
</tr>
<tr>
<td></td>
<td>Irongate Stream at Clarkes Weir</td>
<td>Oxygen-flow modelling</td>
</tr>
<tr>
<td></td>
<td>*Karamu Stream at Floodgates</td>
<td>Oxygen-flow modelling</td>
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<tr>
<td></td>
<td>*Raupare Drain at Ormond Road</td>
<td>Oxygen-flow modelling</td>
</tr>
</tbody>
</table>

*Existing active flow management sites*
TIME FOR LUNCH
Outline of Presentation:

1. Purpose of modelling
2. Methods and assumptions of the model
3. Results
4. Next steps
1. Purpose of Te Tua storage modelling

• A preliminary investigation of the feasibility of Te Tua storage for offsetting the effects of abstraction in the Ngaruroro River
2. Methods and assumptions

- Excel spreadsheet used to simulate:
  - Inflows to storage from Ngaruroro River
  - Volume and surface area of the storage facility for different water levels
  - Rainfall inputs and evaporation outputs at the lake surface
  - The ability of the storage volume to offset the effects of abstraction between 2008 and 2016
  - Various cease-take flows can be simulated
2. Methods and assumptions

• Assumptions:
  • Maximum depletion of river flows from groundwater abstraction = \(800\ \text{L/s}\)
  • Maximum offset required for groundwater and surface water abstraction = \(1,600\ \text{L/s}\)
  • A delivery system for entire offset flow is assumed
  • Maximum storage 5,000,000 \(m^3\) unless specified otherwise
2. Methods and assumptions

- Assumptions:
  - Rainfall and evaporation depth records from Bridge Pa were used, along with surface area of the lake, to calculate volume gains/losses.
  - 800 L/s inflow is assumed, when cease-take flow conditions are met (Ngaruroro at Fernhill).
2. Methods and assumptions

Inflow 800 L/s

Offset flow 800 L/s or 1,600 L/s

Lake Te Tua storage

Cease-take flow at Fernhill
2. Methods and assumptions

\[ y = -5 \times 10^{-9} x^2 + 0.0797 x + 247640 \]
\[ R^2 = 0.9988 \]

\[ y = -1 \times 10^{-13} x^2 + 3 \times 10^{-6} x + 0.2216 \]
\[ R^2 = 0.9994 \]
2. Methods and assumptions

Rainfall → Evaporation
3. Results — offsetting 800 L/s from groundwater takes

Cease-take flow = 2,400 L/s

Te Tua storage

Storage (m$^3$)
3. Results – offsetting 800 L/s from groundwater takes

Cease-take flow = 4,000 L/s

No water 7-17 April 2013
3. Results – offsetting 1,600 L/s from all takes

Cease-take flow = 2,400 L/s

No water 24 March – 17 April 2013
3. Results – offsetting 1,600 L/s from all takes

Cease-take flow = 4,000 L/s

No water 26 Feb – 17 April 2013
3. Results – offsetting 1,600 L/s from all takes

Cease-take flow = 4,000 L/s; increased storage

No water 5-17 April 2013, but 32mm rain
4. Future modelling options

1. Revise spreadsheet model for improved inputs and assumptions

2. Evaluate effects of storage take on Ngaruroro River flows

3. Apply the Heretaunga GW/SW model for a sophisticated model – including losses to groundwater from Ngaruroro River

4. Investigate Te Tua storage for augmenting Paritua and Karamu
Water Allocation Options Assessment

Mary-Anne Baker
# Values matrix

<table>
<thead>
<tr>
<th>Management Scenario</th>
<th>Values</th>
<th>Economic</th>
<th>Ecosystem Health</th>
<th>Wairua</th>
<th>Mauri</th>
<th>ground water levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attributes</td>
<td>Attributes</td>
<td>Economic</td>
<td>Ecosystem Health</td>
<td>Wairua</td>
<td>Mauri</td>
<td>ground water levels</td>
</tr>
<tr>
<td>SoS</td>
<td>Flow - %habitat</td>
<td>Flow – dissolved oxygen</td>
<td>Natural state</td>
<td></td>
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<tr>
<td>Flow</td>
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<td></td>
<td></td>
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<tr>
<td>Natural state</td>
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</tbody>
</table>

**Key**
- **Strong alignment**
- **Medium**
- **Low**
- **Natural state**
## Values matrix

<table>
<thead>
<tr>
<th>Management Scenario</th>
<th>Groundwater</th>
<th>Economic</th>
<th>Ecosystem Health</th>
<th>Wairua</th>
<th>Mauri</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attributes</td>
<td>SoS</td>
<td>Flow - %habitat</td>
<td>Flow – dissolved oxygen</td>
<td>Flow</td>
<td>Natural state</td>
</tr>
<tr>
<td>1. No restriction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Zone based restriction</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>3. Whole of plains restriction</td>
<td></td>
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<td></td>
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<tr>
<td>4. River flow augmentation</td>
<td></td>
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<tr>
<td>5. Managed aquifer recharge (MAR)</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>6. Maintain current allocation</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>7. Reduce allocation</td>
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<td></td>
<td></td>
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<tr>
<td>8. Increase allocation</td>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>
# Values matrix

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<th>Wairua</th>
<th>Mauri</th>
<th>Ground water levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attributes</td>
<td>SoS</td>
<td>Flow - %habitat</td>
<td>Flow – dissolved oxygen</td>
<td>Natural state</td>
<td></td>
</tr>
</tbody>
</table>

## Management Scenario

**Surface Water**

1. No restriction
2. Minimum flow restriction
3. Staged reduction + minimum flow restriction
4. Flow sharing + minimum flow restriction
5. Flow sharing (without minimum flow restriction)
6. Maintain current allocation
7. Reduce allocation
8. Increase allocation
Verbal updates from Working Groups

- Engagement
- Economic Assessment
- Stormwater
- Wetlands/Lakes
- Mana whenua
Next meeting – 27 July 2017

1. Clive River management options
   - Options for flow and channel management

2. Further GW/SW modelling results

3. Stormwater management, including updates from:
   - NCC on Ahuriri wetlands
   - HDC on plan change

4. Nutrient management options
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