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

Meeting 27: 22 March 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

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Agenda

9:30am	Edge of A Raindrop
10:00am	Notices, meeting record
10:15am	Ahuriri state and trends plus management options
12:00pm	Update on WCO, Freshwater Improvement Fund, Water Summit
12:30pm	**LUNCH**
1:00pm	SW-GW quantity modelling • New MALF-7d for Ngaruroro • Why does a change to MALF change flow management regimes • Stream depletion modelling results; Effectiveness of pumping ban and Mitigation options
3:00pm	**COFFEE BREAK**
3:30pm	Plan change skeleton
3.45pm	EAWG update
4:00pm	**CLOSE MEETING**

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Meeting objectives

1. Decide on preferred management strategy for Ahuriri (e.g. get direction for drafting provisions)

2. Consider GW modelling outputs and need for further scenario refinement and testing.

3. Decide on the preferred level of habitat protection for the Ngaruroro and Tutaekuri (to assess scenarios against)

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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

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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.

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Meeting Record – TANK Group 26

- Matters arising
- Action points

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Action points from TANK #26

		Responsible	Status
26.1	Bring Rowan Wallis, HDC Planning Manager along to the next TANK Group meeting to provide an update on the HDC plan change.	Mark Clews	Due next meeting (27 April)
26.2	HBRC to formally respond to the mana whenua position paper.	James Palmer	WIP
26.3	HBRC to come back with a paper explaining the differences between a Water Conservation Order and a Regional Plan.	Mary-Anne Baker	Sent with Agenda for today
26.4	Revise the *Rivers, modified watercourses and farm drains discussion document* based on today's discussion for wider circulation.	Mary-Anne Baker	WIP
	PLUS sediment discussion document	Mary-Anne Baker	WIP
25.	Post meeting update: EAWG has considered how to "insert biological farming and ecological economics expertise into the EAWG"	EAWG	WIP – see Meeting notes for EAWG (portal)

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Action points from TANK #26

		Responsible	Status
26.5	HBRC to provide the volume of water consented/used (?) by each water user type (e.g. municipal, irrigators, urban growth).	Pawel	In today's PPT
26.6	HBRC to provide more information (e.g. in the form of "Factsheets") with more commentary on each of the 10 scenarios.	Rob W	Due next meeting
26.7	Assess each scenario against the values as a means to compare and find the best options to pursue.	Rob W	Due next meeting

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Guest speakers

At TANK #14 in November 2014, protocols and guidelines were agreed for considering potential guest speakers:

Speakers will:

- *be relevant to our process and goals*
- *represent a balance of views*
- *be reputable experts – start with Council staff and look externally if the group supports the need for that*
- *consider emerging science as well as 'pure' science*
- ***be timely / aligned to the group's programme***
- *help to solve a problem/challenge (articulated in advance)*
- *cover management variables (e.g. farm plans), policy options (e.g. from other regions), and other topics (e.g. economics) as well as science.*

A sub-group was set up to select who and when but this never progressed.

PROPOSAL: refer to the Engagement WG.

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The compiled list as at 4 March 2015

ID	Topic [speaker name] (if any)
1	Economic impact of a less secure water supply, ie: increasing numbers of ban days. Particularly impacts on primary producers with the understanding that secondary and tertiary industries will be directly impacted [?]
2	Surface water groundwater connectivity, progress on this model [Stephen Swabey or similar at HBRC]
3	Farm Environmental Management Plans – HBRC's position on PC6's requirements [HBRC?]
4	Farm Environmental Management Plans – approaches in other regions [Angella Halliday (HortNZ)]
5	Security of water supply in the Tukituki catchment based on using different numbers of ban days than the 10 days currently assumed in PC6 [HBRC Science]
6	Soil health and organic methods including Canterbury study comparison of biological farming c.f. conventional farming [Brendan Powell/Nathan Heath (HBRC); Scott Lawson; Dan Bloomer (Landwise)]
7	Nutrient management and water quality outcomes; update on national work programme [?]
8	Mauri [Kepa Morgan]
9	Cultural monitoring indicators for freshwater and stormwater [Jamie Ataria]
10	Irrigation efficiency and changing land use practices [Kevin Davidson + Phyllis Tichinin]

The compiled list as at 4 March 2015

ID	Topic [speaker name] (if any)
11	Horticulture industries nutrient footprint; Industry Good Management Programme; emerging and future advances in horticultural sector nutrient management; current and planned research programmes; water quantity management approaches in other regions *[Chris Keenan or similar at HortNZ]*
12	Groundwater modelling and design *[Chris Daughney]*
13	Whitebait spawning areas and wetlands *[Fred Litchwark]*
14	Groundwater, plus geophysics and hydrogeology; Potential growth of petroleum exploration *[Paul Whyte (GNS)]*
15	Mahinga kai species management *[Hans Rook]*
16	Crop water use models *[Marc Greven]*
17	Nitrogen leaching and modelling *[Brent Clothier (Plant and Food Research)]*
18	Climate modelling and climate change *[?]*

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Ahuriri state and trends; management options

Anna Madarasz-Smith

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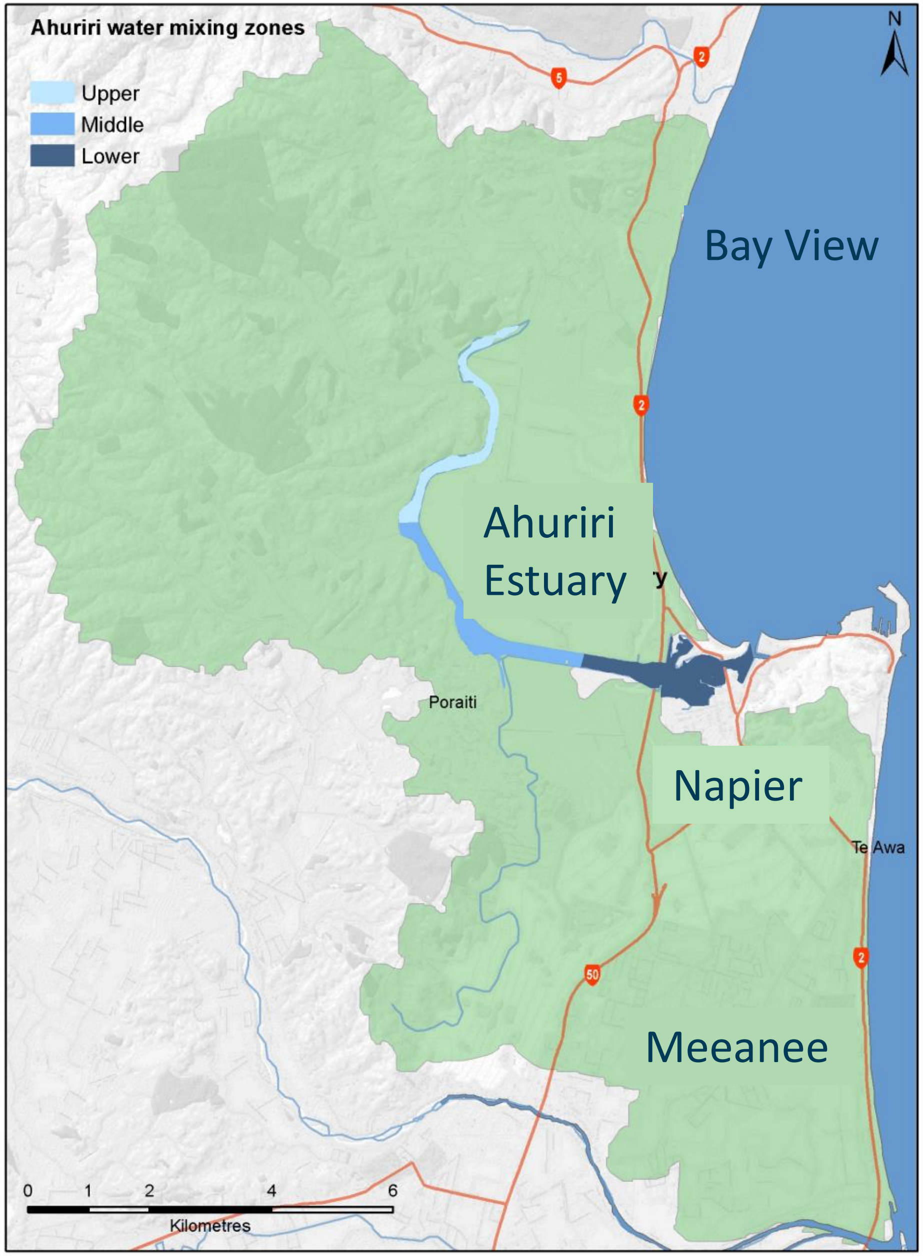

Ahuriri Catchment

- >14 000 ha
- High producing grassland (53%)
- Urban Areas (18%)
- Pine forest (7%)

*LCDB4

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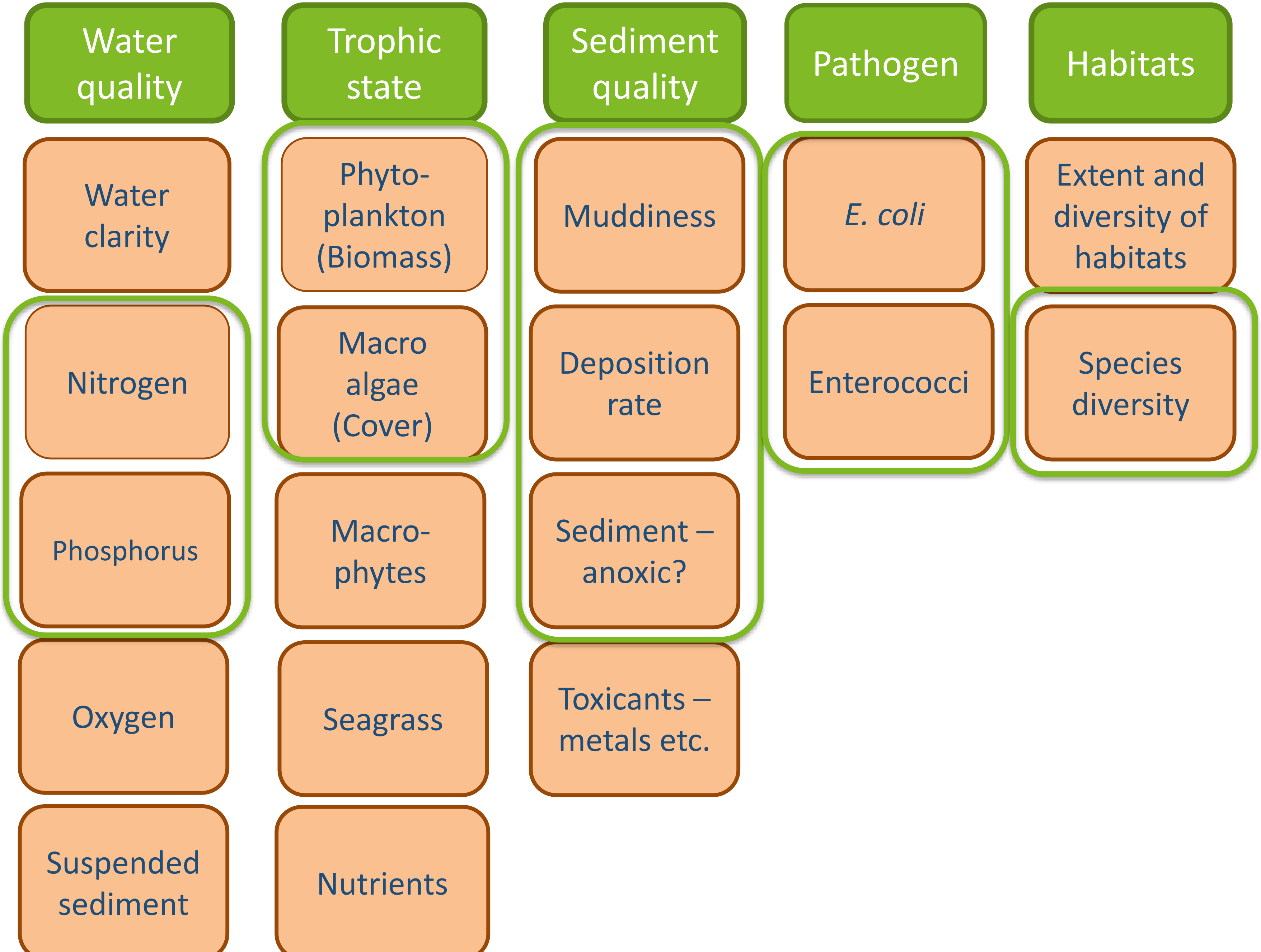
TANK Group concerns:
from TANK interim report

Recognition of the Ahuriri Estuary as a site of ecological, cultural and recreational significance.

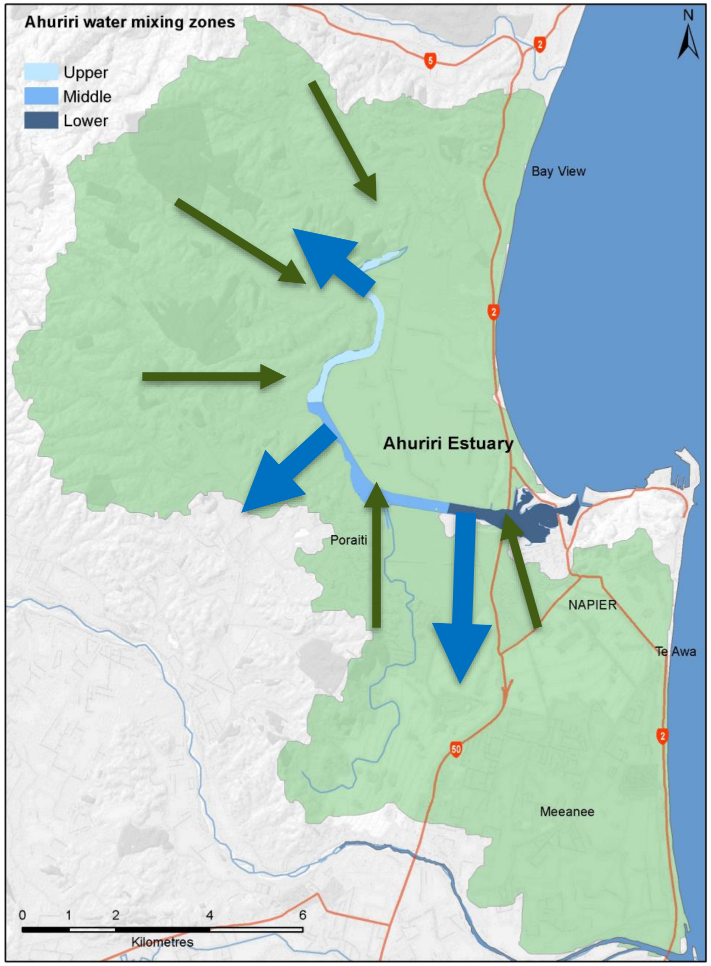
Concern about sediment, nutrient, bacteria and contaminant inputs into the estuary.

Concern about poor water quality in urban streams.



Water quality
Trophic state
Sediment quality
Pathogen
Habitats
Water clarity
Phyto-plankton (Biomass)
Muddiness
E. coli
Extent and diversity of habitats
Nitrogen
Macro algae (Cover)
Deposition rate
Enterococci
Species diversity
Phosphorus
Macro-phytes
Sediment – anoxic?
Oxygen
Seagrass
Toxicants – metals etc.
Suspended sediment
Nutrients

Different 'viewpoint' from other catchments



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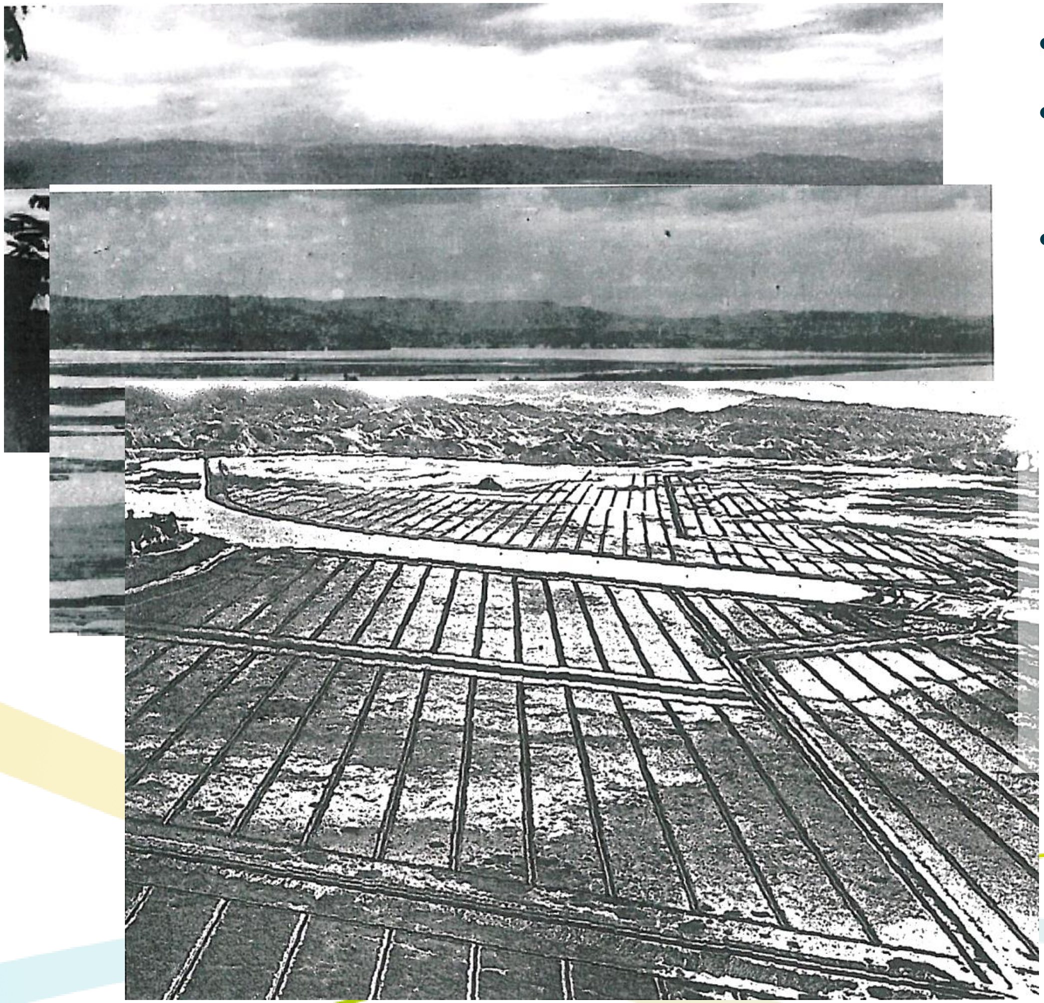
Receiving environment:



- Remnants of the Ahuriri Lagoon
- Vastly modified by both natural and human events
- Although modified, retains significant environmental value:
  - Nationally significant fisheries values

    (Kilner & Akroyd, 1978; Davis, 1987)
  - Nationally significant wildlife values (WERI, SSWI)
  - Nationally important geological features (Kenny & Hayward, 1993)

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What are the issues?

- High sediment load
  - altering benthic habitat; flora; & fauna.
- High nutrients
  - leading to eutrophication
- Extensive expansion of the invasive *Ficopomatus enigmaticus*;
- Stormwater quality

- Many areas where the current state may compromise the values

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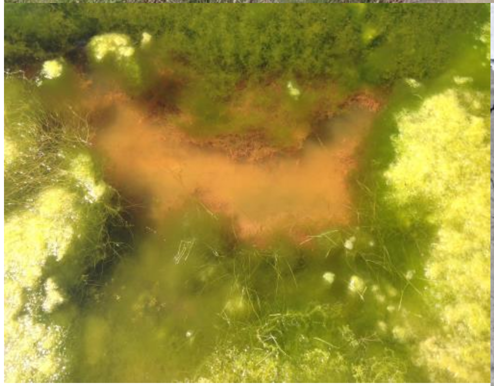
Upper Ahuriri

- Anoxic sediments
- Macroalgae growth
- Pump station
- Elevated nutrients
- Hydrological changes



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Sediments – the master stressor?

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Deposited sediment
Impact on estuarine values

Waitangi Estuary

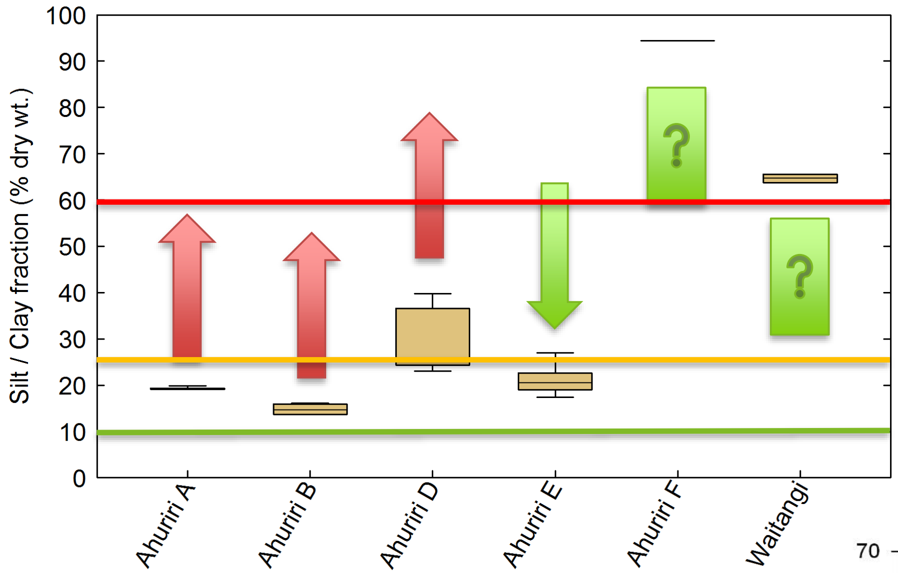
Waitangi Estuary

Ahuriri Estuary

Deposited sediment:

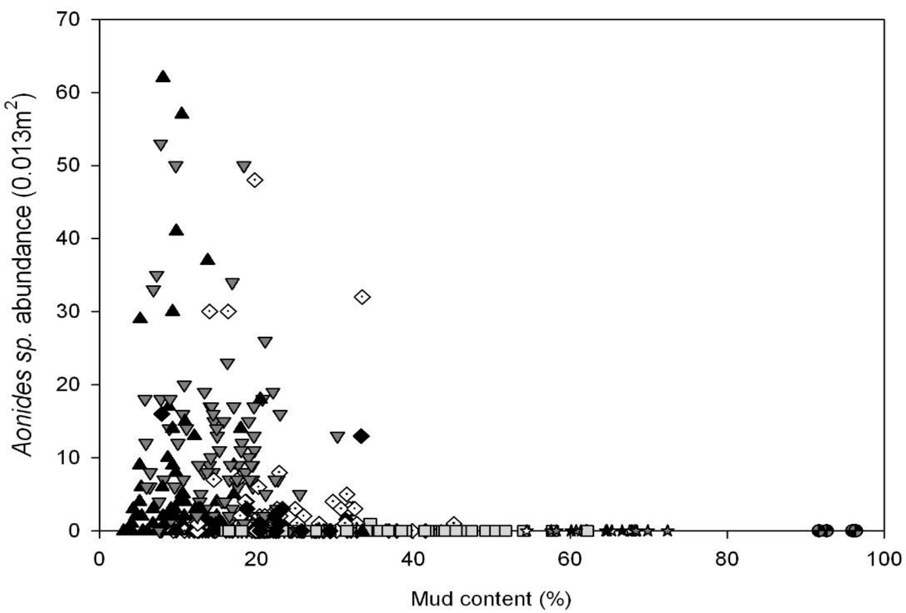
- Change in substrate from gravel and sand (slide on left) to mud (centre slide) means change in species (SoE monitoring)
- Smothering of eelgrass and intertidal vegetation (left slide)
- Smothering of shellfish beds and other infauna (middle slide and SOE data)
- Anoxic layer at surface a sign of increasing fine sediment – nothing can live in this (right slide) !

What are we seeing?



Amount of ‘mud’ in the sediment

How animals respond to that:
Numbers of worms as mud increases



Water Quality – Nutrients and Productivity

Nutrients and Productivity

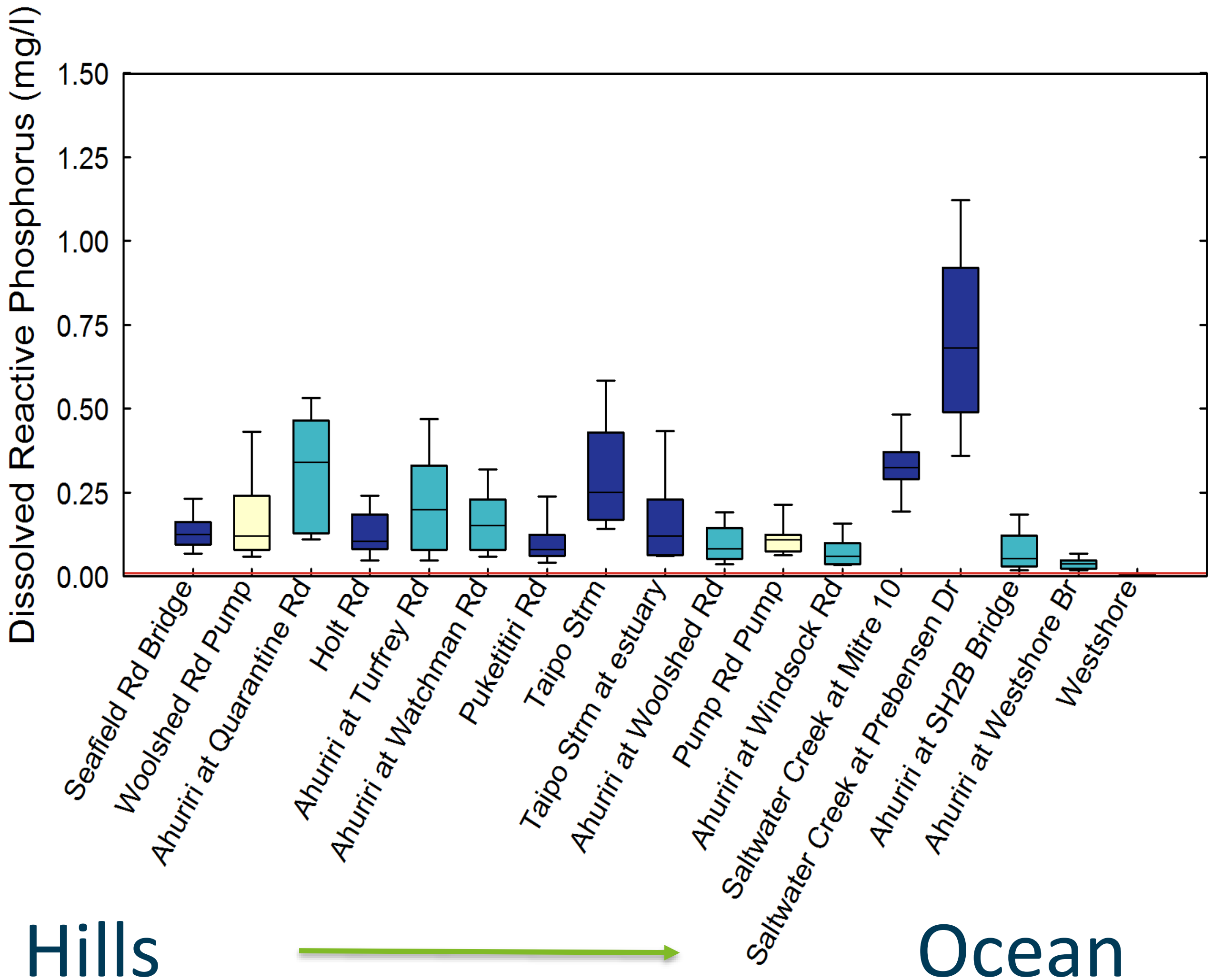
Impact on estuarine values

Phytoplankton (chlorophyll *a*

Amount of particles in the water:

- Clogs and abrades gills of filter feeders
- Filter feeders have to filter more → less energy for growth, reproduction

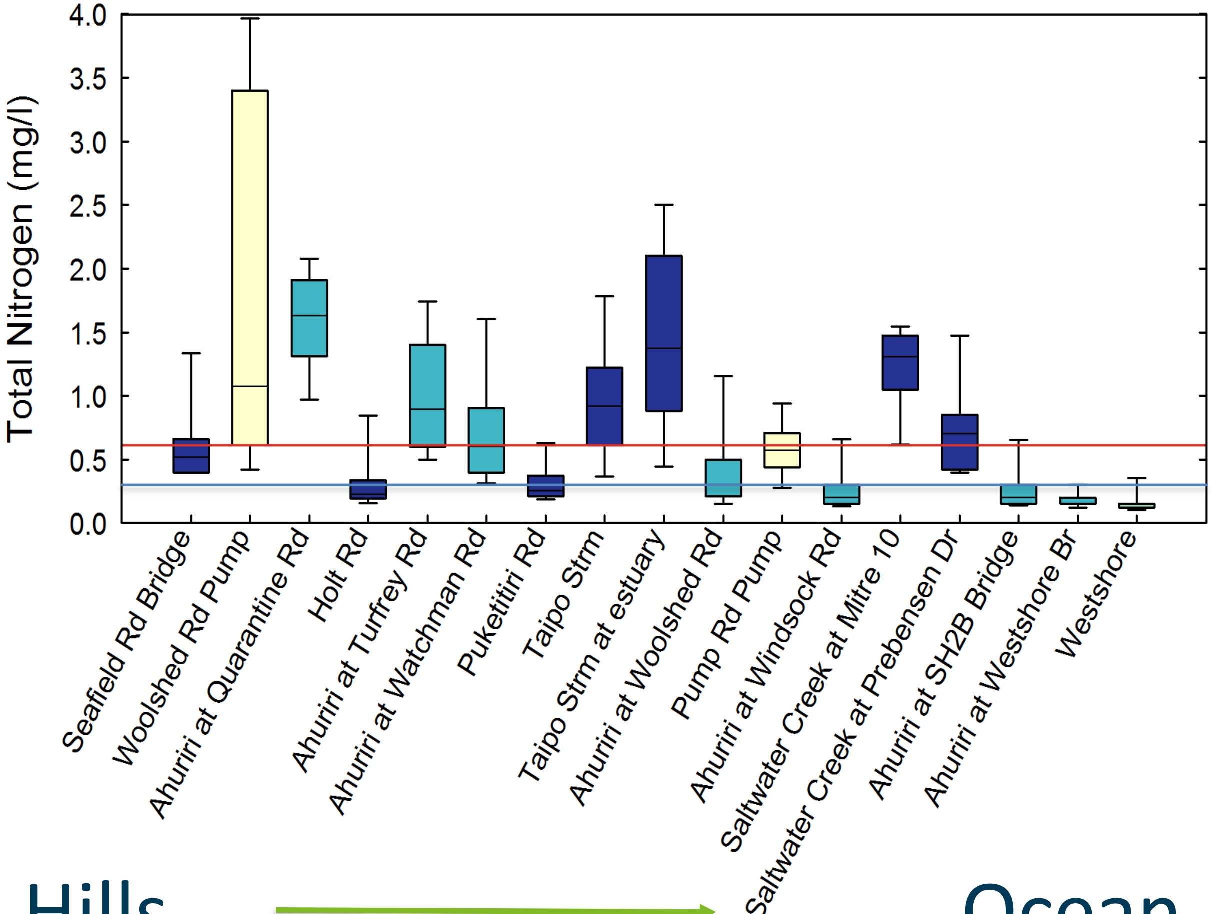
Nutrients - Phosphorus



ANZECC guidelines
Lowland str = 0.010mg/l
Estuarine = 0.005mg/l

Hills → Ocean

Nutrients - Nitrogen

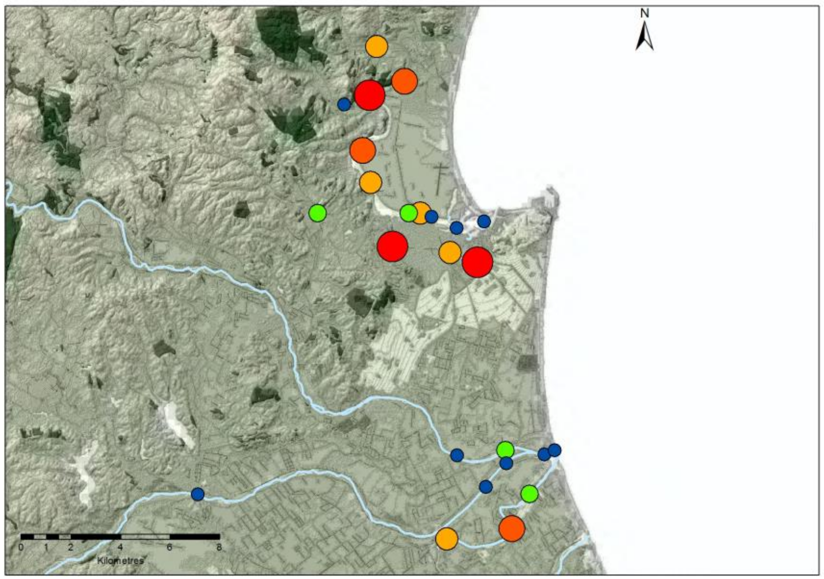


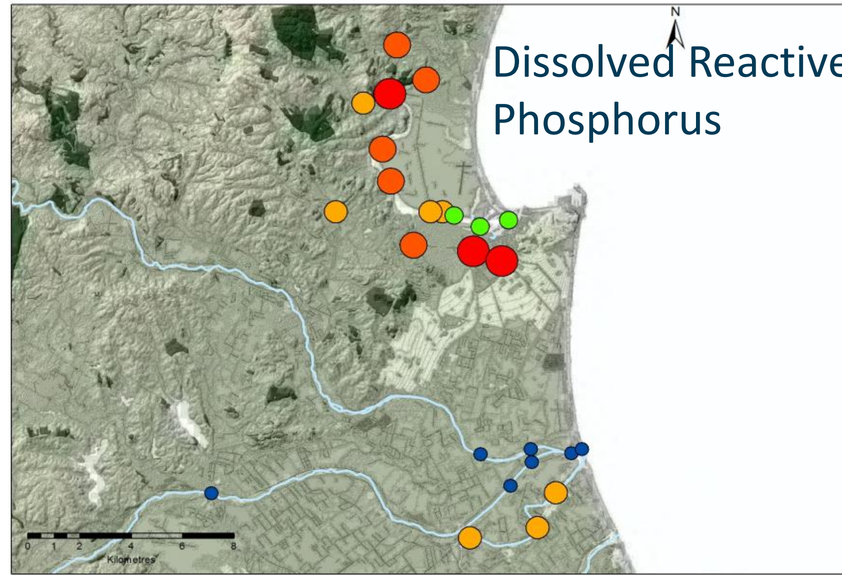
ANZECC Guidelines:
Lowland streams = 0.614mg/l
Estuarine = 0.30mg/l

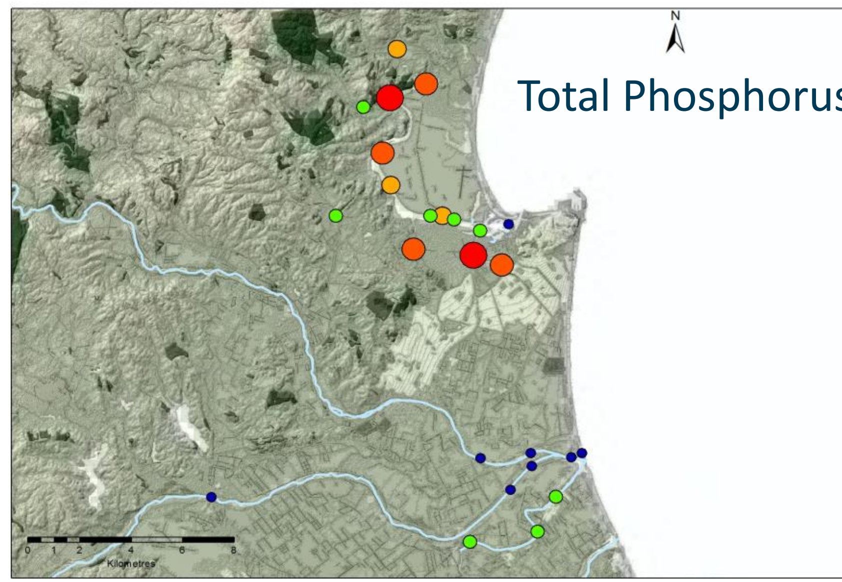
Hills → Ocean

Nutrient sources

Total Nitrogen







On average 74% of P is in DRP

Site name	E.coli	NO_3	Amm-N	Chla	PeriWCC	MPh	DIN	TN	DRP	TP	Bdisk	Turbidity	MCI
Ngaruroro catchment													
Ngaruroro Rv at Kuripapango	A	A	A				A	A	A	A	B	B	E
*Taruarau Rv	A	A	A	A	A		A	A	A	A	B	A	E
Ngaruroro Rv at Whanawhana	A	A	A	B	B		A	A	A	A	C	B	G
*Poporangi Strm	A	A	A	B	B		D	D	F	C	C	C	G
Ngaruroro Rv U/S HB Dairies	A	A	A	C	A		A	A	A	A	C	B	G
Ngaruroro Rv D/S HB Dairies	A	A	A	B	A		A	A	A	B	D	C	G
*Maraekakaho Strm	A	B	A		P		C	D	F	C	C	B	G
Ngaruroro Rv at Ohiti	A	A	B	B			B	A	A	B	D	D	G
Waitio Strm	B	A	B	B	B		C	C	F	C	C	A	G-F
*Ohiwia Strm	C	A	A				D	D	F	F	C	B	F
Ngaruroro Rv at Fernhill	A	A	A	B	B		B	B	A	B	D	C	F
Ngaruroro Rv at Motorway	A	A	A	B	B		B	B	A	B	D	C	G-F
Tutaekuri-Waimate Strm	B	A	A				C	C	F	F	E	C	F
Ngaruroro Rv at Chesterhope NIWA	A	A	A				B	B		C	D	C	G
Tutaekuri catchment													
Tutaekuri Rv at Lawrence Hut	A	A	A	A	A		A	A	A	A	A	A	E
*Mangatutu Strm	A	A	A		D		C	C	F	B	D	B	G
Tutaekuri Rv U/S Mangaone Rv	A	A	B	B	A		B	B	D	B	D	B	G
Mangaone Rv at Rissington	A	A	A	B	A		C	C	F	C	C	A	G
*Mangaone Rv at Dartmoor	A	A	A				B	B	F	D	C	A	G
*Tutaekuri Rv at Puketapu	A	A	A	C	A		B	B	E	B	C	A	F
Tutaekuri Rv at Brookfields Br	A	A	A	D	A		B	B	E	B	C	B	F
Karamu and Ahuriri catchments													
Ruahapia Strm	C	A	B				D	D	F	F	E	C	P
Karewarewa Strm	C	C	C				E	F	F	F	D	C	P
Awanui Strm	B	B	B				E	F	F	F	D	B	P
Poukawa Strm	A	A	A				C	F	F	F	D	A	P
Herehere Strm	D	B	A				C	D	F	F	C	C	P
Mangarau Strm at Keirunga Rd	B	A	A	D			B	C	F	F	E	C	F
Mangarau Strm at Te Aute Rd	B	B	A	C			F	F	F	F	E	B	P
Clive Rv	B	B	A				D	D	F	F	D	B	P
Taipo Strm	C	A	C				D	E	F	F	F	D	P

Marine Invasive Pests – Marine tubeworm

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Marine Invasive Pests – Marine tubeworm

- Records since 1990s
- High nutrient waters good food!
- Problems with flushing
- Habitat alteration

- Management both operative and via plan change.

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Stormwater Inputs

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Stormwater Inputs

- Urban waterways important for flood water removal
- Also important habitat in own right
- Both individual and TA operated consents
- Work underway by Stormwater Working Group

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Swimmability

Swimmability

- Pandora Pond
  - Suitable – 97% of time
- Rest of estuary
  - Spikes after rain but pretty good
- Collecting shellfish/fishing
  - Not recommended for Shellfish Gathering

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How can we improve the health of the estuary?

- Sediment
  - Too much sediment
  - 81% more now than if forested
  - What level of reduction is required?
    - Is 30% enough?
    - What is feasible?
  - Overall e.g. best practice
  - Critical Source/Focused – loss mitigation, riparian, traps etc
  - Co-benefits for Phosphorus and Nitrogen

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How can we improve the health of the estuary?

- Nutrients
  - Too much phosphorus
  - What level of reduction is required? Feasible?
  - Overall e.g. best practice
  - How much captured by sediment management?
  - Nitrogen management?

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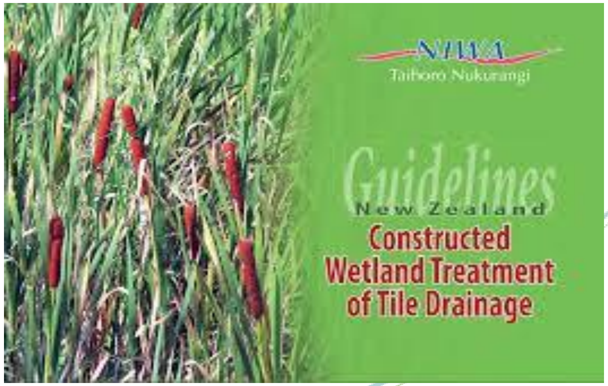
How can we improve the health of the estuary?

- Marine invasive – removal e.g. operational;
- Stormwater discharges (SWG);
- Habitat integrity



What does a healthy Ahuriri Estuary look like?

- Natural water flow patterns;
- Good quality fresh and oceanic water;
- Healthy sediments;
- Open fish access;
- Range of healthy habitats;
- Convoluted edging;
- Natural vegetation sequencing;
- Healthy and diverse species.

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Breakout session

1. What does a healthy estuary look like to you?

2. Do you agree with the management options recommended?

1. Is there anything missing?

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Groundwater and Surface Water Quantity

TANK Collaborative Stakeholder Group
Meeting 27

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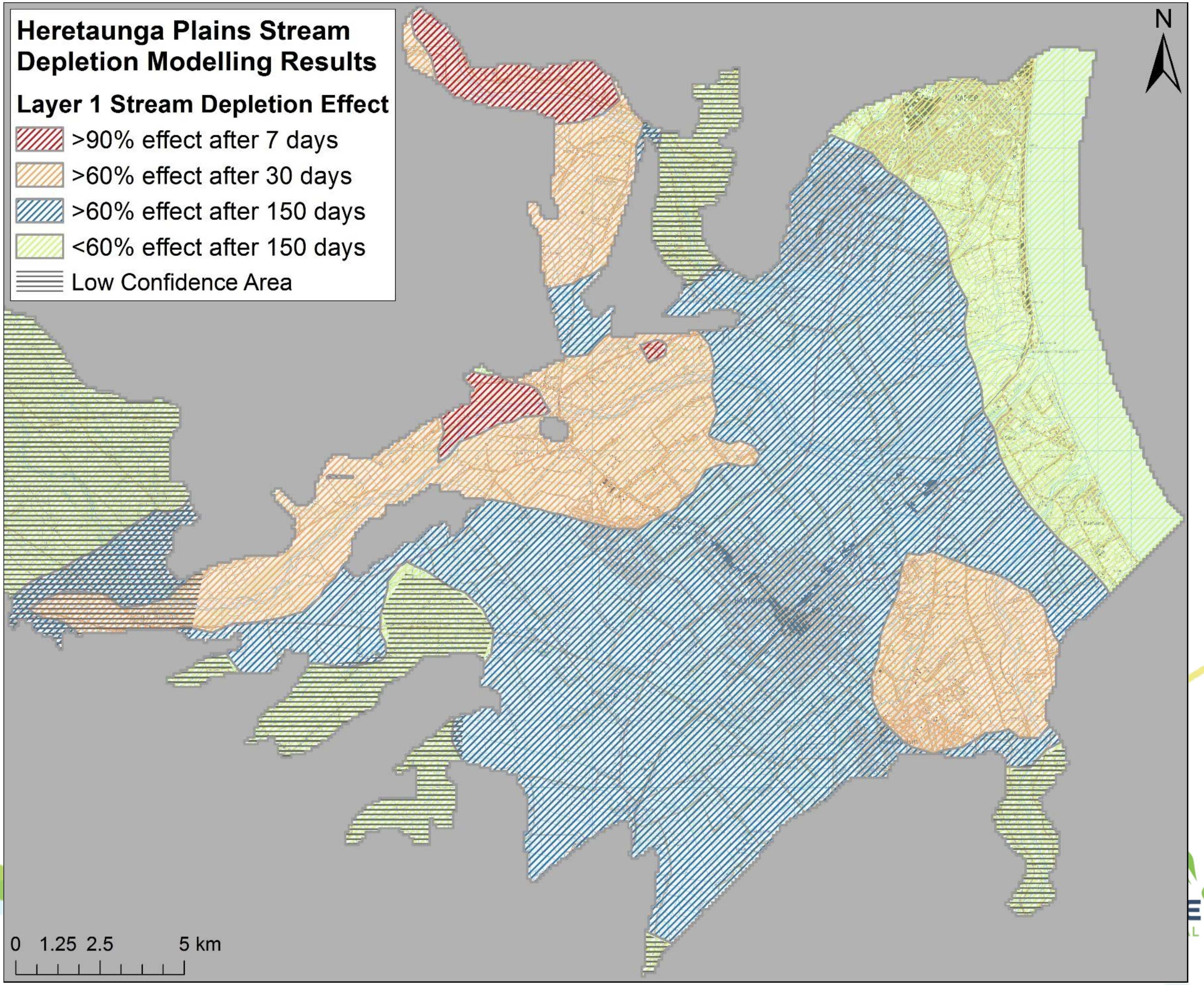
Meeting 26: Stream Depletion Modelling



Scenarios for stream depletion modelling:

1. Mitigation effects of restrictions applied to groundwater takes in stream depletion zones
2. Mitigation effects of management schemes (i.e. flow augmentation or artificial recharge)

Presentations:

1. Revised MALF(7d) for Ngaruroro River at Fernhill
   (Jeff Smith)

2. Low flows, habitat assessment and flow management
   (Thomas Wilding)

3. Groundwater model scenario testing:
   i. Mitigating stream depletion by restricting groundwater abstraction
   ii. Management options for augmenting stream flows
   (Pawel Rakowski)

4. Break out groups

Breakout Questions

1. What percentage of stream depletion recovery should justify restrictions?
2. Over what period of time? e.g. 7, 30, 60 days, other?
3. Should groundwater pumping restrictions be focused on smaller streams?
4. What further modelling is required?
5. Staged reductions or total bans – scenarios in preparation
6. Are we in a position to decide on preferred levels of habitat protection?

Revision of MALF(7d) for the Lower Ngaruroro River

Jeff Smith, Thomas Wilding, Rob Waldron

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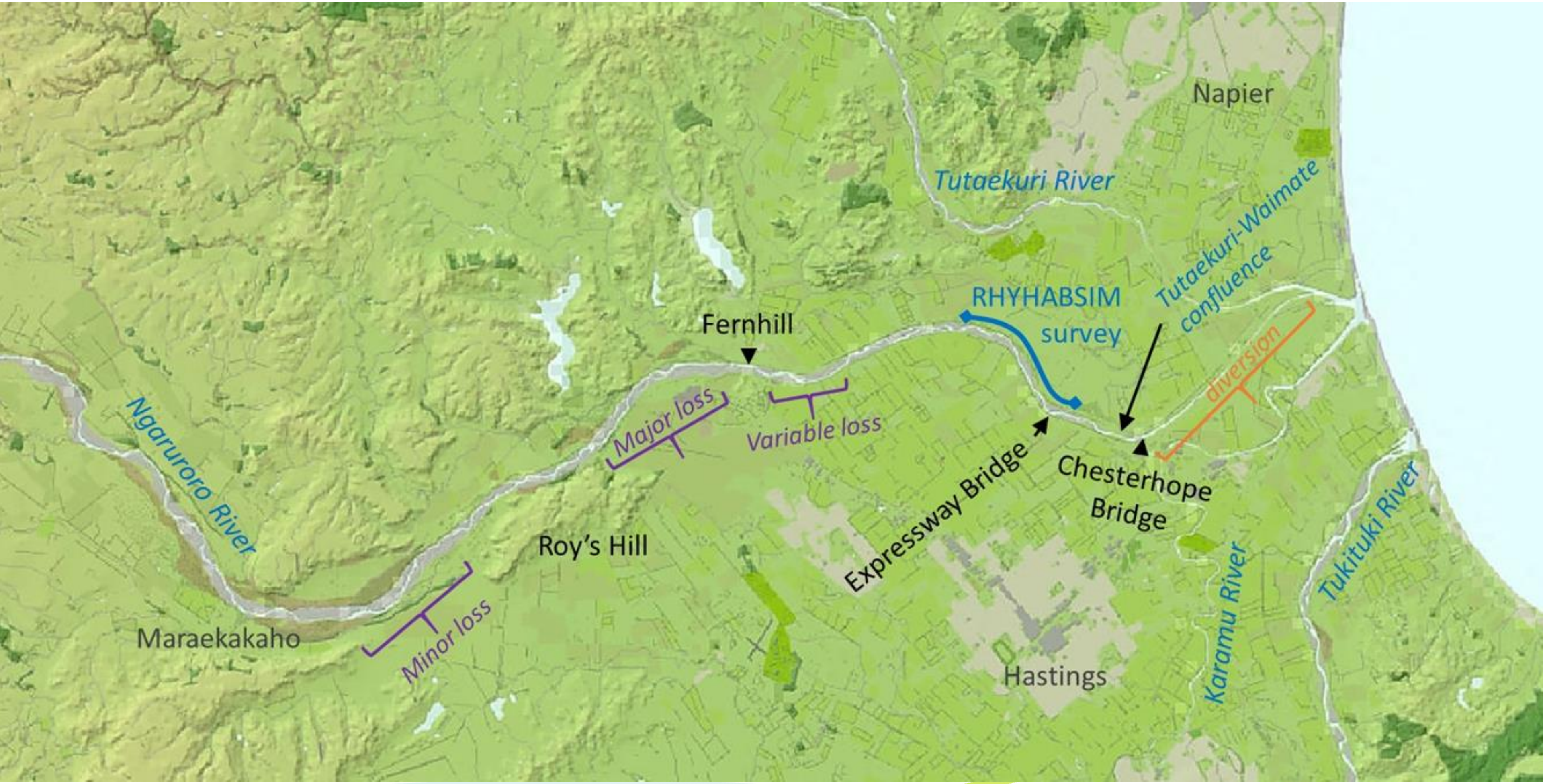
Introduction



Introduction

MALF(7d) is a low-flow statistic commonly used for benchmarking stream and river flows

Outline:

1. MALF(7d) explained
2. Previous MALF(7d) for Ngaruroro R. at Fernhill
3. Revision of MALF(7d)
4. Implications – revised habitat assessment

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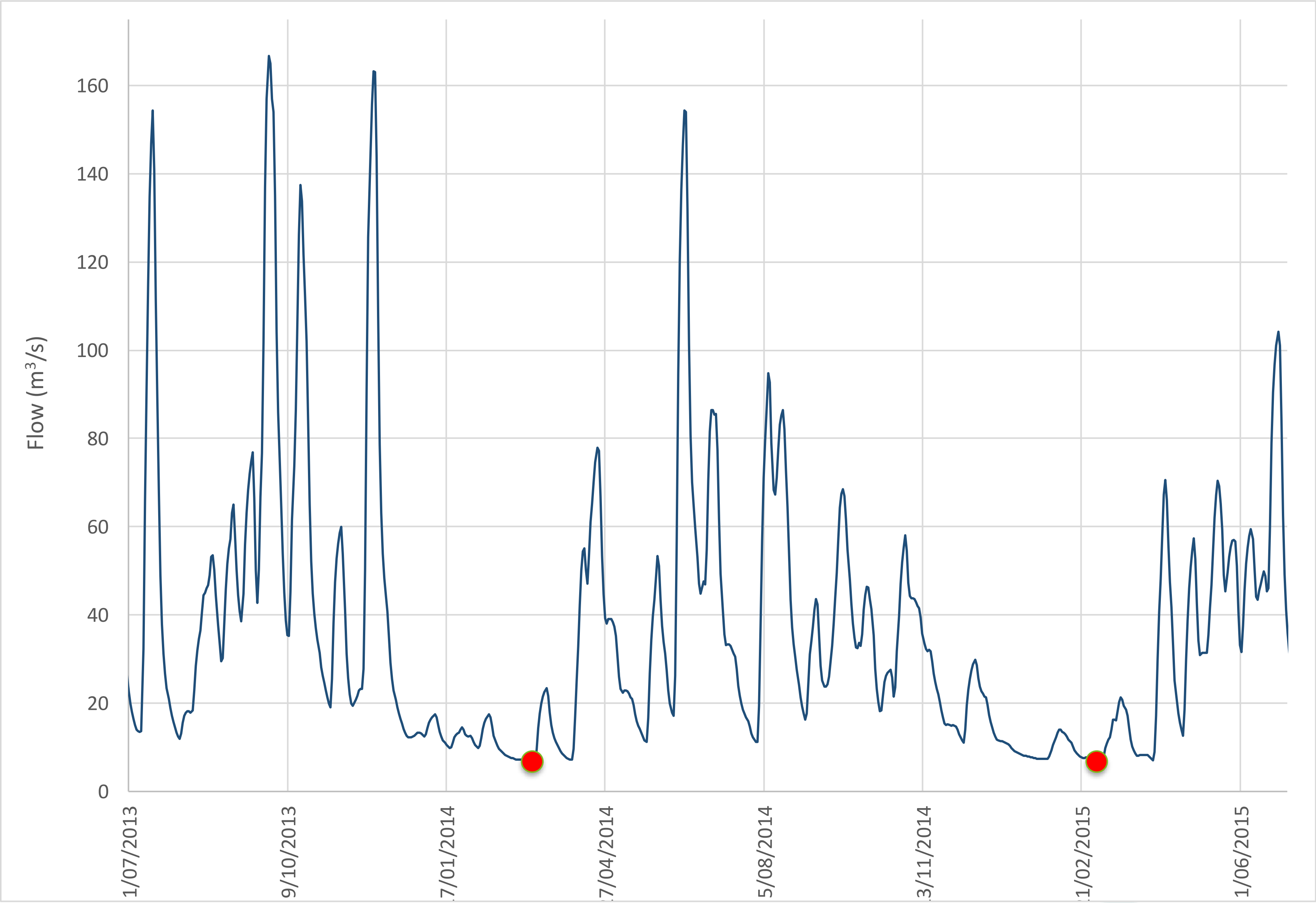
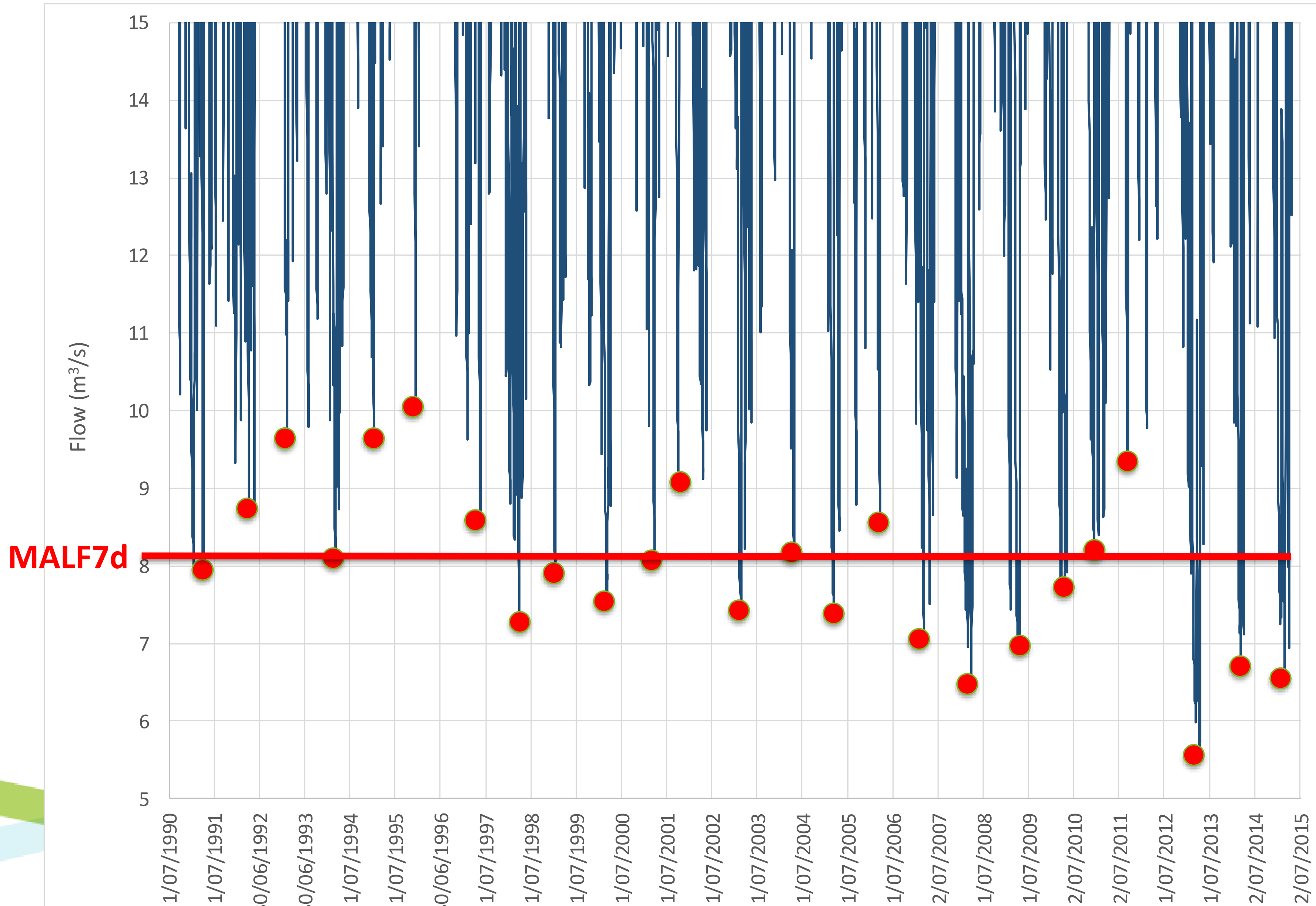
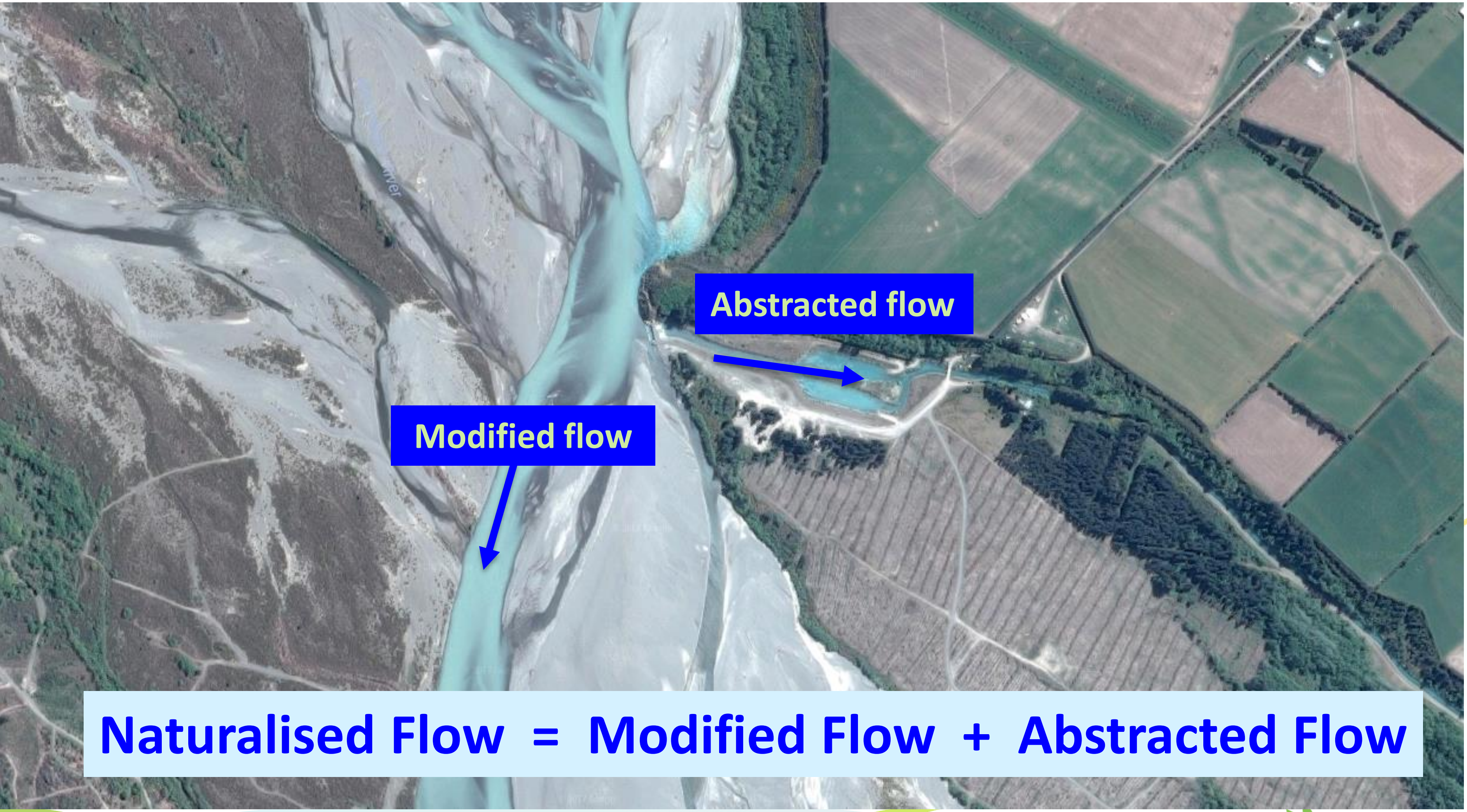
1. MALF(7d) explained



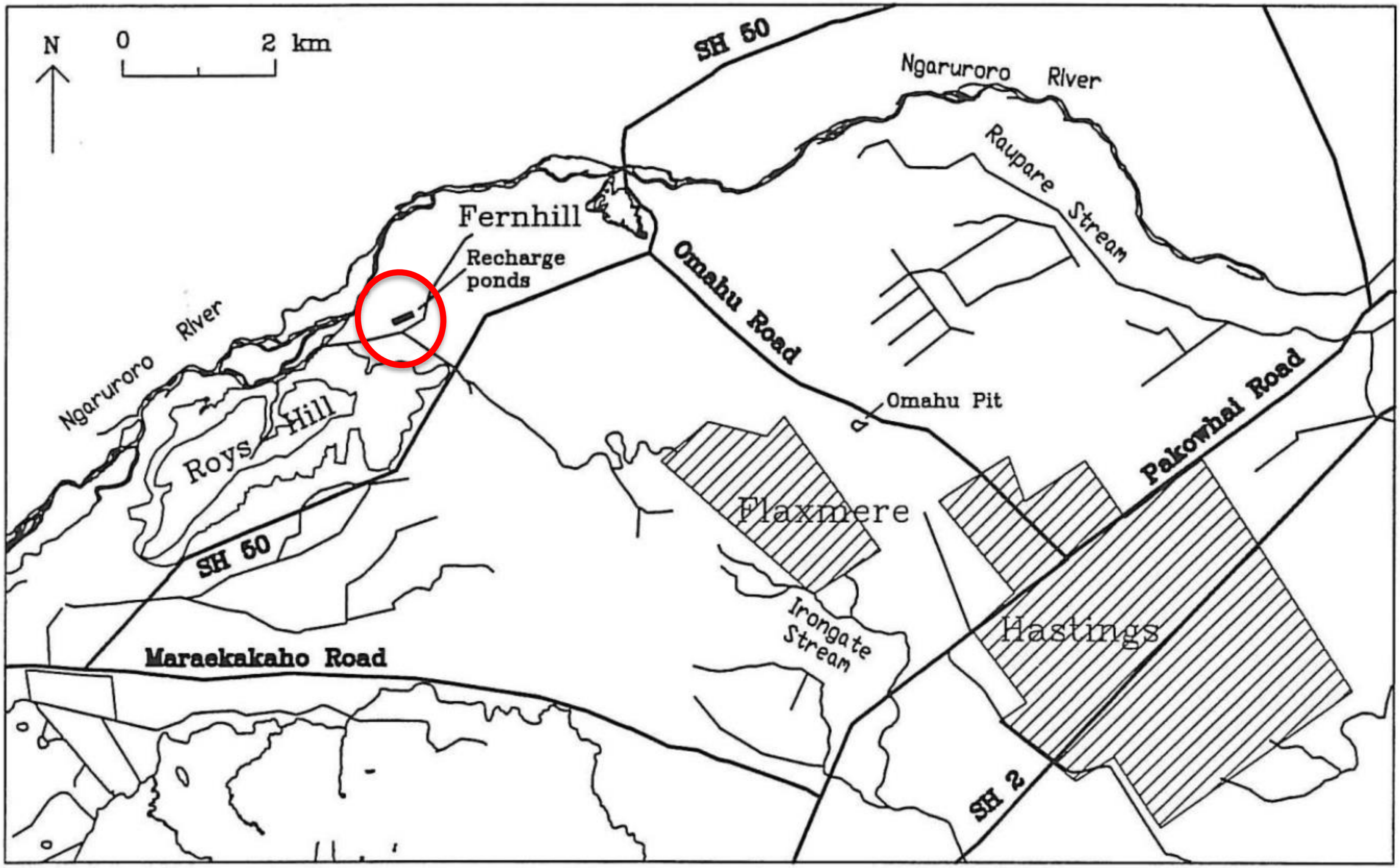
1. MALF(7d) explained



1. MALF(7d) explained



1. Artificial Recharge (AR) Scheme



1. Recharge Scheme

Trials commenced 1982

- Max take 8500 L/s, Min flow 2800 L/s

Scheme commissioned 1988

- Take 3000 L/s when flow > 3500 L/s
- 850 L/s @ flow 2800 L/s

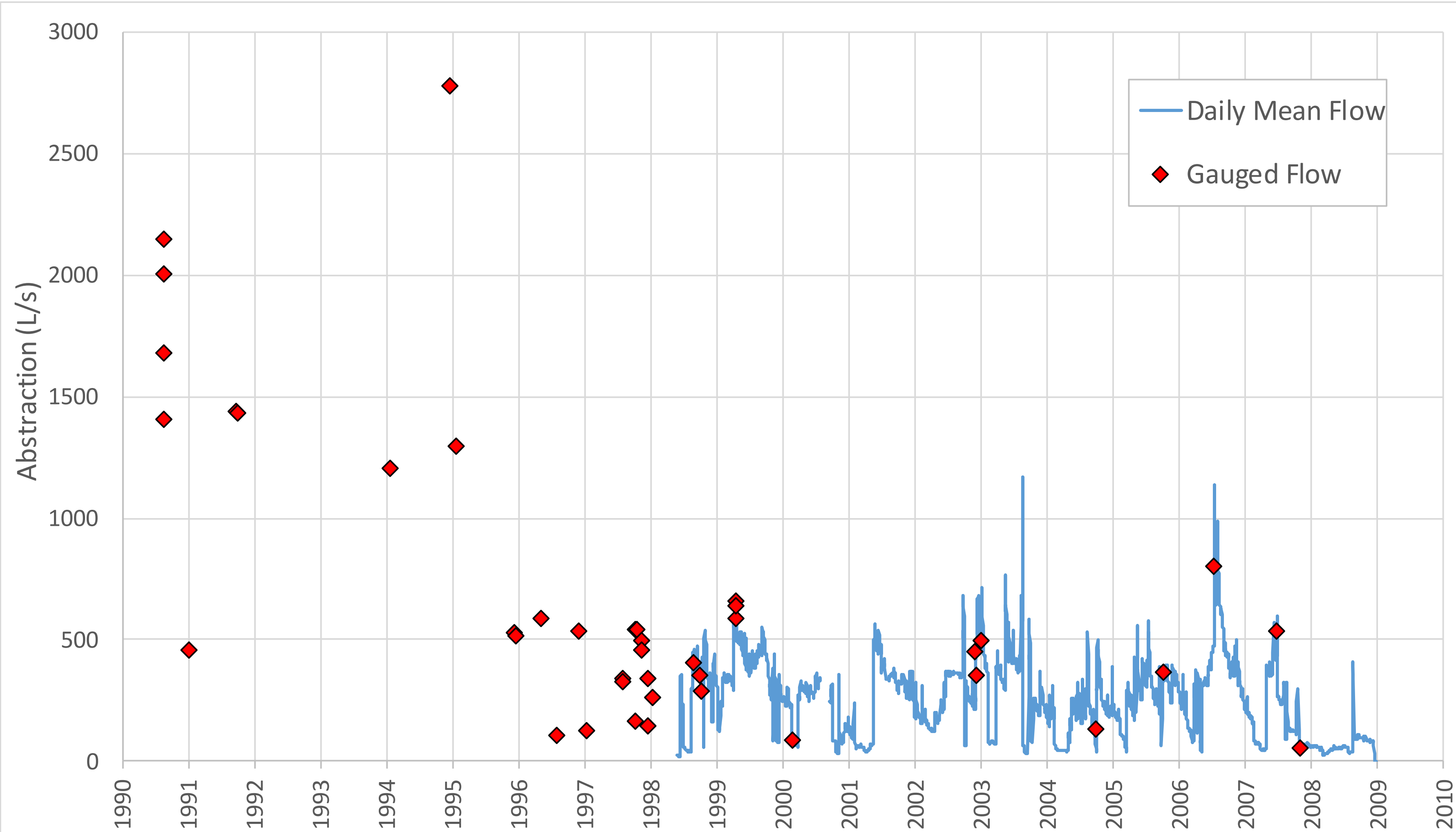
1995 – consent renewal

- Collection channel used because of siltation
- 600 L/s for recharge, min flow 2800 L/s
- Actual take 300-400 L/s

1997 – min flow increased to 5000 L/s

2008 – scheme ceased

1. AR Scheme abstraction data



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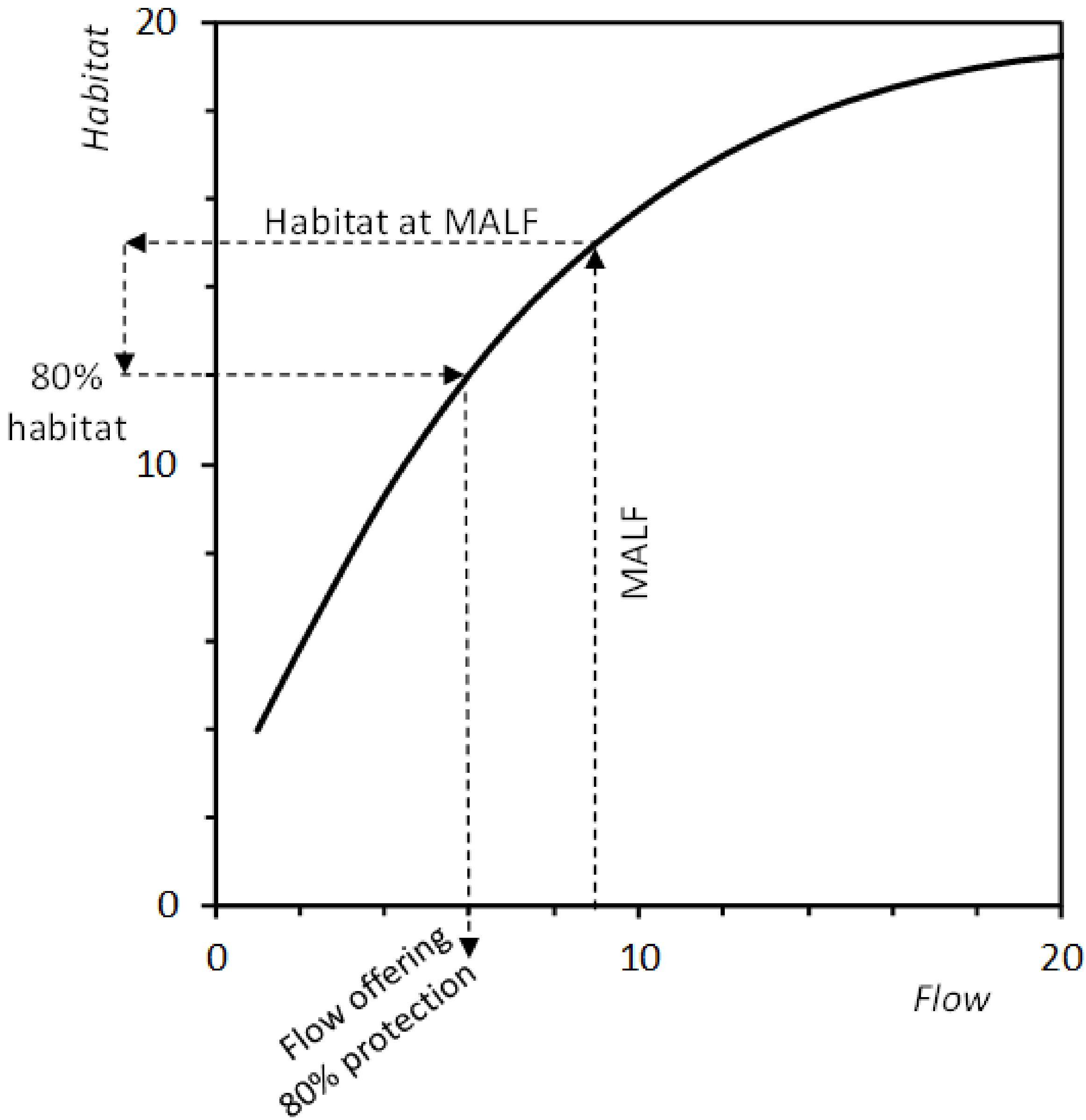
2. Previous MALF(7d) estimates



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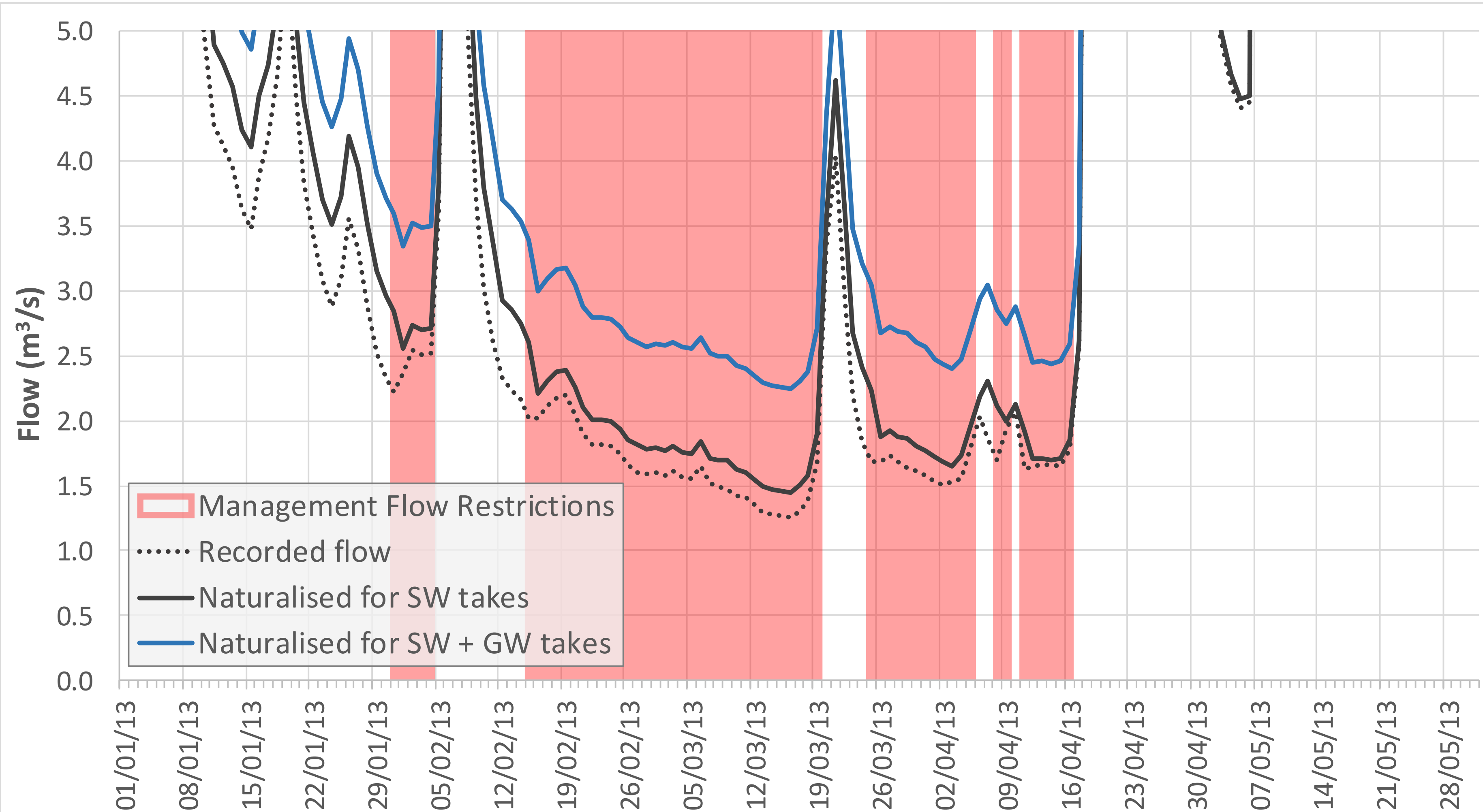
3. Revision of MALF7d

Recalculated flow statistics

- Naturalised flows from **1998 – 2015**
  - **Including stream depleting effects of groundwater takes**
- Calculate MALF(7d) for **1998 – 2015**
- Revisit habitat assessment based on new MALF(7d)

3. Example: Ngaruroro @ Fernhill



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3. Annual Low Flows and MALF7d

	Annual 7-day Low Flows	
	Naturalised	*Recorded*
1998	4404	*3627*
1999	3209	*2337*
2000	4306	*3468*
2001	5321	*4809*
2002	4599	*3833*
2003	6892	*6108*
2004	2904	*2251*
2005	5834	*4791*
2006	4502	*3473*
2007	2970	*2192*
2008	3273	*2490*
2009	4901	*4313*
2010	5956	*4724*
2011	10790	*9836*
2012	2302	*1307*
2013	4513	*3135*
2014	3197	*2228*
MALF7d	**4698**	***3819***

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4. Implications for MALF

- Flow statistics and minimum flows
  - HBRC IFIM report (Johnson 2011)
    - MALF(7d) ***4,500 L/s*** (1969 – 2008)
    - 90% habitat at MALF for torrent fish = ***4,200 L/s***

REVISED MALF7d:

- 1998-2015 MALF(7d) = **4,700 L/s**
- 90% habitat for torrentfish = **4,400 L/s**

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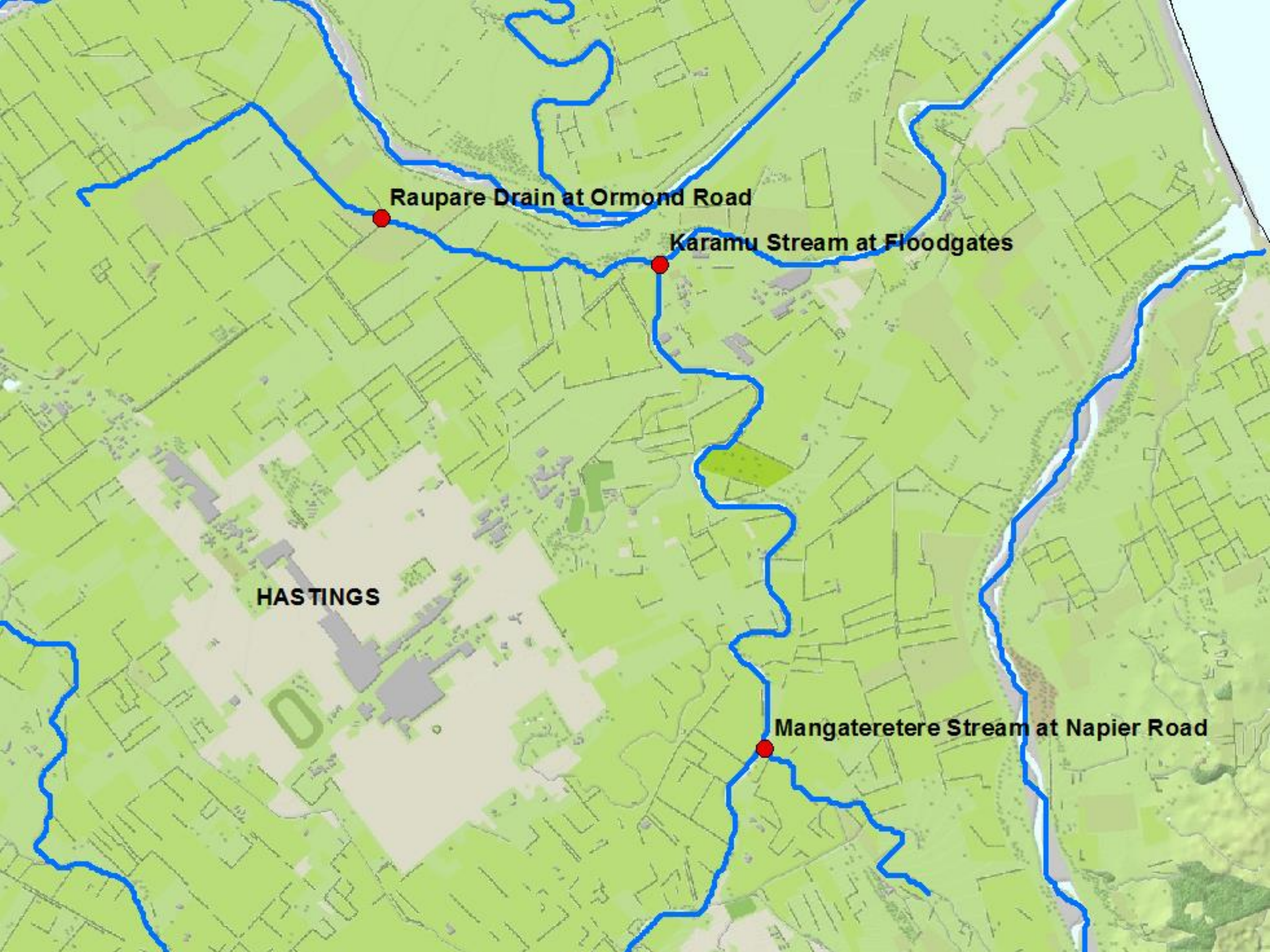

Raupare Drain at Ormond Road
Karamu Stream at Floodgates
HASTINGS
Mangateretere Stream at Napier Road

Summary

1. Naturalised flows were calculated 1998-2015

   - stream depleting effects of groundwater were included

2. Revised statistics 1998 – 2015:
   i. MALF(7d) = **4,700 L/s**
   ii. Flow to provide 90% of habitat at MALF(7d) = 4,400 L/s

3. Other considerations for flow management decisions include:
   i. Reliability of supply
   ii. Economic assessment
   iii. Flow mitigation/augmentation options

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Why does a change to MALF change the ~~Minimum~~ Restriction Flow?

Thomas Wilding

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Interim agreement to use RHYHABSIM to inform water use decisions - that does not bind you to torrentfish or the 90% protection level.

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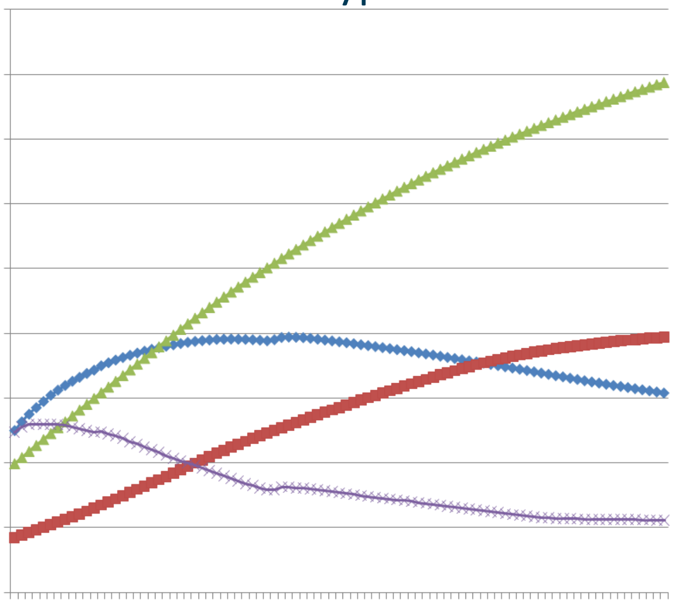
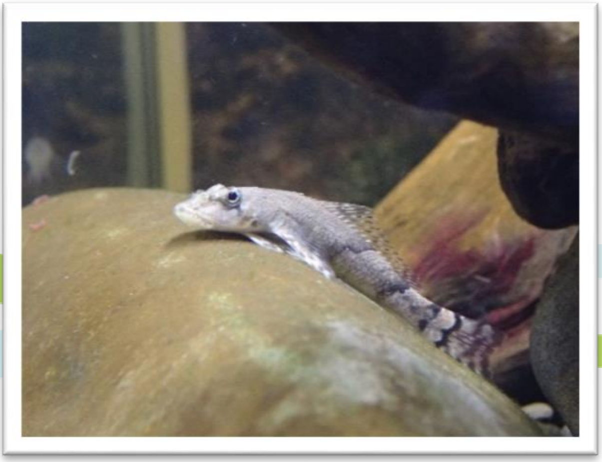
RHYHABSIM – **R**iver **Hy**draulic **Hab**itat **Sim**ulation

- Torrentfish like fast and shallow riffles, where there are plenty of mayflies to eat and they can hide from predators
- Use RHYHABSIM to predict how the area of fast and shallow riffles changes with flow
- Repeat for other types of fish

That's it!

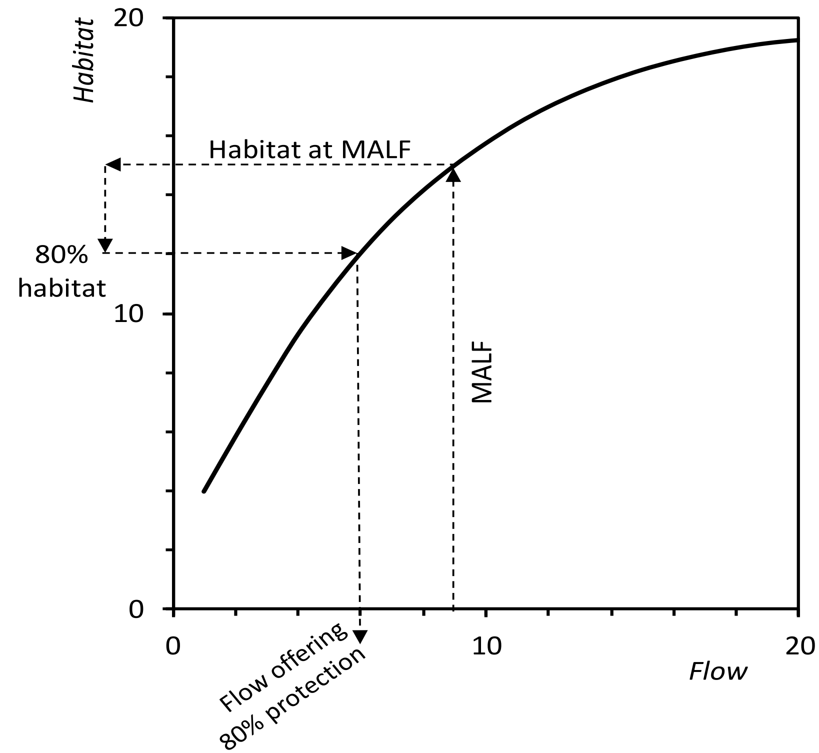
Change in habitat with flow for each type of fish





Habitat Protection Levels explained

- RHYHABSIM plots are converted to habitat protection levels
- Enable consistent decision making across catchments and across species
- A habitat protection level of 80% protects 80% of the habitat available to fish in that particular river
- We define habitat available in that river using the average low flow – the MALF.



Protection levels and fish numbers

- Reducing habitat by 10% does not necessarily mean 10% less fish
- We cannot dictate the number of fish in the river because water use is not the only thing that determines abundance
- Instead of setting limits on fish, we are **setting limits on water use**, considering the effects on habitat available to fish, among other factors

RHYHABSIM and fish abundance - Studies Elsewhere

- RHYHABSIM habitat DOES NOT correlate with fish numbers IF something else restricts the population, e.g. floods, no migratory access, toxins.
- Habitat DOES correlate with fish numbers in the absence of other major constraints on the population.
- Drought years are when habitat protection levels are most likely critical to fish populations – lack of flood constraint and maximum reduction in flow

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Ngaruroro flow limits on water use

- Two key steps that relate to ~~minimum~~ restriction flows are:
  1. target fish species, and
  2. what habitat protection levels are used

- Two types of protection levels:
  1. Single level for a complete ban on water use
  2. Staged protection-levels associated with increasing restrictions on water use

- The implication of these options for reliability of supply, and other values is the next step toward setting the flow management regime

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Fernhill Flows

Ngaruroro River - downstream of Fernhill (MALF 4700 L/s)	Flow for 90% habitat	Flow for 80% habitat	Flow for 70% habitat	Habitat protection at 2400 L/s
Fast-water fish i.e. torrentfish	4400 L/s	4000 L/s	3600 L/s	44%
Moderate-water fish i.e. smelt	2700 L/s	2200 L/s	1800 L/s	86%
Slow-water fish i.e. common bully	1200 L/s	<1000 L/s	<1000 L/s	100%

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Summary

- RHYHABSIM predicts the change in suitable depth and velocity with flow for each type of fish
- Convert RHYHABSIM to habitat protection levels
- Habitat protection levels correlate with fish abundance, unless something else limits the population.
- The right method for **setting limits on water use**, considering the effects on habitat available to fish
- 90% protection level for torrentfish is one option, of many, that stakeholders can consider in selecting a restriction regime for the Ngaruroro River

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Stream depletion – modelling outcomes

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Presentation outline

- Background information – groundwater abstraction
- Effectiveness of pumping bans on river flows
- Other Mitigation options:
  - Artificial recharge
  - Stream augmentation
- Conclusions

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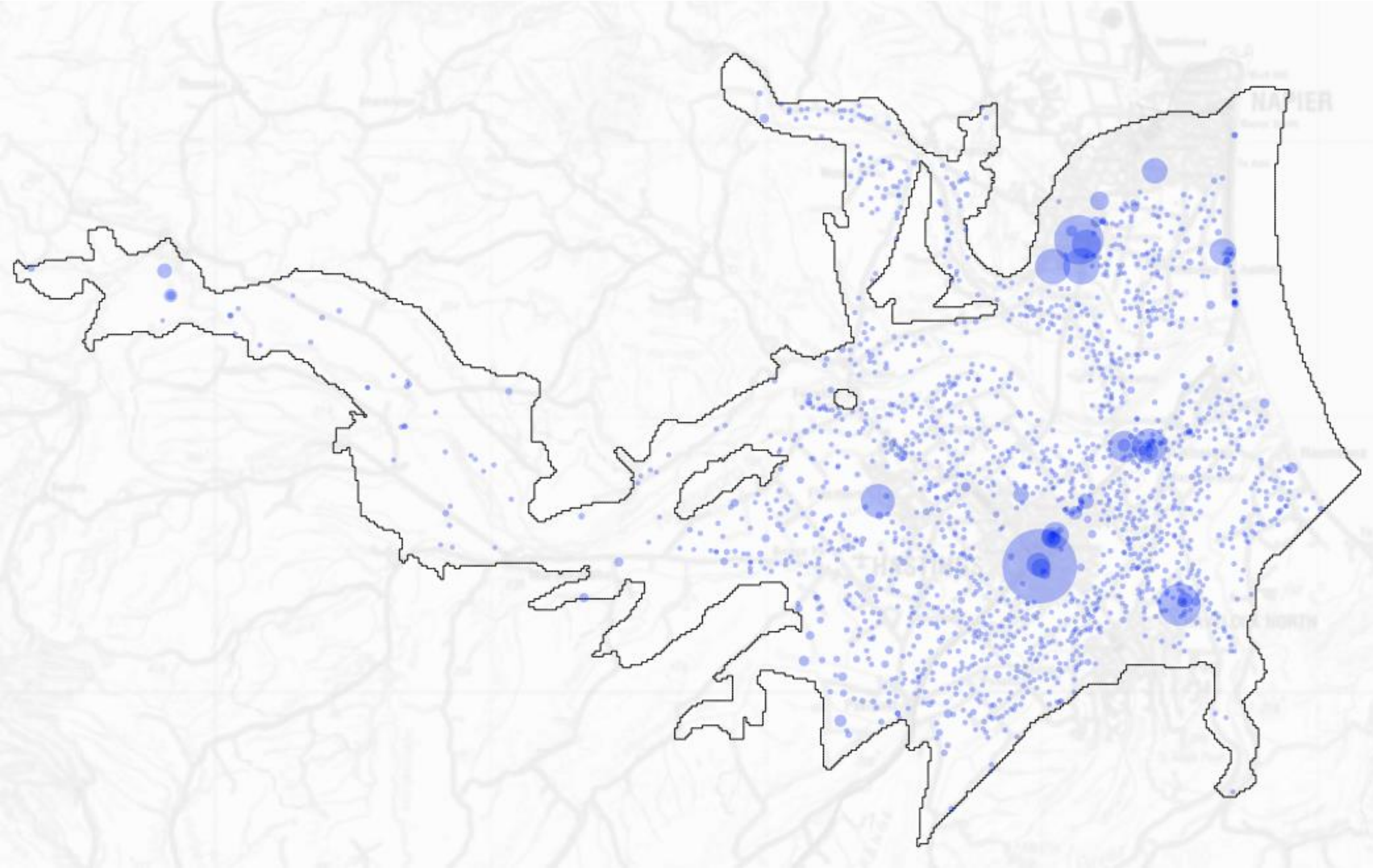
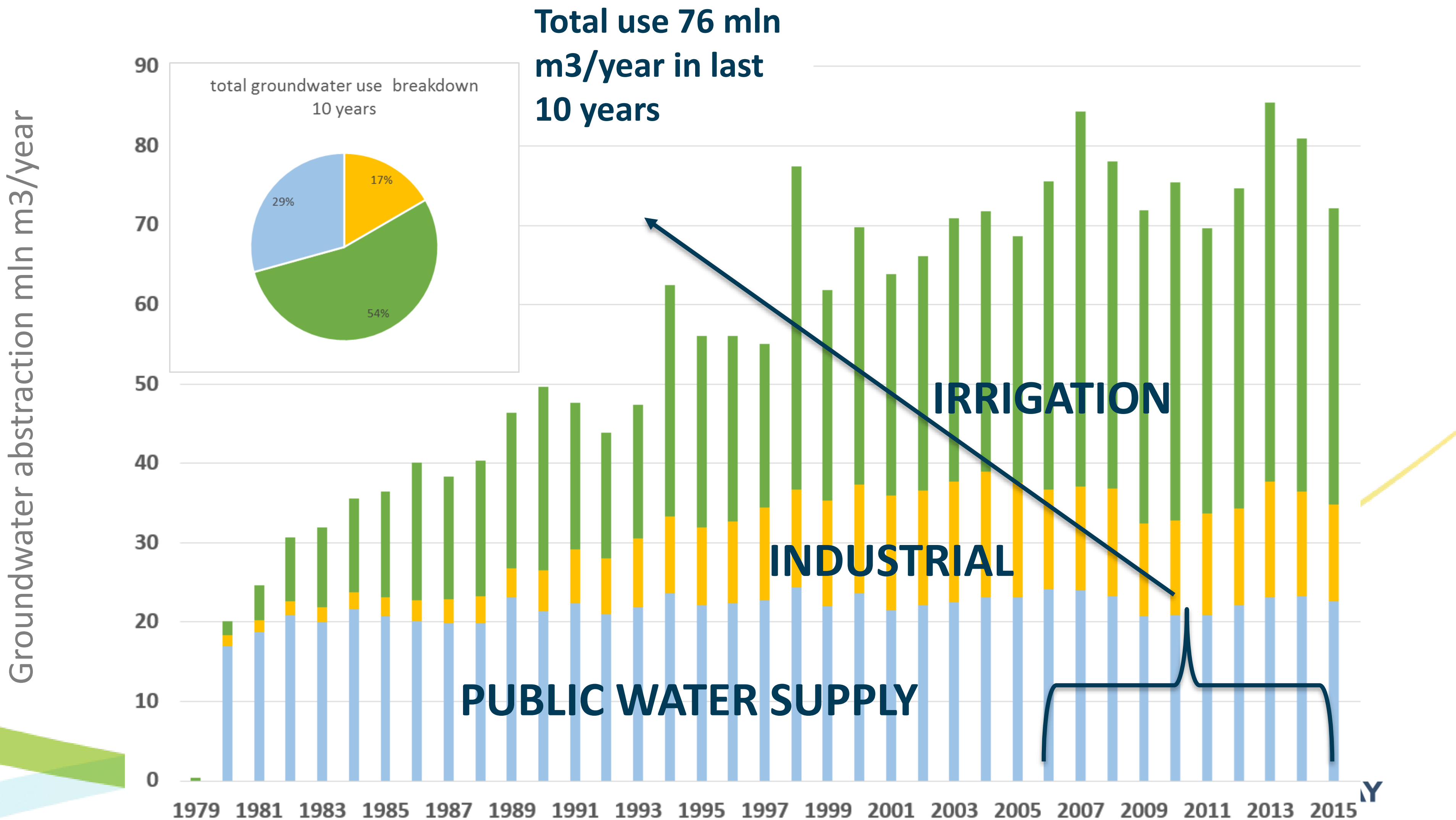
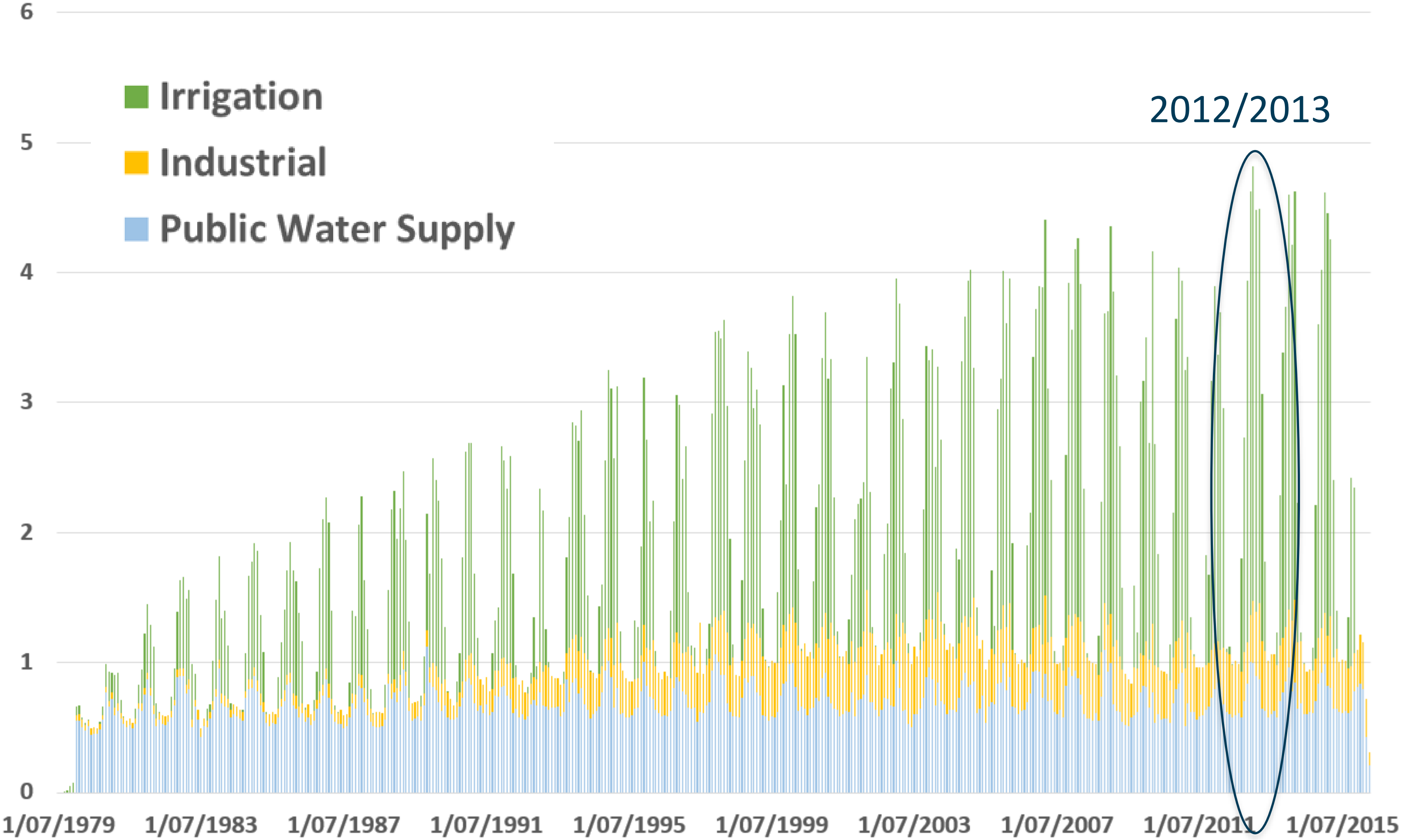
Groundwater abstraction



Groundwater Abstraction



Monthly irrgation



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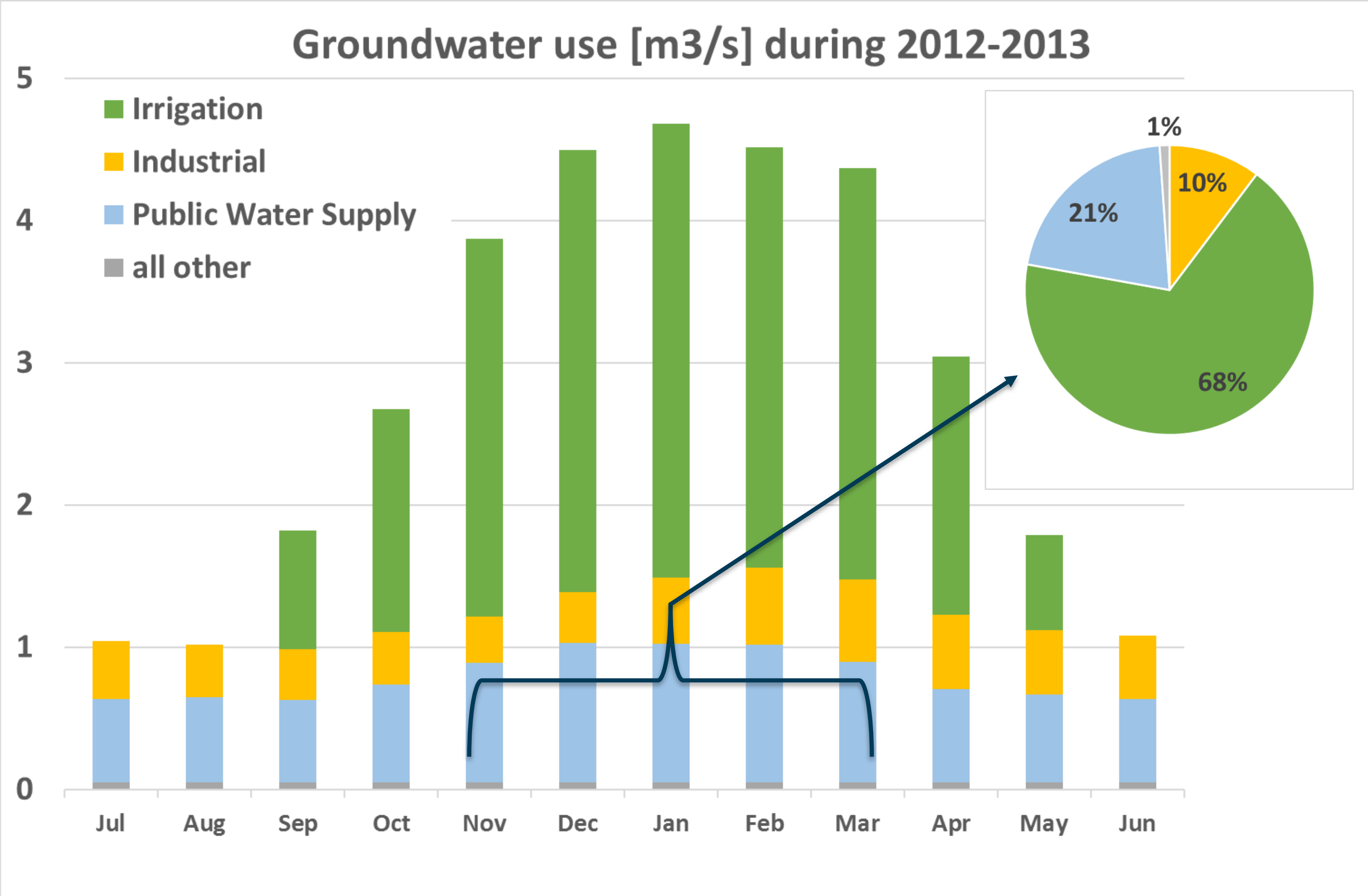

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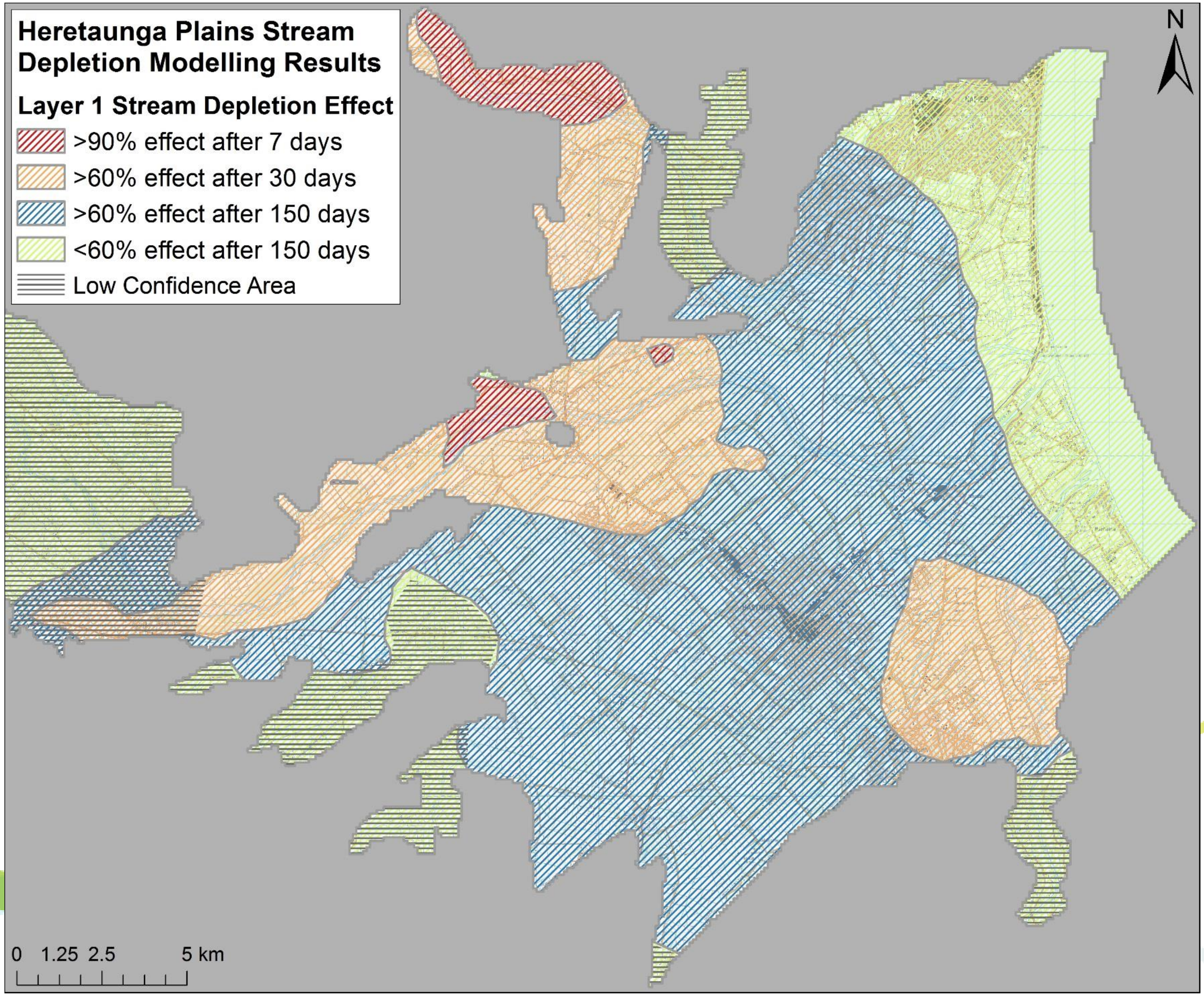
Effectiveness of pumping ban



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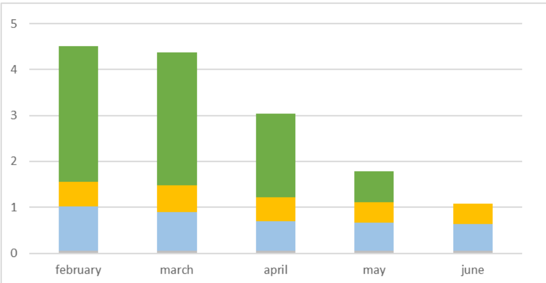
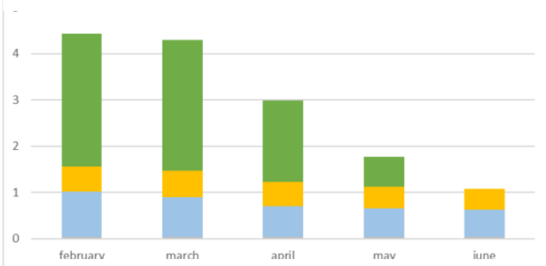
Pumping ban scenarios

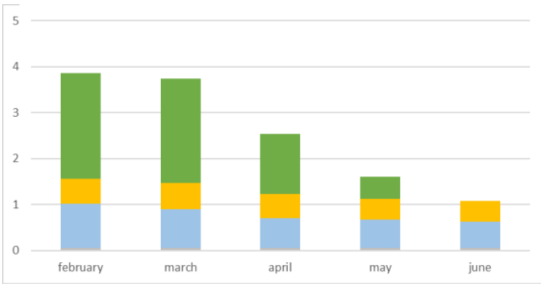
Scenario 0 - No Ban



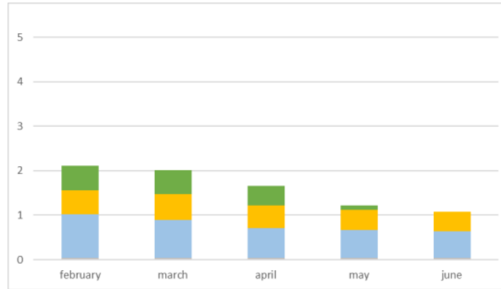
Scenario 1 - Zone 1



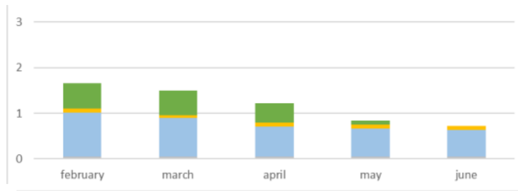
Scenario 2 - Zone 1 +2



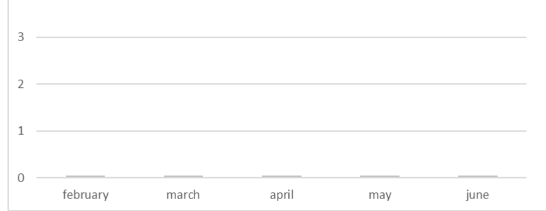
Scenario 3 - Zone 1 + 2 + 3

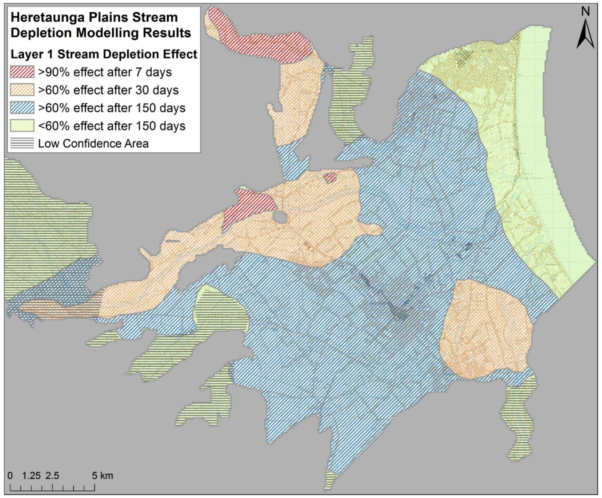


Scenario 9 - Zone 1 + 2 + 3 + Industrial



Scenario 10 – total ban, no pumping





Simulation Feb – Jun 2013

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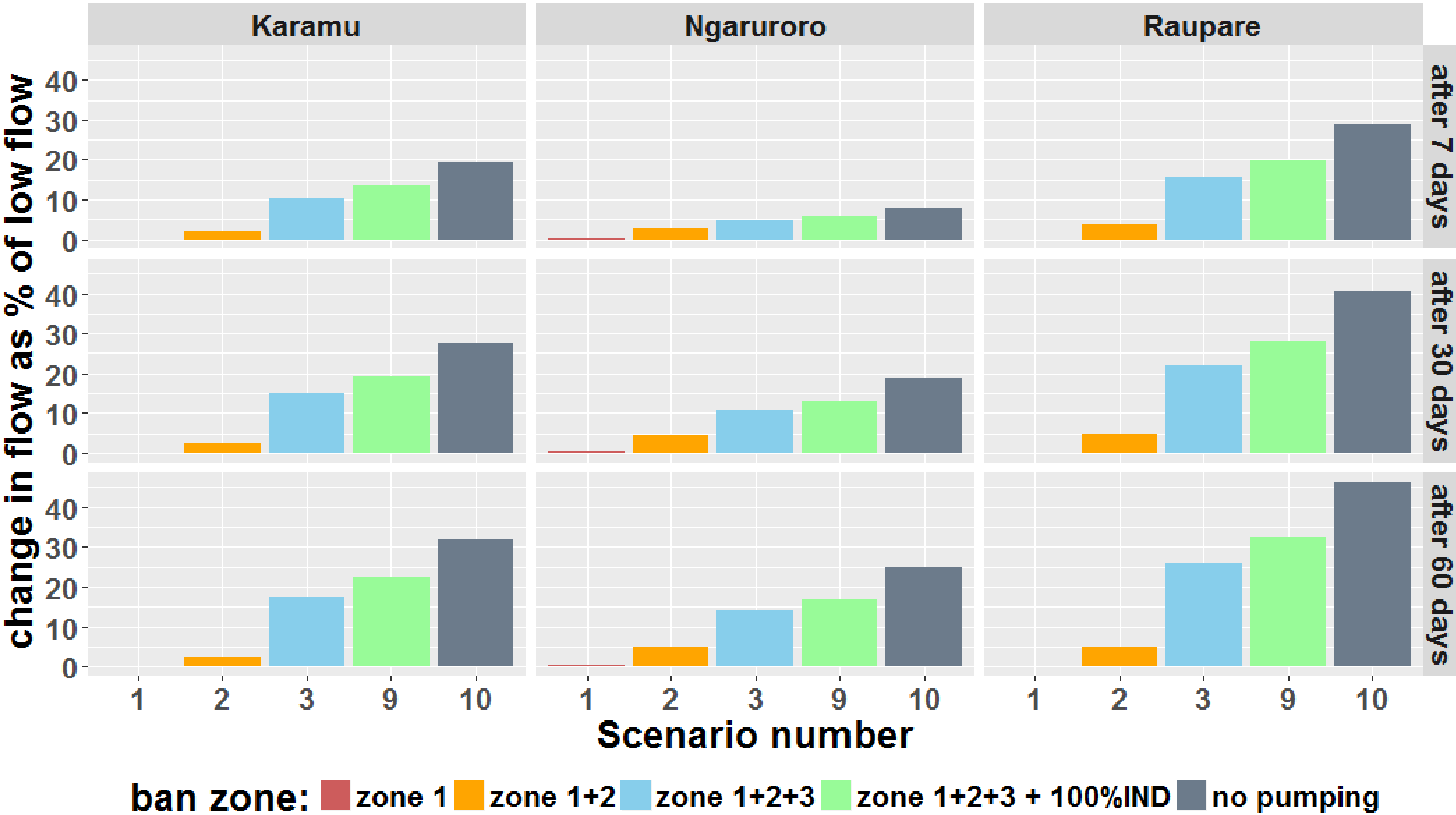
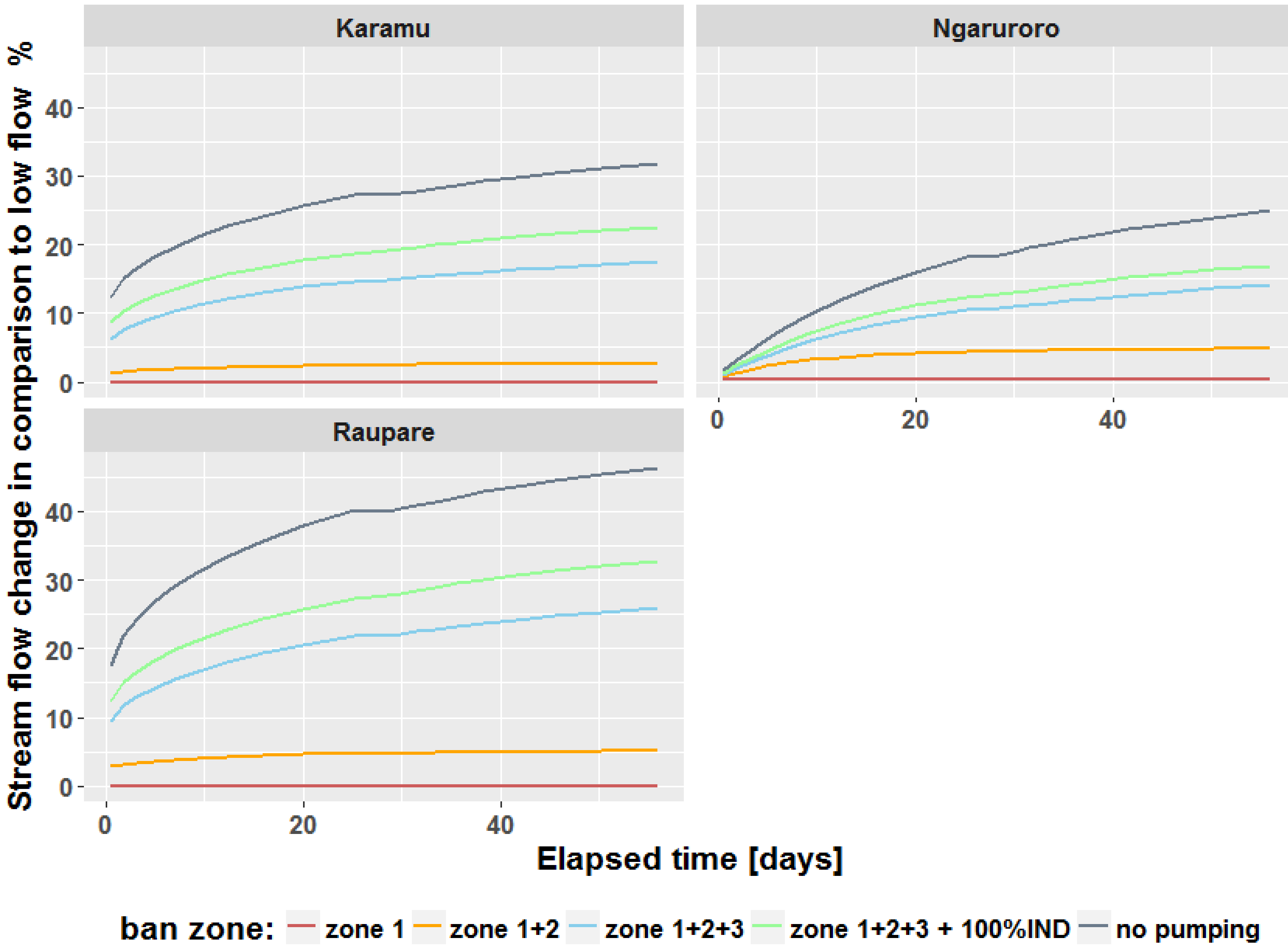
Ban scenario results :

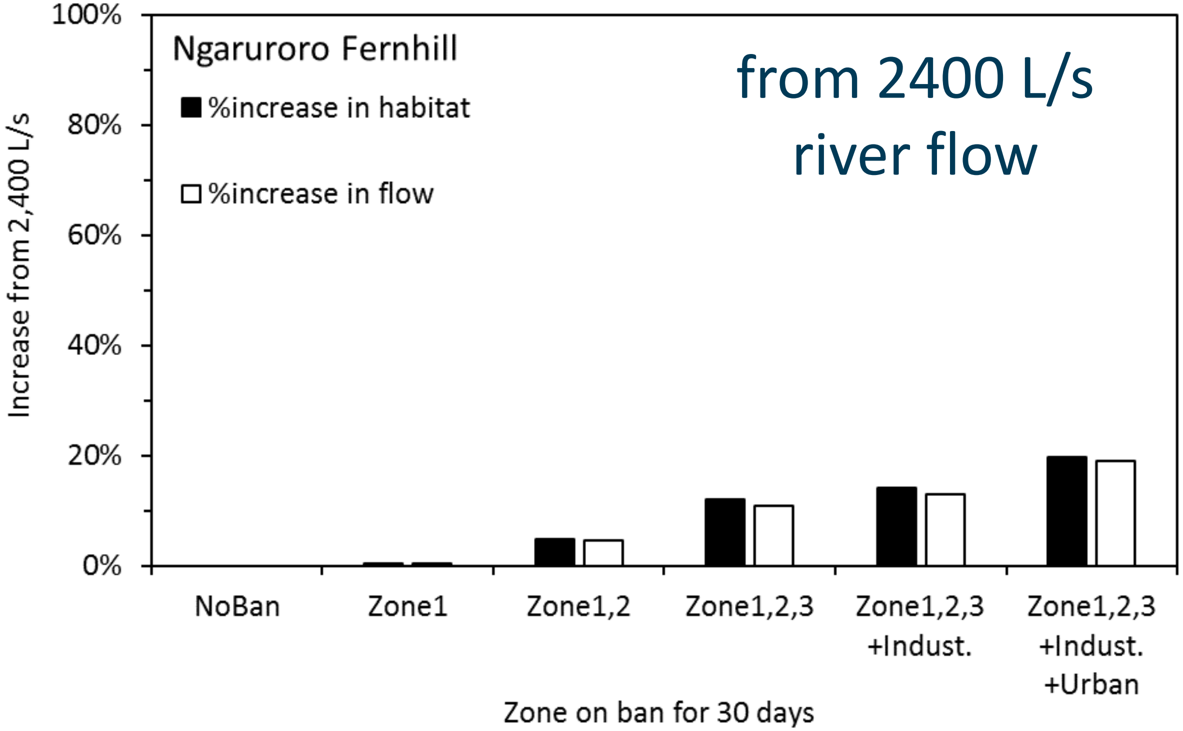


Ban scenario results :

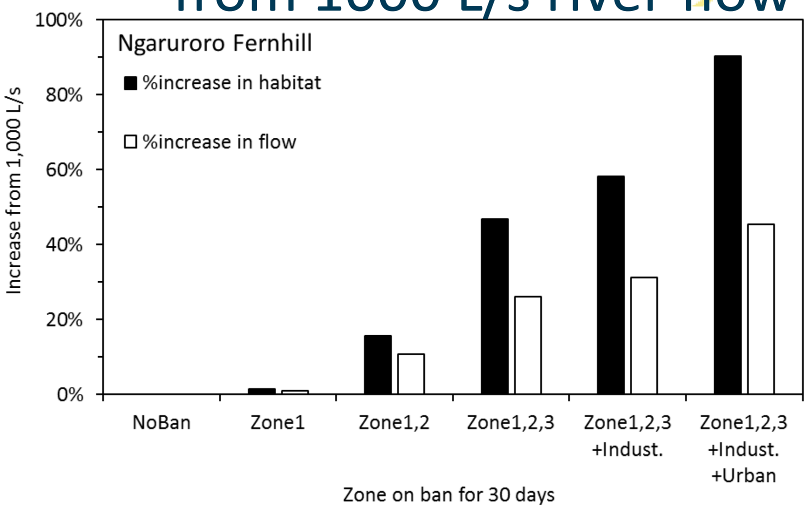


Ngaruroro habitat %increase after ban on use

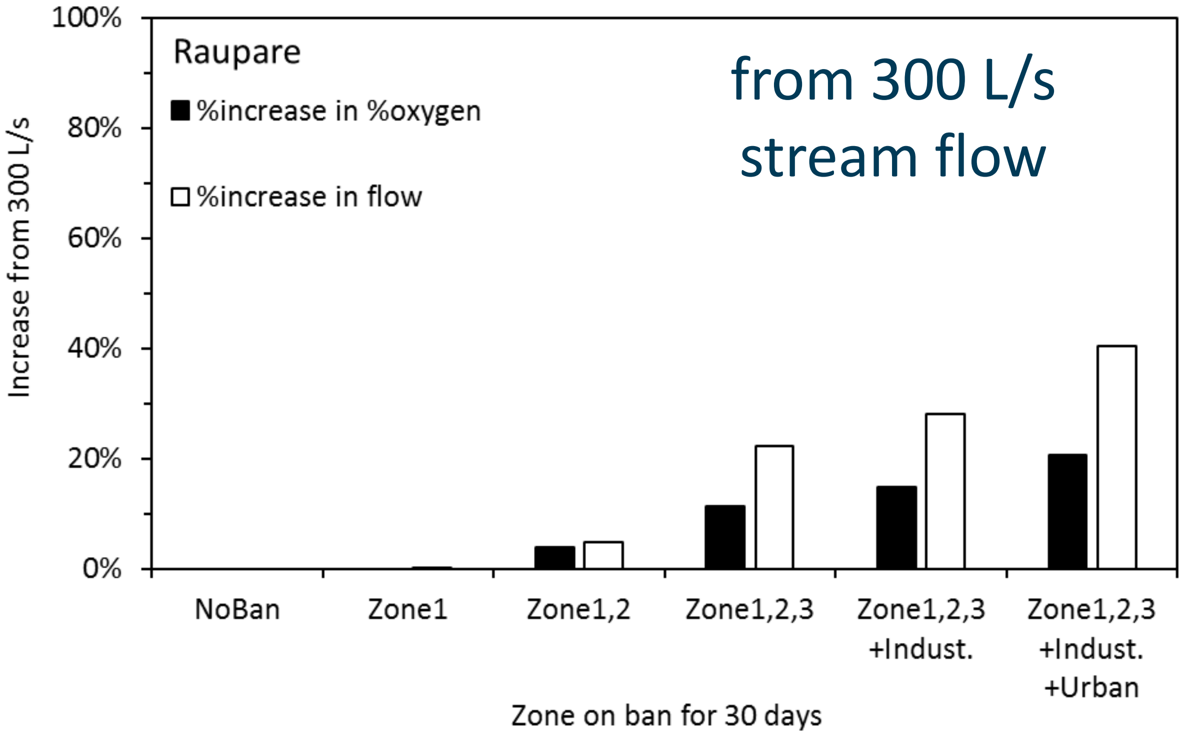
from 2400 L/s river flow



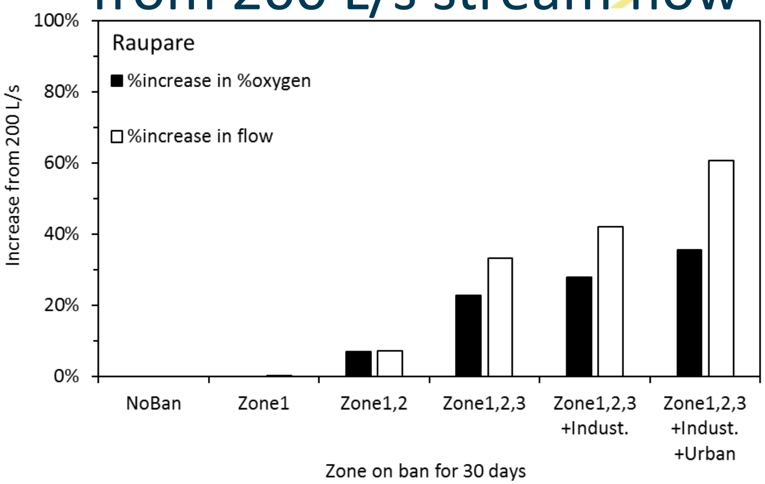
from 1000 L/s river flow



Raupare oxygen %increase after ban on use



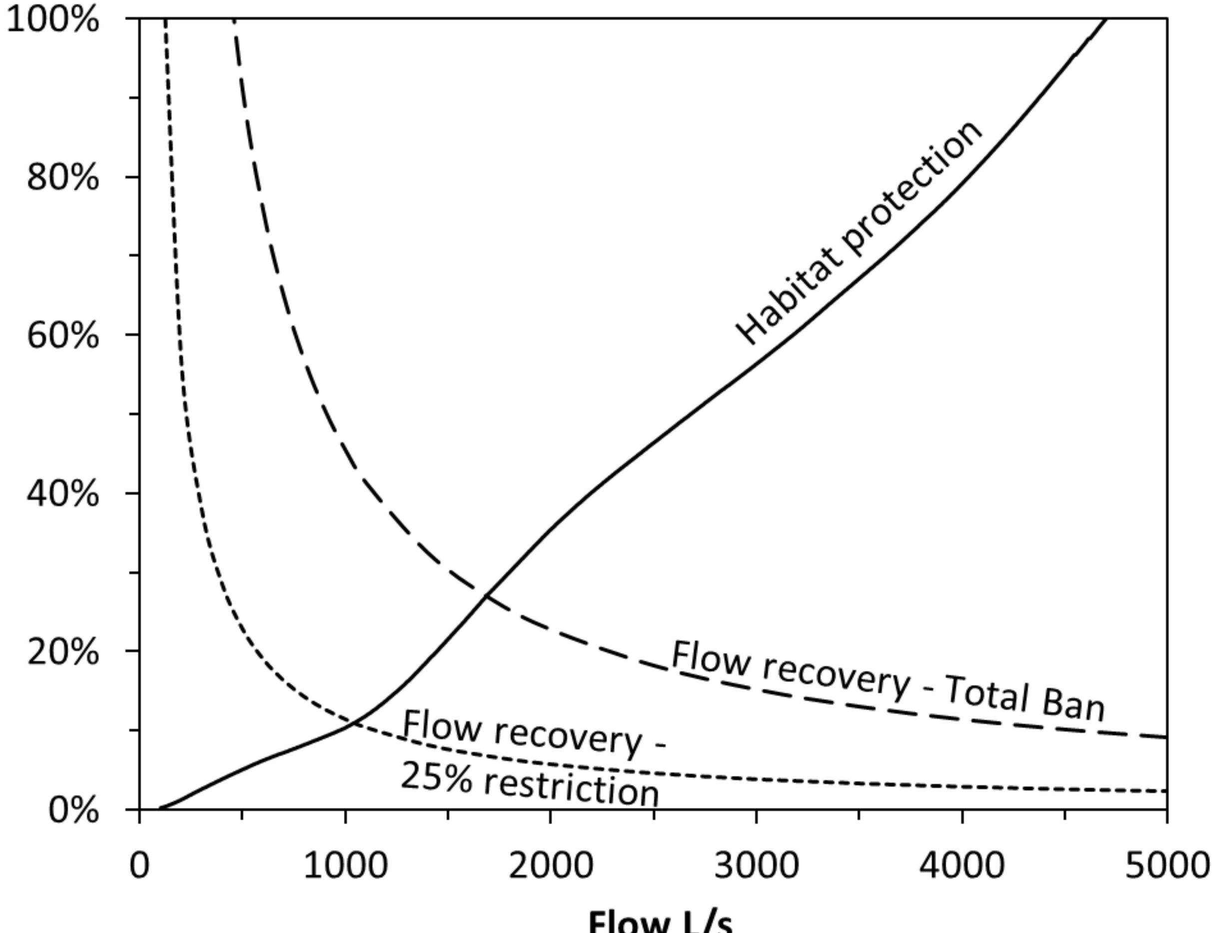
from 200 L/s stream flow



Trade off between **habitat** level and benefit to river from restrictions

Low habitat <<
Short ban <<

>> High habitat
>> Long ban



Ngaruroro

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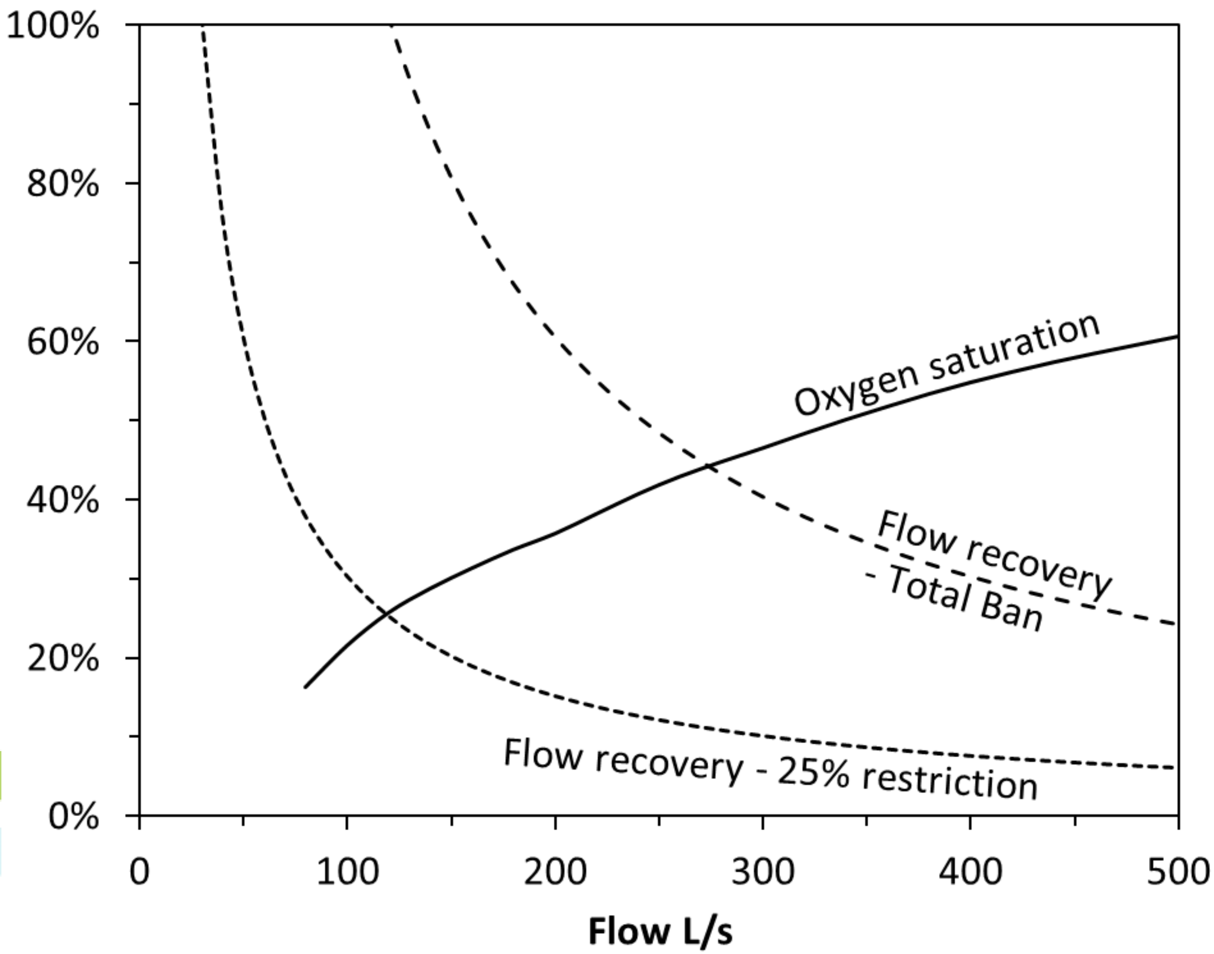
Trade off - **Oxygen** vs flow recovery



Raupare

Conclusions

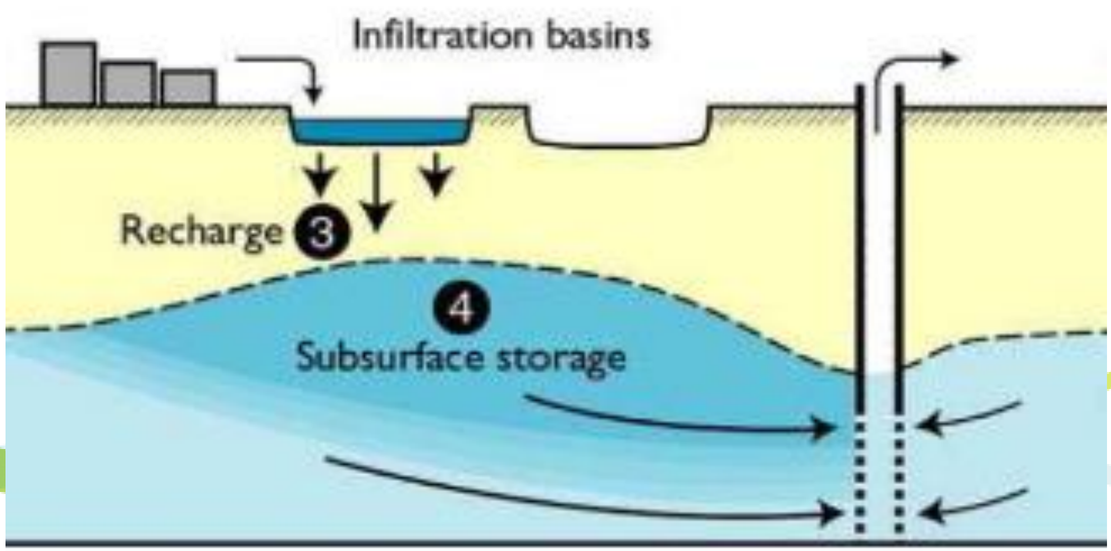
- The modelling results shows some response to pumping bans for all rivers.
- The widespread restriction gives largest response.
- The response relative to total flow was small for Ngaruroro
- For extremely low flows (e.g. < 1000L/s in Ngaruroro) the response may be significant
- The response relative to total flow was more significant for other streams which have not been the focus in the past

Mitigation Scenarios

- Artificial recharge
- Stream augmentation

Artificial recharge - background

- During high river flows take river water and inject/recharge to the aquifer
- This additional water increases aquifer storage temporarily and can be used in drier months
- Fernhill scheme operational 1988 – 2008
- 1998-2008 Q = 300-400 L/s



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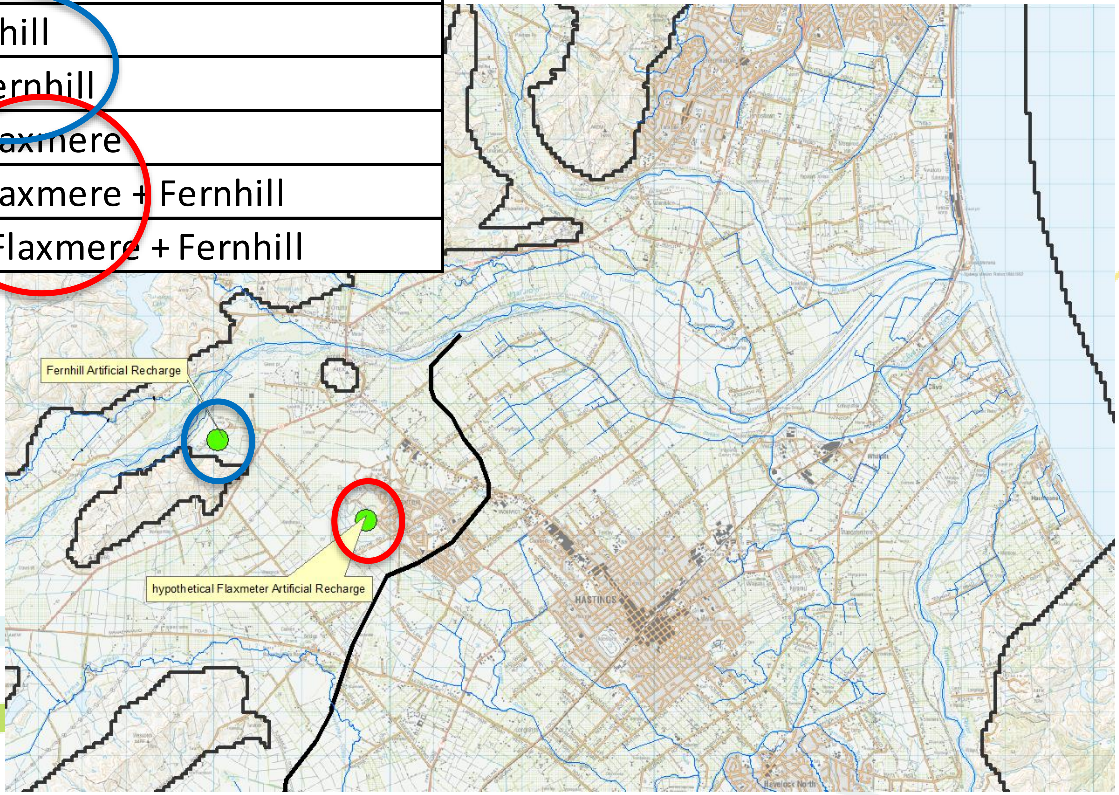
Artificial recharge – scenario set up

- Run model April 2012 until June 2013 (winter and dry summer)

Scenario	Artificial Recharge
0	no recharge
1	1998-2008 recharge at Fernhill
2	3x 1998-2008 recharge at Fernhill
3	3x 1998-2008 recharge at Flaxmere
4	3x 1998-2008 recharge at Flaxmere + Fernhill
5	10x 1998-2008 recharge at Flaxmere + Fernhill



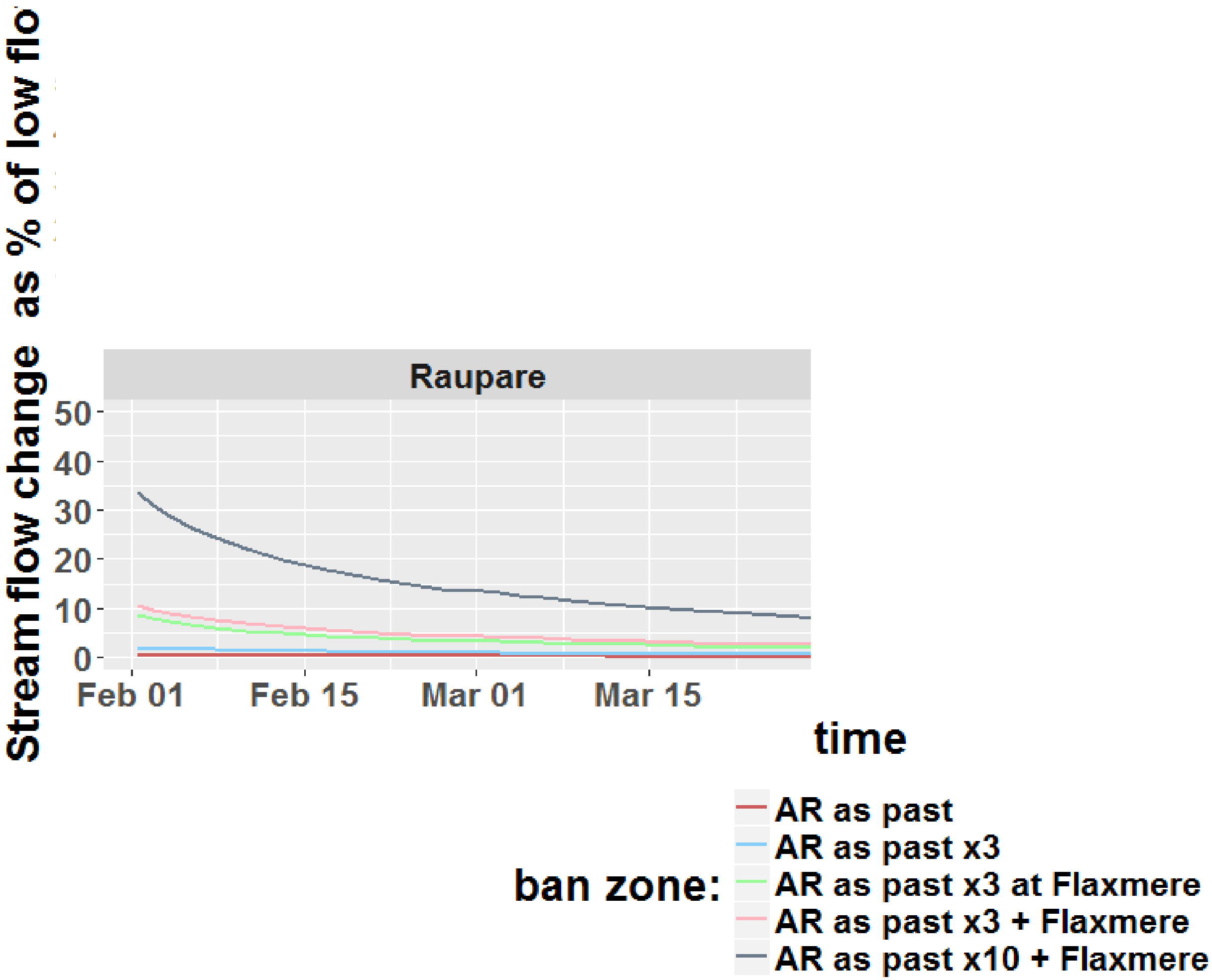
- *Unconfined area*
- *Deep water level*
- *Away from the source*

to prevent back circulation

Question:

does winter recharge help summer flows?

Artificial recharge - scenario results



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Artificial recharge conclusions

- Relatively small effect, even for very large scheme
- Effect quickly dissipates
- Minimal effect for repeat of 1998-2008 scheme

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Stream augmentation

- Pumping groundwater to the streams during dry periods
- Potentially short term benefit in the stream but..
- Possibly additional groundwater drawdown and declines in other streams
- Can be tested using a groundwater model

10% effect in Ngaruroro requires Zones 1-3 to be banned at low flow trigger

22% effect in the Raupare requires Zones 1-3 to be banned at low flow trigger

Questions regarding ban scenarios:

1. What percentage of stream depletion recovery should justify restrictions?
2. Over what period of time? e.g. 7, 30, 60 days, other?
3. Should groundwater pumping restrictions be focused on smaller streams?
4. What further modelling is required?
5. Staged reductions or total bans – scenarios in preparation
6. Are we in a position to decide on preferred levels of habitat protection?

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Questions for other management options:

2. What other options should we consider for managing flows?
   - Decreasing the total allocation Note: To model this would require more complicated SW-GW modelling to show flow response in terms of total effect.
   - Artificial recharge
   - Stream augmentation
   - Out of stream storage

TANK Plan Change skeleton

Mary-Anne Baker

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Verbal updates from Working Groups

- Engagement
- Economic Assessment
- Stormwater
- Wetlands/Lakes
- Mana whenua

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Next meeting – 27 April 2017

- Nutrient management
- SW-GW modelling outputs and further scenario refinement
- Base case economic modelling outputs and scenario development
- Preliminary report from Stormwater Working Group
- Report from Wetland Working Group

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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

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