

A SCIENTIFIC FRAMEWORK FOR SETTING FLOW AND ALLOCATION LIMITS - TAKAKA

Dr Roger Young (Cawthron) and Joseph Thomas (TDC)

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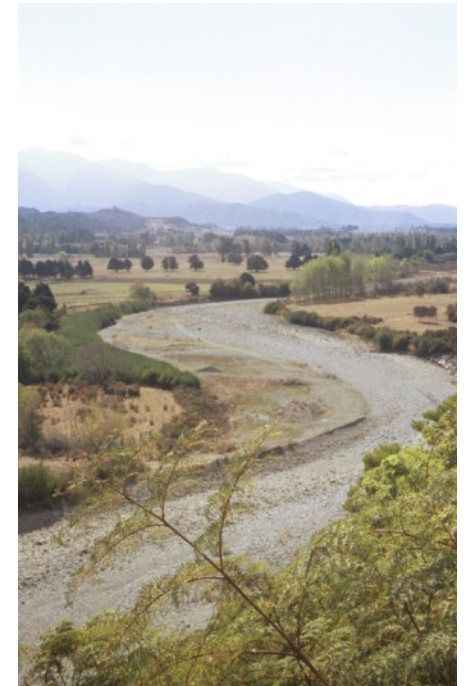


ROGER YOUNG - A BIT ABOUT ME

- PhD in River Ecology, University of Otago 1998
- Freshwater Ecologist, Cawthron Institute for last 17 years
- Coastal and Freshwater Group Manager (Freshwater)

- Provide advice to councils and other stakeholders throughout NZ
- Involved in research relating to water management

- Cobb Power Scheme re-consenting
- Motupipi water quality
- TDC surface water quality reports
- Takaka flow management framework



DETERMINING ENVIRONMENTAL FLOW NEEDS – WHERE DO WE START?

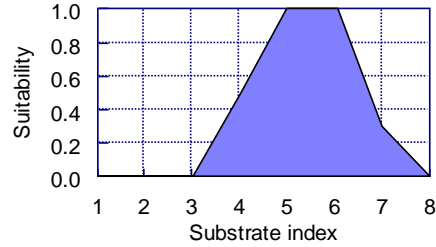
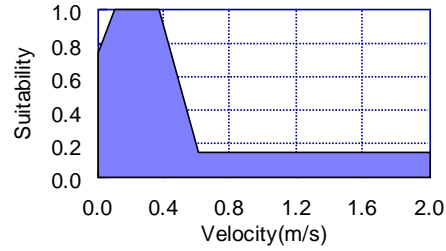
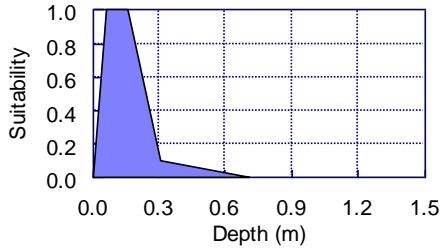
1. Identify instream values
2. Define instream management objectives
3. Focus on critical values
 - those that have highest value and highest flow needs
 - in larger rivers these are typically salmonids and birds
4. Focus on critical flow related environmental requirements
 - physical habitat (space)
 - passage
 - food
 - water quality (temperature, oxygen, etc.)

INSTREAM WATER ALLOCATION GOALS



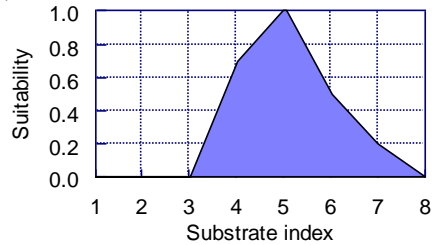
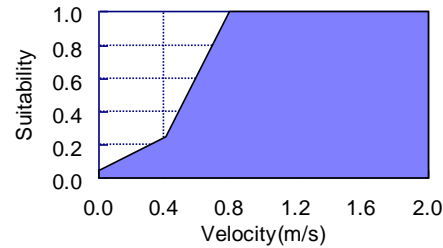
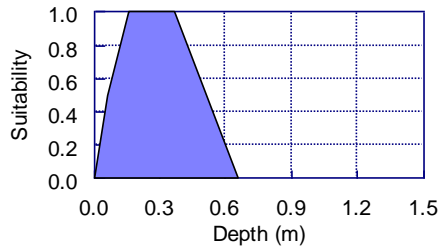
FLOW REQUIREMENTS OF DIFFERENT SPECIES

Upland bully



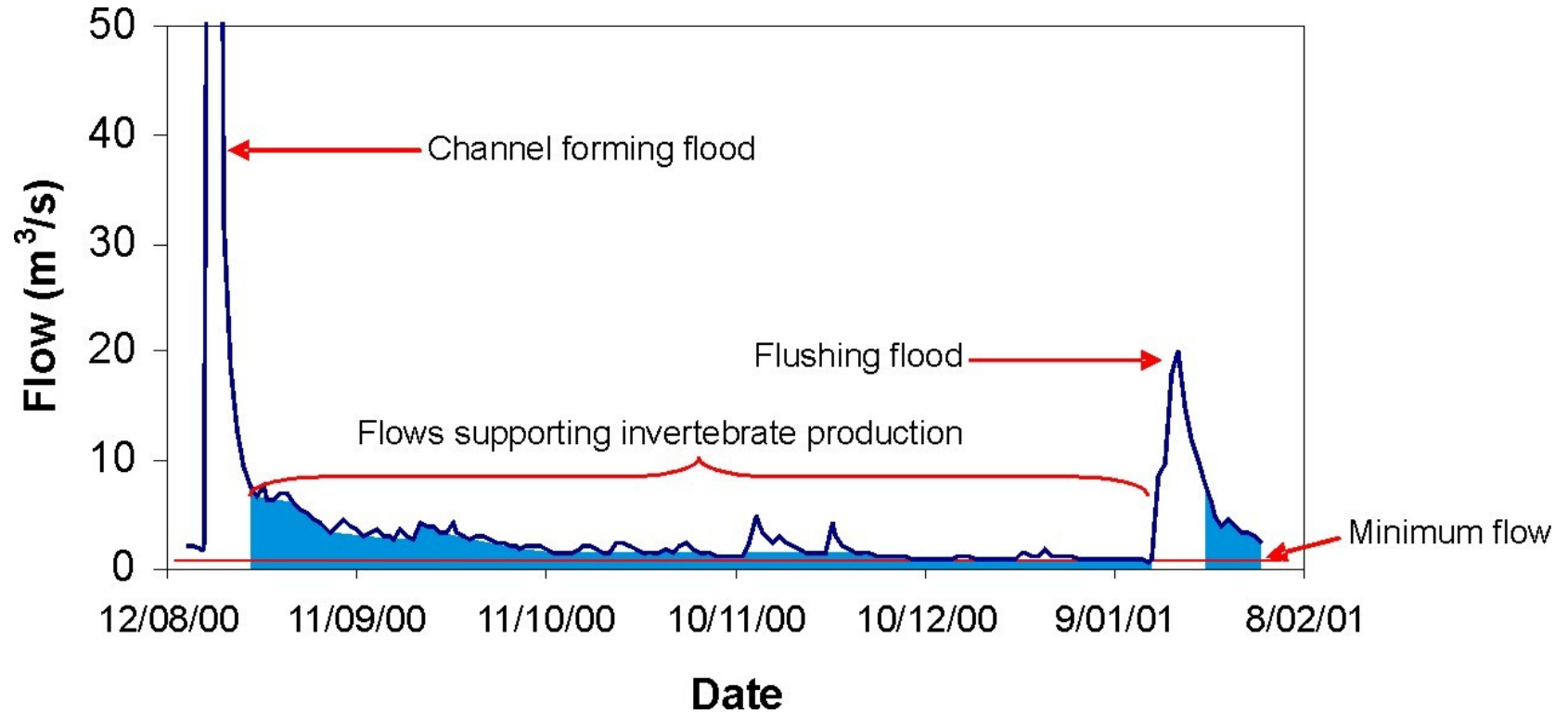
Slow water species

Torrentfish



Fast water species

WHAT FLOW FEATURES NEED ATTENTION?



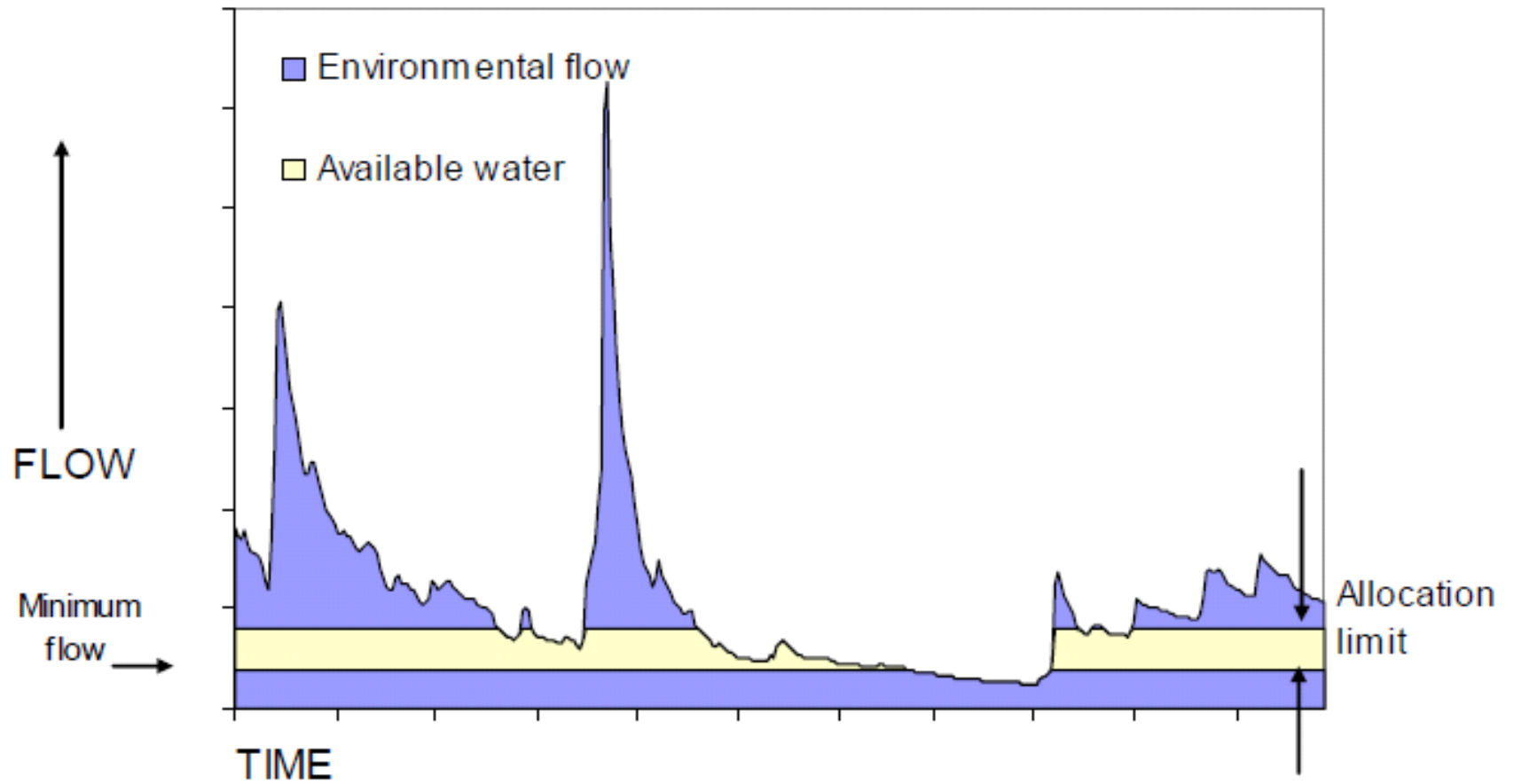
KEY COMPONENTS OF FLOW MANAGEMENT

- Minimum flow is the flow at which abstraction must be restricted or cease
 - Protects instream values

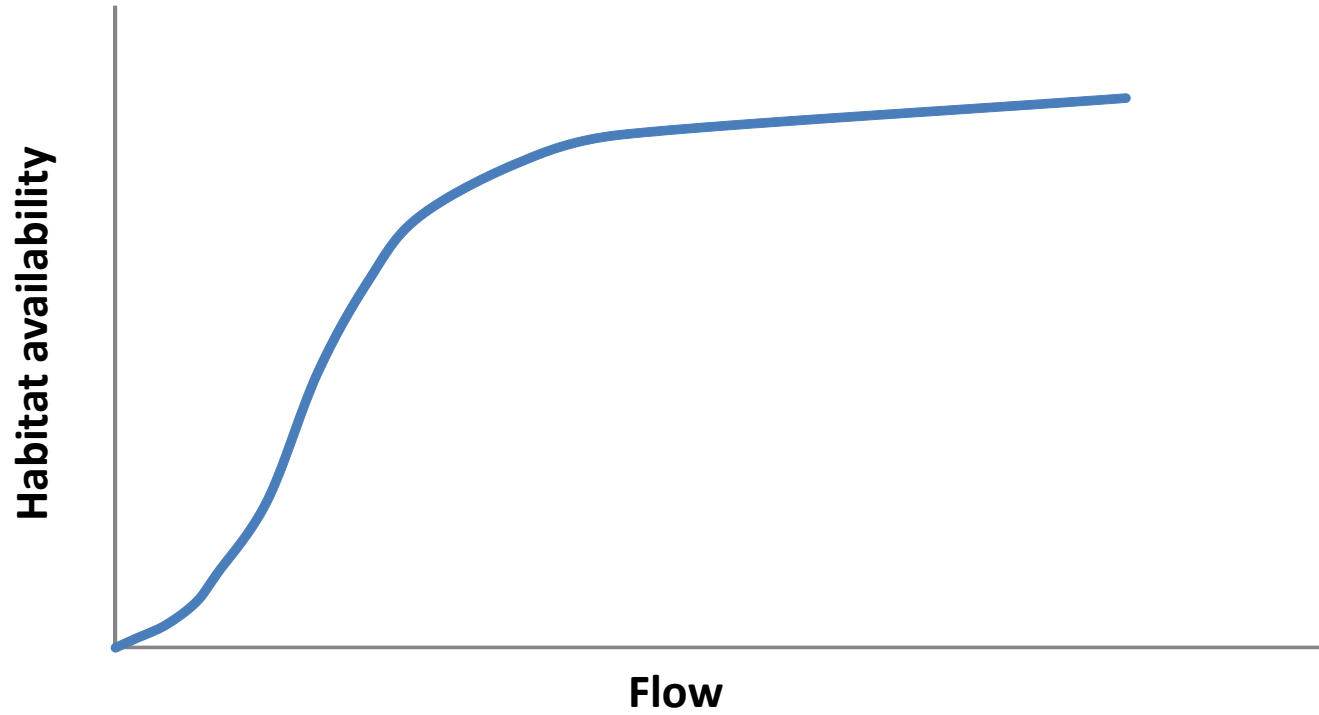
- Allocation limit is the rate (or volume) that water can be extracted
 - Protects instream values by controlling length of low flow period
 - Maintains reliability of supply to abstractors



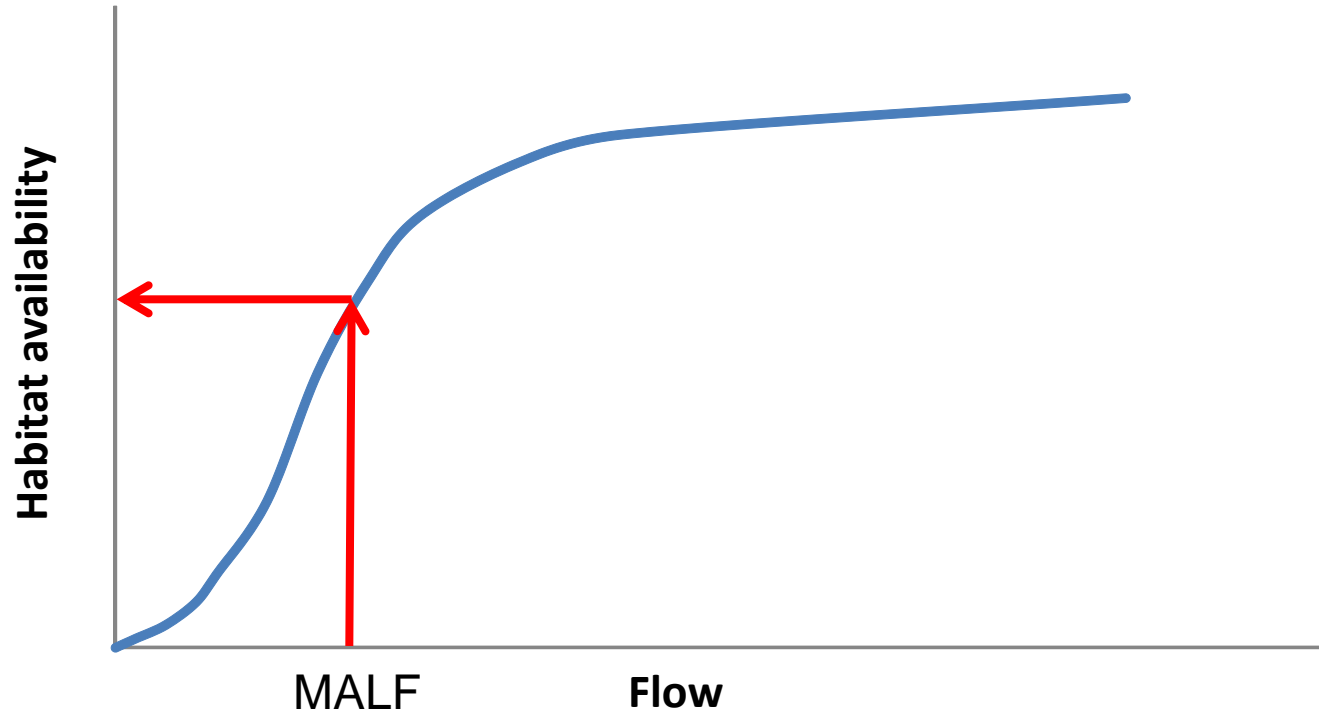
ENVIRONMENTAL FLOW REGIME



HABITAT RESPONSE TO FLOW



HABITAT RESPONSE TO FLOW



TECHNICAL ASSESSMENT METHODS

- Historic flow approaches
- Generalised habitat modelling
- Hydraulic habitat modelling
- Water quality modelling
- Ecohydraulics modelling
- ++ many more

Assume status quo is best
Assume linear response to flow
Easily applied
Non-specific



Assumes habitat (or WQ) is limiting
Non-linear flow response
Linked with specific values
Data hungry
Expensive
Controversial

TECHNICAL ASSESSMENT METHODS – VALUE AND DEMAND

Degree of hydrological alteration	Significance of instream values		
	Low	Medium	High
Low	Historical flow method Expert panel	Historical flow method Expert panel	Generalised habitat models 1D hydraulic habitat model Connectivity/fish passage Flow duration analysis
Medium	Historical flow method Expert panel Generalised habitat models	Generalised habitat models 1D hydraulic habitat model Connectivity/fish passage	1D hydraulic habitat model 2D hydraulic habitat model Dissolved oxygen model Temperature models Suspended sediment Fish bioenergetics model Groundwater model Seston flux Connectivity/fish passage Flow variability analysis
High	Generalised habitat models 1D hydraulic habitat model Connectivity/fish passage Periphyton biomass model	Entrainment model 1D hydraulic habitat model 2D hydraulic habitat model Bank stability Dissolved oxygen model Temperature models Suspended sediment Fish bioenergetics model Inundation modelling Groundwater model Seston flux Connectivity/fish passage Periphyton biomass model	Entrainment model 1D hydraulic habitat model 2D hydraulic habitat model Bank stability Dissolved oxygen model Temperature models Suspended sediment Fish bioenergetics model Inundation modelling Groundwater model Seston flux Connectivity/fish passage Periphyton biomass model Flow variability analysis

PROTECTION LEVELS

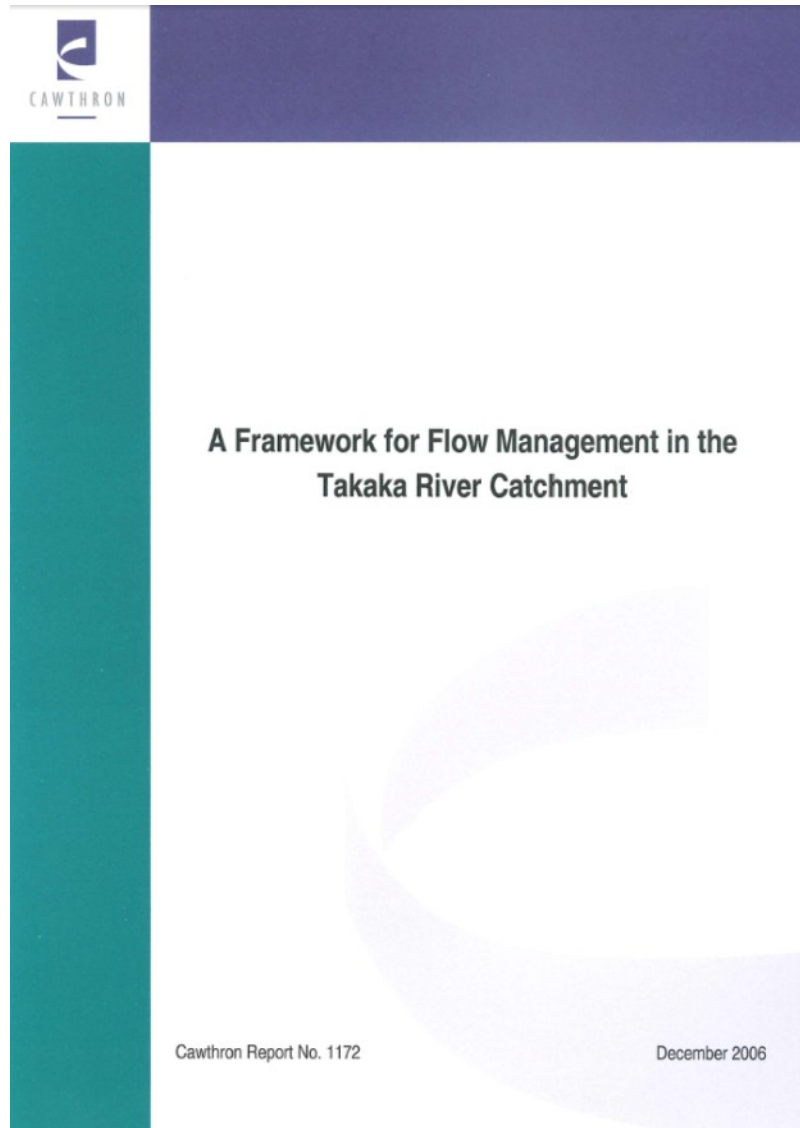
- Risk management
- High value then accept minimal risk
 - minimum flow provides 90-100% habitat retention at naturalised MALF
 - allocation limit 10-20% of MALF
- Lower value then accept more risk
 - minimum flow provides 60-80% habitat retention at naturalised MALF
 - allocation limit 30-50% of MALF

APPROACHES IN OTHER REGIONS

- Historical flow methods to guide broad-scale flow management decisions
- Detailed instream habitat analysis for rivers with very high values and/or large flow alteration
- Protection levels based on risk assessment
- Allocation limits set based on security of supply

Critical value	% habitat retention
Large adult trout – perennial fishery	90
Diadromous galaxiid	90
Non-diadromous galaxiid	80
Trout spawning/juvenile rearing	70
Redfin/common bully	60

CLASSIFICATION OF TAKAKA WATERBODIES 2006

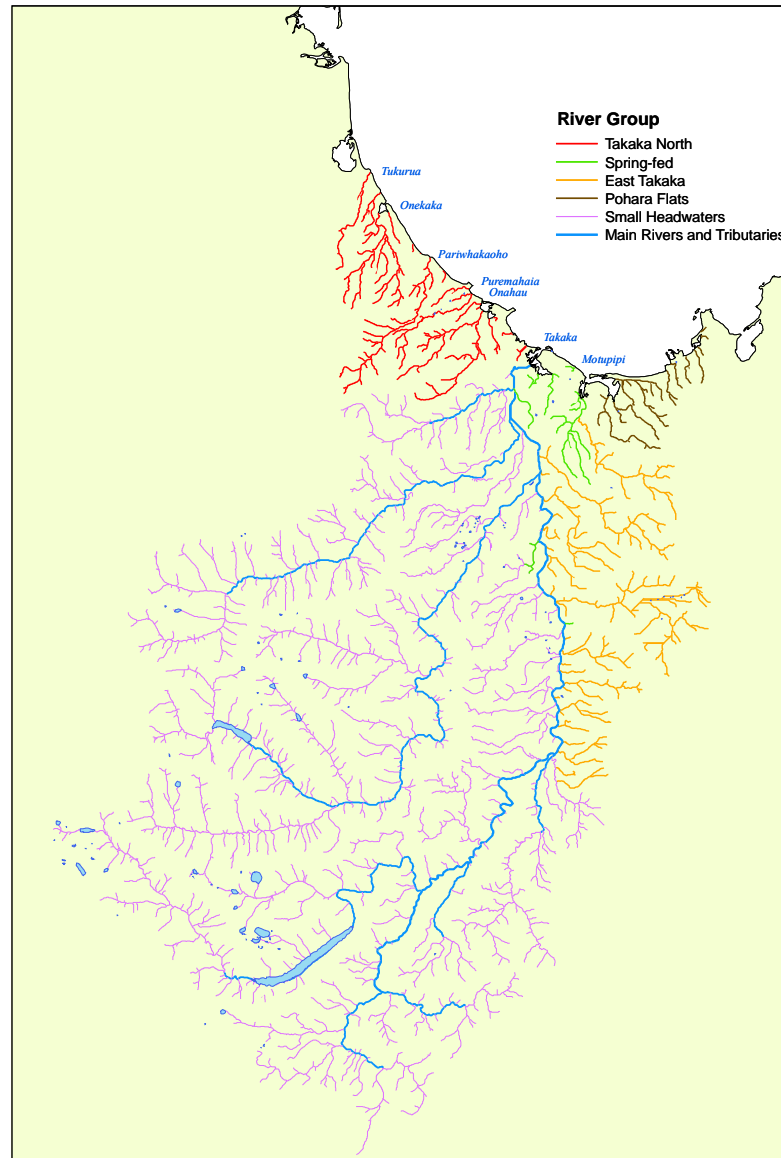


A Framework for Flow Management in the Takaka River Catchment

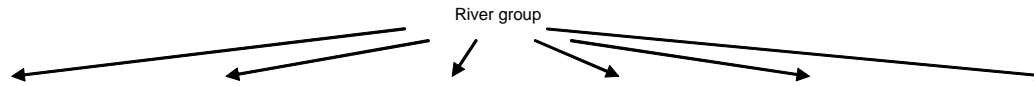
Cawthron Report No. 1172

December 2006

CLASSIFICATION OF TAKAKA WATERBODIES 2006



CLASSIFICATION OF TAKAKA WATERBODIES 2006



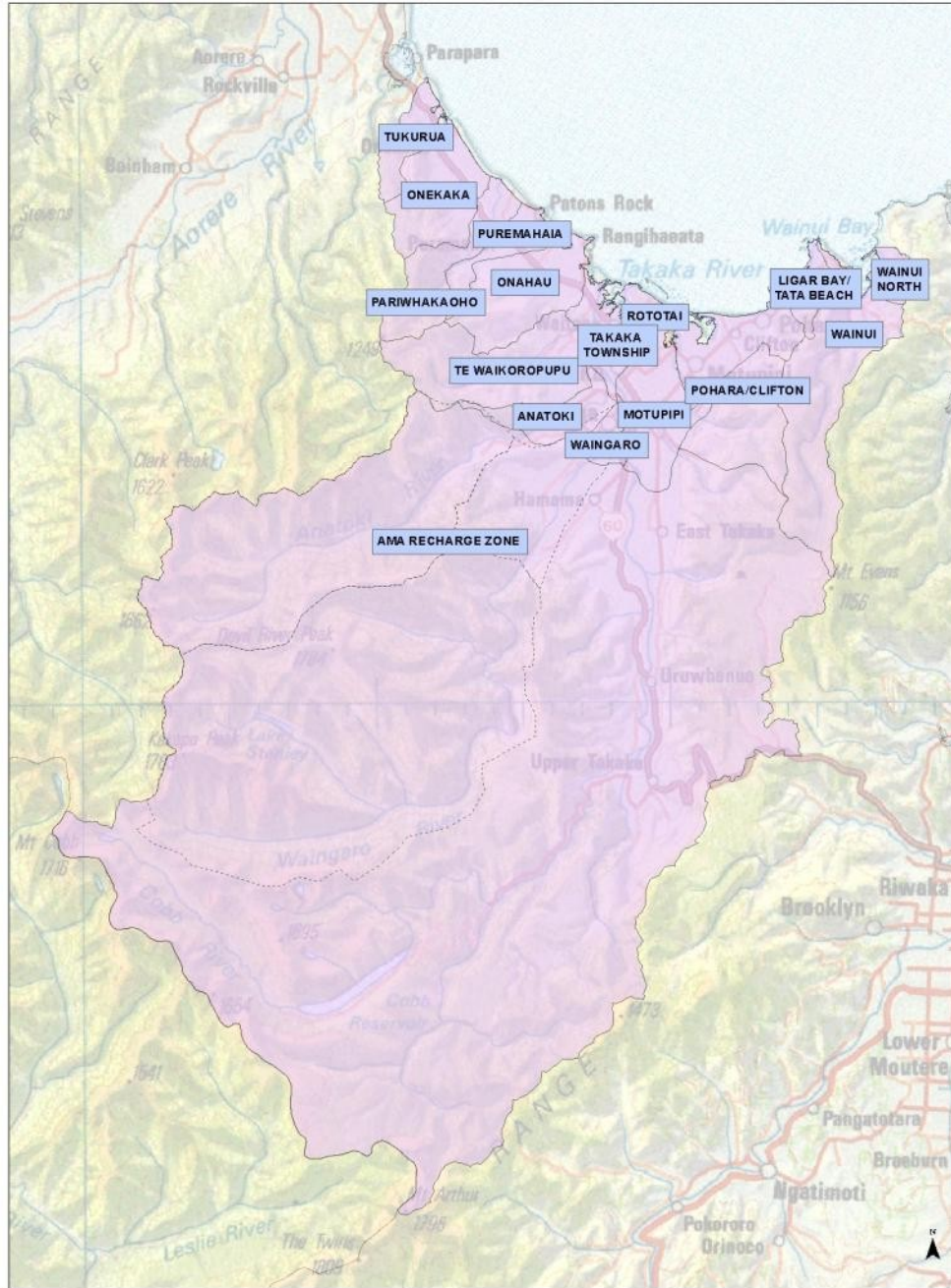
	Takaka North Rivers <i>Tukurua, Onekaka, Pariwhakaoho, Puremahaia, Onahau</i>	Springfed Rivers <i>Motupipi, Te Kakau, Wai Tapu, East Takaka Springs, Spring Brook, Spittals</i>	East Takaka Streams <i>Gorge, Ironstone, Rameka, Scott, Dry</i>	Pohara Flats <i>Kite Te Tahu, Gibson, Ellis, Winter</i>	Small Headwater Streams <i>Tributaries of Anatoki, Waingaro, Takaka and Cobb</i>	Major Rivers and their Tribs <i>Waikoropupu, Takaka, Anatoki, Waingaro, Cobb</i>
Typical Instream Values	Eel Migratory galaxiids (including shortjaw and giant kokopu) Redfin/Common bully Lamprey Torrentfish Koura Trout (Onekaka only) Absence of trout Whitebaiting/Eeling Native biodiversity Landscape values	Eel Migratory galaxiids Redfin/Common/Giant bully Koura Bird habitat Customary values Watercress Whitebaiting/Eeling Native biodiversity Landscape values	Eel (lower reaches) Koaro (upper reaches) Trout spawning/rearing (lower reaches) Native biodiversity Landscape values	Eel Migratory galaxiids (including giant kokopu) Redfin bully Torrentfish Koura Whitebaiting/Eeling Native biodiversity	Eel Koaro Upland bully (upper Takaka) Redfin bully (lower Anatoki tribs) Koura Trout spawning/rearing Native biodiversity Landscape values	Eel Migratory galaxiids (including giant kokopu) Common/Redfin bully (lower reaches) Upland bully Lamprey Torrentfish Koura Large adult trout Trout spawning/rearing Bird habitat and corridor Customary values Whitebaiting/Angling/Eeling Kayaking/Rafting/Swimming Landscape values
Instream Management Objective	Maintain available natural habitat to sustain the diverse native fish community	Protect groundwater recharge, spring flows and water quality	Protect groundwater recharge, maintain natural frequency and duration of drying	Maintain available natural habitat to sustain the diverse native fish community	Maintain available natural habitat for trout spawning/rearing	Maintain available natural habitat to sustain a productive trout fishery
Critical Value	Torrentfish	Native biodiversity	Landscape values	Migratory galaxiids	Trout spawning/rearing	Large adult trout
Critical Factors	Torrentfish habitat	Minimum dissolved oxygen concentration	Duration and frequency of drying	Migratory galaxiids habitat	Trout spawning/rearing habitat	Large adult trout habitat
Protection level	High (90% retention of habitat at natural MALF)	Medium (Maintain minimum dissolved oxygen above critical levels)	Low (<20% change in duration and frequency of drying)	Medium (70% retention of habitat at natural MALF)	Medium (70% retention of habitat at natural MALF)	High (90% retention of habitat at natural MALF)
Likely Demand	Medium	High	Low	Medium	Low	High
Technical method	Detailed instream habitat analysis and models, or set minimum flow at MALF	Water quality modelling and Surface/Groundwater model	Hydrological analysis	Generalised habitat models	Generalised habitat models	Detailed instream habitat analysis and models

← Aligns with FLAG objectives

CLASSIFICATION OF TAKAKA WATERBODIES - UPDATED

- Values
 - Current and likely water demand
 - Measurement points
-
- Coastal rivers (Takaka North plus Wainui)
 - Waingaro
 - Anatoki
 - Upper Takaka
 - Motupipi
 - Te Waikoropupu
 - Pohara Flats/Clifton

TAKAKA WATER MANAGEMENT ZONES



OTHER CONSIDERATIONS

- Minimum flow equals cease take
- Security of supply
- Restriction trigger and number of steps
- Flow statistics – 7Day or 1Day



RECOMMENDED FRAMEWORK

- Historical flow approach across all classes
- Minimum flow equals % of naturalised 7Day MALF
 - High value sites 90-100%
 - Lower value sites 70-80%
- Allocation limit equals % of 7Day MALF
 - High value sites 10-20%
 - Lower value sites 30-50%
- Minimum flow equals cease take
- 50% allocation rationing trigger only in Anatoki and Waingaro applied when flow equals minimum flow plus allocation limit



DISCUSSION/QUESTIONS

WAINGARO

Waingaro Catchment (AMA & Lower Waingaro) Consents & Flow Statistics

- Groundwater Consents
- Surface Water Consents
- Gauging Locations
- Flow Sites

	Total Allocated (l/s)	# of Consents
Surface Water	276.6	8
Groundwater	89.2	8
Total:	365.8	16

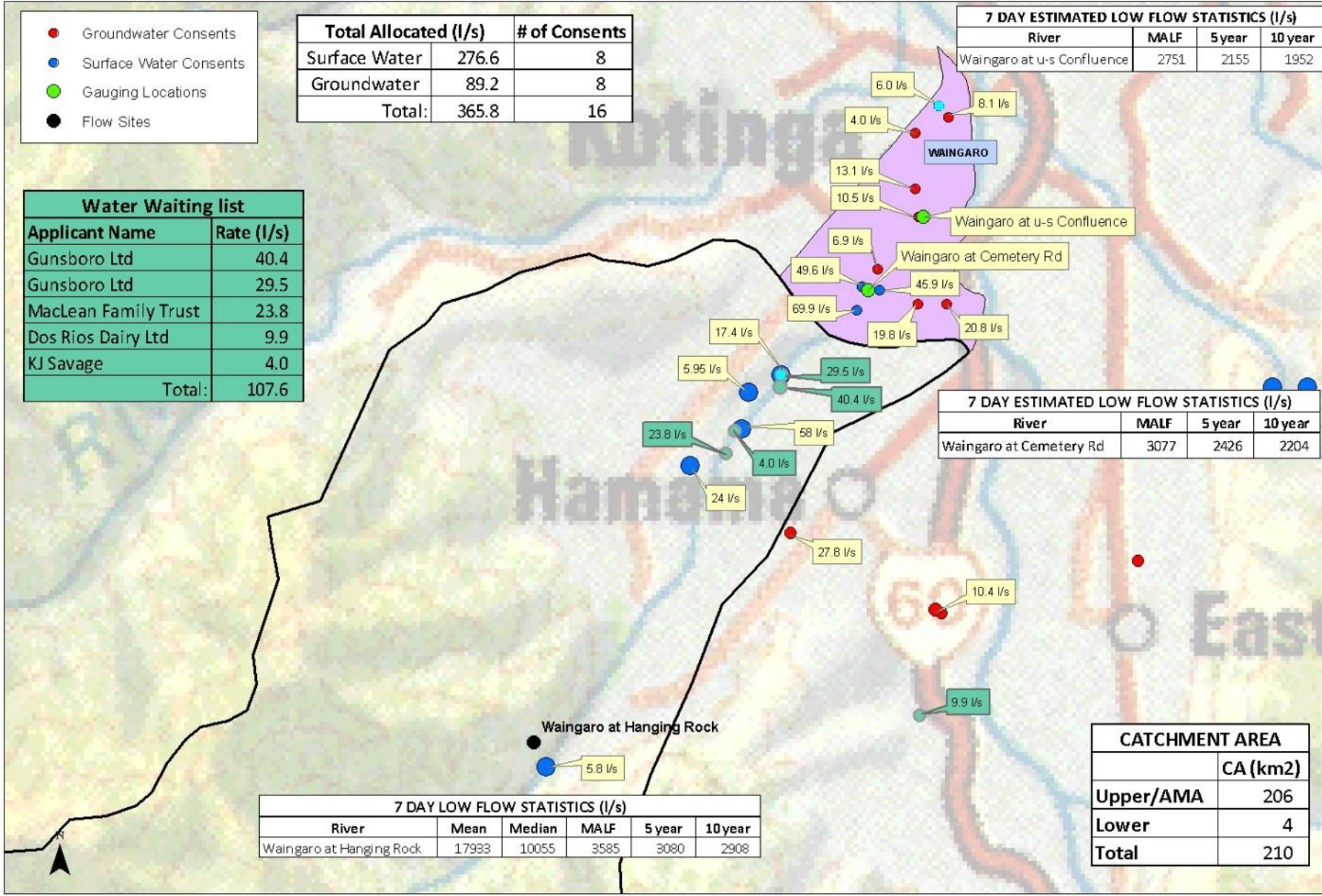
7 DAY ESTIMATED LOW FLOW STATISTICS (l/s)			
River	MALF	5 year	10 year
Waingaro at u-s Confluence	2751	2155	1952

Water Waiting list	
Applicant Name	Rate (l/s)
Gunsboro Ltd	40.4
Gunsboro Ltd	29.5
MacLean Family Trust	23.8
Dos Rios Dairy Ltd	9.9
KJ Savage	4.0
Total:	107.6

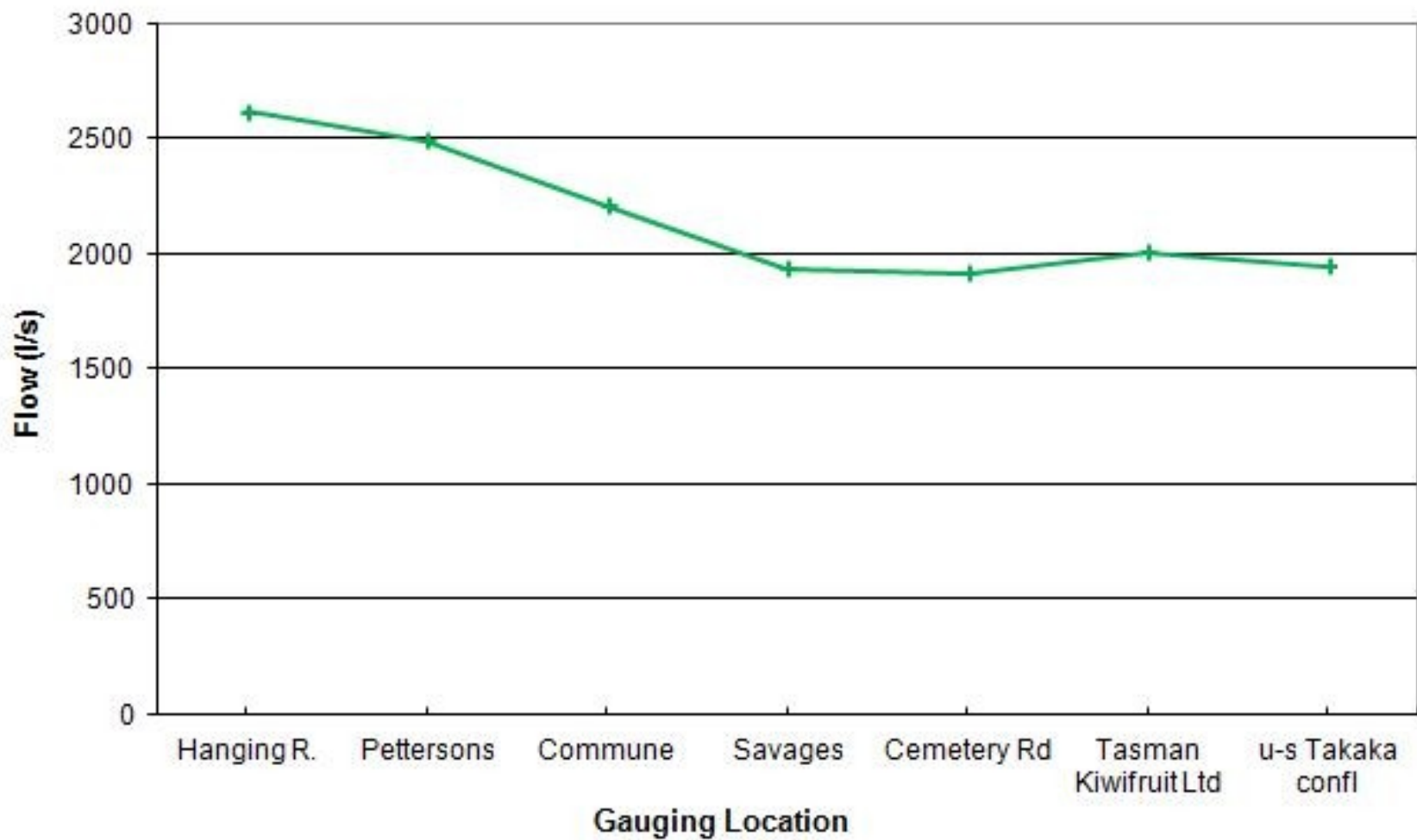
7 DAY LOW FLOW STATISTICS (l/s)					
River	Mean	Median	MALF	5 year	10 year
Waingaro at Hanging Rock	17933	10055	3585	3080	2908

7 DAY ESTIMATED LOW FLOW STATISTICS (l/s)			
River	MALF	5 year	10 year
Waingaro at Cemetery Rd	3077	2426	2204

CATCHMENT AREA	
	CA (km ²)
Upper/AMA	206
Lower	4
Total	210



Waingaro - Lowest Concurrent Gauging Run - 02/05/2001



WAINGARO

- Waingaro class
 - Moderate-High ecological values
 - Small loss to Marble Aquifer (about 8%)
 - Relatively high mean flow (18 m³/s)
 - 366 l/s of current takes
 - Further demand
-
- Minimum flow = 70-90% of 7 Day MALF
 - Allocation limit = 20-30% of 7 Day MALF
 - Minimum flow = cease take
 - 50% rationing trigger at minimum flow+allocation limit
-
- Minimum flows based on flows Waingaro at Hanging Rock
 - Abstraction based on estimated flows at Waingaro at u-s Confluence
 - Abstraction triggered by flows at Waingaro at Hanging Rock



WAINGARO– SECURITY OF SUPPLY

Flow statistic	Flow (l/s)	Average number of days below this flow per year
7Day MALF	3585	
90% 7Day MALF	3227	6
80% 7Day MALF	2868	2
70% 7Day MALF	2510	0.4
90% 7Day MALF + 20% allocation	3777	18
90% 7Day MALF + 30% allocation	4052	26
80% 7Day MALF + 20% allocation	3418	10
80% 7Day MALF + 30% allocation	3693	15
70% 7Day MALF + 20% allocation	3060	4
70% 7Day MALF + 30% allocation	3335	8

WAINGARO– SECURITY OF SUPPLY

Flow statistic	Flow (l/s)	Average number of days below this flow per year
7Day MALF	3585	
90% 7Day MALF	3227	6
80% 7Day MALF	2868	2
70% 7Day MALF	2510	0.4
90% 7Day MALF + 20% allocation	3777	18
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80% 7Day MALF + 20% allocation	3418	10
80% 7Day MALF + 30% allocation	3693	15
70% 7Day MALF + 20% allocation	3060	4
70% 7Day MALF + 30% allocation	3335	8

WAINGARO - RECOMMENDATION

- Minimum flow = 2868 l/s (80% of 7Day MALF at Hanging Rock)
- Allocation limit = 550 l/s (20% of 7Day MALF at u-s Confluence)
- Rationing step (50%) = 3418 l/s
- Cease take at 3143 l/s

- Expect restrictions for 10 days per year
- Expect cease take for 5 days per year

- Small effect on Marble Aquifer managed indirectly
- Some room for more allocation

- Dry weather task force role
- Restrictions in place as soon as practical

DISCUSSION/QUESTIONS

ANATOKI

Anatoki Catchment (Upper Anatoki, AMA & Lower Anatoki) Consents & Flow Statistics

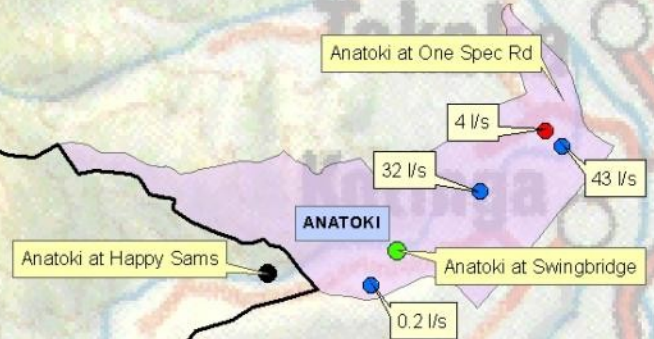
- Anatoki GW Consents
- Anatoki Surface Water Consents
- Gauging Locations
- Flow Sites

Total Allocated (l/s)	# of Consents	
Surface Water	75.2	3
Groundwater	4.0	1
Total:	79.2	4

7 DAY FLOW STATISTICS (l/s)					
River	Mean	Median	MALF	5 year	10 year
Anatoki at Happy Sams	12308	6067	2156	1784	1658

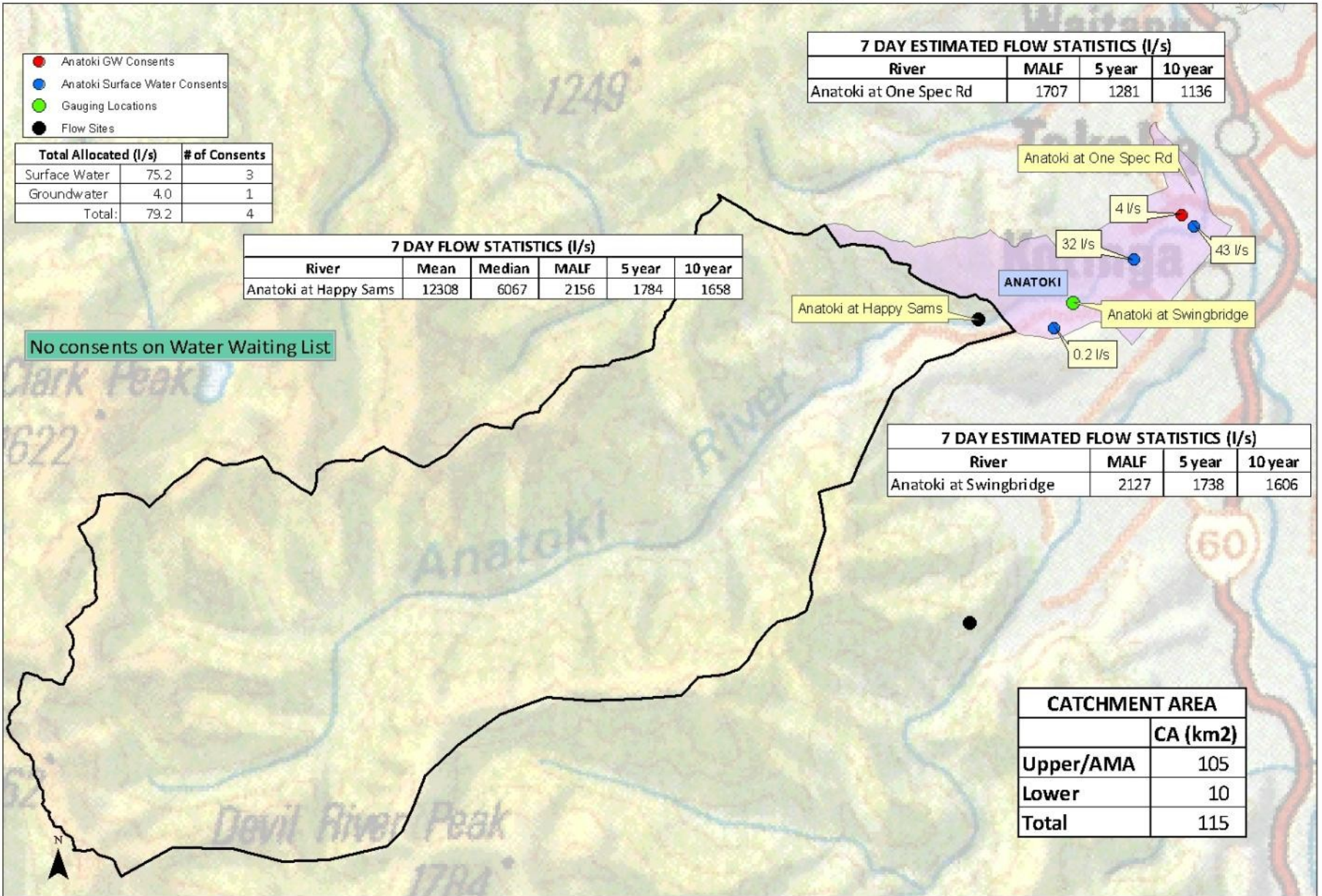
No consents on Water Waiting List

7 DAY ESTIMATED FLOW STATISTICS (l/s)			
River	MALF	5 year	10 year
Anatoki at One Spec Rd	1707	1281	1136

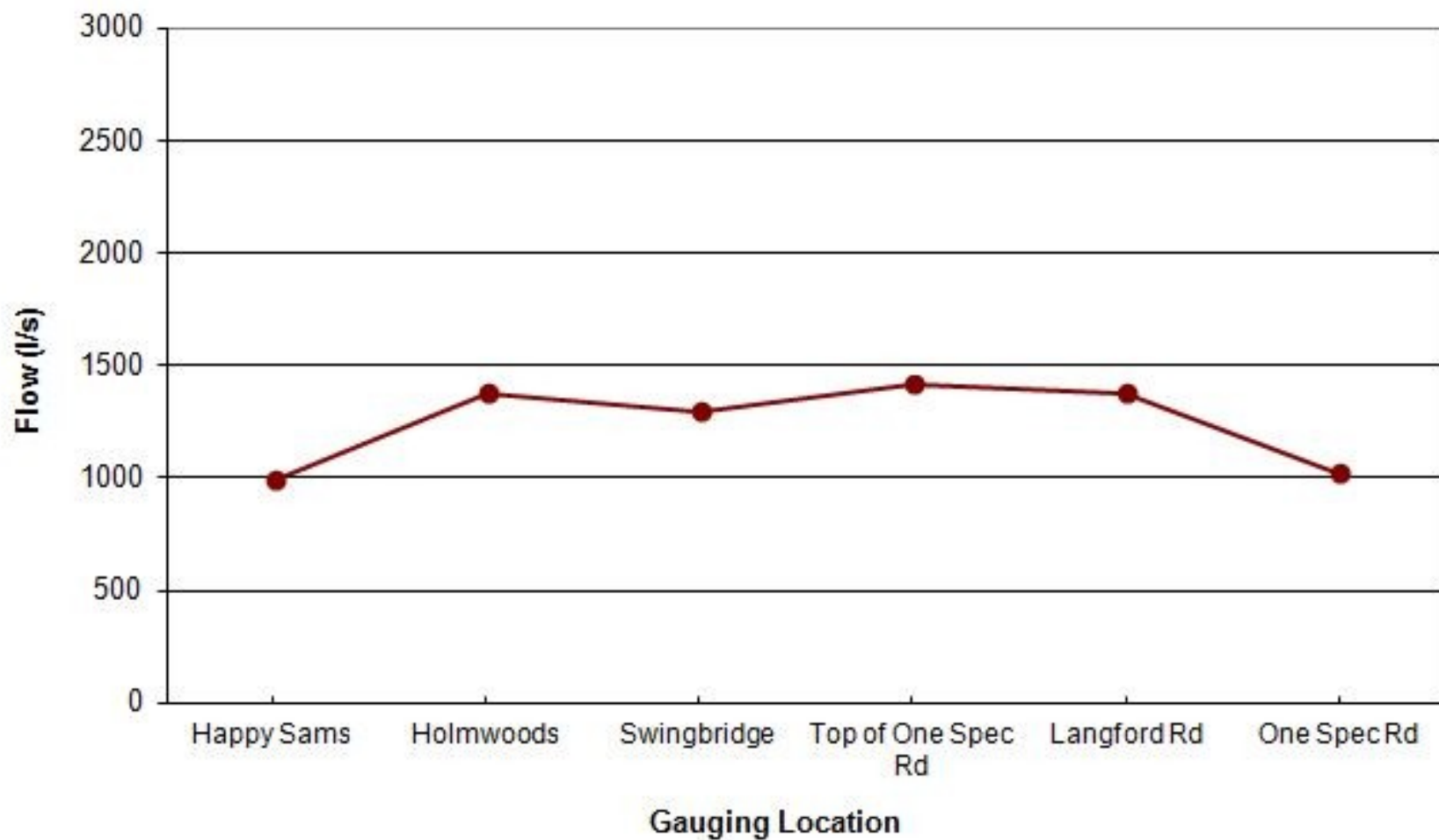


7 DAY ESTIMATED FLOW STATISTICS (l/s)			
River	MALF	5 year	10 year
Anatoki at Swingbridge	2127	1738	1606

CATCHMENT AREA	
	CA (km ²)
Upper/AMA	105
Lower	10
Total	115



Anatoki - Lowest Concurrent Gauging Run - 01/05/2001



ANATOKI

- Anatoki class
 - Moderate-High ecological values
 - No contribution to Marble Aquifer
 - Relatively high mean flow (12 m³/s)
 - 79 l/s of current takes
 - No/limited further demand
-
- Minimum flow = 70-90% of 7 Day MALF
 - Allocation limit = 20-30% of 7 Day MALF
 - Minimum flow = cease take
 - 50% rationing trigger at minimum flow+allocation limit
-
- Minimum flows based on flows Anatoki at Happy Sams
 - Abstraction based on estimated flows at Anatoki at One Spec Road
 - Abstraction triggered by flows at Anatoki at Happy Sams



ANATOKI– SECURITY OF SUPPLY

Flow statistic	Flow (l/s)	Average number of days below this flow per year
7Day MALF	2156	
90% 7Day MALF	1940	6
80% 7Day MALF	1725	3
70% 7Day MALF	1509	1
90% 7Day MALF + 20% allocation	2282	16
90% 7Day MALF + 30% allocation	2453	23
80% 7Day MALF + 20% allocation	2067	9
80% 7Day MALF + 30% allocation	2238	14
70% 7Day MALF + 20% allocation	1851	4
70% 7Day MALF + 30% allocation	2022	8

ANATOKI– SECURITY OF SUPPLY

Flow statistic	Flow (l/s)	Average number of days below this flow per year
7Day MALF	2156	
90% 7Day MALF	1940	6
80% 7Day MALF	1725	3
70% 7Day MALF	1509	1
90% 7Day MALF + 20% allocation	2282	16
90% 7Day MALF + 30% allocation	2453	23
80% 7Day MALF + 20% allocation	2067	9
80% 7Day MALF + 30% allocation	2238	14
70% 7Day MALF + 20% allocation	1851	4
70% 7Day MALF + 30% allocation	2022	8

ANATOKI - OPTIONS

- Minimum flow = 1727 l/s (80% of 7Day MALF at Happy Sams)
- Allocation limit = 341 l/s (20% of 7Day MALF at One Spec Rd)
- Rationing step (50%) = 2067 l/s
- Cease take at 1895 l/s

- Expect restrictions for 9 days per year
- Expect cease take for 5 days per year

- Allows significant increase in allocation compared with current situation
- Cap allocation at or near current levels??

- Restriction implementation same as Waingaro

DISCUSSION/QUESTIONS

PARIWHAKAHO

PARIWHAKAOHO

- Coastal rivers class
 - Significant ecological values
 - Relatively low mean flow
 - No current takes
 - Minimum flow = 90-100% of 7 Day MALF
 - Allocation limit = 10-20% of 7 Day MALF
 - Minimum flow = cease take
 - No rationing trigger
-
- Minimum flows and abstraction based on estimated flows at Pariwhakaoho at SH60
 - Abstraction triggered by flows at Anatoki @ HappySams



PARIWHAKAOHO – SECURITY OF SUPPLY

Flow statistic	Flow (l/s)	Average number of days below this flow per year
7 Day MALF	197	12
90% 7Day MALF	177	5
7Day MALF+10% allocation	217	24
7Day MALF +20% allocation	236	35
90% 7Day MALF + 10% allocation	195	12
90% 7Day MALF + 20% allocation	213	21

PARIWHAKAHO – SECURITY OF SUPPLY

Flow statistic	Flow (l/s)	Average number of days below this flow per year
7 Day MALF	195	12
90% 7Day MALF	177	5
7Day MALF+10% allocation	217	24
7Day MALF +20% allocation	236	35
90% 7Day MALF + 10% allocation	195	12
90% 7Day MALF + 20% allocation	213	21

PARIWHAKAOHO - RECOMMENDATION

Minimum flow = 177 l/s (90% of 7Day MALF)

Allocation limit = 20 l/s (10% of 7Day MALF)

Cease take 195 l/s

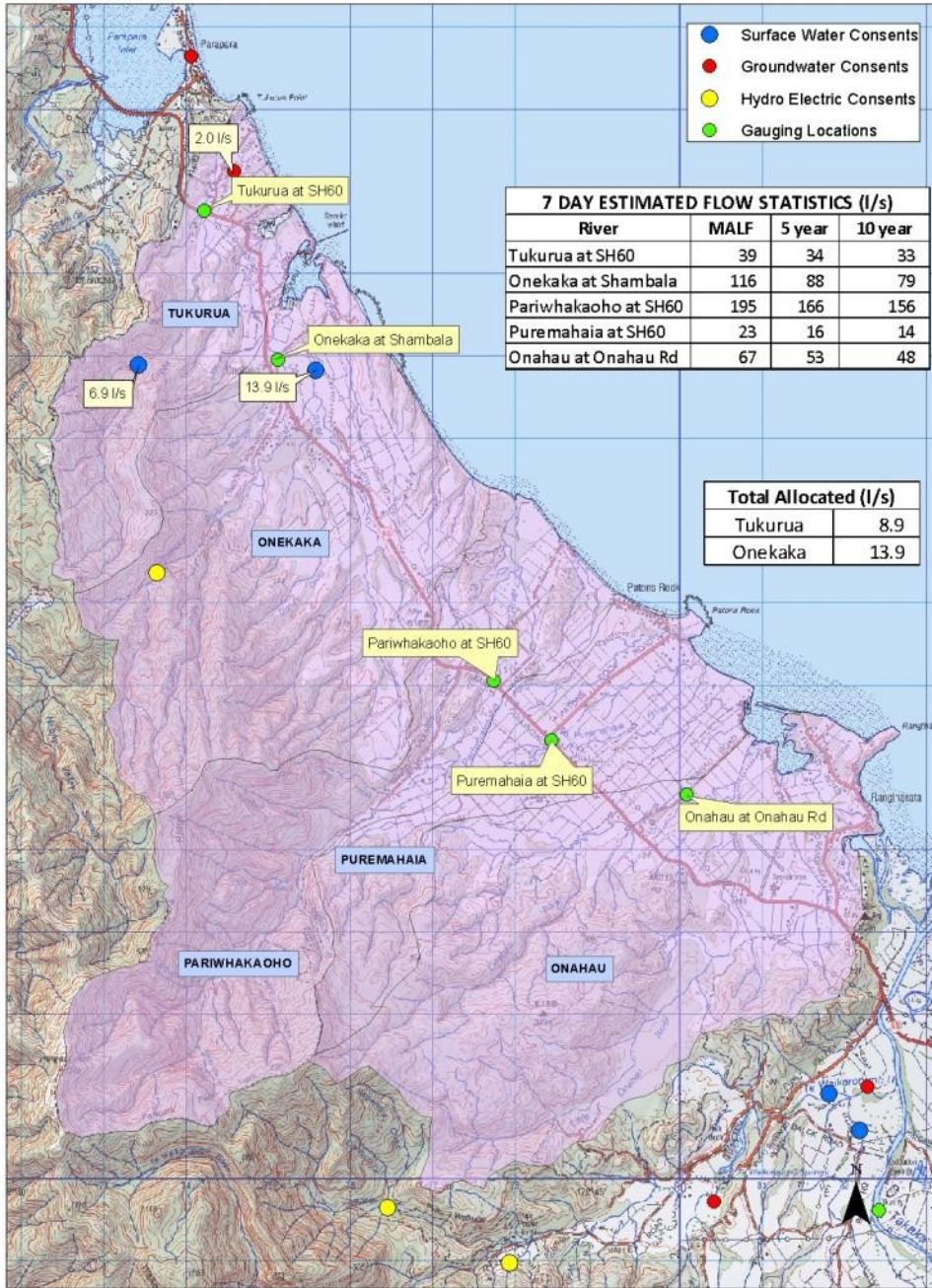
Expect cease take for 12 days per year

FLAG preference was MALF + 10% cease take

Security of supply implications

Confirm preference

North Takaka Zones Consents & Flow Statistics



Wainui Zone Consents & Flow Statistics

