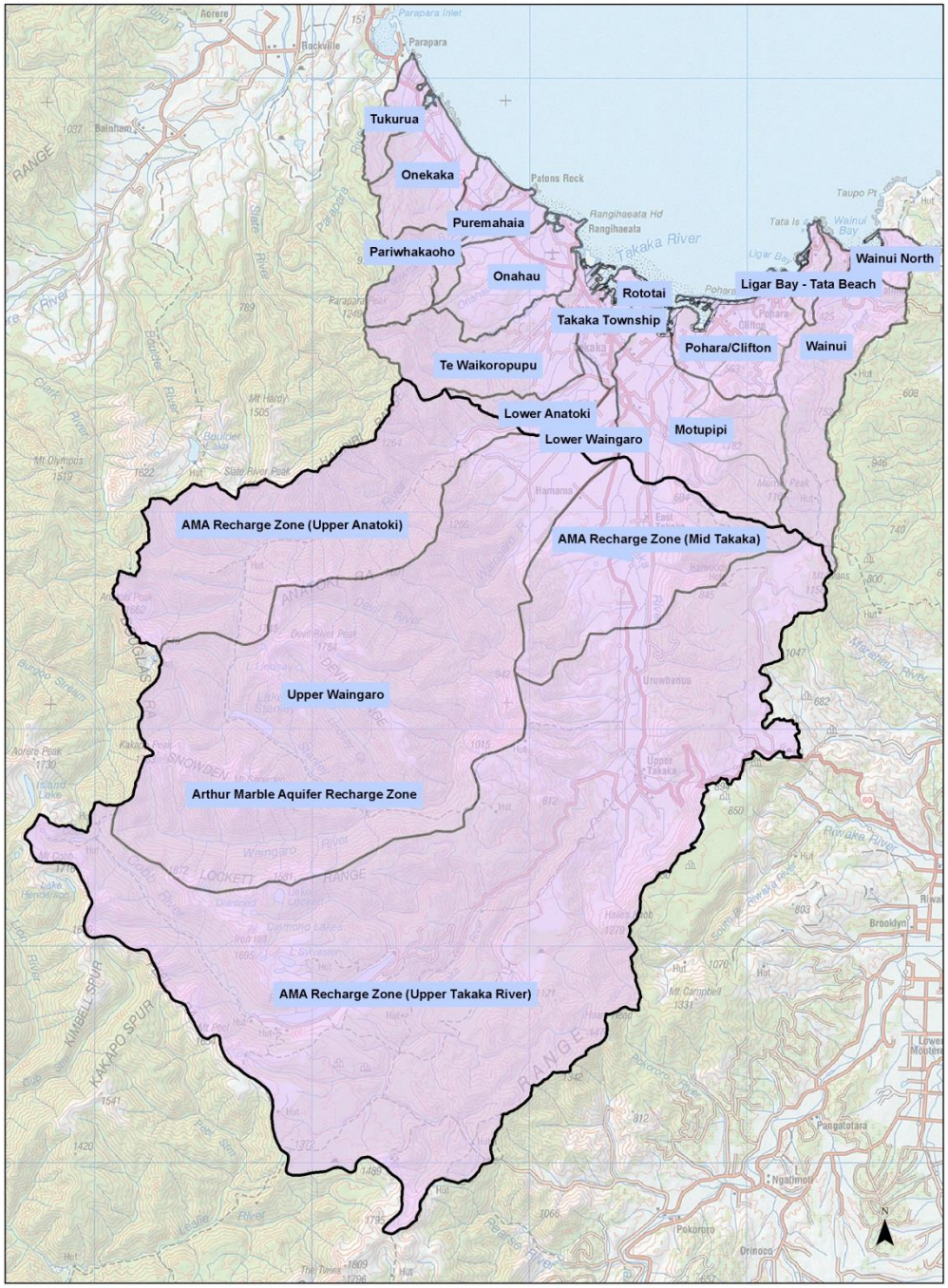
CAWTHRON INSTITUTE

ANOTHER LOOK AT THE AMA…

DR ROGER YOUNG/JOSEPH THOMAS (TDC) | 8 JULY 2016

Takaka Water Management Area Zones

Date Saved: 10/03/2016



DRIVERS OF THIS REVIEW OF AMA

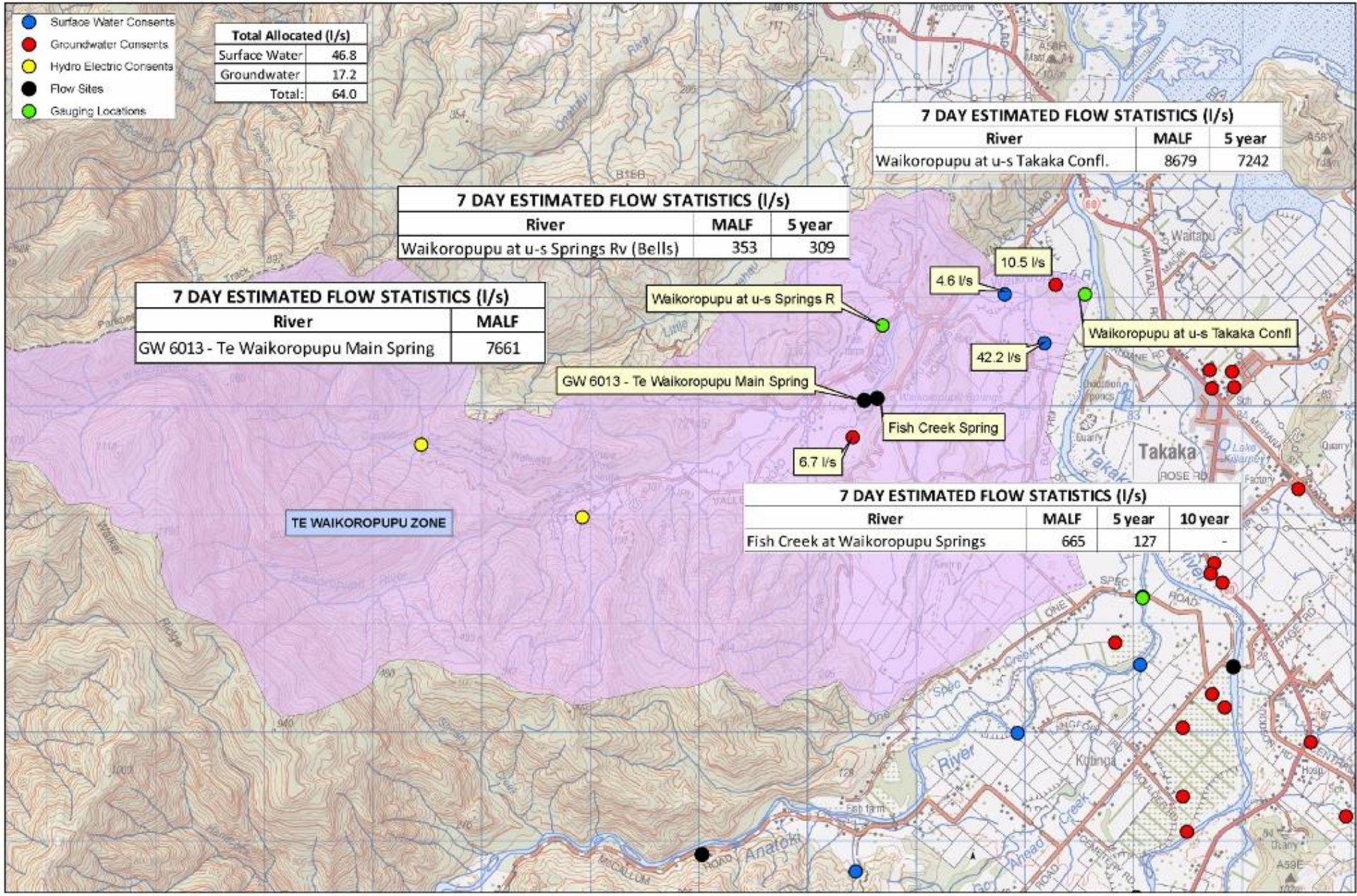
- FLAG queries
  - Trigger at Main Spring
  - Trigger at Fish Creek
  - Security of supply

- Upper Takaka irrigators queries
  - Security of supply concerns
  - 7-Day versus 1-Day stats
  - Daily average not continuous measurement
  - Sowman cease take justification
  - Another flow recorder

TE WAIKOROPUPU

Te Waikoropupu Zone
Consents & Flow Statistics

Date Saved: 10/06/2016



TE WAIKOROPUPU ZONE

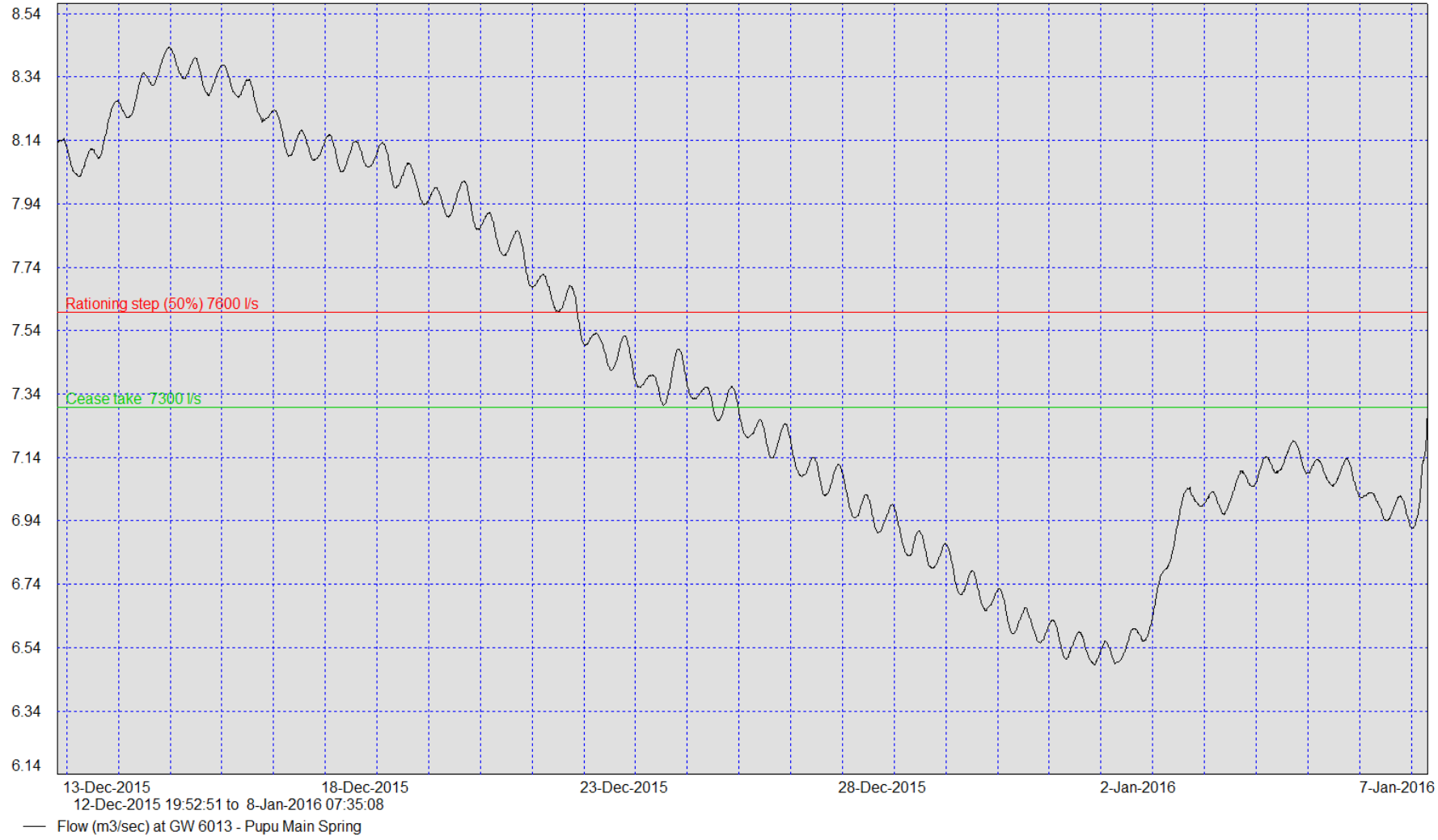
- Te Waikoropupu class
- Moderate-High ecological values
- Very high cultural values
- Fed by Marble Aquifer
- 64 l/s of current consumptive takes

- Minimum flow = 90-100% of 7 Day MALF
- Allocation limit = 10-20% of 7 Day MALF
- Minimum flow = cease take

TE WAIKOROPUPU SPRINGS – INITIAL RECOMMENDATION

Whole Springs area including recharge zone

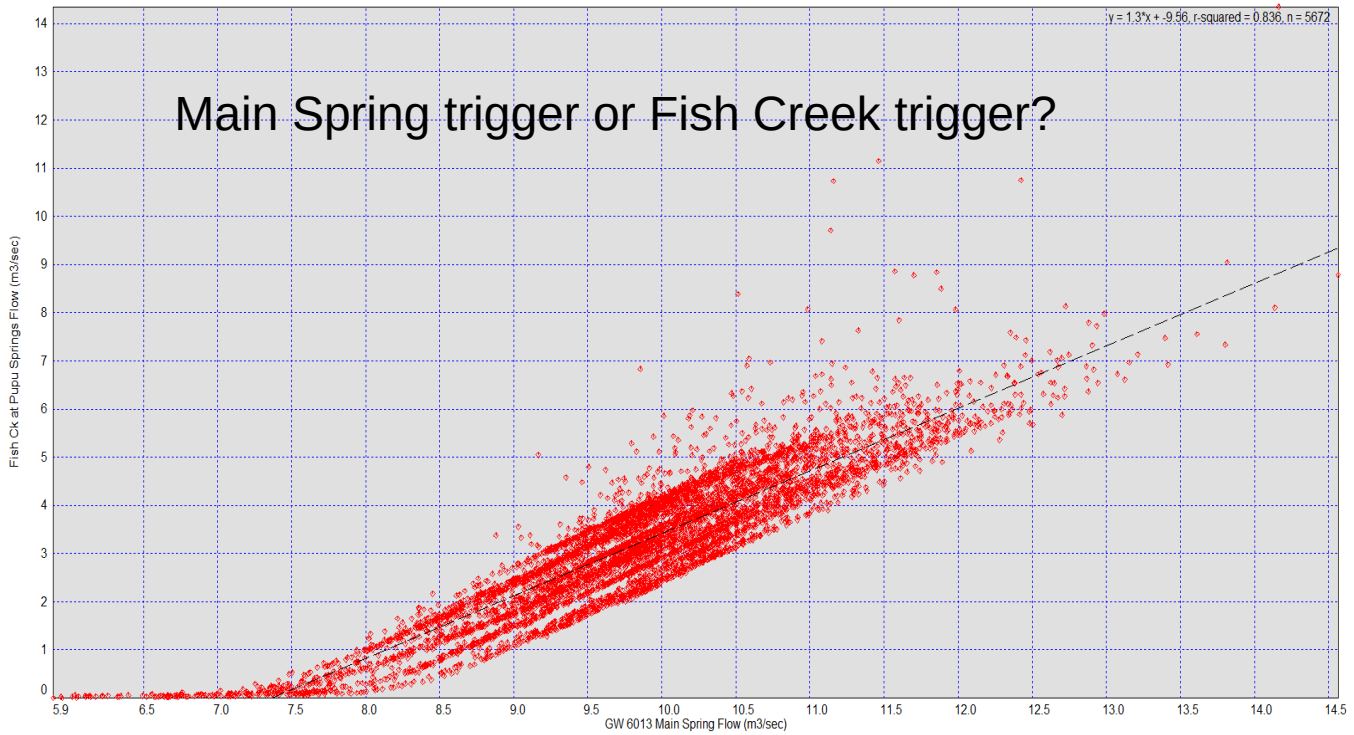
- Minimum flow = 6895 l/s (90% of 7Day MALF at Main Spring)
- Allocation limit = 766 l/s (10% of 7Day MALF at Main Spring)
- Rationing step (50%) = 7661 l/s
- Cease take at 7278 l/s

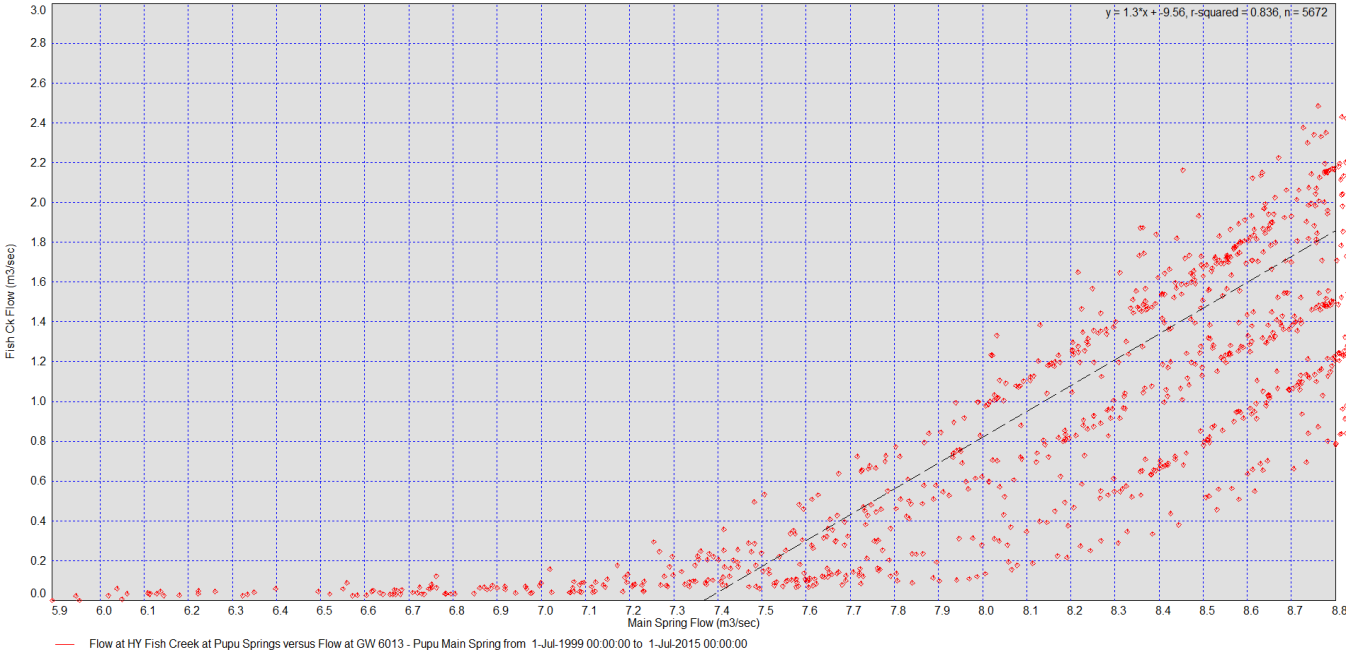


Rationing step unsuitable

Cease take = 7661 l/s

Main Spring trigger or Fish Creek trigger?





MAIN SPRING VERSUS FISH CREEK

- Once flows in the main spring drop below 7.4 m^3/s, flows in Fish Creek are always below 0.4 m^3/s
- Flows <0.2m^3/s can occur in Fish Creek even if flows in the main spring are as high as 8.1 m^3/s
- Fish Creek can stop flowing once flows in the main spring are below 6.1 m^3/s
- Fish Creek drying – somewhere between 1-in-5 and 1-in-10 year event
- At main spring MALF, Fish Creek won't be dry

Long-term changes in generation regime at Cobb affect flows in Fish Creek and main spring

SECURITY OF SUPPLY IMPLICATIONS

Te Waikoropupu Springs

GW 6013 Data - 1999 to 2016	Flow (l/s)		Days Below Flow (l/s) Per Hydrological Year (August to July)															
			1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Based on 15min interval instantaneous flows																			
Cease Take 7660 l/s (MALF)		Average:																	
Cease Take - number of days below (total)	7660	12.6	0.0	39.5	0.0	2.0	8.0	5.5	64.0	0.0	4.5	0.0	51.0	0.0	0.0	2.5	8.5	12.5	16.8
Cease Take - # of times > 3 days in a row below 7660 l/s	7660	8 years	0	4.0	0	0	1	1	2	0	0	0	3	0	0	0	1	2	1.0
Cease Take - longest consecutive # days below 7660 l/s	7660	15 times	0	11 days	0	0	8 days	5 days	33 days	0	0	0	24.5 days	0	0	0	8.5 days	4.5 days	16.8 days
Cease Take - # of times > 5 days in a row below 7660 l/s	7660	7 years	0	4	0	0	1	1	2	0	0	0	3.0	0	0	0	1	0	1.0
Cease Take - longest consecutive # days below 7660 l/s	7660	13 times	0	11 days	0	0	8 days	5 days	33 days	0	0	0	24.5 days	0	0	0	8.5 days	0	16.8 days

Duration (for all record):
Flow was greater than 7660 l/s 96.5% of the time between August 1999 and August 2015 (all year)

Flow was greater than 7660 l/s 93.6% of the time between August 1999 and August 2015 (Nov-Apr incl)

Fish Creek at Pupu Springs

Fish Ck at Pupu Springs Data - 1999 to 2016	Flow (l/s)		Days Below Flow (l/s) Per Hydrological Year (August to July)															
			1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Based on 15min interval instantaneous flows																			
Cease Take 665 l/s (MALF)		Average:																	
Cease Take - number of days below (total)	665	22.3	0.0	49.5	0.0	15.5	15.0	10.5	86.5	3.0	24.5	5.5	68.5	3.5	0.0	4.5	10.5	37.5	45.0
Cease Take - # of times > 3 days in a row below 665 l/s	665	12 years	0	2.0	0	2	1	1	3	0	1	1	1	1	0	0	1	2	3.0
Cease Take - longest consecutive # days below 665 l/s	665	19 times	0	25 days	0	8 days	15 days	10.5 days	40.5 days	0	23.5 days	5.5 days	61 days	3.5 days	0	0	9.5 days	29.5 days	32 days
Cease Take - # of times > 5 days in a row below 665 l/s	665	11 years	0	2	0	2	1	1	3	0	1	1	1.0	0	0	0	1	2	2.0
Cease Take - longest consecutive # days below 665 l/s	665	17 times	0	25 days	0	8 days	15 days	10.5 days	40.5 days	0	23.5 days	5.5 days	61 days	0	0	0	9.5 days	29.5 days	32 days

Duration (for all record):
Flow was greater than 665 l/s 95.5% of the time between August 1985 and August 2015 (all year)

Flow was greater than 665 l/s 92.3% of the time between August 1985 and August 2015 (Nov-Apr incl)

SECURITY OF SUPPLY IMPLICATIONS

Fish Creek at Pupu Springs

Fish Ck at Pupu Springs Data - 1999 to 2016	Flow (l/s)		Days Below Flow (l/s) Per Hydrological Year (August to July)															
			1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Based on 15min interval instantaneous flows																			
Cease Take 599 l/s (90% MALF)		Average:																	
Cease Take - number of days below (total)	599	20.9	0.0	47.5	0.0	13.5	13.5	10.5	83.5	2.0	23.5	5.0	64.0	3.0	0.0	3.0	9.0	35.0	42.0
Cease Take - # of times > 3 days in a row below 599 l/s	599	12 years	0	2.0	0	2	2	1	3	0	1	1	1	1	0	0	1	1	3.0
Cease Take - longest consecutive # days below 599 l/s	599	19 times	0	25 days	0	6 days	10 days	10.5 days	39 days	0	23.5 days	5.0 days	61 days	3.0 days	0	0	9.0 days	28 days	32 days
Cease Take - # of times > 5 days in a row below 599 l/s	599	11 years	0	2	0	2	1	1	3	0	1	1	1.0	0	0	0	1	1	2.0
Cease Take - longest consecutive # days below 599 l/s	599	16 times	0	25 days	0	6 days	10 days	10.5 days	39 days	0	23.5 days	5.0 days	61 days	0	0	0	9.0 days	28 days	32 days

Duration (for all record):
Flow was greater than 599 l/s 95.7% of the time between August 1985 and August 2015 (all year)

Flow was greater than 599 l/s 92.8% of the time between August 1985 and August 2015 (Nov-Apr incl)

Fish Creek at Pupu Springs

Fish Ck at Pupu Springs Data - 1999 to 2016	Flow (l/s)		Days Below Flow (l/s) Per Hydrological Year (August to July)															
			1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Based on 15min interval instantaneous flows																			
Cease Take 400 l/s		Average:																	
Cease Take - number of days below (total)	400	17.4	0.0	43.8	0.0	6.0	8.5	6.2	76.0	0.0	20.0	4.0	59.5	2.0	0.0	0.8	7.8	26.0	35.5
Cease Take - # of times > 3 days in a row below 400 l/s	400	11 years	0	3.0	0	1	1	1	3	0	1	1	1	0	0	0	1	2.0	2.0
Cease Take - longest consecutive # days below 400 l/s	400	17 times	0	12.5 days	0	4.5 days	8.5 days	6.2 days	38.5 days	0	20 days	4 days	59.5 days	0	0	0	7.8 days	20 days	30 days
Cease Take - # of times > 5 days in a row below 400 l/s	400	9 years	0	3	0	0	1	1	2	0	1	0	1.0	0	0	0	1	2.0	1.0
Cease Take - longest consecutive # days below 400 l/s	400	13 times	0	12.5 days	0	0	8.5 days	6.2 days	38.5 days	0	20 days	0	59.5 days	0	0	0	7.8 days	20 days	30 days

Duration (for all record):
Flow was greater than 400 l/s 96.6% of the time between August 1985 and August 2015 (all year)

Flow was greater than 400 l/s 94.2% of the time between August 1985 and August 2015 (Nov-Apr incl)

Fish Creek at Pupu Springs

Fish Ck at Pupu Springs Data - 1999 to 2016	Flow (l/s)		Days Below Flow (l/s) Per Hydrological Year (August to July)															
			1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Based on 15min interval instantaneous flows																			
Cease Take 200 l/s		Average:																	
Cease Take - number of days below (total)	200	12.8	0.0	25.0	0.0	0.0	7.5	2.2	66.5	0.0	14.5	0.0	55.5	0.0	0.0	0.0	1.0	21.0	24.5
Cease Take - # of times > 3 days in a row below 200 l/s	200	7 years	0	3.0	0	0	1	0	2	0	1	0	2	0	0	0	0	2.0	1.0
Cease Take - longest consecutive # days below 200 l/s	200	12 times	0	10 days	0	0	7.5 days	0	32 days	0	14.5 days	0	30 days	0	0	0	0	17 days	23 days
Cease Take - # of times > 5 days in a row below 200 l/s	200	7 years	0	2	0	0	1	0	2	0	1	0	2.0	0	0	0	0	1.0	1.0
Cease Take - longest consecutive # days below 200 l/s	200	10 times	0	10 days	0	0	7.5 days	0	32 days	0	14.5 days	0	30 days	0	0	0	0	17 days	23 days

Duration (for all record):
Flow was greater than 200 l/s 97.6% of the time between August 1985 and August 2015 (all year)

Flow was greater than 200 l/s 95.8% of the time between August 1985 and August 2015 (Nov-Apr incl)

FOR COMPARISON - UPPER TAKAKA SECURITY OF SUPPLY – CURRENT TRIGGER AND FLAG TRIGGER

Upper Takaka Status Quo -1657 l/s

Takaka at Harwoods Data record: 1975 - 2015	Flow (l/s)		Days Below Flow (l/s) Per Hydrological Year (August to July)															
			1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Based on 15min interval instantaneous flows																		
Cease Take 1657 l/s - Minimum Flow		Average:																
Cease Take - number of days below (total)	1657	6.8	0.0	0.5	0.0	0.0	0.0	0.2	22.0	2.8	18.6	9.2	21.8	7.2	0.0	12.3	4.2	10.6
Cease Take - # of times > 3 days in a row below 1657 l/s	1657	2 times	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Cease Take - longest consecutive # days below 1657 l/s	1657	2 years	0	0	0	0	0	0	0	0	0	0	5 days	0	0	0	0	4.5 days
Cease Take - # of times > 5 days in a row below 1657 l/s	1657	1 time	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Cease Take - longest consecutive # days below 1657 l/s	1657	1 year	0	0	0	0	0	0	0	0	0	0	5 days	0	0	0	0	0

% of time flow is above cease take trigger 1657 l/s (based on data from 1975-2015, Nov-Apr inclusive) 97.9%

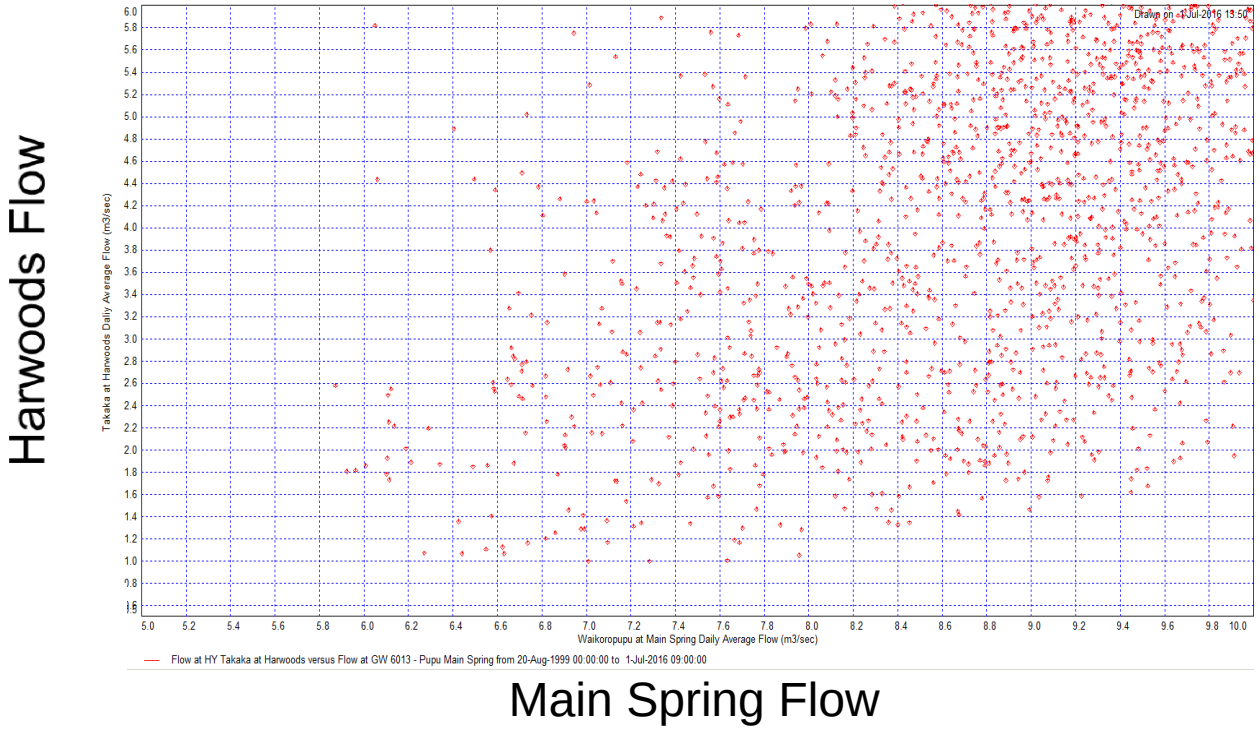
Upper Takaka FLAG Trigger - 70% MALF & 15% Allocation

Takaka at Harwoods Data record: 1975 - 2015	Flow (l/s)		Days Below Flow (l/s) Per Hydrological Year (August to July)															
			1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Based on 15min interval instantaneous flows																		
Cease Take 2023 l/s (Min Flow + Allocation)		Average:																
Cease Take - number of days below (total)	2023	14.3	0.0	12.5	0.0	6.3	10.1	9.6	37.4	11.2	31.5	18.9	33.3	14.6	0.0	18.7	6.2	18.1
Cease Take - # of times > 3 days in a row below 2023 l/s	2023	5 years	0	1.0	0	0	0.0	0	0.0	0	1.0	1	1.0	0	0	0	0	1
Cease Take - longest consecutive # days below 2023 l/s	2023	2 times	0	4.5 days	0	0	0.0	0	0	0	4 days	3 days	5 days	0	0	0	0	4.5 days
Cease Take - # of times > 5 days in a row below 2023 l/s	2023	1 year	0	0	0	0	0	0	0	0	0	0	1.0	0	0	0	0	0
Cease Take - longest consecutive # days below 2023 l/s	2023	1 time	0	0	0	0	0	0	0	0	0	0	5 days	0	0	0	0	0

% of time flow is above cease take trigger 2023 l/s (based on data from 1975-2015, Nov-Apr inclusive) 92.9%

NO MINIMUM FLOW TRIGGER FOR AMA?

- Even if the entire AMA allocation was halted with a cease take, the response in Fish Creek and the main spring would be relatively small and take several days to fully materialise.
- Justifiable to set cease take based on Spring flows?
- Just rely on allocation limit to address potential effects?



KEY POINTS

- Security of supply lower if we choose Fish Creek trigger
- Comparison with security of supply for upper Takaka irrigators based on river flows – main spring MALF slightly lower than current upper Takaka River take security of supply
- No 1:1 relationship between Takaka flows and Spring flows
- Changes in flow at the Te Waikoropupu Springs and Fish Creek are influenced by the magnitude and duration of flow change, other factors e.g. rainfall, tides…
- GNS work indicates that the full effect of flow fluctuations from the Cobb Power Scheme are only felt after 5 – 11 days and only a proportion (mean 49%, range 12-83%) of the flow change is observed at Te Waikoropupu Springs (White et al. 2000).
- Wheel of Water modelling by Landcare Research/Aqualink more specifically indicates that the magnitude of response at Fish Creek is only about 16% of any change in abstraction within the AMA

OPTIONS FOR FLAG TO CONSIDER

- Minimum flow based on Fish Creek
- Minimum flow based on Main Spring
- Triggers for both Main Spring & Fish Creek (e.g. MS 7660; FC 200)
- No minimum flow for AMA

- Triggers would apply to all takes within AMA, including upper Takaka River takes

- Risk assessment not technical decision

- Note: trigger still needed for river takes to protect in-river values

WAINGARO - RECAP

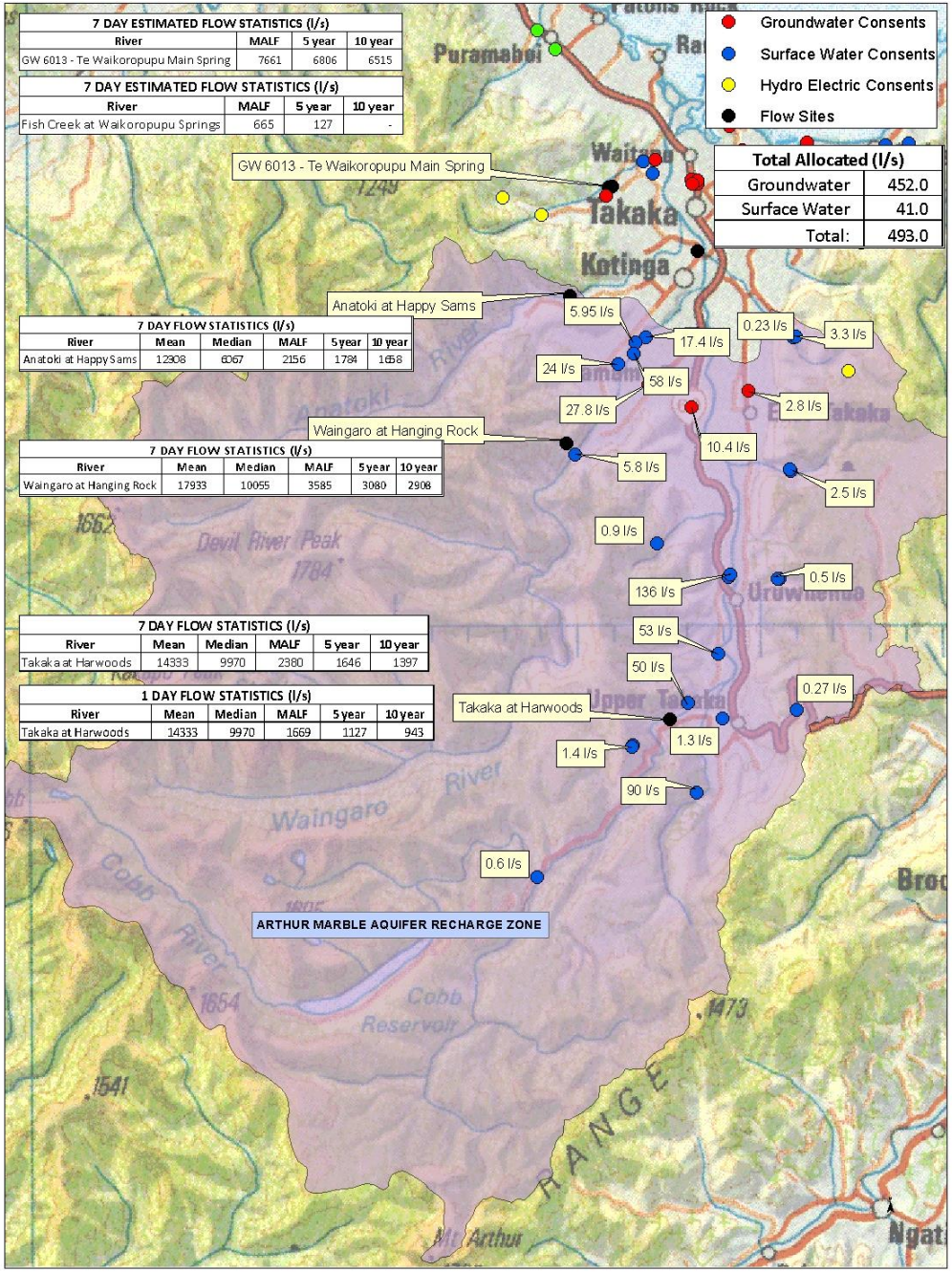
WAINGARO – RECOMMENDATION – ADOPTED BY FLAG

- 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 2868 l/s

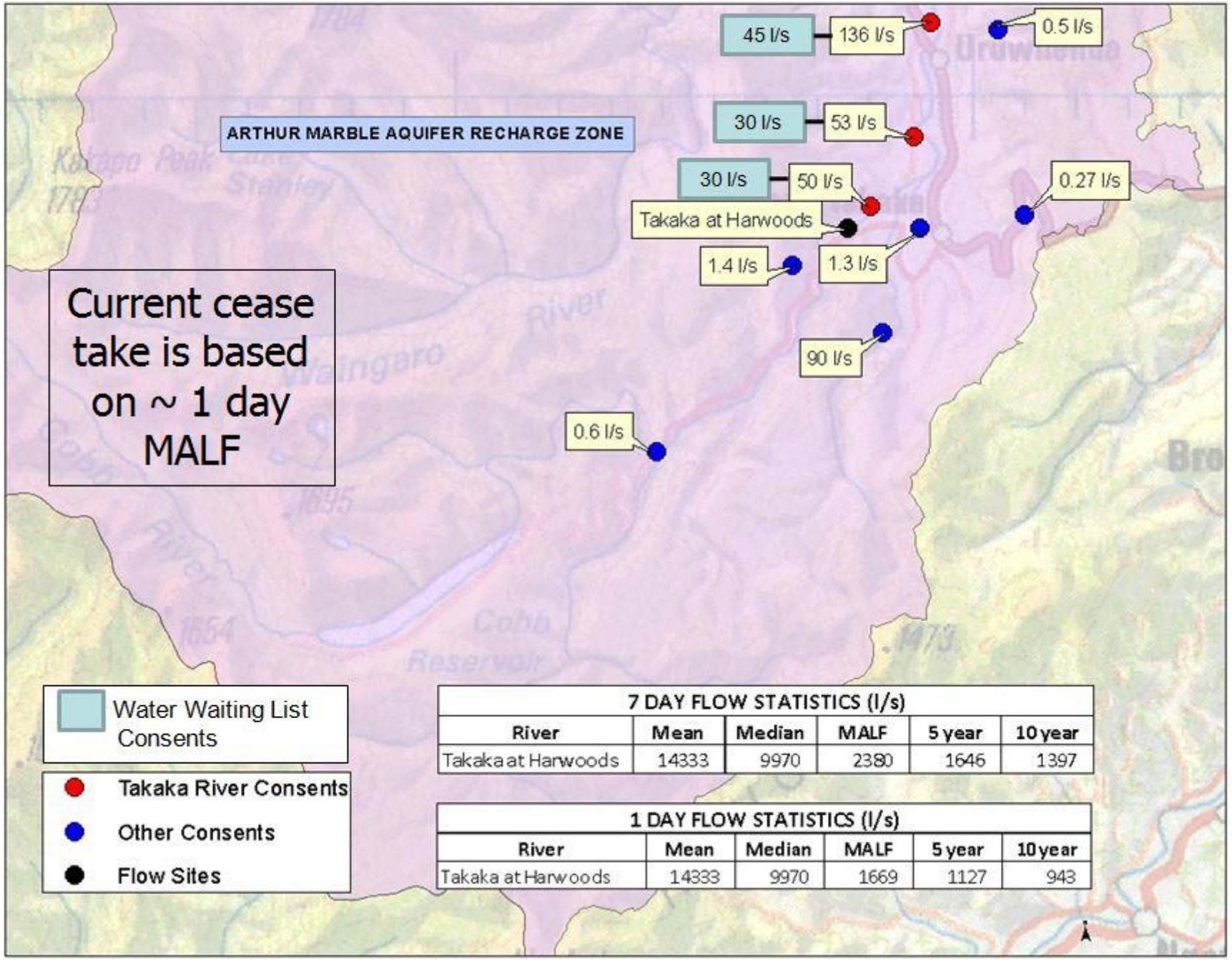
- Expect restrictions for 10 days per year
- Expect cease take for 2 days per year

UPPER TAKAKA

Arthur Marble Aquifer Recharge Zone
Consents & Flow Statistics



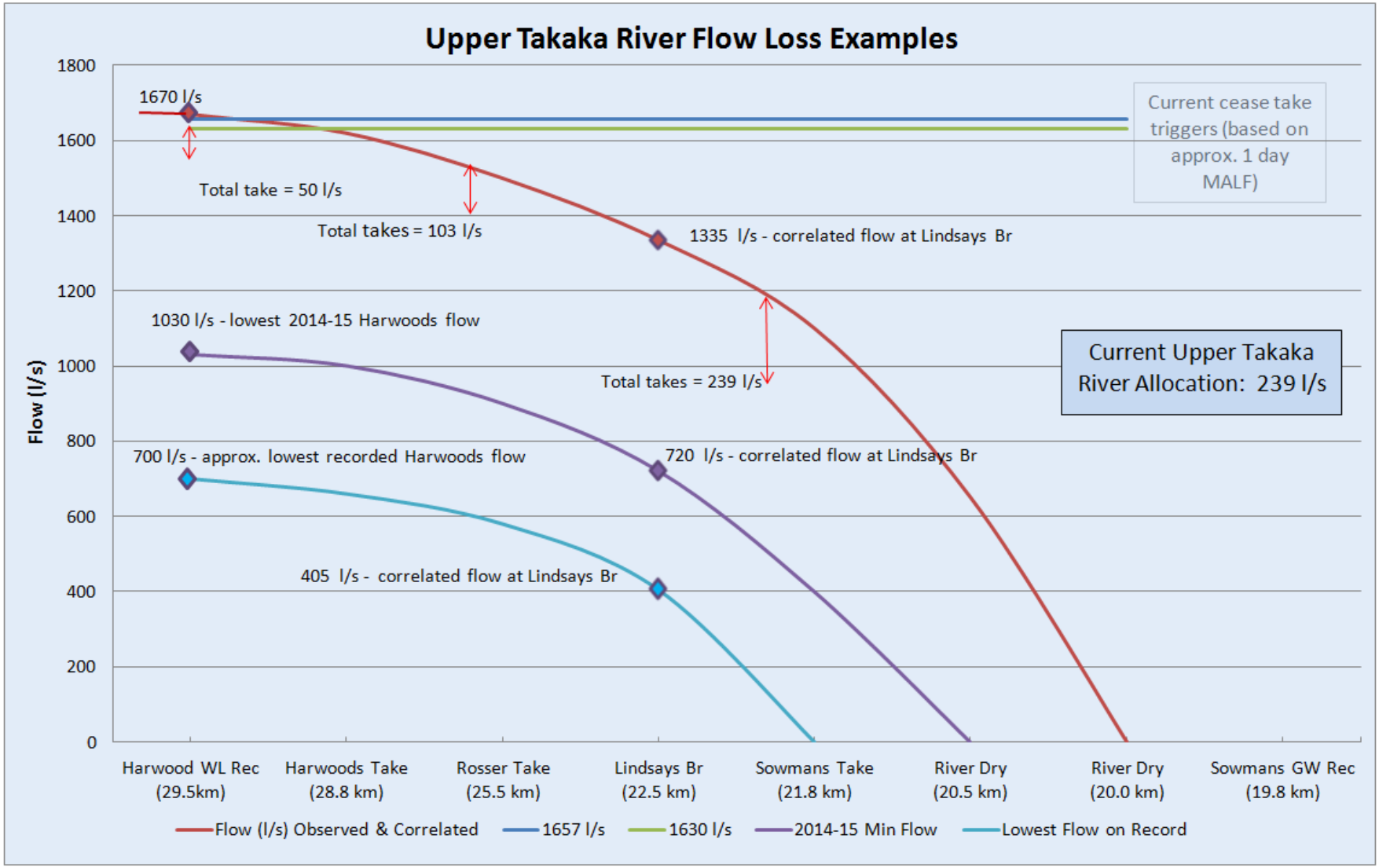
Current Water Take Consents



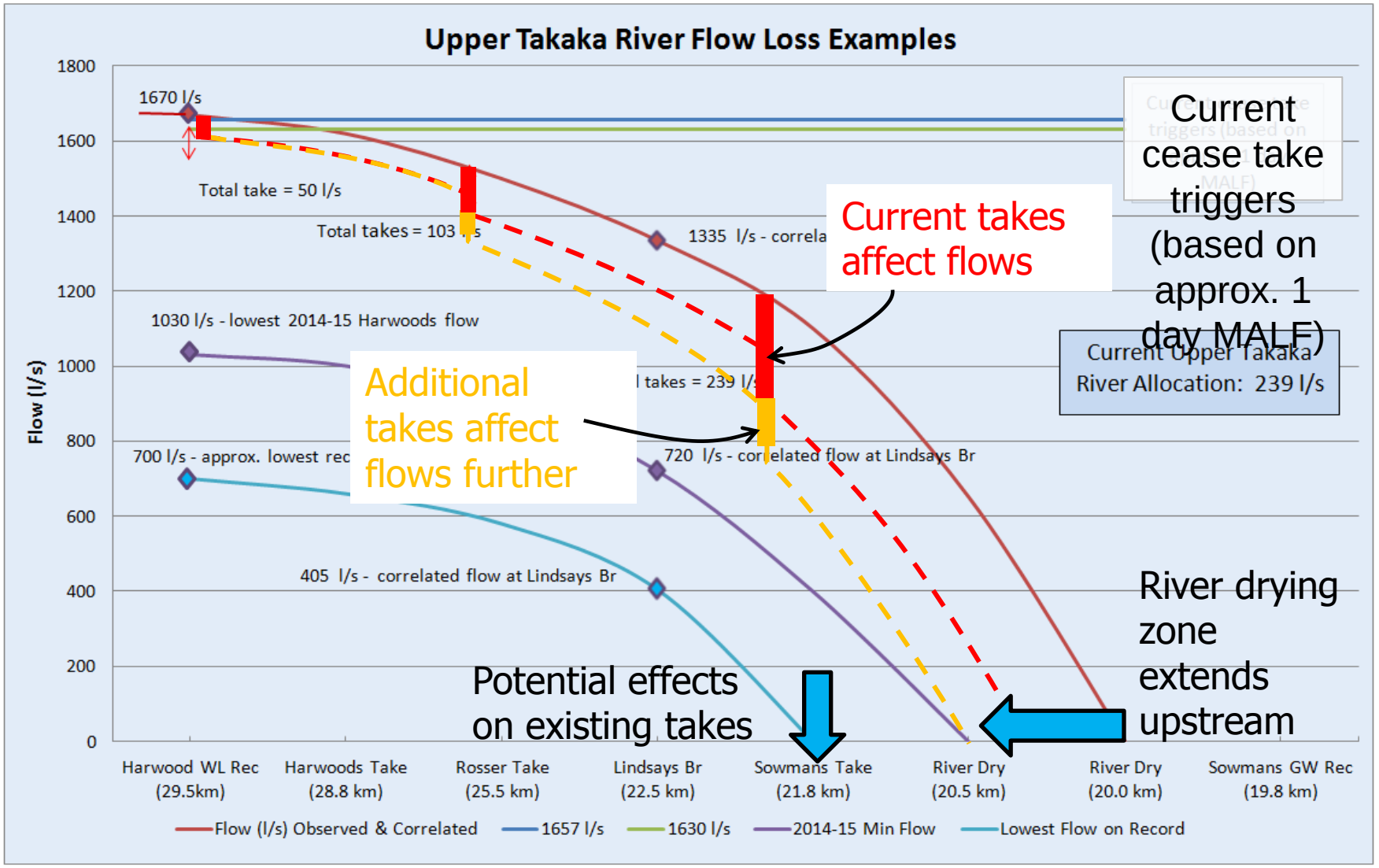
7 DAY FLOW STATISTICS (l/s)					
River	Mean	Median	MALF	5 year	10 year
Takaka at Harwoods	14333	9970	2380	1646	1397

1 DAY FLOW STATISTICS (l/s)					
River	Mean	Median	MALF	5 year	10 year
Takaka at Harwoods	14333	9970	1669	1127	943

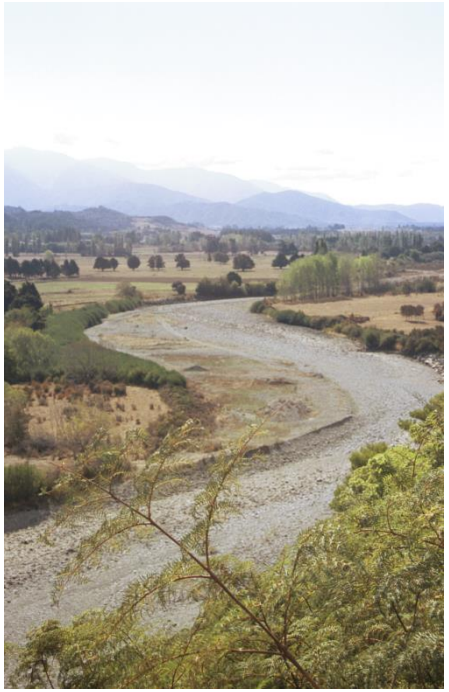
LOSSES TO GROUNDWATER



LOSSES TO GROUNDWATER



UPPER TAKAKA

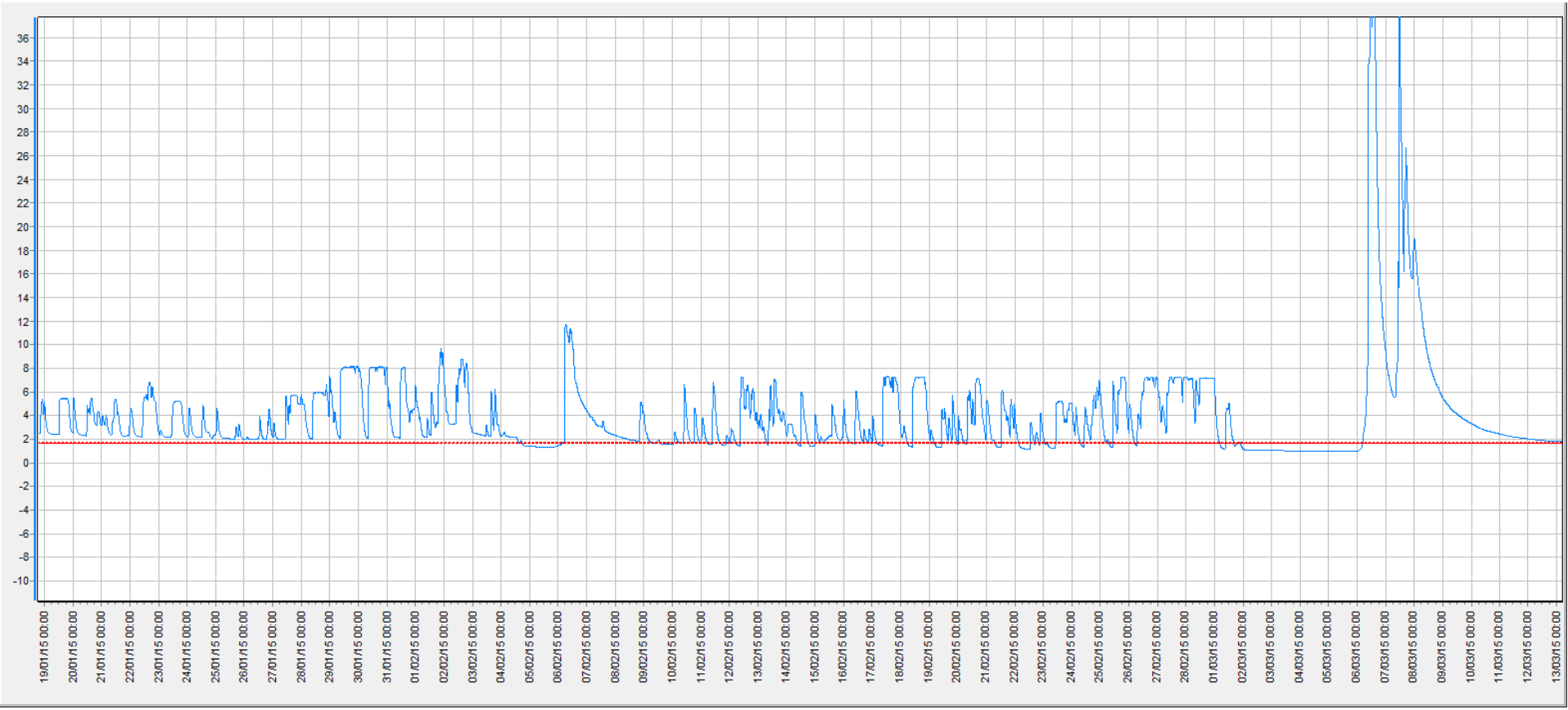


- Upper Takaka class
- Moderate ecological values
- Significant loss to Marble Aquifer (up to 100%)
- Significant contribution to Te Waikoropupu (45%)
- Relatively high mean flow (14 m^3/s)
- 239 l/s of current takes
- Further demand
- Current minimum flow (cease take) = 1657 l/s (70% 7 Day MALF)
- 1 Day MALF = 1669 l/s

- Minimum flow = 70-80% of 7 Day MALF
- Allocation limit = 20-30% of 7 Day MALF
- Minimum flow = cease take
- No rationing trigger
- Minimum flows and abstraction based on flows at Takaka at Harwoods

FLUCTUATING FLOWS – COBB POWER SCHEME

- Frequent fluctuations of 6-7 m^3/s related to power scheme generation



UPPER TAKAKA– SECURITY OF SUPPLY

Flow statistic	Flow (l/s)	Average number of days below this flow per year
7Day MALF	2380	
70% 7Day MALF	1666	8
70% 7Day MALF + 10% allocation	1904	12
70% 7Day MALF + 20% allocation	2142	16

UPPER TAKAKA – SECURITY OF SUPPLY

Flow statistic	Flow (l/s)	Average number of days below this flow per year
7Day MALF	2380	
70% 7Day MALF	1666	8
70% 7Day MALF + 10% allocation	1904	12
70% 7Day MALF + 20% allocation	2142	16

UPPER TAKAKA – FLAG DECISION

- Minimum flow = 1666 l/s (70% of 7 Day MALF)
- Allocation limit = 357 l/s (15% of 7 Day MALF)
- Cease take = 2023 l/s

- Security of supply

Upper Takaka Status Quo -1657 l/s

Takaka at Harwoods Data record: 1975 - 2015	Flow (l/s)		Days Below Flow (l/s) Per Hydrological Year (August to July)															
			1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Based on 15min interval instantaneous flows																		
Cease Take 1657 l/s - Minimum Flow		Average:																
Cease Take - number of days below (total)	1657	6.8	0.0	0.5	0.0	0.0	0.0	0.2	22.0	2.8	18.6	9.2	21.8	7.2	0.0	12.3	4.2	10.6
Cease Take - # of times > 3 days in a row below 1657 l/s	1657	2 times	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Cease Take - longest consecutive # days below 1657 l/s	1657	2 years	0	0	0	0	0	0	0	0	0	0	5 days	0	0	0	0	4.5 days
Cease Take - # of times > 5 days in a row below 1657 l/s	1657	1 time	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Cease Take - longest consecutive # days below 1657 l/s	1657	1 year	0	0	0	0	0	0	0	0	0	0	5 days	0	0	0	0	0

% of time flow is above cease take trigger 1657 l/s (based on data from 1975-2015, Nov-Apr inclusive) 97.9%

Upper Takaka FLAG Trigger - 70% MALF & 15% Allocation

Takaka at Harwoods Data record: 1975 - 2015	Flow (l/s)		Days Below Flow (l/s) Per Hydrological Year (August to July)															
			1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Based on 15min interval instantaneous flows																		
Cease Take 2023 l/s (Min Flow + Allocation)		Average:																
Cease Take - number of days below (total)	2023	14.3	0.0	12.5	0.0	6.3	10.1	9.6	37.4	11.2	31.5	18.9	33.3	14.6	0.0	18.7	6.2	18.1
Cease Take - # of times > 3 days in a row below 2023 l/s	2023	5 years	0	1.0	0	0	0.0	0	0.0	0	1.0	1	1.0	0	0	0	0	1
Cease Take - longest consecutive # days below 2023 l/s	2023	2 times	0	4.5 days	0	0	0.0	0	0	0	4 days	3 days	5 days	0	0	0	0	4.5 days
Cease Take - # of times > 5 days in a row below 2023 l/s	2023	1 year	0	0	0	0	0	0	0	0	0	0	1.0	0	0	0	0	0
Cease Take - longest consecutive # days below 2023 l/s	2023	1 time	0	0	0	0	0	0	0	0	0	0	5 days	0	0	0	0	0

% of time flow is above cease take trigger 2023 l/s (based on data from 1975-2015, Nov-Apr inclusive) 92.9%

FOR COMPARISON - UPPER TAKAKA SECURITY OF SUPPLY – CURRENT TRIGGER AND FLAG TRIGGER – DOWN TO 1 DAY AND 12 HRS INTERVAL

Upper Takaka Status Quo -1657 l/s

Takaka at Harwoods Data record: 1975 - 2015	Flow (l/s)		Days Below Flow (l/s) Per Hydrological Year (August to July)														
			1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Based on 15min interval instantaneous flows																		
Cease Take 1657 l/s - Minimum Flow		Average:																
Cease Take - number of days below (total)	1657	6.8	0.0	0.5	0.0	0.0	0.0	0.2	22.0	2.8	18.6	9.2	21.8	7.2	0.0	12.3	4.2	10.6
Cease Take - # of times > 3 days in a row below 1657 l/s	1657	2 times	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Cease Take - longest consecutive # days below 1657 l/s	1657	2 years	0	0	0	0	0	0	0	0	0	0	5 days	0	0	0	0	4.5 days
Cease Take - # of times > 5 days in a row below 1657 l/s	1657	1 time	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Cease Take - longest consecutive # days below 1657 l/s	1657	1 year	0	0	0	0	0	0	0	0	0	0	5 days	0	0	0	0	0
Cease Take - # of times > 1 day in a row below 1657 l/s	1657	24 times	0	0	0	0	0	0	6	0	2	1	4	1	0	4	1	5
Cease Take - longest consecutive # days below 1657 l/s	1657	8 years	0	0	0	0	0	0	2 days	0	2 days	1 day	4 days	1 day	0	1 day	1 days	4 days
Cease Take - # of times > 12 hours in a row below 1657 l/s	1657	85 times	0	1	0	0	0	0	14	2	14	8	16	3	0	11	3	13
	1657	10 years																

% of time flow is above cease take trigger 1657 l/s (based on data from 1975-2015, Nov-Apr inclusive) 97.9%

Upper Takaka FLAG Trigger - 70% MALF & 15% Allocation

Takaka at Harwoods Data record: 1975 - 2015	Flow (l/s)		Days Below Flow (l/s) Per Hydrological Year (August to July)														
			1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Based on 15min interval instantaneous flows																		
Cease Take 2023 l/s (Min Flow + Allocation)		Average:																
Cease Take - number of days below (total)	2023	14.3	0.0	12.5	0.0	6.3	10.1	9.6	37.4	11.2	31.5	18.9	33.3	14.6	0.0	18.7	6.2	18.1
Cease Take - # of times > 3 days in a row below 2023 l/s	2023	5 years	0	1.0	0	0	0.0	0	0.0	0	1.0	1	1.0	0	0	0	0	1
Cease Take - longest consecutive # days below 2023 l/s	2023	2 times	0	4.5 days	0	0	0.0	0	0	0	4 days	3 days	5 days	0	0	0	0	4.5 days
Cease Take - # of times > 5 days in a row below 2023 l/s	2023	1 year	0	0	0	0	0	0	0	0	0	0	1.0	0	0	0	0	0
Cease Take - longest consecutive # days below 2023 l/s	2023	1 time	0	0	0	0	0	0	0	0	0	0	5 days	0	0	0	0	0
Cease Take - # of times > 1 day in a row below 2023 l/s	2023	47 times	0	5	0	0	2	1	7	1	5	3	8	3	0	4	2	6
Cease Take - longest consecutive # days below 2023 l/s	2023	12 years	0	3 days	0	0	2 days	1 day	2 days	1 day	3 days	2 days	4 days	2 days	0	1 day	1 day	4 days
Cease Take - # of times > 12 hours in a row below 2023 l/s	2023	219 times	0	16	0	4	10	9	32	11	36	17	27	13	0	19	5	20
	2023	13 years																

% of time flow is above cease take trigger 2023 l/s (based on data from 1975-2015, Nov-Apr inclusive) 92.9%

UPPER TAKAKA IRRIGATOR QUERIES

- Security of supply concerns
- 7-Day versus 1-Day stats
- Daily average not continuous measurement
- Sowman cease take justification
- Another flow recorder

SECURITY OF SUPPLY

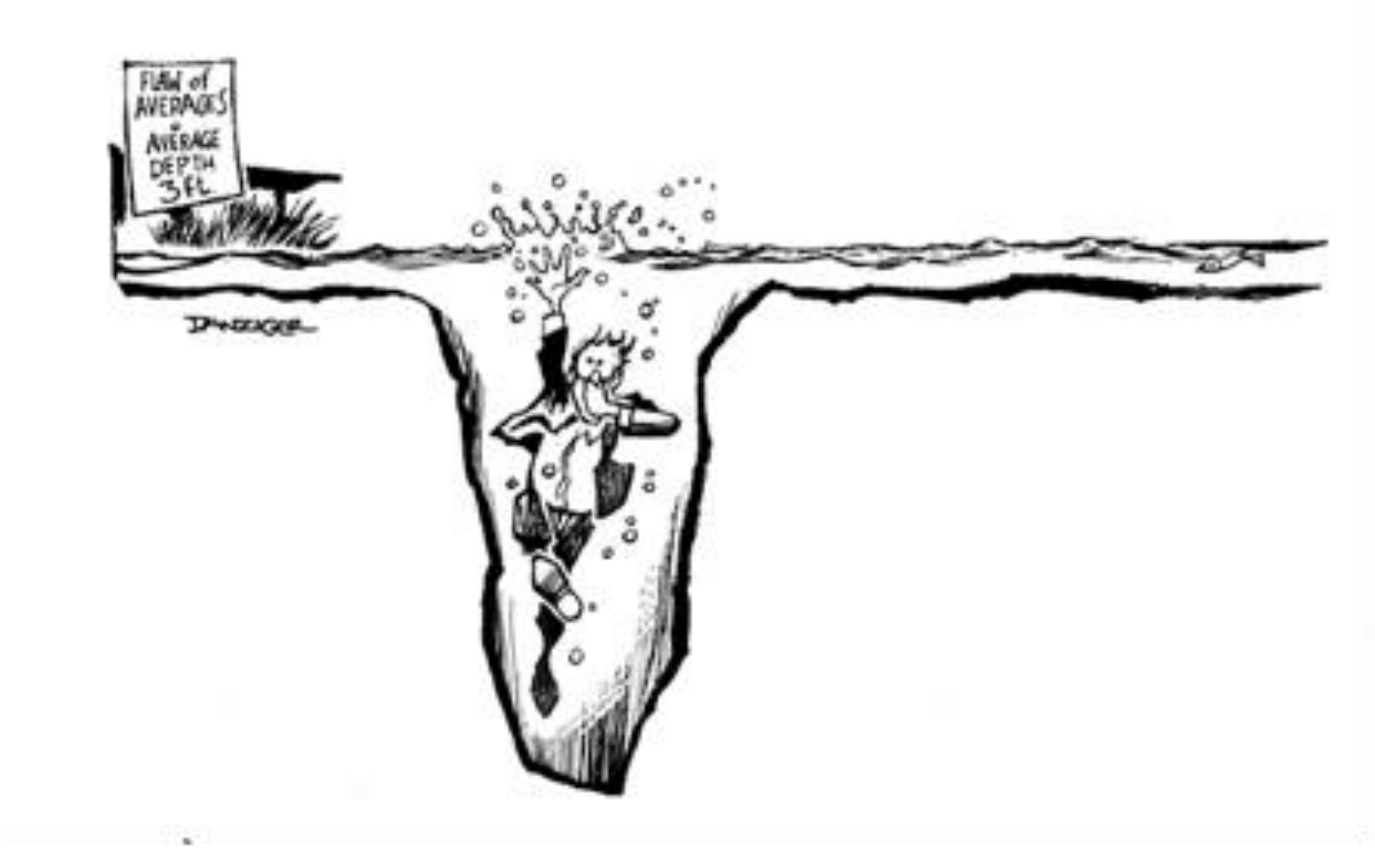
- Concerns raised in irrigators query
- Cease takes relatively common, but only for short duration due to fluctuations from the Cobb
- While total duration stats may be longer in years with low flows/generation, cease takes are interspersed with higher generation flows meaning that each cease take is of short duration – unless Cobb shutdown

7-DAY V 1-DAY

- 7-Day stats for Upper Takaka are strongly influenced by Cobb, but so are 1-Day
- Waingaro v Takaka 7-day:1-day ratios
- Limited point in comparing Takaka ratios with other rivers - where do you stop
- The 7-day MALF was used in preference to the 1-day MALF because:
  - The 7 Day MALF has consistently been used as the critical low flow statistic in TDC plans for rivers elsewhere in the region e.g. TRMP Water - Policies - Chapter 30 - 30.1.3.13 & 30.1.3.15
  - The proposed NES specified a 7-day MALF
  - There are advantages for assessing TDC water usage compliance as TDC typically uses weekly usage to assess compliance with allocation

DAILY AVERAGE NOT CONTINUOUS FLOWS

- Significantly increase security of supply
- Average daily flows not relevant for ecological values – minimum flows are critical
- You only die once!!



SOWMANS EXEMPTION

- Sowman's take is just above the top of the drying zone
- Questions whether any ecological need for minimum flow given limited values downstream in drying zone
- Has a point but…

- Some values in drying zone
- Where do you draw the line, same argument could be made by next upstream take

ANOTHER FLOW RECORDER

- Downstream of Rossers take
- Benefits?
- Affected by groundwater losses

KEY POINTS

- Strong effect of Cobb Scheme – poses benefits and challenges to river health and users
- Some security of supply consequences of FLAG decision, but change from status quo relatively small
- Use of 7-day hydrological statistics maintains consistency for the catchment and district
- Current allocation (239 l/s) has cease take trigger of 1-day MALF (1669 l/s) – outcome of sequence of consent applications

OPTIONS FOR FLAG TO CONSIDER

- Stick with interim FLAG decision
  - Min flow 70% 7-D MALF (1666 l/s)
  - Allocation limit 15% of 7-D MALF (357 l/s)
  - Cease take trigger for river takes (2023 l/s = MF+AL)

- Grandfathering existing Takaka River takes using status quo conditions
  - Cease take 1657 l/s (Class A)
  - Current allocation 239 l/s
  - Any other takes from river subject to new cease take trigger (Class B)

- Spring trigger will apply to all river takes (and other AMA takes) as well

CAWTHRON INSTITUTE

ECOSYSTEM HEALTH OF TE WAIKOROPUPU SPRINGS

WORKSHOP DISCUSSIONS - UPDATE

ROGER YOUNG

WORKSHOP OBJECTIVES

- Summarise existing physicochemical and biological data for Te Waikoropupu Springs and connected water bodies to improve understanding of the current state of the springs and changes over the last few decades

- Based on the above, and expert knowledge, describe ecosystem health of the springs and highlight the major anthropogenic risks to spring health

- Provide recommendations on relevant attributes (and bands) that can be used in objective setting processes

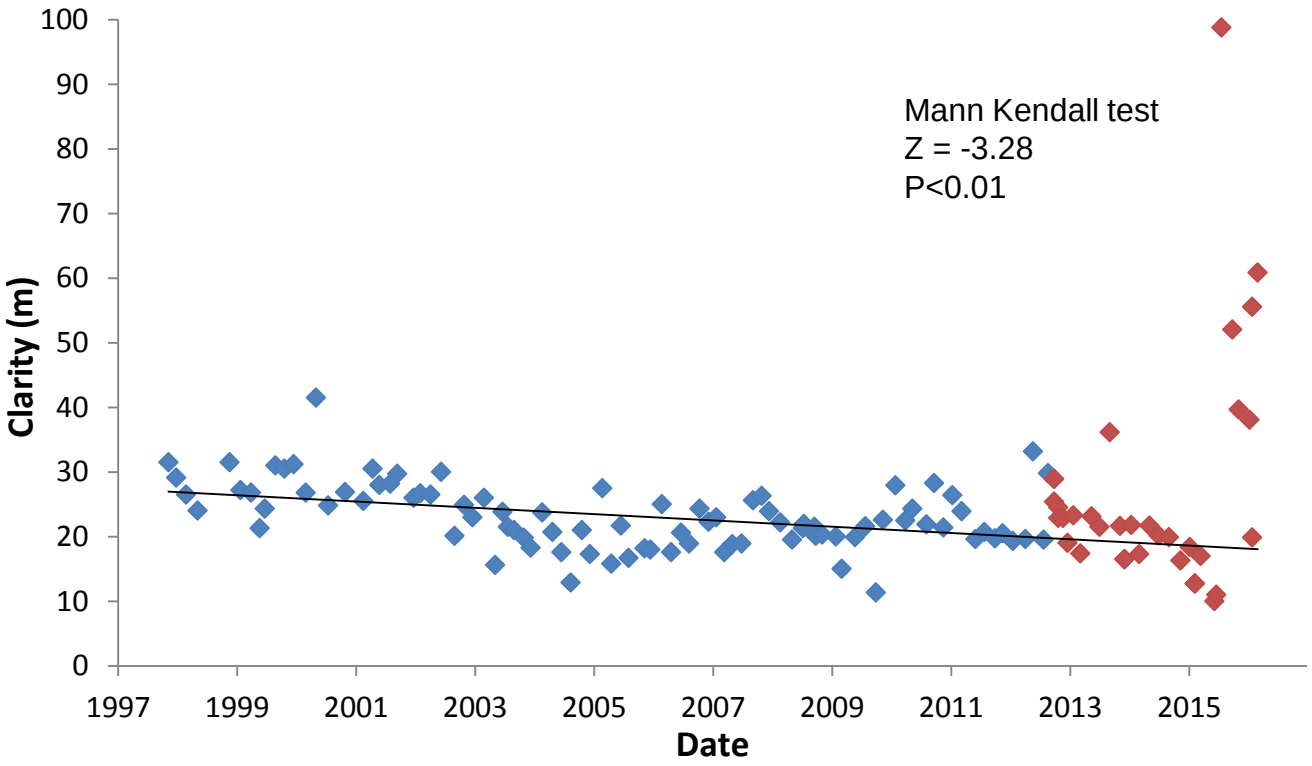
- More than just about nitrate!!

FLAG FEEDBACK

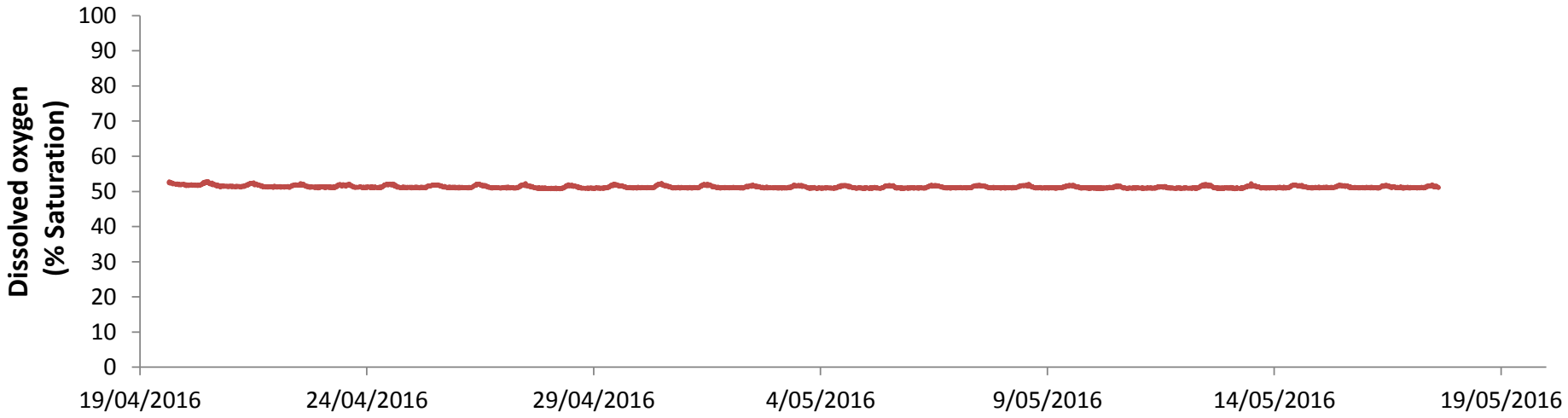
- Look for any relevant clarity, periphyton and *E. coli* data
- Install DO logger in the main spring
- Learn from Irish aquifer problems
- Trend analysis on data – incorporating latest FoGB data
- Issue with NIWA report
- Consider differences between labs

WATER CLARITY UPSTREAM OF SALMON FARM

Data not ideal as monitoring location downstream of Fish Creek's influence
Not necessarily reflecting main spring clarity



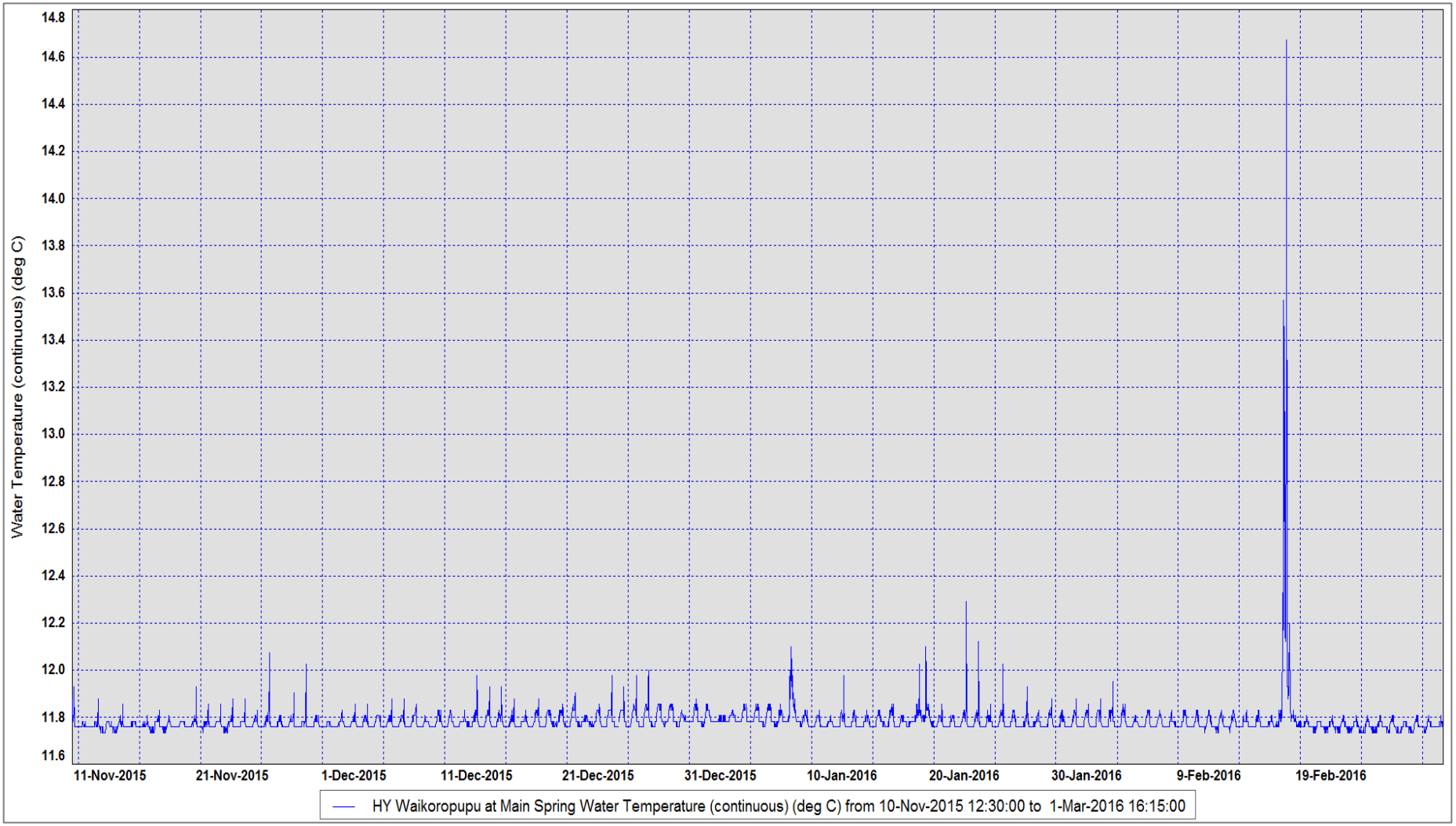
DISSOLVED OXYGEN IN MAIN SPRING



DO Saturation early 1970's (Michaelis)	58-64%
DO Saturation April May 2016	50-53%

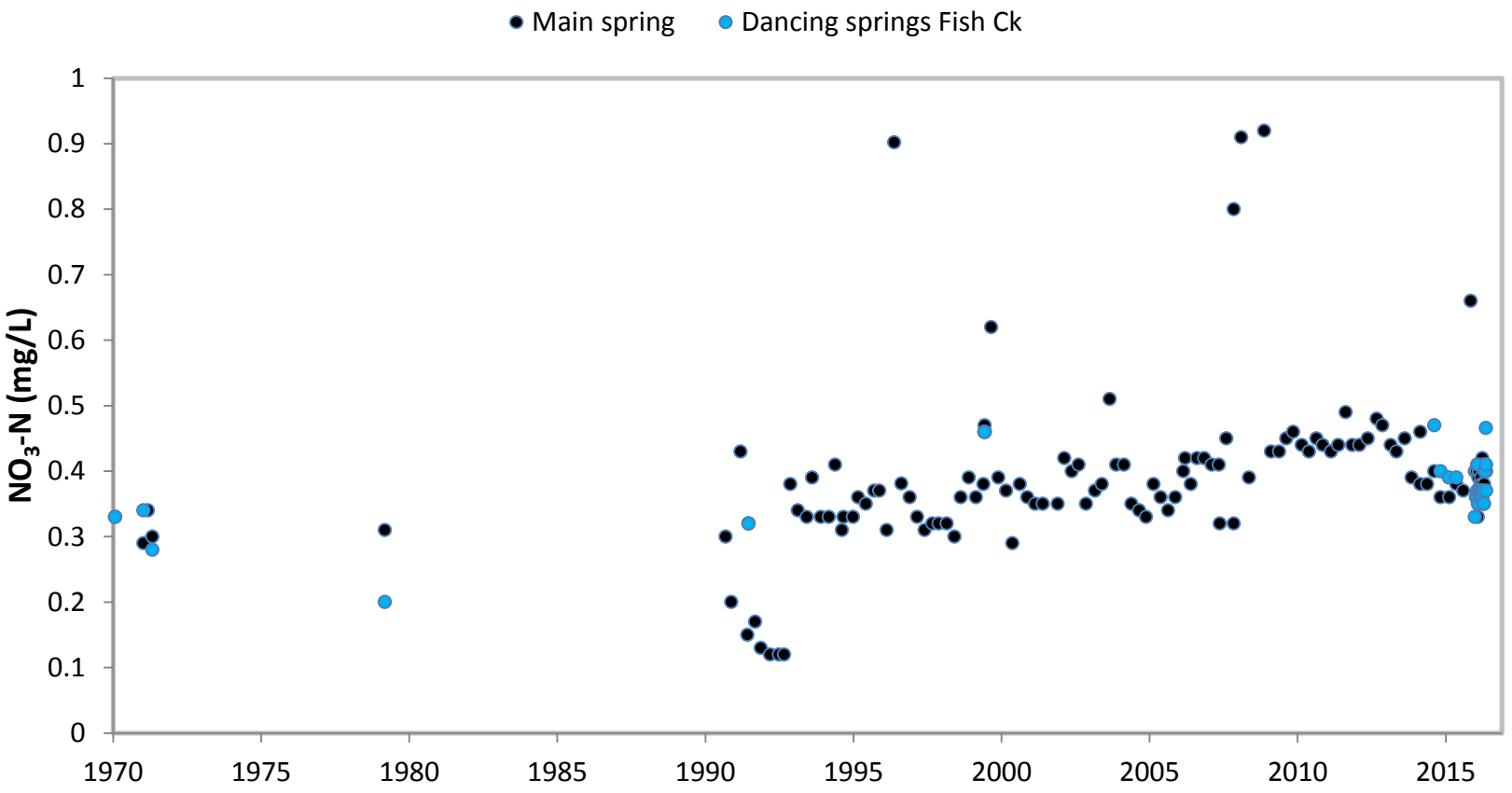
A decrease….but accurate DO measurement is difficult, with difference similar to measurement uncertainty

WATER TEMPERATURE



Michaelis 1971 – 11.7 °C

NITRATE CONCENTRATIONS



NITRATE TRENDS

- There is a ‘statistically’ significant increase over the full data record. The change is 0.9% per year

- **If the trend continues at this rate** the Springs would get to the lowest level of concern for nitrate toxicity (1.0 mg/L) by 2124. If you set a ‘trigger’ at 0.5 mg/L, then if the trend continued at the current rate we’d get to this trigger by 2047.

- If you look at just the last 20 years of data (excluding outliers) you still get a statistically significant upwards trend, but the slope is very low (0.25%).

- If you look at the last 10 years of data (excluding outliers) you get a statistically significant downwards trend with a slope of 1.5%.