Waipara River
Surface Water Hydrology

Darren Leftley

Senior Hydrological Scientist

Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Presentation Plan

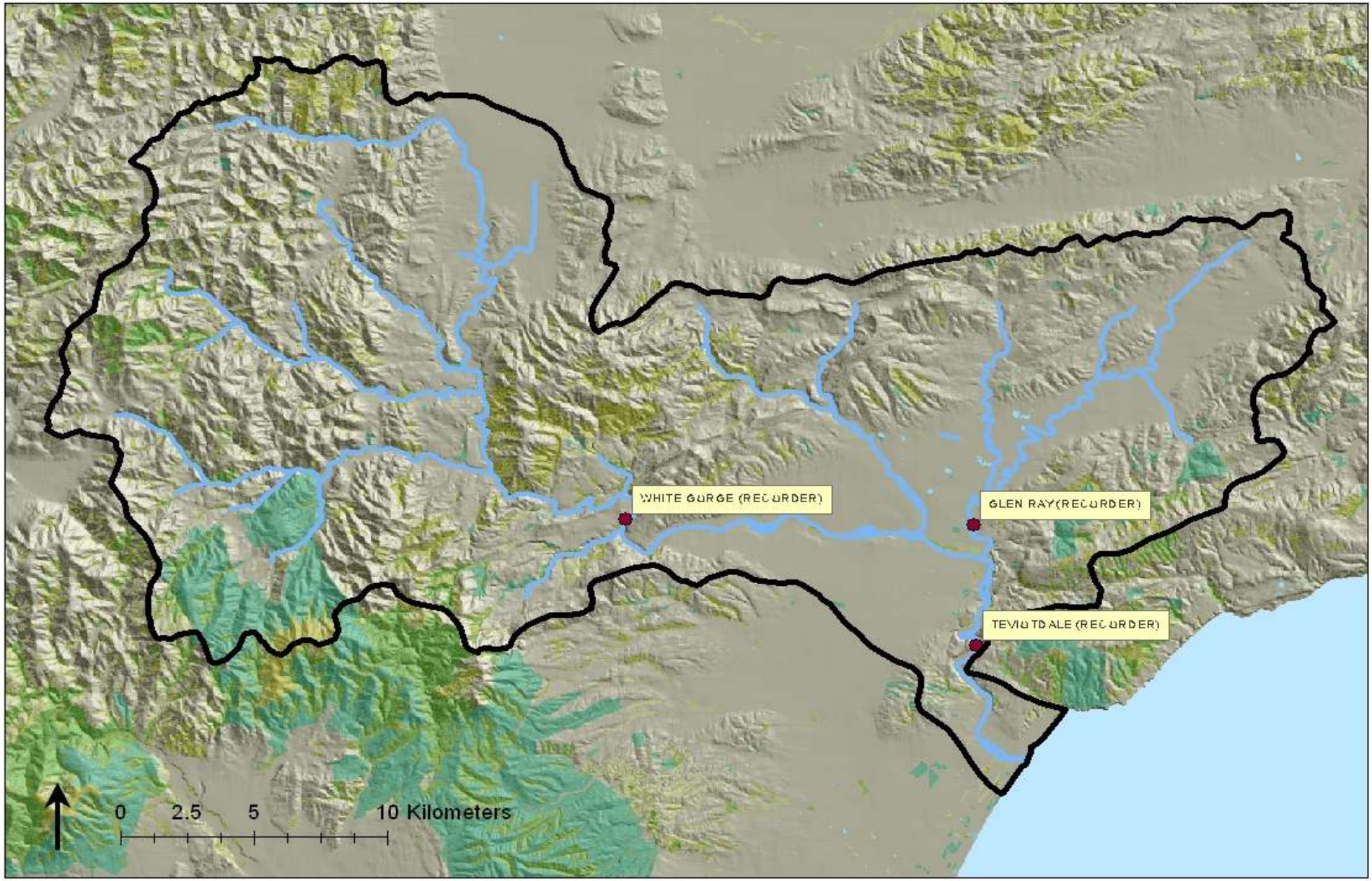
- Recorded flows
- Natural flows
- Effect of takes on flows
- Omihi minimum flow sites
- Reliability of supply analysis

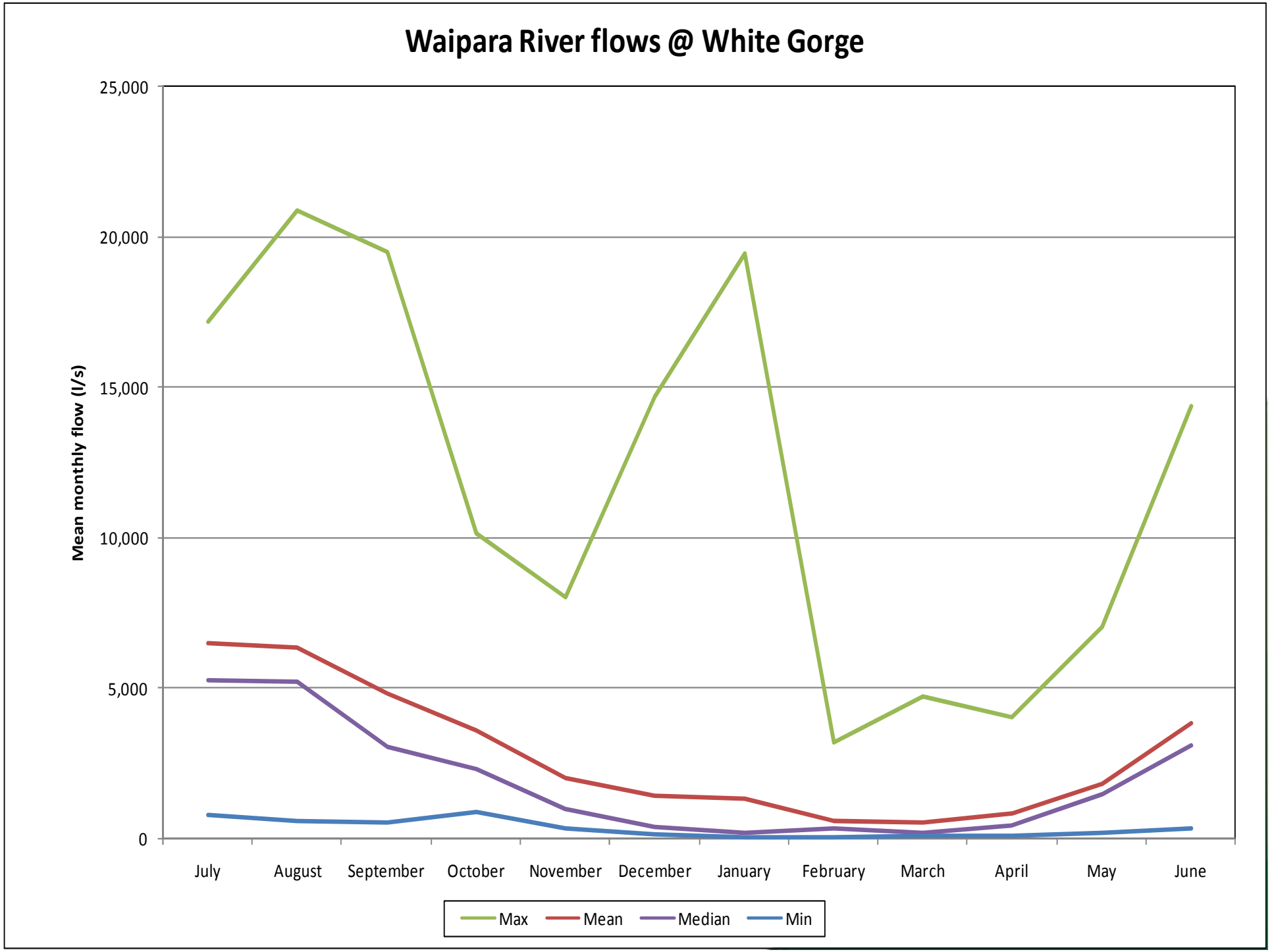
Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

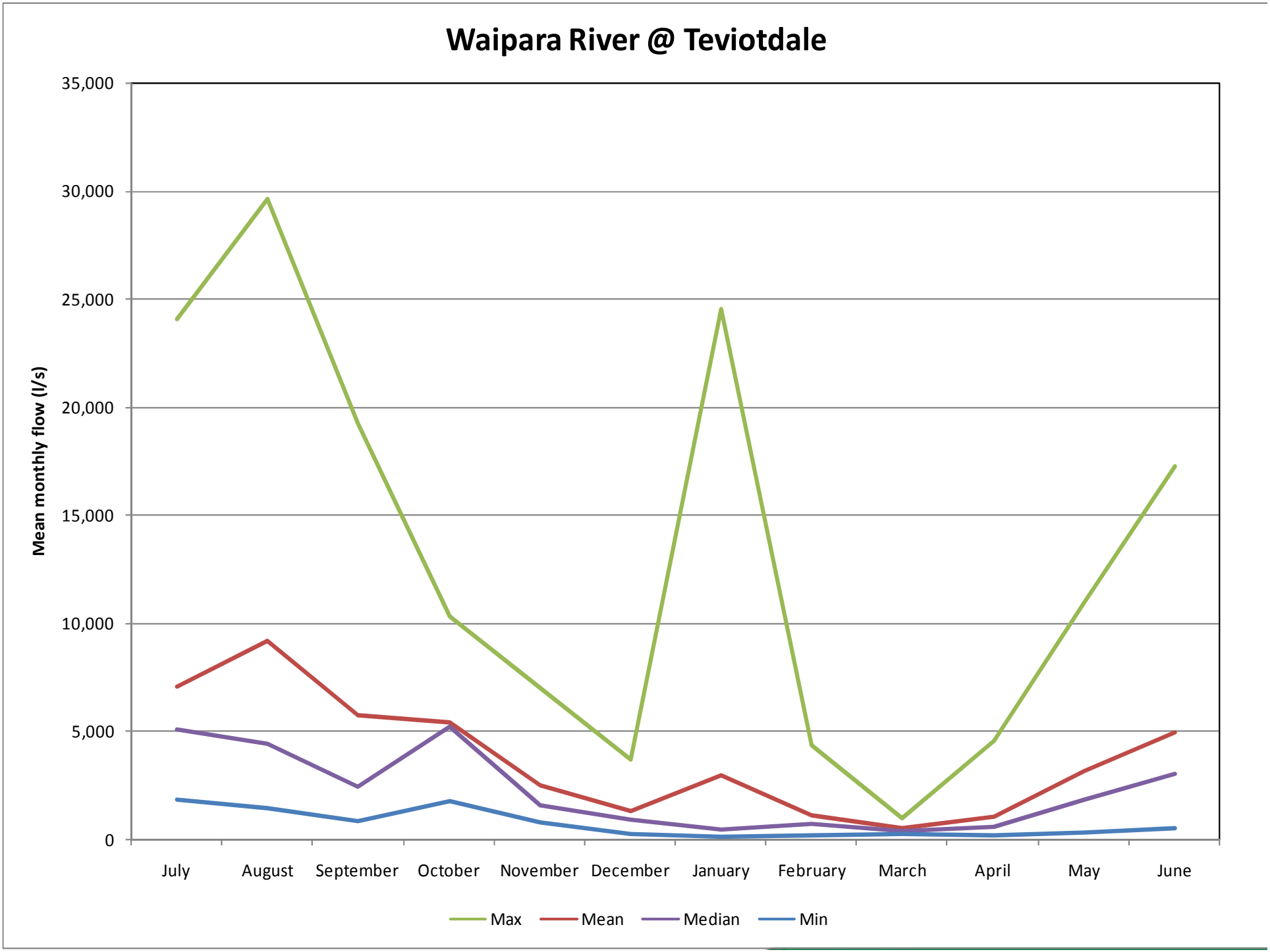
Waipara River recorded flows

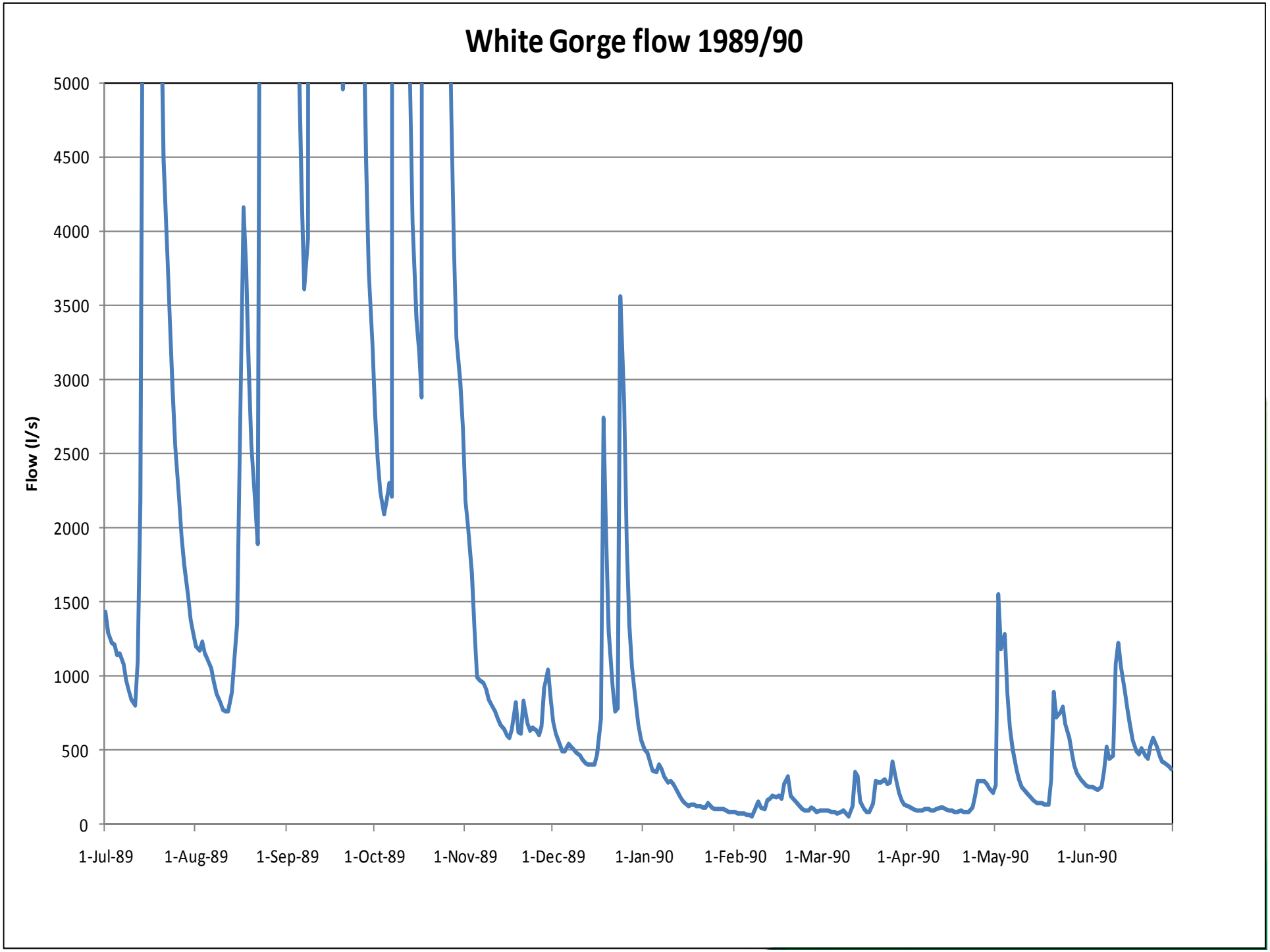
Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Recorded flows




Waipara River flows @ White Gorge
Mean monthly flow (l/s)
25,000
20,000
15,000
10,000
5,000
0
July
August
September
October
November
December
January
February
March
April
May
June
Max
Mean
Median
Min


Waipara River @ Teviotdale
Mean monthly flow (l/s)
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
July
August
September
October
November
December
January
February
March
April
May
June
Max
Mean
Median
Min


White Gorge flow 1989/90
Flow (l/s)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1-Jul-89
1-Aug-89
1-Sep-89
1-Oct-89
1-Nov-89
1-Dec-89
1-Jan-90
1-Feb-90
1-Mar-90
1-Apr-90
1-May-90
1-Jun-90

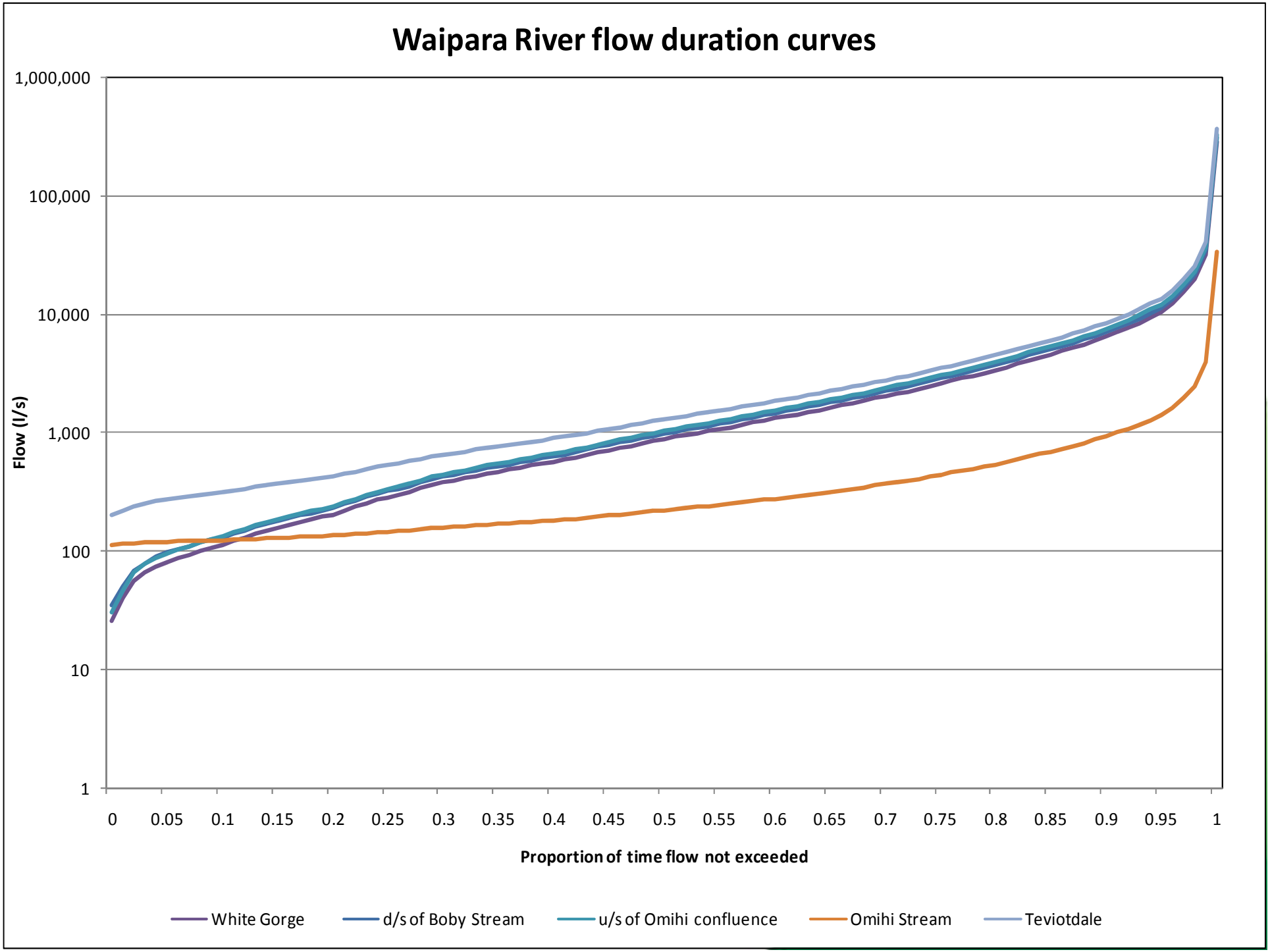
Waipara River natural flows

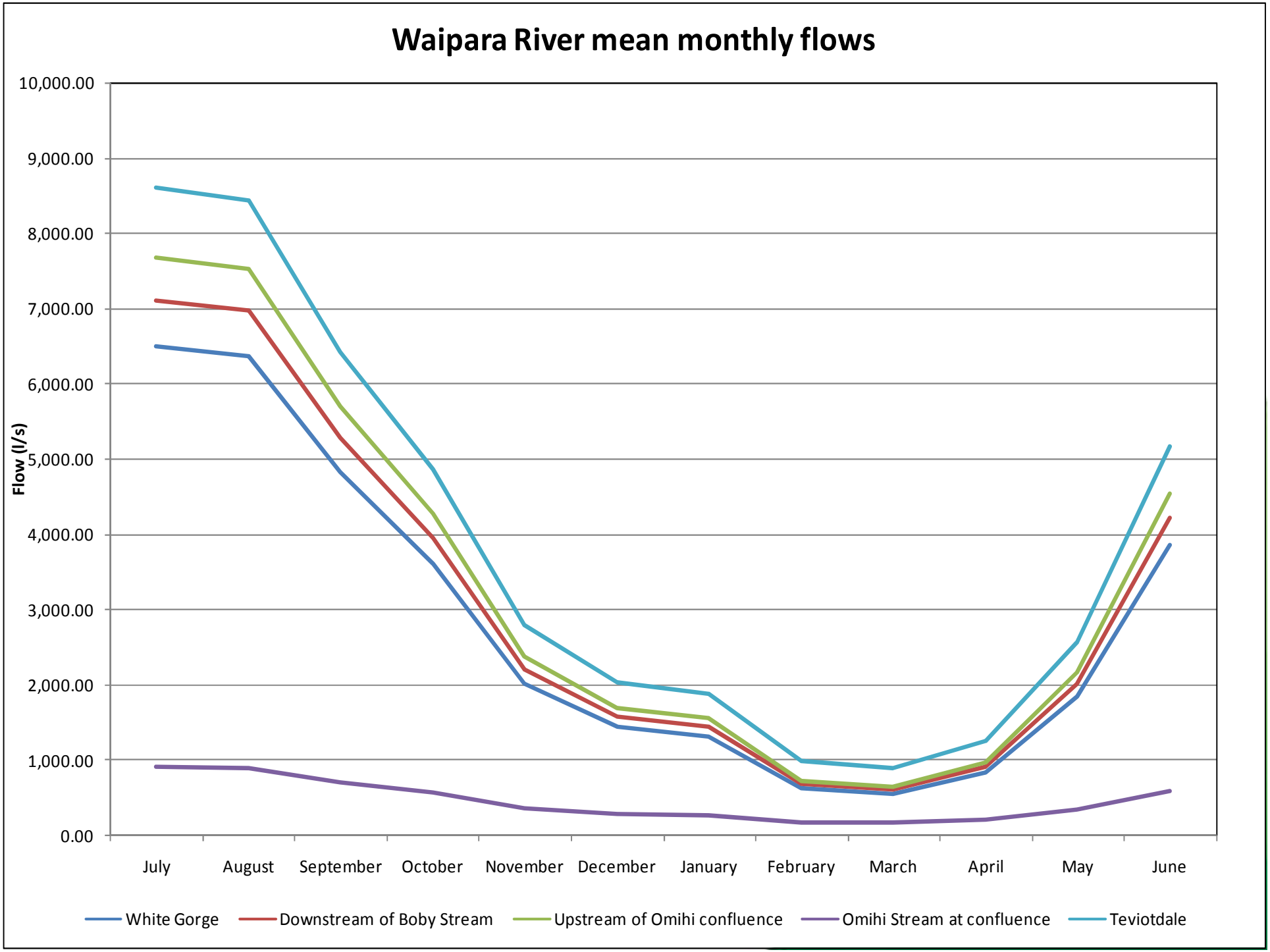
Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Natural Flows

- Flow duration curves
- Mean monthly flows
- Flow statistics

Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha


Waipara River flow duration curves
1,000,000
100,000
10,000
1,000
100
10
1
Flow (l/s)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
Proportion of time flow not exceeded
White Gorge
d/s of Boby Stream
u/s of Omihi confluence
Omihi Stream
Teviotdale


Waipara River mean monthly flows
10,000.00
9,000.00
8,000.00
7,000.00
6,000.00
5,000.00
4,000.00
3,000.00
2,000.00
1,000.00
0.00
Flow (l/s)
July
August
September
October
November
December
January
February
March
April
May
June
White Gorge
Downstream of Boby Stream
Upstream of Omihi confluence
Omihi Stream at confluence
Teviotdale

Natural Flow statistics

Flow Statistic	Waipara @ White Gorge	Waipara below Boby Stream confluence	Waipara upstream of Omihi confluence	Waipara @ Teviotdale	Omihi upsteam of Waipara confluence
Mean Flow (l/s)	2813	3084	3322	3827	461
Median flow (l/s)	870	958	1027	1301	221
Q_{95} (l/s)	10375	11357	12253	13555	1395
Q_5 (l/s)	82	96	97	277	119
MALF (7d) (l/s)	99	115	117	299	117
Fre-3 (l/s)	2610	2874	3082	3903	663

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Effect of takes on river flow

Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

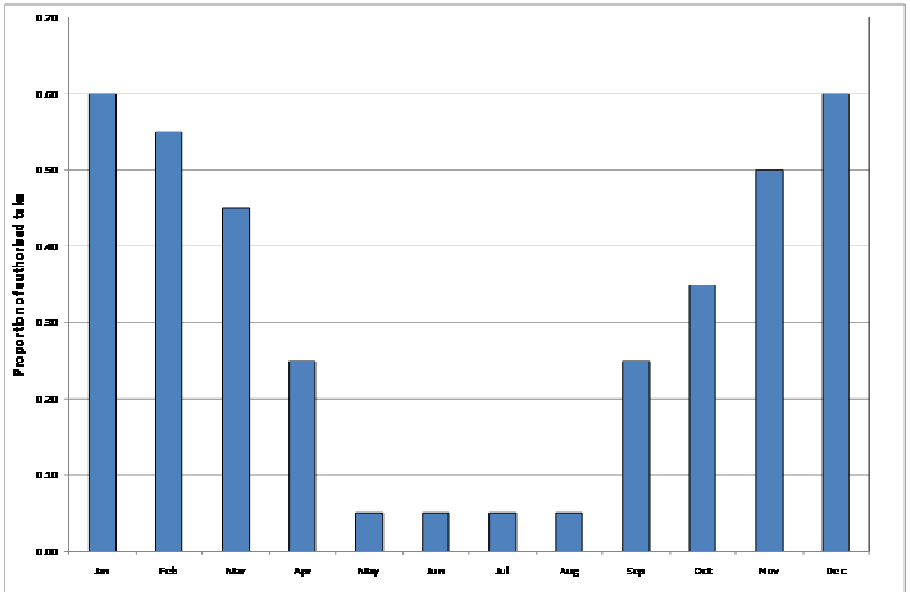
Effect of takes on river flow

- Take scenarios
- Flow duration curves
- Low flows
- Drying reaches

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

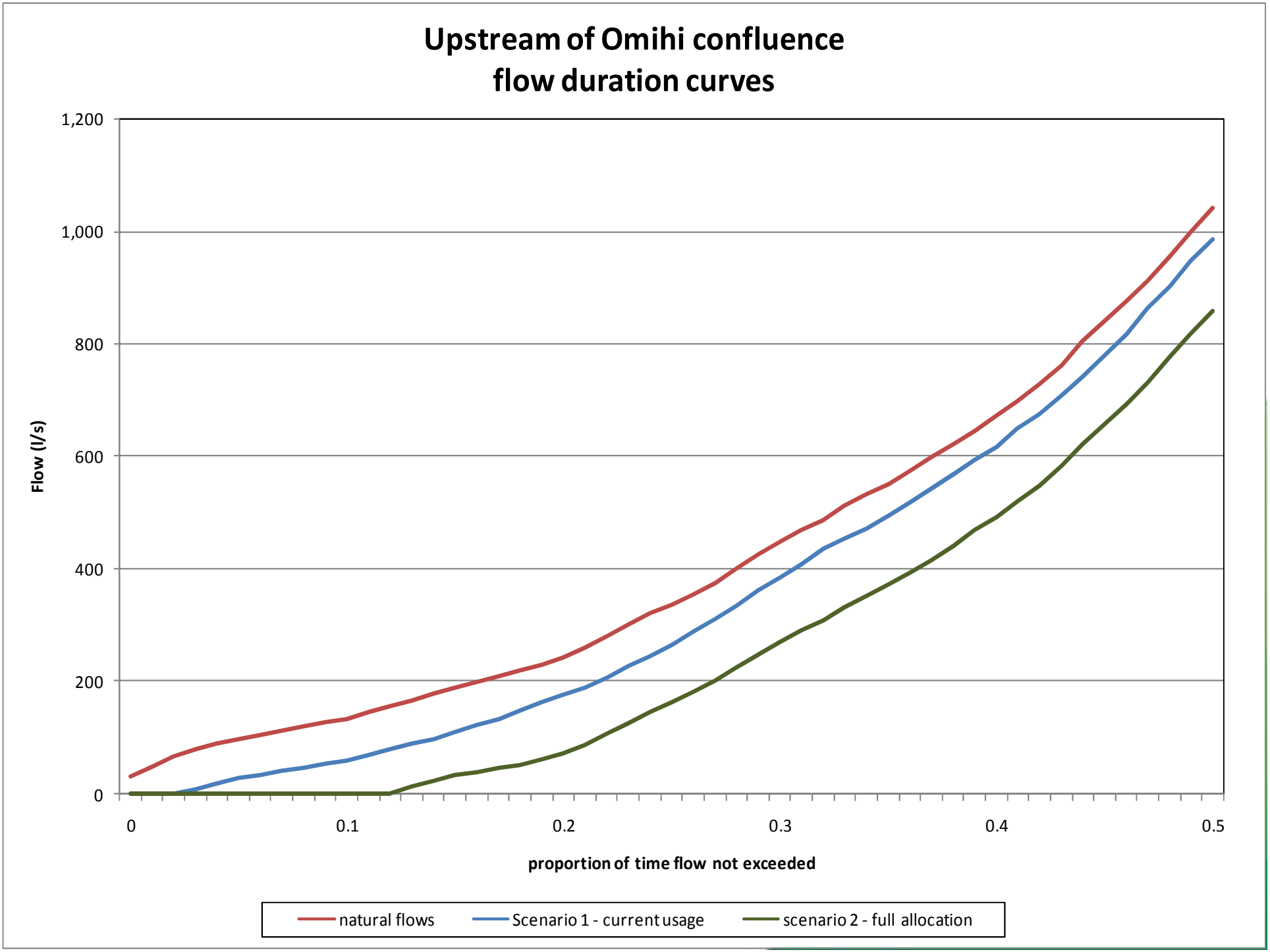
Take Scenarios

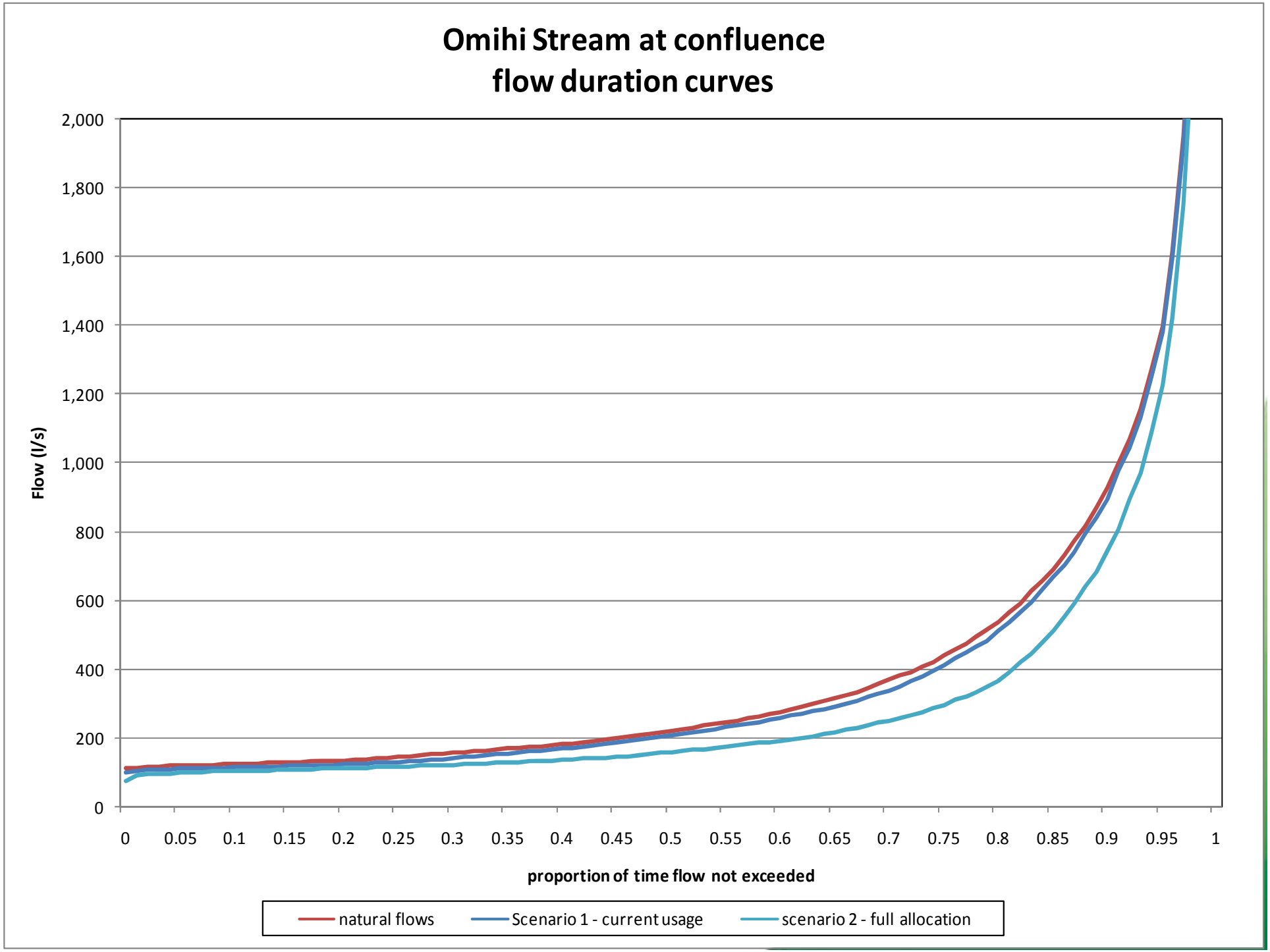
Scenario 1 – current use

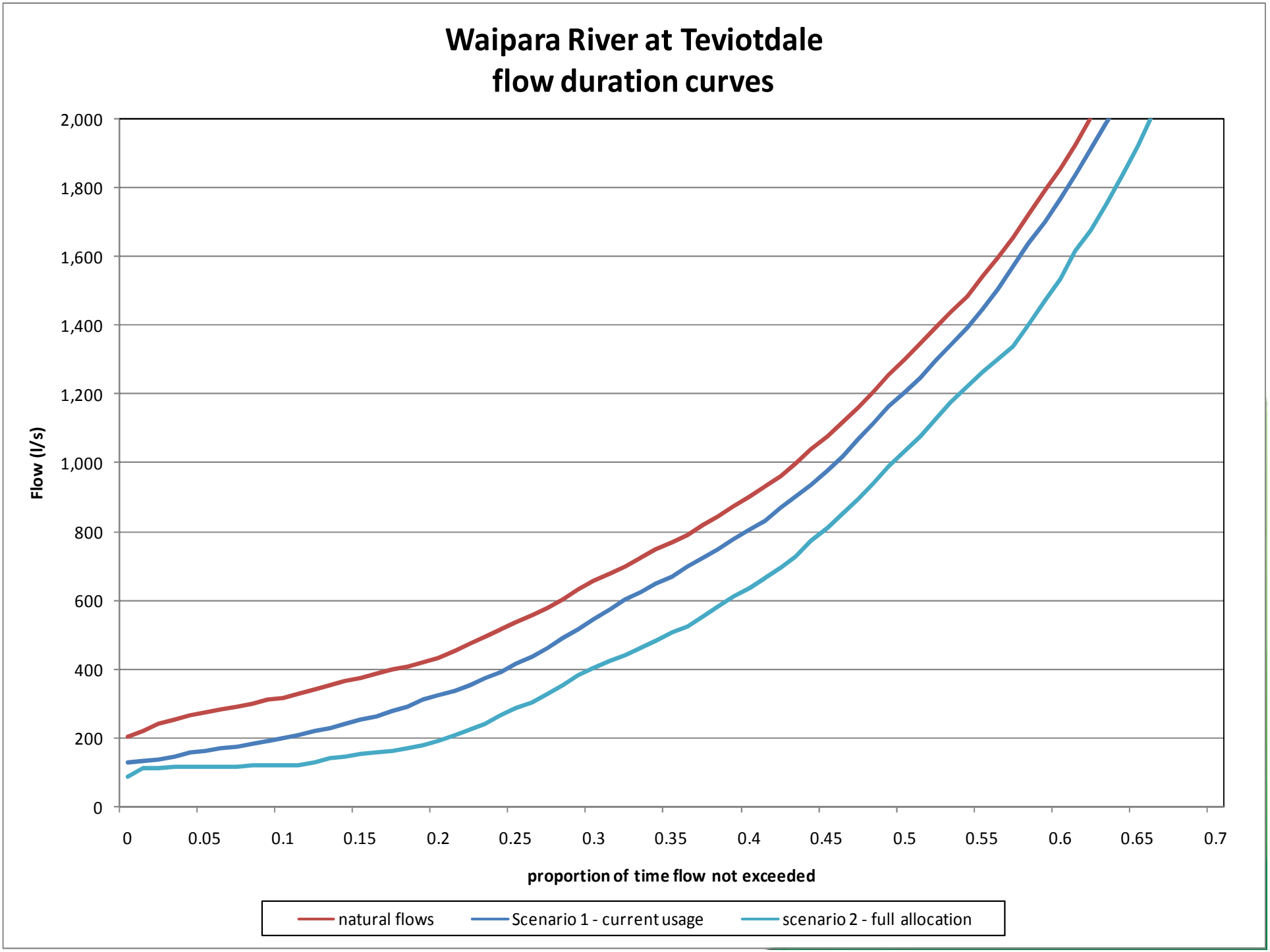


Scenario 2 – Fully allocated & fully used

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha


Upstream of Omihi confluence
flow duration curves
1,200
1,000
800
600
400
200
0
Flow (l/s)
0
0.1
0.2
0.3
0.4
0.5
proportion of time flow not exceeded
natural flows
Scenario 1 - current usage
scenario 2 - full allocation


Omihi Stream at confluence
flow duration curves
Flow (l/s)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
proportion of time flow not exceeded
natural flows
Scenario 1 - current usage
scenario 2 - full allocation


Waipara River at Teviotdale
flow duration curves
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Flow (l/s)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
proportion of time flow not exceeded
natural flows
Scenario 1 - current usage
scenario 2 - full allocation

Low flow frequency

		Average no. of days < MALF (7d) per year				Average no. of days < Min. flow per year		
Location	Natural MALF (7d)	Natural	Scenario 1	Scenario 2	Minimum flow	Natural	Scenario 1	Scenario 2
u/s of Omihi	117 l/s	29	57	82	50 l/s	5	32	64
Omihi Stream	117 l/s	11	52	86	120 l/s	23	63	97
Teviotdale	299 l/s	29	66	91	110 l/s	0	0	1

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Low flow duration

	Total no. of events >10 consecutive days below MALF (7d)			Total no. of events >20 consecutive days below MALF (7d)			Total no. of events >30 consecutive days below MALF (7d)		
Location	Natural	Scenario 1	Scenario 2	Natural	Scenario 1	Scenario 2	Natural	Scenario 1	Scenario 2
u/s of Omihi	**15**	**30**	**49**	**8**	**19**	**28**	**6**	**13**	**17**
Omihi Stream	**6**	**25**	**31**	**5**	**9**	**20**	**4**	**7**	**13**
Teviotdale	**15**	**34**	**50**	**8**	**24**	**31**	**6**	**14**	**19**

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Drying Reaches

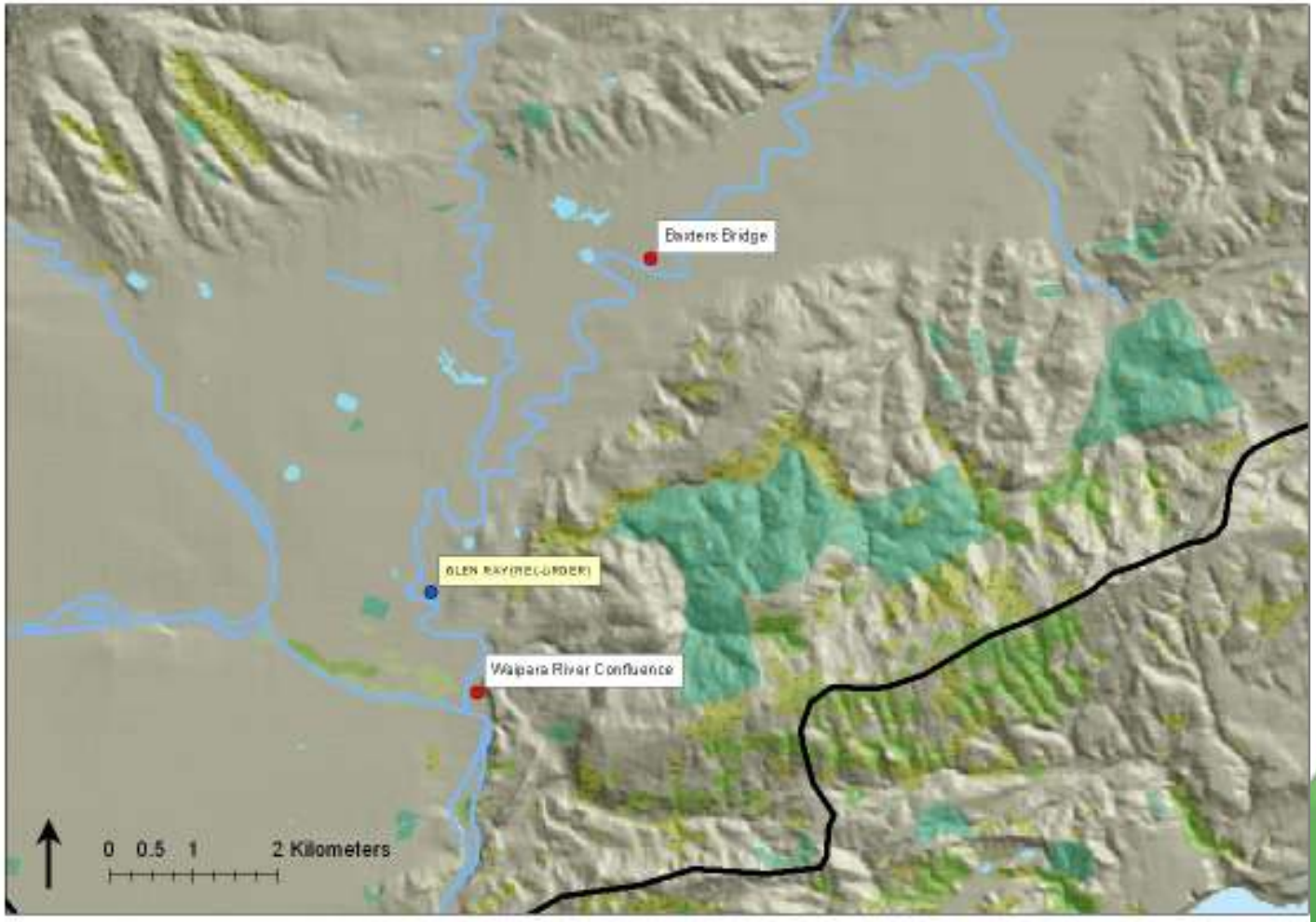
- Upper Waipara – takes increase the dry frequency from never dry naturally to 3% of the time for scenario 1 and 12% for scenario 2
- Lower Waipara – below 350 l/s @ Teviotdale, discontinuous flow to lagoon. This occurs 13% naturally, 22% scenario 1 and 28% scenario 2.

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Omihi minimum flow sites

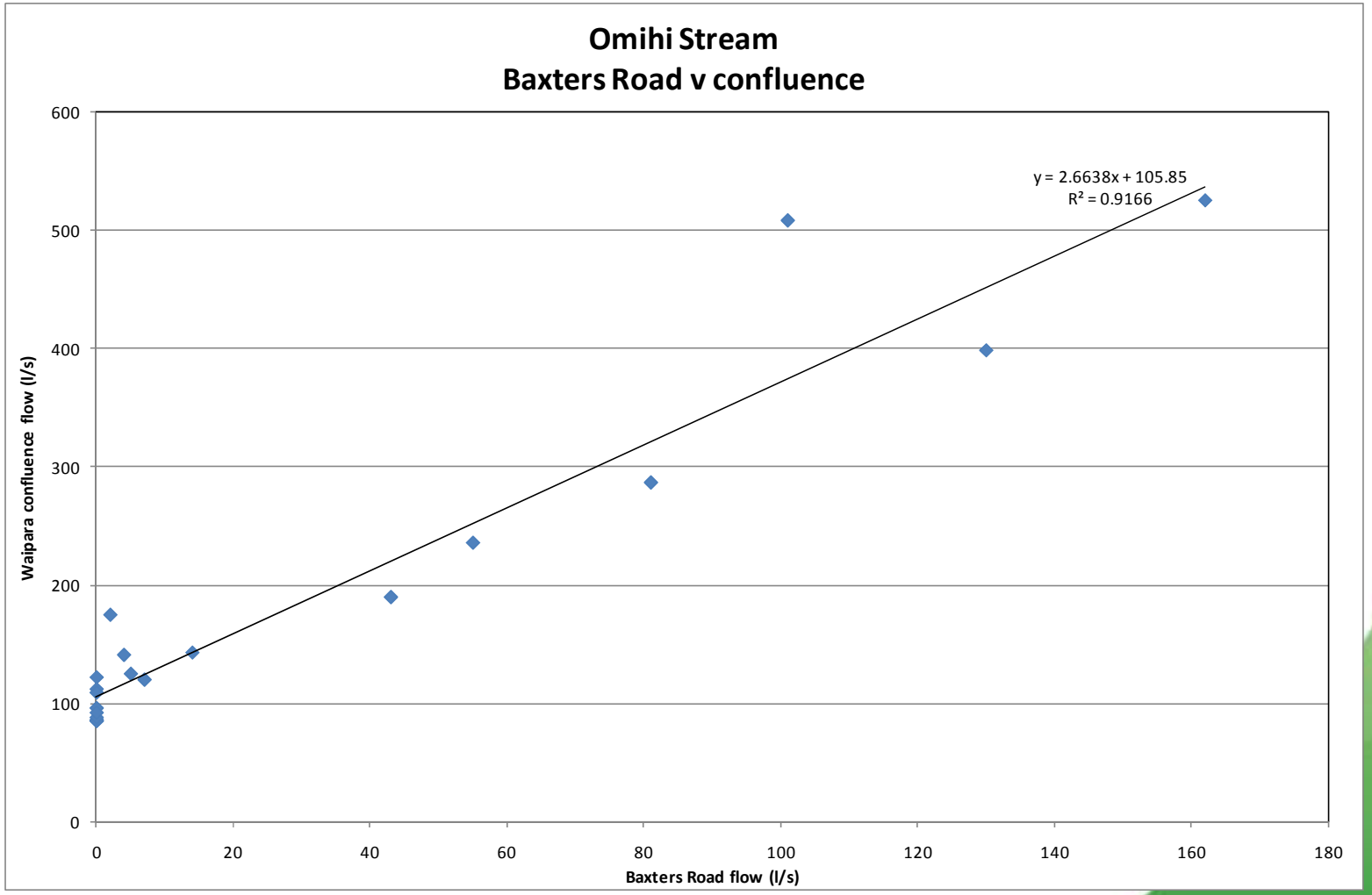
Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Omihi Minimum flow sites



Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Omihi Minimum flow sites



Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Omihi minimum flow sites

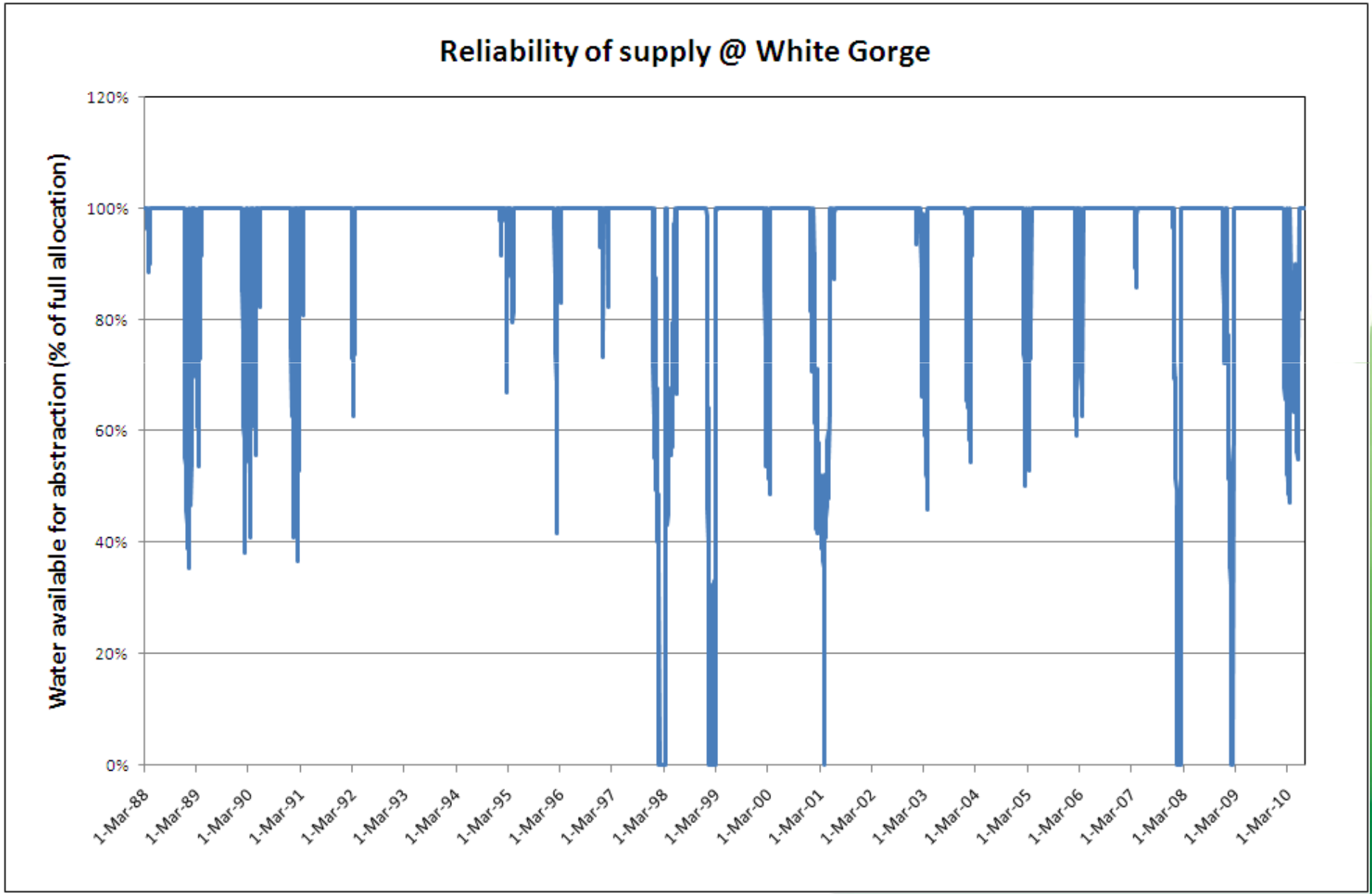
- New recorder site – only 2 years of data and limited concurrent gaugings between other minimum flow sites
- Continue to undertake concurrent gaugings over the next two years and review recommendation

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Reliability of supply analysis

Environment Canterbury
Regional Council
Kaunihera Taiao ki Waitaha

Consents tied to White Gorge



Current reliability of supply

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Current Situation	61%	57%	63%	81%	91%	98%	100%	100%	100%	100%	100%	83%

White Gorge surface water take

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Current Situation	88%	87%	96%	99%	100%	100%	100%	100%	100%	100%	100%	100%

White Gorge groundwater take

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Current Situation	100%	99%	99%	99%	99%	100%	100%	100%	100%	100%	100%	100%

Teviotdale take

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Effects of partial restrictions and changes to minimum flows (1)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Current Situation	61%	57%	63%	81%	91%	98%	100%	100%	100%	100%	100%	83%
Partial restrictions 50 l/s min	44%	46%	45%	64%	86%	96%	100%	100%	100%	100%	97%	71%
Partial restrictions 60 l/s min	43%	45%	44%	62%	85%	96%	100%	100%	100%	100%	96%	69%
Partial restrictions 80 l/s min	42%	43%	40%	60%	84%	95%	99%	100%	100%	100%	95%	66%
Partial restrictions 100 l/s min	40%	39%	37%	57%	82%	93%	99%	100%	100%	100%	93%	63%

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Effects of partial restrictions and changes to minimum flows (2)

Scenario	Maximum volume required to maintain current reliability (Mm^3 per irrigation season)
Partial restrictions 50 l/s min	0.9
Partial restrictions 60 l/s min	1.0
Partial restrictions 80 l/s min	1.2
Partial restrictions 100 l/s min	1.3

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha