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Subject:	PC7 evidence on behalf of CSIFG
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Attachments:	PC7 LWRP evidence Angela Christensen_FINAL170720.pdf PC7 LWRP evidence Mark Webb_Final170720.pdf

Hello

Please find attached two briefs of evidence from Central South Island Fish and Game (Submitter No PC7-351). We wish to speak to our evidence at the hearings and if available, at a location in South Canterbury.

Please let me know if you require anything further.

Kind regards

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BEFORE INDEPENDANT HEARING COMMISSIONERS
APPOINTED BY THE CANTERBURY REGIONAL COUNCIL

UNDER:	the Resource Management Act 1991
IN THE MATTER OF:	Proposed Plan Change 7 to the Canterbury Land and Water Regional Plan – Section 14: Orari-Temuka-Opihi-Pareora

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STATEMENT OF EVIDENCE OF MARK WHITBY WEBB ON BEHALF OF
Fish and Game New Zealand, Central South Island Region
(SUBMITTER NO. PC7-351)

Dated: 17 July 2020

Contents

1. INTRODUCTION

1.1 My full name is Mark Whitby Webb. I am employed as a Fish and Game Officer by Fish and Game New Zealand within the Central South Island Region ("**Fish and Game**") based at Temuka. I have held this position for 35 years.

Qualifications and experience

1.2 I graduated from the University of Canterbury with a BSc in 1979 and have since worked for the Ministry of Agriculture and Fisheries, the former South Canterbury Acclimatisation Society and from 1990 its successor, the Central South Island Fish and Game Council. With that experience I have acquired a sound understanding of habitat requirements of sports fish and game birds, the recreation supported by these species and conflicts associated with water allocation and use.

1.2 I have been a community appointee on the Orari Temuka Opihi Pareora ("**OTOP**") Zone Committee and have participated on community steering groups that developed the Pareora Catchment Environmental Flow and Allocation Regional Plan and Policies relating to the Orari River Catchment contained in sub-regional section 14.4 of the proposed Canterbury Land and Water Regional Plan ("**LWRP**").

Background

1.3 My role as a Fish and Game Officer has included years of undertaking sports fish and game bird surveys on rivers of the OTOP Zone, preparing and giving evidence at resource consent hearings in the Zone, fish salvage during low flows, school and club education and liaison with landowners and authorities on sports fish and game bird habitat.

1.4 As a member of the OTOP Zone Committee since its inception in 2010, I have contributed to development of the Zone Implementation Programme. This has involved many public meetings throughout the Zone and I have been a Zone Committee representative on five Catchment Groups including Upper Opihi, Opuha, Lower Opihi, Waihi – Temuka and Orari. This has culminated in publication of the Zone Implementation Programme Addendum ("**ZIPA**") that contained the Zone Committee's recommendations to Canterbury Regional Council ("**ECan**") for water

quality and quantity limits for inclusion in the Canterbury Land and Water Regional Plan ("**LWRP**") through the process known as Plan Change 7 ("**PC7**").

1.5 I have been the Fish and Game representative on the Opihi Flow and Allocation Working Party ("**FAWP"**), the Adaptive Management Working Group ("**AMWG**") and the Temuka Catchment Working Party ("**TCWP"**) that were established to provide feedback to the Zone Committee on flow and allocation for the Opihi River mainstem and tributaries from an effected party perspective.

1.6

3. EXECUTIVE SUMMARY

3.1 The Opihi Catchment including the Temuka, Waihi, Te Ana Wai, Opuha, North Opuha and South Opuha rivers and Lake Opuha sustain valued sports fish habitat and sports fisheries.

3.2 The Opihi River sea-run chinook salmon fishery confined to the Opihi and Opuha rivers downstream of Lake Opuha is one of the smallest catchments supporting a self-sustaining population. The importance of this fishery is acknowledged in the LWRP where salmon spawning sites are identified and protected in Schedule 17.

3.3 Lake Opuha supports the only rainbow trout fishery in the Catchment and is ranked second in angler use behind the Opihi River mainstem brown trout and salmon fisheries.

3.4 Opihi and Opuha rivers tributaries provide a range of sports fishing experiences. The Temuka, Te Ana Wai and upper Opihi rivers are valued for providing quality fish to eat while headwater fisheries in the North and South Opuha rivers are valued for the fishing experience they provide.

3.5 Fish and Game supports the stakeholder agreed recommendations developed by the TCWP in regard to reduction in size of the Temuka Catchment A and B allocation blocks, provision of a C allocation, and monthly variable minimum flows as contained in proposed PC7 Tables 14 (i), 14(j), 14(k) and 14(j). Finer time scales for minimum flow regimes recognise that the shoulder months in spring (September to November) and autumn (March, April) can sustain higher minimum flows that benefit the habitats of sports fish and gamebirds and the recreations these support.

3.6 There have been no habitat surveys of the North Opuha River to contribute information on habitat provided by the current ORRP and potential habitat from proposed PC7 flow regimes. It is my view that minimum flows proposed in PC7 Table 14(m) will not have noticeable impact on the trout fishery or its value as a nursery for Lake Opuha trout. I believe the reduction in minimum flows is more than compensated for by introduction of pro-rata restrictions that will prevent the river flow below the

recording site being reduced below the minimum flow by abstraction downstream of the minimum flow site, as potentially occurs under the ORRP.

3.7 Proposed minimum flows and allocations in PC7 Table 14(n), Table 14(p), Table 14(r), and Table 14(s), for the South Opuha, upper Opihi, and Te Ana Wai rivers were adopted by the Zone Committee following recommendations from the FAWP. Fish and Game was a member of the working party. Fish and Game supports the introduction of monthly variable minimum flows, a cap on abstraction for A Permits, and introduction of pro rata partial restriction regimes recommended in theses tables.

3.8 Monthly variable minimum flows proposed in PC7 Table 14(n), Table 14(p), Table 14(r), and Table 14(s) provide significant increases in minimum flows in spring, winter, and autumn from current ORRP levels. These will benefit habitat for adult trout and salmon passage and spawning, food producing habitat, and habitat available for drift feeding adult trout during peak trout fishing periods in spring and autumn. Minimum flow increases proposed in the mid-summer months provide very little improvement to angling conditions and habitat for adult trout remains below 65% of maximum in the South Opuha River and less than 35% in the upper Opihi and Te Ana Wai rivers.

3.9 The Section 42A Officer Report minimum flow, allocation and partial restriction recommendations in their Tables 14(m) to 14(s), offer no change to minimum flows, allocations, and partial restrictions from those provided in proposed PC7, recommending only that they be introduced earlier.

3.10 The Opihi River has a long history of low flows, drying up in the mainstem below Pleasant Point even before construction of the Levels Plain Irrigation Scheme in the 1930's. The frequency of dry river reaches increased in step with increased irrigation abstraction until the Opuha Dam was commissioned in 1998.

3.11 The Saleyards Bridge minimum flow regime developed in collaboration with the Opuha Dam Development Company and later incorporated into the ORRP, satisfied the need to provide 95% reliability of supply to irrigation and maintain enhanced minimum flows balanced against Dam storage and inflows. Fish and Game believe the monthly minimum flows developed in 1998 and still applied today have been successful at reducing river mouth closure at crucial sports fish migration times, providing flows that encourage sports fish angling enable sports fish passage throughout the Opihi

passage across the river mouth. The variable flow regime reflected the natural hydrology of the O

Table 1. Estimated angler effort (angler days) in the Opihi Catchment by all sports fish licence holders, number of trout caught and the proportion kept (harvested) for the 2007/08 fishing season.

Waterway	**Section**	**Angler days**	**Trout caught ± 90% confidence**	**Trout harvested**
Lake Opuha	Total	3,650	3,810 ± 1,550	38%
Opihi River	Total	18,050	7,750 ± 1,780	28%
Opihi River	Below Temuka Rv confluence	9,430	850 ± 450	54%
Opihi River	Temuka confl. to Te Ana Wai confl.	3,760	3,820 ± 1,410	17%
Opihi River	Te Ana Wai confl. to Opuha confl.	1,560	1,450 ± 760	37%
Opihi River	Opuha confl. To top of Opihi Gorge	150	140 ± 120	50%
Opihi River	Above Gorge	90	360 ± 400	39%
Opihi River	Unidentified sect.	3,060	1,130 ± 480	27%
Opuha River	Total	320	600 ± 470	18%
Kakahu River	Total	50	70 ± 70	29%
Waihi River	Total	680	720 ± 680	17%
North Opuha Rv	Total	250	780 ± 700	19%
South Opuha Rv	Total	220	620 ± 460	27%
Te Moana River	Total	40	-	
Temuka River	Total	970	740 ± 400	35%
Te Ana Wai River	Total	160	150 ± 180	40%
Opihi Catchment	Total	24,400	15,240 ± 2680	29%

5.5 The 2007/08 season was prior to Didymo making a significant appearance in the catchment. *Phormidium* was present throughout the Opuha and Opihi below the Dam but not in the Upper Opihi and its presence was likely to negatively influence an angler's decision to take a trout to eat.

5.6 The Opihi River sustains a recreational fishery for sea-run Chinook salmon of regional importance (Unwin, 2006). The salmon fishing season runs from October to March with the peak of the run being January to March. Most angling effort occurs in the lower river with about 95% below the confluence of the Opihi and Temuka rivers. Occasionally anglers report catching salmon as far upstream as Hanging Rock, 28 Km above the river mouth, and such events are usually the result of salmon taking trout fishing tackle.

5.7 Fish and Game has completed random stratified surveys of anglers since 1994 at the end of each fishing season to estimate angler use of the salmon fishery and catch. Since 2000, the number of individual salmon anglers fishing the Opihi River has averaged 620 annually, ranging from 340 to 990 and over the same period there has been an annual catch of 470 salmon with a range of 120 to 1,110. The Opihi salmon fishery ranks alongside the Hurunui River salmon fishery as regionally important with total angling effort of between two and ten thousand angler-days per year (Unwin , 2006)

5.8 Salmon anglers spend on average between 12 and 20 days each fishing for salmon. Total salmon angler effort sustained by the Opihi is likely to be between 4,000 and 10,000 angler days annually. The South Island's East Coast sea-run salmon fisheries sustain about one-fifth of all river fishing in New Zealand.

OVERVIEW OF CATCHMENT

6. TEMUKA CATCHMENT

6.1 The Temuka River has its headwaters in the Four Peaks Range which is a coastal mountain range and not an alpine range. River flows are therefore affected more by short duration coastal rain patterns rather than long term storage as snow and ice. The river emerges onto the plains as the Waihi River and flows for about 26 km before being joined by its other Four Peaks Range-origin tributary, the Te Moana River. Below

the junction of these two rivers the river is called the Temuka River and it flows for a further 7 km before joining the Opihi River about 4 km above the coast. A third significant flow contribution to the Temuka River is made by the Kakahu River that drains the south and eastern faces of the Kakahu Forest, west of Geraldine. The Kakahu River flows for about 35 km before joining the Te Moana River about 4 km above the Te Moana junction with the Temuka River.

6.2 The Waihi River between Geraldine and Winchester (approximately 4 km), the Kakahu River above its confluence with the Te Moana River (6 km), and the Te Moana River above its confluence with the Temuka River (6 km), are reaches that lose surface flow to groundwater. These reaches sustain no surface flow on a regular basis of at least one year in three.

6.3 The flow monitoring site for implementing restrictions for the Temuka Catchment is at Manse Bridge which is about 4.5 km upstream from the Temuka confluence with the Opihi River. The majority of consented abstractions are upstream from Manse Bridge with only consents on Taumatakahu Stream and Raupo Creek totalling approximately 160 L/sec, downstream from the flow recorder.

6.4 The ORRP provides an A allocation block of 1,600 L/sec for permits issued before 1 January 1999, and a B allocation block of 400 L/sec. These allocations were determined based on the sum of A permits being 1,600 L/sec at the time and providing for further allocation with a limit of 400 L/sec through the B block. B permits are less reliable than A permits by being subject to a higher minimum flow. The summer minimum flows for the A block are 1,300 L/sec at Manse Bridge for 50% restriction and 700 L/sec for total restriction. For the B block in summer there is no restriction if the flow is greater the 1,600 L/sec and total restriction if the flow is 1,599 L/sec or less.

6.5 Despite the ORRP setting allocation limits of 1,600 L/sec and 400 L/sec, consents for abstraction have continued to be issued since the ORRP became operative in 2000. The current totals amount to 2,157 and 653 L/sec for A and B permits respectively (Davison & Clark 2018). The A block is 557 L/sec over-allocated and the B block is 253 L/sec over-allocated according to the ORRP.

6.6 The ORRP regime does not provide separation between the A and B blocks to allow for a period of natural flow variation to be provided to the river in flows above the

minimum. In the Temuka Catchment the situation is made worse by the ORRP providing an overlap of allocations where B consents can be actioned before the A block has been fully utilized. As the consenting authority continued to issue consents beyond the A and B allocation block limits, the extent of over-allocation of the A and B block allocations has increased.

6.7 Partial restrictions under the ORRP for Temuka Catchment A and B allocations are not set with steps or pro-rata to prevent abstraction taking river flow below the minimum flow. Currently, if the summer flow at Manse Bridge is 701 L/sec (1 L/sec above the minimum flow) then 50% of total A block abstraction can be taken. This amounts to 1,050 L/sec of abstraction and is 349 L/sec more water than the total flow of the river at Manse Bridge. Additionally, at the transition from full allocation to 50 % restriction of the A block (1,300 L/sec flow at Manse Br) and at the transition of the B block from full allocation to total restriction (1,600 L/sec flow at Manse Br), there is the same potential to dewater the river – more water can be abstracted than flows in the river.

6.8 The potential to dry up the river over a wide range of flows has been caused by –

i. excessive A and B block allocations,
ii. permits to abstract from the A and B blocks continuing to be granted above their allocation limits,
iii. lack of separation of the blocks, and
iv partial restrictions that do not protect the minimum flows.

These problems can only be fixed by amending all of the allocation and flow regime components.

6.9 Fish and Game supports the stakeholder agreed recommendations developed by the TCWP in regard to reduction in size and distribution of the Temuka Catchment A and B allocation blocks, provision for a C allocation block, and monthly variable minimum flows as contained in Tables 14 (i), (j), and (k) and in part of Table (l). These proposed changes would be expected to result in improvements in surface water flows that would have positive impacts on the habitats of sports fish and game birds and the recreations these support.

6.10 The Temuka River from its confluence with the Opihi River upstream to the Beeby Rd crossing (15.5 Km) is recognised as a high value salmon spawning habitat supporting a

fishery of regional importance (Unwin, 2006). This river reach is listed in Schedule 17 of the Land and Water Regional Plan.

6.11 Prior to construction of the Opuha Dam, the Temuka River sustained on average about 40% of all salmon spawning in the Opihi Catchment. The Opuha Dam brought more assured flows to the Opihi River. The flow range of 7,500 L/sec to 8,000 L/sec at Saleyards Bridge in March and April provided more assured salmon access and spawning conditions in the Opihi River mainstem. Previously the Waihi-Temuka was a lower river safe haven for salmon when the Opihi River flows were low. After the Opuha Dam, improved Opihi mainstem flows have been more attractive for salmon spawning and the Waihi-Temuka and Te Moana rivers have sustained about 25% of Opihi Catchment spawning. Annual counts identify 20 to 150 redds (nests) and 50 to 400 adult fish present in the Temuka River.

6.12 The Opihi salmon run begins at the river mouth in late December and peaks in February/March. Salmon enter the lower reaches of the Waihi-Temuka from early March through to May and spawning occurs from late April to late June. While spawning is essentially a winter season activity and river flows are unlikely to be affected by abstraction at that time, the earlier upstream migration of large bodied adult salmon of up to 12 Kg in autumn can be compromised by the drying Waihi River reach between Winchester and Geraldine and irrigation abstraction can add to this.

6.13 As a member of the TCWP, Fish and Game recognised that introducing variable monthly flows through the sub-regional planning process, to replace the summer/winter flows in the ORRP, provided the opportunity to better meet ecological requirements such as salmonid migration and spawning in the Temuka Catchment. Finer time scales for minimum flow regimes recognise that the shoulder months in spring (September to November) and autumn (March, April) can sustain higher minimum flows that benefit instream ecosystems.

6.14 The TCWP proposed to the Zone Committee a range of variable monthly flows with increasing minimum flows and decreasing allocation in a two-step process. The Zone Committee adopted the TCWP recommendations in its ZIPA and these have been included in PC7 in Table 14(i) for A Permits and Table 14 (j) for B permits. Fish and

Game supports the minimum flows, allocation limits and restriction regimes proposed in PC7 tables 14(i) and 14(j).

6.15 PC7 Table 14(l) proposes an additional step to further reduce minimum flows and allocation limits and implement pro-rata restrictions by 2035.

6.16 During sea-run salmon migration and spawning in the Temuka River, minimum flows at Manse Bridge have been increased for A permits from ORRP levels of 700 L/sec in March and 1,000 L/sec in April to June, to PC7 Table 14(i) and Table 14(l) proposed levels of 1,200 L/sec in March, and 1,500 L/sec in April to June. These represent 25% to 40% increases in minimum flows.

6.17 NIWA was contracted by Environment Canterbury to undertake physical habitat surveys in 2018 to inform recommendations for minimum flows at key locations in the Opihi Catchment. The Temuka Catchment site was in the lower river below Manse Bridge and within the Schedule 17 LWRP Salmon Spawning Site. The habitat modelling indicated maximum Weighted Usable Area (WUA) for salmon spawning habitat in the survey reach was provided in flows of about 2,000 L/sec (Jellyman, 2018).

6.18 At the current ORRP minimum flow, over the April to June salmon spawning period, of 1,000 L/sec, WUA is predicted to be 65.1% of maximum. At the proposed PC7 Table 14(l) April to June minimum flow of 1,500 L/sec, WUA is predicted to be 88.7% of maximum (Figure 31, Jellyman 2018).

6.19 I believe the 23.6% increase in salmon spawning habitat availability at the 1,500 L/sec minimum flow for April to June in both the proposed PC7 Table 14(i) and PC7 Table 14(l) regimes will improve conditions for salmon spawning compared to current ORRP minimum flows (Table 2). This improvement recognises the importance of salmon spawning habitat in the Temuka River as a Schedule 17 water and its contribution to sustaining the Opihi River salmon fishery.

Table 2. Monthly improvement in habitat availability moving from current ORRP to proposed PC7 Table 14 (l) minimum flows for salmon and trout spawning, juvenile and adult trout, and food producing habitat for the Temuka River (data from Figure 31, Jellyman 2018).

	ORRP	PC7 Table 14(l)	Change in WUA as proportion of maximum (%)				
Month	Min flow (L/sec)	Min flow (L/sec)	Salmon spawning	Trout spawning	Trout juvenile	Trout adult	Food producing
Sep	1,000	1,500			+19.0	+14.6	+21.4
Oct	700	1,200			+26.1	+13.7	+23.6
Nov	700	1,050			+16.9	+9.2	+16.3
Dec	700	1,050			+16.9	+9.2	+16.3
Jan	700	1,050			+16.9	+9.2	+16.3
Feb	700	1,050			+16.9	+9.2	+16.3
Mar	700	1,200			+26.1	+13.7	+23.6
Apr	1,000	1,500	+23.6	+28.9	+19.0	+14.6	+21.4
May	1,000	1,500	+23.6	+28.9	+19.0		
Jun	1,000	1,500	+23.6	+28.9	+19.0		
Jul	1,000	1,500		+28.9	+19.0		
Aug	1,000	1,500			+19.0		
Average			+23.6	+28.9	+19.5	+11.7	+19.4

6.20 Brown trout support a well-utilised recreational fishery in the Temuka River with the four National Angler Surveys undertaken since 1994 indicating 1,000 to 3,000 angler days of fishing effort annually.

6.21 Brown trout spawn throughout the Temuka Catchment at roughly the same time as sea run salmon and have similar flow, depth and substrate requirements for spawning habitat. The NIWA habitat modelling surveys in the reach below Manse Bridge indicated peak trout spawning habitat was available at about 2,400 L/sec. The current ORRP minimum flows for April to June of 1,000 L/sec provide 51.5% of maximum WUA for trout spawning (Jellyman, 2018). The proposed PC7 Table 14(i) and PC7 Table 14(l) regimes minimum flow for April to June is 1,500 L/sec and provides 80.4% of maximum WUA and a significant 28.9% improvement over current trout spawning habitat availability (Table 2).

6.22 To maintain recreational trout and salmon fisheries, juvenile trout and salmon need food and space as they grow. For resident trout their entire lives will be spent in freshwater while salmon must go to sea for 1.5 to 3 years before returning as adults. Food and habitat for juvenile salmonids has year-round requirements for sustaining harvestable adult populations. NIWA habitat modelling in the Temuka River for December to February indicates an approximate 16.9% increase for juvenile brown trout availability in proposed PC7 Table 14(l) compared to current ORRP, achieving 82% of maximum habitat availability. In the irrigation shoulder months of March, April and September to November the amount of habitat for juvenile trout as a proportion of maximum habitat availability increases by an average of 21% under proposed PC7 Table 14(l) minimum flows, reaching 97% of maximum habitat. (Jellyman, 2018).

6.23 Fish and Game supports the proposed PC7 Table 14(l) minimum flow regime for its benefits to trout and salmon spawning, juvenile trout rearing and food producing habitat

6.24 Trout fishing is popular throughout the Temuka Catchment. Salmon fishing tackle is not suited to the narrow channel and shallow water of the Temuka River. Occasionally trout anglers will hook salmon in the Temuka River as a bycatch.

6.25 Only one comprehensive survey of trout angler catch has been undertaken for the Opihi Catchment. The 2007/08 season survey identified approximately 700 trout

caught in each of the Waihi and the Temuka rivers with the Kakahu and Te Moana rivers contributing another 100 trout between them for a total in the catchment of 1,500 trout. About three-quarters of trout caught were returned to the water. Total trout angler effort was estimated at 1,740 angler-days which was close to the National Angler Survey estimate of 1,550 angler-days for the same season. The Waihi -Temuka River was the third most popular sports fishery in the Opihi Catchment behind the Opihi River and Lake Opuha.

6.26 The first National Angler Survey during the 1994/95 sports fishing season estimated approximately 3,000 angler-days of trout fishing effort in the Waihi and Temuka rivers. Since that time there has been a decline in angler use with 1,660, 1,550, and 980 angler-days reported in 2001/02, 2008/09, and 2014/15 respectively. I believe the increase in consented abstraction causing more frequent low flows and for longer periods, will have contributed to poorer trout fishing conditions over the last 25 years.

6.27 The trout fishing season extends from October to April with early and late season angling being the most popular. Temuka Catchment anglers understand that in most years mid-summer flows are low and together with high water temperatures that provide conditions suitable for weed and nuisance algal growth, these are not good conditions for trout fishing.

6.28 The habitat suitability criteria for adult brown trout used in the Opihi Catchment ecological flow assessment undertaken by NIWA in 2018, provided estimates of change in Weighted Usable Area (WUA) with flow for adult brown trout habitat as a proportion of the maximum WUA. The habitat suitability criteria used in this assessment were for New Zealand drift feeding adult brown trout (Hayes and Jowett 1994). Habitat that provides for trout to feed on invertebrate drift has a close association with the recreational value provided by that habitat for trout fishing as it is feeding adult brown trout that the angler seeks. Flows that provide more trout drift feeding habitat should also provide more opportunities for anglers than flows that provide less trout drift feeding habitat.

6.29 The proposed PC7 Table 14(l) increase to the November to February minimum flow of 350 L/sec from current, is predicted to increase adult trout drift feeding habitat (+9.2%) and food producing habitat (+16.3%) to the benefit of adult trout (Table 2).

Despite these modelled increases in the predicted availability of adult trout drift feeding habitat in the summer months, WUA will still remain only about 25% of its maximum for adult brown trout. Preferred flows for trout fishing are likely to be 2,000 L/sec and higher when adult trout habitat exceeds 50% of its maximum availability. I believe minimum flows proposed in PC7 Table 14(l) will remain too low for there to be a noticeable improvement in trout angling in river flows around the minimum flow from November to February.

6.30 In spring and autumn Temuka River flows are naturally higher and cooler. These are the shoulder months for irrigation so demand is less and it is more likely the river will be above minimum flows. Trout are widely distributed and actively feeding in spring after spawning or actively feeding in autumn to put on condition before spawning. For Temuka River anglers it is the feeding behaviour of trout in spring and autumn that is most important for this is when the natural flow in the river is more likely to be in the preferred flow range.

6.31 Spring and autumn minimum flows in proposed PC7 Table 14(l) are 500 L/sec higher than current ORRP. NIWA habitat modelling indicates the TCWP minimum flow regime recommended to the Zone Committee and carried through to PC7 Table 14 (l), provides a 20% increase in the proportion of maximum food producing habitat available in spring and autumn. These flows also provide a 10% to15% increase in adult brown trout habitat present in spring and autumn (Table 2).

6.32 I believe these improvements to the predicted habitat for drift feeding adult brown trout in spring and autumn should produce an increase in the size and number of trout available to anglers at flows around the minimum flow.

6.32 The Section 42A Report in its Table 14(i), recommends adoption of the same minimum flow regimes and allocation limits in proposed PC7 tables 14 (i), 14(j) and 14(l) and reducing the timetable for when these apply. It also recommends introduction of the pro rata restrictions in proposed PC7 Table 14(l), to apply from when the plan becomes operative. The Section 42A Report changes only the date of application. In this respect the Section 42A Report recommendations do not provide any more sports fish or angling habitat than that proposed in PC7 Table (l).

6.33 Fish and Game supports –

Proposed PC7 Table 14(l) -

Allocation block limit of 1,600 L/sec for A Permits
Allocation block limit of 400 L/sec for B Permits

Variable monthly minimum flows
Pro-rata restriction on abstraction

7. NORTH OPUHA RIVER CATCHMENT

7.1 The North Opuha River flows into the northern corner of Lake Opuha. As well as being a valued trout fishery in its own right, juvenile trout originating from spawning in the North Opuha River represent a significant proportion of the recruitment that maintains the self-sustaining Lake Opuha brown and rainbow trout fishery.

7.2 The North Opuha runs for about 18 km across the Ashwick Flat after emerging from the Sherwood Range. The lower 10 km of the river, from about Stoney Creek junction to Lake Opuha is the most commonly fished reach due to the river being predominantly in a single channel and the streambed is steep and bouldered making for challenging angling. Upstream of Stoney Creek the river channel is broader, and the stream is braided in an unstable shingle bed.

7.3 The three National Angler Surveys conducted by NIWA between 1994 and 2008 did not separate angling in the Opuha River into its three component parts being the North Opuha River, South Opuha River, and the Opuha River below Lake Opuha. Estimated angler use of the Opuha River between 1994 and 2008 was approximately 1,000 angler days per season and ranged between 400 and 1,500 angler days.

7.4 In the 2007/08, in conjunction with the NAS that season, CSIFG undertook its own survey of angler use of the Opihi Catchment fisheries. This estimated a total of 790 angler days for the North and South Opuha rivers and the Opuha River below the lake with effort evenly split between the three. The North Opuha sustained the greatest angler success with 780 trout caught of which 82% were returned to the water. The high return rate indicates a fishery where anglers enjoy the challenge of catching a fish above taking it to eat.

7.5 These angler surveys suggest that the North Opuha sustains moderate angler use and is rated highly for its fishing experience.

7.6 The flow recording site for the North Opuha is located at Clayton Road Bridge and is upstream of all of the abstraction in the catchment apart from 7.5 L/sec allocated to community supply. In the North Opuha in the summer months the current minimum flow is 850 L/sec and there are no partial restrictions. This means that the full 255 L/sec of A allocation that is available downstream of the gauge can be taken until the flow reaches 850 L/sec at the flow recorder. At the most downstream abstraction site and for the remainder of the river downstream to the lake, flow in the North Opuha could be 595 L/sec, 255 L/sec below the minimum flow, or lower if there are additional channel losses to groundwater.

7.7 The North Opuha River supports about 40% of rainbow trout spawning that maintains the recreational fishery of Lake Opuha. Higher minimum flows in early to mid-winter under the current ORRP and proposed PC7 Table 14(m) provide sufficient flows for adult trout to migrate upstream from Lake Opuha for spawning. Most rainbow trout spawning occurs downstream of the flow gauge at Clayton Settlement Bridge.

7.8 There have been no habitat surveys of the North Opuha River to provide information on habitat provided by the current ORRP and potential habitat from proposed PC7 flow regimes. It is my personal assessment that the North Opuha currently provides good quality habitat for trout and trout fishing, a view supported by trout angler use and success. I do not believe minimum flows proposed in PC7 Table 14(m) will have noticeable impact on the trout fishery or its value as a nursery for Lake Opuha trout.

7.9 Fish and Game supports the introduction of pro-rata restrictions for a North Opuha water user group that will ensure abstraction is managed to preserve the minimum flow. Fish and Game believes the reduction in minimum flows is more than compensated for by introduction of pro-rata restrictions that will prevent river flow below the recording site being reduced below the minimum flow by abstraction downstream of the minimum flow site, as potentially occurs under the ORRP. The cap on the size of the A block allocation is supported as a mechanism to improve efficiency of use of A block water taken for irrigation, and prevent any further A block allocation.

7.10 Fish and Game supports –

a) Current A block allocation capped at 255 L/sec - its current use as presented in evidence by Ms Johnston for FAWP.

b) Table 14(m)

i. variable monthly minimum flows

ii. pro-rata restrictions for WUG members subject to acceptance of a revised definition of pro-rata proposed by the FAWP

iii. stepped partial restrictions for non WUG members

iv. a cap on A block allocation at its current allocation

v. timing for introduction of i. to iv.

8. SOUTH OPUHA RIVER CATCHMENT

8.1 The South Opuha River flows for approximately 10 km across Ashwick Flat after emerging from the Two Thumb range before flowing into Lake Opuha. The Ashwick Flat reach is the most popular for trout fishing and is similar in topography to the lower reach of the North Opuha – single channel, fast broken water and mostly cobble and boulder substrate. Typically, headwater fisheries are steep and fast and carry low numbers of good conditioned fish that offer a challenge to catch and land. Trout anglers will be targeting the small pieces of deeper water below bankside or instream obstacles and the quiet pocket water behind large mid-stream boulders. Trout fishing is known to occur in the alpine reach above Ashwick Flat; however, the perception of anglers and Fish and Game is that provision of access favours commercial fishing operations.

8.2 In all four National Anger Surveys conducted since 1994, angler effort in the South Opuha River has not been separated from total Opuha River effort. The 2007/08 harvest survey undertaken by CSIFG estimated slightly lower use of the South Opuha River than the North Opuha River by anglers that season – 220 angler days compared to 259 angler days and a slightly lower trout catch rate – 2.8 fish per day compared to 3.1 fish per day. The biggest difference between the two rivers was that 27% of South Opuha trout were kept while 19% of North Opuha trout were kept. I am not sure if this difference is significant and overall, I believe both rivers offer similar high-quality fishing experiences that anglers enjoy above simply harvesting trout to eat.

8.3 There is one irrigation consent for Cascade Irrigation Company of 634.4 L/sec on the South Opuha and 97 L/sec allocated to community supply.

8.4 Fish and Game support introduction of a cap on BA allocation at its current level and pro rata partial restrictions in proposed PC7 Table 14(n). Pro rata restrictions will formalise the Cascade Irrigation Company's current voluntary management of low flows to protect the minimum flow when the natural flow in the South Opuha River is above the minimum flow.

8.5 The current ORRP minimum flow regime for the South Opuha River provides 500 L/sec for spring and summer months (Sep to Apr incl.) and 800 L/sec in winter months (May to Aug incl.). The ORRP does not place a limit on the amount of water able to be taken as A block allocation.

8.6 Proposed PC7 2025 Table 14(n) provides for increases in South Opuha River minimum flows across the year - 400 L/sec increases in winter months, 20 L/sec to 50 L/sec increases in mid-summer, and 300 L/sec to 500 L/sec increases in the September, October, November, and April shoulder season months. Monthly variable minimum flows better provide for ecological values in the river and compliment the reduced agricultural demand in the shoulder months of the irrigation season. Current ORRP minimum flows that recognise only broad summer and winter minimum flows do not offer the same opportunities to adapt minimum flows to important needs both instream and agricultural, on a finer time scale.

8.7 Increased minimum flows in the river in the shoulder months will provide more habitat for invertebrate food production. In September, October, November and April proposed PC7 Table 14(n) offers greater than 20% increase in food producing habitat with that habitat also sustained through the winter (Table 3). Proposed PC7 Table 14(o) offers no further increase in food producing habitat over that provided by proposed PC7 Table 14(n) in September, October, November and April.

8.8 Increases to minimum flows in proposed PC7 Table 14(n) in December, January, February, and March are predicted to increase food producing habitat availability by 1% to 3% and a further 3% to 5% under proposed PC7 Table 14(o) minimum flows. Proposed PC7 Table 14(o) does not offer any further increases in minimum flows from

those proposed in PC7 Table 14(n), other than for the mid-summer months of December to mid-March.

Table 3. Monthly change in predicted food producing habitat in the South Opuha River survey reach relative to maximum WUA under the current ORRP Full Availability minimum flow regime for September to April and proportional change in WUA relative to ORRP minimum flows for proposed PC7 Table 14(n), and proposed PC7 Table 14(o) minimum flow regimes. (data from Figure 15, Jellyman, 2019).

	ORRP		ORRP→PC7 Table 14(n)		PC7 Table 14(n)→14(o)	
Month	Min flow (L/sec)	Proportion max. WUA (%)	Min. flow (L/sec)	WUA change from ORRP (%)	Min. flow (L/sec)	WUA change from PC7 Table 14(n) (%)
Sep	500	50.0	1,000	+26.2	1,000	0
1-14 Oct	500	50.0	900	+22.1	900	0
15-31Oct	500	50.0	800	+17.0	800	0
Nov	500	50.0	800	+17.0	800	0
Dec	500	50.0	550	+2.9	600	+2.9
Jan	500	50.0	520	+1.2	600	+4.6
Feb	500	50.0	520	+1.2	600	+4.6
1-14 Mar	500	50.0	550	+2.9	600	+2.9
15-31Mar	500	50.0	600	+5.8	600	0
1-14 Apr	500	50.0	800	+17.0	800	0
15-30 Apr	500	50.0	1,000	+26.2	1,000	0

8.9 PC7 Table 14(n) and PC7 Table 14(o) propose the same increased minimum flows in April, May, and June of 300 L/sec to 500 L/sec above current ORRP values. These improved minimum flows will increase average water depth and assist access of adult trout in the South Opuha on their spawning migrations. Proposed PC7 minimum flows from April to June are supported for maintaining brown trout spawning habitat availability above 90% of its maximum predicted availability (Jellyman, 2018).

8.10 The North and South Opuha rivers contribute approximately 80% of known juvenile trout recruitment to Lake Opuha to sustain the recreational fishery. Since 2011, 10 to 20 trout redds (nests) have been counted annually in each with likely contribution of 20,000 fry to the lake per year from each river. Lake Opuha is an important angling destination in Canterbury sustaining between 3,000 and 5,000 angler days per year and between 20% and 40% of all angling in the Opihi Catchment (Unwin, 2016). Maintaining or increasing angler use of Lake Opuha relies on recruitment of juvenile trout from the North and South Opuha rivers.

8.11 PC7 Table 14(n) and PC7 Table 14(o) propose the same minimum flows, increased from current, in October, November, the second half of March and April. These periods are the beginning and end of the sports fishing season. These minimum flows increase adult trout drift feeding habitat by 25% to 30% above current ORRP levels to reach almost 90% of its maximum WUA (Table 4).

Table 4. Monthly change in predicted adult trout drift feeding habitat in the South Opuha River survey reach relative to maximum WUA under the current ORRP Full Availability minimum flow regime for October to April and proportional change in WUA relative to ORRP minimum flows for proposed PC7 Table 14(n), and proposed PC7 Table 14(o) minimum flow regimes. (data from Figure 15, Jellyman, 2019).

	ORRP		ORRP→PC7 Table 14(n)		PC7 Table 14(n)→14(o)	
Month	Min flow (L/sec)	Proportion max. WUA (%)	Min. flow (L/sec)	WUA change from ORRP (%)	Min. flow (L/sec)	WUA change from PC7 Table 14(n) (%)
1-14 Oct	500	59.4	900	+29.0	same	0
15-31Oct	500	59.4	800	+25.2	same	0
Nov	500	59.4	800	+25.2	same	0
Dec	500	59.4	550	+5.4	600	+5.1
Jan	500	59.4	520	+1.8	600	+8.7
Feb	500	59.4	520	+1.8	600	+8.7
1-14 Mar	500	59.4	550	+5.4	600	+5.1
15-31Mar	500	59.4	600	+10.5	same	0
1-14 Apr	500	59.4	800	+25.2	same	0
15-30 Apr	500	59.4	1,000	+31.0	same	0

8.12 Minimum flows from December to early March in proposed PC7 Table 14(n) provide monthly increases that range from 20 L/sec to 50 L/sec from current. Additional 50 L/sec to 80 L/sec per month increases are provided in proposed PC7 Table 14(o). Adult trout drift feeding habitat availability increases by 2% to 5% under proposed PC7 Table 14(n) and an additional 5% to 9% under proposed PC7 Table 14(o). Proposed PC7 Table 14(o) raises adult trout drift feeding habitat to about 70% of its maximum availability for the December to mid-March months.

8.13 Trout anglers are unlikely to fish the Ashwick Flat reach of the river in mid-summer under current ORRP or either of the proposed PC7 minimum flow regimes. If the river is at or near its minimum flow level, the low availability of adult trout habitat, presence of warm water temperatures compared to early and late season conditions, and the absence of other important adult trout habitat, means conditions are not conducive to enjoyable or productive fishing. In summary I don't believe improvement in December to March adult trout drift feeding habitat in proposed PC7 Table 14(o) minimum flows will noticeably improve trout fishing conditions.

8.14 Fish and Game supports –

PC7 Table 14(n)–

i. variable monthly minimum flows particularly in spring and autumn months
ii. increased minimum flows particularly in autumn, winter and spring
iii. pro rata restrictions for all BA permits
iv. a cap on BA allocation at its current 634.4 L/sec
v. timing for implementation of i.to iv.

PC7 Table 14(o)

i. variable minimum flows for 15 March to end of November

8.15 The Section 42A Report in its Table 14(n), recommends adoption of the same minimum flow regimes, reduction in allocation and application of pro rata restrictions as PC7 Tables 14(n) and 14(o). The only nett difference is the reduction in time for these to apply under Section 42A Table(n). The Section 42A Report recommendations do not provide any increased sports fish habitat or angling habitat from that in proposed PC7 Tables 14(n) and 14(o).

9. UPPER OPIHI RIVER CATCHMENT

9.1 The upper Opihi River from its junction with the Opuha River upstream to Burkes Pass is approximately 43 km and the telemetered flow gauge is just below the gorge at Rockwood, approximately 4 km upstream from the Opuha junction.

9.2 The upper Opihi River sustains three sports fish species- chinook salmon, brown trout, and brook char. The former two species are the most widespread and sustain almost all recreational angler activity. Brook char are highly prized by anglers but are unable to compete for habitat against brown trout. This has restricted their distribution to Paddys Market Creek, a small steep and rocky stream entering the upper Opihi from the north about 2km downstream from Burkes Pass township. This habitat is harsh and mature brook char grow to no more than 200mm making them unattractive to anglers.

9.3 In the 2007/08 sports fishing season it was estimated that –

a. Approximately 240 days were fished by trout anglers in the upper Opihi being 150 days in the section from the Opuha confluence to the top of the Gorge plus 90 days in the section above the Opihi Gorge. This was about 1% of season effort by all trout anglers fishing in the Opihi Catchment.
b. About 500 trout were caught by anglers in the upper Opihi comprising 140 trout in the section from the Opuha confluence to the top of the Gorge plus 360 trout in the section above the Opihi Gorge. This was about 3% of all trout caught in the Opihi Catchment.
c. Angling success was higher in the upper Opihi section of the Opihi Catchment than the average across the catchment – 3% of catchment-wide trout harvest was taken for only 1% of catchment-wide effort.
d. Approximately 42% of trout caught in the upper Opihi River were harvested (kept). Elsewhere in the catchment only the harvest rate in the river below the Temuka confluence at 54%, exceeded that of the Upper Opihi. In the lower river, sea-run brown trout are targeted by anglers particularly in the lagoon and these prime fish that spend most of their lives at sea, are not available elsewhere in the catchment.
e. Other than for the upper Opihi River and Opihi mainstem reach below the Temuka confluence, the average harvest rate for trout in river reaches of the Opihi Catchment was 27%. The high harvest rate of 42% for trout in the

upper Opihi indicates that anglers valued the quality of the fish for eating and is a reflection of the anglers' consideration that habitat quality is good in the upper Opihi River.

9.4 The quality of the sports fishery of the upper Opihi River is determined by the amount and quality of habitat for sport fish provided by river flow in addition to water quality. There is no information on the relationship between trout angling success and Upper Opihi River flow to identify preferred flows for successful angling. However, trout anglers target drift feeding brown trout so indicators of drift feeding habitat available to trout, and for invertebrate production, relative to flow, should indicate conditions suitable for trout angling.

9.5 NIWA undertook instream habitat modelling surveys in the upper Opihi River just above the gorge in 1996 and further work programmed for February/March 2018 could not be completed due to Cyclone Gita. As reported by NIWA, the physical habitat surveys were not repeated in 2018 and the 1996 data were combined with new habitat suitability criteria not available in 1996 (Jellyman, 2018).

9.6 NIWA reported that useable habitat for adult brown trout increased with flow across the flow range (0 to 3,300 L/sec) and was continuing to increase at the maximum flow assessed. Similarly, food producing habitat weighted useable area continued to increase with increasing flow (Figure 18, Jellyman, 2018). Of the 21 ecological values modelled by NIWA, excluding nuisance algae, availability of adult brown trout habitat as a proportion of maximum WUA in the flow range of 790 L/sec to 1,000 L/sec was the lowest of all ecological values. Regardless of which summer minimum flow regime is applied minimum flows of 790 L/sec to 1,000 L/sec do not support abundant adult brown trout habitat. It is my professional judgement that in the river reach between the Gorge upstream to Fairlie, flows above 3,000 L/sec are ideal for trout fishing.

9.7 A conclusion from the NIWA habitat survey that trout and food producing habitat increased with increasing flow in the flow range up to at least 3,300 L/sec at the above gorge site in the upper Opihi River, is not surprising. The NIWA survey section was representative of the river over the approximate 6.5 km reach between the top of the gorge and the SH8 Bridge at Fairlie. In this reach the river can be described as actively braided with generally shallow flow over gravel and occasional deeper water

associated with instream obstructions and natural channel morphology. At low flow the wetted channel is a small proportion of the riverbed. As flow increases, the proportional width of existing braids increases more than the proportional depth, dry channels begin to flow and the amount of trout drift feeding habitat and invertebrate food producing habitat increases. Despite habitat modelling showing increases in the amount of adult trout and food producing habitat, as a proportion of maximum habitat the availability remains low (<31%) for these values in the summer minimum flow range of 850 L/sec to 1,000 /sec of proposed PC7 Table 14(p) and Table 14(q).

9.8 The potential to improve availability of food producing habitat and adult brown trout drift feeding habitat in the upper Opihi River at flows around the minimum flow, to benefit trout angling, is limited in the same way that it is in the South Opuha River. Trout anglers are unlikely to fish the upper Opihi River in the gorge to Fairlie reach in mid-summer under current ORRP or either of the proposed PC7 flow regimes if the river is at or near its minimum flow. For these regimes, the low availability of adult trout habitat and presence of warm water temperatures when the river is at or near its mid-summer minimum flow compared to early and late season conditions, means it will remain unattractive to trout anglers.

9.9 The most significant increases to the minimum flows from current ORRP levels in proposed PC7 Table 14(p) and Table 14(q) have been achieved for the winter months when current irrigation needs are minimal. Allocating the additional 220 L/sec above the current ORRP for winter minimum flows protects winter flows from the potential for future harvest for irrigation storage and provides very good conditions for trout and salmon spawning occurring in winter.

9.10 Trout and salmon spawn in the upper Opihi River from April to July. The reaches from the Opihi/Opuha confluence upstream to the bottom of the Gorge, and from the top of the Gorge upstream to Fairlie are preferred spawning grounds for salmon. Salmon spawning records from 1991 to the present indicate on average about 15% of all spawning in the Opihi Catchment occurs in these reaches of the upper Opihi River. This level of use identifies the upper Opihi as a priority spawning tributary and it is afforded this status in Schedule 17 of the LWRP. Trout and salmon need access to spawning grounds in the upper Opihi River from March to July. Minimum flows in proposed PC7 Table 14(p) and Table 14(q) have been increased from current ORRP by 220 L/sec in

April to September and these will assist large salmon of up to 12 kg to access and use their upper Opihi River spawning grounds.

9.11 Fish and Game supports –

a) Table 14(p)

i. variable monthly minimum flows at presented rates

ii. pro rata restrictions for WUG members

iii. stepped partial restrictions for non WUG members

iv. Cap on allocation at current 474 L/sec

v. Timing for implementation of i. to iv.

b) Table 14(q)

i. April to September minimum flows for salmonid spawning

ii. AN and BA Allocation limit at current use

iii. Restriction regimes for WUG and non WUG

9.12 The Section 42A Report in its Table 14(p), recommends adoption of the same minimum flow regimes, reduction in allocation and application of pro rata restrictions as PC7 Tables 14(p) and 14(q). The only nett difference is the reduction in time for these to apply under Section 42A Table 14(p).

10. TE ANA WAI RIVER CATCHMENT

10.1 The Te Ana Wai River is approximately 60 km in length from its headwaters in the Rollesby, Dalgety and Albury ranges downstream to its confluence with the Opihi River at Pleasant Point. The flow gauge for consent monitoring is located at Cave, about 15 km upstream from the Opihi River confluence. There is a surface water losing reach that starts about 2 km upstream from the Opihi confluence and extends upstream for approximately 6 km. The losing reach is downstream from the flow gauge.

10.2 The Te Ana Wai River has a valued and well recognised trout fishery. Anglers target early and late season angling from October to December and March/April respectively. In the early part of the fishing season river flows are generally good coming out of winter and adult trout have wide distribution after spawning in winter. In mid-summer flows almost always limit trout access in the surface water losing reach. Fish and Game undertake fish recovery from disconnected pools between Pleasant Point and Cave on average one year in three. High summer water temperatures and low river flows do not provide good trout fishing conditions. By March and April water temperatures are

cooling and seasonal rain triggers adult trout migration around the Te Ana Wai and into the river from the Opihi River as brown trout prepare for spawning. Anglers also target these conditions.

10.3 The Te Ana Wai trout fishery has featured in all four National Angler Surveys conducted since 1994. Annual angler use of the river is highly variable ranging from 70 to 900 angler days. I believe the most significant factor contributing to that variability is river flow with regular freshes across the season producing higher median and average flows sustaining higher interest from anglers.

10.4 The Fish and Game Opihi Catchment harvest survey over the 2007/08 season estimated 160 angler days sustained by the Te Ana Wai River that season with a catch of 150 trout of which 40% were kept. The high harvest rate suggests that when flows are suitable, anglers value the Te Ana Wai as a river with high quality habitat including good water quality producing fish that are good to eat.

10.5 Despite its summer low flow issues the Te Ana Wai is a very productive brown trout nursery. Historically trout spawning surveys have identified a wide distribution of low-density spawning throughout the river at about 2 redds (nests) per kilometre, apart from a concentration of spawning at about 6 redds per kilometre, in the 1.5 km between the Opihi confluence and the Te Ana Wai Bridge. This concentration is likely to indicate spawning by Opihi River resident migrants rather than Te Ana Wai River resident trout and inter-gravel water flow that benefits trout egg incubation in the surface water gaining reach.

10.6 The number of juvenile trout observed annually in the main river below Cave far outweighs production from spawning in the vicinity suggesting recruitment from upstream tributaries to the Te Ana Wai River may be underestimated in number and importance. While some of these juveniles will stay-on and grow to maturity in the Te Ana Wai River the vast majority will move downstream as they grow to reach the Opihi River in the following summer and autumn. Assured downstream access for these fish to the Opihi River through the lower Te Ana Wai River drying reach will be a contributing factor to the sustainability of the Opihi River trout fishery.

10.7 Sea-run Chinook salmon spawn and rear for up to a year in the Te Ana Wai River. Prior to the Opuha Dam on average 40% of Opihi Catchment salmon spawning occurred in the Te Ana Wai with counts of 100 to 250 redds and 250 to 600 adult salmon present in the river up to Limestone Valley about 38 km above the Opihi confluence. About one third of salmon spawning occurs in or below the drying reach of the Te Ana Wai and about two-thirds above.

10.8 The Opuha Dam brought reliability of flow to the Opihi River mainstem and salmon spawning shifted to the larger and more reliable flows in the Opihi. Since the Opuha Dam the Te Ana Wai has sustained about 20% of Opihi Catchment spawning which still amounts to annual counts of 10 to 120 redds (20 to 300 adult fish). The Te Ana Wai River salmon fishery is recognised as regionally important and its spawning habitat is of high value (Unwin, 2006).

10.9 The adult salmon run into the Te Ana Wai River occurs in winter when abstraction is minimal. However, salmon appear in the lower Opihi River from January onwards with peak runs at the river mouth from January to March. Having passed through the river mouth, these fish require Opihi River flows in excess of 3,000 L/sec to enable them to reach preferred upriver spawning grounds. Spawning salmon do not usually appear in the Te Ana Wai until April so good flows in this river at this time and into winter are important for salmon spawning.

10.10 There is no fishing allowed for salmon in April in the Te Ana Wai with the season closing at the end of March in all Central South Island salmon fisheries to protect spawning salmon. The recreational salmon fishery in the Opihi River is concentrated at the river mouth and comprises 300 to 1,000 anglers who fish for 4,000 to 10,000 angler days and catch 100 to 1,100 fish (1993 to 2019 season ranges). Without successful salmon spawning and juvenile rearing in the mainstem Opihi and its tributaries there would be no recreational fishery.

10.11 To complete their life cycle juvenile sea-run Chinook salmon must have access to the sea where they spend two to three years growing after having migrated from their natal river at three months to one year of age. Approximately 80% of the juvenile salmon produced each year will move out of the Te Ana Wai between August and

December as 35 mm to 70 mm fingerlings. River flows in spring through to December are important to enable these salmon to migrate down the Te Ana Wai River to the Opihi confluence.

10.12 There are no differences in the minimum flow regimes proposed in PC7 Table 14(r) and Table 14(s). The only difference being the change from stepped irrigation restrictions to pro rata in Table 14(s). Fish and Game supports the monthly and split monthly flows in these proposed tables that enable variability in the flow regime to provide flow triggers and flow rates that will improve sports fish values.

10.13 In regard to sports fish, increased minimum flows proposed in PC7 Table 14(r) and Table 14(s) will –

a. provide minimum flows increased by 300 L/sec (+75%) to 600 L/sec (+100%) from April to July for improved adult trout and salmon upstream passage; and

b. increase average water depth by 10% to 20% in April, October and November that will improve conditions for trout fishing when the river is at its minimum flow (Ryder, 2018, Figures 11 & 12); and

c. increase adult trout drift feeding habitat by 22% in October and April, and by 7% and 10% in early and late November respectively; and

d. increase food producing habitat by 10% to 20% in October and November that will improve conditions for trout fishing when the river is at its minimum flow (Figure 27, Jellyman, 2018); and

e. Improve juvenile trout and salmon downstream passage from August through April by 50 L/sec (10%) to 500 L/sec (80%) increases in minimum flows during this period.

10.14 Minimum flows proposed in PC7 Table 14(r) and Table 14(s) for December to March will provide 50 L/sec to 150 L/sec increases from current minimum flows and will provide only small improvement in adult trout drift feeding habitat. Habitat availability

as a proportion of maximum WUA for adult trout habitat is estimated to increase by 3% in December to early March, and 10% in late March (Figure 27, Jellyman 2018).

10.15 The Te Ana Wai River sports fishery is a spring and autumn fishery and minimum flows proposed during that part of the fishing season in PC7 Table 14(r) and Table 14(s), will be substantially increased to the benefit of adult trout. In mid-summer the Te Ana Wai is naturally low and even if abstraction was totally restricted, I do not believe there would be sufficient flow to improve adult trout habitat to the extent that it supported sustainable harvest.

10.16 Higher December, January and February minimum flows proposed in PC7 Table 14(r) and Table 14(s) will improve downstream passage for juvenile Chinook salmon. The increased minimum flows are also predicted to increase juvenile brown trout rearing habitat and food producing habitat as a proportion of maximum habitat by between 3% and 4%. Despite this increase in predicted food producing habitat, maximum habitat availability is provided in flows of at least 1,700 L/sec and at a minimum flow of 450 L/sec proposed in PC7 Table 14(r) and Table 14(s), food producing habitat availability will remain low at 35% of maximum (Figure 27 , Jellyman 2018).

10.17 I believe freshes in river flow that occur in mid-summer play a major role in sustaining adult brown trout habitat and trout fishing in the Te Ana Wai River. In this respect the proposed changes to the minimum flow and allocation regimes for BN Permits proposed in PC7 Table 14(y) will provide for more natural flow variation in the range of flows between 700 L/s and 2,500 L/sec. 700 L/sec is the flow at which the full A Permit allocation can be taken and 2,500 L/sec is the minimum flow for BN Permits in proposed PC7 Table 14(y). Currently the BN Permit minimum flow is 1,100 L/sec and there is no sharing of flows with all permits stacked.

10.18 A Permits upstream from the flow recorder at Cave provide for abstraction of 77 L/sec. Current practice for these consents is to self-manage their takes to ensure the minimum flow at Cave is not breached. The imposition of pro-rata restrictions on these consents provides regulatory support for current practice. Downstream of the Cave flow recorder there is potential for large environmental gains from the application of pro-rata partial restrictions.

10.19 Fish and Game support–

a) Table 14(r)
    i. current A block allocation of 261.6 L/sec as provided in evidence by Ms Johnston for the FAWP
    ii. variable monthly minimum flows
    iii. stepped partial restrictions
    iv. timing for implementation of i. to iii.
b) Table 14(s)
    i. Variable monthly minimum flows as for Table 14(r)
    ii. Cap on abstraction as for Table 14 (r)
    iii. Pro rata partial restrictions
c) Table 14(y)
    i. BN Permit minimum flow of 2,500 L/sec
    ii. BN Permit allocation of 800 L/sec
    iii. Pro rata partial restrictions

10.20 The Section42A Report in its Table 14(r) and Table 14(y) recommends adoption of the same Te Ana Wai River minimum flow regimes, allocation and partial restriction regimes as proposed PC7 Table 14(r), Table 14(s), and Table 14(y). The only nett difference is the reduction in time for these to apply under Section 42A Table 14(r) and Table 14(y). The Section 42A Report recommendations do not provide any increased sports fish habitat or angling habitat from that proposed in PC7 Table 14(r) Table 14(s) and Table 14(y).

11. OPIHI RIVER MAINSTEM

The Opihi River pre-Opuha Dam

11.1 My first day of work for the South Canterbury Acclimatisation Society was 4 December 1984 and on that day I started salvaging stranded trout and juvenile salmon from the drying Opihi River. This work continued almost unbroken for the next five months as the river dried back from the Temuka Junction up to Pleasant Point, a distance of about 15 km.

11.2 In total the distance salvaged was at least twice that. Each time we received more than 5 mm of rain the river would rise and start to reclaim dry reaches filling in pools and

fish would take the opportunity to move downstream. If there was 10 mm of rain the river might flow 2 or 3 km. When the rain stopped so did the river and as it receded, we were required to save fish from places we had cleared only a few days or weeks earlier. Some sections of the river were salvaged up to four times.

11.3 As an introduction to the Opihi Catchment I had strong misgivings about working in a place where this work was called fisheries management.

Opihi River upstream from the SH1 Bridge, March 1985.

11.4 We did not identify and count every fish, only making daily estimates of fish shifted. For the 1984/85 summer we estimated approximately 50,000 trout and salmon shifted plus many thousands of native fish, mostly bullies and eels. Early in the summer when the extent of the drought was unknown fish were shifted to a section of the Opihi with stronger flow either upstream or downstream. As the drought strengthened fish were shifted further afield to other catchments including a night trip at the end of the day's salvaging, to the MacKenzie Country with a fish transporter load of 1,000 stressed juvenile trout.

11.5 Between 1984 and 1998 we had two other summers where we shifted 20,000 to 30,000 trout and salmon from the Opihi River to other waterways.

11.6 Since commencement of operation of the Opuha Dam in 1998 and reinforcement of the variable minimum flow regime in the ORRP, the Opihi River has retained connectivity at all times throughout its length and no fish salvage operations have been required. In the summer of 2014/15, the actions of OEFRAG in recommending Water Shortage Directions to ECan retained connectivity in the Opihi River when otherwise the river would have been dry in January 2015.

11.7 Prior to provision of higher and more assured minimum flows from operation of the Opuha Dam, the Opihi salmon fishery was weak. Most spawning occurred in the lower river tributaries particularly the Temuka and Te Ana Wai as these offered more reliable flows in their lower reaches. In most years, even when the main Opihi River flowed continuously, flows were not high enough to enable salmon to negotiate the lower river to reach preferred spawning grounds in the Opihi above the Gorge and in the Opuha below the Gorge.

11.8 In the early 1990's water quality throughout the Opihi Catchment was high and it was unforeseen that it would become an issue. The issue of the time was water quantity.

Planning Processes

11.9 The Opihi River Water Management Plan 1984-1990 provided for a total of 4,060 L/sec of private and Levels Plains Irrigation Scheme abstraction that was tied to Saleyards Bridge minimum flows. A further 1,060 L/sec was provided for municipal and rural water supply and groundwater abstraction from wells more than 400m from main river channels. The 1,060 L/sec takes were unrestricted and were not required to comply with the minimum flow set at Saleyards Bridge.

11.10 The 1984-1990 plan had a minimum flow at Saleyards Bridge of 2,000 L/sec at which all private and Levels Plains Irrigation Scheme abstraction was required to cease. At that time, it was considered that groundwater abstracted more than 400m from main river channels was not hydraulically connected to surface flows in the river channels and therefore did not need to be restricted during times of low flow.

11.11 The plan identified that a flow of 2,000 L/sec at Saleyards Bridge reduced to about 1,100 L/sec just above the Opihi River junction with the Temuka River due to losses to groundwater.

11.12 The 1984 - 90 plan acknowledged that "… while it is desirable to raise the minimum flow level to $3m^3/s$ (approx.1:2 year low flow) this is clearly unacceptable to established irrigation interests."

11.13 Fish and Game entered the consultation phase of the ORRP seeking 3,200 L/sec as the minimum flow at Saleyards Bridge. An early public discussion document prepared by Canterbury Regional Council (CRC) in December 1990 identified 2,500 L/sec as the likely minimum flow again justifying this as any higher being too expensive for irrigation interests (Dons et al.1990).

11.14 It was clear to Fish and Game that we were never going to get 3,200 L/sec as the minimum flow at Saleyards Bridge through the statutory planning and political advocacy opportunities available to us.

11.15 At about the same time CRC was preparing its review of the Opihi River Water Management Plan, the Soil and Water Opihi Resource Development ("SWORD") was investigating options for enhancing flow in the Opihi River for further irrigation development including consideration of environmental needs. In 1990 SWORD applied to the Waitaki Catchment Board for a water permit to take up to 6,000 L/sec from Lake Tekapo and discharge it to the headwaters of the Opihi River at Burkes Pass.

11.16 The Environmental Impact Assessment for the SWORD application section 5, assessed benthic and fisheries habitat in the Opihi River. The assessment included review of hydraulic modelling surveys in 1988 by the Ministry of Agriculture and Fisheries (MAFFish) of the Opihi River a short distance upstream from Saleyards Bridge and at Rockwood to identify flows needed to sustain the ecological health of the river.

11.17 The MAFFish assessment concluded –

Avoiding river mouth closure and discontinuous flows are therefore considered to be of prime importance for an initial assessment of the flow requirements of fish in the Opihi River. Therefore we recommend a minimum flow of $3.2m^3/s$ throughout the year at Saleyards Bridge on the basis that this will maintain a continuous flow between the Saleyards Bridge and the Temuka confluence (Scarf et al. 1984) and an open river mouth will be maintained most of the time (Todd 1983). Further support for a $3.2m^3/s$ minimum flow comes from a preliminary analysis of river hydraulics and habitat

simulation based on field measurements taken in the vicinity of Saleyards Bridge. This analysis indicates that the area of habitat favoured by fish and invertebrates declines rapidly once the discharge falls below 3.0m^3/s (Sagar 1988).

11.18 Against this background of planning uncertainties and doubtful enhancement of river flows by augmentation from outside the catchment, in early 1994 the Opuha Dam Development Company proposed a community irrigation scheme with a dam in the Opuha River and an objective to provide a 6,000 L/sec minimum flow at Saleyards Bridge year-round.

11.19 Fish and Game considered this opportunity and believed we could still do better by varying flows on a monthly basis to better reflect the natural hydrograph of the Opihi River and its ecological and recreational needs. The Opuha Dam Development Company agreed to the concept of variable minimum flows provided that no more water was required to be released from the Dam on an annual basis than that needed to maintain a flat 6,000 L/sec minimum flow.

11.20 Fish and Game's objective was to make use of the same volume of water needed to be released from the Dam to maintain 6,000 L/sec as a minimum flow at Saleyards Bridge and to vary it so that in some months critical for fish passage or spawning or recreation there could be more than 6,000 L/sec. These high flow periods would be balanced by lower minimum flows in other months, typically in winter when fish activity and recreation needs were low, and in mid-summer when historically the natural flow of the river was low.

11.21 The Fish and Game approach was to start with the known sports fish values and needs – a flow of around 8,000 L/sec was considered by anglers to be ideal for trout and salmon fishing with peak activity for these in October/November and March/April respectively. The need for an open river mouth early in the spring for native fish access to the river from the sea and for whitebaitng was recognised. Historically the Opihi has sustained low flows over mid-summer and flows to maintain connectivity within the river were the priority rather than higher flow needs of angling. Similarly in winter, flows could be lower as cold temperatures reduce the activity of all aquatic species. It was recognised that flow changes are important triggers for many fish migrations and

behaviours and Fish and Game was assured these would be maintained by natural flow variations from the Upper Opihi, Te Ana Wai and Temuka rivers.

11.22 In early 1994 there was intense discussion within Fish and Game and with the Opuha Dam Development Company. Modelling of the Dam Company's 20-year flow model to identify the cost of variable flow regimes contributed to refinement of a proposed flow regime.

11.23 In July 1994 Fish and Game submitted a variable minimum flow regime to the Opuha Dam Development Company. That submission contained key components to be included in the flow regime (Table 5).

Table 5. Ecological and recreational considerations in development of the Saleyards Bridge minimum flows submitted to the Opuha Dam Development Company in 1994.

Month	Minimum flow (L/sec)	Environmental and Recreational requirements satisfied
January February	3,500 3,500	Flow to maintain native fish and introduced fish passage within the river. Mouth opening subject to increases in natural inflow or mechanical opening when justified (water quality etc)
March April	7,500 8,000	Encourage salmon entry to river and access to spawning grounds through open mouth and higher flows identified as challenging to anglers
May June July August	4,500 4,000 4,000 4,500	Stable flows for egg incubation and juvenile rearing, flow sufficient for fish passage and natural inflows to open mouth
September October November December	6,000 8,500 7,000 6,000	Provide for native fish passage and spawning. Increased flow to fishing season. Maintain trout access and flows to encourage trout angling. Provide for recreation over holiday period

11.24 The Opuha Dam Development Company agreed to this variable flow regime and Fish and Game presented the regime in evidence in support of the applicant at the Hearing of Applications for Resource Consents by Opuha Dam Limited in Fairlie, March 1995.

11.25 The resource consents for the Opuha Dam were granted and the Dam was commissioned in October 1998. The discharge consent required the minimum flows that later appeared in ORRP Table 5.13 to be maintained at Saleyards Bridge with allowance for abstraction downstream of Saleyards Bridge.

11.26 In October 2000 the Opihi River Regional Plan ("ORRP") became operative after 10 years of public consultation and appeals. Augmented minimum flows at Saleyards Bridge were provided for under Rule 2(1)(b) of the ORRP when the Opuha lake level was above 375m and these retained the variable monthly flow regime first recommended by Fish and Game in 1994 and included as a condition of the Opuha Dam Company consent.

11.27 Fish and Game objectives for environmental enhancement of the Opihi River from operation of the Opuha Dam always had the river below the Dam as the first priority and in particular the sea-run salmon fishery. Any sports fishery and recreational values that developed above the Dam were a bonus and Fish and Game would not support any above-Dam management that compromised availability of stored water for maintaining minimum flows at Saleyards Bridge.

Connectivity

11.28 The evidence of Ms Blakemore for the AMWG explains the relationship between OEFRAG, Fish and Game, and the AMWG.

11.29 Through the winter and spring of 2014, there were very low inflows and snow pack in the catchment above the Opuha Dam. From the beginning of December 2014, Fish and Game agreed with OEFRAG recommendations to ECAN for Water Shortage Directions (WSD) at fortnightly intervals and by 16 February when lake storage had decreased to 14%, a minimum river flow of 2,500 L/sec at Saleyards was recommended, a minimum not seen since before the Dam. This flow was the equivalent of a 30% reduction on the 3,500 L/sec minimum flow for February in the ORRP.

11.30 The minimum flow at Saleyards Bridge was further reduced to 2,000 L/sec on 11 March. Equivalent to a 70% reduction in the March minimum flow in the ORRP.

11.31 On 25 March 2015, with the lake within 90mm of "zero" there was rain in the catchment sufficient to maintain the minimum flow and lake storage above zero. Lake level reached 375m on 25 April and the minimum flow was raised to 4,000 L/sec. If the minimum flows had been any higher than 2,000 L/sec between 11 March and 25 April and irrigation had not been restricted from 1 December, it is almost certain that the lake would have emptied and the river would have run dry. From experience with previous salvage operations in the Opihi I estimate that 45 days of flows less than 2,000 L/sec at Saleyards Bridge would have resulted in dewatering of at least an 8 km reach of the Opihi River above the Temuka junction and including State Highway One. I believe this could have resulted in the loss or salvage of 10,000 trout and juvenile salmon in the Opihi River and the deaths of a further 5,000 adult trout and 20,000 juvenile trout if Lake Opuha reached its minimum level.

11.32 Between January and March 2015, I monitored stream flow in the Opihi River at up to four sites - Saleyards Bridge, below the Levels Plain offtake, above the SH1 Bridge and above the Temuka junction. These assessments were to identify the flow in the Opihi above the Temuka junction that ensured fish passage was maintained and the river stayed connected. It was also hoped to establish flow relationships between these sites in recognition that such low flows had not occurred for the last 20 years and previous flow relationships were established under a much different minimum flow and abstraction regime.

11.33 The Opihi River Water Management Plan 1984-1990 ("**ORWMP, 1984**") identified that channel losses occurred at a relatively constant rate between Saleyards Bridge and the Temuka River confluence. Based on previous analysis by de Joux (1981) the flow relationship between the two sites was given by the formula below where F_1 is the flow in m^3/s at the Temuka confluence and F is the flow at Saleyards Bridge:

$$F_1 = 0.926(F) – 0.725.$$

11.34 Therefore, when the flow at Saleyards Bridge was 2,000 L/sec, the flow at Temuka confluence was calculated to be 1,130 L/sec - a loss to groundwater in this section of the river totalling 870 L/sec (ORWMP, 1984).

11.35 Flow gauging undertaken on 2nd and 7th March 2015 when all irrigation had ceased indicated mean daily flows at the Saleyards Bridge recorder site of 2,687 L/sec and 2,107 L/sec respectively, produced gauged flows 400m upstream of the Temuka junction of 1,094 L/sec and 802 L/sec respectively. An estimated loss to groundwater between those sites of between 1,305 L/sec and 1,593 L/sec and 50% to 80% greater than channel losses reported in the Opihi River Water Management Plan 1984-1990.

11.36 From my observations of the Opihi River during the summer of 2014/15 and flow gauging undertaken, I believe a minimum flow of 800 L/sec in the Opihi River just above the Temuka junction maintains fish passage and connectivity, avoiding massive loss of fish life. This flow equates to 2,000 L/sec at Saleyards Bridge.

11.37 Fish and Game supports the evidence of Dr Mills for AMWP and AMWG proposed Table 14(v(ii)) that recommends a minimum flow of 3,500 L/sec at Saleyards Bridge for the Level 2 Alternative Management regime. This flow maintains the ecosystem health of the Opihi River mainstem (Sagar and Palmer, 1990). Connectivity is lost in Saleyards Bridge flows of less than 2,000 L/sec and the life-supporting capacity of the river is lost.

Environmental flow regimes and recreation – Monthly assessment

11.38 It is common sense that a river with no water has no fish habitat and when water is added, habitat suitable for fish and other life develops. I believe that most people think that as more flow is added to a river channel then more habitat is created, and this continues for as much water that is added until it's a flood. This is not the reality.

11.39 All fish, invertebrates and other life in a river have individual habitat needs defined by such things as water velocity and depth, bed substrate size, food availability, and reproduction needs. These are different for all species to minimise competition and to make sure all life supporting habitat is used. The amount of habitat that is available for each species is a complex combination of the availability and quality of each of essential components needed by that species. In a braided river like the Opihi the natural features of the riverbed – width, gradient, number of channels, and size of substrate, change as flow changes. For instance, a native fish such as the common bully that lives in generally slow flowing and shallow water may have a lot of good habitat available to it at low flow and at higher flows up to when the flow reaches the foot of the bank in the channel. As flow increases, the river reaches higher up the banks but

gains very little in width. The bully has lost most of the habitat it had in the middle of the channel as this is now too fast and the slow flowing habitat is only on the outer margins of the channel and in new channels that may have started to flow. So for the bully there was no habitat at zero flow, there was an abundance of habitat at the flow that covered the bed and just above, and then habitat abundance declined in the original channel as water velocity and depth increased.

11.40 When considering flow needs for life in rivers it is important to identify the species of interest and their individual habitat needs in regard to completing essential parts of their life cycles and not simply assume that more flow equates to more habitat.

11.41 The NIWA habitat survey undertaken in the lower Opihi River in early 2019 modelled habitat available for instream values in a range of flows that cover the current ORRP minimum flow at Saleyards Bridge, the proposed PC7 Table 14(v) and Table 14(w) minimum flows and the AMWG minimum flows.

11.42 Fish and Game has statutory responsibility to manage, maintain and enhance the sport fish and game resource in the recreational interests of anglers and hunters (s.26Q(1) Conservation Act 1990). Of particular interest to Fish and Game are the predicted habitat responses modelled by NIWA under the four Full Availability regimes, for -

i. *Delatidium* mayfly/food producing,
ii. trout spawning,
iii. salmon passage,
iv. salmon spawning,
v. juvenile brown trout rearing,
vi. juvenile salmon rearing,
vii. drift feeding adult brown trout
viii. and waterfowl hunting habitat.

Full Availability Regime – Deleatidium mayfly/food producing habitat

11.43 The results of surveys of habitat response to changing flows in the lower Opihi River for four invertebrate species and food producing habitat generally, indicated that the relationship of food producing habitat suitability criteria was nearly identical to Deleatidium as both reached 80% of their habitat maximum at 2,750 L/sec, both peaked at 7.25 L/sec, and both retained 95% of maximum habitat at 9,750 L/sec (Jellyman 2019).

11.44 During the summer of 1983/84 Fisheries Research Division of the Ministry of Agriculture and Fisheries undertook monthly sampling of benthic invertebrates at sites between Mill Rd, just downstream from Saleyards Bridge, to the State Highway One Bridge. The fauna was dominated by the Deleatidium mayfly, representing 54% of all individuals counted (Sagar and Palmer, 1990).

11.45 Mayflies are a large component of the food eaten by brown trout and every Opihi River fly angler carries numerous mayfly imitations in his or her tackle box. Maintenance or improvement in habitat for trout food under proposed minimum flow regimes is a priority for sports fish anglers.

11.46 From these indicators of the importance of Deleatidium as the major component of the lower Opihi invertebrate fauna, the similarity of its habitat responses to those of food producing habitat, and its contribution to trout food and angling success, the response of Deleatidium habitat to changing flows is an important issue when considering Full Availability minimum flow regimes.

11.47 The January to March 2019 lower Opihi River mainstem habitat survey undertaken by NIWA at Kerrytown Rd, indicated that the habitat available to Deleatidium in response to changing flows had a point of inflection in its flow v WUA curve at about 3,000 L/sec. Habitat availability rapidly declined below this flow and only gradually increased in higher flows. Maximum habitat was provided at about 6,000 L/sec for Deleatidium (Figure 11, Jellyman, 2019).

11.48 The NIWA habitat modelling also presented weighted useable area (WUA) for different flows as a proportion of the maximum WUA for each species. This data enables a more detailed comparison of the impact of differences in the proposed monthly minimum flows on the habitat of the one of the main food species for drift feeding adult trout, juvenile brown trout, and juvenile Chinook salmon – Deleatidium mayfly (Table 6).

Table 6. Monthly change in spring and summer habitat relative to maximum WUA for Deleatidium sp under current ORRP, and proportional change in WUA relative to ORRP minimum flows and proposed Full Availability minimum flows proposed PC7 Table 14(v), Table 14(w), and the AMWG minimum flow regimes. The current ORRP and proposed PC7 Table 14(v) flow regimes are the same. (data from Figure 25, Jellyman, 2019).

	ORRP & PC7 Table 14(v)		AMWG		PC7 Table 14(w)	
Month	Min flow (L/sec)	Proportion max. WUA (%)	Min. flow (L/sec)	WUA change (%)	Min. flow (L/sec)	WUA change (%)
Sep	6,000	98.6	6,000	0	6,600	+1.3
Oct	8,500	98.4	8,000	+0.9	9,400	-2.9
Nov	7,000	100	7,000	0	7,300	0
Dec	6,000	98.6	6,000	0	6,300	+0.5
Jan	3,500	86.6	4,500	+5.7	3,800	+1.6
Feb	3,500	86.6	4,500	+5.7	3,800	+1.6
Mar	7,500	99.9	7,000	+0.1	7,800	-0.2
Apr	8,000	99.3	7,000	+0.7	9,000	-2.2
Average		96.0%		+1.6		0

11.49 The current ORRP spring and summer minimum flows and all three proposed alternative regimes offer high availability of Deleatidium habitat, exceeding 95%. The AMWG regime potentially increases Deleatidium habitat over that proposed by the PC7 Table 14(v) and PC7 Table 14(w) regimes particularly in the mid-summer months with almost 6% increase over predicted habitat under the current ORRP in January and February. The proposed PC7 Table 14(w) regime is variable in the proportion of monthly maximum WUA it is predicted to provide but on average across all the spring and summer months it provides the same amount of Deleatidium habitat as the current ORRP regime.

11.50 NIWA also modelled food producing habitat at the Mill Rd lower Opihi River site. Food producing habitat is less specific than habitat identified for Deleatidium and covers conditions suitable for a wide range of invertebrate species some of which will be food for trout. Review of the NIWA data for food producing habitat under the various minimum flow regimes identifies a similar pattern – food producing habitat for all regimes including the current ORRP, is high (>96% of maximum WUA) averaged across the spring and summer months and the AMWG regime offers the most potential food producing habitat (>98% of maximum WUA) and the PC7 2030 minimum flow regime, the least at 97.1% of maximum WUA.

11.51 Fish and Game supports the AMWG Full Availability minimum flow regime for the summer months when food availability for trout growth is more important than in winter months. Proposed PC7 Table 14(w) May to September minimum flows are 600 L/sec to 800 L/sec higher than those proposed in the AMWG regime and will provide more predicted food producing habitat.

11.52 Trout surveys undertaken by Fish and Game for the last four years in spring throughout the Opihi Catchment rarely find poor condition juvenile trout with fish abundance more likely linked to winter floods impacting on egg incubation and fry survival. There is no indication that current food availability for juvenile trout in winter is limiting trout development and survival, and that increased food producing habitat is required. I believe the proposed PC7 Table 14(w) increased Full Availability minimum flow levels in winter will increase the likelihood of low flows being implemented in summer due to reduced capability to store winter flows in the winter.

Full Availability Regime – trout spawning habitat

11.53 Brown trout spawning occurs from late April through to early July. Peak spawning is in mid-May. Unlike Chinook salmon and rainbow trout, brown trout do not generally undertake migrations to reach distant spawning grounds, preferring to spawn locally and probably in the nearest suitable site. This creates a wide distribution of brown trout spawning effort in the Opihi River mainstem from the top of the lagoon to the headwaters, with local variations that reflect the size of the local adult population.

11.54 Consistent brown trout spawning concentrations occur in the 3 km above State Highway One Bridge and from 3 km below Hanging Rock Bridge up to Raincliff.

11.55 The NIWA habitat modelling of brown trout spawning habitat in the lower Opihi River mainstem presented WUA for different flows as a proportion (%) of the maximum WUA. This data enables a more detailed comparison of the impact of differences in the proposed monthly minimum flows on predicted availability of habitat for brown trout spawning (Table 7).

Table 7. Monthly change in predicted brown trout spawning habitat relative to maximum WUA under the current ORRP Full Availability minimum flow regime for April to July and proportional change in WUA relative to ORRP minimum flows for proposed PC7 Table 14(v), PC7 Table 14(w), and the AMWG minimum flow regimes. The current ORRP and proposed PC7 Table 14(v) flow regimes are the same. (data from Figure 25, Jellyman, 2019).

	ORRP & PC7 Table 14(v)		AMWG		PC7 Table 14(w)	
Month	Min flow (L/sec)	Proportion max. WUA (%)	Min. flow (L/sec)	WUA change (%)	Min. flow (L/sec)	WUA change (%)
Apr	8,000	33.7	7,000	+1.1	9,000	-2.6
May	4,500	59.1	4,500	0	5,300	-9.3
Jun	4,000	65.0	4,000	0	4,800	-12.7
Jul	4,000	68.0	4,000	0	4,800	-12.7
Average		57.2		+0.3		-9.3

11.56 The current ORRP and proposed PC7 Table 14(v) and AMWG minimum flow regimes offer low to moderate brown trout spawning habitat availability (57%) in comparison to maximum availability that is provided in flows of about 2,000 L/sec. The proposed PC7 Table 14(w) regime offers less than 50% of maximum WUA availability.

11.57 Modelled brown trout spawning in the lower Opihi River at Kerrytown Rd peaks at 2,000 L/sec (Jellyman2019). As river flows decrease below this flow or as they increase above it, habitat available for trout spawning declines. The PC7 2025 and AMWG Full Availability April to July minimum flows provide the highest proportion of maximum WUA for trout spawning of all regimes.

Full Availability Regime – Chinook salmon passage

11.58 Adult chinook salmon require river flows sufficient for upriver passage in the Opihi River from January through to May.

11.59 I believe that since the Opuha Dam began augmenting flows to maintain minimum flows of between 3,500 L/sec and 8,000 L/sec at Saleyards Bridge between January and May, flows have been sufficient for adult salmon passage throughout the mainstem. This statement relates only to movement of adult salmon within the river and does not consider other factors such as river mouth condition and water temperatures that also influence the ability of salmon to migrate.

11.60 The proposed PC7 Table 14(v), PC7 Table 14(w), and AMWG Full Availability minimum flow regimes all provide flows at least equal to those of the current ORRP and should provide for upstream passage of adult Chinook salmon. Proposed AMWG Full Availability minimum flows are the highest of all of the regimes in January and February and proposed PC7 Table 14(w) minimum flows are the highest in March, April and May.

Full Availability Regime – Chinook salmon spawning

11.61 I have no doubt that salmon spawning distribution has changed as a result of improved low flow management after construction of the Opuha Dam.

11.62 Pre-dam, unreliability of Opihi mainstem flow and persistent river mouth closure resulted in delayed runs of salmon. Spawning salmon have a predetermined deadline

for spawning and late access to the river or low flow barriers to upstream passage provided sufficient time for salmon to access only the lower river tributaries. The Temuka and Te Ana Wai rivers sustained about 80% of Opihi Catchment spawning prior to 1998.

11.63 Since 1998 the Temuka and Te Ana Wai rivers contribute about 20% of Opihi spawning each. Salmon now have better access to upriver spawning grounds particularly in the Opihi and Opuha rivers above their confluence at Raincliff and these two areas combined now sustain about 40% of catchment spawning.

11.64 NIWA modelling of spawning habitat availability at Kerrytown Rd in the lower Opihi, is unlikely to represent spawning habitat availability in the preferred upper river spawning reaches. The spawning habitat predictions from the Kerrytown reach should be applicable to the 20% of salmon spawning that occurs from the Opihi junction with the Temuka upstream 25 km to Hanging Rock Bridge (Table 8).

Table 8. Monthly change in predicted Chinook salmon spawning habitat in the Kerrytown survey reach relative to maximum WUA under the current ORRP Full Availability minimum flow regime for April to June and proportional change in WUA relative to ORRP minimum flows for proposed PC7 Table 14(v) and Table 14(w), and the AMWG minimum flow regimes. The proposed PC7 Table 14(v) and AMWG flow regimes are the same. (data from Figure 25, Jellyman, 2019).

	ORRP		PC7 Table 14(v) & AMWG		PC7 Table 14(w)	
Month	Min flow (L/sec)	Proportion max. WUA (%)	Min. flow (L/sec)	WUA change (%)	Min. flow (L/sec)	WUA change (%)
Apr	8,000	40.8	7,000	+6.5	9,000	-5.0
May	4,500	74.7	4,500	0	5,300	-10.5
Jun	4,000	81.7	4,000	0	4,800	-10.5
Average		65.7		+2.2		-8.7

11.65 Salmon spawning is of shorter duration than brown trout and generally does not extend beyond the end of June.

11.66 The current ORRP, proposed PC7 Table 14(v), and AMWG minimum flow regimes offer moderate salmon spawning habitat availability (65.7%) compared to maximum availability that is provided in flows of about 2,250 L/sec. The proposed PC7 Table 14(w) regime offers about 9% less than the other regimes and only about 57% of maximum WUA availability.

11.67 The AMWG Full Availability April to June minimum flows for the Opihi River at Saleyards Bridge provide the highest proportion of maximum WUA for salmon spawning of all regimes. This regime provides moderate habitat availability which is comparable to current ORRP levels.

11.68 The loss of 9% of salmon spawning predicted for the PC7 Table 14(w) minimum flows cannot be supported by Fish and Game.

Full Availability Regime – juvenile brown trout rearing

11.69 Brown trout emerge from the gravels as free-living 25 mm fry from August to October. Fry generally move downstream as they grow searching for unoccupied habitat and grow to around 120mm by the end of their first summer. Trout can have high mortality in their first year, with up to 98% mortality from predation and natural causes such as floods and droughts (Radway Allen, 1952). Availability of suitable juvenile trout habitat improves survival by providing refuge from predators and access to conditions that favour food production.

11.70 NIWA habitat availability modelled for the Kerrytown survey reach indicates the current ORRP and three proposed alternative Full Availability minimum flow regimes provide on average moderate juvenile brown trout habitat availability over spring to autumn (Table 9).

Table 9. Monthly change in predicted juvenile brown trout rearing habitat in the Kerrytown survey reach relative to maximum WUA under the current ORRP Full Availability minimum flow regime for August to April and proportional change in WUA relative to ORRP minimum flows for proposed PC7 Table 14(v), Table 14(w), and the AMWG minimum flow regimes. The current ORRP and proposed PC7 Table 14(v) flow regimes are the same. (data from Figure 25, Jellyman, 2019).

	ORRP & PC7 Table 14(v)		AMWG		PC7 Table 14(w)	
Month	Min flow (L/sec)	Proportion max. WUA (%)	Min. flow (L/sec)	WUA change (%)	Min. flow (L/sec)	WUA change (%)
Aug	4,500	76.0	4,500	0	5,200	-8.3
Sep	6,000	60.6	6,000	0	6,600	-4.1
Oct	8,500	42.0	8,000	+3.4	9,400	-6.5
Nov	7,000	52.6	7,000	0	7,300	-1.9
Dec	6,000	60.6	6,000	0	6,300	-2.1
Jan	3,500	88.5	4,500	-12.5	3,800	-3.2
Feb	3,500	88.5	4,500	-12.5	3,800	-3.2
Mar	7,700	48.9	7,000	+3.7	7,800	-1.8
Apr	8,000	45.4	7,000	+7.2	9,000	-6.9
Average		62.6%		-1.2%		-4.2%

11.71 Juvenile brown trout habitat as a proportion of the maximum WUA in the Kerrytown reach modelled by NIWA across the spring to autum months on average contained moderate (62.6%) habitat availability for all Full Availability flow regimes. Juvenile brown trout habitat under the AMWG regime had equal or better availability in all months other than in January and February when proposed flows had been increased to provide better recreation. The proposed PC7 Table 14(w) flows provided uniformly less juvenile brown trout habitat in all months compared to current ORRP and proposed PC7 Table 14(v) and in seven of nine months compared to the AMWG regime.

11.72 Fish and Game cannot support the proposed PC7 Table 14(w) Full Availability minimum flows as maintaining or improving juvenile brown trout rearing habitat from current ORRP or proposed PC7 Table 14(v) and AWMG levels.

Full Availability Regime – juvenile salmon rearing

11.73 Juvenile salmon emerge from river gravels at about the same time as brown trout. Their life cycle requires them to move downstream to reach the sea at 3 months to 12 months of age where they spend 1.5 to 2.5 years before returning as mature adult fish.

11.74 Transition from freshwater to seawater for juvenile salmon is a significant contributor to salmon population dynamics with improved survival likely for fish in the best condition when they reach the sea.

11.75 Juvenile salmon habitat modelling at the Kerrytown survey reach produced similar trends in monthly availability of habitat for all four Full Availability minimum flow regimes as for juvenile brown trout. There was less than 2% range in the average habitat availability across the four regimes for the nine spring to autumn months.

11.76 All Full Availability minimum flow regimes maintained moderate to high (72%) habitat availability as a proportion of maximum WUA predicted to be provided in a flow of 1,250 L/sec for juvenile salmon.

11.77 Fish and Game believes there is no difference in the amount of spring and summer habitat provided for juvenile salmon by the current ORRP and proposed PC7 Table 14(v), PC7 Table 14(w) and AMWG Full Availability regimes.

Full Availability Regime – adult brown trout habitat

11.78 When the original Saleyards Bridge minimum flow regime for the Opihi at Saleyards Bridge was discussed with the Opuha Dam Company it was proposed that the natural seasonal hydrograph for the Opihi River would be a starting point for modelling the variable minimum flow regime. It was accepted that mid-summer low flows would be incorporated into the improved regime and that storage could be released from the Dam to ensure that mid-summer flows were not so low that the river would dry up or that fish passage in the river would be compromised. It was also important to balance the plusses and minuses of monthly flows to maintain an average for minimum flows of 6,000 L/sec across the year, that being the environmental flow across the year that modelling of Opuha Dam feasibility had been based on.

11.79 The ORRP 2000 confirmed the Saleyards Bridge variable minimum flow regime included in consent conditions that applied to operation of the Opuha Dam. Over the 20 years that the variable minimum flow regime has applied, the only consistent public concern from a recreation perspective received by Fish and Game has been about the low level of minimum flows in January and February of 3,500 L/sec. This concern has been based on low flow conditions at the river mouth that are considered unsatisfactory for fishing.

11.80 The habitat suitability criteria for adult brown trout used in the lower Opihi River ecological flow assessment by NIWA that informed PC7, were for New Zealand drift feeding adult brown trout (Hayes and Jowett 1994). This habitat has a close association with trout angling as it is feeding adult brown trout that the angler seeks.

11.81 A predicted 19% increase in drift feeding habitat for brown trout in the AMWG minimum flow regime in January and February is a significant improvement over that predicted to be present under the PC7 Table 14(v) regime and addresses concerns about reduced recreational value in those months, at least for trout fishing. The AMWG proposed January and February minimum flows under Full Availability are also 14% higher than adult brown trout habitat availability under proposed PC7 Table 14(w) flows (Table 10).

Table 10. Monthly change in predicted adult brown trout habitat in the Kerrytown survey reach relative to maximum WUA under the current ORRP Full Availability minimum flow regime for October to April and proportional change in WUA relative to ORRP minimum flows for proposed PC7 Table 14(v), PC7 Table 14(w), and the AMWG minimum flow regimes. The current ORRP and proposed PC7 Table 14(v) flow regimes are the same. (data from Figure 25, Jellyman, 2019).

	ORRP & PC7 Table 14(v)		AMWG		PC7 Table 14(w)	
Month	Min flow (L/sec)	Proportion max. WUA (%)	Min. flow (L/sec)	WUA change (%)	Min. flow (L/sec)	WUA change (%)
Oct	8,500	92.3	8,000	+2.5	9,400	-8.0
Nov	7,000	100.0	7,000	0	7,300	-0.5
Dec	6,000	97.1	6,000	0	6,300	+1.5
Jan	3,500	59.3	4,500	+19.2	3,800	+5.2
Feb	3,500	59.3	4,500	+19.2	3,800	+5.2
Mar	7,700	98.4	7,000	+1.6	7,800	-1.1
Apr	8,000	95.8	7,000	+4.2	9,000	-7.5
Average		86.0		+6.7		-0.7

11.82 Over the summer months the current ORRP and proposed PC7 Table 14(v) Full Availability regimes are predicted to maintain on average 86% of brown trout habitat present at 7,000 L/sec - the flow at which adult brown trout WUA is maximised (Figure 14, Jellyman 2019). The proposed AMWG regime is predicted to increase adult brown trout habitat across summer to 93% and the proposed PC7 Table 14(w) minimum flows are predicted to provide the least adult brown trout habitat of the four regimes.

11.83 The proposed AMWG Full Availability regime provides 100% of maximum adult brown trout WUA in November, March and April, and exceeds 95% in five of the seven months of the sports fishing season.

11.84 Fish and Game accepts that Full availability flows in October, March, and April under the AMWG proposal are lower than current ORRP, and proposed PC7 Table 14(v) and PC7 Table 14(w) flows in order to recover storage used to maintain higher mid-summer flows in January and February. From a recreation perspective reduced AMWG Full Availability flows in March, April and October are considered acceptable in that they –

a) remain at or above the flow required to maintain the mouth open 90% of the time that is particularly important in the spring for native and sports fish harvesting; and
b) have not been required to be as high as previous for salmon angling in April due to closure of salmon fishing in April since 2006; and
c) maintain fish passage throughout the river that is important for large adult salmon seeking to spawn in upriver habitat in March and April; and
d) provide more adult brown trout habitat in five of the seven months of the trout fishing season than the PC7 Table 14(v) and PC7 Table 14(w) flow regimes.

11.85 Fish and Game believes the proposed AMWG Full Availability minimum flows for October to April provide greater predicted adult brown trout habitat availability and will produce better sports fishing conditions for anglers.

Full Availability Regime – waterfowl hunting

11.86 Fish and Game manages game bird hunting in the recreational interest of game bird hunting licence holders. The Opihi Catchment is a well utilised game bird hunting

resource with on average about 500 hunters using the area and taking on average 25 waterfowl per season.

11.87 The waterfowl hunting season runs from the first Saturday in May to the end of July. Tagging Day occurs on the first Sunday in April and is when hunters are able to claim their hunting sites a month ahead of the season opening. For hunters intending to hunt the Opihi River, flow variation between Tagging Day and Opening Day is an important consideration. This unknown is not an issue for hunters with access to ponds away from the river. If there is too much variability in river flow from conditions on Tagging Day then Opening Day could find hunters either flooded out or on dry land.

11.88 The difference between the minimum flow in April and the minimum flow in May under the proposed AMWG Full Availability regime is less than the differences between those months in the current ORRP, PC7 Table 14(v), and PC7 Table 14(w) proposed regimes. This improves waterfowler confidence that hunting sites selected on Tagging Day in the first week of April will be more likely to remain huntable for the opening of the waterfowl hunting season in the first week of May. PC7 Table 14w) provides the greatest opportunity for interference with waterfowl hunting by having the biggest difference in the minimum flows for these months.

11.89 Fish and Game supports the AMWG proposed Full Availability April and May flows in Table 14(v)(ii) as providing greater security to waterfowlers than either of the PC7 proposed flows and is also better than current ORRP minimum flows.

Summary – Full Availability regimes

11.90 A summary of the habitat assessments in sections 11.42 to 11.88 indicates that the proposed AMWG Full Availability regime provides the greatest positive benefit to the values assessed relative to the current ORRP regime (Table 11).

Table 11. Summary of positive (+), insignificant (0), or negative (-) changes to habitat values predicted by the NIWA habitat survey for the proposed PC7 Table 14(v), AMWG, and PC7 Table 14(w) Full Availability regimes compared to the rating assessed for provision of habitat under the current ORRP.

Habitat	ORRP rating	PC7 Table 14(v)	AMWG	PC7 Table 14(w)
Mayfly producing	high	0	0	0
Trout spawning	low	0	0	-
Salmon passage	adequate	0	+	+
Salmon spawning	adequate	0	0	-
Juvenile trout rearing	adequate	0	0	-
Juvenile salmon rearing	adequate	0	0	0
Adult trout	high	0	+	0
Waterfowl hunting	adequate	0	+	-

11.91 Proposed PC7 Table 14(v) Full Availability minimum flows do not offer any benefits to the Fish and Game habitat values assessed beyond those already provided by the ORRP. The proposed AMWG regime provides improvements to salmon passage, adult trout drift feeding (angling) and waterfowl hunting, and maintains current ORRP habitat for the remaining five Fish and Game values. The proposed PC7 Table 14(w) regime improves salmon passage, maintains current ORRP habitat for three Fish and Game values and is detrimental to current ORRP habitat provided for trout spawning and rearing, salmon spawning and waterfowl hunting.

11.92 Fish and Game supports the proposed AMWG Full Availability minimum flow regime proposed in Table 14(v)(ii) for the maintenance or benefits it has on assessed Fish and Game values compared to the current ORRP.

11.93 Fish and Game opposes the proposed PC7 Table 14(w) Full Availability minimum flow regime for the adverse impact it is assessed to have on Fish and Game values compared to the current ORRP.

11.94 Fish and Game cannot support the justification for increased Full Availability minimum flows proposed by PC7 Table 14(w), being that increased tributary minimum flows will contribute to sustaining the Saleyards Bridge increases. I believe the extra Lake Opuha storage that will be used to maintain the increased Saleyards Bridge flows will increase the time that Opihi River flows will be on Level 1 and Level 2 restriction regimes and will increase likely introduction of Water Shortage Directions. The harm caused to the ecology of the river from periods of flow restriction and possibly no flow, due to release of extra dam storage to maintain PC7 Table 14(w) proposed Full Availability flows will be greater than any benefits from higher Full Availability flows during the time they flow.

11.95 Fish and Game accepts that Full availability flows in March, April, and October under the AMWG proposal are lower than current ORRP, proposed PC7 Table 14(v) and PC7 Table 14(w) flows in order to recover storage used to maintain higher mid-summer flows in January and February.

"Alternative Management Regime" Minimum Flows

11.96 Fish and Game supports the proposed AMWG Level 1 Restriction regime Table 14 (v)(ii) minimum flows for the months of January and February of 4,000 L/sec. These minimum flows are greater than those proposed by PC7 Table 14(v) and PC7 Table 14(w) Level 1 restriction regimes for the same months. The higher minimum flows for January and February respond to public concern at reduced recreational values of current ORRP minimum flows in January and February of 3,500 L/sec. Increased January and February minimum flows from current are maintained for both Full Availability and Level 1 restriction regimes under the AMWG proposals.

11.97 For the remaining months of the year (March to December) the Level 1 restrictions in the Alternative Management Regime proposals in PC7 Table 14(v) and PC7 Table 14(w), appear to have been based on recommended changes to the ORRP that OEFRAG submitted to ECan as a Draft Regime in 2008.

11.98 It was the experience of OEFRAG over the 2014/15 season that the trigger for implementing restrictions set at a lake level of RL375m retains too little storage to maintain minimum flows and abstraction and creates too great a risk of there being no storage to maintain either.

11.99 In times of low inflow and low water levels in Lake Opuha, when without the Dam the Opihi River would have been naturally low even without irrigation, the regime that introduces earlier restrictions on release of storage for abstraction and the environment with greater likelihood of retaining connectivity in the river in extreme summers conditions, is supported. Such conditions occurred in the 2014/15 summer and Fish and Game supports the Alternative Management Regime proposals of the AMWG that were developed from this experience.

11.100 The Level 1 Alternative Management Regimes for AMWG, PC7 2025 and PC7 2030 all provide flows sufficient for salmon passage from January to June. The higher Level 1 and Level 2 flows in proposed PC7 2030 Table 14(w) will drain storage from Lake Opuha at a greater rate and create greater risk of harsher WSD levels if low flows continue. This could be a significant issue if Level 1 and 2 regimes are implemented in the spring.

11.101 From September to December, PC7 2030 Table 14(w) provides for Level 2 minimum flows of 4,600 L/sec to 5,900 L/sec while AMWG alternative regime (Table 14(v)(ii)) recommends 3,500 L/sec across all months. In a dry season, higher minimum flows in the spring required by PC7 2030 will have increased risk of draining the Lake Opuha storage to zero and producing a dry Opihi River bed, than the AMWG alternative.

11.102 Fish and Game supports the stated objective of the AMWG to retain connectivity of the Opihi River and the evidence of Dr Kerr for AMWG that in the 2014/15 summer, the current ORRP and Alternative Management Regimes proposed by PC7 Table 14(v) and PC7 Table 14(w) would not have prevented the Opihi River flow at Saleyards receding below 3,000 L/sec .

12. LAKE OPUHA

12.1 Lake Opuha was formed in 1998 by the damming of the North and South Opuha rivers just below their confluence. Previously sea-run Chinook salmon had access to spawning grounds in the headwaters of the rivers and on average about 4% of annual salmon spawning occurred above the Dam site. CSIFG was a supporter of the Dam during its planning and consenting processes with our goal being enhancement and security of lower Opuha River and Opihi River flows for the benefit of sports fish habitat and angling.

12.2 The developed and management of a sports fishery in Lake Opuha was considered a secondary benefit and was not pursued to the detriment of downstream flow enhancement. CSIFG considered the loss of sea-run salmon production by the barrier the Dam posed to upriver migration, would be more than compensated for by more assured access for all fish species across the Opihi River mouth, enhancement of salmon and trout spawning habitat below the Dam, and improved flows for sports fish angling in the lower river.

12.3 Fish and Game also acknowledged that Lake Opuha would inundate sections of the North and South Opuha rivers and their gorge and cause the loss of valued river fisheries in those reaches.

12.4 Almost immediately after filling of Lake Opuha a significant change in the distribution of salmon and trout spawning became apparent from catchment-wide aerial spawning

surveys. Where previously around 80% of salmon spawning was found in lower river tributaries that required relatively short passage in the Opihi River upstream from the sea, after flow enhancement the proportions were reversed. Increased flows in the Opihi and Lower Opuha rivers produced quality spawning habitat and flow security ensured reliable hatching success, juvenile rearing and access for juvenile salmon to the sea.

12.5 Improved Opihi River flows also changed the distribution of adult trout and the fishing targeted to trout. The lower river tributaries retained their trout populations and mainstem Opihi River trout flourished. It is unfortunate that the arrival of *Didymo* in 2006 and the rise in prevalence of cyanobacteria has compromised the ability of anglers to fish and to enjoy the angling experience. Water quality is now the biggest issue for the sports fishery of the lower Opuha and Opihi rivers and with on average two-thirds of all flow in the lower Opihi River coming from the Opuha Catchment above the Dam, water quality of Lake Opuha is an issue.

12.6 Lake Opuha has brown and rainbow trout fisheries. Three of the four National Angler Surveys have been undertaken since the lake was created and estimate annual angler usage at 3,000 to 5,000 angler days. The 2007/08 CSIFG angler harvest survey estimated angler use for that season at 3,650 angler days with a catch of 3,800 trout of which approximately 40% were kept.

12.7 Trout spawning that sustains the Lake Opuha trout fishery occurs mostly in the North and South Opuha rivers with minor additional spawning in other smaller tributaries that include Ribbonwood, Stony, Deep and Station creeks. Total spawning is about 100 redds per year and is sufficient to maintain current fishery needs.

12.8 After limitations in the Lake Opuha land-locked salmon fishery were recorded around 2010, rainbow trout were introduced to Lake Opuha in 2013 and they have been recorded spawning in tributaries since 2015. The rainbow trout fishery is still developing with more fish being caught each season with increasing interest from anglers. CSIFG have resisted calls from licence holders to open the trout fishery to angling all year until we can be sure that rainbow trout spawning is able to sustain the additional fishing pressure.

12.9 Typically, artificial low altitude water impoundments like Lake Opuha are subject to temperature stratification during long periods of settled hot weather. Stratification of the lake has potential to affect growth and survival of trout in Lake Opuha and downstream from Lake Opuha from discharge of poor quality lake water to the Opuha River. Within a temperature stratified lake, trout can be trapped between oxygenated surface water that is too warm for their survival and cooler deeper water that has oxygen levels that are too low for their survival. In the situation where a lake such as Lake Opuha has stratified and the outflow from the lake is drawn from the bottom of the lake, the outflow can be low in oxygen and have high concentration of dissolved compounds released from the bed of the lake under anoxic conditions. The outflow quality is likely to be harmful to the ecological health of the river.

12.10 For a number of years Opuha Water Limited have operated an aeration system that inhibits stratification by increasing the mixing of lake waters. This appears to have worked well when OWL start aeration before the lake drops to 40% Dissolved Oxygen saturation.

12.11 Fish and Game supports a regime for Lake Opuha that will maintain good water quality and mixing of waters in the lake and avoid contribution to nuisance algal growth in the Opuha and Opihi rivers below the dam.

13. OPIHI RIVER MOUTH

13.1 In this section I provide details of my personal experience of the direct impact of low Opihi River flows on fish survival in the river over the 1984/85 summer below Saleyards Bridge before construction of the Opuha Dam. In that same summer, the daily diary of South Canterbury Acclimatisation Society Senior Field Officer Graeme McClintock recorded 64 days of river mouth closure spread over four events between December and April. Mouth closure occurred when inflows to the lagoon were insufficient to maintain a surface flow to the sea.

13.2 Regular and extended loss of access to and from the sea for migratory native and sports fish will have a more certain and drastic impact on the sustainability of those populations than loss of connectivity and death of fish in drying river reaches. For migratory fish species essential parts of their life cycles are completed in marine and freshwater habitats. If migratory fish are denied access from freshwater to the sea or

from the sea to freshwater their life cycle cannot be completed and the outcome is that the species will perish.

13.3 Adult sea-run salmon return to freshwater to spawn in the river in which they were born after two to three years at sea. Opihi River origin salmon must access the Opihi River from the sea between January and April. If the river mouth is permanently closed due to low river flows over this period, then salmon will die at sea or a few (about 10%) may stray to another river. If the mouth is only periodically open, then some salmon will enter the river if they are near-by.

13.4 If salmon are able to enter the river during these sporadic events, and river flow remains low, the river mouth soon closes behind them and they are left trapped in the lower river with insufficient flow for them to reach upriver spawning grounds. With a predominantly three-year lifecycle for salmon, if river mouth conditions are poor in three successive years, there is a risk that the Opihi origin salmon fishery will be lost and likewise the substantial recreational resource that relies on it.

13.5 Other important fish migrations through the Opihi River mouth include longfin and shortfin eel adults from the river to the sea in summer, longfin and shortfin eel juveniles from the sea to the river in spring to early summer, torrentfish larvae to the sea in late summer and juveniles returning to the river in autumn in winter, lamprey juveniles to the sea all year and adult return to the river in winter and spring, and black flounder juveniles into the river all year. In addition, true marine species including yellow-eyed mullet and kahawai will periodically enter the river and stay within the tidal zone for short periods.

13.6 In my experience with the Opihi River mouth before the Opuha Dam, if river flows entering the lagoon were less than about 3,000 L/sec for 10 days or more and the river mouth was open, the beach bar was sufficiently porous that most of the inflow seeped through the bar rather than across the bar at the mouth as surface flow. At the same time there was less resistance by river flows to onshore movement of beach gravels caused by sea action at the mouth. Beach gravels would be pushed up into the mouth from the sea side causing the river mouth channel to become shallow and elevated. The elevated river mouth caused the lagoon level to rise and the longer this situation remained the higher the lagoon became and the further the river mouth channel or

"gut" would become extended along the beach, almost parallel to the sea. Eventually the mouth would block, there would be no surface flow to the sea and all inflows to the lagoon would either dissipate through the bar or add to rising lagoon levels.

13.7 I have seen the gut more than a kilometre long from where it enters the lagoon side of the bar to where it meets the sea. In this situation the river flow in the gut would be about 1,000 L/sec compared to 3,000 L/sec entering the lagoon. If the gut was straight through the bar i.e. perpendicular to the coast, which was the normal "reset" position after a flood, the gut would be less than 100m long and deep with a straight line of sight along the bed of the gut from the sea to the bed of the lagoon.

13.8 A straight deep Opihi mouth provides much better access to the river for fish entering from the sea. There is little difference in the elevation of high tide with the bed of the lagoon so fish enjoy the elevator that high tide provides for them to enter the lagoon. When there is a long shallow gut parallel to the coast, the gravel bar produces an extra hurdle of fast flowing shallow water over an elevated gravel ridge that fish have to negotiate even at high tide. The long gut produces a ridge of gravel between the high tide level and the bed of the lagoon. The ridge can be elevated more than 2m above the bed of the lagoon.

13.9 The accumulation of gravel at the mouth, the reduced river flow going out of the mouth prior to construction of the Opuha Dam, and the gentle angle of entry of river flow to the sea provided a situation where it became very easy for the mouth to block completely. Strong onshore easterly or southerly winds would cause the mouth to block and this was a common occurrence in the Opihi in summer prior to operation of the Opuha Dam (Table 12).

13.10 Fish and Game maintained daily records of Opihi river mouth condition and angling success for consecutive October to April fishing for four seasons prior to construction of the Opuha Dam, from 1989/90 to 1992/93, and for four seasons after, from 2008/09 to 2011/12. These records were obtained from honorary ranger and field staff diaries and salmon angler diaries for the pre-dam seasons and from targeted river mouth diaries for the post-dam seasons.

Table 12. Fish and Game records of Opihi River mouth closure during October to April fishing seasons before and after Opuha Dam augmentation of minimum flows.

	October to March Season	Total days closed	Number of Events	Maximum consecutive days
Pre Opuha Dam	1989/90	80	8	35
	1990/91	39	9	9
	1991/92	57	7	18
	1992/93	37	7	10
	Average	53	8	18
Post Opuha Dam	2008/09	9	6	3
	2009/10	12	8	2
	2010/11	15	7	5
	2011/12	10	4	5
	average	11	6	4

13.11 Pre Opuha Dam in most October to March seasons, the mouth was closed on at least 7 occasions for a total of 40 to 80 days and having one event of at least 10 days of continuous closure per season. Augmentation from the Opuha Dam to maintain variable minimum flows at Saleyards Bridge has not significantly reduced the number of closures per season but has reduced total days of closure by 75% down to 10 to 15 per season and has reduced the maximum days of consecutive closure by 80% down to 2 to 5 per season.

13.12 A landmark study of the effect of low river flows on the closure of the Opihi River mouth identified that a flow of 6,000 L/sec entering the lagoon would maintain an open river mouth 90% of the time and that if the mouth was closed a flow of about 14,000 L/sec was required to open it (Todd, 1983). In flows of less than 6,000 L/sec when the river mouth was blocked, the gravel beach bar was sufficiently porous to pass this flow without surface flow over the bar.

13.13 There is no question that augmentation of Opihi flows by operation of the Opihi Dam has provided increased certainty of an open river mouth.

13.14 My experience of Opihi River mouth closure is that onshore conditions will still cause the mouth to block even with augmented flows, however the supplemented minimum flows entering the lagoon cause the lagoon to rise more rapidly than prior to Dam operation. Surface flow entering the lagoon is greater than can be passed through the beach bar and the lagoon reaches a level at which the beach bar becomes breached at its lowest or weakest point before the sea has time to reinforce the bar. The river mouth still experiences incidents of closure but even in the low flow months of January and February the closures are for much shorter periods than prior to operation of the Dam (Table 12).

13.15 Fish and Game supports the Full Availability, Level 1 and Level 2 minimum flows proposed in the AMWG evidence at Table 14(v)(ii) for January and February that are higher than the minimum flows in the current ORRP and in proposed PC7 2025 and PC7 2030 regimes. The AMWG proposed 4,500 L/sec January and February minimum flows are 1,000 L/sec higher than current ORRP flows and will help maintain an open mouth for longer while it is open and when the mouth is closed the increased flows

will reduce the time it takes to fill the lagoon to effect a breach. This is expected to improve recreational use of the river mouth.

14. PROVISIONS APPLYING TO ALL CATCHMENTS – UPPER OPIHI, NORTH AND SOUTH OPUHA, TE ANA WAI

Pro Rata Restrictions

14.1 Pro rata reduction in allocation/take is the most efficient method for irrigators to make use of the water that is available when full allocation cannot be taken. Where there are two or more irrigators under the same minimum flow regime the use of a Water User Group (WUG) enables water to be provided within the WUG to those who most need it while ensuring that across the WUG the minimum flow is not breached.

14.2 Fish and Game supports the incentive for abstractors to become members of a water user group by application of stepped partial restrictions on irrigators who are not part of a WUG that provide reduced access to water through 50% and 100% restriction steps. Fish and Game supports these provisions in Tables 14(l), 14(m), 14(n), 14(o), 14(p), and 14(q).

B Block

14.3 The "B" Block provides for abstraction to storage in high flow conditions. The current ORRP does not provide an upper limit to "B" allocations for the Upper Opihi, North and South Opuha, and Te Ana Wai rivers.

14.4 Fish and Game submits that in some of these tributaries the current ORRP flow at which "B" takes can commence is too low and does not provide sufficient space between the upper limit of "A" takes and the commencement of "B" takes to allow for natural mid-range flow variation to be retained in the river. For example, in the Te Ana Wai River the ORRP "A" allocation band provides for a take of 432 L/sec from the river in flows above the summer minimum of 400 L/sec. At river flows above 832 L/sec the river starts to receive natural flow variation however the ORRP provides for "B" takes to commence at 1,100 L/sec and the current allocation to the "B" block is 800 L/sec. This means that at a river flow of 1,900 L/sec potentially 1,232 L/sec can be abstracted and only 668 L/sec retained in the river. Of the 668 L/sec that remains in the river, 400 L/sec is the minimum flow and only 268 L/sec is natural variability above the minimum

while abstraction takes 1,232 L/sec or about 80% of the natural variability of the river. The proposed PC7 B permit regime provides for much more of the natural variations in flow to be retained within the river before B permits are activated. Natural flow variations are important triggers for many fish behaviours and biological processes.

14.5 Fish and Game supports the recommended significant increase in the minimum flow at which "B" takes commence in the Te Ana Wai River from the current 1,100 L/sec to 2,500 L/sec and a cap on the allocation at its current use of 800 L/sec as proposed in Table 14(y).

14.6 Fish and Game agrees that "B" allocation capped at its current use and available above a flow of 90% of the naturalised mean flow in the Upper Opihi, and North and South Opuha rivers, would provide greater natural variability in river flows above the minimum flow than the current regimes in these rivers.

14.7 Any "B" block minimum flows and allocations have potential to reduce the size and duration of mid-range flows in the rivers where these flows are in the range that provides good angling flows in the summer fishing months. In this respect it is acknowledged that there may be some impact from proposed B block allocations on the area of fishing water and the time it is available; however, I believe the benefits that are gained by having the "B" allocation capped and better provision for adult and juvenile trout habitat at flows around the "A" allocation monthly minimum flows, particularly in spring and autumn, outweigh the negative impacts on mid-range flows.

15. REMEDY SOUGHT

Fish and Game supports **-**

Temuka River

Proposed PC7 Table 14(l)

Allocation block limit of 1,600 L/sec for A Permits

Allocation block limit of 400 L/sec for B Permits

Variable monthly minimum flows for A permits

Pro rata restriction on abstraction

North Opuha River

Current A block allocation capped at its current use of 255 L/sec as presented in evidence by Ms Johnston for the FAWP

Proposed PC7 Table 14(m)

i. variable monthly minimum flows

ii. pro rata restrictions for WUG members

iii. stepped partial restrictions for non WUG members

iv. a cap on A block allocation at its current allocation

v. timing for introduction of i) to iv)

South Opuha River

Proposed PC7 Table 14(n)

i. variable monthly minimum flows particularly in spring and autumn months

ii. pro rata restrictions for all BA permits

iii. a cap on BA allocation at its current 634.4 L/sec

iv timing for application of i. to iii.

Proposed Table 14(o)

I. variable minimum flows from 15 March to end of November

Upper Opihi River

Proposed PC7 Table 14(p)

i. variable monthly minimum flows

ii. pro rata restrictions for WUG members

iii. stepped partial restrictions for non WUG members

iv. Cap on allocation at current 474 L/sec

v. Timing for implementation of i. to iv.

Proposed PC7 Table 14(q)

i. April to October minimum flows

ii. AN and BA Allocation limit at current use

iii. Restriction regimes for WUG and non WUG

Te Ana Wai River

Proposed Table 14(r)

i. A current A block allocation of 257.97 L/sec

ii. variable monthly minimum flows

iii. stepped partial restrictions

iv. timing for implementation of i. to iii.

Proposed Table 14(s)

i. Variable monthly minimum flows as for Table 14(r)

ii. Cap on abstraction as for Table 14 (r)

Proposed Table 14(y)

i. BN Permit minimum flow of 2,500 L/sec

ii. BN Permit allocation of 800 L/sec

Opihi River mainstem

AMWG alternative Table 14(v)(ii)

Full Availability variable minimum flow regime

Level 1 Alternative Management Regime variable minimum flow regime

Level 2 Alternative Management Regime minimum flow of 3,500 L/sec

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