BEFORE THE Ministry for the Environment Special Tribunal

SUBJECT Application by Majac Trust to amend Buller Water Conservation Order

STATEMENT OF EVIDENCE OF NEIL ALASTAIR DEANS ON BEHALF OF NEW ZEALAND AND NELSON MARLBOROUGH FISH AND GAME COUNCIL

Dated this 25th day of October 2005

Introduction

1. My name is Neil Alastair DEANS. I am the Manager of the Nelson Marlborough Fish and Game Council. I completed a Bachelor of Science with Honours in Zoology from the University of Canterbury in 1982 and a Diploma of Parks and Recreation Management with Distinction from Lincoln College in 1985. I have worked for the Wildlife Service, New Zealand Forest Service, Lands and Survey Department and Department of Conservation in a variety of roles in the recreation and conservation field and in a variety of locations throughout the country during the 1980s, being based in Hamilton from 1986-90. I moved to Nelson in 1990 to take up a position with the Department of Conservation as their Senior Conservation Officer for Freshwater and Ecological Survey for the Nelson Marlborough Conservancy, which I held until taking up my present position in 1994. I have undertaken environmental impact assessment and ecological surveys in locations from Northland to Stewart Island and am very familiar with freshwater resources, particularly the fisheries and wildlife, of the Nelson Marlborough region. I have written or co-authored a number of papers on freshwater management, including most recently one on Sports Fishery Management in New Zealand[1].

2. For the last two years I have also held the part time position of Assistant Director (Advocacy) for Fish and Game New Zealand at a national level, predominantly to assist with national issues in the resource management area. I am a member of the New Zealand Ecological Society, New Zealand Entomological Society and have been President of the New Zealand Freshwater Sciences Society (formerly New Zealand Limnological Society) for the last 3 years.

3. I have frequently appeared at local authority resource consent hearings as an expert witness or on behalf of Fish and Game or government agencies. I coordinated initially the Department of Conservation and later Fish and Game contributions and negotiations on the Buller and Motueka Water Conservation Orders, including the drafting of the conditions now attached to those water conservation orders. I have been asked to provide advice to other Fish and Game Councils prior to their applying for Water

[1] Deans, NA; MJ Unwin and M Rodway (2004) **Sport Fishery Management** Chapter 41 in Freshwaters of New Zealand Jointly published by the New Zealand Hydrological Society and New Zealand Limnological Society.

Conservation Orders. I was also a principal witness in the hearings for the Motueka and Buller Water Conservation Orders, including before the then Planning Tribunal.

4. I am familiar with the Gowan River, having undertaken drift diving, electric fishing and spawning surveys in and on the river at various times over the last 15 years.

5. I have read the Environment Court Practice Note 2005 and agree to comply with it.

Relevant background to the Water Conservation Order for the Buller River

6. The former Nelson Acclimatisation Society (now Nelson Marlborough Fish and Game Council) applied for a water conservation order for the upper Buller River catchment, including the Gowan River, in 1987. A chronology of events is appended to this evidence. The Special Tribunal convened by the Minister for the Environment reported in 1989, recommending in favour of an order for the whole river catchment, including the Gowan River, for a variety of outstanding values. This was appealed to the then Planning Tribunal. After considerable negotiations between a wide variety of parties leading to agreement as to provisions of most of the Order, a limited hearing was held by the Planning Tribunal in 1996 to consider the remaining issues. This included the Gowan River for which an allowance for a future hydroelectric power scheme was sought by the then Tasman Energy.

7. The Planning Tribunal ruled that the Gowan River was outstanding for its rafting amenity and adopted the conditions as recommended by the applicant as negotiated between parties as appropriate for the Order. While Fish and Game was naturally disappointed that its specific interest in the fishery was not recognised, the provisions protecting the rafting amenity also served to protect the fishery, so our principal objective was attained. For this reason Fish and Game did not appeal the decision even though it did not recognise the outstanding fishery of the Gowan River.

8. Around the time of the gazettal of the Order in 2001, the Majac Trust approached Fish and Game seeking its agreement to their proposal for a power scheme for the Gowan River. On Fish and Game advice, further evaluation was undertaken for Majac by the Cawthron Institute of the instream needs for the brown trout fishery in the Gowan. At a later stage, discussions between Majac and Fish and Game resulted in a reassessment of the IFIM approach originally undertaken by Ian Jowett of NIWA. The model was recalibrated specifically for the Gowan after on site investigations involving Fish and Game and Cawthron Institute staff. This is discussed in more detail below.

9. Fish and Game opposes the application by the Majac Trust to amend the Buller Water Conservation Order in respect of the Gowan River. Fish and Game has carefully considered the material provided by the applicant, but remains of the view that the Gowan River contains an outstanding brown trout fishery. Fish and Game is concerned that the specific proposal to amend the WCO would detrimentally affect the outstanding brown trout fishery of the Gowan.

Fish and Game values of the Buller River catchment in the Gowan River vicinity and relevant provisions of the present WCO

10. The Nelson Lakes (Rotoiti and Rotoroa), their inflowing rivers, Travers, Sabine and D'Urville and outflowing rivers, upper Buller and Gowan, all provide outstanding brown trout fisheries. The lakes are the core of the Nelson Lakes National Park and provide an angling opportunity which is mostly appreciated by boat anglers. The three inflowing

rivers are back country fisheries which are celebrated internationally for their inherent qualities and the chance of catching brown, or occasional rainbow, trout. The two lake-fed rivers have exceptional trout densities, as are commonly found in stable flowing lake fed fisheries. Indeed, the Buller and Gowan had the highest and second highest fish densities from the so-called '100 rivers' investigation undertaken of 158 sites in 88 rivers throughout New Zealand during the mid-late 1980s[2]. Lake fed rivers provide excellent fish rearing and growing conditions which not only provide excellent angling opportunities but also supplement fish numbers in other parts of the river system. All of these water bodies except the Gowan have been recognised as outstanding in a national context for their trout fisheries in the Buller Water Conservation Order. In my opinion, omission of the Gowan River as an outstanding fishery in the Buller Water Conservation Order is inappropriate. The Gowan River is part of the Buller River system, and the contribution it makes to the outstanding trout fishery is considerable. Indeed, it is only an accident of naming that calls it the Buller River system; at its confluence with the Buller the Gowan is the larger of the two rivers and hydrologically speaking the whole system should be called the Gowan. This is traversed in more detail below, but in my view it is inappropriate to dissect a river fishery into small pieces when each of these pieces is intimately dependent on the adjacent pieces for the long term sustainability of its value.

11. Conditions in the present Buller Water Conservation Order have been devised to protect this outstanding amenity, including the protection of river flows, river bed morphology, fish passage and water quality sufficient to sustain the fishery.

Fish and Game values of the Gowan River

12. Trout abundance in the Gowan is exceptional because the river presently provides very high quality habitat. Trout favour waters of high quality including appropriate water temperatures; but which have relatively stable flow, having neither floods nor excessive or prolonged low flows but which are not constant; an abundance of suitable food; a suitable substrate to provide food and cover and living space for a range of different life stages.

13. The Gowan's waters have a high input of seston, or organic production, from the waters of Lake Rotoroa. This provides a high quality food source for the hugely abundant invertebrate populations which inhabit the substrate of the Gowan. Net spinning caddisflies, for example, reach densities of tens of thousands per square metre. Some of these invertebrates are continuously washed off into the drift, which provides a continuous 'conveyor-belt' of food for a visual predator such as trout, as they wait in velocity refuges for food and grab this as it passes. The particularly clear water of the Gowan, which is almost never discoloured as the river has a relatively constant flow, provides both good production of periphyton or invertebrate food, but also a high proportion of large and favoured invertebrate taxa such as mayflies, caddis and stoneflies. Trout are able to select high quality food over a greater visual distance and therefore grow larger (Hayes, Stark and Shearer, 2000; Hayes and Hill, 2004). These issues are explored more fully below.

14. In my opinion the Gowan River is outstanding as a trout fishery. This is based on three aspects; high trout numbers, challenging fishing and contribution of trout numbers to other outstanding fisheries in the upper Buller. These three aspects are detailed below:

[2] Tierney, LD and IG Jowett (1990) **Trout Abundance in New Zealand Rivers: An Assessment by Drift Diving** New Zealand Freshwater Fisheries Report No. 118 Freshwater Fisheries Centre MAF Fisheries Christchurch ISSN 0113-2504

a. High trout numbers

i. Tierney and Jowett (1990) described the results of the so-called '100 Rivers' survey of 158 sites in 88 larger rivers undertaken during the late 1980s. This survey included drift dive assessments of all these sites in what was, and still is, the most comprehensive overview of river salmonid fisheries in New Zealand. The Gowan River was then identified as having the highest numbers of trout per unit area of any of the sites in New Zealand, with similar numbers of fish being found on subsequent occasions (Fish and Game drift dive data from 1995, 1996 and 2004, summarised in Figure 1).

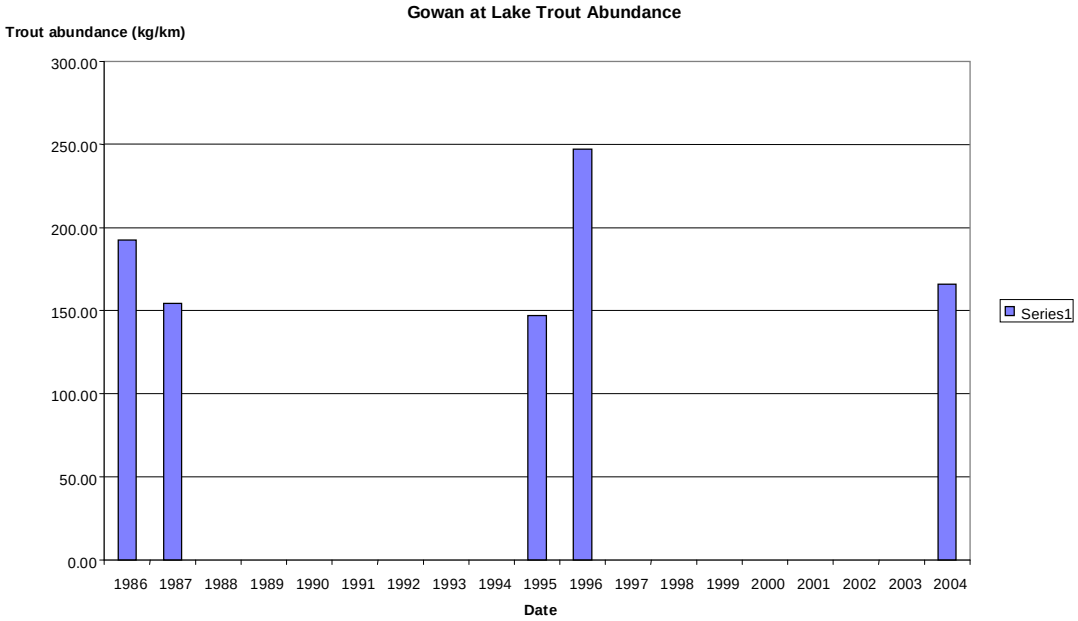

Figure 1 Drift Dive records from the upper Gowan River site. Note that only the Gowan River has fish numbers over 200 kg/km. Fish and Game Council and NIWA data.

ii. This high fish biomass is supported by a dense and diverse range of macroinvertebrates (Harding, 1994), which feed on the abundant periphyton growing on the boulder cobble substrate of the river in the stable lake-fed river flows which are further supplemented by primary production in Lake Rotoroa.

b. Challenging fishing

i. The Gowan River, despite its high trout biomass, is a challenging river to fish due to its closely vegetated riverbanks, large boulders and slippery substrate, steep gradient and fast water velocity and few accessible fishing locations. Few anglers attempt to fish the Gowan as it is particularly difficult to land fish without considerable skill, but the river is fished extensively by those relatively few anglers who have the time to learn its secrets. The Gowan therefore has the attributes of a remote back country fishery in terms of angler usage, but with the advantage of proximity to other more heavily fished areas (such as Lake Rotoroa and the Buller River upstream and downstream of the Gowan confluence). One advantage for those anglers who have learnt where and how to fish the river is that the large numbers of fish means getting a fish hooked is

relatively easy. Anglers experienced on this river have noted that the angling opportunity declines at flows below about 20 cumecs. They consider that reduced flows may not improve the fishing, which is often associated with the entry of side channels into the main flow. Such channels are significantly reduced or even dried up by occasional naturally occurring low flow events. As a lake fed river, the Gowan is often available at times when other rivers cannot be fished, which makes it popular with knowledgeable locals and fishing guides and their largely overseas clients.

ii. Access to the river is provided in the form of an almost continuous Queen's Chain along 89% of the true left bank and 95% of the true right bank of the Gowan (Fish and Game, unpublished data). Although not formed along the whole river and often not apparent on the ground, this public land, largely legal road, adjacent to the river ensures a right of public access to the river for angling and protection of river banks. Fish and Game has identified six access points to the river in an angler access pamphlet and with stiles and signs, although some of the latter go missing from time to time. In some locations, access has been made more difficult by the illegal locking of a gate on a public road, or because of difficulty of practical walking access, which can reduce angler use. Most adjacent landowners, however, have no difficulties with public walking access to the river.

c. Contribution of trout numbers to other outstanding fisheries in the upper Buller

i. As well as being outstanding in its own right as a fishery, the Gowan River makes a substantial contribution to the production of trout in the upper Buller River system. Trout spawned and reared in the Gowan and its immediate tributaries make a significant contribution to the numbers of fish caught in Lake Rotoroa immediately upstream and the adjacent parts of the Buller River immediately downstream, both recognised as outstanding for their brown trout fisheries. A lack of impediment to fish movement in the upper Buller, including the Gowan, improves the resilience of the fishery and enables brown trout and other fish to move as appropriate to the most suitable habitats, (Young, 2002).

ii. In 1994-5, at the time of the last hearings into the Gowan River trout fishery, conventional wisdom was that brown trout, by comparison with rainbow trout, were sedentary and did not migrate to any significant extent (eg Frost & Brown, 1967, p. 51). This was based largely upon tagging studies where brown trout were usually found only a short distance from where they were tagged, even after quite extensive time periods. More recently, however, radiotracking and energetics studies have shown brown trout will migrate considerable distances each year, not necessarily just to spawn, but also to feed in more suitable areas or to avoid unsuitable water temperatures, (eg Strickland et al, 1998; Wilson and Boubee, 1995). These trout sometimes then return to locations at or near where they had formerly resided, which explains why they are frequently caught in immediate proximity of where they were tagged by conventional means. Fishing diary records from Lake Rotoroa have also shown an increase in trout numbers in the lake after the 1994 Gowan River flood, when locals noted an influx of fish attributed as from the river (eg Parker, unpublished).

iii. In addition to supporting a high biomass of trout, the Gowan, including its various side channels and its tributaries such as Marr Creek and New Creek are highly productive as spawning and rearing environments for juvenile fish, to supplement the high trout numbers in the Gowan and nearby Buller River system. The Gowan is particularly good as a spawning and rearing environment due to its stable flows. Although suitable spawning gravels are not abundant in the Gowan, any suitable areas are heavily used by spawning fish and productivity of parts of the river is very high, (Fish and Game unpublished spawning records).

iv. In making its decision on the Gowan River trout fishery, the then Planning Tribunal held that while the numbers and density of trout in the Gowan were higher than any other river fishery in the country, this was not in itself an outstanding feature, as the numbers of anglers in the Gowan are relatively small. In other words, a fishery is a product of both the numbers of fish and the number of anglers. In my opinion a fishery can be outstanding by virtue of fish numbers due to its outstanding fish habitat qualities, angling effort or unique angling characteristics or its contribution to other outstanding waters and that the Gowan is outstanding on all three grounds. Ironically, the Planning Tribunal also found the eel fishery of the nearby Lake Rotoroa to be outstanding, even though as a National Park the fishery receives no fishing at all. It should be noted, also, that Clause 10 of the Order has the effect of ensuring fish passage for both trout and native fish (including eels), where these fisheries are identified as being outstanding features. It is submitted that this should apply to the Gowan as both trout and eel populations need to be able to freely traverse the Gowan River.

v. In my opinion that there are several differences in our understanding of the value of the trout fisheries of the Gowan now compared with the previous hearing. Firstly, the evidence in support of the large trout biomass remains strong; secondly, there is more evidence of the use of the river by anglers and its special nature and thirdly and most crucially, there is more evidence of the extent to which brown trout migrate and are able to contribute to the outstanding adjacent Buller and lake fisheries due to fish spawning and rearing in the Gowan.

What is required to sustain the outstanding Gowan River trout fishery?

15. The Gowan supports such high fish numbers due to a variety of factors. The high water quality, including water clarity for diurnal feeding trout and stable water temperatures conducive to maximum trout growth; stable flows which both lack floods and have few low flows; highly productive invertebrate food resource from lake and instream productivity, and falling from the lush terrestrial riparian vegetation; freedom of fish movement to take advantage of suitable conditions for growth and reproduction; refuge areas and side channels for fish spawning, rearing and growth all contribute to this productivity.

<u>River flow requirements for brown trout in the Gowan</u>

16. Default flow requirements to maintain fisheries in the Buller River system were the subject of considerable debate and negotiation at the time of the previous Planning Tribunal hearings in 1994. It is difficult to arrive at a single flow regime which can be confidently expected to sustain fisheries in a range of different sized rivers. The

Planning Tribunal accepted the argument that, unless specified otherwise, no more than a 5% change in a river's instantaneous flow should usually sustain its fisheries. This provided for both the actual and potential needs of irrigation in the Buller River catchment as well as sustaining the fisheries. In some specific locations more specific figures were used. In the case of the Gowan, this was to provide for the projected irrigation demand for up to 1 cumec to be drawn for water augmentation elsewhere in Tasman District, while maintaining the trout fishery.

17. Fish and Game has asked for, and contributed to, investigations into the flow requirements of fish in the Gowan River at various times over the last 10 years or so. The most recent review resulting in some investigations was undertaken after discussions between Fish and Game and the Majac Trust's advisors in 2004 and 2005. Although this recent work has addressed some of these matters that need to be understood in order to evaluate the potential effects of a change to the existing WCO regime for the Gowan River, there are still numerous questions about the potential effects of the changes sought on the river and its ecological and amenity values.

18. The growing view amongst fisheries biologists in setting sustainable flow regimes has moved beyond just setting a minimum flow. To 'flatline' a flow is unnatural and can lead to significant difficulties for the ecology of the river, as aquatic organisms are not adapted to constant flow. As well as a minimum flow, it is usually considered that maintaining some flow variability is important. A method of achieving this is to have a flow sharing arrangement above the minimum flow, which allows an agreed proportion of the natural flow to be retained in the residual river. Such a flow regime can be seen in Figures 3.1-3.3. This ensures that there is some natural variability in flow. In addition, when the consequence of the abstraction is that, even with a flow sharing arrangement, there are lengthy periods without significant change to the flow, there is a 'flushing flow' which is used to flush any buildup of periphyton. Usually a flow of at least 3 times the median flow (FRE3) is required to achieve this flushing effect. In the case of the Majac proposal, the ability to provide for flows for rafting could be extended to provide such flows periodically for flushing purposes during extended low flow periods. The only problem with this approach is that during such times, the natural flow in the river has usually reduced to a level which prevents sufficient water being available to effectively flush the river, as the scheme has no water storage. The natural FRE3 flow for the Gowan is about 70 cumecs, which due to the stable flow in the Gowan occurs naturally only about 2% of the time (Waugh, 2004). This explains why the Gowan is naturally prone to the buildup of algae on the substrate.

19. In addition to flow requirements to sustain the ecology of rivers, increasing attention is being given to the flow requirements to sustain recreational and other amenities in the river. There is little detailed information on this, but anecdotal advice from anglers who have regularly fished the Gowan River over extended periods suggests that fishing is best between approximately 20 and 30 cumecs, and becomes significantly more difficult at flows below 20 cumecs.

20. In my opinion, the largest ecological question at issue in this application has been the relevance or suitability of the instream flow incremental methodology (IFIM) developed by Ian Jowett at a location in the upper river to establish the flow needs of trout in the Gowan, particularly in the reach potentially affected by the applications proposed development. The initial IFIM suggested a maximum habitat for trout at a flow of about 5 cumecs, which seemed not to recognise the existing high trout biomass, and that flows have only once reached the supposedly ideal flow to provide for trout habitat. In other words, the actual trout numbers seemed to contradict the model's prediction.

21. Three possible reasons were advanced at the meeting of technical experts as to why the actual numbers of fish were so high. First, the actual water velocity where trout were feeding might be considerably less than the average velocity measured. Second, water depths may vary from the model predictions and third, the high invertebrate numbers may reflect the 'supercharging' of the food supply from the seston, or primary production in the waters of Lake Rotoroa. This supercharging effect presently supplements productivity in the Gowan to an unknown extent. It may be significantly curtailed if the proposed scheme was to proceed as about half or more of the water from the river is drawn off into the scheme's head race.

22. As noted above, effectively all of the modelled reach lies upstream of the proposed diversion into the head race of the scheme. Mr Jowett's recent draft evidence indicates he considers the river is somewhat different in this upper area, being all in a single channel, with generally a boulder substrate and relatively low gradient and is relatively deep, by comparison with the river downstream of the intake. The Gowan has multiple channels over about two thirds of the distance of the proposed power scheme. There is a variety of habitat available for fish in these reaches, from small, slow moving channels to steep drop-offs. This variety includes various substrate sizes, accesses for angling, spawning and rearing areas for trout and native fish. It is difficult to compare this part of the river with the reach which was modelled using IFIM. The effects on trout habitat of reducing flows in this part of the river will certainly differ from the single channel areas upstream and would almost certainly require higher flow minima to safeguard adequate fish production.

23. A major issue in the use of IFIM in the Gowan is that the average water velocity in the river is considerably higher than that preferred by trout, being on average nearly 0.7 m/sec rather than the less than 0.4 m/sec preferred by adult brown trout. Trout are observed in the Gowan in velocity refuges behind rocks or other cover. Unlike other rivers, the average water velocity was not reflecting the water velocity where fish were feeding or living. In addition, trout were found in deeper water than usual due to the upper part of the turbulent and fast flowing 'white water' being unsuitable for occupancy by fish. This matter was investigated by a joint team of Cawthron and Fish and Game staff in May 2004, with the results being forwarded to Ian Jowett to enable him to recalibrate his IFIM model. This data was provided to Fish and Game in the form of draft evidence by Mr Jowett on the 6th of September 2004. No measurements of the increased productivity of river invertebrates from the lake seston have been made nor has the effect the scheme drawing the bulk of the river's flow out of the river might affect fish productivity downstream been evaluated. Further no consideration, or even mention, been given in Mr Jowett's draft evidence of the effects of flow alterations to the multiple channel reach of the river.

24. The results of Mr Jowett's recalibrated model are summarised in figures 2.1 and 2.2. These results are very different from the earlier calibration, which had suggested that river velocities were too high and a significant reduction in flows would be beneficial to adult brown trout habitat in the Gowan. Instead, depending upon which method of calculating habitat is used, there is a maximum of habitat for adult brown trout available at a flow of about 12 cumecs in the % WUA curve (Figure 2.2) or a maximum at about 24 cumecs for the m^2/m curve (Figure 2.1). The latter curve is very flat however, suggesting that increases in flow above a certain point provide little increase in adult trout habitat. Mr Jowett considers that there is a break point in that curve at a flow of about 9 cumecs, but in my opinion the point of inflection in the curve is at about 12 cumecs. This is also the figure of highest % weighted usable area (Figure 2.2). This is the flow above which the rate of increase in adult trout habitat with flow begins to decrease. Such a point of inflection is often taken as an appropriate point to set as a

minimum flow, although a more conservative approach is sometimes considered when protection of an outstanding resource is being protected.

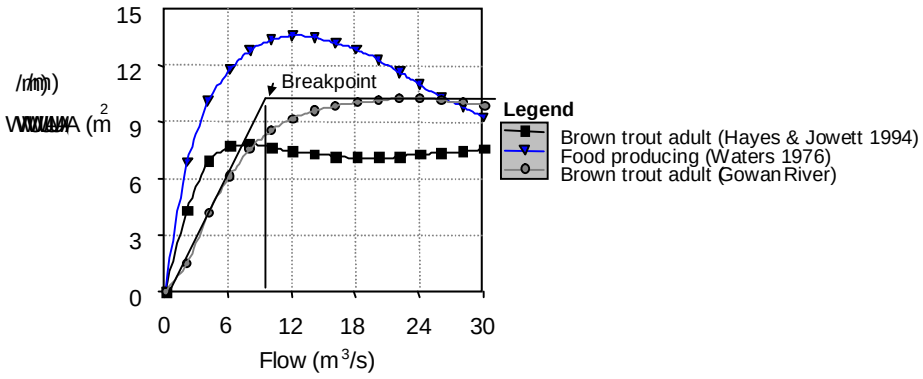

Figure 2.1 Weighted Usable Area (m^2/m) by Flow for the Gowan River, (from Jowett, 2004)

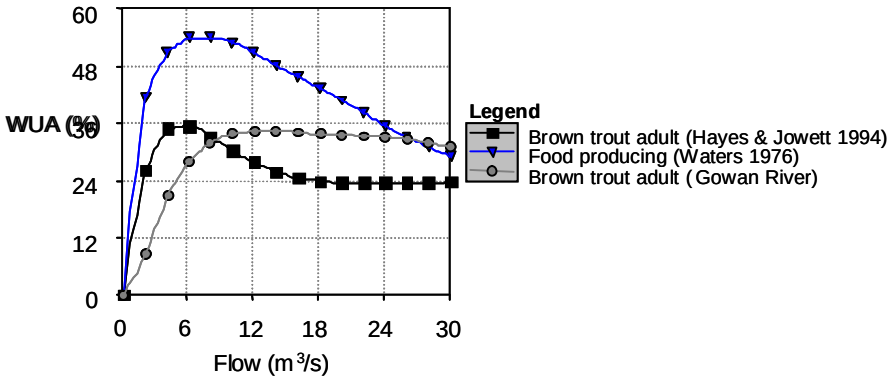

Figure 2.2 Weighted Usable Area (%) by Flow for the Gowan River, (from Jowett, 2004)

25. Another flow issue which Mr Jowett refers to in his 6th of September 2004 draft evidence is the effect of flow fluctuation on river health. Analysis of the flow record and superimposing the flow regime resulting from the proposed changes to the Order on three consecutive years (1983, 1984 and 1985) representing a wet, average and dry year of the record, suggests that the river might be left at the minimum flow of 9 cumecs for, respectively 51, 181 and 73 consecutive days in each of those years (Waugh, unpublished data). The effects of these changes in flow are illustrated by the following figure produced by Mr John Waugh, a hydrologist.

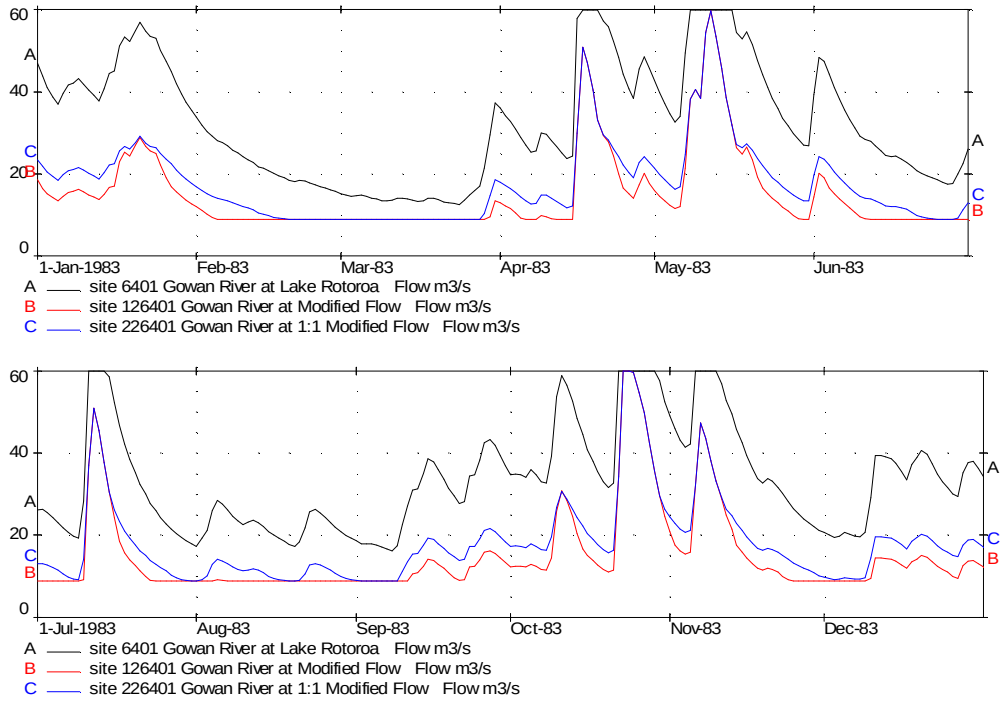

Figure 3.1 Gowan River Wet Year (1983) Hydrographs (from Waugh, 2004)

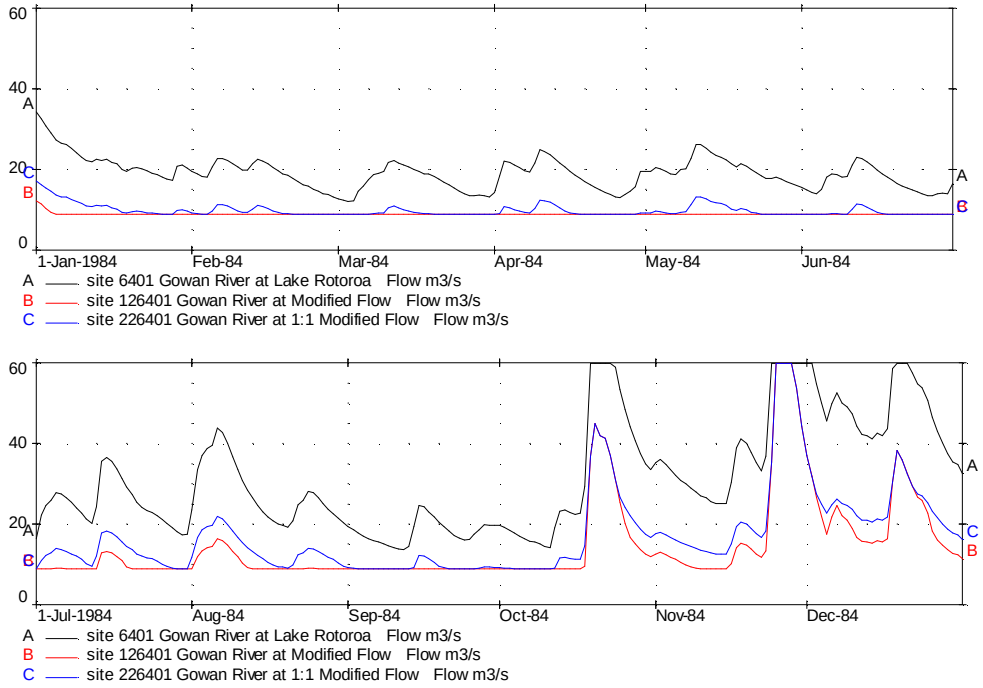

Figure 3.2 Gowan River Average Year (1984) Hydrographs (from Waugh, 2004)

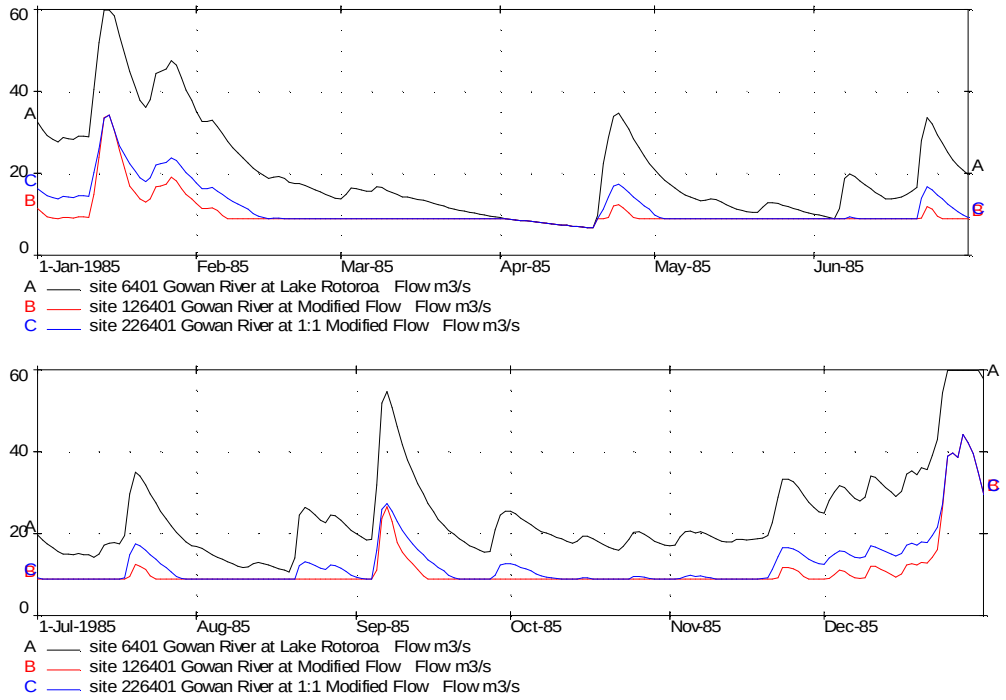

Figure 3.3 Gowan River Dry Year (1985) Hydrographs (from Waugh, 2004)

26. The dramatic changes in flow which would occur if the Majac proposal was to proceed can be expressed in a tabular form, in terms of the total number of days at 9 cumecs in the affected reach and the maximum number of consecutive days at the low flow, as follows:

Table 1 Gowan River – Days with Flow at 9 cumecs (from Waugh, 2004)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Yr	Continuous
1973 (driest)	29	28	31	22	0	14	31	31	30	31	2	23	272	110
1983 (wet)	0	23	28	7	1	18	18	29	9	0	7	8	148	51
1984 (Average)	27	29	31	30	31	30	22	18	30	16	5	0	269	181
1985 (Dry)	0	22	31	24	31	25	25	31	19	31	23	0	262	73

27. As the Gowan has a naturally stable flow and a lack of major floods, it is especially vulnerable to being “flatlined” at a constant 9 cumecs, which is likely to allow massive growth of periphyton, which is known to reduce habitat quality for both invertebrates, on which fish feed, and for the fish themselves directly. In my opinion to maintain the outstanding fishery any altered flow regime would have to provide flow fluctuations sufficient to slough off periphyton and maintain a healthy invertebrate community on which the fishery depends. Mr Waugh provides an example in the form of a 1:1 flow sharing regime as the blue line on his graphs, but other flow sharing regimes could be used such as 1:2 or 1:3 if these were considered more appropriate.

28. Having a constant river flow would also allow the encroachment of vegetation, especially willows, onto the river bed. This would reduce angler access along the river margins, impede their ability to cast and could be hazardous to navigation.

29. The effects of relatively sudden changes in flow on angler safety are of concern. The Gowan is a swift river with a slippery substrate. Angling is challenging even now, but flows are constant over the period of fishing. If anglers were fishing in a residual reach with a flow of 9 cumecs and flow was reinstated to provide for rafting over a relatively short period, there is a real risk of anglers being inundated or swept away. In a river like the Gowan, this poses a significant threat of death or serious injury.

30. It is possible that changes in river flow would continue downstream of the proposed scheme tail race when the flow reinstatement occurred. This may occur because water flowing down a canal would have a different average velocity to that moving down the river. Given that the Gowan is generally a larger river than the Buller at their confluence, it is possible that, unless particular care is taken with the flow change ramping regime, there could be instantaneous changes in the flows in the Buller River below the Gowan River confluence which were greater than the 10% permitted in the present Conservation Order (Clause 8(3) and Schedule 2(2). This is a matter which the applicant has provided little information on.

31. In summary, I consider that a minimum flow necessary to sustain the outstanding brown trout fishery would be 12 cumecs. A fluctuating flow regime, preferably based upon the natural flows as some proportion of the natural flow would also be essential, as would occasional flushing flows to keep the periphyton and invertebrate communities healthy.

Water Quality Issues

32. The Gowan's water quality is presently close to ideal water quality for salmonid production. The black disc visibility or water clarity in the Gowan seldom drops below about 5 m and can reach more than 12 m. Smith (1994) advised that any black disc visibility of more than 6.9 m is in the top 5% nationally. Such clear water both enables trout to see and feed on the abundant invertebrate food resource and enables the angler to spot the trout for sight fishing.

33. The Gowan provides an ideal and stable temperature for salmonid production. Brown trout attain fastest growth in water temperatures of 13^{o}C. At temperatures less than 4^{o}C they will lose condition, while above 19^{o}C they will stop feeding, and become increasingly stressed at 24^{o}C and may die at temperatures above 26^{o}C. The Gowan's temperature was measured monthly during flow gaugings over a long period. A sine curve plotted average temperature for the Gowan River for 120 readings taken between 1950 and 1991 gives a temperature of 12.9^{O}C, or a mean of the same data gives a temperature of 12.8^{O}C (Waugh, unpublished data), representing an almost perfect temperature for maximum trout growth.

34. It is unclear what the effect of a draw off of water from the residual river would have on its water temperatures, or what water temperature effects, if any, might arise from running the diverted water in a canal. While I would prefer to have seen this modelled, I would consider this would probably be a minor consideration compared to other issues such as flow or fish passage.

35. Other water quality parameters are not sought for amendment and Fish and Game submits that they should be retained as in the present Water Conservation Order.

WCO Provisions necessary to protect Fish and Game values

36. Maintenance of river fishery habitat requires a number of features. Water flows must be adequate, as well as water quality. Fish populations also have biological requirements such as free passage between areas necessary to sustain fish production, such food producing and spawning areas, or to seek thermal refuges. Large river systems with no impediment to fish movement, such as the Buller, have fish populations which are more resilient to change than smaller rivers, or those which are dissected or truncated by falls, dams or diversions. In addition local physical features of the river such as its substrate and the combination of riffles, runs and pools affects the habitat and amenity and is usually important. I **attach** as Appendix 1 the changes to the Order that would ensure the outstanding fishery is protected.

37. Aspects of water quality in the Gowan which need to be protected include
- maintaining high water clarity including a relative absence of turbidity;
- an appropriate temperature range to favour trout growth;
- maintaining pH at a level appropriate for healthy ecosystems;
- nutrient levels and other contaminants which may affect the growth of undesirable biological growths (particularly given the recent discovery of the unwanted organism *Didymosphenia geminata* in the nearby Buller River and the suitability of the Gowan for its growth);
- avoiding contamination of waters which may render aquatic organisms unsafe for public consumption or rendering waters unsafe for human consumption or for recreation; and
- dissolved oxygen within the range necessary to allow aquatic life to thrive.

38. Channel form must also be maintained to protect fishery features. Clause 8a refers to channel form and braiding pattern, and applies to the Gowan. This application does not seek to alter clause 8a. However, the multiple channel nature of the Gowan in the reach which would be affected by lowered flows due to the proposed changes to the Order would have the effect of drying up at least some of these channels. The proposed changes to the Order are likely to result in a breach of clause 8a, and an internal inconsistency. Furthermore, the channels are important for spawning, juvenile fish production and for angling at a variety of flows, but they rarely dry up under natural flow conditions.

39. Fish Passage must be maintained to ensure the protection of the outstanding fishery. Clause 10 refers to the maintenance of fish passage, which is essential to maintaining the contribution of the Gowan to the productivity of the trout fishery of Lake Rotoroa and the adjacent Buller River in particular. Fish and Game submits that this no damming provision, with the change to the word ‘impede’ rather than ‘prevent’ as outlined below, should be retained as part of the Order and applied to the Gowan River.

40. In particular, the effects of a substantial change in the flow regime, removal of a significant proportion of the river’s flow and its production from the mainstem, the effects of changes in flow in the multiple channel reach of the Gowan and the effects of the proposal on fish movement and angling amenity have not been adequately addressed in the information provided by the applicant to date. This lack of information makes it difficult to properly assess the effects of the proposal on the fisheries and other interests in the river. In my opinion the Special Tribunal has been given insufficient scientific information by the applicant upon which to base a sound decision to recommend any change to the present order. The Fish and Game Council has applied for its own amendment to the Water Conservation Order for the Gowan River, at which time these matters would be traversed in more detail.

Concerns with the application to amend the WCO by Majac Trust and its effects upon the present WCO and the trout fishery

Fish passage and screening

41. This section of my evidence is largely in response to paragraph 11 of Mr Swan's evidence, which describes the proposed screen at the intake

42. As the Gowan River is both productive and an important migratory highway for trout and other fish including eels, any diversion from or return discharge of water into the Gowan would need to ensure that free passage for fish in and through the residual river was maintained. In general, it can be assumed that fish will migrate in numbers proportional to any flow which is diverted, although some species or life stages will preferentially migrate in different parts of the water column. In the case of the proposal by the Majac Trust for a power scheme, for much of the year the great majority of the river's flow would enter the intake canal. Screening which would be effective in preventing adult and juvenile trout and eels from being entrained into the canal would be essential.

43. Extensive work has been undertaken on the requirements necessary to ensure that fish screens are effective, particularly for salmonids in North America. There are a number of specific requirements, including ensuring that fish have adequate opportunity to detect and avoid any screens. With juvenile salmonids, which usually migrate downstream in the current while facing upstream, US authorities recommend approach velocities to the screens of not more than 0.15 m/sec. This is both to prevent fish impinging on and/or being damaged by screens and being able to avoid them once detected. A review of fish passage for salmonids in the Canterbury region (Hardy, 2004) summarised these requirements and also the size of the mesh screen necessary to avoid trapping salmonid fry, which is about 3 mm. Mr Swan has suggested in his evidence that screens would have a size of 25 mm. This would be inadequate to avoid entrainment by a large proportion of salmonids of all size classes except the largest fish. The effects of this on large fish would be considerable, as few large fish can survive transit through turbines.

44. In addition, fish screens must be self cleaning to avoid their being blocked by floating debris. Conditions necessary to ensure that screens are effective are provided in the recommended conservation order provisions sought by Fish and Game in the appendix attached to this evidence. Stringent monitoring and maintenance is also required to ensure they are effective. Hardy found that such maintenance was rare and few fish screens in Canterbury were effective at ensuring fish populations were not detrimentally affected by diversions.

45. At the downstream tail race end of any scheme, a velocity barrier could be created to prevent swimming and jumping fish like salmonids from entering the tailrace. This would need to have exit channels to ensure any fish attracted could return to the residual river.

46. Another aspect of fish passage is the avoidance of physical barriers such as dams. Damming is prevented under the current provisions of the Order, to ensure that fish movement and safe river navigation is maintained. Clause 7 of the Order refers to the prohibition on damming, which, in my opinion, is necessary to retain fish passage. The issue, from a fish passage perspective, is that dams should not be allowed which would impede fish movement at all. Use of the word "prevent" might imply that any structure which reduces fish passage but does not prevent it entirely is acceptable. However an impediment to fish passage could have a significant effect on the fishery. I have investigated other circumstances where what may appear to be minor impediments to fish movement can significantly affect fish numbers. An example is with the fishery of the Baton River in the Motueka River catchment. A concrete ford blocked up and

restricted fish movement over a 700 mm high weir for most of a decade. Fish and Game sought several times that this impediment be removed, but this was only achieved after a flood removed a section of the ford. After this occurred fish numbers increased significantly, as shown in Figure 4.

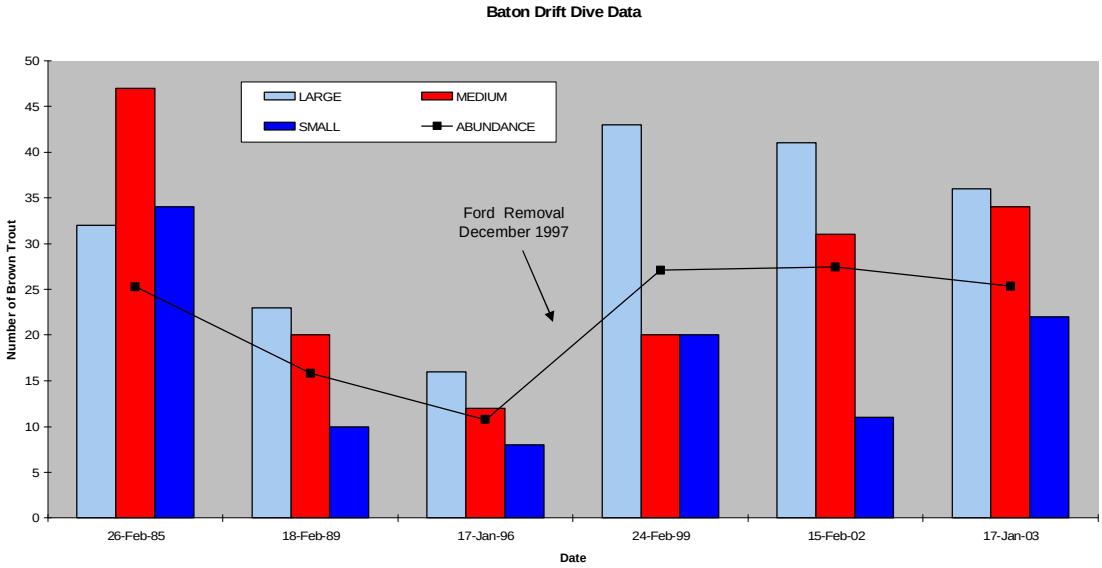

Figure 4 Trout numbers as measured by drift diving in the Baton River 1985-2003, showing the effect of the lower Baton River ford until 1997 and subsequent improvement in fish numbers. Fish and Game Council unpublished data.

47. Therefore, if changes to the WCO are being contemplated to enable a scheme of the nature and scale described by Mr Swan, I recommend that clauses 7 and 10 be amended to ensure that any such proposal does not impede the passage of fish, and is appropriately screened. Those changes are tracked in Appendix 1 **attached** to my evidence.

River morphology

48. In his evidence, Mr Swan indicates that the Gowan River's flow would be significantly reduced in the reach below the intake of their proposed scheme. Instead of the mean annual flow of around 27 cumecs, the mean annual flow would be much closer to the 9 cumec minimum flow in the reach affected. This is illustrated in the hydrological data above. The effect of this would be to cause an encroachment of vegetation from the river margins onto the shallower parts of the river and a loss of minor channels which would be likely to become quite overgrown. This would make access for angling and other river uses more difficult than it is at present.

49. Mr Swan implies in his evidence that a stable flow would somehow allow less 'damage' from floods and a more stable river bed. My observation of the Gowan is that it seldom floods naturally and, also due to the average size of the substrate being very large, the bed is very stable compared to most rivers. There is an implication that floods are necessarily undesirable. This is not so. The greatest invertebrate abundance and biodiversity occurs in rivers with variable flows, including minor floods at about the annual return period size. This provides the food resource for the fish, so is very important. While large floods can impact invertebrate and fish populations, the invertebrate densities usually return within about a month. The Gowan River effectively

does not flood from a fisheries perspective, which is probably a contributing factor to the abundance of trout noted.

50. In summary, as noted earlier in my evidence the changes to the flow regime proposed by the applicants are likely to have an adverse effect on the outstanding fishery.

Conclusion

51. Fish and Game is of the opinion that the Gowan supports an outstanding brown trout fishery. Fish and Game oppose the application to amend the WCO, because the changes are likely to result in a downgrading of the fishery in and adjacent to the Gowan, due to the following factors:
    a. Unsuitable flow regime for instream habitat, and corresponding reduction in water quality,
    b. Unsafe conditions for anglers,
    c. Undesirable encroachment of vegetation,
    d. Alteration of channel form and braiding pattern
    e. Potential for subsequent power scheme to impede fish passage and entrain fish

Appendix 1.
Proposed Amendments to Water Conservation (Buller River) Order 2001

6. Waters to be protected—

Because of the outstanding characteristics, features, and values identified in clause 4,—

(a) the waters specified in Schedule 2 are to be protected in accordance with the restrictions and prohibitions in clauses 7 to 11, as specified in Schedule 2:

(b) the waters specified in Schedule 3 are to be protected in accordance with the restrictions and prohibitions in clauses 7 and 12, as specified in Schedule 3.

7. Restrictions on damming of waters—

(1) For the purposes of this clause, damming does not include any intake or deflection structure that does not—

(a) harm any salmonid fish spawning or impede the passage of any fish; or

(b) prevent the use of the waters for rafting or canoeing; or

(c) reduce the wildlife habitat; or
(d) intrude visually to the extent that it reduces wild and scenic values

(2) No resource consent may be granted or rule included in a regional plan permitting the damming of the waters specified in Schedule 2 whenever any of the characteristics in subclause (1) are listed as outstanding in Schedule 2 and that schedule refers to this clause.

8. Restrictions on alterations of river flows and form—

(1)(a) if the effect of the resource consent or rule would not generally maintain the channel cross-section, meandering pattern, and braided river channel characteristics of the form of any river specified in Schedule 2:

(b) if the effect of the resource consent or rule would alter the naturally occurring instantaneous flow of the water in any river specified in Schedule 2 by more than 5%.

(2) The restriction in subclause (1)(a) does not apply in respect of dams, weirs, roads, fords, bridges, access ways, or fish passes lawfully existing on the date this order comes into force.

(3) Despite anything in subclause (1),—

(a) any change in flow permitted in that part of the Buller River specified in item 2 of Schedule 2 must not be greater than 10% of the naturally occurring instantaneous flow:

(b) any change in flow permitted in that part of the Buller River specified in item 3 of Schedule 2 must not be greater than 15% of the naturally occurring instantaneous flow:

(c) in the Gowan River, item 11 of Schedule 2:,—

(i) whenever the naturally occurring instantaneous flow is 16 cumecs or more, any change in flow permitted must not be greater than ~~15~~25% of the naturally occurring instantaneous flow; or

(ii) whenever the naturally occurring instantaneous flow is between 16 cumecs and 12 cumecs, any change in flow permitted must not result in less than 12 cumecs of instream flow

(iii) whenever the naturally occurring instantaneous flow is less that ~~9~~12 cumecs, any change in flow permitted must not be greater than 5% of the naturally occurring instantaneous flow.

10. Requirement to maintain fish passage—

No resource consent may be granted or rule included in a regional plan for the waters specified in Schedule 2 unless that resource consent or rule maintains—

(a) adequate natural or artificial passage for trout through those waters where Schedule 2 identifies trout as or contributing to an outstanding characteristic; and

(b) adequate natural or artificial passage through those waters for those native fish that require such passage where Schedule 2 identifies native fish as or contributing to an outstanding characteristic.

Any intake shall be screened to prevent the intake of fish with a mesh size not exceeding 3mm in diameter and shall be constructed so that;

(i) placement of the intake does not cause stream bed invertebrates to be entrained,

(ii) that the migration habits and passage of fish are not compromised or adversely affected in any way due to the placement of the intake, and

(iii) the intake does not result in a navigation hazard.

No resource consent may be granted or rule included in a regional plan for the waters specified in Schedule 2 unless any diversion ensures that the intake velocity does not exceed 0.15 metres per second at all times. The intake shall be cleaned and maintained to ensure that the intake velocity is not exceeded.

11. Restrictions on alteration of water quality—

(1) No resource consent may be granted or rule included in a regional plan permitting a discharge into any of the waters specified in Schedule 2 if, after allowing for reasonable mixing of the discharge with the receiving waters, the discharge would—

(a) alter the concentration of suspended solids or turbidity in the receiving waters by more than 1 milligram per litre or 1 NTU where the ambient concentration of suspended solids or turbidity is less than or equal to 10 milligrams per litre or 10 NTU respectively; or

(b) alter the ambient concentration of suspended solids or turbidity in the receiving waters by more than 10 milligrams per litre or 10 NTU where the concentration of suspended solids or turbidity is more than 10 milligrams per litre or 10 NTU respectively; or

(c) alter the visual clarity of the waters by more than 20%; or

(i) by more than 3 degrees Celsius; or
(ii) by increasing the water temperature to more than 20 degrees Celsius; or
(iii) so as to adversely affect, during their spawning season, the spawning of

(A) rainbow and brown trout
(B) inanga
(C) koaro
(D) giant, banded, and short-jawed kokopu
(E) alpine, long-jawed, dwarf and common galaxies.

(2) No resource consent may be granted or rule included in a regional plan permitting the discharge into any of the waters specified in Schedule 2 or Schedule 3 unless, after allowing for reasonable mixing of the discharge with the receiving waters,—

(a) any change in the acidity or alkalinity in the receiving waters, as measured by the pH and attributable to that discharge, would either—

(i) maintain the pH within the range of 6 to 9 units; or

(ii) not allow a change by more than 0.5 units when the natural pH lies outside the range of 6 to 9 units; and

(b) there would be no undesirable biological growths attributable to the discharge, including—

(i) bacterial or fungal slime growths that are visible to the naked eye; or

(ii) seasonal maximum covers of streams or river beds by

(A) periphyton as filamentous growth or mats (larger than 3 millimetres thick) exceeding 40%; or

(C) 40 grams ash-free dry weight per square metre of exposed surface area; and

(c) aquatic organisms are not made unsuitable for human consumption through the accumulation of excessive concentrations of contaminants; and

(d) the water is not made unsuitable for recreation by the presence of contaminants, or the median bacterial level of 5 samples or more taken over a period of 30 days would not exceed 126 E coli per 100 millilitres.

(3) No resource consent may be granted or rule included in a regional plan permitting a discharge into any of the waters specified in Schedule 2 if, after allowing for reasonable mixing of the discharge with the receiving waters, the discharge would reduce the concentration of dissolved oxygen below 80% of saturation.

(4) For the purposes of subclause (3), if the natural concentration is less than 80% of saturation, the natural level must be maintained or increased.

SCHEDULE 2

PROTECTED WATERS

Waters	Outstanding characteristics	Restrictions and orprohibitions

Item		features	
10	Gowan River	Trout fishery, contribution to trout fishery, Rafting	cls 7, 8(1)(a), 8(2), 8(3)(c), 10, and 11

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52. Appendix Chronology of Events in the Development of a Water Conservation Order for the Buller River Catchment

1985-86 Nelson Acclimatisation Society prepares case for an application for a Water Conservation Order for the upper Buller River and contributing waters.

29 September 1987 Nelson Acclimatisation Society and Council of South Island Acclimatisation Societies applies for a National Water Conservation Order for the upper Buller River and contributing waters.

12 August 1988 Minister for the Environment advertises the application for a National Water Conservation Order for public submissions and appoints a special tribunal of Drs Neil Algar, Mike Johnston and Jonet Ward to hear any submissions.

24 September 1988 Closing date for submissions on the application. 162 submissions received on the application. Note many of these submissions in support enlarge the scope of the order to encompass the whole river catchment.

20-22 March 1989 Hearing of submissions by the Special Tribunal in Westport. Twenty-nine parties represented, with 49 witnesses.

18 July 1989 Special Tribunal advises a decision to create a Draft National Water Conservation Order for the whole catchment of the Buller River.

Special Tribunal decision appealed to the Planning Tribunal by various parties (see below). Some appellants were seeking the order be removed or reduced in scope, while others sought its extension.

August 1991 – May 1992 Various discussions between parties and four pre-hearing conferences by the Planning Tribunal. A draft version of the order was produced in July in an attempt to resolve some objections.

1 October 1991 Resource Management Act comes into force, which includes water conservation orders. The present order would continue under the Water and Soil Conservation Act but once the process was complete, it would be gazetted under the new Act.

6 July 1992 Planning Tribunal begins its public inquiry into the Draft National Water Conservation (Buller River) Order 1989. Numerous parties included:

- The applicants, (now Nelson Marlborough Fish and Game Council and New Zealand Fish and Game Council);
- Department of Conservation, Ministry for the Environment, Ministry of Commerce;
- Buller District Council, West Coast Regional Council, Tasman District Council;
- Tasman Energy Limited, Buller Electricity;
- Milburn New Zealand Limited, Coal Corporation of New Zealand Limited, Macrae's Mining;
- Maruia Society, New Zealand Canoeing Association

Questions of law were raised at this hearing which caused the inquiry to be adjourned for the Tribunal to consider its views.

7 May 1993 Planning Tribunal makes interlocutory decision on the order (C28/93). This has the effect of rejecting the "whole catchment" approach of the draft order. Instead, Judge Skelton outlines the tribunal's view that each specific part of the catchment needed to be identified as outstanding for a particular reason and either preserved or specific conditions outlined in the order designed to protect the identified outstanding feature.

1994-1995 Negotiations and discussions between various parties to try and incorporate concerns about the scope and wording of the order to encompass the areas considered outstanding by the proponents while removing parts of the catchment or providing suitable conditions to alleviate concerns raised by objectors. This excluded the river downstream of Te Kuha below the lower gorge and most of the Inangahua River catchment, for example. Most parts of the river now sought for inclusion were not now contested between parties, nor were most of the conditions sought to protect waters. Contested waters included the Gowan, lower Matakitaki, Matiri, and Waitahu and Larry's Creeks in the Inangahua River catchment.

1-12 May 1995 Planning Tribunal resumes its hearing of rebuttal evidence and cross-examination for two weeks at Westport.

3-7 July 1995 The hearing is resumed in Christchurch.

22-23 August 1995 The hearing is completed in Christchurch Evidence was heard from a total of 43 witnesses.

31 May 1996 Planning tribunal decision released in favour of a water conservation order for the Buller River. This confirmed most of the uncontested waters, supported the inclusion of the Gowan River on a split decision of the Tribunal, but excluded parts of the lower Matakitaki and Matiri Rivers on canoeing grounds and confirmed some boundaries for the Order's effect for the Waitahu and Larry's Creeks. Subsequently a number of drafts of the order appropriate for gazettal and also faithful to the Planning Tribunal decision, which involved many of the parties to the Planning Tribunal hearing.

18 June 2001 Buller River Water Conservation Order gazetted.

5 July 2001 Majac Trust takes High Court Action regarding delays in proceedings of the Buller Water Conservation Order gazettal.

21 July 2001 Buller River Water Conservation Order takes effect with celebration at the source of the Buller River at Lake Rotoiti.

11 October 2002 Majac Trust sought support to amend the Gowan River provisions of the Buller Water Conservation Order from Fish & Game, but support not forthcoming.

7 July 2004 Environment Minister, Marion Hobbs announces the appointment of a Special Tribunal to consider an application to amend the Buller Water Conservation Order

Hearing commences, with legal arguments over scope of the matters for consideration by the Special Tribunal.

Special Tribunal ruling that all matters pertaining to the Gowan River can be considered.

Appeal by Majac on Special Tribunal decision is successful

2 August 2005 Fish and Game New Zealand makes application for a Water Conservation Order for the outstanding brown trout fishery on the Gowan River.