

To the North Canterbury Catchment Board

SUBMISSION ON THE PROPOSED  
BALMORAL IRRIGATION SCHEME

BY  
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FISHERIES ENVIRONMENTAL REPORT NO. 5

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## FISHERIES ENVIRONMENTAL REPORTS

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## CONTENTS

	<u>Page</u>
1. Introduction	1
2. Fish and Fishery Values of the Hurunui River	3
2.1 Quinnat salmon	3
2.2 Trout	4
2.3 Eels	4
2.4 Whitebait	5
2.5 Other native fish (freshwater)	5
2.6 Estuarine/marine migrants	6
3. Use of the Fishery Resource	6
3.1 Salmon and trout	6
3.2 Eels	9
3.3 Whitebait	9
4. The Effects of Low Flows on Fishery Values	9
4.1 Problems of upstream passage	10
4.2 Closure of river mouth	12
4.3 Changes in river temperature regime	14
4.4 Loss of littoral habitat	16
4.5 Reduction in quality of habitat	16
5. Safeguards for the Protection of the Fishery	17
6. Literature Cited	18

## FIGURES

1. Hurunui River system.	2
2. Braided channels 3 km below S.H.7, 15 March 1976.	11
3. Hurunui River mouth, 7 February 1978.	13

## 1. INTRODUCTION

Fisheries Research Division (FRD), Ministry of Agriculture and Fisheries, has responsibility for research and advisory functions related to freshwater fish and fishery values in New Zealand, and the Ministry of Agriculture and Fisheries (MAF) as a whole also has responsibility for the management of these resources. FRD acts as advisors to:

1. Acclimatisation Societies who have had delegated to them by MAF under the Fisheries Act (1908), the statutory authority for the management of recreational fisheries.
2. Fisheries Management Division of MAF on matters related to the management of other fisheries.
3. Enterprises involved commercially in the development and exploitation of these fisheries.

We are therefore responsible for and concerned to see that the fish and fishery resources of New Zealand are not unduly or irresponsibly affected by man-induced changes in the aquatic environment, and become involved in examining a wide spectrum of problems from over-exploitation of fishery resources to water abstraction and water pollution.

It is our view that the Hurunui River (Fig. 1) constitutes a significant fishery resource. If excessive quantities of water are abstracted from the river, this fishery resource will be seriously damaged. Therefore, our purpose in making representations to the Board is to demonstrate that the fishery is a valuable one and to indicate those aspects of the fishery that we believe to be endangered by proposed abstractions.

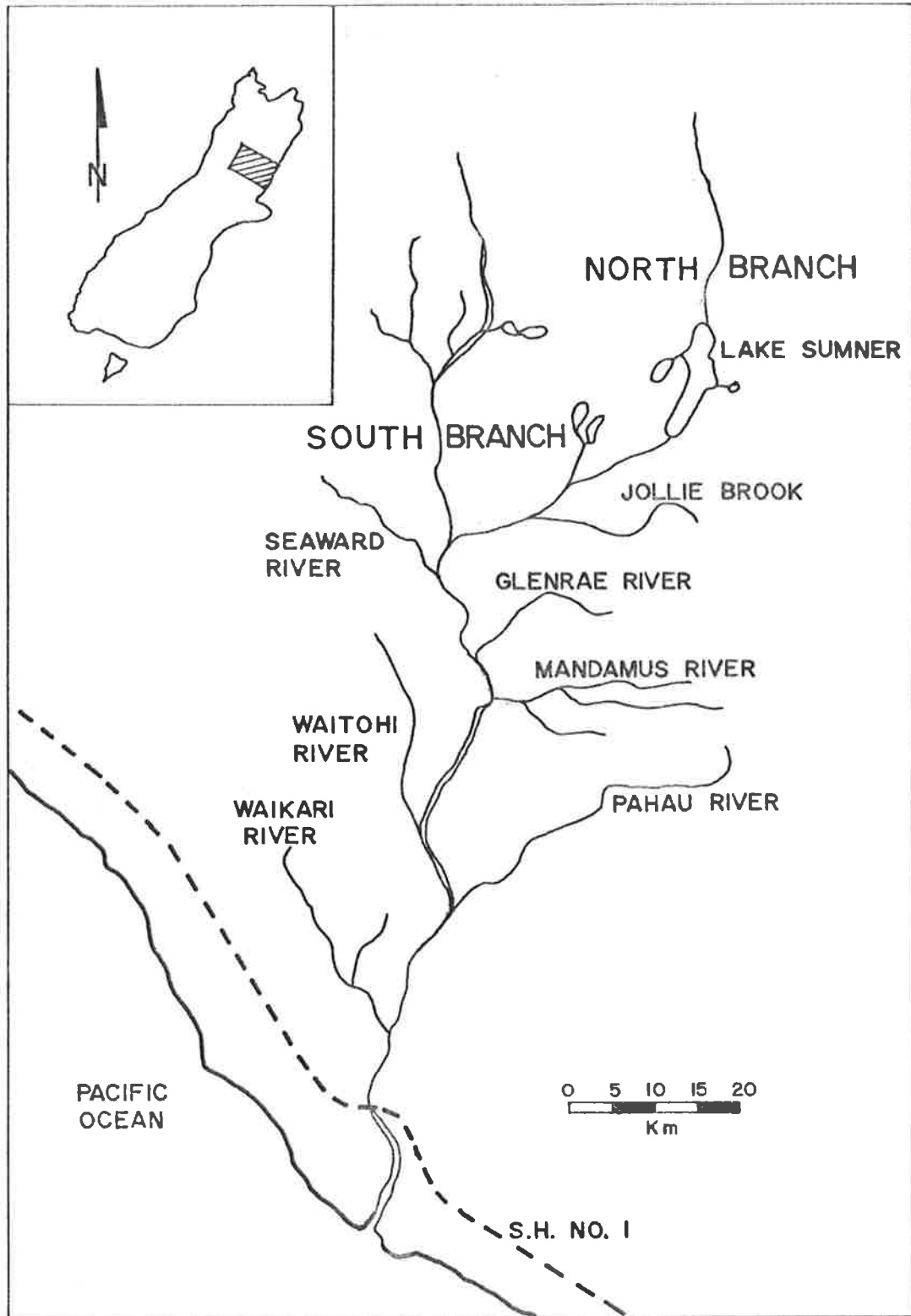


FIGURE 1. Hurunui River system.

FRD recognises that use of water for irrigation purposes is a responsible use of the water resource. However, since each irrigation proposal is subject to an individual water right, the cumulative effects of irrigation withdrawals on the whole river system are not always taken into account. Our concern is for the fishery resources of the whole catchment, particularly since most of the fish species of the Hurunui system are migratory at some stage of their life cycle.

## 2. FISH AND FISHERY VALUES OF THE HURUNUI RIVER

The Hurunui fisheries have been described by Docherty et al. (1978) and Docherty (1979), and include the following:

### 2.1 Quinnat Salmon

This is a migratory species that uses the entire river system to complete its life cycle:

- (i) The river mouth for entry and exit of migratory stages moving from and to the sea. Adult salmon enter the river from December to May, while the young leave at a variable age in their first year of life, primarily from September to April.
- (ii) The main stem of the river for -
  - (a) access for adults migrating upstream to the spawning areas and for young salmon migrating to sea
  - (b) rearing of young salmon to the smolt (migratory) stage prior to migration to the sea.

Many newly hatched salmon are undoubtedly swept out to sea by floods and contribute little, if any, to the numbers of returning adults. An analysis of returning adults to the Hurunui shows that of those that did survive, most spent their early months

in the river system, and did not get to sea soon after hatching. The river is therefore very important as a rearing habitat for young salmon.

- (iii) The upper river (both North and South Branches) and its tributaries (e.g. Landslip Creek) as the main spawning areas.
- (iv) Lake Sumner as a rearing area for a lake-limited population of quinnat salmon.

## 2.2 Trout

Both brown and rainbow trout use virtually the entire river system. Browns are much more numerous than rainbows but essentially their behaviour and use of the river are similar. Their use of the river includes:

- (i) The mouth to enable the movement of sea-run stocks of brown trout throughout the year. In the period March to May this movement includes the upstream spawning migration of adults. Anglers consider sea-run browns a highly desirable sports fish.
- (ii) The main stem river as habitat for adults, particularly those areas containing deep pools and runs with stable cover - such as the reaches above the Mandamus confluence.
- (iii) The lower river below the gorge as habitat for juvenile trout, particularly the many side channels.
- (iv) The upper tributaries as spawning areas for adult trout, although river side channels and lake margins are also used to some extent.

## 2.3 Eels

Two species of migratory eels, the long- and shortfinned, make extensive use of the river system:

- (i) The mouth for entry of the young glass eels into the river system in spring and early summer, and the outmigration of adults from February through July, when they go to sea to spawn.
- (ii) The mainstem river and particularly the lower reaches for early growth of the juveniles. The fish tend to move upstream and into the deeper holes as they grow larger. Penetration of the river system is very extensive, particularly by the longfinned eel. Eels climb the falls in the Sisters Stream giving them access to Lakes Taylor and Sheppard.

#### 2.4 Whitebait

All five species of whitebait occur in the Hurunui River. Their use of the system varies from species to species, but essentially resembles that of previous fish discussed:

- (i) The mouth, for entry into the river system by juveniles in the spring and early summer and exit to sea by the larvae in the late summer to early winter, from about February onwards. One of the species (*Galaxias maculatus*) requires an intertidal habitat for spawning and so makes extensive use of the lagoon area.
- (ii) The main river and its tributaries as a rearing area by some of the species. Such use varies with species. For example, one species utilises the lower reaches and lives openly in shoals in pools, one lives in deep holes in the lower reaches, while another migrates well upstream into bouldery tributaries, like Jollies Brook.

#### 2.5 Other Native Fish (freshwater)

A variety of other native fish species utilise the Hurunui River. These are listed in Docherty's (1979) Table 2, p.10. Of the 18 species listed under "native", 14 are marine migratory requiring the ability to move in and out of the river system.

## 2.6 Estuarine/marine Migrants

A small number of species, primarily marine, use the estuary as an intermittent habitat. They form the basis for small, mainly recreational fisheries.

## 3. USE OF THE FISHERY RESOURCE

### 3.1 Salmon and Trout

The Hurunui River is the most important and heavily utilised salmon fishery in North Canterbury, north of the Waimakariri. It has the benefits not only of a sizeable salmon population but also of good access without being too far from population centres. Salmon population-size varies from year to year from a few hundred to several thousand. The variation in numbers is related in part, to the accessibility of the spawning grounds - which may be restricted at low flows in autumn - and to the stability of the spawning grounds during winter and spring.

The proposed development of a commercial salmon ranch in the upper Hurunui - for which the North Canterbury Catchment Board has already granted a water right - adds a significant value to the river. The population of salmon in the river could increase by an order of magnitude once this venture is operational. This would not only assign a significant commercial value to the in-river flow but would lead to increased use of the river by salmon anglers eager to make use of the much enhanced salmon resource.

Quinnat salmon restricted to Lake Sumner provide a salmon angling resource throughout the fishing season.

The Hurunui River also supports a very popular and distinctive trout fishery, affording angling for sea-run trout at the mouth, and river fish in many upstream reaches, but especially from the upper gorge

to Lake Sumner. There is also excellent trout fishing in all of the lakes of the Sumner basin.

Limited data are available on the numbers of anglers using the Hurunui River. Some of these do not distinguish between salmon and trout anglers. Graynoth and Skrzynski (1974) described the trout and salmon fisheries of the North Canterbury Acclimatisation District, based on angling results collected since 1947 by eight angling diary schemes and two postal questionnaires in 1958 and 1963. The 1963 results ranked the Hurunui River as the fifth most popular fishing water in Canterbury after the Waimakariri, Selwyn and Rakaia Rivers and Lake Coleridge.

In another survey (Octa Associates Limited 1976) carried out for the North Canterbury Acclimatisation Society during the 1975/76 fishing season, it was found that 7.5% of the respondents (1,285 replies out of 2,000 sampled) regularly fished the Hurunui River. The total number of North Canterbury Acclimatisation Society licence sales for that season was 15,264, which gives an estimate of 1,145 anglers regularly fishing the Hurunui River and its tributaries.

Lakes Sumner and Katrine, and Lakes Taylor, Sheppard and Mason were categorised separately in the Octa questionnaire. Estimates of usage are 626 anglers fishing Lakes Sumner and Katrine, and 840 anglers fishing Lakes Taylor, Sheppard and Mason in 1975/76. North Canterbury Acclimatisation Society licence sales for 1978/79 show an increase of approximately 11% over those for 1975/76. Assuming that angling preferences have not substantially altered, estimates for present angler usage of the Hurunui system are:

Hurunui River and tributaries	1,271
Lakes Sumner and Katrine	695
Lakes Taylor, Sheppard and Mason	932

These numbers do not include anglers from outside the North Canterbury Acclimatisation Society district. The Octa survey showed that 53.6% of their respondents fished more than one day outside their own acclimatisation society district. This suggests that fishing by anglers from outside the North Canterbury district may be a significant and additional, unsurveyed part of the angling effort.

The Octa survey also assessed the relative popularity of fishing waters within Canterbury. The Hurunui was the seventh most popular, after the Waimakariri and the Rakaia Rivers, Lake Ellesmere (including the lower Selwyn River from S.H.1 bridge), Lake Coleridge, the Ashley River and Lakes Pearson and Grasmere. However, in the North Canterbury area, the Hurunui is far more popular than the Waiau and Hope Rivers nearby (together ranked 20th) and the Clarence River and Lake Tennyson (ranked 16th). Thus the importance of the Hurunui, particularly to the local North Canterbury angling community, is clearly evident.

Observations by FRD staff since 1977 have shown that the river mouth is the most popular area for salmon anglers. Spot counts of anglers were made during the 1977 and 1978 salmon runs and the largest number of anglers observed was 51 (at 7 a.m. on February 18 1978). Counts have been made at frequent daily intervals since December 22 1979 to assess current usage of the salmon resource and since this date the greatest number has been 25 (at 1 p.m. on January 16 1980, and at 10 a.m. on February 24 1980). Frequent floods and dirty river conditions have made rivers unfishable and have undoubtedly deterred many anglers this season, contributing to lower counts.

Total angler counts per day are difficult to obtain as anglers comprise a mobile population. Those fishing in the morning are not usually those fishing in the afternoon or evening. Also, when the river is in flood or dirty, anglers do not fish. Nevertheless, our

records give some indication of numbers of salmon anglers fishing at the Hurunui mouth. Records over the last three years during the period from the end of December to mid-April, give average weekly counts ranging from 24-239 anglers, with the highest counts occurring during February.

### 3.2 Eels

There is a small commercial fishery for eels in the lower reaches of the Hurunui River. In addition, an initial harvesting of eels in Lakes Taylor and Sheppard is reputed to have produced a total catch of 14 tonnes worth some \$12,600 to the fishermen. Repeated returns by fishermen to the lakes and river for further cropping can be expected.

### 3.3 Whitebait

The Hurunui River system contains a small, primarily recreational whitebait fishery.

Minor use is made of marine migrants with netting for mullet and flounders and angling for Kahawai at the mouth.

The variety of native freshwater fish species present in the Hurunui system is of conservation interest. The alpine galaxias (*Galaxias paucispondylus*) occurs only in the swift, cold, snow-fed streams of sub-alpine and alpine Canterbury, and the longjawed galaxias (*G. prognathus*) has so far been found only in the upper reaches of east coast South Island rivers.

## 4. THE EFFECTS OF LOW FLOWS ON FISHERY VALUES

In the preceding discussion we have sought to point out, in a general way, the use made of the Hurunui River by the various fish species present, in particular the need for the mouth to remain open and for suitable living habitats to be available for each of the different life stages of the species involved.

At low flows, it is our view that a variety of these habitat parameters could become critical, and wish now to enumerate our reasons for this.

#### 4.1 Problems of Upstream Passage

We would draw the attention of the Board to the fact that reports on conditions in the river (by the North Canterbury Catchment Board and Ministry of Works and Development) focus primarily on mean flow conditions. There is little doubt that even under so-called mean conditions some factors, like mouth closure and water temperatures would be critical (see below).

Of even more importance, however, are the conditions which pertain in critical sections of the river. Depth, for instance, which might be acceptable when the river is confined in a single braid, is likely to become critically limiting when the river breaks up into several braided channels as it frequently does in the lower reaches (see Fig. 2). In such instances depth is reduced and would undoubtedly become critical. The effects of low flows are evident from data on the Hurunui salmon population - in particular, a very poor recruitment occurred in 1976 as a result of a prolonged period of low flows (below 13.6 cumecs) in 1973 (February 12 to April 15).

In any year of abnormally low flow, the minimum acceptable instream flow should be the natural flow of the river as, for example, during the summer to early autumn period of 1978.

Prolonged denial of upstream access to adult salmon may force them to spawn in main channel areas in the lower reaches. Survival from incubating eggs to emergent fry may be relatively low in such areas, due to severe erosion and deposition of the bed during frequent winter floods.

#### 4.2 Closure of River Mouth

A river mouth-lagoon cycle is characteristic of South Island braided rivers. The lagoon is a transient feature created by displacement of the mouth northward by littoral drift along the enclosing beach. In times of flood the beach is breached opposite the main river channel, and the lagoon disappears until such time as it is re-established by longshore drift (Kirk, Owens and Kelk 1977). Thus the interaction between river level and littoral drift determines the behaviour of the mouth. Extended periods of low flow permit the littoral drift to accumulate shingle deposits on the bar so that higher stages of floods or more frequent floods are required to breach the mouth and re-establish the lagoon cycle (R.M. Kirk, pers. comm.).

Since the littoral drift process is continuous, protracted periods of low flow can result in:

- (i) closure of the mouth
- (ii) alteration of the normal lagoon cycle
- (iii) the occurrence of ponding in the lower channels at high flows, causing flooding (e.g. Clutha River mouth) (R.M. Kirk, pers. comm.).

Fisheries staff observed constrictions of the Hurunui River mouth during March 8-23 1978. During this period, the mouth migrated northwards (see Fig. 3) and the depth of water over the bar became very shallow, less than 25 cm maximum depth. Entry into the river was observed to be very difficult for salmon across this shallow area of fast flowing water. The discharge during this period (as measured at Mandamus) was less than 12.4 cumecs. On March 28 1978 a flood (daily mean discharge 102.3 cumecs) re-established the lagoon cycle by breaching the bar opposite the main river channel.



**FIGURE 2**

**DATE: 15 March 1976**

**DISCHARGE: 29.1 cumecs**

**LOCATION: 3 km below SH 7**



FIGURE 3.

DATE: 7 February 1978

DISCHARGE: 19.7 cu mecs

Although the occurrence of closure of the river mouth is unpredictable, the reasons for and consequences of its occurrence are well known and should be taken into account. Access to the river is of critical importance for the maintenance of viable populations of salmon, trout, eels, whitebait and a variety of other freshwater and marine species.

In view of how critical it is to fishery values that the mouth does remain open, we consider that the river flow after abstractions should at the very least exceed that at which the mouth can remain open and navigable to fish at all times. Our own observations showed that the mouth began to close at discharges below 12.4 cumecs. Since it appears that no precise numerical value can presently be assigned to the discharge below which mouth closure occurs, it is recommended that cessation of abstraction when the mouth becomes constricted should be an integral part of any proposed water abstraction scheme.

#### 4.3 Changes in River Temperature Regime

We have no empirical data on the relationship between discharge and water temperatures. However a survey of the relevant literature shows an inverse relationship, with temperatures tending to rise as discharge drops.

From informal discussions with research staff at the University of Canterbury's Geography Department we understand that studies of Hurunui River temperatures during the 1979/80 summer show that there is a clear inverse relationship between discharge and temperature. Unfortunately, owing to conditions this summer discharges in the river have been high at all times (mostly more than 50 cumecs), so that accurate predictions of river temperatures at very low discharges cannot reliably be made.

FRD's own observations show that summer water temperatures in the Hurunui River reach high levels - in excess of 23°C - and we are most concerned at the potential effects of the proposed abstraction on water temperature, and the resultant effects on the fish populations.

The optimum temperature range for migrating quinnat salmon is 11° - 14°C, with the upper lethal limit being 25°C (Bell 1973). The cumulative effects of high water temperatures and difficulties of access through the river mouth and passage through highly braided reaches cause stress in the fish. Salmon only spawn once and to be successful the fish must reach the stable headwater areas. Since adult salmon cease feeding once they enter freshwater, each fish is entirely dependent on the energy reserves within its body to reach the spawning zones, complete maturation of the gonads, and dig its nest in which to spawn. Once in the river system, the fish must survive in a healthy condition in order to ensure the migration upstream and spawning.

Thus low flows may:

- (i) permit closure of the mouth which would hinder or delay entry of fish and lead to a decline in their condition and viability, or
- (ii) stress the fish in the river itself, due to a combination of high temperatures and difficulty and delays in passage, leading to a further decline in condition.

The relationship between temperature and dissolved oxygen concentrations should also be noted - as temperature rises, dissolved oxygen is reduced. Many stonefly, mayfly and caddisfly larvae (important fish food species), are very sensitive to dissolved oxygen levels (Philipson 1954; Nebeker 1972). Limiting conditions may develop at reduced flows in some of the smaller side braids which might otherwise be quite important to fish.

#### 4.4 Loss of Littoral Habitat

One of the serious implications of reduced flows is the loss of habitat both for fish and for bottom fauna animals that constitute fish food.

Wetted perimeter - a term that is used to describe the interface between the water and the stream bed - is closely related to discharge. This relationship varies with the conformation of the river bed cross-section, but in rivers like the Hurunui that tend to spread widely across a flat to basin-shaped bed, wetted perimeter declines rapidly with flow. Bottom fauna production is a function of wetted perimeter and therefore is related to discharge. Similarly, the variety of small native fish present live and spawn in marginal bouldery shallows and would be affected by reduced flows, particularly if flows dropped suddenly.

#### 4.5 Reduction in Quality of Habitat

Water velocity will be the parameter most affected by water abstractions. The most seriously affected areas are likely to be the braided channels which provide important rearing habitat for both juvenile salmon and trout, and for all age classes of native fish species.

In addition to the loss of riffle areas, a decline in water velocities below a minimum level could precipitate a number of changes in the behaviour and ecology of fish communities:

- (i) may alter the partitioning of stream space between species, as they depend largely on a range of velocities being available to achieve such separation
- (ii) may induce significant changes in the cover and territorial requirements of fish (e.g. fish may aggregate in shoals in pools rather than actively defend feeding territories in riffles), which could ultimately affect growth and survival

- (iii) may seriously reduce the production of fish food organisms, which in turn would increase competition for food between fish species, resulting in poor growth and survival
- (iv) may affect predator-prey relationships between fish species, which may lead to a serious loss in numbers of an economically valuable species.

Long periods of low stable flows may result in an increased abundance of algae. Algae can flocculate the suspended material typically carried by rivers such as the Hurunui, resulting in a loss of invertebrate habitat, by filling the interstices between stones.

#### 5. SAFEGUARDS FOR THE PROTECTION OF THE FISHERY

1. The mouth must remain open at all times to enable fish movement. Therefore if mouth closure is imminent preventing access to the river from the sea by fish, all abstraction should cease. This is in accord with the Board's stated objective (1) of the Hurunui River Water Management and Allocation Plan (1979) - "To preserve the natural flow pattern of the river".
2. If the river flow measured at Mandamus is less than 22 cumecs, we request that abstraction cease for 12 hours every 3 days. (This could be timed to suit irrigator's day to day planning of water use). This measure would assist passage up-river for salmon and trout and permit the retention of bottom fauna in the normally wetted margins of the river. It should also be used if continuous low flows prevent salmon passage upstream.
3. Consideration should be given to reducing or ceasing abstraction if river temperatures at Mandamus exceed 19°C at about which temperature stress and mortalities of salmon are known to occur.

4. All intakes for water abstraction should be screened, so that fish are not lost from the river system.

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