in the matter of: the Resource Management Act 1991

and

in the matter of: applications for resource consent by applicants in the lower Waitaki River Catchment under the Waitaki Catchment Water Allocation Regional Plan

Brief of evidence of Ian George Jowett

Dated: 28 August 2008

BRIEF OF EVIDENCE OF IAN GEORGE JOWETT

QUALIFICATIONS AND EXPERIENCE

1 My full name is **Ian George Jowett**.

2 I am a scientist and was employed by the National Institute of Water and Atmospheric Research until my retirement on 31 October 2007. Since then, I have been a private consultant. I am authorised to give this evidence on behalf of Meridian Energy.

3 My qualifications and experience are set out in the evidence I presented to the Hearing Panel in August 2007 for NBTC and October 2007 for HDI.

4 I have read the Code of Conduct for Expert Witnesses (Rule 330A, High Court Rules and Environment Court Practice Note) and agree to comply with it. I have complied with it in the preparation of this statement of evidence.

5 In preparing my evidence I have reviewed:

5.1 The resource consent applications of the Applicants;

5.2 Relevant parts of the Waitaki Catchment Water Allocation Regional Plan;

5.3 Relevant submissions of others, namely Fish & Game and the Department of Conservation.

SCOPE OF EVIDENCE

6 I have been asked by Meridian Energy Limited (MEL) to prepare evidence in relation to the changes to the flow regime and instream habitat of the lower Waitaki River under all existing consents and those being heard as a part of the current hearing process under various scenarios. This includes the NBTC and HDI consents. Mr Potts describes the consents in his evidence.

7 I consider two allocation scenarios, the existing consents and those being heard as a part of the current hearing process (74.5 cumecs) and full allocation (90 cumecs). I consider the effects of these two allocation scenarios on river flows and habitat for the cases when the Waitaki River discharge is low and results in a minimum flow of 100 cumecs below the most downstream intake, and when the

Waitaki River is at median flow. In my HDI evidence (October 2007) I also evaluated the effects of these two allocation scenarios with the proposed HDI minimum flow of 100 cumecs and the Waitaki Catchment Water Allocation Regional Plan ("*WRP*") minimum flow of 150 cumecs. Those comparisons are relevant for the present consent applications and are summarised in paragraphs 67, 68, and 72 of my HDI evidence.

8 For this hearing, I consider a minimum flow of less than 150 cumecs and present:

8.1 A summary of the proposed takes from the river and the resulting flow regime;

8.2 A summary of habitat changes along the river with the two abstraction scenarios and the river at median flow and the low flow that results in the greatest habitat changes.

8.3 An assessment of the ecological effects of the habitat differences taking the frequency and duration of low flows into account.

9 Not all applicants being heard as a part of the current hearing process seek the same minimum flow. At the time of preparing this evidence, I understand that Waihao Downs Irrigation Limited seeks a 100 cumec minimum flow (like the HDI). The non-consumptive take by Clarkesfield Holdings (1996) Limited also seeks a 100 cumec minimum flow but discharges back to the Waitaki River.

10 The majority of applicants seek a variable monthly minimum flow based on the NBTC 'AFR' flow regime. As an alternative, they seek a 100 cumec minimum flow but they currently state that this is dependent on an agreement with Meridian Energy Limited. Three applicants (Torach Farms Limited, Waitaki Orchards and Chalmers) are seeking a 150 cumec minimum flow.

Summary of flow regime changes

11 Flow statistics for the Waitaki River can differ depending on the period of record used and the way the power station and upstream storages are operated. The recorded flows for the Waitaki Power Station for the period January 1980 to December 2005 were used for the analysis of the effects of the NBTC on the Waitaki River, and were described in the NBTC evidence of Mr Henderson. Mr Henderson showed that flows between 1980 and 2005 were slightly

higher (5.5%) than normal, with a mean flow of 382 cumecs, a median flow of 369 cumecs and a 7 day mean annual low flow of 206 cumecs. However for the analysis of irrigation reliability for the HDI, we used a longer time series (Plexos) that simulate the operation of the Waitaki Power Station. These flows have a mean flow of 361 cumecs, a median flow of 348 cumecs and a 7 day mean annual low flow of 187 cumecs.

12 Most of the existing and proposed takes (including the HDI and Waihao Downs takes) occur below Black Point in the lower 30 km of the river (Fig. 1).

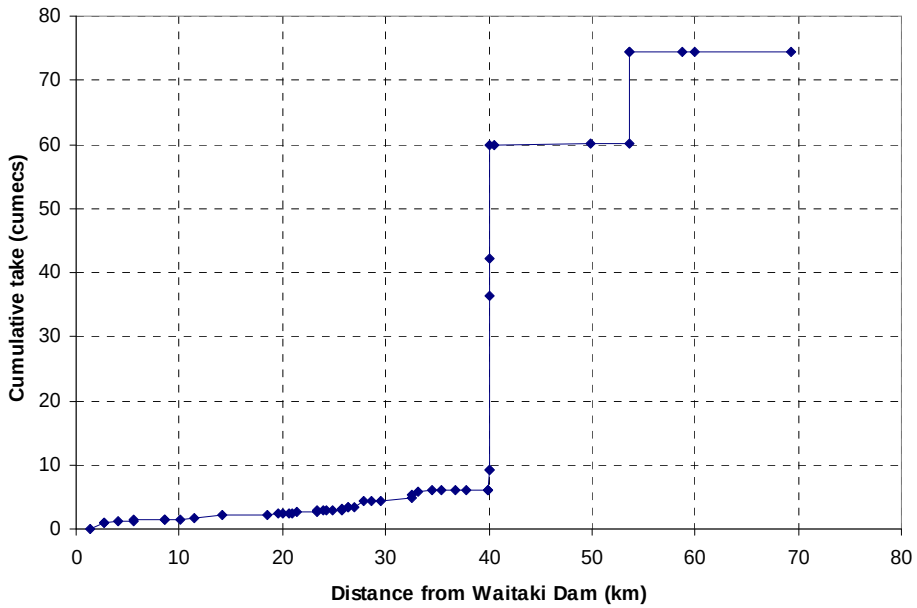

Figure 1. Cumulative abstraction of existing and proposed takes (shown with markers) below Waitaki Dam.

13 From Waitaki Dam, the total abstraction gradually increases to about 6 cumecs until Black Point, 40 km from the dam, where it then increases sharply by about 60 cumecs (mainly HDI, Waihao Downs, Morven Glenavy and Lower Waitaki Irrigation). The next large abstraction is a further 14 cumecs (Morven Glenavy) at Bell's Pond about 54 km below the dam. Figure 1 shows clearly that abstractions between Waitaki Dam and Black Point will have very little effect on the river flow and aquatic organisms, and that the main effects will occur in the reaches below Black Point and below Bell's Pond.

14 With full allocation (90 cumecs), there is a general reduction in flow below Bell's Pond. For example, the flow that is exceeded 90% of

the time reduces from 223 to 167 cumecs. However, it is evident from the flow duration curves that flows are between 215 and 400 cumecs for 80% of the time and only fall below 150 for a relatively small amount of the time (7%).

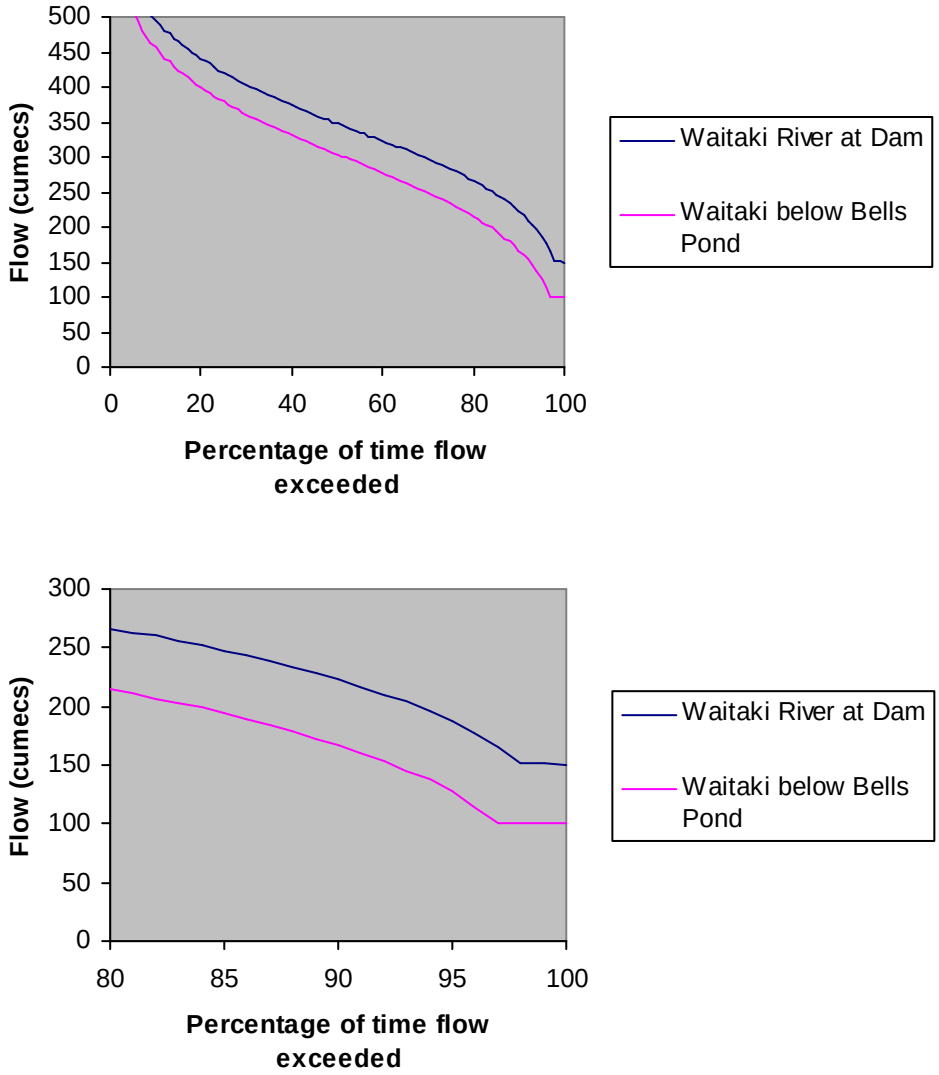

Figure 2. Flow duration curves (July 1931 to June 2004) (lower curve shows the low flow range) for the Waitaki River at the Waitaki Dam (dark line) and the Waitaki River below Bell's Pond (light line) with full allocation and a minimum flow of 100 cumecs.

15 The main changes to the flow regime of the lower Waitaki River that would result from the HDI, full allocation (90 cumecs) and a minimum flow of 100 cumecs are:

- Low flows are most likely to occur between November and February.

- With a minimum flow of 100 cumecs, flows below Bell's Pond would normally be between 150 and 100 cumecs for 18 days a season and at 100 cumecs for 4 of those days. In very dry seasons, flows could be at 100 cumecs for 60 days and 150 cumecs or less for up to 80 days (recurrence interval > 1 in 15 years).

- Between Black Point and Bell's Pond, the minimum flow would be about 115 cumecs for 4 days per season, on average, but could be at this flow for 60 days in very dry years.

- Above Black Point, abstractions will result in very little change to the flow regime.

16 With existing and proposed takes (74.5 cumecs), the flow regime is similar with:

- Flows below Bell's Pond would normally be between 150 and 100 cumecs for 13 days a season and at 100 cumecs for 2 of those days. In very dry seasons, flows could be at 100 cumecs for 55 days and 150 cumecs or less for up to 70 days (recurrence interval > 1 in 15 years).

17 A variable monthly minimum flow of between 110 and 150 cumecs for some of the applicants will have little effect, on the overall flow regime, because their total abstraction is about 2 cumecs of the total existing and proposed abstractions of 74.5 cumecs.

Habitat changes along the river resulting from abstraction

18 Depending on the flow in the river and the species being considered, a reduction in flow from abstraction can increase or decrease the amount of suitable instream habitat. I have excluded salmonid spawning and algae from this evaluation, because spawning occurs outside of the irrigation season and because some algae species are regarded as deleterious.

19 With a median flow of 348 cumecs, the existing and proposed takes reduce the amount of habitat below Black Point by an average of 2.0% for 21 fish and invertebrate species/life stages and by an average of 2.7% below Bell's pond (Fig. 3 attached to the end of this evidence). With full abstraction, the average reduction is slightly greater at 2.7% below Black Point and 3.4% below Bell's Pond (Fig. 4). With median flow, there is a slight increase or little change in salmon angling and salmonid habitat and generally a decrease in habitat for native fish and benthic invertebrates. My

assessment of effects for the HDI focussed on the river below Bell's Pond where the greatest reduction in flow and habitat would occur. This analysis shows that effects would be less between Black Point and Bell's Pond, and above Black Point, irrigation abstractions would only have a minor effect on instream habitat.

20 Maximum habitat loss occurs when the flow at Waitaki Dam is sufficient to provide for all abstractions and leaving a minimum flow of 100 cumecs. With existing and proposed abstractions and a flow of 174.5 cumecs at Waitaki Dam, the average reduction in habitat is 9.6% at Black Point and 11.8% at Bell's Pond (Fig. 5). With full abstraction and a flow of 190 cumecs at Waitaki Dam, the average reduction in habitat is slightly greater, with 11.0% below Black Point and 13.1% below Bell's Pond (Fig. 6). With these flows, there is an increase in adult brown trout and salmon angling habitat and a decrease in habitat for juvenile salmonids, native fish and benthic invertebrates.

21 In a braided river, a reduction in flow is accompanied by a relatively large reduction in wetted area, and this usually results in a loss in habitat for many aquatic species. Of the aquatic species or life stages considered here, a flow reduction to 100 cumecs results in a net loss of habitat for all but two, salmon angling and adult brown trout, for which a reduction in flow created more preferred habitat. Habitat loss was greatest for native fish because they tend to live in small braids. There were only small changes to the quality of habitat, as measured by the average habitat suitability index (Table 2 of my HDI evidence) and this suggests that the reductions in habitat might reduce total numbers, but not densities nor species composition.

Ecological effects

22 The habitat analyses presented above show that habitat loss usually increased as the amount of water taken from the river increased. However, this does not necessarily mean that there will be significant ecological changes. Reductions in habitat should only affect a species if that species is already limited by the amount of available habitat. The duration of low flows should also be taken into consideration, with detrimental effects usually increasing with duration of low flow.

23 Above Black Point, irrigation abstractions reduce instream habitat by less than 2%, even when flows below Bell's Pond are at minimum flow as I show in Figures 3 to 6. Such small changes in instream habitat will have no effect on the biological state of the river.

24 Habitat loss and potential effects increase below Black Point, with maximum effects below Bell's Pond. Even there with median river flows, the loss of habitat is small: less than 3% on average and no more than 10% for any species. The question is whether minimum flows that persist for 3 or so days each season would have any detrimental effect on aquatic organisms. It seems unlikely that such a small change, for such a short time, would have more than a short-term effect on fish or benthic invertebrates through localised displacement and perhaps some mortality. If benthic invertebrates were affected, they can re-establish populations within weeks, as their rapid cover from the deleterious effects of floods demonstrates.

25 However, in very dry seasons, low flows could persist for more than 60 days and this duration of low flow is sufficient to result in reductions in native fish and salmonid populations. Fast water native fish species (torrentfish and bluegill bullies) would be most affected. Native fish populations would recover in the following season with recruitment from the sea. Although adult brown trout habitat would not be affected by a reduction in flow, there would be a reduction in food supply. This could either reduce the adult trout population or reduce the condition of the trout. Less is known about the effects of low flows on adult rainbow trout or juvenile salmon, but the loss of habitat and reduction in food supply might affect these species, and the recovery time would be about 3 years.

26 Thus, the proposed abstraction with a minimum flow between 100 and 150 cumecs is likely to have limited ecological effects, other than in extremely dry seasons. Benthic invertebrates would not be affected because of their short life cycles, and any productive areas temporarily lost as flows reduce would soon be recolonised. It is unlikely that there would be any long-term effects on the food chain because of the short duration of the low flows. Native fish habitat would be limited for a short time and it is possible that there could be some effect on torrentfish and bluegill bullies, either by reducing numbers or causing them to concentrate in the most suitable habitats. Salmon angling would be affected, but this would be for a very limited time of the short duration of low flows and because minimum flows would generally occur before the peak of the angling season. Adult brown trout habitat would increase, but there would

be some decrease in juvenile salmonid habitat. Salmon and brown trout spawning would not be affected because spawning occurs in the winter when there is little abstraction.

FLOW AVERAGING 24, 48 AND 72 HOUR

27 Dr Painter and Mr Stewart have suggested that the minimum flow for irrigation purposes should be based on the 24 hour average rather than a one hour flow, as specified in the Waitaki Catchment Water Allocation Regional Plan. This is eminently practical for the operation of an irrigation intake. For example, flows from the Waitaki Dam have always varied during the day, usually with higher flows during the day and lower flows during the night. In my evidence for the HDI, I showed that over the 4 years, 1996-2000, the average daily fluctuation was about 80 cumecs. This amount of fluctuation is equally likely during periods of high and low average flow, as shown on Figure 8 of my HDI evidence. If the average daily flow were about 190 cumecs, flows from Waitaki could vary from 150 to 230 cumecs during the day. With constant irrigation abstraction of 70 cumecs or more through the day, flows in the river below Bell's Pond could be below a minimum of 100 cumecs for about half a day, even though the daily average would be greater than the minimum. These excursions below minimum flow would be rare. Daily mean flows at Waitaki Dam are less than 190 cumecs for about 5% of the time.

28 The ecological effect is to increase the varial zone at low flow and this results in some additional habitat loss for benthic invertebrates. A 40 cumec flow change affects about 24 m or 14% of the total wetted river width. However, the overall effect of this habitat reduction is likely to be minor because firstly the events will be infrequent and secondly because benthic invertebrates can recover from the effects of fluctuations within a matter of weeks, provided higher flows are re-established. Fish species are more mobile than benthic invertebrates and I would not expect them to be affected, either directly or through the food chain. Increasing the averaging interval to 48 or 72 hours increases the risk of larger fluctuations and correspondingly greater effects.

SUMMARY

29 The ecological effect of any change to the flow regime of the Waitaki River will depend on the duration and magnitude of low flows. The duration and frequency of low flows was calculated from modelled flows assuming current (2005) operating procedures, a 150 cumec

minimum at Waitaki Dam, seasonally varying maximum irrigation takes, and a minimum flow of 100 cumecs to the sea. The main point to note is that periods of low flow are usually of relatively short duration, with river flows between 215 and 400 cumecs for 80% of the time and less than 150 cumecs for only 7% of the time.

30 If minimum flows for abstraction are based on a 24 hour or longer average flow, flow fluctuations from Waitaki Dam could result in the flows falling below the minimum flow for periods during the day. This would occur infrequently and would only affect immobile species, such as benthic invertebrates. Benthic invertebrates would recover with a few weeks, so that I would not expect any significant effect on the amount of benthic invertebrates available to fish.

31 Although abstraction reduces the amount of habitat for fish and invertebrates, any effect on fish or benthic invertebrates is likely to be small in the river because of the usually short duration of low flows. The minimal change in average habitat suitability suggests that there would be good quality habitat in the river at low flows and that any reductions in habitat might reduce total numbers, but not density or species composition.

32 The worst effects of a reduction in minimum flow would occur in extremely dry seasons (approximately 1 in 15), when the minimum flow would persist for about two months. As with natural ecosystems, this would create year to year variability, and populations would recover within 1 to 3 years.

33 The small amount of abstraction by applicants seeking variable monthly minimum flow or a minimum of 150 cumecs will not affect the low flow statistics or my assessment of overall effects.

34 My assessment of effects has focussed on areas of the river below Bell's Pond where the greatest reduction in flow would occur. Effects would be less between Black Point and Bell's Pond, and above Black Point, irrigation abstractions would have an insignificant effect on instream habitat and aquatic organisms.

Dated: 28 August 2008

Ian Jowett

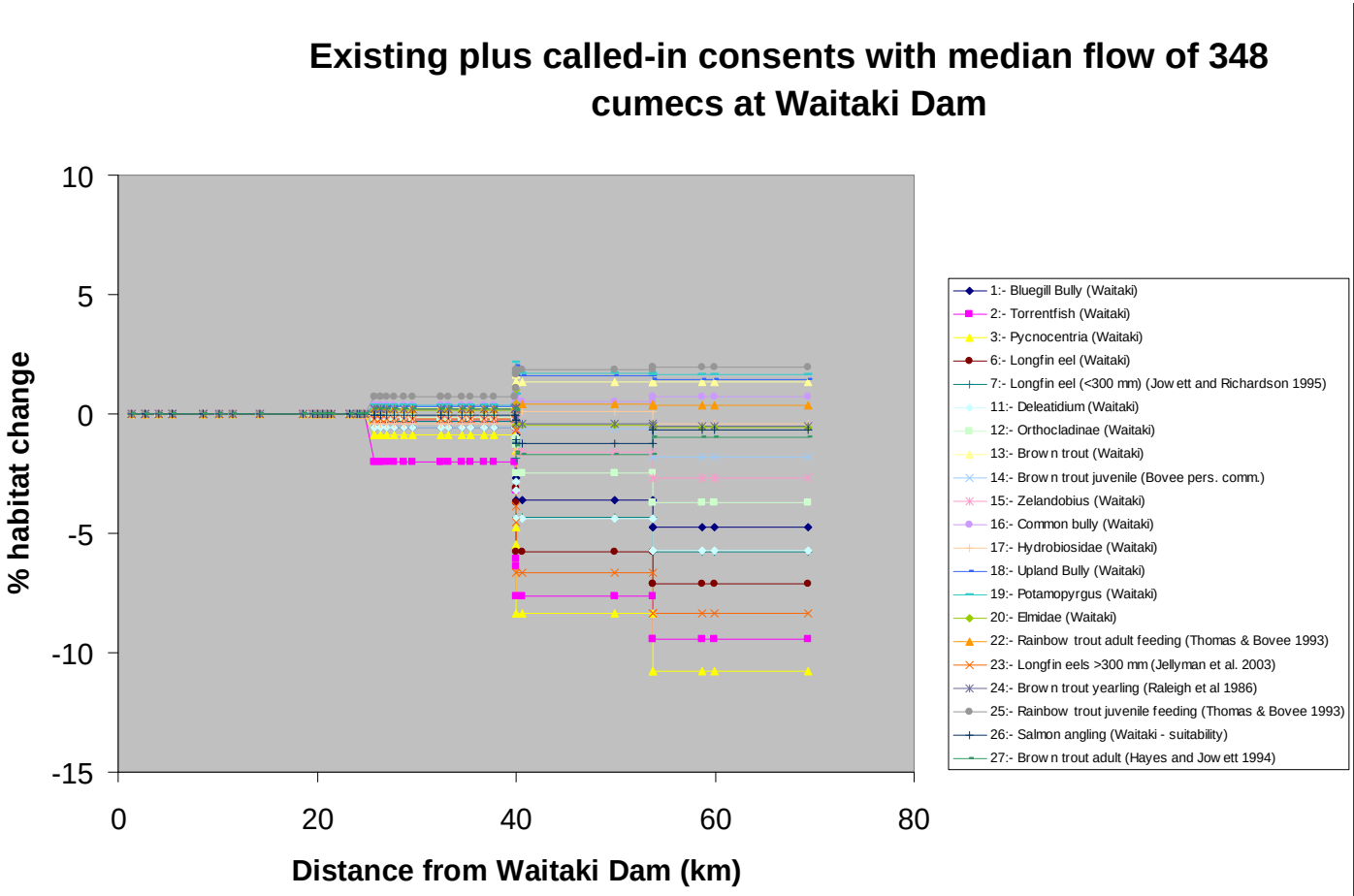

Figure 3. Cumulative percentage change in habitat caused by existing consents and those being heard as a part of the current hearing process with a median flow of 348 cumecs at Waitaki Dam. Black Point is at 40 km and Bell's Pond at 53 km.

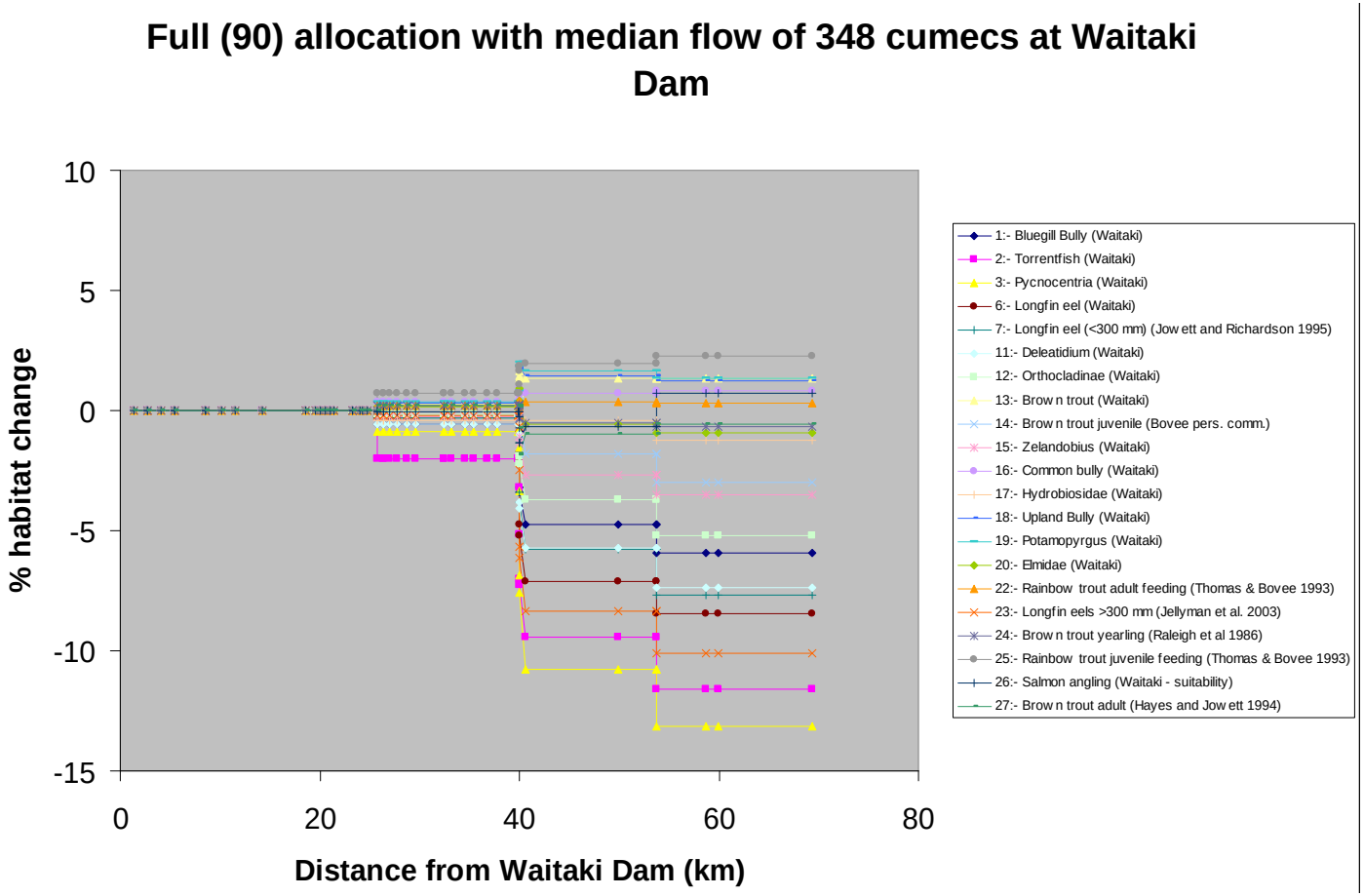

Figure 4. Cumulative percentage change in habitat caused by total abstraction of 90 cumecs with a median flow of 348 cumecs at Waitaki Dam. Black Point is at 40 km and Bell's Pond at 53 km.

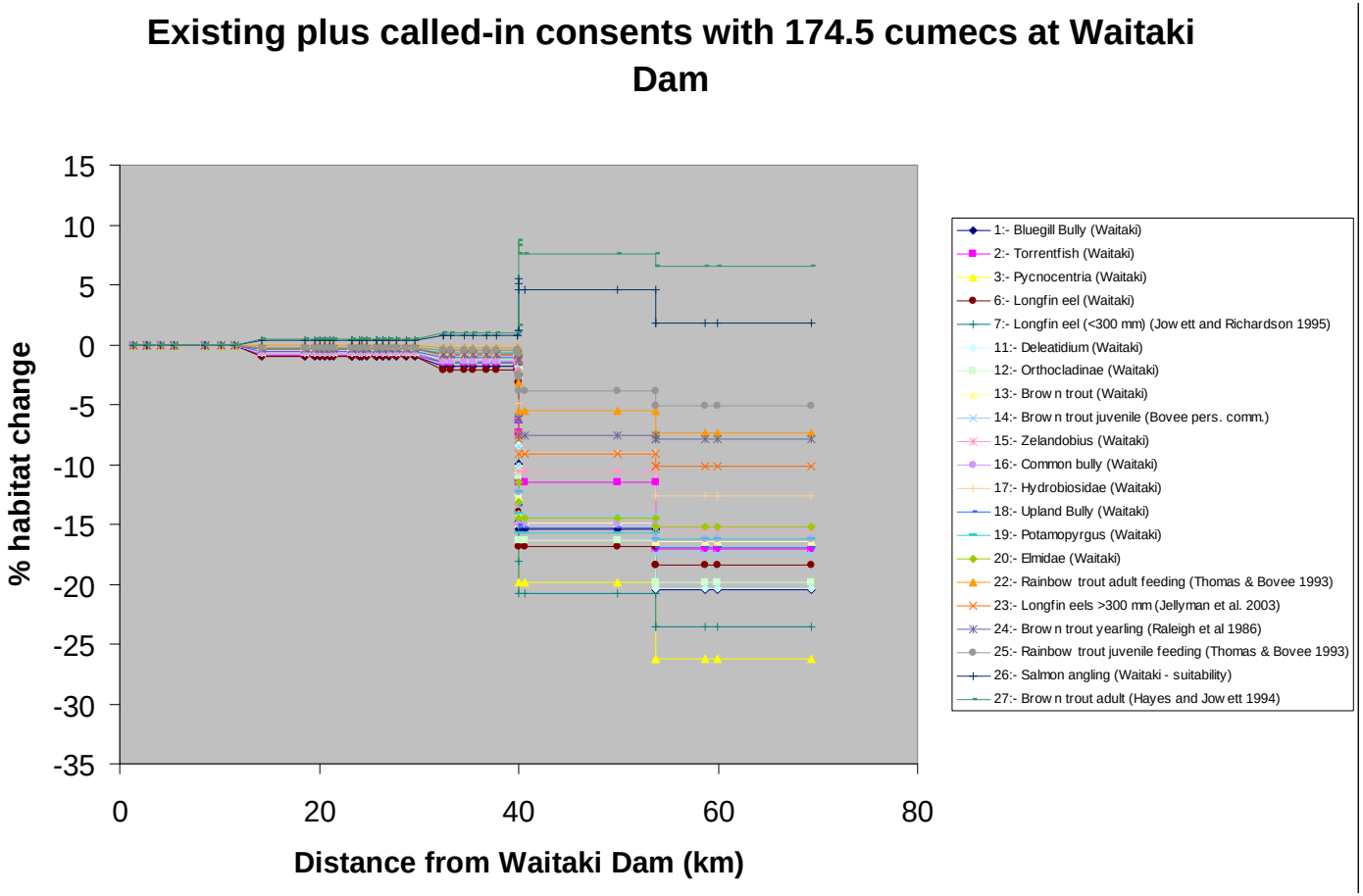

Figure 5. Cumulative percentage change in habitat caused by existing consents and those being heard as a part of the current hearing process with a flow of 174.5 cumecs at Waitaki Dam. Black Point is at 40 km and Bell's Pond at 53 km.

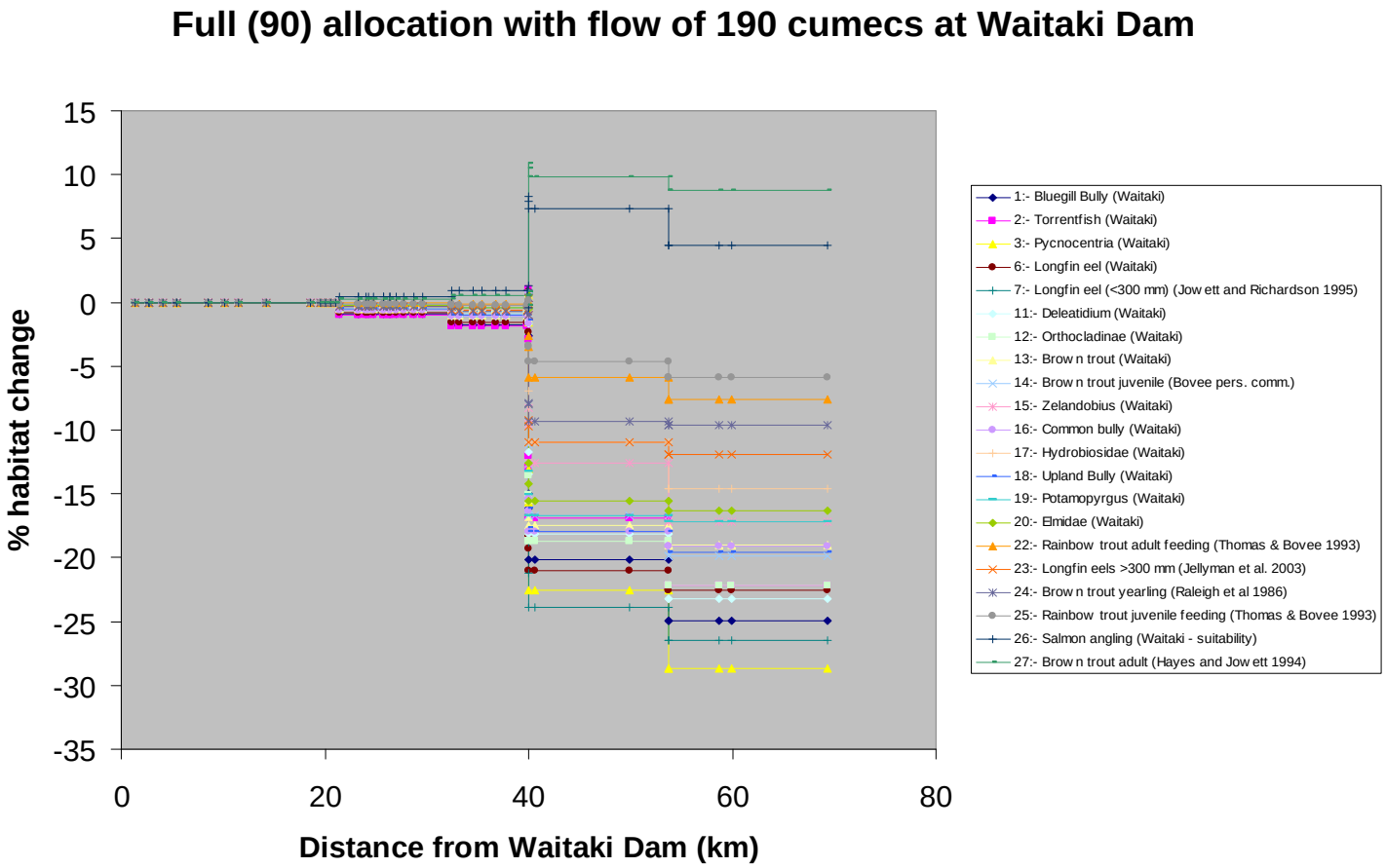

Figure 6. Cumulative percentage change in habitat caused by total abstraction of 90 cumecs with a flow of 190 cumecs at Waitaki Dam. Black Point is at 40 km and Bell's Pond at 53 km.