CAWTHRON INSTITUTE

REPORT NO. 2414

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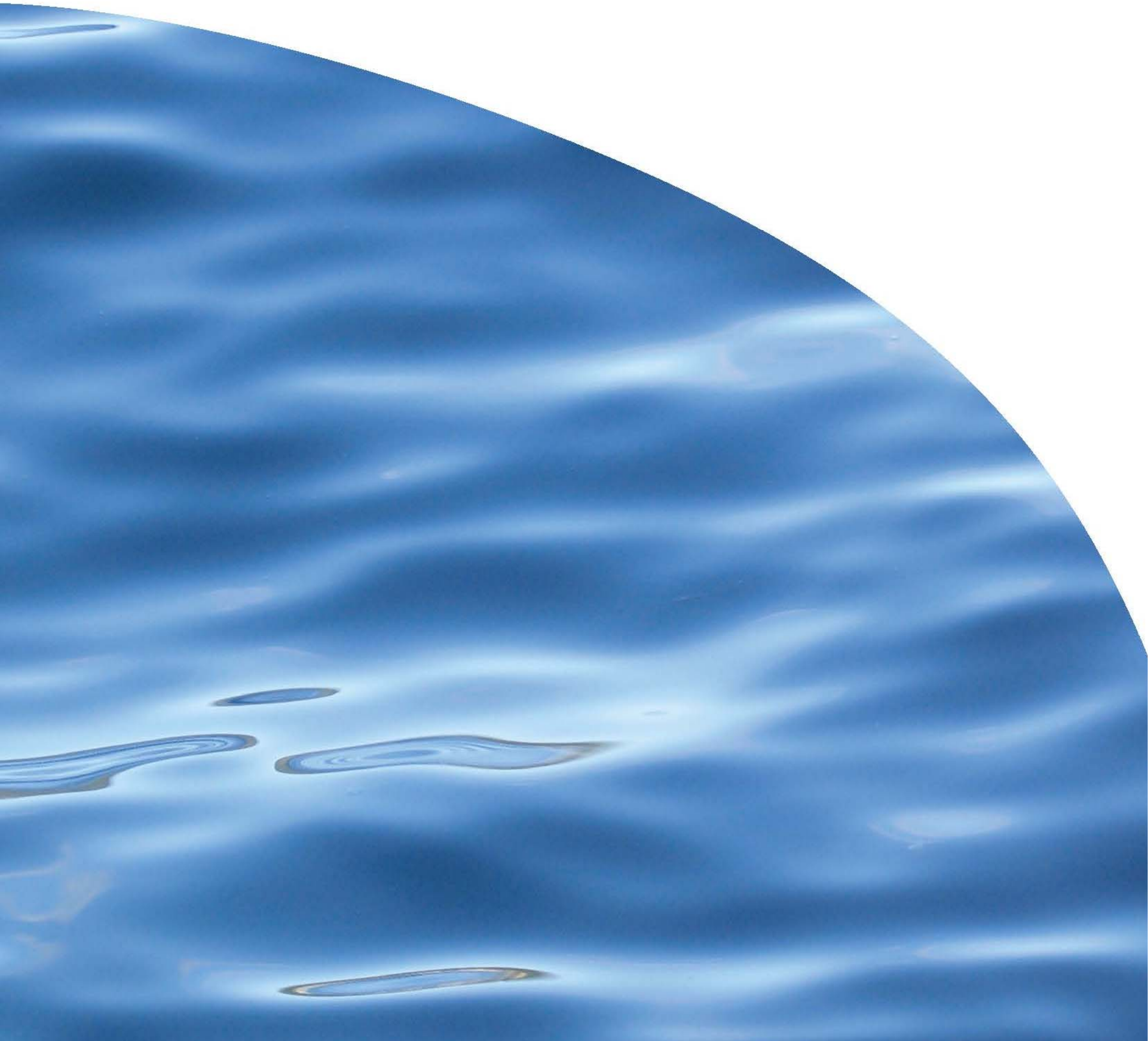

IMPLICATIONS OF DIFFERENT MINIMUM FLOWS IN THE LOWER WAIMEA RIVER

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Prepared for Tasman District Council

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ISSUE DATE: 17 September 2013

RECOMMENDED CITATION: Young R, Allen C 2013. Implications of different minimum flows in the Lower Waimea River. Prepared for Tasman District Council. Cawthron Report No. 2414. 6 p.

1. HABITAT AVAILABILITY FOR FISH

In this report we summarise the results of existing studies on the implications of different minimum flows in the Waimea River.

Ecological flow requirements for the Waimea River in the section upstream of the Appleby Bridge were assessed by Hay and Young (2006). Using a physical habitat model, Hay and Young assessed the effects of different minimum flows on the maintenance of habitat for adult brown trout. Brown trout attract relatively high angler use of the Waimea River and have the potential to support a valued fishery, given sufficient flows. Brown trout are also among the most flow demanding freshwater fish in New Zealand rivers, and so providing adequate flow for them should also provide for the flow needs of other species, including most native fishes.

The estimated natural mean annual low flow (MALF) of 1.3 m^3/s was used as the environmental benchmark minimum flow for the Waimea River, immediately upstream of the Appleby Bridge. Based on this, Hay and Young (2006) found that a minimum flow of 0.5 m^3/s would retain 70 % of the adult brown trout habitat available at the natural MALF, while a minimum flow of 0.8 m^3/s would retain 80 % of habitat. Using the habitat - flow relationship modelled by Hay and Young (Figure 1), it is possible to predict the impact of minimum flows other than those initially assessed. The habitat – flow relationship for adult brown trout indicates a fairly linear decline in habitat with flow below 1.7 m^3/s. A minimum flow of 0.65 m^3/s is predicted to retain approximately 75% of the adult brown trout habitat available at the natural MALF.

Hay and Young (2006) predicted that there would be a consistent increase in habitat availability with flow for most of the native fish that were modelled (Figure 2). In contrast, inanga feeding habitat availability was predicted to peak at around 0.8 m^3/s with a rapid decline in habitat availability at flows above and below this level (Figure 2), while habitat availability for upland bully was predicted to be relatively similar across the flow range modelled (Figure 2).

Longfin eels, torrentfish, inanga, bluegill bully and redfin bully are classified as ‘declining’ in the latest national threat classification for native fish (Allibone et al. 2010). Despite this classification, these species are still relatively widespread and common. Nevertheless, it is worth considering the retention of habitat availability for these species compared with that available at the MALF. A minimum flow of 0.5 m^3/s is predicted to retain >80% of the habitat available at the natural MALF for longfin eel, shortfin eel, redfin bully, common bully and common smelt, but only 45-50% of the habitat available at the natural MALF for bluegill bully and torrentfish. A minimum flow of 0.8 m^3/s is predicted to retain >90% of the habitat available at the natural MALF for longfin eel, shortfin eel, redfin bully, common bully and common smelt, but only 70% of the habitat available at the natural MALF for bluegill bully and torrentfish.

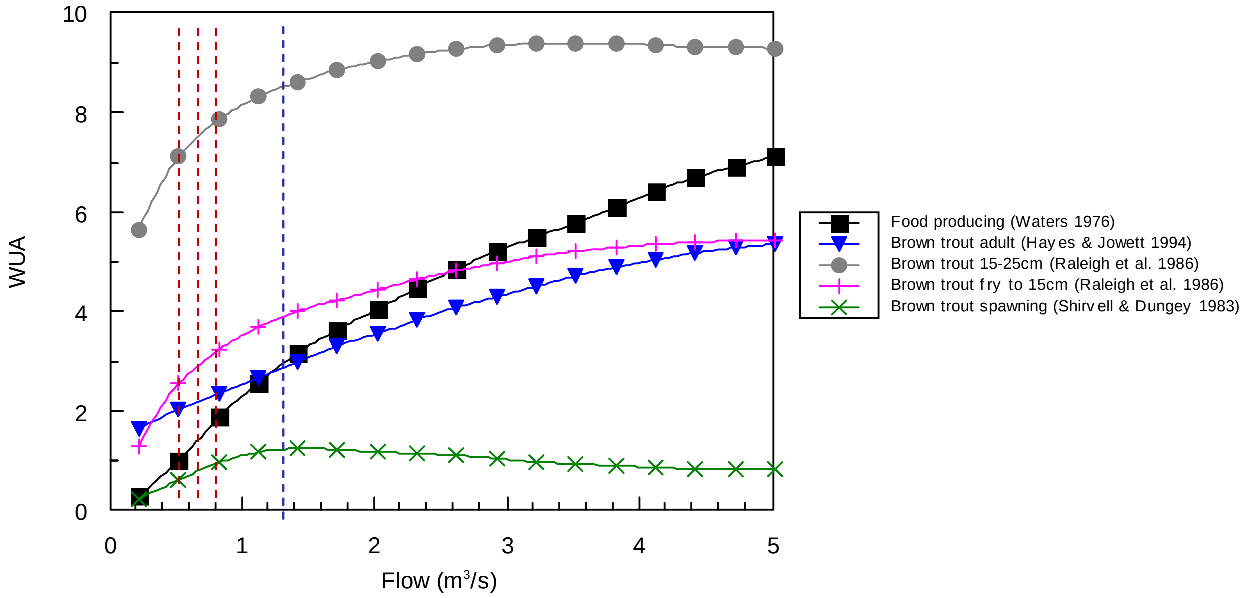

Figure 1. The relationship between habitat availability (WUA[1]) and flow for brown trout. (Source: Hay & Young 2006). The red dashed lines show flows of 0.5 m^3/s, 0.65 m^3/s and 0.8 m^3/s. The blue dashed line shows the mean annual low flow (MALF), as defined by Hay and Young (2006).

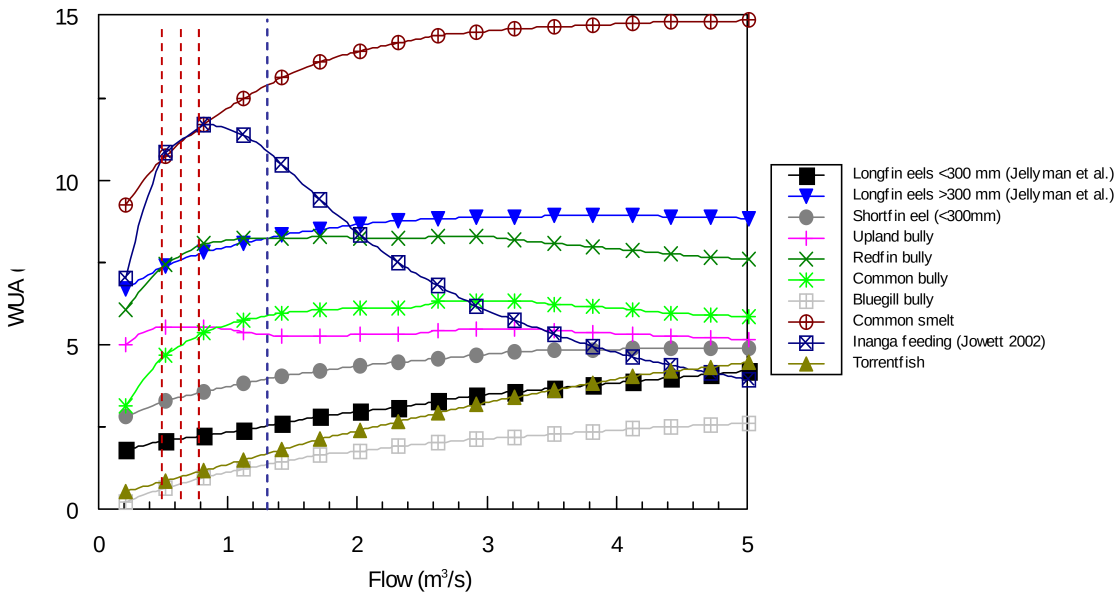

Figure 2. The relationship between habitat availability (WUA[1]) and flow for a variety of native fish (Source: Hay & Young 2006). The red dashed lines show flows of 0.5 m^3/s, 0.65 m^3/s and 0.8 m^3/s. The blue dashed line shows the mean annual low flow (MALF), as defined by Hay and Young (2006).

[1] WUA is an index of both habitat quality and quantity

The decision on what level of habitat should be retained is based more on risk management than ecological science. The risk of ecological impact increases as habitat is reduced. When instream resource values are factored into the decision making process, then the greater the resource value the less risk is acceptable. For example, Jowett & Hayes (2004) suggested that a high quality fishery of national significance, or a threatened species of national or international conservation status, might warrant at least a 90% habitat retention level. A low valued fishery of local significance might warrant up to 70% habitat retention level, and a moderately valued fishery would fall somewhere in between these levels of habitat retention.

A minimum flow set at the MALF (1.3 m^3/s) would be the most environmentally conservative minimum flow. In contrast, a minimum flow of 0.5 m^3/s would provide only 70% of the adult brown trout habitat available at the natural MALF. A reduction in habitat of this magnitude would be expected to cause some level of decline in trout abundance from the condition at the natural MALF.

2. FISH PASSAGE

Minimum depths for fish passage in the Waimea River were assessed in an earlier in-stream habitat assessment by Hayes (1998). Modelling indicated that adult trout passage would be possible throughout all sites in the lower Wairoa / Waimea rivers with flows greater than 0.65 m^3/s (Figure 3). However, at 0.5 m^3/s fish passage would not be possible at one of the lower Wairoa / Waimea sites — a riffle located below the confluence with the Wai-iti River. There is a breakpoint in the response of river depth to flow at around 0.3–0.5 m^3/s, below which the maximum depth decreases more rapidly.

Native fish species are able to negotiate very shallow water and hence flows that are adequate for the passage of adult trout will be more than sufficient for the native species present in the catchment.

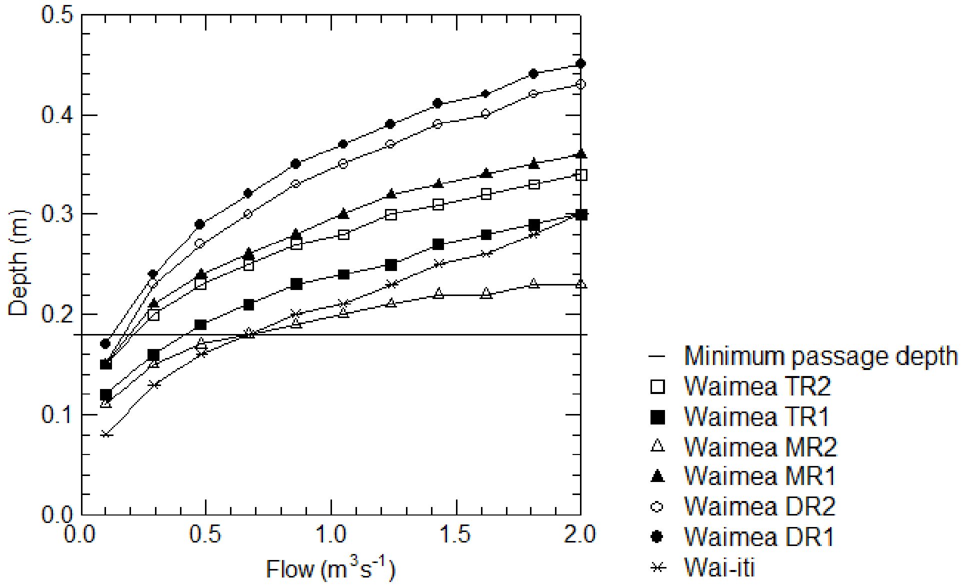

Figure 3. Relationships between maximum depth and flow for riffle cross-sections in the Wairoa / Waimea and Wai-iti rivers. (TR = Clover Road, MR = d/s Wai-iti confluence, DR = Challies Island reaches). The horizontal line is the minimum depth requirement for adult trout passage (0.18 m). (Source: Hayes 1998)

3. BENTHIC CYANOBACTERIA

Phormidium is a type of benthic cyanobacteria that can form extensive black mats on river beds. In some situations, these mats can produce toxins which represent a potentially serious health risk to people and domestic animals that come into contact with the mats. Dogs, in particular, are attracted to the musty smell of cyanobacteria mats washed up along the river margins, and can die within minutes of consuming this material if it contains the toxins. Benthic cyanobacterial mats also reduce habitat quality for fish and river invertebrates by clogging up the spaces between stones on the river bed, displacing edible algae from rock surfaces, and perhaps having toxic effects on some other river life. They also impart a musty/earthy taint to fish flesh, reducing palatability. Aesthetic values of rivers are also reduced by proliferations of these black mats. Therefore, although it is naturally present in NZ rivers, proliferation of *Phormidium* is considered undesirable.

While the occurrence of benthic cyanobacteria mats in parts of New Zealand have apparently increased in recent years, there has been no evidence to suggest that this is due to the magnitude of low flows. Rather, recent research has suggested that *Phormidium* can grow in a variety of depths and velocities, and blooms are largely driven by the absence of recent flushing flows (Heath et. al in press). Therefore, the occurrence of benthic cyanobacteria in the Waimea River is not likely to be affected by changes in minimum flows over the 0.5–1 m^3/s range.

4. WATER TEMPERATURE

Some sensitive aquatic species will tolerate only relatively cold water and may become stressed or die if water temperatures become too high. Habitat data collected by Hay and Young (2006) were used to model temperature change with flows of between 0.3–1.3 m^3/s. Maximum and minimum temperatures are predicted to be marginally higher and lower, respectively, with reduced flow (Figure 4). However, the mean temperature is predicted to remain unchanged across the modelled flow range. Studies from elsewhere indicate that water temperatures are not particularly sensitive to changes in flow — and noticeable effects are expected only at extremely low flows (Theurer *et al.* 1984). The effects of shading (or lack of) and changes to inputs of cool groundwater would be expected to have a much greater impact on the thermal regime of the river (Young *et al.* 2013).

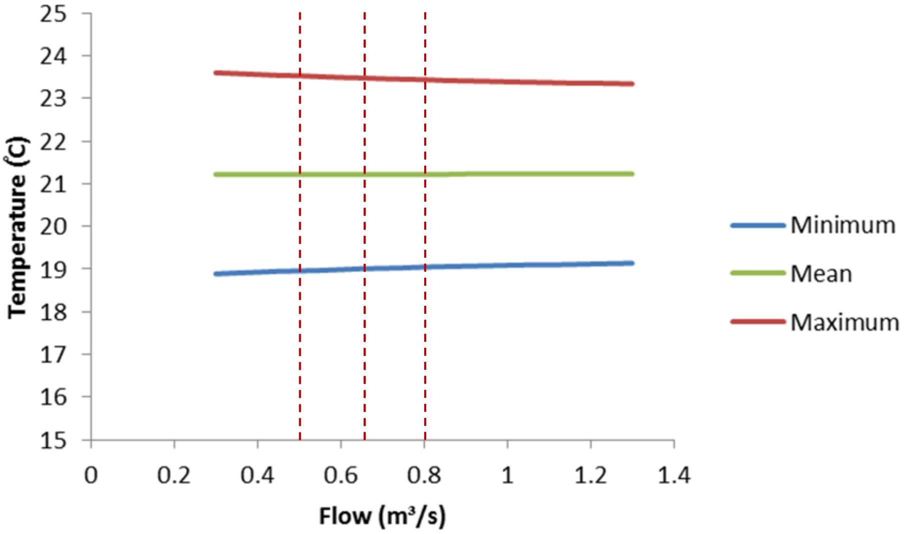

Figure 4. Modelled change in temperature with change in flow for the lower Waimea River. The red dashed lines show flows of 0.5 m^3/s, 0.65 m^3/s and 0.8 m^3/s.

5. SUMMARY

The most environmentally conservative minimum flow for the Waimea River would be based on the natural MALF (1.3 m^3/s). A minimum flow of 0.5 m^3/s would provide 70% of the adult brown trout habitat available at the natural MALF and 50% of the torrentfish habitat available at the natural MALF. Minimum flows of 0.65 m^3/s and 0.8 m^3/s are in between these extremes and would retain approximately 75 to 80% of habitat available for adult brown trout, and 60 to 70% of habitat available for torrentfish. The decision on what level of habitat should be retained is based more on risk management than ecological science. High levels of habitat retention are

appropriate to support significant values, while lower levels of retention may be acceptable if the values are considered to be of lesser importance.

Fish passage is predicted to be possible throughout the lower Waimea / Wairoa rivers at flows >0.65 m^3/s. However, at a flow of 0.5 m^3/s minimum water depths in at least one riffle are expected to restrict adult trout movement.

The cyanobacterium *Phormidium* can grow in a variety of depths and velocities, and blooms are largely driven by the absence of recent flushing flows. Therefore, the occurrence of benthic cyanobacteria in the Waimea River is not likely to be affected by changes in minimum flows over the 0.5–1 m^3/s range

Changes in minimum flows over the range between 0.5 and 1.0 m^3/s are predicted to result in negligible changes in water temperature.

6. REFERENCES

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