

IN THE MATTER OF

the Resource Management Act
1991

AND

IN THE MATTER OF

applications by Central Plains Water
Trust to:

Canterbury Regional Council for
resource consents to take and use
water from the Waimakariri and
Rakaia Rivers and for all associated
consents required for the
construction and operation of the
Central Plains Water Enhancement
Scheme

Selwyn District Council for resource
consents to construct and operate
the Central Plains Water
Enhancement Scheme

AND

IN THE MATTER OF

a notice of requirement by Central
Plains Water Limited to:

Selwyn District Council for the
designation of land for works
associated with the construction and
operation of the Central Plains
Water Enhancement Scheme

SUPPLEMENTARY EVIDENCE OF RICHARD MARK ALLIBONE

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INTRODUCTION

1. My full name is Richard Mark Allibone. My qualifications and experience, and the basis on which I prepared this brief, are set out in my main brief of evidence prepared for the Central Plains Water Enhancement (CPW) hearing (dated January 2008). I have prepared this supplementary brief of evidence to address matters raised by Associate Professor Angus McIntosh in his evidence (presented on 25 August 2008) with respect to Canterbury mudfish.
2. Associate Professor McIntosh in his initial evidence (Section 4.2) makes the following statement:

To replicate the Waianiwaniwa mudfish populations would therefore require a low-gradient, connected, stream network of at least 23 km, largely free of predatory fish like trout and eels and with a mostly perennial flow. I know of no such potential habitat in Canterbury.

By accepting this statement, the only option for CPW to protect the existing Waianiwaniwa Valley population for the loss of habitat is to look at creating new habitat for mudfish

3. In supplementary evidence (Section 3.3) Associate Professor McIntosh states:

The length of habitat (the proposed artificial channel) is close to that estimated to be currently occupied by mudfish in the valley, but to enhance security and to offset the loss of biological integrity any proposal should contain more length of habitat. I know of no scientific basis for evaluating how much more, but it would need to be substantial.

4. The two statements are addressing different issues but are related. Associate Professor McIntosh has acknowledged the proposal to create habitat will provide a similar area of physical habitat to the existing habitat, and that is the only option available to CPW. The subsequent statement then indicates that substantially greater area is required to enhance security and off-set the loss of biological integrity, but that he knows no way to evaluate how much is required. The statement also indicates that the security of the populations is enhanced by providing larger areas. In my opinion, this is only partially correct, as a number of processes that threaten mudfish occur independently of area, such as predator invasions, stock impacts, drought and poor water quality.

5. This statement is inconsistent with Associate Professor McIntosh's statement in Section 3.5 (Supplementary evidence) which says:

The protection of the population would be enhanced by the monitoring and physical barriers for predators proposed.

From this I understand Associate Professor McIntosh to be agreeing that the proposed fish passage barriers will enhance security. In my opinion, this enhancement occurs without the requirement to provide additional area for mudfish.

6. Associate Professor McIntosh's assessment also does not take into account the fact that the mitigation proposal includes riparian planting and fencing to exclude stock. In Section 2.4 (c) he notes the current mudfish population is impacted by poor water quality and stream habitat. My observations in the Waianiwaniwa Valley are also that stock are causing damage to the riparian zone. The fencing of the created habitat is additional protection that would again enhance security and the planting of the riparian margin would also improve biological integrity of the mudfish habitat.
7. Associate Professor McIntosh raises concerns about a lack of independent water supply for the mudfish habitat. I am uncertain as to why he believes the supply from the reservoir is a risk. In section 3.4 he suggests there are risks such as oil spills, toxic algal blooms and low oxygen levels which are a potential issue. I do not believe the intake would be at risk from oil spills and as they are proposed to be subsurface takes from the reservoir, as oil floats, then in the unlikely event of a spill the intake is even less likely to draw in oil.
8. A number of studies of mudfish, reviewed by O'Brien & Dunn (2007a) indicate mudfish are very tolerant of low oxygen levels. In the event that oxygen levels drop in the reservoir this can also be managed by aerating water during the pumping process. Associate Professor McIntosh notes in his supplementary evidence (e.g. Section 2.4) that the mudfish survive despite poor water quality currently present in the Waianiwaniwa Valley. The provision of water all year around with good oxygen levels will also enhance security.
9. In summary, I would note again the proposed constructed channels provide c. 23 km of habitat. It is low-gradient, to match the observed gradients in the Waianiwaniwa Valley where high density mudfish populations occur. The channels will be free of trout and eels and the flow will be perennial, and can be managed to optimise it for mudfish. The two main channels on the Homebush Ridge can be interconnected with

channels, wetlands or both to the enhance habitat diversity provided and maintain physical pathways for mudfish to move between areas. Additional habitat diversity can be provided in the form of deep pools and by varying water depth and water volume in the channels.

10. It is also worth noting that the 23 km of habitat in the Waianiwaniwa Valley is assumed to be connected and that mudfish move among the sites. Figure 2 in Associate Professor McIntosh's evidence shows the known mudfish locations, and there is a large section of the Waianiwaniwa River with no mudfish recorded (there may be no sampling in these areas). It is hard to argue no connectivity but it may be only in downstream directions rather than two way. It is simple to replicate one-way larval dispersal with larval transfers between the channels.

11. In Section 4.7 of his evidence in chief, Associate Professor McIntosh states:

Creation of wetland-type habitat in the vicinity of the dam would not mitigate the loss of the Waianiwaniwa mudfish habitat because it is stream habitat being lost. As explained above, Canterbury mudfish are primarily flowing water fish, but most flowing water habitat in Canterbury has been lost. Therefore, one of the special features of the Waianiwaniwa mudfish population is its presence in stream habitat.

This statement draws on early parts of his evidence in chief that discusses how the Canterbury mudfish is a stream-adapted mudfish, unlike other mudfish that are associated with wetlands.

12. In Associate Professor McIntosh's supplementary evidence (Section 4.5) he discusses the nature of the habitat used by mudfish and physico-chemical requirements with respect to the proposed constructed channels and states:

Moreover, given the low success rate of Canterbury mudfish translocations so far (described in previous evidence), it is likely that another, unidentified, factor is affecting translocation success. That could be an association with wetland habitats in the riparian zone, for example. Some of the Waianiwaniwa high density populations are in stream habitats associated with natural wetland remnants and that may be important in some way.

This would appear to be presenting a different picture of habitat requirements, although the second statement is qualified by "could be" and "may be" and therefore suggests some uncertainty. It is also possible for CPW to include wetland habitats on the riparian margin of the created channels, so this can be addressed. The issue of

habitat diversity is mentioned in other parts of Associate Professor McIntosh's evidence and again can be addressed as part of the design criteria.

13. Ms Sjaan Charteris Bowie in her evidence in chief (Section 4.4, Natural stream populations), states:

Nearly a quarter of known Canterbury mudfish sites consist entirely of water race or drain habitat, while in total 30 sites contain some amount of channelised habitat.

14. Both Associate Professor McIntosh and Ms Charteris Bowie make a series of statements in their evidence quoting the O'Brien & Dunn (2007b) review of translocations, saying that more than 50% have failed and conclude that there is a high risk of failure of the mitigation. There is a tension between the statement above and the results of translocations. I agree that general translocations where fish have been deliberately introduced to new areas have not always worked, but mudfish have introduced themselves to artificial habitats (e.g., stock water races), and this has happened on a number of occasions. It is also important to note that while translocations have failed, the level of effort and the types of habitat in which these failures have occurred have not been presented in evidence.

15. Mr Tony Eldon of MAF in the 1980s conducted some of the translocations that have been reviewed by O'Brien & Dunn (2005). Mr Eldon undertook translocation of mudfish after advertising in the Christchurch Press for landowners that would allow translocations of mudfish to areas on their properties. He made the following notes (Eldon 1983) with regard to four translocation sites:

A small pond at Ohaka, north of Christchurch. Originally constructed as a soak pit for storm water, the pond is probably capable of supporting only 40 -50 adult fish. It has the advantage, however, of being apparently permanent water. Free of other species.....

A pond in an old borrow pit at Lowcliff on the coast south of Ashburton. The pond is fed and drained by a small spring stream. It was a matter of surprise that mudfish were not already present, so it may be that for some reason the site is unsuitable. However, both pond and stream look favourable.

A series of 3 farm dams in a watercourse 6 km in a straight line ESE of Cave in South Canterbury. The fish were liberated in the smallest top-most pond and it is hoped that they will eventually colonise the series

A small farm dam 13 km in a direct line SSW of Cave. There are numerous similar ponds in the area and it may be that the fish will be able to spread from their liberation point.

Mr Eldon selected these translocation sites after viewing 22 sites in total. Interestingly all the sites are ponds, all are artificial habitats, one is small and he had concerns about a second. None are similar to the constructed channels proposed for the Waianiwaniwa Valley.

16. Follow-up management was conducted at one of these sites, after Mr Eldon revisited them to gauge the success of the translocations (Eldon 1985). Only one site, the first at Cave, was successful, but at the time of the revisit required remedial work to protect the habitat that was undertaken successfully by the landowner. The failure of these translocations reflects several factors: concern about the suitability of the habitat, the fact that there was no on-site management at three sites, the fact that the small habitat areas can be a problem, and that there was no preparation of the habitat prior to the introductions. The lack of success of some of these translocations should not therefore be taken as indicative of the outcome of the CPW proposal.
17. In his supplementary evidence, Associate Professor McIntosh commented on the size of the population to be held whilst creating the constructed habitat. He states in Section 3.9 of the supplementary evidence:

Finally, the number of fish proposed for transfer to the races is very small. The figure of three to four hundred was mentioned in oral evidence by Dr Allibone. I am not an expert in population genetics, but I would have thought a number one or two orders of magnitude higher would have been appropriate. Canterbury mudfish are thought to have reduced genetic diversity because of past population bottlenecks (Davey et al 2003).

18. This statement is implying that Canterbury mudfish populations need to have an effective population¹ size somewhere between 3,000 and 40,000 individuals. Very few if any mudfish populations in Canterbury would have 40,000 effective individuals, and many smaller populations will be unlikely to have an effective population size of 3,000. This would indicate that current populations persist at much lower numbers than Associate Professor McIntosh suggests should be held for populating the constructed habitat.

¹ Effective population size excludes non-breeding fish and reduces as sex ratios are skewed to either males or females and therefore is always lower than total population

19. One of the most successful translocations of Canterbury mudfish has been to an artificial wetland at the NIWA campus in Christchurch (Lake Eldon). This small wetland has supported mudfish since 1985. This population has been subjected to a number of small studies and is a source of mudfish fry for translocations. Tony Eldon, the creator of the population, fished it in 1992 to determine how many fish might be present in his 21 m² wetland, and using a mark recapture technique estimated 30 adult fish were present (Eldon 1992). This population has been used to provide fry for translocations for some time. O'Brien & Dunn (2005) discuss genetic diversity of this population as part of their report on captive rearing of mudfish and state:

However, the captive population of N. burrowsius in Lake Eldon which has reproduced in isolation for at least 20 years showed no sign of genetic loss (Davey et al. 2003).

20. I have read Davey et al. (2003) and it does not state the Lake Eldon population shows no sign of genetic loss. This is because Davey et al (2003) undertook a study to determine the genetic structure of Canterbury mudfish and this technique is not ideal for measuring genetic diversity within a population although it does provide some indications of the diversity present and can allow comparisons to other species. However, Davey et al (2003) do state that genetic diversity in Canterbury mudfish is very low (as noted in Associate Professor McIntosh's evidence) in the area of mitochondrial DNA investigated compared with other New Zealand mudfishes and this implies that there may be little diversity (if any) left to lose.
21. Other considerations of genetic diversity loss have to be thought about with regard to Canterbury mudfish especially in light of Associate Professor McIntosh's reference to bird studies. The risk of loss of diversity centres on the amount of diversity initially present, the size of the population at its bottleneck and the rate of recovery from a bottleneck. For populations with no diversity, there is no risk of loss regardless of size of the bottleneck as there is simply no diversity to lose. For populations with a lot of genetic diversity there is a high risk of some loss and this increases the smaller the population bottleneck is and the longer the population is depressed. For bird populations that are reduced to a small size the time taken to recover is long due to the small clutch size. This exposes birds to significantly more risk than fish, like Canterbury mudfish, that are highly fecund and can increase their population size rapidly in good habitat.

22. Ms Charteris Bowie made a number of comments in her evidence in chief regarding captive rearing and translocations. Firstly in Section 7.1 she notes:

The University of Canterbury also has an outdoor facility in which Canterbury mudfish have successfully reproduced since 1999 (O'Brien 2005). Also in 2007 the local Mahaanui DOC office have created a pond where Canterbury mudfish from the Canterbury University have been transferred into (they seem to be doing well so far).

and in Section 7.4:

However the Mudfish recovery group in 2006 concluded that captive rearing should only be encouraged in the context of a specific translocation and made the comment that "fry" are not a limiting factor so there is no need for breeding facilities as fry can be harvested, grown on and then released. (Department of Conservation 2006).

and Section 7.5, final sentence:

For Canterbury mudfish it is well known that they are not threatened by low numbers but threatened by habitat loss, degradation and fragmentation (O'Brien 2005).

23. From these three statements we have a successful transfer of fish from a small captive population to a pond not a stream environment. Secondly, the Mudfish Recovery Group has concluded that fry are not limiting. This is important as recovery from population bottlenecks is rapid if fry are abundant and survive, and the risk of loss of genetic variation is more limited as the population recovers from the small size rapidly. Thirdly, O'Brien (2005) states low numbers (hence bottleneck and loss of genetic diversity) are not a key risk. Dr Leanne O'Brien is one of the authors of the Davey et al. (2003) paper so would have been aware of the genetic issues, low diversity and bottleneck effects. Other parts of this final statement are positive with respect to the CPW mitigation. The proposed dam will cause habitat loss and CPW will cause this; there is no way of avoiding it in the proposed scheme. But habitat degradation in the constructed habitat will not be present and fragmentation is limited and can be managed by active transfers of larvae as a consent condition(s) or as part of a management plan, so the CPW proposal does provide benefits as well.
24. Associate Professor McIntosh also refers to some of the risk to mudfish in the constructed habitat, including low oxygen levels causing mortality. In his

supplementary evidence (Section 4.5) he also notes a range of habitat characteristics that need to be considered prior to construction of the proposed channels and concludes that many characteristics are not reliably known. This is a conclusion on the conservative side and the proposal for the constructed habitat is to seek to mimic the present Waianiwaniwa Valley habitat as closely as possible (without farming impacts); in my opinion these existing habitat characteristics can be estimated and matched in the constructed habitat. O'Brien & Dunn (2007a) provides a summary of all the habitat and water quality information available. In my opinion, this *does* provide good information on a number of ecological requirements of Canterbury mudfish, such water quality and habitat use.

25. Associate Professor Angus McIntosh in Section 4.2 of his supplementary evidence commented on the status of the water race and captive populations.

The water race and captive populations of Canterbury mudfish are only partially relevant to whether habitat creation and translocation are likely to succeed. The fact that mudfish do exist in some water races is testament to the adaptability of the fish and does demonstrate potential to create populations.

From this I would take it that Associate Professor Angus McIntosh accepts mudfish live in artificial habitats and are adaptable, and therefore flexible in the habitat conditions required.

28. In Section 4.2 Associate Professor Angus McIntosh later states:

Moreover, many of the water race populations probably only exist as metapopulations supported by immigrants from (headwater) source populations elsewhere, as implied by Dr Meredith in his supplementary evidence.

I have searched the New Zealand Freshwater Fish Database and looked for records of Canterbury mudfish in drains and races. To assess whether these populations could be supported by immigrants from upstream (headwaters), I have plotted their location along with records of other Canterbury mudfish populations (Figures 1 and 2). In the Ashburton region (Figure 1), it does not appear likely that two of the four stock water race sites could be supported by immigration from upstream as no upstream populations are reported. In the Hororata region (Figure 2), again there appears to be limited, if any ability for the stock water race populations to receive immigrants from upstream as the sites are upstream of the natural populations. Therefore I do not accept Associate Professor McIntosh's or Dr Meredith's implied metapopulation theory

that the stock water race populations are supported by immigration and would note this appears to be in conflict with statements made by Ms Charteris Bowie (see above Section 13).

29. Finally, Associate Professor Angus McIntosh in Section 4.8 of his supplementary evidence requires that a demonstration is required of a successful habitat creation project that has been successful for a number of seasonal cycles. Given the time frame of the CPW hearing and potential Environment Court appeals it appears very unlikely this could be achieved, even if appropriate consents and funding was available. However I would again indicate that the stock water races and drains do exactly this; they are artificial habitats that have supported generations of mudfish for many years.

Conclusions

30. Genetic variation in Canterbury mudfish is low and the ability for mudfish populations to expand in size rapidly means the risk of loss of the remaining diversity is limited.
31. The constructed stream can provide habitat diversity, including pools and wetland areas, and enhanced security of the population can be achieved through measures such as protection from predators, and improved habitat quality rather than through providing a greater area of habitat.
32. Stock water races do provide examples of successful artificial habitat, all be it of an unmanaged nature that does not provide the most suitable habitat.
33. Early mudfish translocation attempts were supported with limited resources and at the time were conducted into habitats that were not considered ideal or that required maintenance. Thus, estimates of the likely success of mudfish translocations into habitats managed specifically for mudfish should not be based on failed past attempts that have not had ongoing management.

Richard Allibone

September 2008

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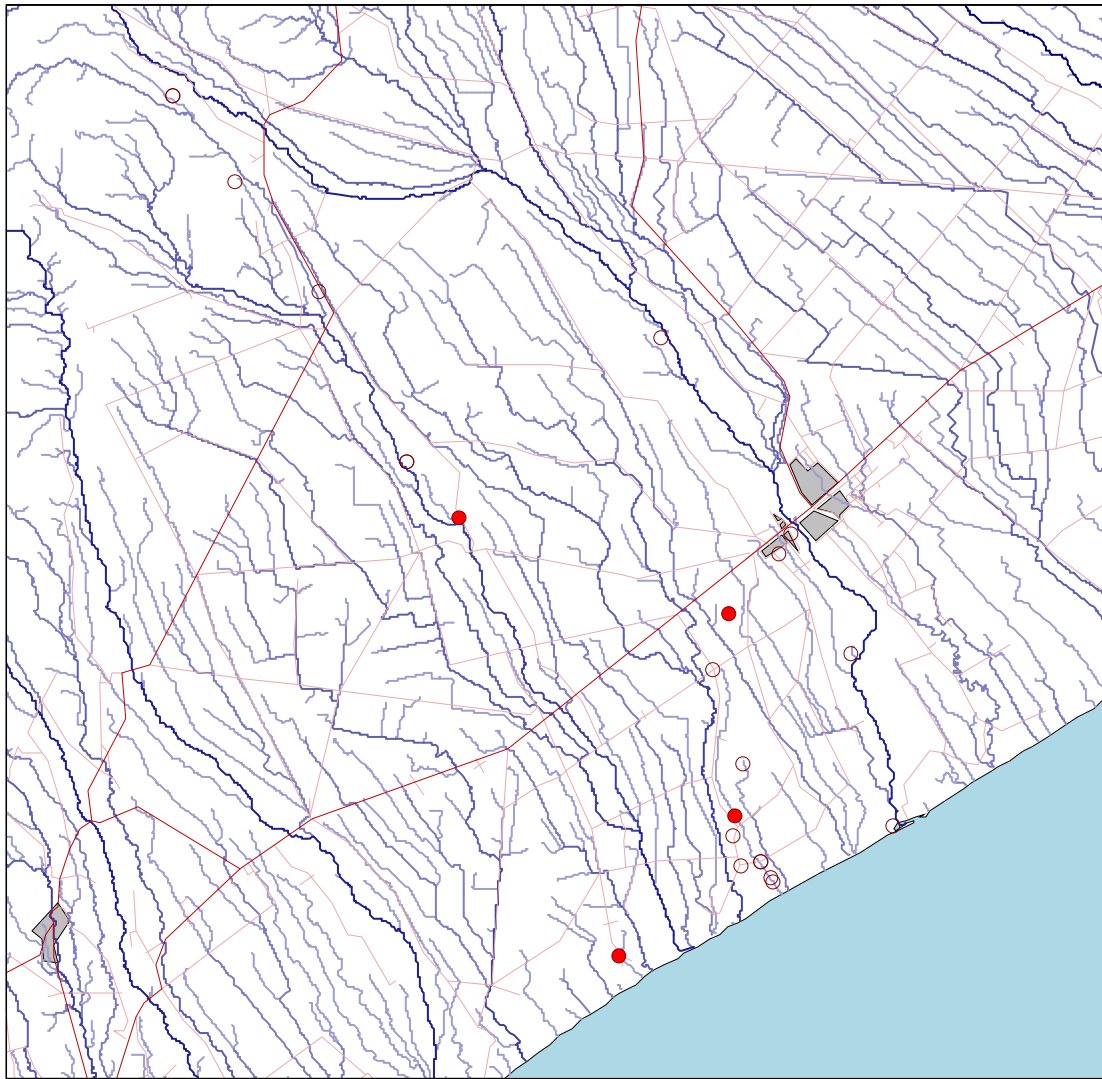


Figure 1. Canterbury mudfish in the Ashburton area, closed circles are drain and stock water race records (data source NZFFD, 8 September 2008).

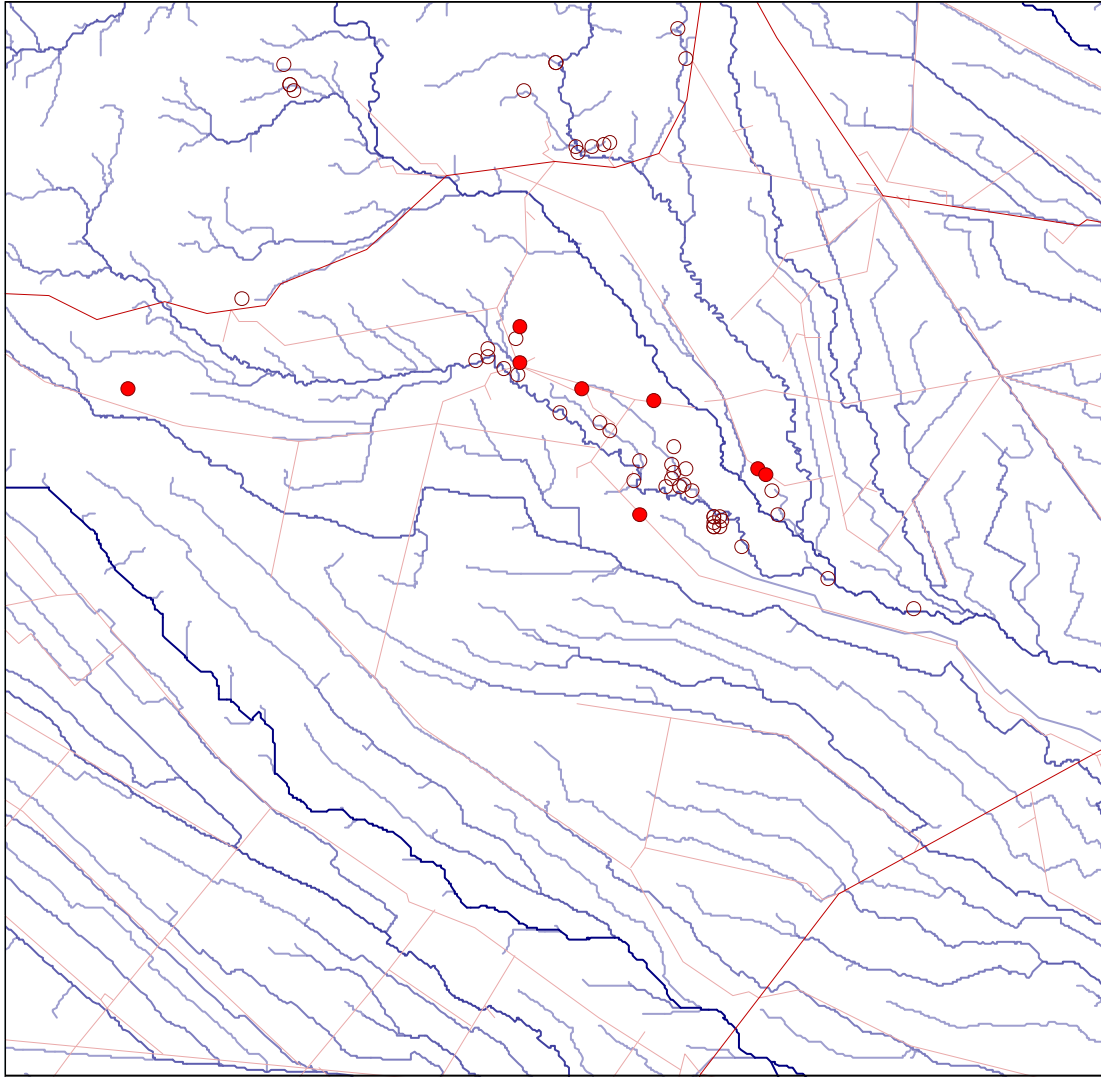


Figure 2. Canterbury mudfish in the Hororata area, closed circles are drain and stock water race records (data source NZFFD, 8 September 2008).