BEFORE THE HEARINGS PANEL

IN THE MATTER OF	the Resource Management Act 1991 ("the Act")
AND	
IN THE MATTER OF	the Proposed Horizons Regional Council One Plan for the Manawatu-Wanganui Region (Water Hearing)

STATEMENT OF EVIDENCE OF LOGAN ARTHUR BROWN ON BEHALF OF THE MINISTER OF CONSERVATION

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STATEMENT OF EVIDENCE OF LOGAN BROWN

INTRODUCTION

1 My full name is Logan Arthur Brown.

2 I hold a Masters of Science degree, a Bachelor of Science degree majoring in Ecology, and Bachelor of Business degree majoring in Economics.

3 I am a member of the New Zealand Freshwater Sciences Society.

4 I am employed as a Freshwater Technical Support Officer at the Wanganui Conservancy of the Department of Conservation.

5 I have read the Environment Court's Code of Conduct for Expert Witnesses contained in the Practice Note on Alternative Dispute Resolution and Expert Witnesses issued by the Environment Court on 31st March 2005, and I agree to comply with it. My qualifications as an expert are set out above. Except where I state that I am relying upon specified evidence of another person, the issues addressed in this brief of evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE:

6 My evidence addresses the following:

a. consideration of some of New Zealand's aquatic life with a specific focus on some species found within the Horizons Regional Council boundaries, particularly on Whio (blue duck) and native freshwater fish;

b. the Proposed One Plan's approach to water management including the use of water management zones and values in particular:

- Sites of Significance – Aquatic (SOS-A);

- Native Fish/Inanga Spawning Values;

- Barriers to fish passage;
- Sites of Significance – Riparian (SOS-R); and
- Objective 6-1 – Water Management Values;

c. Water Quality in the Proposed One Plan in particular:

- algae and nutrient levels;
- Whio as a case study for water quality;
- Policy 6-4 (enhancing existing water quality);
- the Clean Streams Accord;
- point source discharges; and
- sediment.

d. Water Quantity in the Proposed One Plan in particular:

- Habitat quantity and flow variability;
- The approach to water allocation taken in the POP;
- Setting minimum flows using the needs of Trout; and
- Rule 15.5.

e. Beds of lakes and rivers in particular:

- effects of instream works on aquatic biodiversity;
- the importance of habitat variability within waterways and threats to it;
- Policy 6-28; and
- the Environmental Code of Practice for River Works.

OVERVIEW OF AQUATIC LIFE

New Zealand's Native Freshwater Fish

7 This section provides a brief outline on some of the life habits of native freshwater fish. It provides background information to references that are made about freshwater fish throughout my evidence. Importantly this information shows that generalisations about native freshwater fish cannot be made as the life cycles vary between species.

8 New Zealand has a total of 39 freshwater fish species (New Zealand National Freshwater Fish Database). Just under 50% of these species are diadromous (David et al, 2004), that is they require access to the sea at some stage in their life cycle.

9 The part of the life cycle spent at sea depends on the fish species. Adult eels spend the majority of their life cycle in freshwater, going to sea to spawn. The juveniles returning as elvers to the freshwater environment. Others such as lamprey spend the majority of their adult life cycle at sea and return to freshwater to spawn. The juveniles remain in freshwater for up to 24 months and then move out to sea.

10 Other species, such as Upland bullies or dwarf galaxiids (although commonly referred to as non-migratory as they do not spend part of their life cycle at sea), require access throughout the water channel. Therefore structures in streams not only affect migratory species but also other species that may be present in a waterway.

11 New Zealand's native fish species have very varied life cycles. For example, three of the species which make up part of the whitebait catch, kōaro (*Galaxias brevipinnis*), short jaw kōkopu (*Galaxias postvectis*), and banded kōkopu (*Galaxias fasciatus*), are reliant on being able to spawn on riparian vegetation in elevated flows (Charteris *et al*, 2003). It is during these elevated flows that adults lay their eggs, outside of the normal water levels. In a study carried out by Charteris *et al* (2003), spawning sites were found on the banks of the stream, near or just above bankfull (bankfull being defined as the highest point that a normal flood was thought to reach). The spawning sites were found on ground that was

downstream sloping among tightly packed substrate and had at least a small amount of vegetation and debris present (see appendix 1). Eggs take between three to four weeks to develop and are reliant on another flood coming through upon which the eggs hatch and the larvae make their way towards the sea (Charteris *et al* 2003). The larvae of these species then feed and grow at sea and return as "whitebait" to freshwater streams and rivers, migrating upstream towards adult habitat.

12 Other species such as redfin bullies lay their eggs on rocks within the streambed with the adults guarding the eggs until they hatch. Upon hatching, the larvae are washed out to sea and later return to the freshwater environment as juveniles.

13 Another example are short and long fin eels, which spend the majority of their life in freshwater, migrating to the sea to spawn in sites as far away as Tonga. After spawning, the adults die and the juveniles ride the ocean currents back to New Zealand, later migrating up streams and rivers into adult habitat. This is by no means an indepth look at the life cycle of New Zealand's freshwater fish fauna, but gives an indication of how varied the life cycles of our native fish are.

Other Freshwater Species

14 My evidence specifically discusses particular species of native freshwater fish and bird species, but invertebrate species are grouped together. This does not mean that these invertebrates are not important or that that some of the species are not rare. On the contrary invertebrates are an important aspect of biodiversity values within waterways, they form a food supply for fish species and other invertebrates and are frequently used in the biological monitoring of waterways as will be considered later in my evidence.

15 An example of a threatened freshwater mollusc found within the Horizons Region that I will consider later in my evidence is the kākahi (freshwater mussels), currently classified as in gradual decline in the Department of Conservation threat classification lists (Hitchmough, 2007). Very little is currently known about the distribution of kākahi in running waterways within the Horizons Region and indeed New Zealand wide (for running waterways). There are also threatened invertebrate species found within the Horizons Region such as the freshwater

polychaete but once again very little is known on their distributional range within the region. My evidence may therefore appear to be biased towards certain freshwater species, but this is generally to do with the current availably of knowledge.

Native Fish Fauna within Horizon's Regional Council Boundaries

16 Within Horizons Regional Council boundaries, 18 species of native freshwater fish can be found. Of these 18 species, 14 (78%) require access to the sea at some stage in their life cycle. Table One below contains the national threat rankings from the current list (2007) and new proposed threat rankings (2009). The rankings are in draft form and are awaiting peer review and is therefore subject to change. It does, however, give an indication of the plight of freshwater fish species in New Zealand (pers comm. Hitchmough). Table One does not contain other threatened aquatic species such as kākahi (freshwater mussels) and other invertebrate species which are found within the region.

Table One: Freshwater fish species found within the Horizons Region, their threat rankings and migratory requirements.

Species	**Migratory**	**Ability to landlock**	**Regionally rare (as proposed in the One Plan)**	**National threat ranking (2007)**	**Nationally threatened (in draft)**
Long fin eel	Yes	No	No	Yes - Declining	Yes – Declining
Short fin eel	Yes	No	No	No ranking	No ranking
Torrentfish	Yes	No	No	No ranking	Yes – Declining
Giant kōkopu	Yes	Yes	Yes	Yes - Declining	Yes – Declining
Kōaro	Yes	Yes	Yes	No ranking	Yes – Declining
Banded kōkopu	Yes	Yes	Yes	No ranking	No ranking

Inanga	Yes	Yes	Yes	No ranking	Yes – Declining
Short jaw kōkopu	Yes	No	Yes	Yes - Sparse	Yes – Declining
Lamprey	Yes	No	Yes	Yes - Sparse	Yes – Declining
Smelt	Yes	Yes	No	No ranking	No ranking
Giant bully	Yes	No	No	No ranking	No ranking
Redfin bully	Yes	No	Yes	No ranking	Yes – Declining
Bluegill bully	Yes	No	Yes	No ranking	Yes – Declining
Common bully	Yes	Yes	No	No ranking	No ranking
Dwarf galaxiid	No	n/a	Yes	Yes - Declining	Yes – Declining
Upland bully	No	n/a	No	No ranking	No ranking
Crans bully	No	n/a	No	No ranking	No ranking
Brown mudfish	No	n/a	Yes	Yes - Declining	Yes – Declining

Whio (blue duck)

17 Whio (blue duck, *Hymenolaimus malacorhynchos*) are endemic to New Zealand, and are one of only four of the world's 159 waterfowl species to live permanently in rivers. They are classified as nationally vulnerable by the Department of Conservation (Department of Conservation, 2009). They inhabit one of New Zealand's harshest environments and have evolved to endure these conditions. I frequently refer to Whio in my evidence as they are frequently referred to as an indicator of riverine ecosystem health. They also provide a good case study to show the potential effects of nutrient enrichment of waterways and are a species

used by Horizons Regional Council to identify Sites of Significance – Aquatic (SOS-A)

18 In the upper trophic level in New Zealand riverine ecosystems Whio serve as an indicator of riverine ecosystem health and of the completeness of ecological relationships within that ecosystem. The presence of Whio is an easily recognisable indicator of the success of restoration and protection programmes in New Zealand riverine ecosystems.

19 Whio have vanished from many areas where they were once common and it is widely accepted that they have declined in number and distribution (Mills & Williams, 1979). Modifications of waterways, loss of riparian (stream-side) vegetation, and the introduction of mammalian predators have led to a dramatic decline in the distribution and numbers of Whio. Today, Whio are classified as nationally vulnerable (Department of Conservation, 2009).

20 An icon of backcountry waterways of New Zealand, Whio are a taonga species that have cultural, spiritual, historic, and traditional significance for Māori. This iconic nature of the Whio has helped raise the profile of conservation efforts within New Zealand. Within the Horizons Region, in some Whio areas the Department of Conservation is reliant on volunteers to clear stoat lines to help protect this species. One of these programmes, Te Potae o Awarua in the Northern Ruahines at one stage had a waiting list of two years for volunteers to monitor the stoat line on a monthly basis. Another success story of public involvement with these species is the Manawatu Deerstalkers Association, who secured funding, established and now maintain a stoat line in the headwaters of the Oroua River on both public conservation estate and down onto private land.

21 At a national level, the Department is in the process of finalizing the latest Whio recovery plan. The following is an extract taken from this plan: "*The aim of management over the next five years is to secure whio populations at eight sites ("Security Sites") throughout New Zealand"* (van Klink in draft, 2009). Of the eight security sites mentioned within the recovery plan, two fall within the Horizons' boundaries, these being the Manganui-o-te-Ao/Retaruke and the Tongariro forest. As well as identifying sites for securing populations the recovery

plan identifies 14 additional sites for recovery sites, 10 of these falling within the South Island and 1 of the 4 from the North falling within the Horizons region (Northern Ruahines). From this document it can be implied that the Horizons region has strongholds of Whio populations which are seen as essential to ensure the survival of this species.

22 I will provide further details about Whio and water quality in the section titled "The Consequences of Algae and Nutrient Levels" and in other places throughout my evidence.

Summary

- New Zealand has a total of 39 native freshwater fish species, about half of which require access to the sea during some part of their life cycle.
- The life cycles of New Zealand's freshwater fish are varied, making generalisations about native fish life cycles difficult.
- The Horizons Region has 18 of these species present, with 14 being diadromous and many considered nationally threatened.
- The Horizons Region has stronghold populations of Whio with the identification of 2 security sites and 1 recovery site through the draft Whio/Blue duck Recovery Plan 2007-2017.
- The majority of my evidence concentrates on freshwater fish, Whio and invertebrate communities.

PROPOSED ONE PLAN'S APPROACH TO WATER MANAGEMENT

23 My evidence on the One Plan's approach to water management will cover:

a. Sites of Significance – Aquatic;

b. Native Fish/Inanga Spawning Values;

c. Barriers to Fish Passage;

d. Sites of Significance – Riparian (SOS-R); and

e. Objective 6-1 – Water Management Values.

Sites Of Significance – Aquatic

24 The POP has broken the Horizons Region into Water Management Zones (WMZ) and sub-zones. Water management values and objectives have been identified for each of these WMZ and sub-zones as shown in the POP in Schedule D (Proposed as Ba in the Officer's Reoprt).

25 The listed values are divided into particular value groups. Within the Ecosystem Value Group the following individual values are identified: Sites of Significance – Aquatic (SOS-A); Sites of Significance – Riparian (SOS-R); Natural State (NS); Life-Supporting Capacity (LSC); and Native Fish Spawning (NFS).

26 SOS-A have been identified based on the presence of nationally and regionally rare and threatened freshwater fish species and Whio. The presence of aquatic bird species was used to identity SOS-R. SOS-A and SOS-R are considered in more detail later in my evidence.

27 I support the approach taken by Horizons Regional Council in identifying the values that are contained in each of the WMZ and sub-zones and then defining and monitoring water quality standards to protect these values within these WMZ and sub-zones. I support basing many of these standards on the best current scientific knowledge as contained in technical reports and expert opinions.

28 SOS-A are relevant in a number of ways throughout the water chapters of the POP including in relation to discharges, water takes and activities in, on, under or over the beds of rivers and lakes.

29 The SOS-A as currently identified in the POP have taken records from the New Zealand National Freshwater Fish Database, sometimes referred to as the NIWA Freshwater Fish Database, to identify sites which are important to ensure the survival of species that are deemed threatened (nationally) or are rare regionally. This database is a collective of information gathered by various organisations for

varied purposes. Horizons Regional Council selected the information from 1991 to 2006 for the basis of the SOS-A list of sites.

30 The following paragraphs explain the process followed in identifying these sites, why the accurate identification of these sites is important for conservation of New Zealand's freshwater fauna, highlight what I believe are omissions from the SOS-A and outline the need for the classification of SOS-A to be able to evolve.

Identification of SOS-A

31 The process of the identification of these sites is set out in the report entitled *Sites of Significance for Aquatic Biodiversity in the Manawatu-Wanganui Region* (McArthur, Clark, & McGehan, 2007). The approach that has been taken by Horizons Regional Council in identifying these SOS-A is supported. In summary (based on the section 42A report by Maree Clark the approach involves):

a. Distribution records from the New Zealand National Freshwater Fish Database between 1991 and 2006 were used to identify sites where one or more of the nationally and regionally rare/threatened species used for identification of SOS-A as listed in Table Two below were known to occur;
b. Each of the records in the NZFFDB was recorded as a geographical point identified by a NZMS 260 map reference;
c. In order to provide a buffer zone of suitable habitat around each site of significance, the reach was extended from the NZFFDB point to whichever was the shortest of:
    i. 2 km upstream and downstream of the recorded site; or
    ii. downstream to the nearest major confluence; or
    iii. to the source of the water body if the reach ended at a 'Natural State' boundary.

32 Small extensions to the buffer zone were made to link ecologically relevant habitats together to a reach of river classified as Natural State, or to the sea. This is because the species identified for classification into SOS-A are migratory, and where sites containing SOS-A species were found to be near, or within short

distances to the sea, these reaches were linked together to provide for the migratory pathways. Where several sites were located in close proximity within a river these were linked together because the instream habitat was likely to be contiguous (e.g. the Waikawa Stream).

33 The nationally threatened and regionally rare freshwater fish and bird species used to identify the current SOS-A are:

Table Two: List of nationally and regionally rare/threatened species used for identification of SOS-A.

Giant kōkopu	Dwarf galaxiid
Kōaro	Banded kōkopu
Brown mudfish	Shortjaw kōkopu
Lamprey	Redfin bully
Bluegill bully	Whio

34 The list of species contained in Table Two differs from the Department of Conservation's current (Hitchmough et al, 2007) and draft (Hitchmough, pers comm.) nationally threatened freshwater fish classifications. Long fin eels and torrentfish are not listed in Table Two, while banded kōkopu are included in Table Two but not in the Department's classifications. However, I agree with banded kōkopu being used to identify SOS-A in the POP as they were only recorded during 17 sampling events between 1991 to 2006 within the entire Horizons Region.

35 Torrentfish have been recorded during 85 sampling events in the Horizons Region between 1991 and 2006. However, the number of sites that they are present at is likely to be much higher. As their name suggests, torrentfish live in fast flowing water which is likely to be too swift and deep for electro-fishing. In large rivers electro-fishing surveys are undertaken in edge habitat where it is safer and fishing more effective. Therefore the presence of torrentfish within the region's rivers is

likely to be higher than the current information contained in the New Zealand National Freshwater Fish Database. Until such surveys can be undertaken in these waters and more information is gathered their exclusion from the POP SOS-A list is valid, in my opinion.

36 I also agree with the exclusion of long fin eel from the list of species used to determine SOS-A. Long fin eels are numerous throughout the Horizons Region and are likely to be indirectly afforded some protection through SOS-A due to rules and policies providing protection of the habitat found within SOS-A.. Therefore, the habitat that is protected through the SOS-A is available as habitat for long fin eel.

37 I support the inclusion of Whio in the list of species that are used to identify the SOS-A. Whio use the riparian margins of waterways to nest and rest during the day and the water habitat for sourcing food. It is therefore vital that Whio have access to both the riparian margin of waterways and that water quality is maintained to protect their food supply.

38 As mentioned earlier some native freshwater species require access to riparian vegetation in order to spawn. Schedule E of the POP contained in the provisional determination Biodiversity and Heritage hearing recognises this riparian margin as an At-Risk habitat and is regulated under rule 12-6. Due to the spawning habitats of these species and the importance of instream debris as discussed later in my evidence the provision of a 20 m buffer zone on streams and rivers for SOS-A is vital for the maintenance of spawning and habitat variability.

39 In summary, the approach taken by Horizons Regional Council in identifying SOS-A based on the recorded presence of one or more regionally rare and threatened species is supported.

Omissions from SOS-A

40 The POP as notified identified 149 sites as SOS-A within the Horizons Region. Although the data to draw up the list was been taken from the New Zealand National Freshwater Fish Database, there appears to have been an oversight in that a report called "Manawatu – Wanganui Brown Mudfish (*Neochanna apoda*)

Survey" commissioned by Horizons (Tonkin et al, 2004) did not have its data added to the New Zealand National Freshwater Fish Database.

41 This means that the current list of SOS-A is missing six sites which contain either nationally or regionally threatened species. The species and their distribution are given below in Table Three and mapped in Figure One. The following sites should be added to the SOS-A at the earliest point possible.

Table Three: The location of 6 additional sites to be identified as SOS-A

Species	**Location name**	**Location coordinates**
Brown mudfish	Whitiki Swamp	270100 6065500
Brown mudfish	Lake Herbert	2706300 6067200
Brown mudfish	Knottingly Swamp	2698800 6113100
Banded kōkopu	Heatherlea Park Swamp	2704100 6066700
Banded kōkopu	Te Whanga Swamp forest	270300 6067200
Banded kōkopu	Artillery Swamp	2697800 6115700

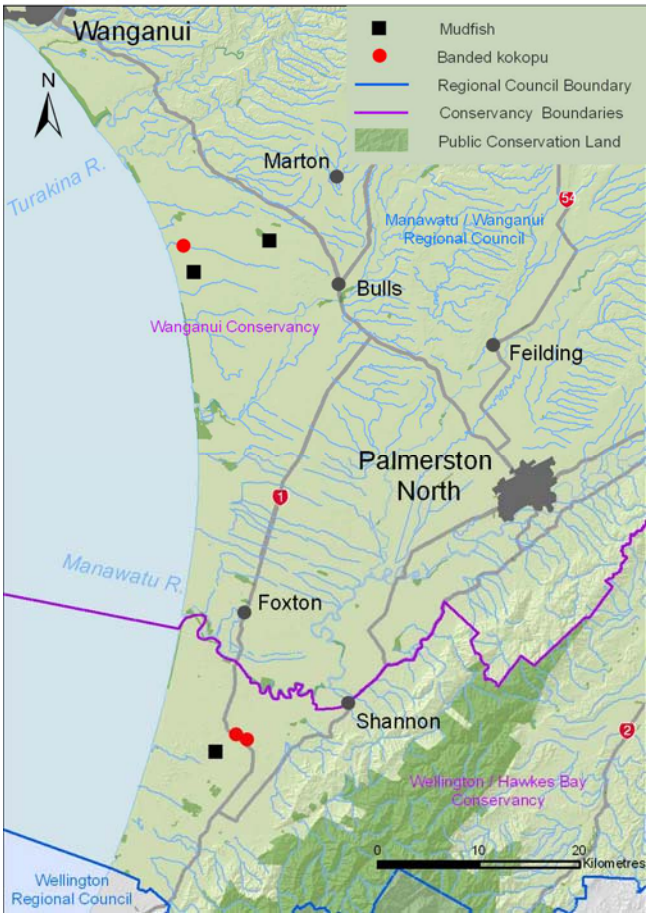

Figure One: Distribution of the additional banded kōkopu and brown mudfish sites contained within Manawatu – Wanganui Brown Mudfish (*Neochanna apoda*) survey commissioned by Horizons (Tonkin et al, 2004).

Updating the list of SOS-A

42 The list of SOS-A contained within the POP is fixed. Figure Four attached to this evidence shows vast areas within the Horizons boundary which have not been surveyed. It is likely that in future years more exploratory surveys will be carried out and that species used for SOS-A may be encountered in some new sites. With this in mind it is important that the current list of SOS-A is updated when information becomes available to ensure that it reflects the current best knowledge.

43 In the Minister's submission the following was requested for the SOS-A *"Include as a policy and a method that the council will further develop and maintain its*

inventory of aquatic sites of significance and carry out further survey work to ensure that it is comprehensive and up to date. In addition refer within the plan to the Council's intention to take the information in the inventory into consideration in consent decision-making, and to notify a plan change on the matter, if appropriate, within no more than 2 years of the plan becoming operative"

44 I agree that there needs to be a method contained within the POP that maintains an up to date inventory as new sites are surveyed and that this information is used to inform future consent making decisions.

Identification of SOS-A in the POP

45 Concern has been raised in some submissions that the SOS-A (and Sites of Significance – Riparian (SOS-R)) are not clearly identified in the POP. I disagree with this interpretation. Map D.11 and Table D.5 in the POP clearly identify the areas which are SOS-A. Further more information on the actual distribution of SOS-A is provided through the POP, table Ba 12 – Sites of Significance for aquatic biodiversity (SOS-A) in the region and my understanding is that when the POP becomes operative that this information will still be contained within it. Figure Two attached to this evidence shows that a large proportion of the SOS-A fall within public conservation estate.

Summary:

- I support the method used by Horizons Regional Council for the identification of SOS-A.
- The additional 6 sites identified in Table 3 of this evidence added to the SOS-A as soon as possible based on the known presence of banded kōkopu and brown mudfish in these sites.
- The identified SOS-A in the Proposed Plan should be updated regularly to reflect the results of further surveys.
- I consider that SOS-A are clearly identified in the POP.

Native Fish/Inanga Spawning Values

46 Table 6-2 of the POP which sets out Water Management Values and Purposes identifies "Native Fish Spawning" as an individual value. The value is applied to appropriate Water Management Zones in Schedule D (or proposed schedule Ba in the Officer's Report).

47 A submission by Horizons Regional Council requested that the value "native fish spawning" be renamed "Inanga Spawning". The Officer's Report recommends that this submission is accepted on the basis that the reference to Inanga Spawning more accurately reflects the values of importance.

48 I support this recommended change on the basis that the river/stream reaches that are identified within the POP as Native Fish Spawning reaches refer to the spawning reaches of Inanga (Galaxias maculates) not all native fresh water fish.

Summary:

- I support renaming the value Native Fish Spawning as Inanga Spawning .

Barriers to Fish Passage

49 The ability to move unimpeded in waterways is vital for the majority of freshwater fish species found within the Horizons Regional Council boundaries, due to various developmental phases of their life cycles occurring at sea. Those species that require access to the sea are contained in Table One above.

50 Of the 18 native freshwater fish species found in the Horizons Region, 14 require access to the sea for some stage of their life cycle. Of the 9 fish species used for the identification of SOS-A (being either nationally or regionally rare), 7 require access to the sea at some stage of their life cycle (McDowall, 1995).

51 Passage to the sea is compromised by barriers which prevent the unimpeded passage of fish upstream. These barriers can range from a poorly constructed culvert to dam structures. Although some native fish species are able to climb or

pass obstacles, this ability is very much dependant on the species that is being considered. The climbing ability of these freshwater fish is dependant on the species which is being considered. Kōaro are generally considered a species that has a good climbing ability. Kōaro are sometimes found above waterfalls, as long as the waterfall has a moist surface that they are able to climb. Whereas, Inanga are considered to have poor climbing abilities and small obstacles and high water velocities are barriers to this species. Man-made structures such as poorly installed culverts (e.g. perched culverts) can prevent the upstream movement of these diadromous species.

52 Some of the species in Table One are able to form land locked populations. This means that they are able to use a lake as a substitute for the part of their life cycle which would otherwise have been conducted at sea. Although populations of fish have been known to landlock, the trigger for this to occur is currently unknown. Situations in which this occurs should be considered the exception, not the norm, if a barrier were to be constructed.

53 I fully support the request by Horizons Regional Council submission point 146, which requested:

> *"Insert a new method in Chapter 6 which sets out a programme for inspecting structures and assessing them to see if they provide for fish passage, and progressively upgrading those structures that do not provide for fish passage. This should be done in consultation with the appropriate land owners, infrastructure owners and interested community groups and iwi."*

54 The implementation of a programme to upgrade problematic structures will ensure that barriers to migration are identified and rectified and fish passage is not impeded. I note that some such projects have already been undertaken, such as "A preliminary assessment of potential barriers to fish migration in the Manawatu River catchment, North Island, New Zealand" (James & Joy, 2008) and "Prioritisation for restoration of out-flow stream habitat of coastal wetlands on the west coast of the Manawatu-Wanganui region" (James & Joy, 2009).

Summary:

- Due to New Zealand's freshwater fish migratory habits barriers to their migration can have significant effects on their distribution.
- I support Horizons Regional Council's submission to implement a new method within Chapter 6 to set out a programme for inspecting and assessing instream structures to see if they provide for fish passage, and to progressively upgrade structures that do not provide for fish passage.

Sites Of Significance – Riparian (SoS-R)

55 Within the POP, SOS-R have been identified in schedule D (now proposed to be schedule Ba). The process of identifying these sites is contained in the report "Sites of significance based on the habitat requirements of selected bird species. Technical report to support policy development" (Lambie, 2007). The process is further discussed in the s42A report of Mr James Lambie.

56 I agree with the approach taken by Horizons Regional Council to establish these SOS-R based on the current information about the distribution and habitat requirements of the selected birds.

57 Within the POP SOS-R values are identified in Schedule (proposed Ba) for sand and gravel nesting habitat (based on habitat requirements of banded dotterels and black-fronted dotterel). This habitat is protected through standard conditions for permitted activities involving the beds of rivers and lakes, table 16.1, chapter 16, as follows:

a. *For the purpose of minimising disturbance to nesting dotterels; between 1 August and 31 December, gravel extraction and bed disturbance on gravel beaches shall only take place:*

    i. *(i) within 7 days following a flood of the area of beach that is the subject of the activity, or*

ii. *(ii) where the extraction or disturbance commenced at the same location prior to 1 August and has not been interrupted for more than 7 days.*

58 The habitat of royal spoonbill and wrybill (waders) is regulated as threatened habitat as contained in Schedule E, with more detail provided in the quote taken from Mr Lambie's s42A report point 55:

> "I am of the opinion that most of the critical wader habitat of Horizons' Region is captured under the Saltmarsh wetland habitat description (identified as a threatened habitat in Table E.1 of "Version 5 Schedule E" of the POP). This definition includes open expanses of estuarine mudflat substrate. This habitat description captures much of the extent of the estuarine feeding and roosting habitats of coastal waders like wrybill".

59 As taken from the Minister's original submission:

a. *"The term 'riparian' refers to a wide range of features and processes associated with rivers but the table appears to focus on bed habitat used by birds, including selected threatened species, particularly dotterel. Stretches of rivers which are important for bank or river corridor vegetation, or as bird migration corridors, for example are not included, nor are the riparian habitats"*

60 I request that Sites of Significance – Riparian be renamed as 'Sites of Significance for aquatic bird habitat'. I note that this differs from the Minister's original submission with the addition of the word "habitat". The reason for this is that I believe that this title is a more accurate description in that the aim is to address activities affecting the bird habitat.

Updating the list of SOS-R

61 The SOS-R as currently contained within the POP is a fixed list. It is likely that in future years more information may become available on the distribution of the species used to identify SOS-R. With this in mind it is important that the current list of SOS-R is updated when information becomes available to ensure that it reflects the current best knowledge.

- Summary:
- I agree with the approach by Horizons Regional Council to identify SOS-R.
- The term "Sites of Significance – Riparian" be replaced with "Sites of Significance for aquatic bird habitat" to more accurately the value that is being described.
- The list of SOS-R should be regularly updated as more information is gathered from previously unsurveyed areas within the Horizons Regional Council boundaries

Objective 6-1 Water Management Values

62 Objective 6-1 of the notified POP states:

> **Objective 6-1: Water management values**
>
> Surface water bodies are managed in a manner which sustains their life-supporting capacity and recognises and provides for the values set out in Schedule D.

63 The officers' report for water proposes amending objective 6-1 as follows:

> **Objective 6-1: *Water* management values**
>
> Surface *water bodies*^ are managed in a manner which ~~sustains~~ safeguards their life-supporting capacity and recognises and provides for the values set out in Schedule ~~D~~ba by 2030.

64 I disagree with the recommended inclusion of the 2030 timeframe for water management to meet the values that have been recognised through the POP in schedule D (proposed Ba).

65 One of the reasons that I disagree with such a long timeframe is the decline of freshwater fish numbers nationally. In the last few years there has been concern raised over a decrease in the number of sites at which large galaxiids are being encountered were they have previously been found. The Department of

Conservation has a recovery plan for large galaxiids, entitled *New Zealand Large Galaxiid Recovery Plan*, *2003-2013* (Department of Conservation, 2005). Large galaxiids in the recovery plan consist of banded kōkopu, giant kōkopu, shortjaw kōkopu and kōaro. Without improvements in surface water bodies before 2030 we are likely to see the elimination of some values from Water Management Zones and sub-zones as identified in the POP Schedule D (proposed Ba) and the reduction in the values of others.

66 The importance of recognising and providing for water values is supported by consideration of the way that contaminant in waterways can influence the distribution of fish species based on the fact that some migratory species use odours within the water column to guide them towards their favoured habitat. There are currently two schools of thought as to what these cues are. The following is taken from Atkinson and Joy (2008), pg 173 "The origins of these cues are controversial and two major hypotheses have been suggested. The first hypothesis suggests that the upstream migration of fish is guided by the odour of upstream conspecifics, whose presence may indicate suitable and accessible habitat, whereas the second hypothesis suggests that organic odours, that are directly related to upstream habitats, are used as a cue in stream selection and navigation."

67 Work on native freshwater fish species in controlled experiments has found that juvenile inanga were attracted to odours emitted from adult inanga, banded kōkopu, and kōaro but not towards odours from common bullies. Kōaro were only attracted towards odours from kōaro, and banded kōkopu from odours emitted from banded kōkopu (Baker & Hicks, 2003., Baker & Montgomery, 2001). Conversely, in trials with bluegill bully and natural stream water, Atkinson and Joy found that habitat odours may be more important than odours emitted from conspecifics.

68 Regardless of the two theories there is evidence that migratory fish use cues of some sort to guide them in their upstream migration. Baker & Montgomery, 2001 found that low levels of cadmium in the water column in controlled experiments affected the ability of banded kōkopu to detect cues emitted from adults upstream,

showing that cadmium presence in the waterways could affect the distributional patterns. Although limited to cadmium in these trials it shows that anthropogenic effects on waterways can potentially affect the distribution of New Zealand's freshwater fish.

69 Although individuals of species are being encountered at sites currently surveyed we have no indication of their age structure. Some native fish species are known to have long life cycles, with long fin eels known to have lived for 80+ years, short fin eels for 40+ years, lamprey 9+ years, kōaro 15+ years (McDowall, 2000) and giant kōkopu 27+ years (Bonnett et al, 2002). Therefore, it is possible that the individuals being encountered now are long lived individuals and that once these individuals die that the species will be absent from that site in the long term (10+ years). Therefore, the establishment of a long time period before improvements are necessary in water quality may result in the disappearance of some species from water management zones that they are currently present in.

70 Therefore, in my opinion without improvements in surface water bodies before 2030 we are likely to see the elimination of some values from Water Management Zones as identified in the POP Schedule D (proposed Ba) and the significant reduction in the values of others.

Summary:

- The addition of a 2030 timeframe for meeting the values that have been recognised through the POP in schedule Ba is not supported.
- Recent surveys are failing to find large galaxiids in sites which they were previously present in, given the long life cycles of some of these species we may only be seeing the effects of previous land uses now.
- Contaminants in waterways have been shown to affect the ability of banded kōkopu to be able to migrate and due to the long life cycles of some native fish species we may not see present day effects for many years into the future.

- Without improvements in surface water bodies before 2030 we are likely to see the elimination of some values from Water Management Zones as identified in the POP Schedule D (proposed Ba) and the reduction in the values of others

WATER QUALITY IN THE PROPOSED ONE PLAN

71 Water quality was identified as one of the four main issues in the POP. There are many factors which affect water quality, such as nutrient enrichment, point-source discharges, and sediment load. I agree that these are key issues. As noted above I support the approach taken by Horizons Regional Council in identifying the values within Water Management Zones (Schedule D now proposed schedule Ba) and establishing water quality standards (Schedule D) to protect these values.

72 Policy 6-7 sets out an approach to land use activities affecting surface water quality. The Policy specifically addresses the key issues of nutrients, faecal contamination and sediment. I support the intent of policy 6-7 and its aim to reduce land use effects on waterways.

73 My evidence in respect of water quality issues covers the following matters:

- the effects of algae and nutrient levels;
- Whio as a case study for water quality;
- Policy 6-4: Enhancement where water quality standards are not met;
- Clean Streams Accord;
- Point source discharges; and
- Sediment.

The effects of algae and nutrient levels

74 I support the approach taken in schedule D of the POP which sets standards for nutrients, periphyton levels (though measurements of Chlorophyll a levels) and Macroinvertebrate Community Indexes (MCI) for Water Management Zones. These standards are based on protecting the values that have been identified for each of the Water Management Zones in Schedule D. This is because the

standards identified in Schedule D are based on technical reports and expert opinion based on the currently available scientific literature.

75 In the case of periphyton growth (a term used to refer to diatoms, mats and filamentous algae), I support the use of periphyton measured as Chlorophyll standards within the POP Schedule D. The reason I support this approach is that the POP identifies values through Schedule D (proposed Ba) that will be affected by nuisance periphyton levels and then sets appropriate nutrient standards to address these periphyton levels.

76 The proliferation of periphyton can lead to the following effects within waterways. A lowering of oxygen levels, a reduction in aesthetic values, a reduction in the institial space available as habitat for fish and invertebrates, a change in the community composition of the waterway and a reduction in the amount of spawning habitat that is available for some species. These are expanded on further below.

77 It is noted that the growth of periphyton within waterbodies is a natural process. Periphyton makes up the primary productive base of the aquatic food chain (Winterbourn, 2004 & Biggs, 2004). However, problems occur, when human-induced changes to the environment result in the growth of periphyton reaching nuisance levels. The provision of nutrients, light, suitable substrate, channel form, and stable flows all affect the ability of periphyton to reach nuisance levels.

78 Before human presence all waterways would have had riparian vegetation of some description surrounding them. This would have consisted of woody growth (such as trees) or been limited to flax and grasses. However, as a result of vegetation clearance to create suitable land for production, the amount of sunlight reaching waterways has greatly increased. This is more pronounced for small waterways (less than 3.5 m in width) as these would have previously been completely shaded by riparian vegetation. Larger waterways (greater than 3.5m in width) would have naturally had less shading due to the fact that riparian vegetation would only be able to establish on the riparian margins that were more stable (less prone to flood effects) and therefore the shading from the riparian vegetation would cover a

smaller percentage of the streambed (Davies-Colley et al, 1998). Periphyton biomass can be up to 100 times higher in open canopy streams (where high light levels reach the streambed) than in streams with low light levels (Boothroyd et al, 2004). This proliferation of algae can have a number of effects as explained below.

79 Low levels of dissolved oxygen (DO) can be a major stressor to aquatic life, including fish, invertebrates, and micro-organisms, which depend upon oxygen for their efficient functioning. During the daytime algae carries out photosynthesis which produces oxygen into the environment in which they live. During night-time hours algae begins to respire which utilises oxygen and leads to the production of carbon dioxide and therefore a reduction in the dissolved oxygen levels within waterways (Hickey et al, 1989).

80 Fish abstract oxygen by pumping water across their gill membranes where it is absorbed into the blood and then distributed to tissues (Dean et al, 1999). Therefore a reduction in the amount of oxygen available in the water can result in a reduction in the amount of oxygen that is available to the tissue in fish. This can lead to changes in behaviours of some fish as they try to accommodate this lower oxygen level. These changes can include leaving the water completely to respire in air (this is known to have occurred in banded kōkopu), gulping in air at the surface of the water column, reduced activity in some species and increased activity in others to try to escape the lower oxygen levels (Dean et al, 1999). These strategies can be carried out for short term exposure to low oxygen levels but as exposure time increases these avoidance mechanisms start to negatively impact on fish survival. These avoidance mechanisms are highly energy expensive and increase the predation risk to the individual (Dean et al, 1999).

81 The growth of excessive amounts of periphyton can lead to a reduction in amount of spawning habitat available for some native fish species. Although some native fish species lay on streamside vegetation, other native species lay eggs within and on substrate on the streambed itself (Appendix 3 provides examples of eggs laid on instream substrate). As can be seen by the photos provided in Appendix 3, access to clean substrate is needed for fish to be able to lay their eggs on. As

discussed above, high algal mass can also lead to lower oxygen levels. Obviously, eggs are unable to move to the water surface, meaning that they are more susceptible to low oxygen levels.

82 The instream macroinvertebrate community composition can change with the amount of periphyton present in a waterway. A frequently used method of monitoring biotic health of waterways in New Zealand is through the Macorinvertebrate Community Index and its variants (Stark et al, 2007). This is discussed further below.

83 Periphyton proliferation can lead to a reduction in the amount of interstitial habitat available for fish and invertebrates to use. Interstitial spaces (habitat) is used by invertebrates and fish to live and feed in. The excessive growth of periphyton can infill these interstitial spaces either through directly growing into them, or parts of filamentous algae breaking of and infilling these spaces. This can have flow on effects when the periphyton begins to breakdown and oxygen demand increases with microbial breakdown of the algae.

84 The excessive presence of periphyton is known to affect the aesthetic values of waterways, although out of my area of expertise it is something that is frequently relayed to me during the course of my work in waterways

85 I believe that the approach taken by Horizons Regional Council in establishing nutrient levels to control the growth of periphyton (as contained in Schedule D) should result in the protection of the values that are indentified in Schedule D (proposed schedule Ba) of the POP.

Whio as a case study for water quality

86 Whio population success is dependent on a high standard of water quality. Although the current focus of threats to Whio is on the control of introduced predators, Whio are dependant on high quality water for their survival. Collier (1991) found that Whio on the Manganui o te Ao River consume a large proportion of cased caddisfly larvae, with the main species of cased caddisfly

eaten being *Beraeoptera roria*. During the month of September, Plecoptera (stoneflies) also constituted a high component of the diet of these birds.

87 These invertebrate species are dependent on high water quality for survival and this is reflected in the individual Macroinvertebrate Community Index (MCI) scores. Macroinvertebrate Community Index scores provide information on how sensitive particular species are to organic enrichment. A score of 10 means that a species is highly sensitive to organic enrichment and can only live in pristine waters (e.g. *Stenoperla* (Plecoptera) – see image below). Conversely, a low MCI score would indicate a has low sensitivity to organic enrichment and can live in highly degraded habitats (such as *Austrosimulim* (Diptera) which has an MCI score of 3 – see image below).

88 Organic enrichment comes primarily in the form of dissolved reactive phosphorous (DRP) and soluble inorganic nitrogen (SIN). High levels of DRP and SIN in waterways can lead to proliferations of periphyton, leading to changes in macroinvertebrate communities. Periphyton covering the substrate can also make it difficult for Whio to access the surface of rocks and scrape macroinvertebrates from them.

	
Stenoperla (MCI score 10)	*Austrosimulium* (MCI score 3)

Photos courtesy of Landcare Research

89 The excessive growth of filamentous algae (which can be the result of euthroprication) is thought to limit the availability of invertebrates to Whio and has been implicated as a factor in juvenile mortality during unusually dry winters (Collier & Lyon, 1991).

90 Appendix 4 shows photos of Whio feeding and how they are reliant on clean substrate that allows them to access macroinvertebrates present on rock surfaces.

91 As can be seen from the above points, the growth of periphyton and therefore the level of nutrients, particularly dissolved reactive phosphorous (DRP) and soluble inorganic nitrogen (SIN), in waterways can have profound effects on Whio populations. Within the Horizons Region there are numerous catchment zones and subzones which have Whio present and these are included in Appendix 6 of this evidence, along with the proposed DRP, SIN and periphyton standards as contained in Schedule D of the POP for these water management zones.

92 As outlined in the section 42A report by Dr Barry Biggs, "periphyton is the primary link between nutrient standards and stream and river values in the POP. More generally, periphyton proliferation is a primary symptom of excessive nutrient input to streams and rivers" (Biggs, pg 7).

93 The identification of values within waterways and defining and monitoring water quality standards within the POP to protect these values within Water Management Zones (WMZ), as has been done with waterways which have Whio present, and relating these to periphtyon growth and therefore the amount maximum of allowable nutrient levels (DRP and SIN) based on scientific literature and expert knowledge I believe should protect the water quality within Whio habitats and ensure that the food supply of Whio is not adversely effected. This in turn with the protection proposed for SOS-A should ensure that the habitat and food supply of Whio should not be adversely affected.

Policy 6-4: Enhancement where water quality standards are not met

94 While I support the approach taken within the POP to reduce nutrients levels in Water Management Zones I do not support the Officers' recommendation to add word 'maintains' in Policy 6-4 highlighted below (emphasis added):

Policy 6-4: Enhancement where water quality standards are not met

(a) In each case where the existing *water^* quality does not meet the relevant *water^* quality standard within a W~~w~~*ater M~~m~~anagement S~~s~~ub-zone**1, as shown in Schedule D, activities shall be managed in a manner which **maintains** or enhances existing *water^* quality in order to meet the *water^* quality standard for the W~~w~~*ater M~~m~~anagement S~~s~~ub-zones** shown in Schedule D.

(b) For the avoidance of doubt, ~~subsection~~ (a) applies:

(i)in circumstances where the existing water quality of a W~~w~~*ater M~~m~~anagement S~~s~~ub-zone** does not meet any of the water quality standards for the sub-zone (in which case ~~subsection~~ (a) applies to every water quality standard for the sub-zone)

(ii)in circumstances where the existing water quality of a W~~w~~*ater M~~m~~anagement S~~s~~ub-zone** does not meet all of the water quality standards for the sub-zone (in which case ~~subsection~~ (a) applies only to those standards not met).

95 The addition of the word "maintains" implies that there may be no need for improvement of water quality in those Water Management Zones that do not currently meet the standards in Schedule D.

96 The POP clearly identifies values within Water Management Zones in Schedule ~~D~~ Ba and the water quality standards in Schedule D are based on the requirements to meet these values. Without enhancement of water quality in the areas that do not currently meet the standards, we will jeopardise the values that have been identified in the POP.

- Summary:
- The approach taken in the POP of setting values and identifying standards to

maintain those values, based on scientific literature and expert opinion, is fully supported.

- The effects of nutrients in waterways and the flow on effects to periphyton levels can lead to significant adverse effects on aquatic biodiversity values and the complete change or elimination of aquatic communities.
- Whio as a case study show what the effects of high nutrients and its flow on effects can be for species.
- The addition of the word 'maintains' in Policy 6-4 is not supported.

Clean Streams Accord

97 The Clean Streams Accord "provides a statement of intent and framework for actions to promote sustainable dairy farming in New Zealand" agreed to by Fonterra, Ministry for the Environment, Regional Councils and Ministry of Agriculture and Forestry in May 2003. The Accord had a number of overarching goals that were to be achieved. These are reproduced below as taken from the Accord:

> "This Accord reflects an agreement that: Fonterra Co-operative Group, regional councils and unitary authorities, the Ministry for the environment, and the Ministry of Agriculture and Forestry will work together to achieve clean healthy water, including streams, rivers, lakes, ground water and wetlands, in dairying areas. In particular, the **goal** is to have water that is suitable, where appropriate, for:
>
> - Fish;
> - Drinking by stock;
> - Swimming (in areas defined by regional councils)."
>
> (pg 1, Clean Streams Accord, 2003)

98 The Clean Stream Accord (2003) aimed to have dairy cattle excluded from 50% of streams by 2007 and 90% by 2012. Streams being defined as deeper than a "Red Band" (ankle deep) and "wider than a stride" and permanently flowing.

99 Although not a direct component of the clean streams accord, in some areas riparian planting is also undertaken with this retirement of land next to the stream edge. This riparian planting is particularly beneficial for native fish as discussed above, as it provides habitat, invertebrate food supply and shading for smaller waterways.

100To date the meeting of some of the targets within the Clean Streams Accord has been slow. For example I have provided a quote from a recent press release (15th October 2009) from Taranaki Regional Council *"Of the existing fencing and vegetation, only 8% or 9% is new work and the rest existed pre-Accord." Council's Chairman, David MacLeod.* The press release states that farmers will need to markedly increase the amount of work that is being undertaken to be able to meet the target deadlines. In the same press release the council states that 82% of regionally significant wetlands are fenced when the Clean Stream Accord has set a target of 90% of significant wetlands being fenced by 2007.

- Summary:
- The Clean Streams Accord is a non-regulatory agreement between the Ministry for the Environment, Fonterra, Regional Councils and the Ministry of Agriculture and Forestry.
- The fencing of waterways can have beneficial effects for native fish by increasing habitat and their food supply.
- The meeting of some of the targets in the Clean Streams Accord has been slow as a non-regulatory tool.

Point source discharges

101The Officer's Report recommends schedule D, Table D.1a "Region-wide Water Quality Standards that apply to all natural streams and rivers" to use the

percentage change in the Quantitative Macroinvertebrate Community Index (QMCI) upstream and downstream activities, for the purpose of measuring the effect of discharges on macoinvertebrate communities. The reasoning for this addition of the percentage change in the QMCI as a monitoring tool is contained in the s42A by Ms Kathryn McArthur points 190 through to point 194 and also recommended in Dr John Quinn's s42A report point 17 and contained in Schedule D, Table D.1a of the officers recommended changes to the POP.

102 I agree with the recommendations made by Ms McArthur and Dr Quinn in their section 42A reports that the QMCI should be used in waterbodies to monitor compliance monitoring of certain activities. Most commonly the QMCI allows comparisons between reference (usually upstream) and impacted (usually downstream) sites for point source discharges. This monitoring allow the effects of specific activities on waterbodies to be assessed.

103 The use of the QMCI for compliance is well established in stream ecology in New Zealand, with protocols having been published by the Ministry for the Environment on how to collect, process and analysis such samples for hard and soft bottomed streams (Stark et al, 2001 & Stark et al, 2007).

104 Point source discharges are still having significant effects on water quality within the Horizons region. For example, a study carried out by Massey University looking at the effects of gravel extraction on the Oroua River (Death & Death 2004) was unable to assess the effects of the gravel extractions due to large adverse impacts that the Feilding sewage discharge was having on the Oroua River. The macroinvertebrate communities below the sewage discharge as measured by the QMCI were significantly lower and there was no recovery in the reaches assessed downstream of the discharge point (Death & Death, 2004). The s42A report of Kathryn McArthur, point 130 and points 327 to 331, provide information on those Water Management Zones which have significant point source inputs.

105 I draw your particular attention to Policy 6-8 set out below.

Policy 6-8: Point source discharges to water

(a) The management of point source discharges into water shall recognise and provide for the strategies for surface water quality management set out in Policies 6-3, 6-4 and 6-5 after reasonable mixing, while having regard to:

(i) the degree to which the activity will adversely affect the values identified for the relevant Water Management Sub-zone(s)

(ii) whether the discharge, in combination with other discharges including non-point source discharges, will cause the water quality standards set in Schedule D to be breached

(iii) the extent to which the activity is consistent with best management practices

(iv) the need to allow reasonable time to achieve any required improvements.

(b) The Regional Council may make an exception to subsection (a) where:

(i) in the case of discharges, the discharge is of a temporary nature or is associated with necessary maintenance work and the discharge cannot practicably be avoided

(ii) adverse effects can be fully offset by way of a financial contribution in accordance with Chapter 18

(iii) it is appropriate to adopt the best practicable option

(iv) other exceptional circumstances apply and it is consistent with the purpose of the RMA to do so.

106 Subsection (b)(iv) of Policy 6-8 does not provide certainty for environmental outcomes and could undermine the values identified in Schedule ~~D~~ Ba the POP. For example, Ms McArthur's s42A report paragraph 331 describes the existing scenario for large point source discharge applications as follows:

> "Out of seven discharges listed in Table 16 as contributing to poor water quality in the Manawatu River catchment, all are non-complying with the operative MCWQRP standards in Rule 2 for phosphorus and/or periphyton biomass and cover, either through exemption from the Plan standards or because they are operating outside their consents and are in the process of resource consent renewal. Four of the seven Manawatu discharges listed

have been through resource consent renewal since 2000 and have been granted non-complying status with the Rule 2 standards of the MCWQRP, largely by arguing 'exceptional circumstances'. Appendix 2 highlights the fact that these discharges are still adversely affecting the nutrient, E. coli and sometimes the lifesupporting capacity status of a number of Water Management Sub-zones, depending on the flow, to the detriment of the Region's water quality and aquatic biodiversity (see state and trend sections above)."

107. I request that subsection (b)(iv) be removed from Policy 6-8 to provide environmental certainty for those values identified in Water Management Zones and sub-zones in Schedule ~~D~~ Ba of the POP.

Summary :

- I support the use of the QMCI as a tool to monitor the effects of point source discharges.
- Point source discharges are still having significant adverse effects on some Water Management Zones and sub-zones.
- I consider that subsection (b)(iv) of Policy 6-8 provides uncertainty for environmental outcomes and should removed.

Sediment

108 The suspension of sediment within waterways is a natural phenomenon which has been accelerated by land use changes within catchments. This major change in New Zealand has been the clearance of forest vegetation and the resulting use of land for agriculture, forestry, mining and urban settlement (Boubee et al, 1997).

109 The effects of sediment on waterways can be significant as discussed further below. This sediment can be derived from land runoff or works within the

streambed and its margins, this will be considered further in the section on Beds of Lake and Rivers. Suspended sediment can be measured through clarity standards as contained in Schedule D of the POP which is supported, while methods for measuring and monitoring deposited sediment are still being developed.

110 Sediment in waterways is known to cause the following effects:

a. reduction in the amount of periphyton growth;
b. infilling of interstitial spaces when the sediment comes out of suspension, reducing fish and invertebrate habitat;
c. reduction in the ability of some fish species to be able to feed;
d. disruption in the ability of some native fish species to be able to migrate ;
e. blocking of gills in fish and invertebrates;
f. reduction in spawning habitat for some native fish species (instream egg layers e.g. redfin bully);
g. effects on aesthetic values, these effects are explained more fully below.

111 The growth of periphyton (a term used to refer to diatoms, mat and filamentous algae) as noted above is a natural process within waterbodies. Periphyton makes up the primary productive base of the aquatic food chain (Winterbourn, 2004 & Biggs, 2004). Grazing invertebrates need low levels of periphyton to be able to feed. Suspended sediment can result in a reduction in the amount of periphyton growth. Suspended sediment results in less sunlight being able to reach the streambed. As periphyton is reliant on sunlight to grow, this reduced sunlight can have a major impact on the amount of periphyton present. This has flow-on effects to the invertebrates that rely on periphyton as a food source and further effects to fish species that in turn rely on invertebrates for food source.

112 When suspended sediment loads become too high for the water energy to keep them in suspension or the water flow slows down, sediment can fall out of suspension and land on top of substrate or into interstitial spaces in the streambed substrate. Sediment that lands on top of substrate can smother periphyton growing on substrate, although this may not directly kill the periphyton it is likely to lead to a reduction in the amount sunlight that is reaching the periphyton. Sediment

that comes out of suspension that infills interstitial space reduces the amount of habitat that is available for fish and invertebrates to occupy.

113 Suspended sediment also can lead to a reduction in the ability of some fish species to be able to feed. Rowe et al, 1996 found that nephelometric turbidity unit (NTU) levels as low as 20 affected the ability of inanga and banded kōkopu juveniles to be able to actively feed.

114 High levels of sediment can have direct lethal effects by blocking gills of fish and invertebrates (Ryan, 1991). Other indirect effects can be caused by physical abrasion of fish and invertebrates which can later lead to infection or decreased fitness of fish and invertebrates leading to a higher risk of predation or a decrease in reproduction potential.

115 The amount of suspended sediment has been shown to affect the ability of some native fish species to migrate. In a study done by Boubee et al, 1997 banded kōkopu were found to be the most affected by suspended sediment on there ability to be able to migrate. 50% of banded kōkopu showed avoidance of water that had an NTU of 17 (kaolin) and 25 (Waahi silt). Kōaro and inanga also showed avoidance behaviour but this didn't occur at as a low NTU as banded kōkopu. In the same test long fin eels, short fin eels and redfin bullies showed no avoidance behaviour at the suspended sediments tested.

116 A reduction in the amount of habitat that is available for native fish to be able to spawn on. Due to the different spawning behaviours of native fish these effects can vary depending on the species being considered.

117 Some native species are known to spawn on substrate within the streambed, such as the redfin bully. Sediment coming out of suspension has the potential to cover substrate and make the substrate unsuitable for spawning to occur. If spawning has already occurred and sediment comes out of suspension landing on the eggs there is the potential that oxygen supply to the eggs while be reduced resulted in the death of the larvae developing inside the eggs. These sediment effects are known to occur for salmonids (Ryan, 1991).

118 Other native species are known to spawn in riparian habitat. There are those that spawn in the adult habitat were they occur such as banded and shortjaw kōkopu and others that migrate to habitats to be able to spawn such as inanga. In these areas the effects of sediment coming out of suspension are likely to be more detrimental to fish spawning habitat. Deposited sediment can remove suitable habitat by covering vegetation or filling in space in the riparian habitat. If spawning has already occurred, the eggs can become covered in sediment, reducing the ability of oxygen to penetrate the egg and resulting in death of the larvae developing within the egg.

119 The presence of suspended and settled sediment is known to effect the aesthetic value of waterways, but since this is outside of my area of expertise I will not consider it any further other than to simply mention it as something that is affected by the presence of suspended and settled sediment and that it is something that is frequently relayed to me during the course of my work in waterways.

120 There are significant adverse effects from high sediment loads in waterways. However, as outlined in Ms Kate McArthur's evidence:

> *"There is currently a national Envirolink Tools project in development to determine the best monitoring methods to measure deposited sediment and to provide environmental guidelines on acceptable thresholds of deposited sediment. Horizons are championing this project and have been involved in its development from the outset. Catchments with significant erosion issues are likely to have aquatic ecosystems adversely affected by deposited sediment, depending on the substrate of the river and the flow characteristics of particular reaches."* page 77, points 216 and 217.

121 It is a positive move that such work is being undertaken at a national level to determine appropriate monitoring methods and to provide environmental guidelines on acceptable thresholds of deposited sediment. Given the significant adverse effects of high deposited sediment in waterways this research is likely to provide a very important tool for deciding on acceptable levels of deposited sediment in waterways.

122I support the approach taken by Horizons Regional Council with the establishment of clarity in Schedule D of the POP to protect the values that are identified within the Water Management Zones and sub-zones identified in Schedule D (proposed schedule Ba) of the POP. As discussed above suspended and deposited sediment can have significant adverse effects in waterways. The clarity measures as proposed will address the suspended sediment issue, while researched championed by Horizons will develop robust methodology and standards for deposited sediment.

Summary:

- Suspended and deposited sediment entering waterways is a natural phenomenon that has been accelerated by changes in land use.
- The effects from sediment in waterways can be significant resulting in disruption of fish migration, loss of feeding ability for aquatic life and the loss of habitat quantity and quality.
- The inclusion of a clarity standard as contained in Schedule D of the POP should ensure that the effects of suspended sediment are reduced.
- It is pleasing to see an envirolink project to determine appropriate deposited sediment monitoring methods and environmental guidelines

WATER QUANTITY IN THE PROPOSED ONE PLAN

123The specific matters concerning the Plan's approach to water quantity I will address in this evidence are:

a. Habitat quantity and flow variability;
b. The approach to water allocation that is taken in the POP;
c. Setting minimum flows using the needs of Trout; and
d. Rule 15.5.

Habitat quantity and flow variability

124Low flows within waterways set the limit of habitat quantity that is available for aquatic fauna and flora to be able to use and therefore alters community

composition (Biggs, Ibbitt, & Jowett, 2008). As an example, Dewson, James and Death (2007) reviewed the consequences of decreased flow for instream habitat and macroinvertebrates and found the following effects on habitat within waterways:

a. A reduction in the water flow leads to a decrease in water velocity and depth which can lead to reduced quantity of habitat.

b. A reduction in the water flows can lead to changes in the wetted width of the waterway depending on the existing channel morphology. In waterways that have a high width-to-depth ratio, wetted width decreases. However, in waterways with a lower width-to-depth ratio the changes in the wetted width may be less obvious, although depth will decrease. Again this can lead to reduce quantity of habitat. The physical reduction in the amount of habitat that is available for use by aquatic species can lead to increased predation risk as organisms are now concentrated in a smaller area than previously**.**

c. A change in temperature can alter the natural freshwater community composition. Reduced water flows can lead to a change in temperature depending on the waterway in question. This can result in three possible situations as follows:

    i. Decrease in water temperature arises in those waterways that are largely influenced from groundwater. As rising groundwater will make up a larger percentage of the water flow in these situations, there can be a decrease in the water temperature.

    ii. Low flows are frequently associated with warmer climatic conditions which can lead to increases in water temperatures.

    iii. Some studies have found no change in the water temperature with low water flows.

d. There have been no recorded changes in dissolved oxygen (DO) levels in the review by Dewson et al, 2007. However as their review outlined, previous studies have often focused on spot measurements, which are unlikely to coincide with times when daily oxygen levels are lowest (such as dawn). However, James, Dewson, & Death, 2008 showed with continuous monitoring throughout the day (for 2-3 days) there was a marked decline in DO minima overnight with reduced flow.

e. Changes in pH levels may also occur which could potentially affect instream habitat quality.

f. A decrease in nutrient levels may occur as a result of decreased nutrient containing runoff (outside of areas influenced from point source discharges). There may also be an increased uptake of nutrients by periphyton which may result in excessive periphyton levels. The effects of excessive periphyton are considered in my evidence above.

g. All of the studies that have looked at electrical conductivity found an increase.

h. Lower flows generally result lower flow velocities, this can lead to less energy in the water flow and result in sediment particles coming out of suspension. This results in more deposited sediment on the streambed, reducing the amount of instream habitat that is available for use.

i. Most studies have found an increase in the amount of periphyton associated with lower flows, although Suren et al, 2003b found no increase in periphyton levels in an unenriched waterway and large increases in periphyton levels in an enriched waterway associated with low flows. The proliferation of periphyton has flow on effects, such as further reduction in the quality of habitat that is available for invertebrate and fish species (Suren, Biggs, Kilroy & Bergey, 2003., Suren, Biggs, Duncan, Bergey, & Lambert, 2003) and other indirect effects on species as discussed in my evidence on “The consequences of algae and nutrient levels”.

125The above suggest that changes in habitat bought about by low flows can be significant and change the way that organisms are able to live in such an environment.

126As discussed above low flows set the limit of habitat quantity that is available for aquatic fauna and flora to be able to use (Biggs et al, 2008). However, it is flow variability that maintains the quality of this habitat by (based on Biggs et al, 2008):

a. **Small floods and freshes:** flush sediment out of interstitial spaces were it has come out of suspension. This is important because the build up of too much sediment can severely diminish the amount of food producing habitat, and refugia available for invertebrates and fish species. These same floods also wash out periphyton which has settled on the substrate or break the strings of filamentous algae that have developed during the low flows. This is important because excessive periphyton reduces habitat quality. These smaller events entrain small substrate particles (sand and fine gravel) in the water column which can abrade periphyton from the substrate but usually do not move the larger substrate maintaining refuges of invertebrates and fish;
b. **Large floods:** are also referred to as channel forming or channel maintenance flows. These large flows tend to wash out periphyton, macrophytes and invertebrates from river. During these large flows high proportions of juvenile brown and rainbow trout can be removed from waterways, although adult trout being able to better withstand these large flows (Jowett & Richardson, 1989). Native freshwater fish appear to have evolved mechanisms to cope with such large flows. It is thought that native freshwater fish species are able to embed in the substrate that is not being affected by the large flows i.e. below the substrate being moved around by the flood flows (Amber McEwan, pers comm.).

127The importance of this flow variability in maintaining habitat quality within waterways is covered in detail in Dr John Hayes, Ms Raelene Hurndell, Dr

Jonathon Roygard and Mr Joseph Hay's section 42A reports and as I concur with their evidence in this regard it need not be repeated here.

The approach to water allocation in the POP

128I support the approach taken by the POP for water allocation in setting a core allocation for each of the water management zones dependant on the values and information that is available with each of these management zones. This approach should mean flow variability within waterways is maintained. A worked example of this for the Raparapawai Stream is provided in the section 42A report of Ms Raelene Hurndell point 38. Her evidence demonstrates that with the abstraction of the core allocation from the Raparapawai Stream flow variability is maintained, although the minimum flow is reached quicker than it would naturally. Therefore the setting of core allocations as done in the POP should ensure that flow variability is able to be maintained within the regions water management zones.

129It is important that the appropriate methodology and values are used when determining what the minimum flow in a waterway should be.

Setting minimum flows using the needs of Trout

130When setting minimum flows within waterways it is important to consider the waterbodies' values. Minimum flows within waterways are most often calculated based on the needs of the species with the greatest flow requirements. Therefore, these values are frequently based on the flow needs of trout. Some submitters consider that the flows should not be based on trout requirements but on the flow requirement of native species. From the publication "Habitat use by New Zealand fish and habitat suitability models" (Jowett & Richardson, 2008) it can be seen that different native species can have very different flow requirements, and that flow requirements can also vary depending on the part of the fish's life cycle that you are considering.

131It is vital to set appropriate minimum flows to protect the values identified in a waterway. In my opinion the use of trout as a species for flow setting is

appropriate in that the flow requirements of trout will frequently meet the flow requirements of native fish species. Take for example the dwarf galaxias and juvenile brown trout which have very similar habitat suitability curves for depth and velocity, although dwarf galaxias tend to be more specific in their substrate requirements.

Rule 15.5

132Rule 15-5 of the POP specifies that "the taking and use of surface water from a river pursuant to s14(1) RMA, except where the water take is controlled under Rule 13-1" is a controlled activity. Paras (a) – (k) of the rule specify a number of matters over which control is to be reserved. The rule as notified did not provide for control to be reserved over effects on SOS-A.

133Horizons Regional Council submitted (submission point 182/73) that rule 15-5 be amended to provide for control to be reserved over effects on SOS-A. The Officer's Report recommends that this submission be accepted and proposes amending clause (g) of the rule to provide that control be reserved over (amongst other things) "Effects on rare habitats, and threatened habitats and at-risk habitats ~~and~~ Sites of Significance – Aquatic. The reason provided for supporting this proposed addition was that the reference more accurately reflects the issues that need to be considered.

134I agree with this submission. An example of why I support this submission is that dwarf galaxiids (a non-migratory species used to identify SOS-A) have larvae and young that are susceptible to entrapment in water intake structures and such structures could be located to take account of this susceptibility.

Summary:

- I support amending rule 15-5 control (g) to include SOS-A
- Low flows are frequently seen as limiting the quantity of habitat that is available

and flow variation seen as controlling the quality of this habitat. It is therefore vital that the two are considered in conjunction.

- I support the approach taken in the POP for water allocation by setting a core allocation for each of the water management zones as this should ensure that flow variability is maintained.

- It is vital that an appropriate minimum flow is set within a waterway and that this be based on the values identified and through appropriate methodology.

BEDS OF LAKES AND RIVERS

135My evidence on the beds of rivers and lakes will cover:

a. effects of instream works on aquatic biodiversity;
b. the importance of habitat variability within waterways and threats to it ;
c. Policy 6-28; and
d. the Environmental Code of Practice for River Works (ECOP).

Effects of instream works on aquatic biodiversity

136River works affecting the beds of lakes and rivers have the potential for adverse effects on aquatic habitats and hence biodiversity. These effects include loss of habitat variability, sediment suspension, sediment deposition, direct loss of aquatic biodiversity and indirect displacement of fauna. The processes of sediment entrainment, suspension and deposition are discussed in more detail below.

137Generally river works within the wetted channel release varying amounts of sediment into waterways. This increased turbidity results in disruption to some fish species migration (Boubee et al, 1997) and the reduction in the ability of some native fish species to locate food (Rowe et al, 1996). As a case study, Nephelometric Turbidity Unit (NTU) levels are a measure of the cloudiness of water assessed by the attenuation of light as it passes through a sample of water. Rowe et al, 1996 found that NTU levels as low as 20 affected the ability of inanga and banded kōkopu juveniles to be able to actively feed. Migrant inanga were also found not to feed in the absence of light.

138 Increased turbidity in the water column reduces the amount of sunlight reaching the substrate which can lead to an excessive reduction in growth rate of periphyton. As a consequence a lack of periphyton reduces the amount of food that is available for grazing invertebrates. Eventually the sediment will be deposited when the water velocity lacks the energy to maintain the particles in suspension.

139 During low flows most of the deposition will occur on the riverbeds. The deposition of sediment leads to infilling of interstitial spaces, reducing fish and invertebrate habitat. A film of deposited sediment on the riverbed will lower the quality of periphyton available as food to grazing invertebrates.

140 The release of sediment generally occurs at times when the river flow is experiencing lower flows and the water within the active channel is generally flowing at a cleaner state compared to flood flows in which the majority of sediment is carried (Ryan, 1991).

141 During periods of low flows there is less sediment laden runoff and water velocity is usually slower. Therefore suspended sediment loads are generally lower. Conversely at times of high flow there are increased sediment loads and additional ability to convey these extra particles to the coast.

142 As a result of these natural processes the timing of instream works must be considered.

143 Flood protection work includes the removal of gravel from rivers and streams to lower the bed and prevent flood waters overtopping floodbanks. Lowering of the bed can lead to rivers that are confined to one main river channel therefore leading to the removal of braided river systems (Richardson & Fuller, 2008).

144 Some bird species use the riparian habitat of streams and rivers to complete part of their life cycle. Banded dotterels (*Charadrius bicinctus*) and the black fronted dotterel (*Charadius melanops*) are two of the bird species that have been used to

identify Sites of Significant – Riparian (SOS-R). Both of these species can be commonly found (and breed) on gravel beds of rivers (Hallas, 2003) in the Horizons region. Modifications of rivers can have adverse effects on the ability of these species to be able to successfully breed.

145 Braided river systems can lead to the formation of permanent or temporary islands as the river forms many channels around these islands. For example, the Rangitikei River was once a multi channelled (braided) river system, but due to river management practices the river is now mostly confined to a single channel (a single thread river) (Richardson & Fuller, 2008).

146 A study completed by Rebergen et al, 1998 found that the breeding success of banded dotterels was higher for those birds that had attempted nesting on islands compared with the mainland. This is due to the fact that predators are less likely to swim across water to predate on the bird species that are present on these islands (Keedwell, 2006).

147 Furthermore with a reduction in the amount of riverbed that is frequently exposed to flowing water, substrate can become more suitable for the encroachment of weed plant species onto the riverbeds. This is especially so for exotic species such as willows, gorse and lupin which are faster growing compared to native species. The encroachment of plant species onto the riverbed can lead to an increased reduction in the amount of habitat that is available for bird species to use. For example, Maloney et al, 1999 found that the removal of willows from the riverbed increased the foraging and nesting habitat for some river bird populations.

148 See appendix 4 for photos of the types of habitats that black fronted and banded dotterels nest and live in.

The importance of habitat variability within waterways and threats to it

149 Waterways provide a number of different habitat "types' for aquatic species. Scientists frequently refer to the "pool, run, riffle" sequence that is found within rivers. This refers to flow variations within the water channel, which defines

which species the waterway is able to support. It is important to maintain this natural composition of habitat variability for each individual waterway to maintain species diversity.

150 The presence of large woody debris has been shown to be important for the maintenance of habitat variation within streams (Baillie & Davies, 2002). Some native freshwater fish species such as short jaw kōkopu and giant kōkopu are frequently associated with the presence of instream debris. Large woody debris can lead to the retention of organic matter and sediment within streambeds, contribute to debris dams and add to the formation of pools (Baillie & Davies, 2002). Therefore, the presence of large woody debris adds significantly in maintaining the habitat variability that is used by a different freshwater species in New Zealand. The removal of this type of vegetation from streambeds can therefore lead to losses of habitat variability and result in a reduction in the biodiversity values in a waterway.

151 The habitat that is available in waterways is utilised by different species of aquatic life. A survey by Jowett and Richardson, 1995, found that native fish species encountered during these surveys could typically broken up into four different habitat guilds (species found included longfin eel, shortfin eel, torrentfish, upland bully, redfin bully, bluegill bully, common bully, common river galaxias, cran's bully, lamprey, kōaro, inanga, shortjaw kōkopu, common smelt, black flounder and dwarf galaxias). The four guilds indentified were:

a. A fast water guild that occupied central proportions of riffles,
b. a edge-dwelling guild;
c. an intermediate guild;
d. and an ubiquitous guild (Jowett and Richardson, 1995).

152 His survey showed that native fish species make use of a variety of habitats and some species are specialised for living in these types of environments.

153 The following are some examples of species specialization to specific habitat types within the waterbody. These reflect why it is vital that a variety of habitat

types are preserved within waterbodies to maintain aquatic biodiversity within the Horizons region.

154If we take the example of torrentfish, this species is reliant on fast flowing water to be able to carry out its lifecycle. The flattened head and large pectoral fins help this species to anchor on the riverbed, while the raised eyes and ventral mouth are probably adaptations for feeding in this habitat (www.niwa.co.nz/our-science/freshwater/tools-old/fishatlas/species/torrentfish, accessed 06/10/2009).

155As another example banded and shortjaw kōkopu are frequently found in small forested streams which contain log jams and associated vegetation. Bluegill bullies however, are known to occur in high densities within riffle habitat.

156A freshwater mollusc, kākahi (freshwater mussel) also have habitat specialized habitat requirements. Rainforth, 2008 found that in the Whanganui River kākahi were found in areas of slow flow, which generally had more fine sediment, logs and/or macrophytes.

157The following is an example of habitat use by piharau (lamprey, *Geotria australis*) depending on its stage of their life cycle. Adult lamprey have a marine parasitic phase after which they return for 14-16 months to freshwater were they spawn and die (Jellyman & Glova, 2002). Spawning is assumed to occur in small tributaries but this has not been confirmed. The larval (ammocoetes) stage remains in freshwater for 3.5 to 4.25 years during which time they move downstream on floods. Ammocoetes were associated with runs, overhead shade and high proportions of fine sand. The same study (Jellyman & Glova, 2002) also suggests that macrophthalmia (juvenile lamprey) have different habitat requirements from ammocoetes but does not suggest what these differences may be. This represents that a species can have different habitat requirements depending on the stage in its life cycle (Jellyman & Glova, 2002).

158Having considered the importance of habitat variability, this leads to consideration of the potential effects of river works and associated structures. As an example, the nature of flood control schemes is to alter river dynamics with the aim of

reducing impacts on adjacent land uses and existing infrastructure. However, these works have the potential to negatively affect the life supporting capacity of waterways due to the changes that they can cause in the functioning of a dynamic system and potential loss of species diversity.

159 One example is the separation of waterbodies from their natural connectivity with floodplains. This occurs by the creation of stockbanks and other protection works. Among other disciplines, floodplain connectivity is important for the maintenance of ecological diversity. The loss of connectivity with the flood plains may mean that flood events have more destructive effects on fish populations then they used to when there was connectivity with the flood plains. This can be illustrated by the study undertaken by Jowett and Richardson, 1994 which showed that the floodplain areas are likely to provide refuge for freshwater fauna from the conditions of flood events.

160 Edge dwelling fish species were found by Jowett and Richardson, 1994 to occupy areas during the flood that had previously been dry and had also dried out again two days after the flood flows had reduced. They proposed that there could be three reasons for this lateral shift, which are reproduced below:

a. That fish move to feed in the newly flooded zones on the stream margins. Chisnall and Hicks, 1993 quote that "Pasture has been shown to provide terrestrial invertebrates to fish in streams during floods. Eels in lowland pastoral streams are more likely to have access to terrestrial invertebrates then eels in pastoral streams immediaitely below forest where gradients are high and the flood plain is narrower" pg 328. The main point to take from this is that a loss of connectivity with flood plains is that there is a reduction of food availability to eels due to a narrower flood plain;
b. That the fish move to avoid hydraulic stress and shallower areas that less susceptible to disturbance;
c. That fish move to occupy zones where they are less subject to predation from predators.

Summary

- Instream river works have the potential to release and re-suspend significant amounts of sediment into waterways, therefore timing of such instreams works is vital.
- The effects of river works can result in can be direct such removal of habitat, extraction of fish or indirect such as sediment infilling interstitial spaces.
- The maintenance of habitat variability is important in waterways as many of New Zealand's native fish have different habitat requirements and therefore use a variety of different habitats, which can change with flows in waterways.

Policy 6-28: Activities in water bodies with a Value of Natural State, Sites of Significance – Cultural, or Sites of Significance - Aquatic

161 Policy 6-28 of the POP as notified outlines that activities in beds of rivers and lakes are to be managed in a manner which avoids adverse effects on values of Natural State, Sites of Significance – Cultural and SOS-A. A number of submitters have requested that policy 6-28 (set out at para 13 above) should be amended to allow for adverse effects to be remedied or mitigated in addition to being avoided. The Planners' report recommends that the policy be amended to read as follows (emphasis added).

> **Policy 6-28: Activities in *water bodies* with a Value of Natural State, Sites of Significance - Cultural, or Sites of Significance - Aquatic**
>
> In those Water Management Sub-zones with a Value of Natural State, Sites of Significance - Cultural, or Sites of Significance - Aquatic, as shown in Schedule Ba, activities in, on, under or over the beds of rivers and lakes shall be managed in a manner which:
>
> (a) avoids ***or mitigates*** adverse effects on these values
> (b) maintains the habitat and spawning requirements of the species

identified in Schedule Ba as being significant within the subject Water Management Sub-zones.

162 Both instream works and the removal of riparian vegetation have immediate effects on aquatic biodiversity. Given the importance of SOS-A, in my opinion, avoidance of such effects on these sites is vital. For example, instream works during dwarf galaxiid spawning is likely to lead to direct mortalities through eggs and larvae being crushed, and indirect mortalities through sediment deposition on eggs preventing oxygen reaching the embryos. Furthermore, banded and short-jaw kōkopu are highly associated with instream debris. The removal of such debris results in the immediate loss of habitat for these species.

163 I consider that Policy 6-28 should remain as notified in the POP.

Summary

I request that the word mitigate be removed from Policy 6-28(a).

Environmental Code of Practice for River Works (ECOP)

164 My evidence regarding the Environmental Code of Practice (ECOP) is restricted to issues relating to the Sites of Significance (SOS) and the Site Specific Special Standards. As discussed previously in my evidence I support the principle of using SOS in the ECOP to provide protection for specific species and their habitats. However, the use of Site Specific Special Standards in the ECOP does not provide sufficient protection to these biodiversity.

Sites of Significance – Aquatic and Riparian and Site Specific Special Standards

165 As I understand it the intention of the recommendation in the Officers' Report and the revised ECOP is that only those activities in works areas are intended to be covered by Rule 16-13 of the POP and the ECOP. Some of these work areas are either fully or partially in sites identified as having values as SOS-A or SOS-R in the Proposed Plan. The ECOP sets site specific standards (page 101 August 2009

version) for particular sites which although not clearly identified as such correspond with particular SOS-A and SOS-R identified in the Plan.

166 I will comment on a number of matters in relation to how SOS-A and SOS-R are treated under this regime. First, I am concerned that the site specific standards are not consistent between different SOS-A sites that are identified has having the same species present. The same concern arises in relation to SOS-R sites. This does not provide certainty for the protection of the habitat of the rare and threatened species

167Second, as noted above August 2009 of the ECOP and the related rules as recommended by Officers' will only apply to identified Works Areas not entire Scheme Plan areas. However, the Site Specific Special Standards set out in the ECOP (page 101 and following) do not align with the Work Areas. In my opinion this will make the standards that apply to these specific sites difficult to interpret and could lead to confusion.

168Therefore, with these issues in mind I have attached to this evidence (Appendix 7) an amended version of the Site Specific Special Standards which attempts to align the Site Specific Special Standards and the Works Areas as identified in the ECOP August 2009 version. In my opinion this amended version should be incorporated into the ECOP.

169The ECOP (April 2007) listed a number of customary gravel extraction sites in Table 3.1 (page 85) that were proposed to be exempt from the dotterel exclusion conditions. This would have the effect of providing less protection to nesting dotterel at these sites than provided for under the POP Table 16.1 *Standard conditions for permitted activities involving the beds of rivers and lakes* (Officers report dated 31st August 2009). Table 3.1 has been deleted from the August 2009 version of the ECOP. I therefore support this deletion.

170However, the evidence of Mr James Lambie suggests that these sites are being continuously used for gravel extraction. Therefore these sites will already fall under a permitted activity status under Table 16.1 *Standard conditions for*

permitted activities involving the beds of rivers and lakes (below) and will not need further consideration under the ECOP:

i. *For the purpose of minimising disturbance to nesting dotterels; Between 1 August and 31 December, gravel extraction and bed disturbance on gravel beaches shall only take place:*
    1. *(i) within 7 days following a flood of the area of beach that is the subject of the activity, or*
    2. *(ii) where the extraction or disturbance commenced at the same location prior to 1 August and has not been interrupted for more than 7 days.*

Flood protection scheme – Whanganui River

171 The ECOP August 2009 version has identified Works Areas within the Lower Whanganui Scheme, which would therefore fall under the permitted activity status in POP rule 16-13. The Lower Whanganui Scheme is depicted on the map, page 131 of the ECOP August 2009 version, extending from State Highway 3 to Upokongaro. I am concerned that this may be interpreted to include ecologically sensitive areas, such as the Matarawa Stream and its margins.

172 As a background to this issue it is worth noting previous consultation undertaken by Horizons Regional Council in 2008. This related to proposed flood protection works to provide additional protection to Wanganui City. As a result of community concerns the project was subsequently restricted to the Balgownie area.

173 My particular concerns are with the Matarawa Stream area which forms the coastal end of the Lower Whanganui Scheme, and has high ecological and recreational values. The proposed works in the Lower Whanganui Scheme are likely to cause significant adverse effects on the ecological values of the Matarawa Stream and its margins.

174I understand for example that the proposed works include the straightening and culverting of large sections of the Matarawa Stream. The following provides three examples of adverse effects from the proposed works:

a. Matarawa Stream provides significant habitat for inanga spawning within the Whanganui catchment which is important for the maintenance of native freshwater biodiversity. As well as other adverse effects on instream ecology, the proposed works will severely reduce the amount of habitat available for inanga egg laying.
b. The Matarawa Stream provides significant habitat for threatened kākahi (freshwater mussels). In a study carried out by Rainforth, 2008 a total of twenty-two sites within the Whanganui catchment that were previously known to contain kākahi were re-surveyed. The results of this study were that within the Whanganui catchment there were only four sites that still had evidence of kākahi recruitment, and the Matarawa Stream was one of these sites. The culverts will not provide habitat for the kākahi and the substrate will be unsuitable for them to burrow into and the culvert will also speed up the flow of water making it more unsuitable.
c. This stream is a well known recreational whitebaiting stream and culverting of this stream will remove the ability of people to be able to carry out this traditional activity.

175I therefore submit that the area described as the Lower Whanganui Scheme in the ECOP August 2009 version should be amended to include only the currently consented Works Area known as the Balgownie area.

Summary

- I request that if the Environmental Code of Practice for River Works (ECOP) is adopted that the Site Specific Special Standards as attached to my evidence (Appendix 7) are adopted instead of the ECOP August 2009 version.

- I support the removal of Table 3.1 from the ECOP 2007 version as is currently

done in the ECOP August 2009 version.

- I request that for clarity that the Lower Whanganui Scheme more clearly defined. If the Lower Whanganui Scheme as contained in the ECOP August 2009 version is to include the Matarawa Stream I request that it be removed from the ECOP August 2009 version due the significant ecological values within this stream.

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Appendix One

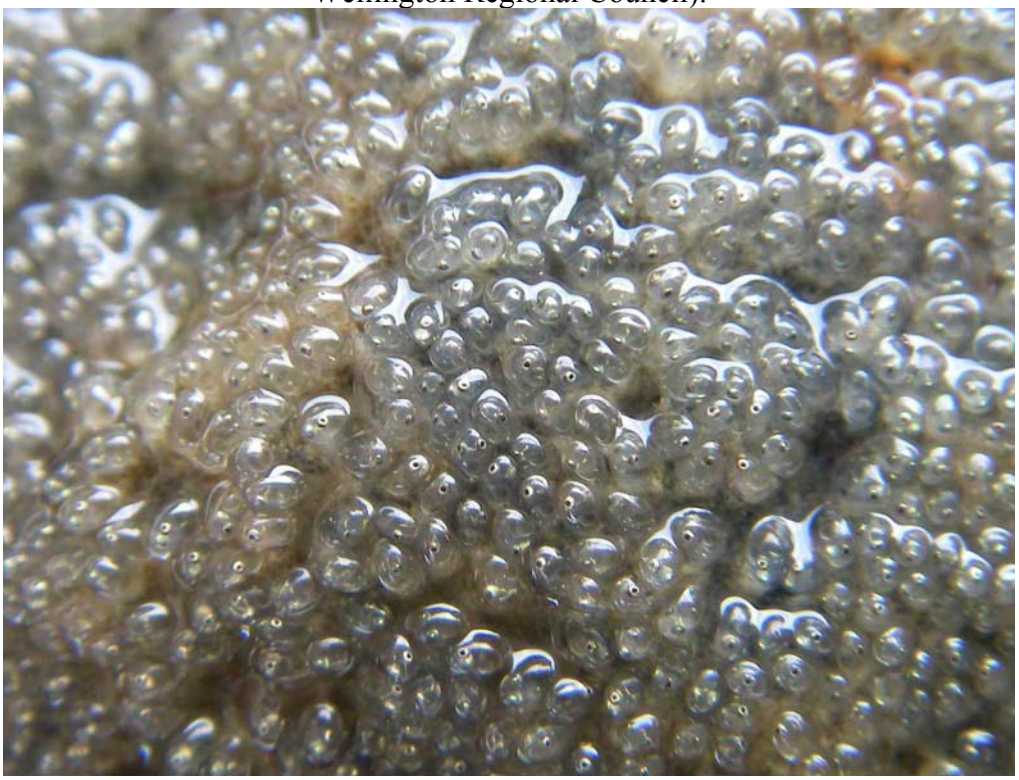
Banded kōkopu spawning site found 23/05/00, Katikara Stream, Taranaki. Photos progressively move in towards the site of the eggs, with the orange arrow indicating the nest site (Photos: Dean Caskey, DOC New Plymouth).

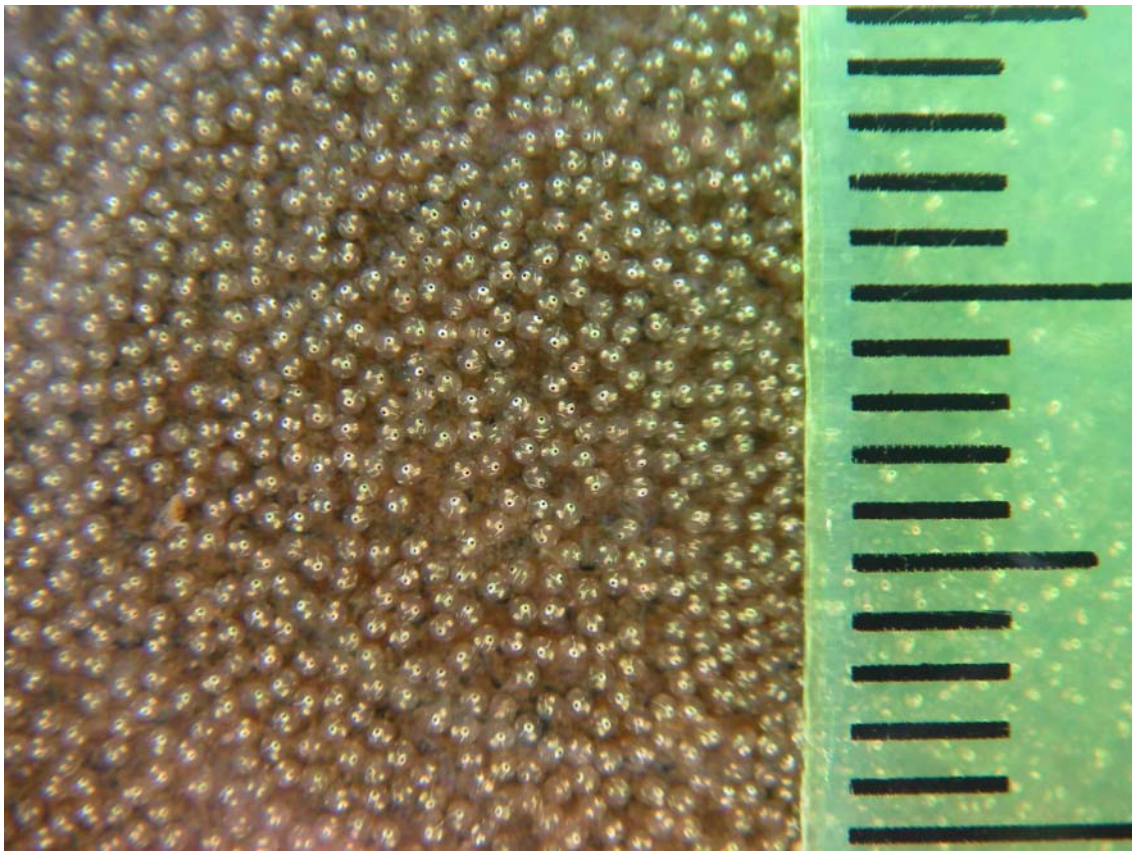
Appendix Two:

Photos of inanga eggs found at the mouths of Kai Iwi and Pukepuke stream mouths. Showing the dense of swath of grass required to maintain moisture (Photos: Hannah Rainforth, DOC Whanganui Area).

Appendix Three

Pictures of common bully eggs (1st picture), Upland bully eggs (2nd picture), bluegill bully eggs (3rd picture) on streambed substrate (Photos: Alton Perrie, Greater Wellington Regional Council).





Appendix Four:

Whio family of two adults and three chicks crossing turbulent water (1st picture), Whio scraping invertebrates from the surface of rocks (2nd picture), and Whio submerged below the water scraping invertebrates from rocks (Photos: DOC)

Appendix Five:

Banded dotterel nest in the gravel riverbed (1St picture), banded dotterel chicks in nest (2nd picture), banded dotterel sitting on nest (3rd picture), black fronted dotterel heading towards nest (4th picture), and black fronted dotterel sitting on nest (5th picture).

Appendix Six:

Sites of Significance – Aquatic that have Whio present and the associated DRP, SIN and periphyton standards to be appealed to the water catchment zones:

Management Zone	**Sub-zone**	**Site**	**Proposed maximum DRP level (g/m^3)**	**Proposed maximum SIN level (g/m^3)**	**Chl a (mg/m^2)**
Middle Manawatu	Upper Pohangina (Mana 10b)	Pohangina River	0.006	0.070	120
Upper Rangitikei	Rangitikei River (Rang 1)	Rangitikei River	0.006	0.070	50
Upper Rangitikei	Rangitikei River (Rang 1)	Mangamarie River	0.006	0.070	50
Upper Rangitikei	Rangitikei River (Rang 1)	Otamatenui Stream	0.006	0.070	50
Middle Rangitikei	Pukeokahu – Mangaweka (Rang 2b)	Mangatera River	0.006	0.070	120
Middle Rangitikei	Pukeokahu – Mangaweka (Rang 2b)	Waiokotore Stream	0.006	0.070	120
Middle Rangitikei	Pukeokahu – Mangaweka	Maropea River	0.006	0.070	120

	(Rang 2b)				
Middle Rangitikei	Pukeokahu – Mangaweka (Rang 2b)	Kawhatau River	0.006	0.070	120
Middle Rangitikei	Pukeokahu – Mangaweka (Rang 2b)	Waikakamaka River	0.006	0.070	120
Upper Whanganui	Upper Whanganui (Whai 1)	Otamangakau Outlet	0.006	0.070	50
Upper Whanganui	Upper Whanganui (Whai 1)	Otamarautara Stream and tributaries	0.006	0.070	50
Upper Whanganui	Upper Whanganui (Whai 1)	Otonokaku Stream	0.006	0.070	50
Upper Whanganui	Upper Whanganui (Whai 1)	Waipapaiti Stream	0.006	0.070	50
Upper Whanganui	Upper Whanganui (Whai 1)	Mangatepopo Stream	0.006	0.070	50
Upper Whanganui	Upper Whanganui (Whai 1)	Okupata Stream (typo in Whio – point out)	0.006	0.070	50
Upper Whanganui	Upper Whanganui (Whai 1)	Tawhitikuri Stream	0.006	0.070	50

Upper Whanganui	Upper Whanganui (Whai 1)	Waione Stream	0.006	0.070	50
Upper Whanganui	Upper Whanganui (Whai 1)	Waipari Stream	0.006	0.070	50
Upper Whanganui	Upper Whanganui (Whai 1)	Waionenui Stream	0.006	0.070	50
Upper Whanganui	Upper Whanganui (Whai 1)	Waione Stream	0.006	0.070	50
Upper Whanganui and Cherry Grove	Upper Whanganui and Cherry Grove (Whai 1 and Whai 2a)	Whanganui River	0.006 and 0.010	0.070 and 0.110	50 and 120
Cherry Grove	Upper and Lower Whakakapa (Whai 2b and Whai 2c)	Whakapapa River and Whakapapiti Stream	0.006	0.070	50
Cherry Grove	Upper Whakapapa (Whai 2b)	Waikare Stream	0.006	0.070	50
Cherry Grove	Upper Whakapapa	Mangahuia Stream	0.006	0.070	50

	(Whai 2b)				
Cherry Grove	Upper Whakapapa (Whai 2b)	Whakapapanui Stream	0.006	0.070	50
Cherry Grove	Upper Whakapapa (Whai 2b)	Papamanuka Stream	0.006	0.070	50
Cherry Grove	Lower Whakapapa (Whai 2c)	Otamawairua Stream	0.006	0.070	50
Cherry Grove	Piopiotea (Whai 2d)	Piopiotea Stream	0.006	0.070	50
Cherry Grove	Pungapunga River (Whai 2e)	Pungapunga River	0.010	0.110	120
Cherry Grove	Upper Ongarue (Whai 2f)	Ongarue River and tributaries	0.006	0.070	50
Cherry Grove	Upper Ongarue (Whai 2f)	Mangatukutuku Stream	0.006	0.070	50
Cherry Grove	Upper Ongarue (Whai 2f)	Maramataha River	0.006	0.070	50
Cherry Grove	Upper Ongarue (Whai 2f)	Piropiro Stream	0.006	0.070	50

Cherry Grove	Upper Ongarue (Whai 2f)	Paupangonui Stream	0.006	0.070	50
Cherry Grove	Upper Ongarue (Whai 2f)	Totara Stream	0.006	0.070	50
Cherry Grove	Upper Ongarue (Whai 2f)	Unnamed Maramataha River and tributary	0.006	0.070	50
Middle Whanganui	Retaruke (Whai 4d)	Retaruke River	0.010	0.110	120
Middle Whanganui	Retaruke (Whai 4d)	Horomea Stream	0.010	0.110	120
Middle Whanganui	Retaruke (Whai 4d)	Morinui Stream	0.010	0.110	120
Pipiriki	Pipiriki (Whai 5a)	Mangapurua Stream and tributaries	0.010	0.110	120
Pipiriki	Pipiriki (Whai 5a)	Mangatiti Stream and tributaries	0.010	0.110	120
Pipiriki	Pipiriki (Whai 5a)	Kaiwhakauka Stream	0.010	0.110	120
Pipiriki	Pipiriki (Whai 5a)	Mangaio Stream and tributaries	0.010	0.110	120
Pipiriki	Upper Middle and Lower	Manganui o te Ao River	0.006 and 0.010	0.070 and 0.110	50 and 120

	Manganui o te Ao (Whai 5d, Whai 5g and Whai 5i)				
Pipiriki	Makatote (Whai 5e)	Makatote River	0.006	0.070	50
Pipiriki	Waimarino (Whai 5f)	Waimarino Stream	0.006	0.070	50
Pipiriki	Middle Manganui o te Ao (Whai 5g)	Manganui o te Ao River tributary	0.006	0.070	50
Pipiriki	Mangaturuturu (Whai 5h)	Mangaturuturu River and tributaries	0.006	0.070	50
Pipiriki	Lower Manganui o te Ao (Whai 5e) – typo should be 5i	Ruatiti Stream	0.010	0.110	120
Pipiriki	Lower Manganui o te Ao (Whai 5e) – typo should be 5i	Makino Strean tributary	0.010	0.110	120
Pipiriki	Orautoha (Whai 5j)	Orautoha	0.010	0.110	120
Upper	Upper	Unnamed tributary	0.006	0.70	50

Whangaehu	Whangaehu (Whau 1a)	of the Whangaehu River			
Upper Whangaehu	Upper Whangaehu (Whau 1a)	Makahikatoa Stream and tributaries	0.006	0.70	50
Upper Whangaehu	Upper Whangaehu (Whau 1a)	Wahianoa Stream	0.006	0.70	50
Upper Whangaehu	Tokiahuru (Whau 1c)	Unnamed tributary of the Tokiahuru Stream	0.006	0.070	50
Upper Whangaehu	Tokiahuru (Whau 1c)	Unnamed tributary of the Unuunuakapuateariki Stream	0.006	0.70	50
Upper Whangaehu	Tokiahuru (Whau 1c)	Unuunuakapuateariki Stream and tributaries	0.006	0.70	50
Lower Whangaehu	Upper Mangawhero (Whau 3d)	Mangawhero River	0.006	0.070	50
Lower Whangaehu	Upper Mangawhero (Whau 3d)	Taonui Stream	0.006	0.070	50
Lower Whangaehu	Lower Mangawhero (Whau 3e)	Mangawhero River	0.010	0.110	120

Appendix Seven:

5. Site Specific Special Standards

Where sites are not listed in the table below but fall within a scheme rating area, the rules in the One Plan will apply.

In addition to the generic and activity standards listed in Part One and Two of this code, and the Generic Special Standards listed above, **the following site specific special standards will apply to any activities undertaken at the sites listed below,** and shown on **the maps** included in this part of the Code.

Generic standards:

- Any herbicidal application is to be timed to coincide with water movement in the stream and outside of the exclusion times below.
- Generic standard? All instream works will ensure that a fish salvage operation is undertaken for all aquatic organisms (fish, koura, mussels) accidentally removed from the stream channel. These species are to be replaced back in the stream channel when work finishes.
- In Sites of Significance - Aquatic for fish species known as riparian spawners there will be no removal of riparian vegetation.

SOS-A and SOS-R	Scheme Name	Species present	Site Specific Special Standards
	Ashhurst Scheme	None	
	Forest Road Scheme	Inanga Spawning Whitebait migration	Inanga spawning and whitebait migration – refer to generic standards
	Foxton East Scheme	None	
	Haunui Scheme	None	
A41	Himatangi Scheme • Roundbush and associated streams • Whitebait Creek	Brown Mudfish Inanga Spawning	Brown mudfish: • A consent will be required to undertake works at this site. Or • Drainage is to occur on a maximum five year return cycle.

		Whitebait migration	• No work is to occur during the spawning season (late autumn – spring). • Staff with appropriate training are to be present during the operation to retrieve aquatic life, recording numbers and species, and to replace them in the stream. • Department of Conservation staff are to be made aware of the operation at least five working days before commencement to allow staff to be on site if resources allow. Inanga spawning and whitebait migration – refer to generic standards
A149	Hokio Scheme	Giant kōkopu Inanga spawning Whitebait migration	Giant kōkopu: • A consent will be required to undertake instream works between the 1st October to the 31st December (whitebait recruitment) • A consent will be required to undertake instream works between the 1st April – 30th July (spawning season). Inanga spawning and whitebait migration – refer to generic standards.
A50	Koputaroa Scheme	Brown Mudfish	Brown mudfish: • A consent will be required to undertake works at this site. Or • Drainage is to occur on a maximum five year return cycle. • No work is to occur during the spawning season (late autumn – spring). • Staff with appropriate training are to be present during the operation to retrieve aquatic life, recording numbers and species, and to replace them in the stream. • Department of Conservation staff are to be made aware of the operation at least five working days before commencement to allow staff to be on site if resources allow.

A46 A45 R19 R13	Makerua Scheme	Brown Mudfish Lower Tokomaru: • Redfin bully • Kōaro • Banded kōkopu	Brown mudfish: • A consent will be required to undertake works at this site. Redfin bully: • A consent will be required to undertake instream works between 1st July and 30th November (redfin bully breeding). • Avoid works instream between 30th November and 1st February where practicable. Where it is not practicable to avoid works, sediment from those works shall not discolour more than 25% of the width of the wetted channel at the works site and the reasons why works have been undertaken shall be documented in accordance with the Code of Practice reporting and monitoring standards (redfin bully recruitment). Kōaro: • A consent will be required to undertake instream works between 1st April and 30th June (kōaro spawning). • A consent will be required to undertake instream works between 1st October and 31st December (kōaro recruitment). Banded kōkopu: • A consent will be required to undertake instream works between 15th April and 30th June (Banded kōkopu spawning). • A consent will be required to undertake instream works between 1st August and 30th November (Banded kōkopu recruitment).
A37 R13 R16	Manawatu Scheme	Brown Mudfish No. 1 Line Wetland	Brown mudfish: • A consent will be required to undertake works at this site. Waders:

R15			• Mud and silt dredging shall only occur as an incidental part of gravel extraction. Dotterels: Between 1st August and 10th January, gravel extraction and bed disturbance on gravel beaches shall only take place: • within 7 days following a flood of the area of beach that is the subject of the activity; or where the extraction or disturbance commenced at the same location prior to 1st August and has not been interrupted for more than 7 days.
R18 R19	Moutoa Scheme	Waders Dotterels	Waders: • Mud and silt dredging shall only occur as an incidental part of gravel extraction. Dotterel: Between 1st August and 10th January, gravel extraction and bed disturbance on gravel beaches shall only take place: • within 7 days following a flood of the area of beach that is the subject of the activity; or • where the extraction or disturbance commenced at the same location prior to 1st August and has not been interrupted for more than 7 days.
R16	Te Kawau Scheme	Dotterels	Dotterel: Between 1st August and 10th January, gravel extraction and bed disturbance on gravel beaches shall only take place: • within 7 days following a flood of the area of beach that is the subject of the activity; or • where the extraction or disturbance commenced at the same location prior to 1st August and has not been interrupted for more than 7

			days.
	Whirikino Scheme	None	
A137 A138	Akitio Scheme	Redfin bully Banded kōkopu Inanga Spawning Whitebait migration	Redfin bully: • A consent will be required to undertake instream works between 1st July and 30th November (redfin bully breeding). • Avoid works instream between 30th November and 1st February where practicable. Where it is not practicable to avoid works, sediment from those works shall not discolour more than 25% of the width of the wetted channel at the works site and the reasons why works have been undertaken shall be documented in accordance with the Code of Practice reporting and monitoring standards (redfin bully recruitment). Banded kōkopu: • A consent will be required to undertake instream works between 15th April and 30th June (banded kōkopu spawning). • A consent will be required to undertake instream works between 1st August and 30th November (banded kōkopu recruitment). Inanga spawning and whitebait migration – refer to generic standards.
R1	Eastern Manawatu Scheme	Dotterels	Dotterel: Between 1st August and 10th January, gravel extraction and bed disturbance on gravel beaches shall only take place: • within 7 days following a flood of the area of beach that is the subject of the activity; or • where the extraction or disturbance commenced at the same location prior to 1st August and has not been interrupted for more than 7 days.

	Ihuraua Scheme	None	
R17	Kiwitea Scheme	Dotterels	Dotterel: Between 1st August and 10th January, gravel extraction and bed disturbance on gravel beaches shall only take place: • within 7 days following a flood of the area of beach that is the subject of the activity; or • where the extraction or disturbance commenced at the same location prior to 1st August and has not been interrupted for more than 7 days.
A46 A45 R18 R19 R13 R16 R15 R8	Lower Manawatu	Brown Mudfish Lower Tokomaru • Redfin bully • Kōaro • Banded kōkopu Inanga Spawning Whitebait migration Waders Dotterels	Brown Mudfish: • A consent will be required to undertake works at this site. Or • Drainage is to occur on a maximum five year return cycle. • No work is to occur during the spawning season (late autumn – spring). • Staff with appropriate training are to be present during the operation to retrieve aquatic life, recording numbers and species, and to replace in the stream. • Department of Conservation staff are to be made aware of the operation at least five working days before commencement to allow staff to be on site if resources allow. Kōaro: • A consent will be required to undertake instream works between 1st April and 30th June (kōaro spawning). • A consent will be required to undertake instream works between 1st October and 31st December (kōaro recruitment).

			Redfin bully: • A consent will be required to undertake instream works between 1st July and 30th November (redfin bully breeding). • Avoid works instream between 30th November and 1st February. Where it is not practicable to avoid works, sediment from those works shall not discolour more than 25% of the width of the wetted channel at the works site and the reasons why works have been undertaken shall be documented in accordance with the Code of Practice reporting and monitoring standards (redfin bully recruitment). Banded kōkopu: • A consent will be required to undertake instream works between 15th April and 30th June (banded kōkopu spawning). • A consent will be required to undertake instream works between 1st August and 30th November (banded kōkopu recruitment). Waders: • Mud and silt dredging shall only occur as an incidental part of gravel extraction. Dotterel: Between 1st August and 10th January, gravel extraction and bed disturbance on gravel beaches shall only take place: • within 7 days following a flood of the area of beach that is the subject of the activity; or • where the extraction or disturbance commenced at the same location prior to 1st August and has not been interrupted for more than 7 days.

			Inanga spawning and whitebait migration – refer to generic standards.
R29 R20	Lower Whanganui	Waders Dotterels Inanga Spawning Whitebait migration	Waders: • Mud and silt dredging shall only occur as an incidental part of gravel extraction. Dotterel: Between 1st August and 10th January, gravel extraction and bed disturbance on gravel beaches shall only take place: • within 7 days following a flood of the area of beach that is the subject of the activity; or • where the extraction or disturbance commenced at the same location prior to 1st August and has not been interrupted for more than 7 days. Inanga spawning and whitebait migration – refer to generic standards.
	Makirikiri Scheme	None	
R5	Mangatainoka Scheme	Dotterel	Dotterel: Between 1st August and 10th January, gravel extraction and bed disturbance on gravel beaches shall only take place: • within 7 days following a flood of the area of beach that is the subject of the activity; or • where the extraction or disturbance commenced at the same location prior to 1st August and has not been interrupted for more than 7 days.
	Matarawa Scheme	Inanga Spawning Whitebait migration	Inanga spawning and whitebait migration – refer to generic standards.

A129 A128 A148 A130 A145 A146 R39 R42	Ohau Manakau Scheme	Redfin bully Blue gill bully Banded kōkopu Shortjaw kōkopu Lamprey Dotterels Waders Inanga Spawning Whitebait migration	Redfin bully: • A consent will be required to undertake instream works between 1st July and 30th November (redfin bully breeding). • Avoid works instream between 30th November and 1st February where practicable. Where it is not practicable to avoid works, sediment from those works shall not discolour more than 25% of the width of the wetted channel at the works site and the reasons why works have been undertaken shall be documented in accordance with the Code of Practice reporting and monitoring standards (redfin bully recruitment). Banded kōkopu: • A consent will be required to undertake instream works between 15th April and 30th June (banded kōkopu spawning). • A consent will be required to undertake instream works between 1st August and 30th November (banded kōkopu recruitment). Shortjaw kōkopu: • A consent will be required to undertake instream works between 1st May and 30th June (shortjaw kōkopu spawning). • A consent will be required to undertake instream works between 1st November and 31st December (shortjaw kōkopu recruitment). Blue gill bully: • A consent will be required to undertake instream works between the 1st September to the 31st February (blue gill bully spawning) • A consent will be required to undertake instream works between the 1st November – 31st January (blue gill bully recruitment). Lamprey:

			• Before starting work on a reach, record the number of pools and ensure that works do not reduce the total number of pools within that reach. • Indigenous vegetation shall only be removed if it has fallen into the bed of the stream. • Willows shall be selectively cleared in accordance with the Environmental Code of Practice. • A consent will be required to undertake in-stream works (excluding flood gate outlet clearance) between 1st September and 31st December. This includes anything that is carried out instream that could release sediment including but not limited to gravel extraction, channel clearance, instream vegetation or debris removal (lamprey spawning). Waders: • Mud and silt dredging shall only occur as an incidental part of gravel extraction. Dotterel: Between 1st August and 10th January, gravel extraction and bed disturbance on gravel beaches shall only take place: • within 7 days following a flood of the area of beach that is the subject of the activity; or • where the extraction or disturbance commenced at the same location prior to 1st August and has not been interrupted for more than 7 days. Inanga spawning and whitebait migration – refer to generic standards.
A125	Pakahi Scheme	Whio	Whio:

			Between 1st July and 1st March, works that disturb the bed or riparian margin shall only take place: • when an inspection of the site using a suitably qualified avian expert or a whio dog shows no whio are present.
A32 A33 R11 R12 R10 R14	Pohangina / Oroua Scheme	Brown Mudfish Kōaro Redfin bully Dotterels	Brown Mudfish: • A consent will be required to undertake works at this site. Kōaro: • A consent will be required to undertake instream works between 1st April and 30th June (kōaro spawning). • A consent will be required to undertake instream works between 1st October and 31st December (kōaro recruitment). Redfin bully: • A consent will be required to undertake instream works between 1st July and 30th November (redfin bully breeding). • Avoid works instream between 30th November and 1st February where practicable. Where it is not practicable to avoid works, sediment from those works shall not discolour more than 25% of the width of the wetted channel at the works site and the reasons why works have been undertaken shall be documented in accordance with the Code of Practice reporting and monitoring standards (redfin bully recruitment). Dotterels: Between 1st August and 10th January, gravel extraction and bed disturbance on gravel beaches shall only take place: • within 7 days following a flood of the area of beach that is the subject of the activity; or • where the extraction or disturbance commenced at the same location

			prior to 1st August and has not been interrupted for more than 7 days.
	Porewa Scheme	None	
A63 A64 R21 R23 R22 R24	Rangitikei Scheme	Brown Mudfish Giant kōkopu Dotterels Inanga spawning Whitebait migration	Brown Mudfish: • A consent will be required to undertake works at this site. Giant kōkopu: • A consent will be required to undertake instream works between the 1st October to the 31st December (whitebait recruitment) • A consent will be required to undertake instream works between the 1st April – 30th July (spawning season). • Drain spraying of the Forest Road Main Drain shall be undertaken only when the drain is flowing. Dotterels: Between 1st August and 10th January, gravel extraction and bed disturbance on gravel beaches shall only take place: • within 7 days following a flood of the area of beach that is the subject of the activity; or • where the extraction or disturbance commenced at the same location prior to 1st August and has not been interrupted for more than 7 days. Inanga spawning and whitebait migration – refer to generic standards.
A22 A4 A5 A6	East Ruahine Scheme	Kōaro Short jaw kōkopu Dwarf galaxias Dotterels	Dwarf galaxias: • A consent will be required to undertake instream works in the Mangaatua Site of Significance between 1st September and 31st December (dwarf galaxias spawning and recruitment).

A7 A3 A2 R1 R2 R3			Short jaw kōkopu: • A consent will be required to undertake instream works in the Mangaatua Site of Significance between 1st May and 30th June (shortjaw kōkopu spawning). • A consent will be required to undertake instream works in the Mangaatua Site of Significance between 1st November and 31st December (shortjaw kōkopu recruitment). Kōaro: • A consent will be required to undertake instream works between 1st April and 30th June (kōaro spawning). • A consent will be required to undertake instream works between 1st October and 31st December (kōaro recruitment). Dotterel: Between 1st August and 10th January, gravel extraction and bed disturbance on gravel beaches shall only take place: • within 7 days following a flood of the area of beach that is the subject of the activity; or • where the extraction or disturbance commenced at the same location prior to 1st August and has not been interrupted for more than 7 days.
	Tawataia Mangaone Scheme	None	
A63	Tutaenui Scheme	Brown Mudfish	Brown Mudfish: A consent will be required to undertake works at this site.
A20 A21	Upper Manawatu Scheme	Kōaro Shortjaw	Kōaro: • A consent will be required to undertake instream works between 1st April and 30th June (kōaro spawning).

R6 R8 R3 R2 R1		kōkopu Dotterels	• A consent will be required to undertake instream works between 1st October and 31st December (kōaro recruitment). Shortjaw kōkopu: • A consent will be required to undertake instream works in the Mangaatua Site of Significance between 1st May and 30th June (shortjaw kōkopu spawning). • A consent will be required to undertake instream works in the Mangaatua Site of Significance between 1st August and 31st December (whitebait recruitment). Dotterel: Between 1st August and 10th January, gravel extraction and bed disturbance on gravel beaches shall only take place: • within 7 days following a flood of the area of beach that is the subject of the activity; or • where the extraction or disturbance commenced at the same location prior to 1st August and has not been interrupted for more than 7 days.
	Upper Whanganui	Whio	Whio: Between 1st July and 1st March, works that disturb the bed or riparian margin shall only take place: • when an inspection of the site using a suitably qualified avian expert or a whio dog shows no whio are present.
R37	Whangaehu Scheme	Dotterels Waders Inanga	Waders: • Mud and silt dredging shall only occur as an incidental part of gravel extraction.

		Spawning Whitebait migration	Dotterel: Between 1st August and 10th January, gravel extraction and bed disturbance on gravel beaches shall only take place: • within 7 days following a flood of the area of beach that is the subject of the activity; or • where the extraction or disturbance commenced at the same location prior to 1st August and has not been interrupted for more than 7 days. Inanga spawning and whitebait migration – refer to generic standards.

1.2 Whitebait Migration

The following standards shall apply in waterbodies valued as whitebait migration:

1. The use of mobile machinery in the actively flowing channel of a river or lake in a manner that releases sediment shall not take place in waterbodies valued as whitebait migration between 15th August and 30th November. For the avoidance of doubt, machinery operating above the water level to place rock or drive piles into the bed of the river is permitted so long as there is no associated excavation or bank shaping below the water level and subsequent sediment release.

2. Drain clearance (either mechanical or herbicidal) in these sites shall not be conducted between 1st August and 30th November.

3. Any herbicidal application at these sites is to be undertaken outside of the exclusion periods outlined above and timed to coincide with water movement in the stream.

1.3 Inanga Spawning Sites

1. New bank protection works that would preclude revegetation shall be designed to ensure that they are over topped at high spring tide level so that water can reach the riparian vegetation (grasses) above.

2. No bank protection works will be undertaken between 1st February and 1st May.

3. The use of mobile machinery in or on the bed of a river or lake in a manner that disturbs the bed shall not take place between 1st February and 1st May.

4. Bank Shaping activities shall not decrease the total length along the river of any areas that are over topped at high spring tide level so that water can reach the riparian vegetation (grasses) above in reaches that are valued for Inanga spawning.

5. Revegetation shall be done with reference to the Planting Guide in Part Five which are known to enhance Inanga spawning.

6. No mowing of riparian vegetation will be undertaken between 1st December and 1st May.

7. Tree clearance alongside Inanga Spawning Sites shall be undertaken to the following standards:

    a. Other than removal of fallen or falling trees, tree removal shall not exceed 10 metres on any one bank per 1 km reach between 1st February and 1st May.

b. Tree layering shall not be undertaken between 1st February and 1st May.

c. Any cleared area shall be revegetated within one month.

8. Notwithstanding standards 1 and 2, tree removal is permitted immediately adjacent (not upstream or downstream) to serious lateral erosion sites to the extent necessary to facilitate reinstatement of live edge protection work.

9. Where tree material is required to reinstate erosion and no immediately adjacent material is available, it may selectively be sourced from nonfrontline plantings either upstream or downstream of the erosion site.

10. This does not apply to removal of pest plants in accordance with the Pest Plant Management Strategy, an extract listing the plant pest to be controlled is included in part five of this code.

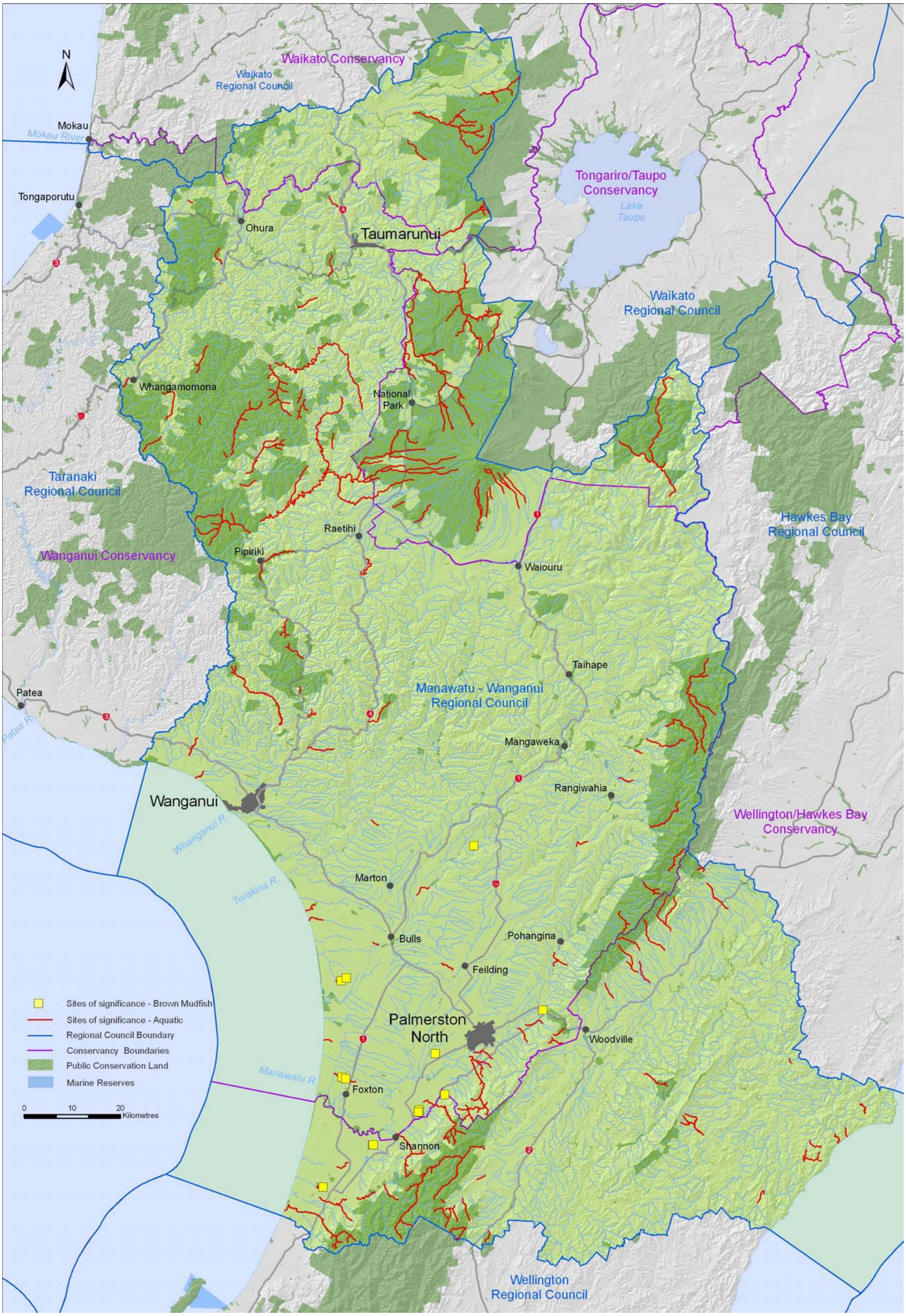


Figure Two: Distribution of SOS-A within the Horizons Regional Council boundaries, showing the SOS-A that occur in public conservation estate.

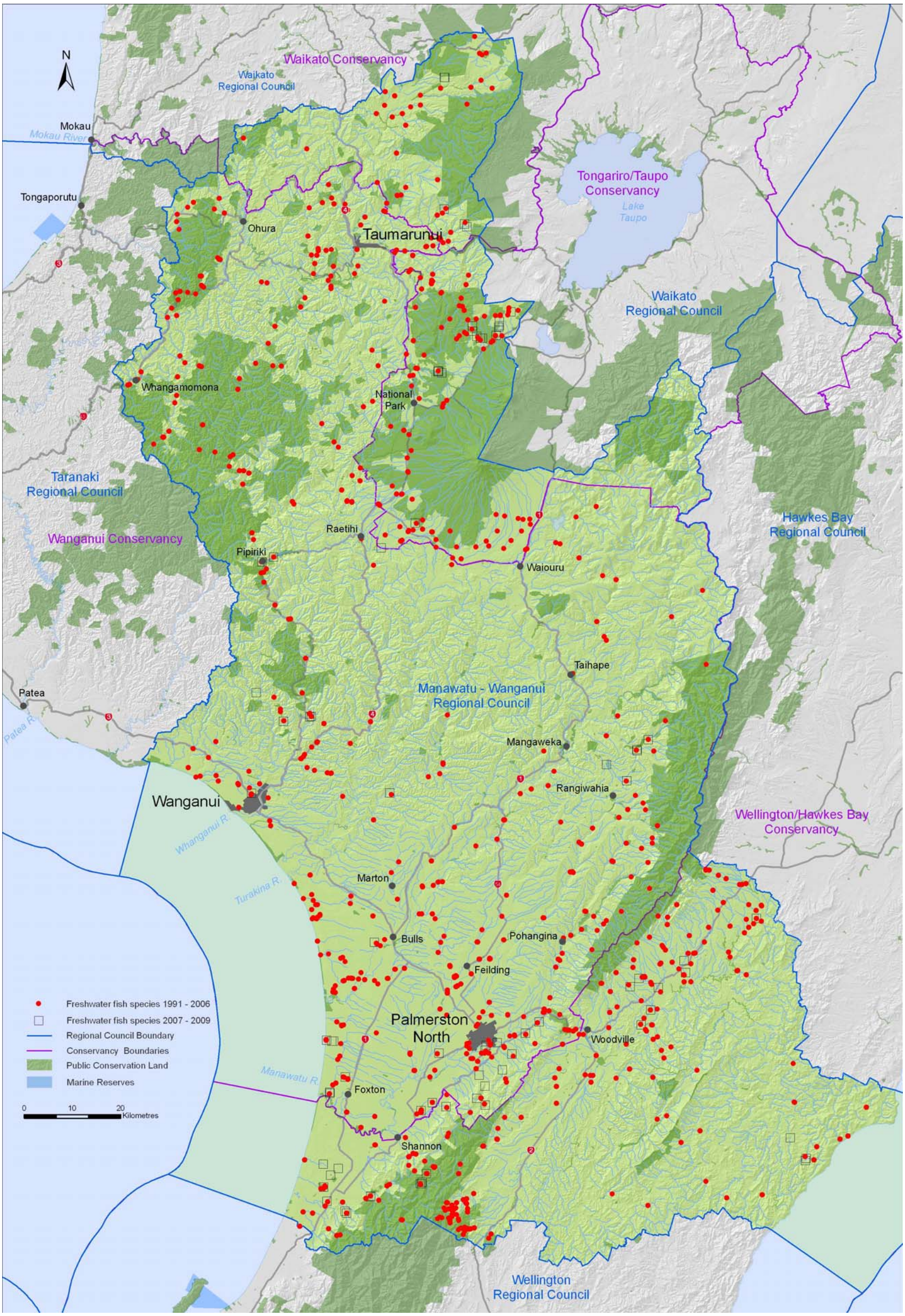


Figure Three: Distribution of freshwater fish survey sites within the Horizons Region boundaries from 1991 to 2009. The red circles representing sites sampled from 1991 to 2006 and the black square outlines representing the sites sampled between 2007 to June 2009.

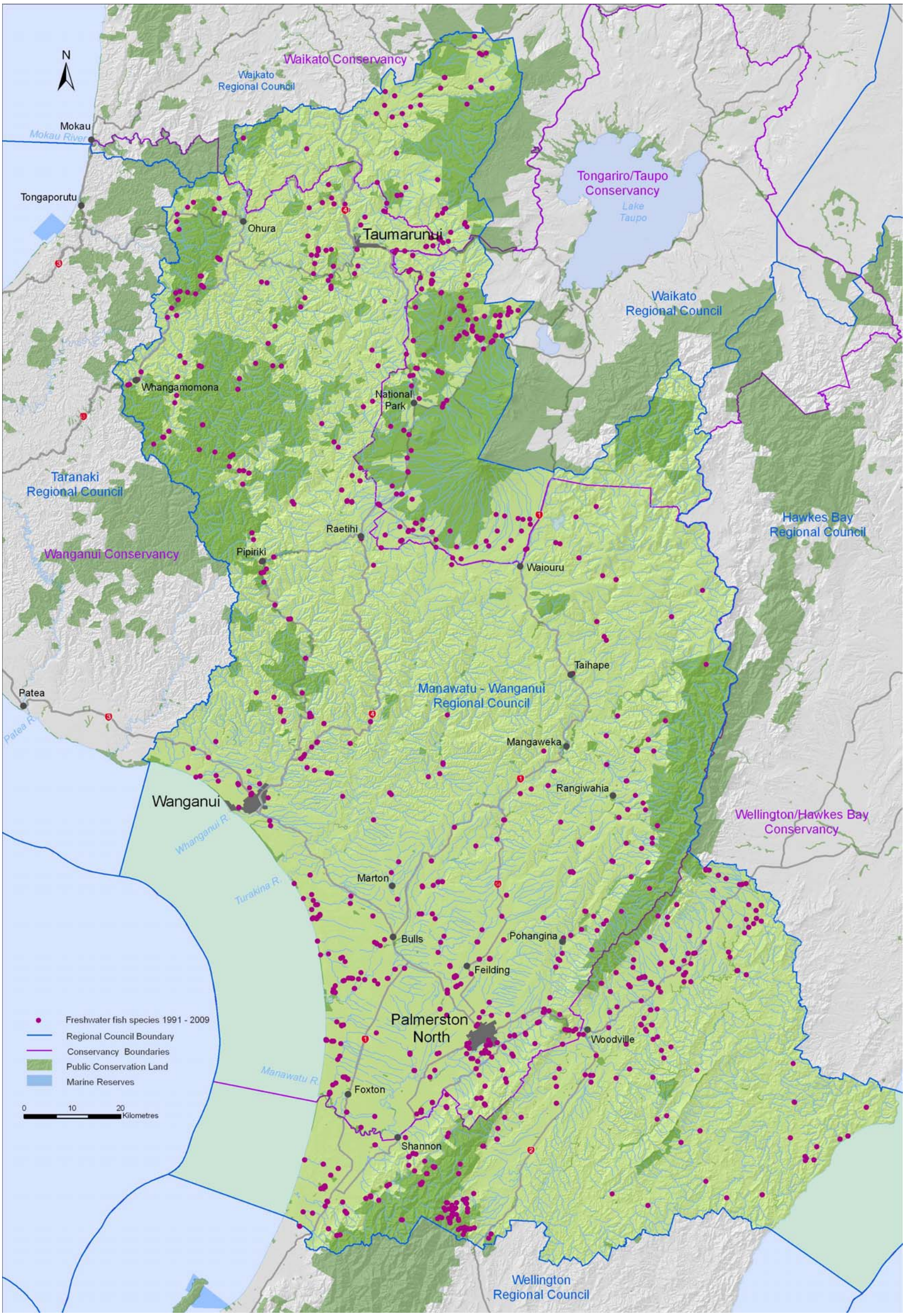


Figure Four: Distribution of freshwater fish survey sites within the Horizons Region boundaries from 1991 to 2009. This map shows the large areas that have not been surveyed.