The words associated with each powerpoint to which I will attempt to speak.

PPT1

One Plan Evidence Associate Professor Russell Death

Freshwater Ecology expert speaking For Wellington Fish and Game

and Royal Forest and Bird Protection Society of New Zealand.

While some may consider that Fish and Game and Forest and Bird are not necessarily on the same page with respect to freshwater management in New Zealand none of the evidence presented by myself does not apply equally to their respective cases.

PPT2

I have been researching stream ecology for 19 years. I came to Massey University in 1991 and have been conducting research on the ecology of rivers in this region ever since.

I have lived in this region most of my life, except when I went to Canterbury University to do my PhD. I come from a farming family and am familiar with the farming way of life.

I currently have a small block of land in the Pohangina Valley on which I run a few sheep.

My research focus has always been international. I collaborate with numerous colleagues around the world including scientists in Spain, Finland, Sweden and USA.

PPT3

I do not intend to reiterate the lessons on stream ecology you have had from Dr Biggs and others, but if you require any clarification on matters of ecology I can refresh what you have heard.

My presentation will follow my evidence in chief and supplementary evidence of other presenters will be discussed with each section.

So my plan:

Briefly:

Why is ecology worth considering? Most do not appreciate the diversity of unique organisms living in New Zealand rivers and streams because it is hidden under the water and stones only coming out at night. Most of which only occur in New Zealand. I have been studying them

for just under 20 years and to me they are just as complex and exciting as any African savannah, tropical rain forest or coral reef.

Conclusion of my 16 years research on the ecological condition of this region's waterways

General approach of POP

Water quality

Water quantity

Beds of lakes and rivers

I have attached reference to each of my EIC points on the powerpoints.

PPT4

Invertebrates – bugs. Most people don't even know they are present in streams.

But they are a good time lapse photo of the streams health and are the main focus of water quality assessment in most developed countries around the world. Which is a change from the traditional chemical measures.

As an example I was involved with some assessments of carrot washing in Ohakune. Horizons had been out monitoring the turbidity from the carrot washing and found no issues. They got some of my students to go up and look at the fish and invertebrates and found they were severely impacted. They then put in some turbidity loggers and it turned out the carrot washers were releasing the sediment at 11 pm at night. There were no visible issues during the day but it was affecting the animals living there.

If you like they are a canary in the cage. Most only occur in New Zealand.

PPT5

Major issues for aquatic ecosystems

1. Sediment
2. Nutrients
3. Flow pattern
4. Habitat diversity

PPT6

This is a little stream in Norsewood illustrating sediment, algae growths and low habitat diversity.

PPT7

Downstream Dannevirke sewage showing the thick brown periphyton growths.

PPT8

Another thick growth of periphyton.

It smothers habitat. It will rot and smell.

Changes water chemistry lowering DO.

PPT9

This is a tributary of the Kahuterawa.

Used to be home to several species of threatened fish including short jaw kokopu. Also major trout spawning stream.

Shows sediment coming in from some activity upstream smothering habitat.

PPT10

This is a map compiled from research my students and myself have conducted over the last 10 years. It shows the QMCI from data from just under 1000 streams we have sampled extrapolated out to the region.

Red indicates the degraded streams on the Manawatu Plains and the green the good water quality streams of the National Park and State Forest Parks.

PPT11

Agriculture does not need to degrade streams. This is a beautiful stream from Asturias in Spain where they have been farming cattle right down to the stream margins, probably for several thousand years.

PPT12

Generally supportive of the approach of the POP.

It is very important we get this right. All around the world management of water is becoming a critical issue.

There are numerous science and popular science books on the state of the world's waterways.

One of many possible quotes

“Clean water is set to become the world’s scarcest but most-needed natural resource” USA National Intelligence Council (2008).

There are some major issues in the Manawatu Whanganui region but we are in a better position than many (e.g., Murray-Darling, Aral Sea, Great Lakes). It is not too late to do something. But this should not make us complacent.

PPT13

But we have to be careful our resources don’t slowly slide away from us. An example I use in my lectures is the Aral Sea

It used to be the world's 4th largest lake at the beginning of last century in Uzbekistan and Kazakhstan.

In the 1930s USSR started abstracting water to irrigate cotton fields.

Short term benefit at the expense of long term benefit.

The mean sea level dropped 20cm per year for 10 years.

Then 60cm/year in the 70s

Then almost a metre per year in the 80s.

By 1990, salinity increased from 10 grams per litre to 45.

20 fish species, 350 invertebrates and 12 higher plants became extinct.

Annual fish-catch dropped from 40,000 tons to zero

PPT14 and PPT15

Fishing boats in what used to be the Aral Sea.

PPT16

I believe the numerical standards should be rigorous thresholds NOT targets.

Targets are too easy to overlook (21).

I think there should be emphasis on biological measures rather than chemical ones as they are better integrators of health (23).

Already mentioned the sediment and Ohakune carrot washers. Another example might be to turn off the oxygen in here for half an hour. We all die. Turn the oxygen back on. Consents officers come in, and walk over the bodies, measure the high levels of oxygen and conclude all is well.

More, and specific, focus needs to be placed on adaptive management (24).

I am on a committee associated with the TPD (Tongariro Power Scheme) that meets regularly to discuss how the resource consent conditions are working with respect to the Tongariro river.

I would like to see a similar formal mechanism for interaction, within the adaptive management framework, between Horizons, local freshwater ecologists, DOC, F&G and Forest and Bird.

The splitting of water quality, quantity, biodiversity and land use makes the plan very difficult to use (25). Even with my PhD I really struggle to find my way. I would have grave doubts the average farmer is going to be able to do better.

PPT17

The conclusions of Horizons scientists are in general consistent with my research findings (26). Water quality is low in many streams of the regions as a result of too much nutrients and sediment.

I think the method of selecting sites of significance –aquatic is a bit primitive (27). Horizons scientists looked in the freshwater fish database for sites where threatened fish had been found. But assumes everywhere has been sampled and most places haven't been. Several scientists in New Zealand have made predictive maps, using existing data, to show where the different species are most likely to be found. It would have been sensible to use these maps to identify where threatened species may occur.

With respect to water quality, from an ecosystem perspective, nutrients and sedimentation are the biggest issues in the regions waterways (28-32).

From my experience I believe the QMCI (although even that is very primitive) is a better biotic index than MCI (I will show you an example later in my presentation).

Professor Harding (who was on the freshwater NPS panel) told me of an example from his work in acid mine drainages from the West Coast. Biomonitoring sampling found only 2 insects (compared to the normal thousands) that had probably floated in from the pristine bush upstream, both with high MCI scores. So the site had a high MCI but as a result of only two animals.

But any biologically based standard would be a **huge** advance (34-35).

PPT18

I would rather see the nutrient standards set from local data. Only 2 of his 30 study streams in Dr Biggs study were from this region (Turakina, Moawhango) (36). I would not consider either of those very representative of the region's waterways.

But the nutrient standards are consistent with my own research on nutrient thresholds in local streams so I am happy to support them (37-40).

PPT19

This is data I have collected (and nutrient data from Horizons) showing the link between QMCI and MCI, nitrate and dissolved reactive phosphorous (DRP). Match with the standards Dr Biggs has set for these streams.

PPT20

Addresses supplementary evidence Dr Scarsbrook presented showing no link between nutrients and one measure of periphyton.

If you just plot the data without considering other factors that affect periphyton it is not surprising there is no link. I collected most of this data and know periphyton is very sensitive to flood events. I would have thought Dr Scarsbrook would know this as he did his PhD on flood disturbances.

Most gardeners know that one of the best ways to increase plant growth is to add fertiliser (nutrients). There is a huge body of science and logic supporting the contention that provided floods and grazers are not controlling periphyton increasing nutrients will increase periphyton growth.

PPT21

Mr Barrows also introduced some Otago University research on trophic cascades I believe to imply trout may be leading to excessive periphyton growths.

In some low nutrient Otago streams trout have been shown to increase periphyton growth by eating all the insects that normally eat periphyton.

May occur in pristine conditions but does not if nutrient levels are high (Biggs et al. 2000).

In the Hautapu River for example, nutrients are high from Taihape sewage discharge and periphyton biomass is high even though there are lots of invertebrates.

PPT22

The top figure shows declining trout numbers in the Mangaitanoka River without any change in periphyton levels.

And the bottom one low levels of periphyton in the upper Rangitikei but increasing abundance of Rainbow Trout.

PPT23

In this region I think sediment is of more concern than high sediment

Smothers animals.

Lowers quality of food. Imagine eating your dinner with silt sprinkled on it.

Destroys their homes.

PPT24

It is good to see the POP acknowledges that sediment is an issue.

But they are unwilling to set a standard because they claim the science is not there to support it.

I agree there is some uncertainty, but no more than with the nutrient standards.

This is a graph of data collected by Horizons in 2008 showing a clear link between QMCI and deposited sediment. From this you could easily argue 500 g/m3 is a minimum level of sediment deposition that will prevent severely degrading waterways.

PPT25

There has been considerable publicity about the evils of farming and water quality. But we need to remember that there are still plenty of point source discharges around the region.

This one shows the QMCI from a study I did on the Oroua River showing a clear impact of the Fielding sewage discharge.

On the left is the equivalent MCI figure. You can see that it is not as clear from this that there is an impact. Despite the QMCI and a number of other indices indicating there is an effect.

PPT26

Water quantity

Do not support the use of IFIM (Instream Flow Incremental Method) as it relies on specific habitat quantity (depth, velocity and sediment) being the limiting factor for riverine animal populations.

An analogous example from farming would be to have a 10 acre paddock and 10 cattle but with no grass. There is plenty of habitat for them, but no food. Most people can work out the result.

In rivers the food of fish is also affected by changes in flow so if you do not take that into account you will not be able to predict what will happen. And this is often the case (e.g., Tongariro Rainbow trout fishery)

But happy to be pragmatic and will support 90% of MALF as a minimum flow. (45-48)

Lower flows set with IFIM would not be supported as I am not confident this will ensure ecological integrity.

PPT27

With respect to flows the most important ecological condition is the maintenance of flow variability. (49) Based on research we have done on experimentally altering flow volumes by up to 90% I would say it is probably more important.

Floods are a characteristic of almost all New Zealand rivers and the ecological communities require them to maintain their integrity.

This is a quote from a recent paper written by 19 leading freshwater scientists from around the world

“It is now widely accepted that a naturally variable regime of flow, rather than just a minimum low flow, is required to sustain freshwater ecosystems, and this understanding has contributed to the implementation of environmental flow management on thousands of river kilometres worldwide” (Poff et al. 2009)

PPT28

In my evidence in chief I suggested some mechanisms for including the flow variability component in the POP

Mr Hay in his supplementary evidence, and changes to Policy 6-16 seems to agree with my concerns.

Mr Hay seems to support the use of ELOHA (Environmental Limits of Hydrological Alteration) and RVA (Range of Variability Approach) as a mechanism to address the above issues but was a bit guarded about their use in New Zealand.

I would like to see them included in the POP.

PPT29

Beds of rivers and lakes

Suitable habitat is critical for a healthy biological community (54).

This includes both the wet bit and the riparian margins. Many insects spend part of their life on land, fish lay their eggs on land and fish eat terrestrial insects and mice (55, 56).

Living both by a stream and a river I fully understand the need for flood control however making rivers into drains, while this may seem best for floods, it is the worst for habitat (57).

I still don't understand why in New Zealand we are still straightening rivers while in the USA (e.g., Mississippi) and Europe (e.g., Denmark, Germany, Switzerland) they are putting the meanders back, both to improve habitat and flood control.

PPT30

Maintaining habitat variability is why NZ organisms can survive floods in our rivers (59). During floods they move to these other areas. A study of native fish during a flood found they moved to large boulders but only during floods. Insects move in to the flood plain, pools, hyporheic zone. Then when flood subsides they come back, sometimes within 24 hours.

Again there is mention of its importance but no specifics e.g., natural character (60,61).

Natural character needs to be quantified and maintained as it appears to be in decline across the region.

Deposited sediment standards should also be included here as these activities, along with inappropriate land use, can be one of the main drivers of higher sediment (62 63).

I believe EIC 64, 65, and 66 have been resolved with caucusing.

PPT31

Most of my concluding remarks simply reiterate what I have said in the main body of evidence.

Only new point I have added here is I would like to see some specific targets against which to judge the POP.

The University these days is all about achieving KPI targets (Key performance indicators).

I think it would be an effective gauge of the POP if it had some KPIs against which to evaluate its effectiveness.

I suggest a suitable KPI would be a 20% improvement in ecological condition in 20% of the regions streams in 20 years as an achievable realistic goal against which to judge how well the POP works (70)

PPT32

As a parent, teacher and scientist I would just like to conclude by reinforcing what I said earlier that the waterways of our region are an extremely valuable resource not just for the current landowners who would seek to profit from it.

But also for the community and future generations, both in New Zealand and I suspect internationally. It is important that we do not allow the complacency of a seemingly unlimited renewable resource to allow us to slide along the path others have been such as the Aral Sea or Murray-Darling River.

It is always surprising to see how society suddenly wakes up every so often to see that the little loss here and a little loss there suddenly leads to occurrences such as the 4th largest inland sea in the world becoming a desert.

Thank you for your time.