LAKE TARAWERA – THE COSTS OF P MITIGATION AND PEST CONTROL

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Greg Corbett
Greg is the Biosecurity Manager with the Bay of Plenty Regional Council. Originally from Auckland, he escaped as soon as he left school in 1983 to work for the old Hawkes Bay Pest Board chasing rabbits and possums. Over the following years pest and biosecurity work has taken him to the Wairarapa, Central Otago, Gisborne, Ruatoria and finally to the Bay of Plenty. Since arriving in the Bay Greg has held various positions from Pest Animal Officer, to Bovine TB Vector Manager to Land Resources Manager and now Biosecurity Manager. In his current role Greg has the pleasure of leading a broadly skilled and passionate team who are dealing with some fairly big challenges, such as lakeweed, catfish and wallabies. In his spare time he enjoys mountain-biking, fishing, hunting pheasants with a German pointer dog and tries to do at least one tramping/climbing/hunting trip to the southern alps each year.

John Paterson
John Paterson is a Sustainable Farming Advisor with BOPRC. Independently of Council, he also works as Project Manager for the 'Phosphorus Mitigation Project'. In his spare time he farms deer at Kaharoa, 20km north of Lake Rotorua.

TRANSCRIPT

Greg Corbett

Kia ora tatou
With a background in pest management, my only experience in phosphorus is mixing it with apple paste to poison rabbits a few years ago. Bringing John along to tag team with me brings a level of credibility to this presentation.

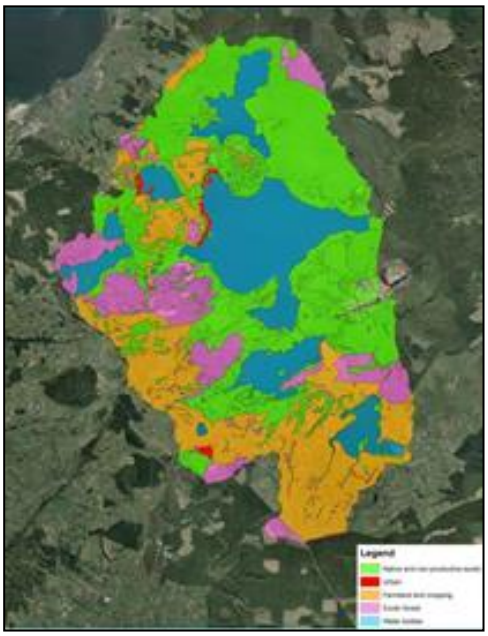
Firstly, we have been asked to talk about the costs of mitigating P in the Tarawera catchments. It is reasonably well understood that farming activities can lead to phosphorus loss if they are not managed properly. Recent studies have also shown the possible links between pests and phosphorus loss in forested catchments.

John and I will give this presentation in two parts. I will talk about pests and then John will move to farming. Neither of us will predict how much phosphorus could be managed nor comment on the cost-effectiveness of any actions. We simply attempt to provide ballpark figures for work that could reduce phosphorus losses to the lakes to some degree.

The basis for our talk is the Tarawera Lakes Restoration Plan, which Chris Ingle talked about this morning. He alluded to the fact that there is a target of reducing phosphorus by 1,200 kilos which is about 10% of the total 11.4 tonnes of phosphorus entering Lake Tarawera each year. The plan also wants to address all known sources of phosphorus and promote better management of agricultural land.

We have made some assumptions and included human-introduced animals as anthropogenic sources in this definition:

- Target P from anthropogenic sources
- Heavy rain leads to P in the lake
- On-going intensive pest control will restore forests and reduce P losses
- Community, stakeholders and funders will support long term work programmes
- The mitigations will not unduly compromise farm productivity
- Costs are indicative only and based on currently available methodologies



Tarawera Catchment Land Use: The green area shows native forest and scrub, the orange areas are farm land, the purple areas are exotic forests and the small patches of red are urban or industrial land:

Urban	196 ha	<1%
Farmland	9,033 ha	31%
Exotic forests	4,634 ha	16%
Native/Scrub	15,521 ha	53%
	29,384 ha	

Over 70% of these catchments are forested with less than a third being used for farming or urban uses.

Pest management: There is substantial pest habitat around the Tarawera Lakes:-

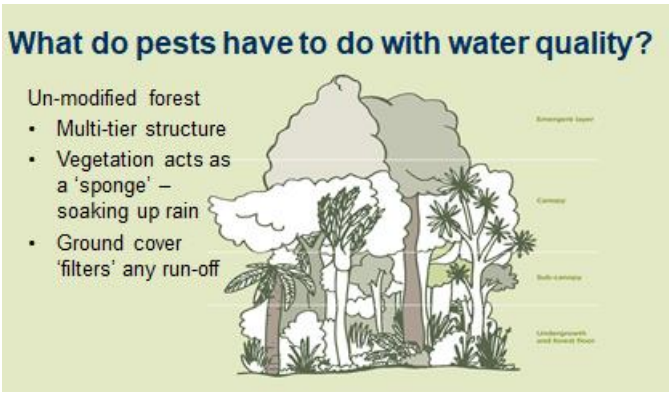
Exotic forests	4,634 ha
Native/scrub	15,521 ha
	20,155 ha

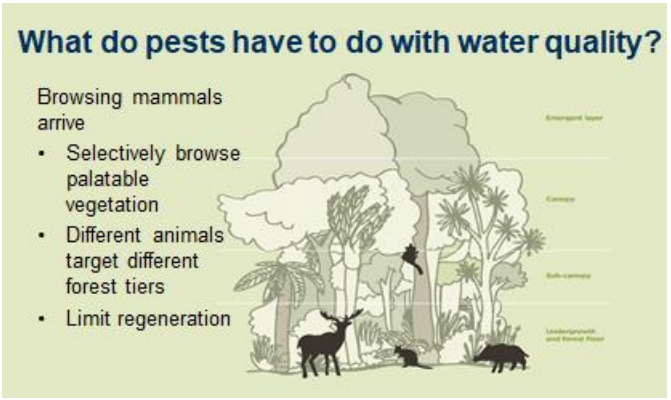
It is just over 20,000 hectares. We do not know whether we need to control pests in the whole area but it doesn't make good sense to only do parts. This will probably lead to increased costs and reduced effectiveness as we would end up with constant pest reinvasion.

Concerns were raised at a previous symposium about increasing P levels in the largely forested catchment of Ōkataina and were wallabies responsible? The University of Waikato investigated the drivers for changes in water quality over time. (Theo Kpodonu, PhD, 2016) Theo determined that erosion was a primary driver for lake productivity and also concluded that invasive mammals, together

with climate change are likely to increase sediment and nutrients entering the lake. Given this, there is a case for invasive mammals being considered for management in forested catchments.

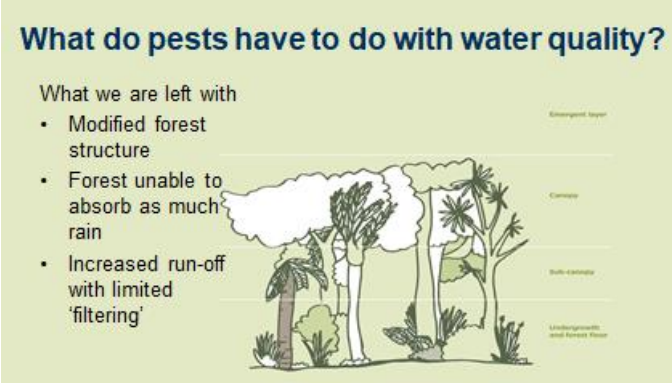
So what do pests have to do with water quality? Firstly, if we look at a normal lowland forest, it is structured with a complex system of plants and shrubs in 4 general tiers. During rain events it acts like a sponge. Once water filters through all the leaf layers to reach the forest floor it begins to pool and flow but we have mosses and ferns and other ground covers there to filter that overland water flow.





Enter a few animals. Most of the browsing mammals in New Zealand selectively browse our forests taking out certain components of the forest and, as this slide demonstrates they target different tiers of the forest. Different pests will have different impacts on the forest.

What we are left with is a thinner forest. The forest structure is compromised and no longer absorbs as much moisture during rain events and allows water to pool and flow over the ground more quickly. There is less ground cover to filter those overland flows and more ability for that water to carry soil particles with it.



What does it look like in the bush?
This is the wallaby exclosure at Dogger Bank in Okataina. Inside the fence on the right-hand side are seedlings, saplings and ground cover recovering. Outside the fence it is a very different story. Those seedlings and ground covers are conspicuous only by their absence.

What pests are we talking about? There will not be many who would defend these two critters. Possum impacts are well-documented; however the impacts of wallabies on native forests are less well-understood. We were lucky that the Forest Service set up a series of exclosures at Dogger Bank in 1984 and these provided us with some useful insights. When Wallace re-measured these plots in 1995 he concluded that wallabies were inhibiting kanuka forest regeneration.

Now for something a little more controversial. These may look like a couple of photos of deer to most people but the hunters out there will recognise red deer on the left, which are the most common deer in New Zealand and hunted for venison. The other one is a Sambar deer which are highly prized trophy animals of limited distribution through New Zealand but found around Rotomahana. The reason we should not ignore deer came from the exclosure plots as well. When the plots were re-measured in 2001 by Mathew Benes and 2007 by Stephen Hall, they both concluded that deer had a greater impact on the forest understory recruitment than wallabies.

The last animal I include in the photo is no less controversial. These pigs are bulldozers on four legs and we cannot ignore them. They do graze vegetation. Their habit of rooting up ground to hunt for invertebrates exposes soil, leaving it vulnerable to erosion.

As Cam Speedy said at the last symposium, ‘There are many methods and approaches to control pests but there are no silver bullets.’ Each method that is available has its advantages and disadvantages. How an operation of the scale we are talking about could be carried out can only be determined through genuine engagement and consultation with land owners, Iwi, adjoining communities and stakeholders.

Basic principles we need to consider:

- Must be effective, i.e. will achieve outcome
- Must be affordable for the long-term
- Must be socially acceptable and supported by the community and Iwi

I have not used the word ‘cost’ effective here as a criteria because there could be some methods that are cost effective but not affordable in the long term so I separated those two. This is about a long term programme of works which must be supported by the whole community.

To do this costing I made a few assumptions. We have not had the conversations with the community about what might be acceptable and how the control would be carried out. But since I don't know what will be acceptable to the community I have based it on a range of control options that meet the effectiveness and affordable criteria and have based my costing scenario on the first two - largely what is effective and what is affordable.

My scenario – the basis of costing

Method	% of habitat	Cost range	Frequency
Aerial 1080	75%	$25 - $30 per ha	3 years
Ground (includes community groups)	25%	$12 - $200 per ha	2 years
Ground hunting	75%	$5 - $10 per ha	3 years of knock down then every 2 year
Operational monitoring	100%	$10K - $20K	Annual
Outcome monitoring	75%	$810K - $349K	10 years
Planning, management	100%	5% - 10% of annual cost	Annual

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You will note that my costing is based on some form of aerial 1080 and includes some ground work and community work as well. We have several groups working in these catchments doing good work. I propose that we have very intensive ground hunting for pigs and deer and also that there is a significant monitoring component to this work. We need to understand the status of our pest populations from year to year to ensure control operations achieving the right results and are implemented when needed. We must also understand what the response from the forest is to those control operations.

Costs

	Year 1 ($,000)	Annual ($,000)	20 years ($,000)
Planning, management	$110	$110	$2,206
Aerial	$401	$140	$2,804
Ground (includes community groups)	$471	$235	$4,709
Ground hunting	$113	$62	$1,238
Monitoring	$306	$59	$1,175
Total	**$1,401**	**$606**	**$12,132**

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Based on that assumption, and assuming that we have approval to implement the whole area in the first year, we would need about $1.4M up front in the first year and then every year after that a cost of about $600,000 a year. It is important to note that if we did end up with a programme that involved less aerial control the costs would climb substantially. For example, if we could only control half the area with aerial 1080, the remaining being done

on the ground, then the costs would climb out to 20 years by an additional $4 million to $6 million. It is important to note this work will not be a one-off operation. It would need to be implemented over at least 15 – 20 years before we know whether we are making any difference and assuming we were then carry on indefinitely.

I would like to conclude by repeating a few thoughts from speakers from the last LakesWater Quality Society Symposium (2015). Willy Shaw recognised the significant ecological threats that these animals pose but did wonder whether the erosion generated by them was significant when compared to storm-induced landslides and lakeshore erosions from fluctuating lake levels, and we are seeing a lot of that this year.

Rob Allen also talked on the status and drivers of change to New Zealand's forests and concluded by posing a few questions:

- Are undesirable changes to our forests reversible?
- Is it economically, socially and biologically feasible to reverse them?
- Do we have a robust evidence-base for our actions?

Who knows? These are still good questions when thinking about implementing a programme of work of the scale that would be needed and the costs involved.

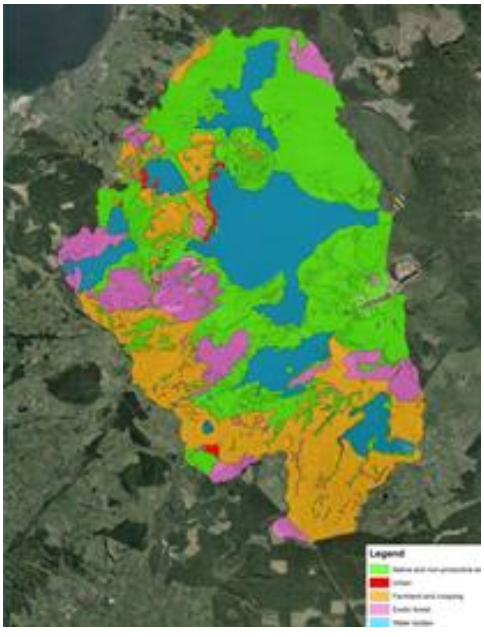
Thank you. I would like to hand over to John now.

John Paterson

My name is John and I am a P addict. My last fix was on Monday night between 8.00 and 9.00 pm. What am I talking about? Phosphorus. I had another as I sat down to dinner at 8.00 last night. Rain. Heavy rain. High intensity rain. That is going to be a repeating theme in my presentation.

I do have to take issue with Chris Sutton. I liaised with Chris for quite a few years and as a Council employee he has always had that line, 'No surprises, John', but his last slide showed that he had bought a wind farm or was going to convert a farm up in Kaharoa to a wind farm and that is a real surprise.

On-Farm Mitigations: Farmland area is shown in orange and is a total of 9,033 hectares, about 31% of the catchment. My presentation is about the cost efficiencies of some farm applied mitigations, not the total cost accountability of P mitigations on farms which is a subject worthy of a whole symposium on its own. P loss from the catchment is highly intermittent and only flows off the land during storm events.

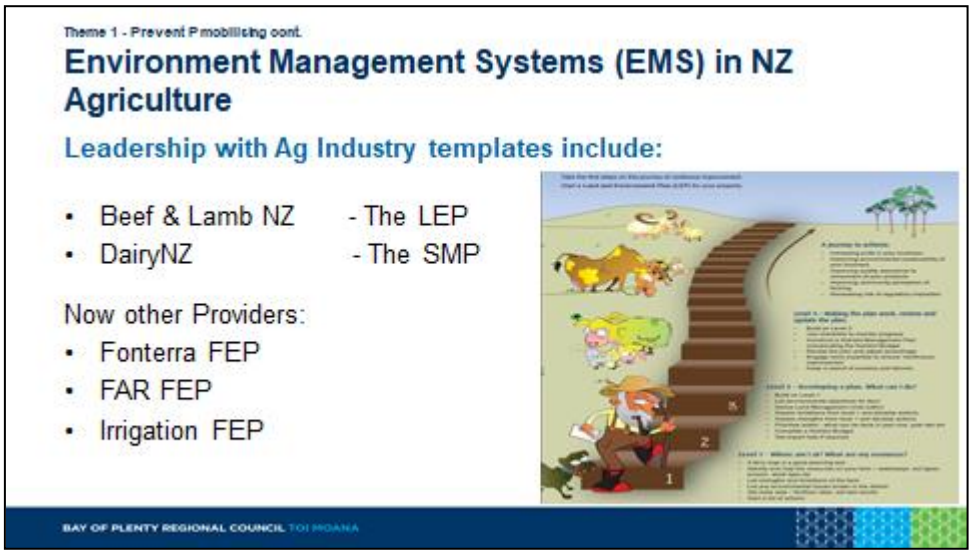


We have some obvious opportunities to deal with P loss that we do not have with nitrogen loss. There are three themes:

- Prevent P mobilising in the first place, achieved largely through good management practices
- Intercept P in transit, like holding down the bolting horse and not as good as the first option
- Treating P loss at its destination with flocculants.

Preventing P mobilising: Phosphorus focussed research is continuing to deliver a growing list of good management practice options but these have to be owned by land managers - farmers, farm owners and farm managers. They have to be perceived as an asset and farmers be convinced they will work and be normalised into land management practices.

The very first step is for farmers to have a farmer-owned Environment Management System (EMS). We have seen really good initiatives on environment management systems in the Tarawera catchments. At the field day at Lake Ōkaro on Wednesday Megan Birchal told us about the environment management system that farmers had engaged in some years ago which was an early version of the Beef & Lamb LEP. Chris Sutton talked about the environment management systems being implemented in the Tarawera Lakes' catchment and that is also the industry LEP and originally the DairyNZ Sustainable Milk Plan.



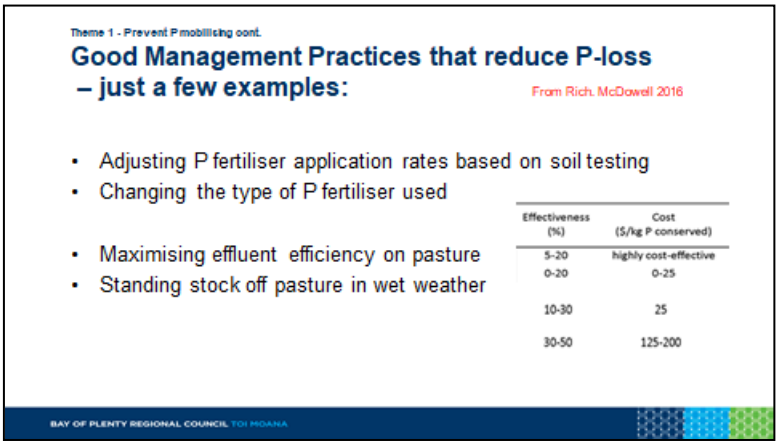
This slide goes back into the history of the development of environment management systems in New Zealand. We need to have confidence in these vehicles. The first environment management system in New Zealand was introduced in 2004, the first published environment management system was in the Deer Farmers' Land Care Manual. I am very familiar with that because I wrote it. In 2007 Beef+Lamb developed their LEP, an interesting exercise, and they went to great pains to be inclusive of every farmer, and to give no farmer any reason to say, 'No I don't want to be involved'.

I put the cartoon sketch in when involved in that working party to try and illustrate the easy first step but unfortunately the cartoonists could not get the angry look off the farmer's face. This is the first time that cartoon has ever been publicised. Some years later

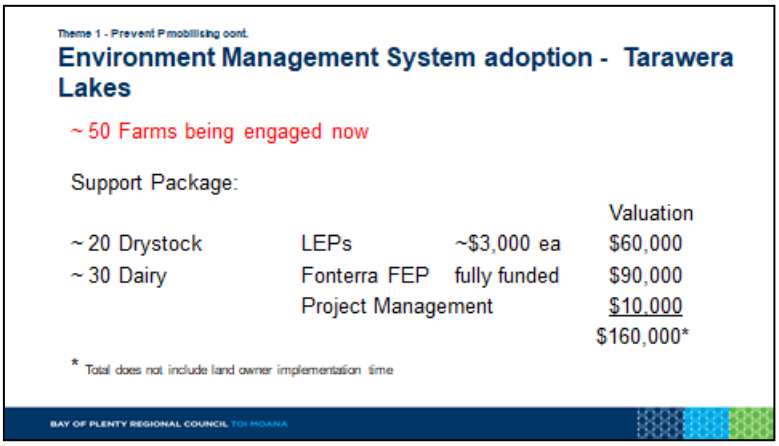
DairyNZ developed a prototype of an environment management system called the Farm Environment Action Plan which was trialled here in the Rotorua catchment on two farms.

I need to explain what an EMS is and the ISO14001, the international standard for environment management systems. It is a very well thought-through plan - Do, Check, Act, Cycle and Continuous Improvement. Nicki Douglas talked about Collective Impact as the goal in the centre. The goal of continuous improvement is what the Council is very keen to promote with farmers and farming groups. It does not matter where they start but engaging in a programme of continuous improvement is fantastic.

This presentation is about costs. Chris Ingle covered this more thoroughly in his presentation, but very roughly, 50 farms are engaged now and the support package is:



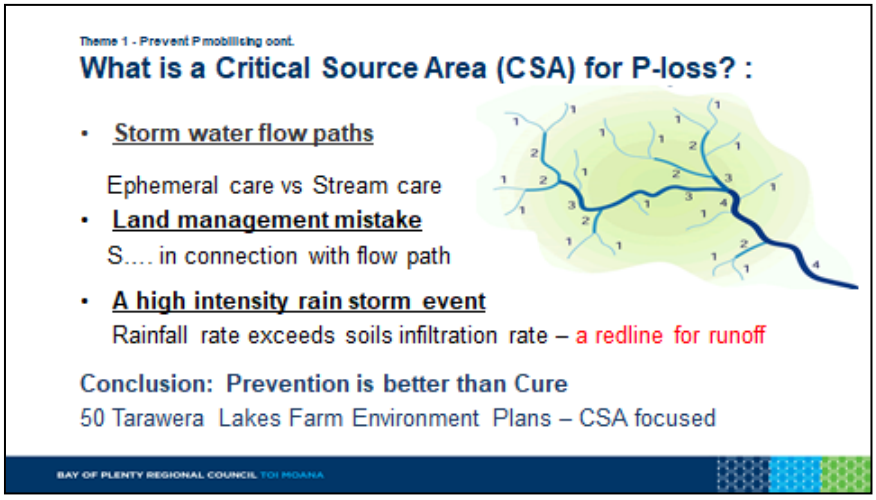
I used the heading 'Valuation' because the industry has really stepped up which is great. We are aiming to have all farms on board by early 2018. Just remember that the pioneers of the Tarawera project are not the Council but some dedicated leading farmers with BOPRC right beside them.



Good Management Practice (GMP) refers to an evolving suite of tools or practices that can be put in place at a land user, sector and industry level to help achieve community agreed outcomes – such as water quality. Some good management practices actually cost very little and some of these slides show material repeated from Richard McDowell's work. Simple things such as adjusting the P loss application rate to be mindful of the optimal agronomic level for pasture growth can cost very little and be highly cost effective with minimising the loss of phosphorus.

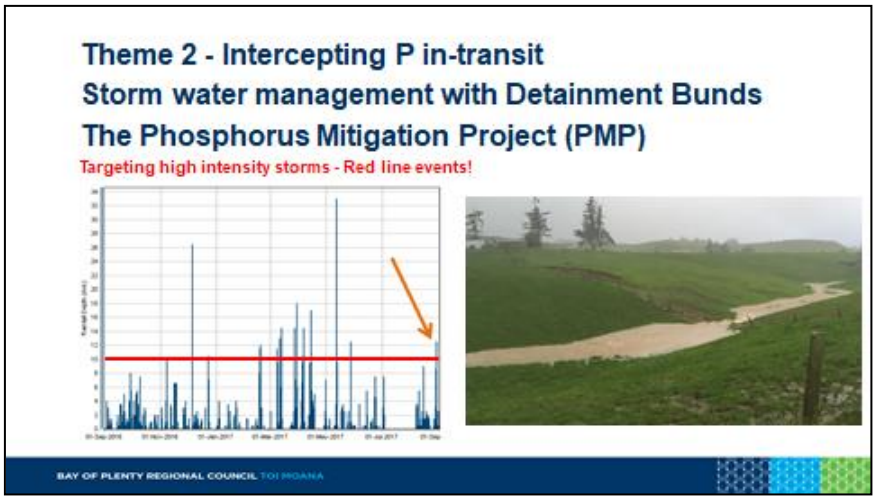
The second low cost possibility with good effect is changing to a less soluble fertiliser. On the bottom line things cost quite a lot more and standing stock off pasture can be quite an expensive process.

Dealing with critical source areas can achieve high cost efficiency. Rich McDowell did a study of 14 farms around New Zealand and noticed that for only a cost of 2% of earnings before interest and tax, 40% reductions could be achieved which shows that things do not necessarily need to cost a lot of money.



What is a critical source area? Just to take the anatomy a step further, it is a combination of not making mistakes in stream flow paths and ephemeral flow paths. Storms generate water flow where water does not flow usually. Those are the first order streams or ephemeral parts of the landscape on everybody's farm. If a farmer makes a mistake in one of those flow paths he gets caned by high intensity storm events which shift it. The red line is those high intensity storms and I referred to my last fix being Monday night when we had a high intensity storm. That is when phosphorus really leaves the landscape.

This is what a critical source area looks like. There is a major storm flow channel through the middle. The farmer has made a mistake in cultivating and putting a fodder crop there. There will be a number of storm flows through the winter. Normally there are about six a year but this last year has doubled to about 12. Exposing such areas to P-loss risk, disturbed soil, concentrated animal excrement is a critical source area and obviously a change in land management practice there would have avoided that. Other critical source areas include poor timing / placement of fertiliser, inappropriate cultivation of slopes and when such mistakes are in places where storm water run-off can wash over them.



The red line is for phosphorus loss which is generally about 10mm per hour but the important thing is looking at the opportunity to intercept it. It only happens for those tiny points in time normally, only a few hours per year. We have moved from doing the preventative stuff to looking at what we could do to intercept this horse which is about to bolt. That photo was taken on Monday in a paddock near my place. The rain on the roof was only 2.5mm in our catchment rain gauges, so it was not a run-off event. Not a P loss event.

To further hijack this event, I want to talk about the Phosphorus Mitigation Project which is a wonderful project that I work on independently of Council. This is a 'watch this space' slide. Brian Levene, a PhD student, is working here for three years to prove how much phosphorus we can catch in these storms if we build low level earth detainment bunds like that shown in the centre photo.

Lastly the acknowledgements. Greg wishes to acknowledge Dale Williams, Dave Paine, Shay Dean (BOPRC), Phil Commins (contractor), Cam Speedy – papers and reports and OSPRI .

I have taken a lot of material from:

- Rich McDowell 2010 – 2016 various papers / presentations
- Genevieve Carruthers (2005), an Environment Management Systems Australian expert who came here to speak to Rerewhakaaitu farmers some years ago.
- Dylan Clarke (2013) who did the first thesis on detainment bunds for mitigating phosphorus and sediment loss
- Phosphorus Mitigation Project (2017 – 2019) MPI Sustainable Farming Fund and 7 co-funders including all 3 New Zealand Pastoral sectors

Thank you very much.