FARMING IN THE FLOOD ZONE:

CASE STUDY: *Rangitikei River*

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EXECUTIVE SUMMARY:

The February floods 2004 were dramatic in our recent river history and may have changed the way our whole river systems are managed, farmed and where we live.

This report is a case study of the Rangitikei River but is only a model for many other river systems in New Zealand.

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INTRODUCTION:

Farming in a flood zone is an everyday reality for my family and myself, as we have been living and farming beside the Rangitikei River for 5 generations.

We have learnt to live with the river over the years, with only an occasional reminder of its impact on our farming methods, in the form of riverbank erosion through infrequent flooding. In fact over the years since arriving in 1856 we have reclaimed more from the river than it has claimed from us, as by narrowing the channel and developing the margins we are now farming the riverbanks that originally would have been part of the wide, braided riverbed.

The flood protection works carried out from the 1950s onwards have afforded protection from floods, reclaimed land for agriculture and made farming the light fertile soils on the river margins very profitable.

But the huge 100-year flood event in February 2004 caused massive widespread damage and has changed the mood of those living near the river. Questions surrounding the efficiency and sustainability of the flood protection scheme, and the way we farm the river margins, as well as the impact of changing land uses in the upper catchment and changing weather patterns need to be addressed.

This report looks at the history of the Rangitikei River scheme, the impact of the 2004 floods and asks where to from here?

Sustainability of our agricultural practices throughout the Rangitikei River catchment must be reconciled with the changing nature of the Rangitikei River.

HISTORY OF THE RANGITIKEI RIVER:

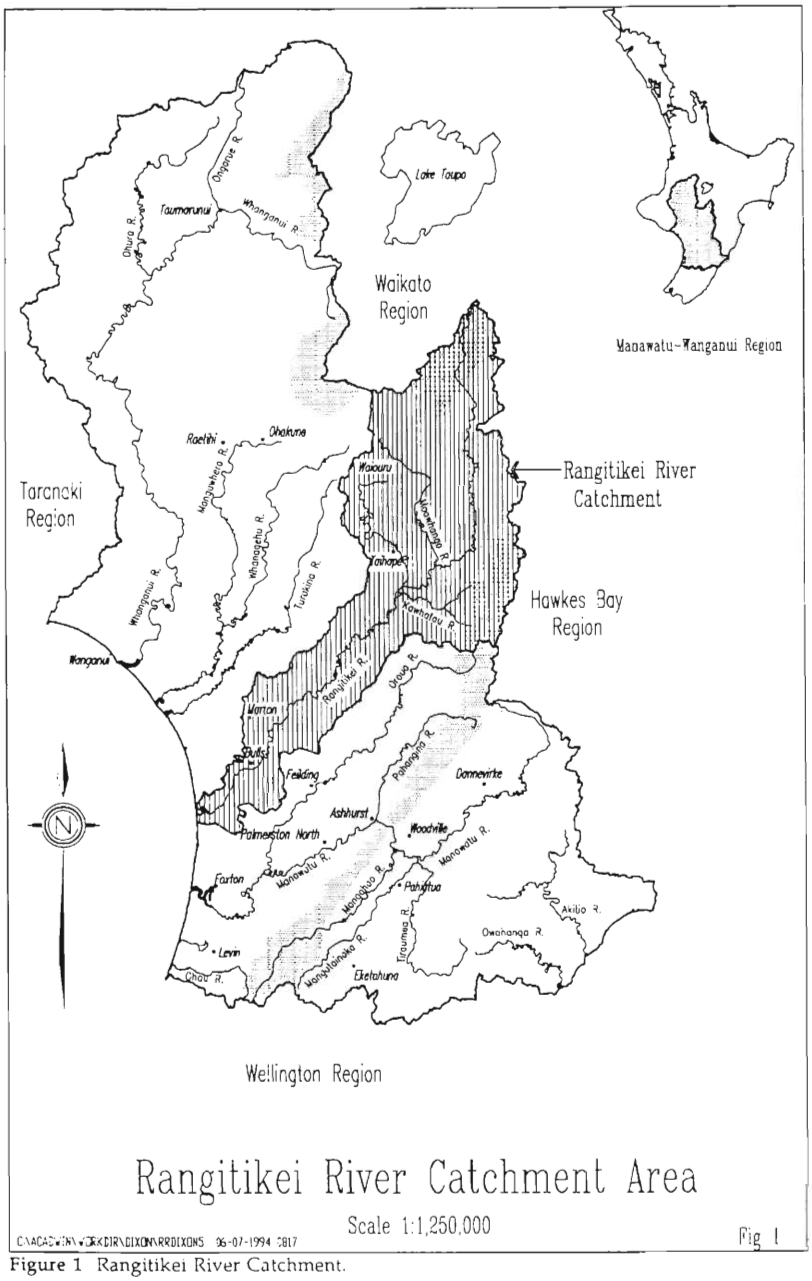


Figure 1 Rangitikei River Catchment.

The Rangitikei River Catchment area extends from deep in the Ruahine and Kaimanawa Mountains north of Waiouru, encompassing many streams and rivers, down to reach the sea at Himatangi and Scotts Ferry. The catchment covers an area of 4,144 square kilometres. From mountainous headwaters the river carves its way through deep and strongly terraced valleys, made up of sediments which are some tens of thousands of years old. These sediments, deposited during the ice age glaciation period, have since been subject to climate warming, with greater precipitation and heavier channel flow causing erosion and carriage of alluvium down to the coast.

High in the catchment the speed and fall of the river causes the gravel and sediments eroded from the valley sides to be washed out of the river channel (degradation). They are then carried down to the lower reaches of the river, where the current and flow of the water are slower and are deposited in the riverbed (aggradation). The river carries gravel all the way to the sea, but the gradient flattens off for the last 15km and consequently the gravel aggrades in that reach. According to Heerdegen in Landforms of New Zealand, "this process of cut and fill in the upper valleys and aggradation and degradation in the lower valleys has already occurred several times".

In pre-European times when the margins of the river were forested, the river is thought to have been a single channel carrying modest amounts of gravel. The forest growing right to the water had the effect of stabilising the banks. However massive clearances of forests by early pioneers around 130 years ago has caused bank and catchment instability, leading in turn to the high sediment load and braided river form of the 1930s to 1950s.

THE RANGITIKEI RIVER SCHEME

Work on the first Rangitikei River scheme commenced in 1952 by the Rangitikei-Wanganui Catchment Board for the purposes of stabilising the channel and 'controlling the wide, braided and unstable river'. One of the driving forces was to reclaim a portion of the riverbed by narrowing the channel and reinstating riverbed to productive land.

The Rangitikei River scheme provides erosion control from Rewa to the sea, a distance of 63km.

The first scheme reclaimed 460hectares of farmland mainly by tree plantings and protection of the banks, using less stopbanking than was originally intended. By the late 1950s the thinking was changing more towards the use of rock and concrete bank protection rather than the less effective tree protection. The second Rangitikei River scheme, begun in 1965, constructed stopbanks, carried out additional channel stabilisation and established protection planting along much of the river. The stopbanks were built over 16km, in five different sections. Designed to handle a 50-year flood, plus 600mm of freeboard, they provide flood protection to around 2,000 hectares.

Unfortunately the channel confinement and gravel extraction caused increasing damage to the tree protection work. Following a review of the scheme in 1983 it was decided the 300-400metre wide channel design of the preceding schemes was too narrow and a 500metre 'fairway channel' with guaranteed protection areas would be more effective. Gravel extraction plans moved extraction sites from degradation to aggradation areas and riprap (rock) bank protection mooted in place of tree protection works. Despite spending $26.7 million up until this point and the expectation that each step would have completed the capital works necessary to stabilise the river, the Rangitikei River Consolidation Scheme cost a further $3.2 million between 1985 and 1994.

PROBLEMS WITH THE RANGITIKEI RIVER SCHEME

A number of problems with the scheme were highlighted at the time of the 1994 review.

Problems included too much gravel extraction in some areas, causing a lowering of the channel and undermining of the protection works; aggradation of the riverbed in the lower river, causing a loss of flood carrying capacity; and a shortage of funds caused by loss of government subsidies in the late 1980s.

SOLUTIONS TO THE PROBLEMS

The lower 63km section of the river was rezoned into three areas, with the rating income from each zone to be spent in that zone. Zone 1, which is the major aggradation zone and contains the stopbanked areas, was to have stopbanks raised to reinstate flood carrying capacity (although it was acknowledged that this

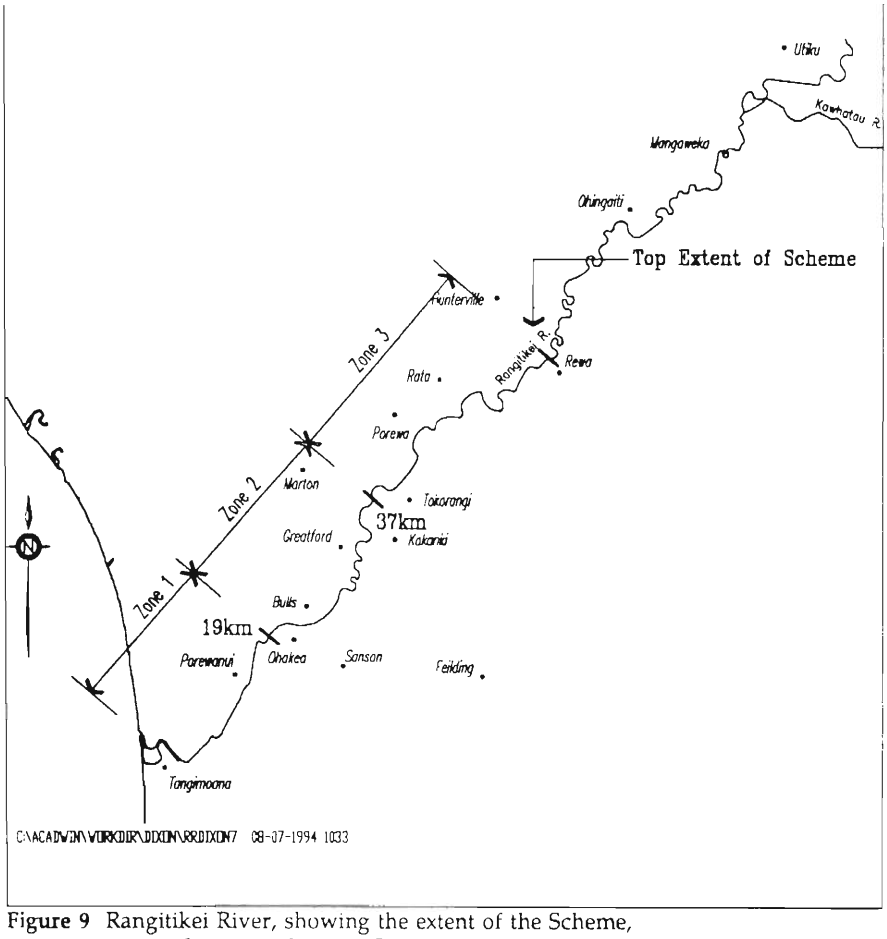


Figure 9 Rangitikei River, showing the extent of the Scheme, and proposed works Zones 1, 2 and 3.

was a short-term measure due to the continued siltation of the river and the eventual ineffectiveness of the banks).

In the 19km of Zone 1, being the major aggradation zone, the riverbed has risen about 30mm/year over the years 1977-89, causing the main channel to become narrower and shallower. Gravel extraction in this zone was encouraged from the time of the review, with no charge being set on this activity.

Zone 2 is the degradation zone from 19km to 37m from the rivermouth. Gravel extraction in this zone was incrementally reduced over a 3-4 year period, with a charge applied of $2.50/m3 within this zone.

In the top zone, Zone 3, minor degradation was taking place. River control was continued, predominantly by use of 'riprap protection', stopbank upgrading and fairway clearing and maintenance of tree planting, and a set of rules developed for erosion protection.

FUTURE SCHEME WORK

Following the review, a 20 year upgrade plan was recommended and adopted to solve the problems of gravel aggradation and berm siltation. Because loss of flood carrying capacity was happening gradually, a longtme period for the upgrade was adopted, to spread the financial impact of the upgrade works.

The review concluded that the planned works could be carried out at a minimum cost in a sustainable manner. The future scheme was to be jointly funded by rates, grazing leases, (an expanded) forestry programme and gravel extractor's contributions. Since the end of government subsidies the Resource Management Act also allows regional councils to ask for governmental financial assistance to mitigate environmental damage.

In summary, up until 2004 the Rangitikei River Scheme was working, and although not perfect, it was generally regarded as a forward thinking river scheme model.

THE 2004 FEBRUARY FLOODS...

In February 2004 disaster struck in the form of a 100year flood event.

During the month of February, 1000mm of rain fell in the Tararua Ranges. The month began with a minor flood event on February 1, followed by a major flood event between 14-18 February causing the main damage. In this 3 days, 300mm of rain fell in the Ruahine ranges. Further rainfall over the following two weeks exacerbated damage and hindered the clean-up process. Many areas experienced 10 more wet days than average and sunshine hours and temperatures were well below average. The Manawatu soil moisture levels reached peak winter saturation levels early on in the major flood event and from there it just got wetter than even a wet winter.

Hillsides, streams and rivers were unable to cope with the volume of water and erosion, surface flooding and damage to hillsides, roads, bridges and homes was widespread in the Wanganui, Rangitikei, Manawatu and Horowhenua regions. Indeed the damage to the lower North Island was initially estimated to be at least $180 million and is now estimated at $300million plus! The Rangitikei River level was measured at the third highest since records began in 1897. On February 16th alone, the Rangitikei region lost 1.7% (4500ha) of its pastures to erosion.

In the steep hillcountry around the headwaters of the river, erosion of hillsides and riverbanks was huge. Streams and tributaries, swollen with silt and runoff, took out tracks, fences, culverts, roads and power and telephone services. There were about one hundred road closures and some 30 bridges disrupted. Further down the catchment, the swollen rivers scoured out the river channel, which in many places had been narrowed by using stopbanks and tree planting on the banks to reclaim grazing and cropping land. As the rivers gained volume and momentum, hectares of land were undermined and swept away, causing an estimated $20million damage to bridges and roads. As the river rose higher, it climbed out of the established river channel and followed a new course, either over or through built up stopbanks. This caused major losses of crops and pastures, massive siltation of pastures, and damage to fences, plant and equipment for irrigation and water supply, and to dairy sheds, farm buildings and houses.

Stock losses were less from hill country properties, but much greater among the dairy herds of the lower flatter country, with an estimated 1000 cows drowned, with 10,000 cows relocated.

Thousands of acres were covered with a thick layer of silt, requiring massive and expensive clearing and regrassing operations. As well as the short-term loss of income through interruptions to stock management and milking ability, the floods caused medium term losses of production through damage to pastures and silage reserves and severe silting of grazing land. Grazing land was permanently lost to newly formed riverbeds, which in some places quadrupled their width.

Crop losses were estimated at $30million, including paddocks of potatoes, onions and squash that were about to be harvested.

In the Rangitikei region, 150 homes were destroyed and many more were damaged by floodwaters, as were many farm buildings. At Scotts Ferry, on the Lower Rangitikei, all 50 homes in the settlement were flooded with 250 people evacuated and 300 people evacuated at the Tangimoana river mouth.

A similar flood occurred in 1926 and a much larger one in 1897. However those floods had possibly less impact due to less people living in the region and less intensive agricultural practices.

Shelley Dew-Hopkins, President of Manawatu-Rangitikei Federated Farmers commented, "A river rules your life, that's the reality for a lot of us, but it was the magnitude of it, (the flooding and the storm) that really blew us all away. It really was just amazing."

STOPBANK FAILURE

As well as the huge problems caused by the swollen silt-laden rivers, stopbank failure in the lower North Island caused the flooding of 2,000ha. Many stopbanks built over the years had altered the natural path of the river and haphazard building of banks had narrowed the bed of the river so much that the water was forced through or over the built-up banks. Large areas of farmland were covered with floodwater that slowed in momentum and dropped its burden of silt. In many cases the water then had nowhere to go as it was hemmed in downstream by the stopbanks and lay on the saturated surface, until it finally evaporated, many weeks later.

Stopbanks designed to withstand a 50year-flood event were unable to cope with the sheer volume of the February floods. Had the stopbanks not been there the water may have initially spread out further over farmland but would have receded more quickly without dropping as much silt. Floodwaters hemmed in behind the banks with no escape route caused the worst siltation and pasture damage, with some paddocks covered with up to 1.5 metres of silt.

RECOVERY:

Recovery from the February floods was slow for most people, and largely dependent on where they lived and how quickly the floodwaters receded.

Many were able to mop up and clean out floodwaters from homes and buildings, retrieve stock and send them out to be grazed and milked elsewhere, while they got on with reinstating pastures, fences and tracks. Some were aided by Taskforce green workers and a labour force of hardworking farmers from other parts of the country.

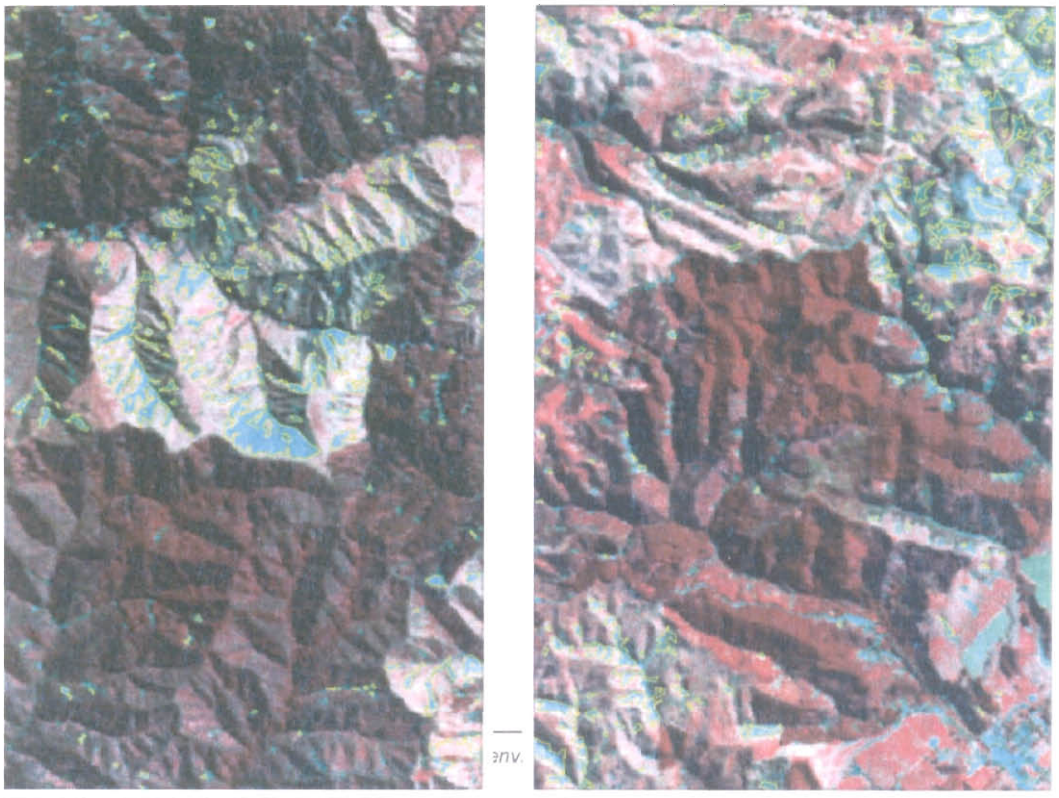
Others who had lost major access bridges and roads had a longer task ahead of them, and they were forced to wait for temporary bridges and reinstatement of services.

For farmers in the hillcountry subject to heavy slipping, it has been estimated that it takes between 10 and 20 years to rebuild a metre of topsoil to about 80% fertility, so theirs is a long road to recovery.

Vegetable and process crop growers who lost total crops were forced to either plough in or shift the rotten produce when the floodwaters receded and wait for the next growing season before trying again. Theirs was a disastrous season, with income totally wiped out, unlike those whose crops could be resown, albeit at large cost.

For many people evacuated from their homes, it has been a long road to getting back to normal. Delays in insurance assessing and then paying to have remedial work done and then the inevitable shortages of tradesmen able to do the flood repairs has meant that some people were forced to find alternative accommodation for months.

The emotional toll has been huge on many people, who have lost confidence in the safety of their homes given their proximity to the river. Each time it rains many people get nervous, worried that there might be another flood. Particularly for the elderly, who may have all their assets tied up in their homes, the prospect of living with the threat of more frequent flooding is emotionally draining.



SATELLITE IMAGES

These are two zooms of the SPOT satellite data, with the slipmap from Landcare Research overlaid on top, showing the contrast between forest and pasture.

Light red is grass, dark red to black is forest, Light blue is bare ground, Yellow lines are the vectorised slipmap. One left we are in the headwaters of the Whangaehu up Parihauhau Rd, on the right, that's Pohangina township in the bottom left corner.

AGRICULTURAL RECOVERY PROGRAMME

Central Government came to the aid of the flood-affected regions with a rather tight (criteria-wise) but well-intentioned flood relief package. The amount of funds is not capped and although there have been some time delays and hitches with paying out, it will ease the financial cost of the disaster for many farmers.
(See Agricultural Recovery Programme Application Details)

Also included in the Flood Relief Package was

> Reinstatement of on-farm flood protection works on private land eg stopbanking where approved by the local Regional Council.
> Reinstatement of pre-flood, farmer-funded bank stabilisation

However, the Horizons Regional Council is mindful about farmers rushing in and restabilising their riverbanks with strategies such as willow tree planting. At a Landuse Meeting in October, groups were invited to discuss the changes to landuse and river management needed to lessen the risk of repeated flood damage. Upland farmers who have used willow tree planting to constrict river channels to maximise useable riverflats will be encouraged to use other strategies in the future.

According to Horizon's chairman Chris Lester, "The remedy, if there is a remedy, is likely to be a combination of things – better and different landuse in the headwaters, different river management – probably wider channels – and less emphasis on the planting of willows."

Householders who lost personal belongings were overwhelmed by the generosity of people in other parts of New Zealand who rallied around and sent huge amounts of donations of money and household goods.

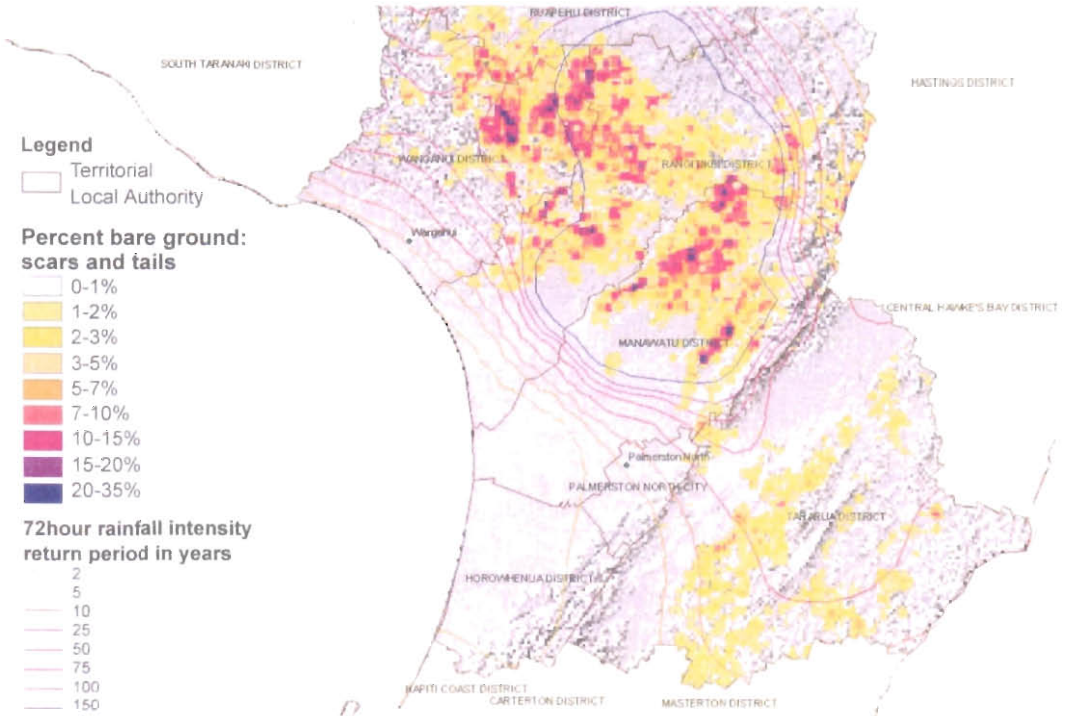


FIGURE 6: Landslides from the February storms, mapped using satellite technology, by Landcare Research with 72 hour rainfall return period contours by NIWA

CHANGING WEATHER PATTERNS – ARE WE LIKELY TO HAVE ANOTHER 100YR FLOOD NEXT YEAR?

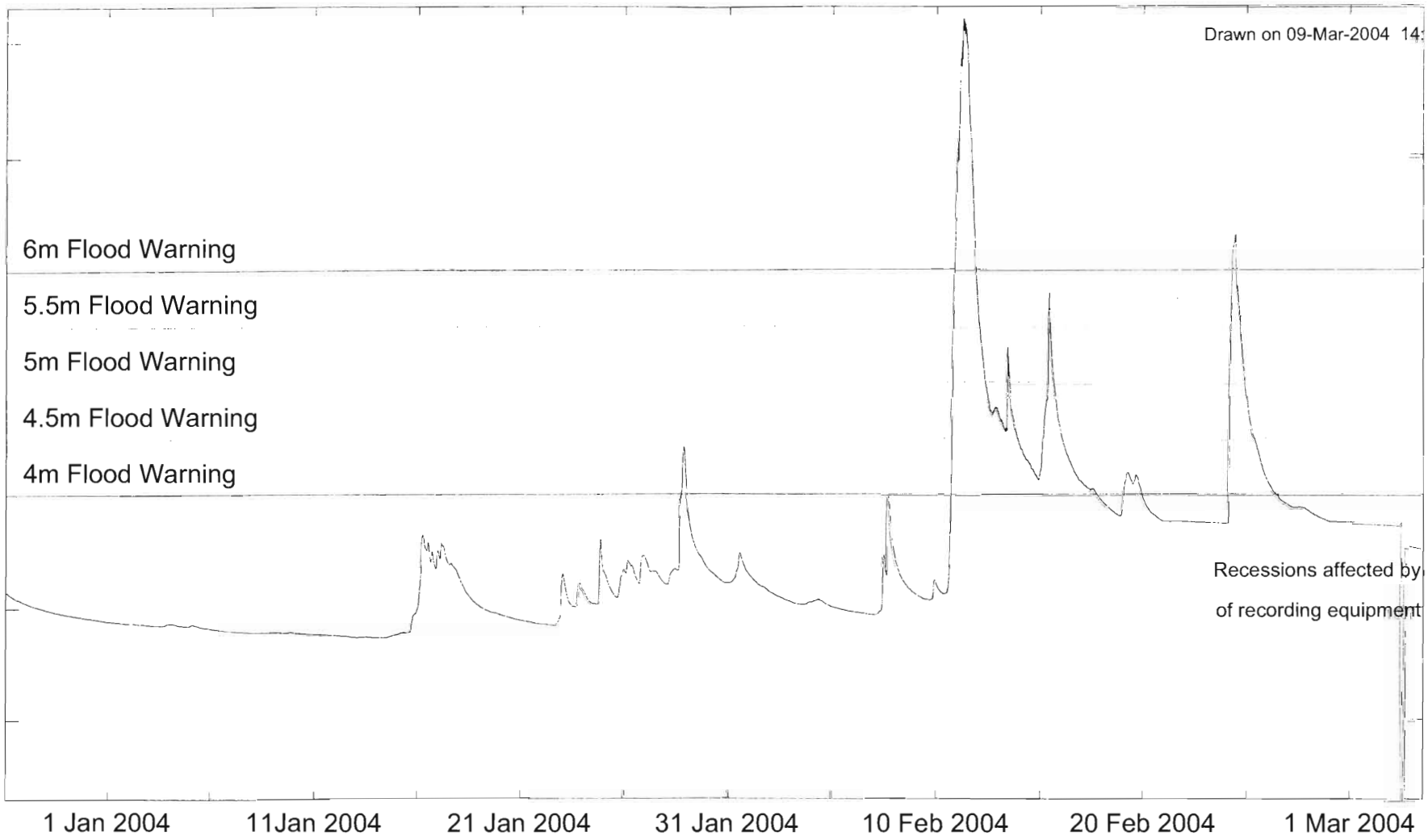
Results of research on the effects of climate change and global warming are inconclusive but most forecasters anticipate that there will be an increase in the frequency and severity of extreme weather events.

Science and Energy Minister Pete Hodgson says, "Climate change can not be ignored."

The west coast of New Zealand is expected to become wetter and up to 3degrees warmer in the next 70-100 years. For example, Taranaki could be up to 20% wetter. This may mean flooding could be up to 4 times as frequent by 2070.

The year 2004 was one of the wettest on record in the Manawatu, with continued heavy rainfalls through the autumn and winter following the February floods. In August, another heavy rainfall period saw the return of floodwaters to many parts of the region, and the Manawatu River again burst its stopbanks near Woodville. Following this the floodgates were opened onto the Moutoa floodway to lessen the chance of the river bursting its banks further downstream. Farmers in the floodplain said that they were used to farming on a floodplain but the floods seem to be coming more often and with more water. "Maybe we have to change how we farm to lessen the effect…I'm not really sure how."

February Hydrograph



Rangitikei at Mangaweka from 01 Jan 2004 00;00;00 to 09 mar 2004 13;00;00

THE CHANGING NATURE OF FARMING ON THE RIVER SYSTEMS

The last fifty years has seen huge changes in landuse within the catchment of the Rangitikei River, particularly the flatter country. Farming has intensified markedly and land has been developed from being covered in native forest and in the hillcountry and the lower country to being sown in high producing pastures and highly fertile cropping land.

The last 20 years particularly has seen a big change to high value crops and intensive farming practices near the river.

Due to river channel management and stopbanking, the light fertile soils along the river have become available to farmers for more intensive uses. Farmers have welcomed the opportunity to use these excellent soils for growing high value horticultural and agricultural crops. New industries for process vegetables have developed in the region to further process and add value to the crops.

Consequently when the riverbanks flooded in February some 150 farmers lost crops of onions, potatoes, squash, maize and vegetables growing close to the river. With a direct cost of around $30 million to the region, the losses also had downstream effects on the jobs of harvesters, process workers and others in the industry.

Dairy farming has also increased on the country adjoining the lower river systems, with huge investment in dairysheds, irrigators, races, effluent systems and water reticulation. Many of these were flooded in February, particularly behind the stopbanks where 2,000ha of dairying land were submerged under water for many weeks.

Landuse changes in the upper catchment have seen development of many steep hillsides and the removal of native forest and scrubland. In the last 150 years, the forest cover has been stripped away, often leaving only a thin layer of grass protecting the soils. As pastures were oversown, fertilised and have become more productive, more cattle have been introduced into the hill country, which are known to accelerate erosion faster than smaller, lighter sheep. Trees have been planted, but not always on the right slopes, and the removal of subsidies for erosion protection plantings around the late 80s meant a huge reduction in the plantings of trees and poles. The floods this year have proved the folly of neglecting erosion control with surveys showing the level of erosion to be much less on protected slopes. As well as the cost of losing productive pasture for the hillcountry farmers there is a huge cost to maintaining the infrastructure in the upper catchment areas: roads, bridges, power and telephone lines are all threatened by flooding and erosion more so than on the flatter country.

The increasing population in the region has meant more people living closer to the river and the rivermouth on the coast. Communities have a big stake in the river systems, with water clarity and bank stability being big issues. Siltation of the river and silt particles suspended in the water reduces clarity thus effecting fish life and biodiversity of the river.

Up until now the considerable amounts of money spent on river protection schemes has afforded a certain amount of protection to the users of the farming lands alongside the river.

With stopbanking, floodgates and flood protection plantings people were relatively sure that their pastures, crops and homes were secure. The Manawatu River has extensive stopbanking to protect towns and land. During the floods Palmerston North was saved due to recent uplifting of the stopbanks. However the 2004 February floods have shown that these schemes can fail. Valuable growing areas were lost due to the failure of structures and in "some peoples views" failure to act. The confidence on many homeowners has been shaken and their complacency replaced with nervousness.

In the present environment our river systems are being managed by regional councils under the auspices of the Resource Management Act, which allows councils to put into place policies and protocols to protect the river and its environment. Farmers will have to fit in with these management practices or face expensive and weighty legal battles

The changing landuse patterns in the upper and lower reaches of the river, along with protection measures taken to safeguard these land uses have had a marked effect on the flow and behaviour of the river. During the floods it was estimated that nearly 20,000 hectares of land slipped, losing a metre of soil in the greater Manawatu region and that up to 28 tonnes of sediment per second was flowing under one bridge. Some of that sediment will have flowed out to sea but a great deal was deposited on flooded agricultural lands and within the lower reaches of the riverbed. The river and surrounding farmland will be more and more prone to flooding in the future as the lower reaches of the river are silting up, unless gravel extraction can lower the level of the river or the stopbanks can be further built up to account for the higher riverbed. Of course this work all comes at a cost, and who is willing to bear the cost?

THE SOIL EROSION PROBLEMS IN THE HILL COUNTRY

As well as the intensity of the February storms, a major problem was that the soils on the hill country were already saturated before the storm and remained very wet for months after the event.

Work with aerial photography and satellite mapping has been carried out since the storms to show the areas of erosion in the river catchments. Once slipping scars and tails on different slopes of land was mapped, it has shown that 50% of the erosion was on flat to strongly rolling slopes with angles under 21 degrees (land that is ploughable). 15% of erosion occurred on moderately steep slopes and 35% on very steep slopes.

Discussion surrounding whether erosion-control plantings in the 1970s and 1980s actually worked in controlling slipping. Findings showed that the erosion probability was 5-10 times higher under pasture than under forest.

According to the Horizons Regional Council analysis, pine tree forests definitely reduce mass movement erosion to around a quarter of the unplanted level. Scattered trees don't make much difference to erosion and spaced plantings can reduce erosion by about half if they are densely planted and mature.

To lessen the impact of future floods, Horizons drew the following conclusions:

- Land need to be identified that is at risk of being flooded, being covered in mud or suffering severe erosion.
- Identify sources of sand, gravel and mud
  Come up with a landuse change package

A combined land management workshop held in September 2004 came to similar conclusions. Farmers are very keen to work towards sustainable development, with a whole community approach from the hills to the plains. There is a need for better information that is easily accessible by farmers, including whole farm plans, to identify areas under threat of erosion and to plan areas of afforestation, land retiring, space planting and change of landuse, taking into account the financial implications of changing landuse on a farm by farm basis. However hill country landowners do not want blanket afforestation or retirement of land. They need help identifying priority areas and putting in place plans for change in areas where the economics stack up. Horizons Regional Council will be taking a leadership role and doing more work on this issue in the near future.

Robert Coulson, private soil conservcator, works with live material (poplars and willows) rather than angles and structures in river work. His view is that when government funding of erosion control in the hill country ceased around 10 years ago, so did the majority of planting. The results of the 2004 flood show that farmers need to return to the rate of plantings seen in the 1970s and 80s. An important part of controlling downstream flooding is trying to stop erosion at the source.

HAMISH HOGG

PERSONAL HISTORY: THE HOGG FAMILY FARMING ON THE RANGITIKEI RIVER

Five generations of the Hogg family have farmed land adjacent to the Rangitikei River just out of Halcombe, since they arrived in 1856. They have seen the river and the land use change markedly in that time.

One hundred years ago the river was wide and braided with many channels covering a large area. Since then the river boundaries of the farm have changed hugely.

Fifty years ago the river flats were largely undeveloped and covered with gorse and lupin. Floods have occurred every 10 years or so and damage has been done.

The Rangitikei River scheme saw stop banking on the opposite side of the river and protection work to stabilise the river into one channel.

Metal extraction caused a lowering of the riverbed and some undermining of the protection works, and although the river has taken about 10ha of land in the last 100 years, the last 20 years have been relatively stable due to the river protection works.

In fact in the last 20 years the family has probably made a net gain from the river as they have developed and farmed the richly fertile river flats ie they have claimed more than they have lost.

Richard's father Hamish, who died recently at 93, always maintained that you could never control the Rangitikei into a tight channel. The 2004 floods would have fascinated him as they very nearly proved him right. Another flood a little bigger would have vindicated his view of river control – that the river needs a wide channel.

SUMMARY:

Farming anywhere along our river systems is going to undergo huge changes, either voluntarily or be forced to by rampant floodwaters or Councils wielding the Resource Management Act.

Farmers have probably pushed the boundaries as far as they can go in terms of developing and using denuded hill country and reclaimed river margins.

For the last 50 years farmers have largely been protected by the river protection schemes which have provided a 'safe haven' for users of land adjacent to the river. The February 2004 "100 year flood' event has shaken the stability of the scheme and left farmers and engineers wondering 'where to from here?'

The Rangitikei River scheme took account of the diverse nature of the river problems and in the late 1980s put into place a differential rating systems for different areas of the river. This was forward thinking but need to be extended to the very upper reaches of the Rangitikei River catchment. For example, Environment Waikato has a similar policy of collecting rates from the lower areas and using an incentive and fines scheme to encourage good land use in the upper catchment.

Farmers in the hills of the Rangitikei River catchment will have to take some sort of responsibility and be encouraged to use land use practices which minimise erosion. These could include space planting of trees for hillside stabilisation, retirement and reforestation of marginal hill country, planting of woodlots, minimising some classes of stock on steep country and reviewing the use of stream and river stabilisation practices.

Those farming the lower reaches will be forced to review the practices of channel control using trees and stopbanks. The intensification of farming the river flats may slow down or even reverse when farmers realise that they are not going to be so protected to crop losses and from flooding. Risk analysis will play a part in deciding which crops to grow on the more vulnerable land close to the river.

The farmers in the lower river system who were caught by stopbank failure have had some central government support for the 2004 floods but this can not be counted on in the future. Farmers will need to take more personal responsibility for the potential damage, looking at insurance cover and strategies for minimising losses. Insurance cover may not be as easy to find for future flood episodes, and the cost is likely to escalate. Land values in 'flood-prone' or 'high-risk' areas may fall, which could impact on the economic viability of some farming operations.

Communities sited on the river could also have difficulties securing insurance cover and may have to live with the threat of flood, or contribute money to flood protection schemes.

The Resource Management Act is alive and well and will act to dictate to those farming and living near the river.

Most solutions to the problems of the changing nature of farming and living on the Rangitikei River are very long term. They will likely include better hill country practices, great insurance cover and more money spent on river protection.

CONCLUSIONS

The Rangitikei River affects everyone living and making a living alongside it from the source to the sea.

The February 2004 floods have severely weakened 50 years of planning and protection works.

The cost and responsibility of living on the Rangitikei River system will be greater in the future.

A 100yr flood event could, due to climate change, happen more often in the next 50 years. When buying or investing in a property in the future, near to the river, "Caveat emptor" – Let the buyer beware.

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