Waimatā River Flooding

Slash Debris Summary

February 2023

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new zealand

On 22nd February 2023 permanent photo points were established along the Waimatā River to document the tree species debris which were translocated and deposited within the recent (February 13th – 15th 2023) cyclone which passed through the east coast, known as 'Cyclone Gabrielle'.

Methods

On the day of the survey the weather was fine with intermittent cloud, approximately 24°C and high relative humidity. There was a light breeze, c.2 on the Beaufort Scale.

Sites were gps'd using NZTM and photographed between 1106 and 1315 hrs on 22/2/23. At all sites the riverbank had slumped significantly as a result of the increased water level. The raised water level also transported significant volumes of silt onto many riparian plants and into adjacent paddocks and roads, affecting stock grazing areas, stock yards, fences, gates, roading culverts and the roads themselves.

A limited range of tree-woody debris species was found to be present within translocated tree debris piles. The Waimata catchment contains limited indigenous (native) vegetation cover. The majority of native cover within the Waimata catchment is primarily mixed kanuka-broadleaf or primarily kanuka dominated canopy regenerating second growth forest over unpalatable divaricating shrub species and ferns. Forests within the Waimata catchment are highly modified and impacted by browsing and grazing introduced herbivores such as feral goat and possum therefore under-storey tiers are often missing with shrub and seedling species limited to several unpalatable forest species such as rohutu, ferns and kanuka (Ecological Survey & Pateke Restoration Site Assessment Waimata Valley Te Tairawhiti, Ecoworks NZ Ltd. 2022).

Pinus radiata was able to be differentiated quite simply from other plant species. After 30 years working within *P.radiata* production forest and undertaking vegetation survey for falcon, macro-invertebrates, native fish, kiwi, native bat, kakabeak and general detailed ecosystem survey it becomes relatively simple to identify *P.radiata* from a number of key features. *Pinus radiata* identification features which were included within this survey are listed below however were were not limited to:

a) Branches or stems containing chainsaw cuts, felling scarfs or chainsaw pruned stems or sign of machinery (teeth dentition) impacts on logs.
b) A fissured bark pattern which was dark grey to brown in colour.
c) A branching pattern and uniform spacing forming a 'whorled' or circular pattern around a central stem.
d) Pine-cones or needles. Dark green, relatively short (15 cm) stout (1.2-2 mm thick).
e) Pine-cones attached to branches.

Other tree/plant species identified within the slash piles and within adjacent drift-wood sites included:

Silver poplar (*Populus alba*)

Macrocarpa (*Cupressus macrocarpa*)

Alder (*Alnus glutinosa)*

Willow (*Salix fragilis*)

Kanuka (*Kunza ericoides*)

Eucalyptus (*Eucalyptus spp.)*

Lemon wood (*Pittosporum eugenioides*)

Matai (*Prumnopitys taxifolia*)

Harekeke (*Phormium tenax*)

Fennel (*Foeniculum vulgare*)

Wheki ponga (*Dicksonia squarosa*)

Unknown logs

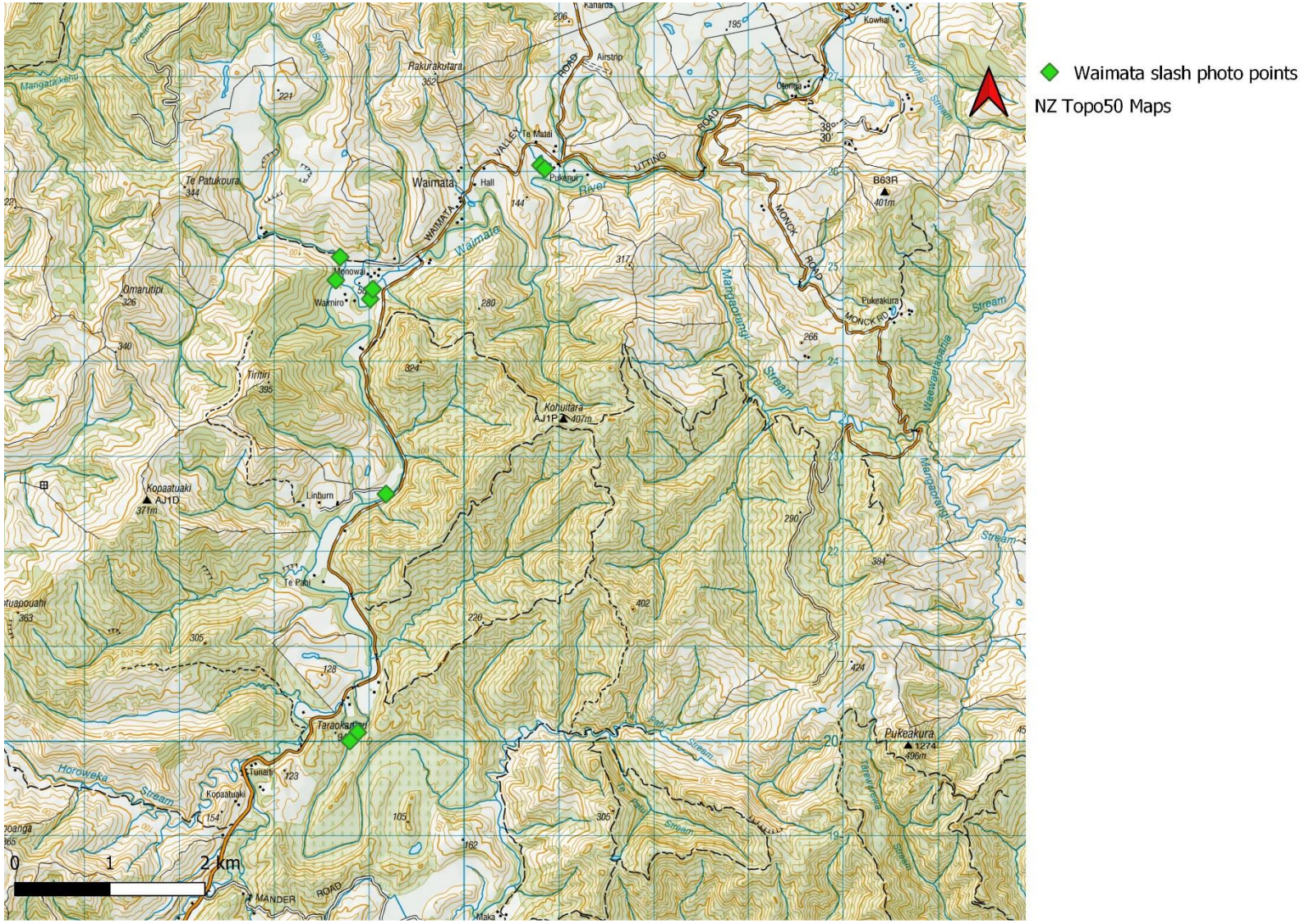

Figure 1. Map of photo point sites within the Waimatā Valley.

Table 1. Summary of information for the nine photo points set up along the Waimatā River in February 2023.

Location	Point ID	Easting	Northing	Photo Bearing	Time (24hr)	Photo No.	Site Description
Waimatā River – 10km	WR1	E2038880	N5720089	201˚	1106	110608	90% pine slash on riverbank. One tree fern, some willow. Goat prints frequent on silt as gates and fences impacted by silt.
Waimatā River – 10km	WR2	E2038798	N5719997	225˚	1115	111526	Primarily pine slash built up against a kānuka. Riverbank has slipped significantly.
Linburn Rd, Watson's bridge	WR3	E2039179	N5722600	182˚	1143	114352	Primarily exotic tree species. 75% P.radiata, 20% silver poplar, 5% other (macrocarpa, kānuka, willow). Significant build up beneath bridge, poplars fallen from bank.
Waimiro, Waimatā Valley	WR4	E2039013	N5724655	273˚	1200	120011	Majority P.radiata, one punga stump. Paddock covered in thick layer of silt with pine slash scattered throughout.
Waimiro, Waimatā Valley	WR5	E2039040	N5724759	233˚	1204	120452	Some silver poplar and willow, 90% pine. Some trunks degraded and difficult to

							identify. Many stems have obvious chainsaw cuts – plantation thinning size.
Monowai Station, Waimatā tributary stream	WR6	E2038695	N5725097	246˚	1230	123040	95% P.radiata, some silver poplar, kānuka and tree punga.
Monowai Station, confluence with Waimatā river	WR7	E2038650	N5724854	114˚	1250	125011	75% P.radiata, a fruit tree, water appears to have travelled over-land pulling other tree species with it and slash getting caught amongst plantings, slight buildup.
Waimatā Valley Road – 18km	WR8	E2040807	N5726065	276˚	1311	131130	Downhill from road, downstream from where culvert became blocked during the storm. 100% pine. Obvious cuts on some trunks.
Waimatā Valley Road – 18km	WR9	E2040854	N5726026	195˚	1315	131557	100% P.radiata deposited, some kānuka pulled over by the weight of slash lifted onto it by the high river water level.

WR1 – Site one on the Waimatā River, around the 10km mark of Waimatā Valley Road. A large build-up of primarily pine debris is on the true left of the river.

WR2 – Site two on the Waimatā River, east of the 10km mark of the Waimatā Valley Road. Pine debris has been caught in kānuka and another *Pinus radiata* plantation on the true left bank of the river.

WR3 – Watson's Bridge, Linburn Road over the Waimatā River. A mix of pine, one macrocarpa and silver poplar has collected beneath the bridge.

WR4 – Waimiro Station, Waimatā Valley. A paddock on the true left of the river has been completely covered in a thick layer of silt with identifiable parts of pine scattered throughout.

WR5 – Waimiro Station, Waimatā Valley. Further north of WR6, more pine forest waste has built up on the true left riverbank.

WR6 – Monowai Station, Waimatā tributary stream. Pine waste has mostly built up on the true left with some scattered on the true right.

WR7 – Monowai Station, confluence of tributary and Waimatā rivers. Debris piled up on island in between, extending out from a paddock inundated by silt.

WR8 – Waimatā Valley 18km culvert. Mainly on true left bank of main river channel, downstream a few metres (WR9) piles are on both banks are c.3 metres in height.

WR9 – Waimatā River, downstream from 18km mark culvert – 2+ metres deep in slash.

Other photos:

At site WR3, an example of how trees that fell in the storm or flooding typically remain in place due to their root structures.

Accumulation of pine debris in the Waimatā River, downstream of the 18km culvert which became blocked during the cyclone.

An example of where the debris has travelled from a pine harvest forest, where the tree has been cut is obvious. Slash to a mean depth of c.3m on right of photo.

Discussion

Forestry practices have well-documented impacts on freshwater ecosystems globally. The addition of terrestrial materials is more common when forests are on steep terrain. Sedimentation can result from the creation of roads to access forests, direct deposition of materials into the waterway, and incidental deposition of materials into the water via slips, resulting from decreased soil stability and increased soil exposure (Wallis & McMahon 1994; Quinn, Boothroyd & Smith 2004). The buildup of material, aggradation, causes physical changes to the terrestrial, riparian, and freshwater habitat. Sedimentation in water systems such as rivers can lead to hypoxic conditions where the oxygen concentration is too low to support the diversity of organisms that would naturally inhabit the area. This often leads to an overgrowth of certain species and can tip a system out of equilibrium, having significant long-term impacts on biodiversity and ecosystem function.

In a Waikato-based study, Quinn & Stroud (2002) found that, in comparison to pasture and native forest, streams running through or adjacent to pine plantations had significantly higher levels of suspended sediment. Additionally, these streams had lower dissolved reactive phosphorus and pH (acidic environment) in comparison to pasture and native forest (Quinn & Stroud 2002). In other studies around the country, pasture has produced higher sedimentation (for example, Fahey & Marden 2000), this result is influenced by the topography of the studied land area so is expected to vary. These results, though they are somewhat location-dependent, demonstrate that commercial pine plantations significantly alter freshwater conditions down to the chemical composition of the water.

The waste produced during the harvest of pine in New Zealand also has significant impacts on riparian, terrestrial and coastal ecosystems, as seen after weather events such as Cyclone Bola, Cyclone Hale and the recent Cyclone Gabrielle. The primary impact resulting from the physical movement of *P.radiata* is demonstrated by the present survey – deposition of logs and debris on riverbanks and beaches is translocated directly by the river flow. This affects the plant, animal, and fungal compositions of these systems as the physical habitat is drastically altered. Many riparian plants had been damaged or displaced at the sites visited in the present survey, by both debris and silt deposition. The breakdown of this material will also have impacts on freshwater, coastal, and riparian systems by entering a significant amount of organic matter, and therefore nutrients, to environments where this is not a naturally occurring nutrient source, nor a naturally occurring quantity of such matter.

As all these systems are intimately connected, flow-on effects are sure to arise. Changes in nutrient composition will alter which plants and fungi are able to grow in affected areas. This will, in turn, alter which invertebrates are present – a factor which will also be impacted by sedimentation, especially for freshwater and riparian systems and in-stream macro-invertebrate populations (EPPT fauna) which are

vital for a range of NZ native and endemic species. Endemic predators – birds, long-tailed bat (DOC Threat Classification Status- Nationally Critical, DOC 2017), and native fish – are likely to be impacted by these changes to the lower trophic levels and may be displaced or extirpated from particular habitats, if the variation in the system is too great.

Above Left – An upper tributary of the Waipaoa River 3 weeks after Cyclone Hale showing a high sediment loading. Macro-invertebrate densities were extremely low due to loss of habitat and dissolved oxygen available. After observing this stream since 2005 the level of silt deposited within this stream has increased markedly since pine harvesting was commenced. Prior to harvesting this sstream contained a coble-shingle bed load. This site contains endemic and endangered long-tailed bat. Bat pass rates at this site during 2022 were recorded at 4.62 bat passes/hr using AR4 spectral bat detectors. Only scattered native vegetation is found at this site the site is dominated by grasses and mixed age class radiata production forest. A maximum of only 5 native bird species were recorded per data point during five-minute bird counts during 2022 (Huanui Forest Ecological Assessment August – Ecoworks NZ Ltd. September 2022).

Above Right – An upper tributary of the Motu River stream also 3 weeks post Cyclone Hale. Native vegetation shades, buffers and protects this stream. Native forest of mixed age classes produces a maximum protection effect for this freshwater habitat. Native bat pass rates at this site are 9.82 passes per hour using the same monitoring methodology as above. Macro-invertebrate fauna is abundant, freshwater fish species including long-finned eel are abundant and native bird species diversity numbers as high as 11 species per 5 minute bird count data point.

In coastal and estuarine systems, excessive sedimentation from the terrestrial environment can cause major issues for marine diversity. Just 2cm of terrestrial sediment deposition onto marine sediment can result in anaerobic conditions, negatively impacting any of the biota living in the system (Thrush *et al*. 2004). In New Zealand, recreational collection of fish and shellfish is highly valued, especially by Māori who have traditional collection grounds and items. Many preferred species will be impacted by sedimentation, for example, shellfish. The commonly collected mussels (e.g., *Artrina zelandica*) and cockles (tuangi/*Austrovenus stutchburyi*) are suspension-feeders meaning that they take food out of the water column. Due to this feeding behaviour, shellfish are at an increased risk of being negatively impacted by suspended sediments coming from upstream human land use (Hewitt 2002). Habitat availability may also be impacted by sedimentation, especially for stationary species like the horse mussel. This can affect survival of and recruitment to the population, having long-term consequences for the meta-population; the distribution of *A. zelandica* is closely linked to suspended sediment load (Ellis *et al*. 2002). Increased sedimentation of these environments is likely to have social impacts as access to sites and resources is impinged.

Recommendations

Forestry companies, under the Resource Management Act (1991) and National Environmental Standards -Production Forest (NES-PF) have responsibilities to the environment and their local community to ensure that their practices are sustainable and not detrimental to the surrounding environment. Management of slash (Regulation 69) is required to avoid the deposition of slash into water bodies or flood plains in order to mitigate potential damage to infrastructure or properties. Regulation 65 stipulates that sediment from harvesting must be managed to ensure there is no "conspicuous change in colour or visual clarity" or "significant adverse effect on aquatic life". As such a significant portion of native forest has been replaced by plantation forests over time, the protection of any native species colonising and/or utilising plantations should be a priority.

After 35 years of ecological management experience across multiple regions and countries throughout the Pacific and 25 years of experience managing and designing ecological management and recovery plans for indigenous species and habitats within *Pinus radiata* production forests for multiple private forest management companies; we believe we have a level of experience which could contribute protocols and harvesting methodology which will support the protection of our freshwater stream habitats, riparian forests, biodiversity and marine ecosystems alongside radiata forest production.

The following points summarise our recommendations which we believe would contribute to improved outcomes for both people and indigenous species.

a. Maintain a 50-metre wide permanent 'biodiversity set-back' along all 1st, 2nd, 3rd and 4th order stream riparian zones; and or other sites identified as ecologically significant, contain RTE (Rare, Threatened or Endangered species) as described within FSC and Forest Environmental Management Plans or those which could have significant downstream impacts on ecosystems, ecosystem services or communities. We recommend a minimum fifty metres on each side of a stream as this provides a degree of wind protection for a range of forest bird species such as North Island tomtit, grey warbler, kereru and fantail. These species are susceptible to die-off events during winter cold weather and wind protection is a key factor in protecting these species during these events. Fifty metre width biodiversity setbacks also provide indigenous forest wildlife corridors for species such as kereru, kaka and long tailed bats, all endemic species which require indigenous habitat and will move significant distances to feed. These large endemic bird species also translocate drupes and seed material such as kohekohe, tawa, hinau and puriri. This is vital to maintain ongoing forest integrity the distribution of next generation seed material. This set-back distance also ensures that any wind fall *Pinus radiata* does not impact the stream margins with an approximate 10 metre tolerance. Fifty metres also provides a minimum distance to include natural gradation of forest tier species. Riparian zones are generally dominated by broad-leaved – sub-canopy species such as putaputaweta, five-finger, tutu and mahoe within the Tairawhiti region. Forest canopy tiers generally merge into larger podocarp and climax forest as distance is increased from the riparian flood zone. Within the Tairawhiti region this includes species such as rewarewa, pukatea, tawa, kohekohe and kahikatea which are generally 10-20 metres from a stream flood zone. It is vital that these mixed forest tier species thrive within the Biodiversity Setback. Quality indigenous forest can contain over 15 species per m² this means that water flow from slope is substantially reduced. Tree roots from larger canopy species such as pukatea and tawa, and leaf litter layers reduce the speed and volume of water flow from a slope and leaf litter and duff layers assist with the absorption of water. Intact canopy species also reduce the direct kinetic impact of heavy rainfall by providing a softening affect and directing water down trunks, stems and branches.
b. Regional Authority Harvesting Consents for a forest area have an extended harvesting time frame of c.25 years with a 5 yearly review of all consent permit requirements and protocols relating to the NES-PF. This allows extended and tactical harvesting operations to take place with no requirement to speed the process and unintentionally cause environmental damage.
c. Maintaining long-term, high integrity permanent harvest access points on pre-determined slopes and ridges which are public use spaces where possible.

d. A significantly increased level of caution and review is required when providing resource consent authority to plant, road-line and harvest production forest within 'red zoned-Very High Risk' Erosion Susceptibility Classification (ESC) sites within Tairawhiti by Gisborne District Council. We believe many sites should now be re-planted or aerial sown with un-palatable native species such as manuka, kanuka, tutu, rohutu which will allow recovery without negative browsing impact from ungulates.
e. High stumping is required to harvested trees to a height of 1.0 metre within one tree length of the permanent 'biodiversity set-back'. This will create slash containment zones in conjunction with the biodiversity set back.
f. Independent auditing is carried out onsite and during harvesting operations in conjunction with harvest managers to ensure environmental standards consistent with District Plans and the NES-PF are maintained.
g. No slash greater than 100mm diameter is to remain within the high stump zone or biodiversity set-back post-harvest.
h. That existing slash deposits (right) and in-situ waste on previously harvested sites be surveyed and reviewed with the aim of removing potential environmentally detrimental risk.

Riparian Biodiversity setbacks and high stumping within all pine plantations to reduce sediment and nutrient loads entering waterways and mitigate flooding and slip impacts would have flow-on effects beneficial to maintaining native biodiversity and healthy ecosystems. For example, macroinvertebrate communities would benefit from reduced suspended sediments and natural allochthonous input to the stream (Quinn, Boothroyd & Smith 2004). Riparian vegetation also helps to normalise stream temperatures through providing shade, this can help to reduce the overgrowth of algae and maintain a more balanced system (Quinn, Boothroyd & Smith 2004). Native vegetation is preferable for this type of project, however Quinn, Boothroyd & Smith (2004) found that leaving already planted pine on riparian margins (rather than harvesting right to the margin) can achieve a similar result in restoring the system.

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Appendix 1.0 – A possible scenario to provide both protection for ecosystem values and maintain production forest estate.