Landcare Research
Manaaki Whenua

Forest harvesting, sediment yield, and what we can do about it: an update

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Acknowledgements

- ErnslawOne Ltd – Peter Weir, Chris Nelson, & his team at Whangapoua
- Donna Rowan & Loretta Garrett - field
- Alex Watson – data analysis
- FRST C04X0012 – “Sustainable Management of Forest Ecosystems”
- Garth Eyles & Barry Fahey – Pakuratahi Study

in this talk …..

- Some questions
- What we found
  - Coromandel
  - Napier
- Comparisons
- What it means
- What can we do
- Take home messages

Questions

- How much sediment is produced post-harvest?
- Where does it come from?
- What processes cause sediment generation?
- How long do bare areas take to recover?
- Where does the eroded sediment end up?
- How much gets in the stream?
- What can be done about it?
- Does it matter?
- Are places like the Coromandel unique?

Forest sediment sources - refresher

- Undisturbed areas, light disturbance
- Bare areas, deep disturbance
- Operational inputs (scalping)
- Landslides
- Roads – surface, fill, batter
- Landings
- Stream bank erosion
- Stream bed erosion

Past is not the present, however!

Why the Coromandel is vulnerable

- **Geology**
  - deeply-weathered andesites
- **Climate**
  - frequent high intensity storms
  - tend to be localised
  - most have 2-yr return period
  - occasional 20-50yr return event
  - probability of a 100-yr return event
- **Physiography**
  - steep slopes
  - deeply dissected valleys
- **Soils**
  - highly variable
  - thin clay and silt loams

Methods - Whangapoua

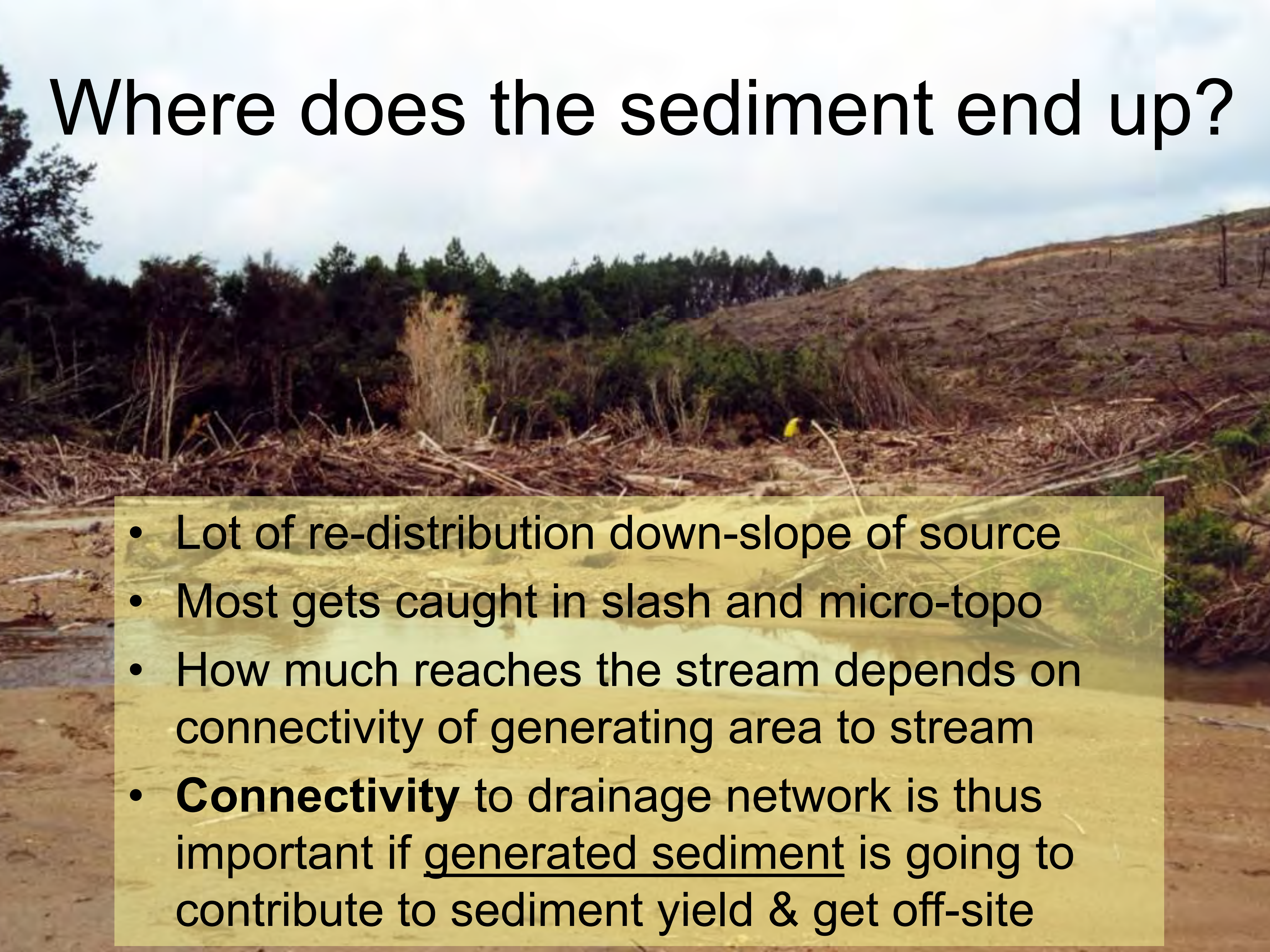
- Disturbance surveys
- 9 m^2 & 1m^2 runoff plots
- Vegetation plots
- Silt fences
- Erosion pins
- 3 auto rain gauges
- 4 simple water level recorders
- 4 auto water samplers
- 2 continuous turbidity probes
- Landslide inventory
- Stream channel cross sections & surveys
- ***No** measurements of <u>road run-off</u>
- ***No** <u>control</u> and limited <u>pre-treatment</u> period

Sediment generation

	Area (ha)	Total Sediment (t)	T/ha	
Undisturbed	14.5	0	0	
LD plots	15.5	16	1	
DD plots	3.6	48	13	
Scalped	3.6	1200	333	
Landslide (n=36)	0.4	600	1500	

Marden, M.; Rowan, D. & Phillips, C.J. (2006)

Where does the sediment end up?



- Lot of re-distribution down-slope of source
- Most gets caught in slash and micro-topo
- How much reaches the stream depends on connectivity of generating area to stream
- **Connectivity** to drainage network is thus important if <u>generated sediment</u> is going to contribute to sediment yield & get off-site

What's the biggest source for material entering the stream?

Process	Sediment generating site	Area connected to stream (ha)	Sediment generated & delivered (t)	% of total
Slope wash	Shallow dist.	n/a	n/a	n/a
	Deep dist.	0.18	2.9	2
Soil scraping	Scalped (40 mm)	0.18	60	26
Landsliding	Landslide source area	0.07 (n=9)	165	72
Totals	All sources	0.25	227.9	100

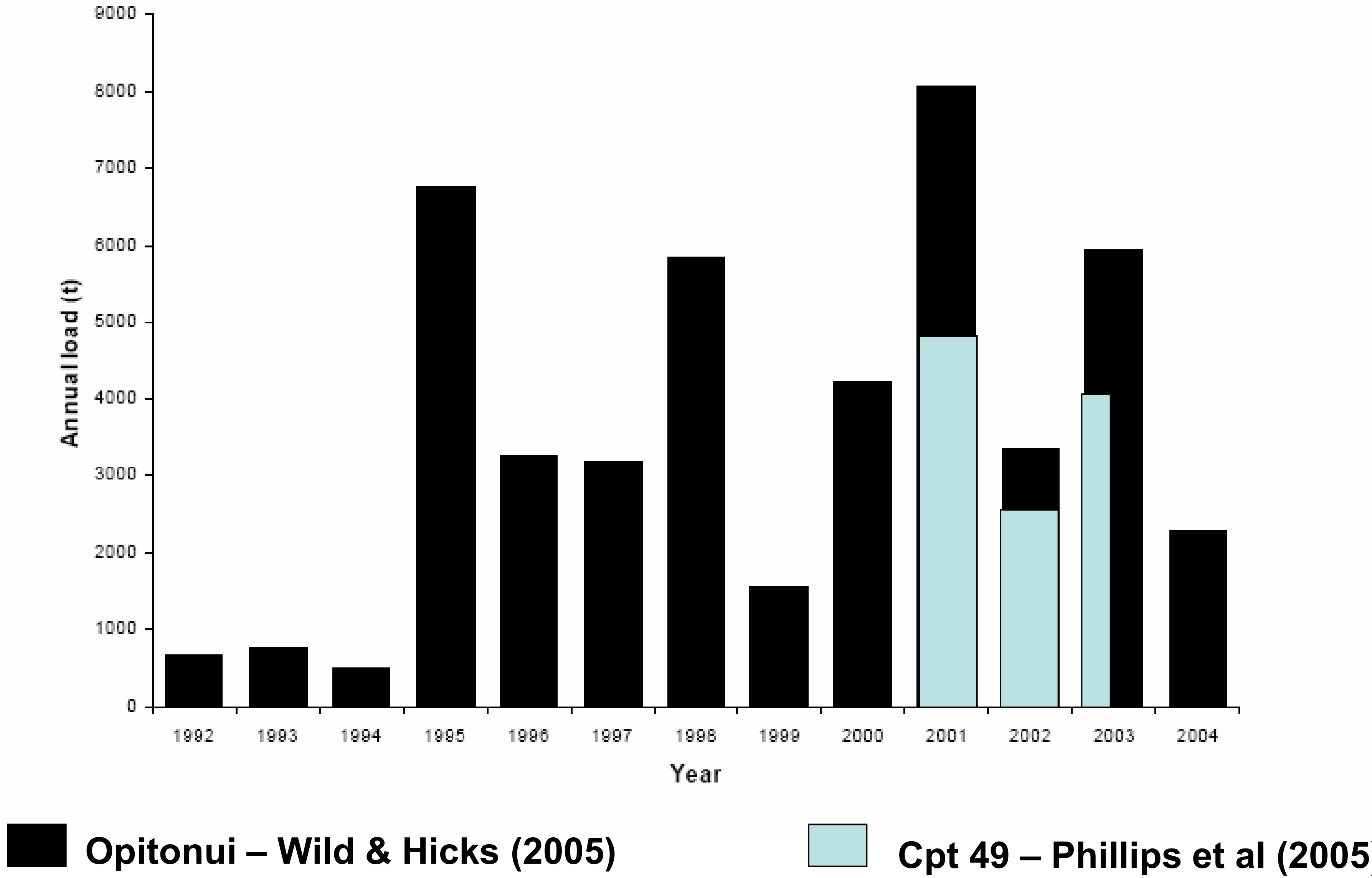
Marden, M.; Rowan, D. & Phillips, C.J. (2006)

Annual sediment yields & storms

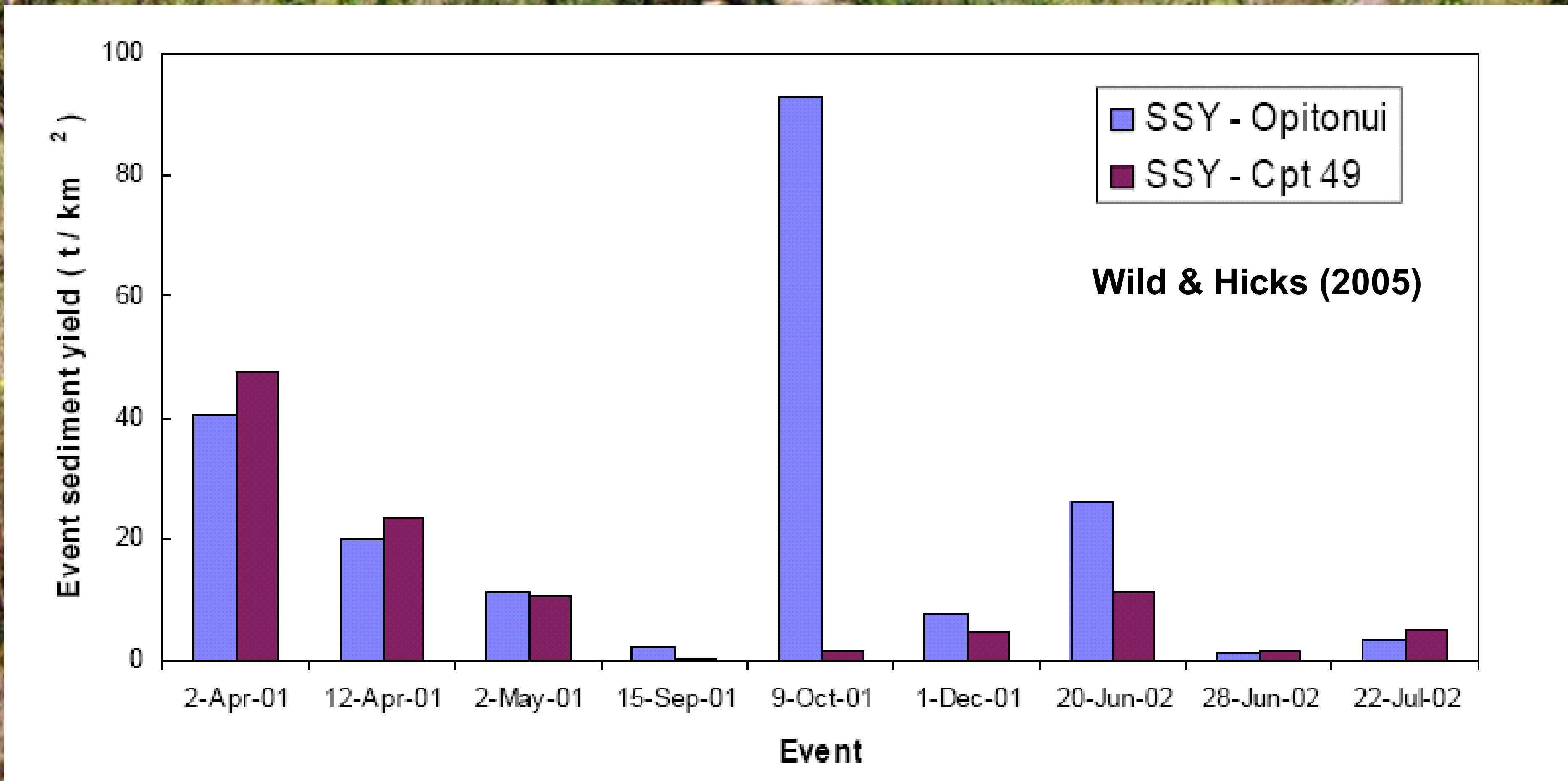
	2000 (Oct-Dec)	2001	2002	2003 (Jan-Mar)
Storms > 0.25m stage	1	11	11	6
Storms > 0.4m stage	0	4	5	3
Sediment yield (t)	1.5 (3 mths)	41	21.3	9.4 (3 mths)
Sediment yield (t km^{-2})	**4.4** (3 mths)	**116** (12 mths)	**59** (12 mths)	**26** (3 mths)

Phillips, C.J.; Marden, M.; Rowan,D. (2005)

Comparison with Opitonui

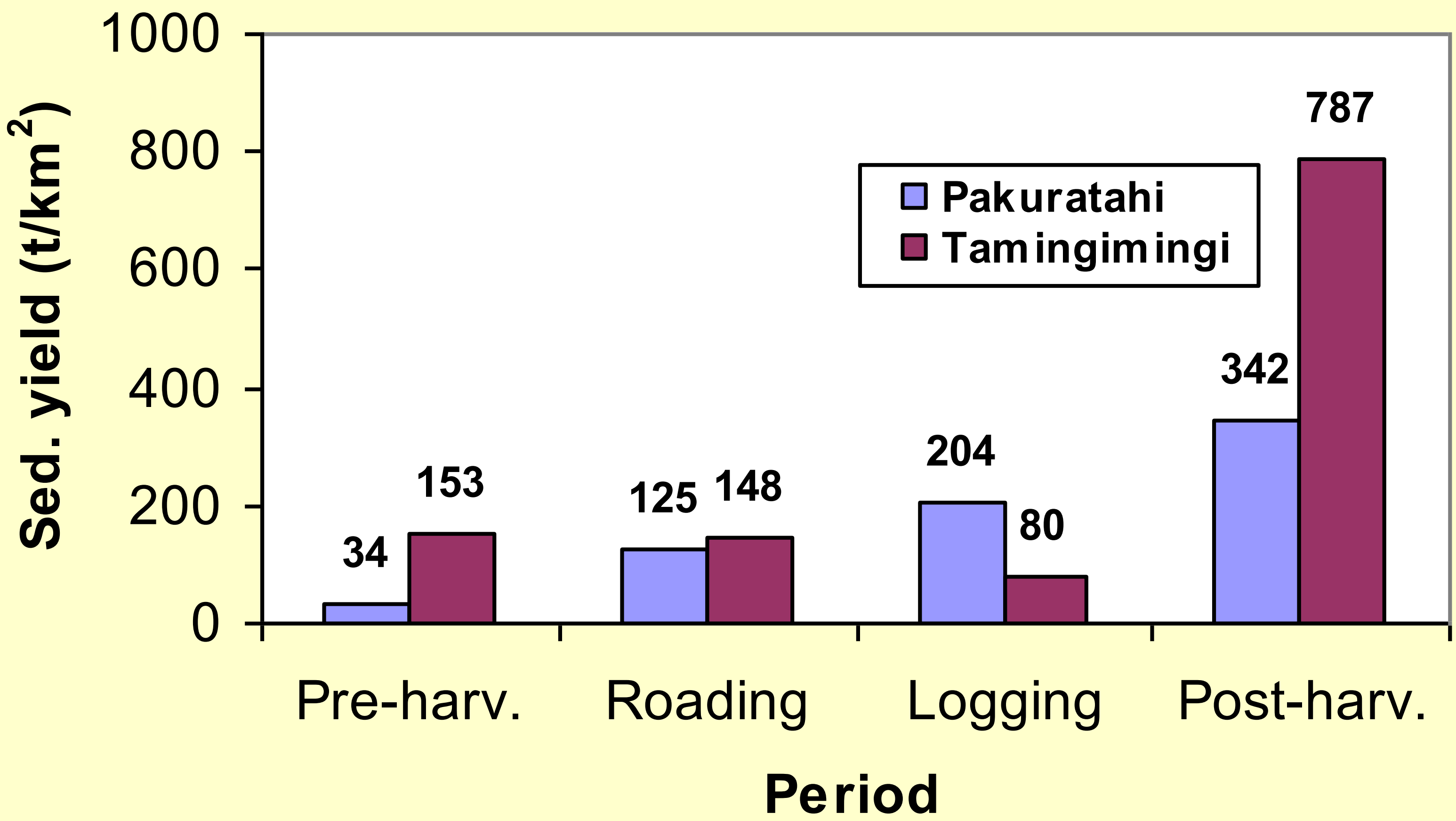


Comparison with Opitonui



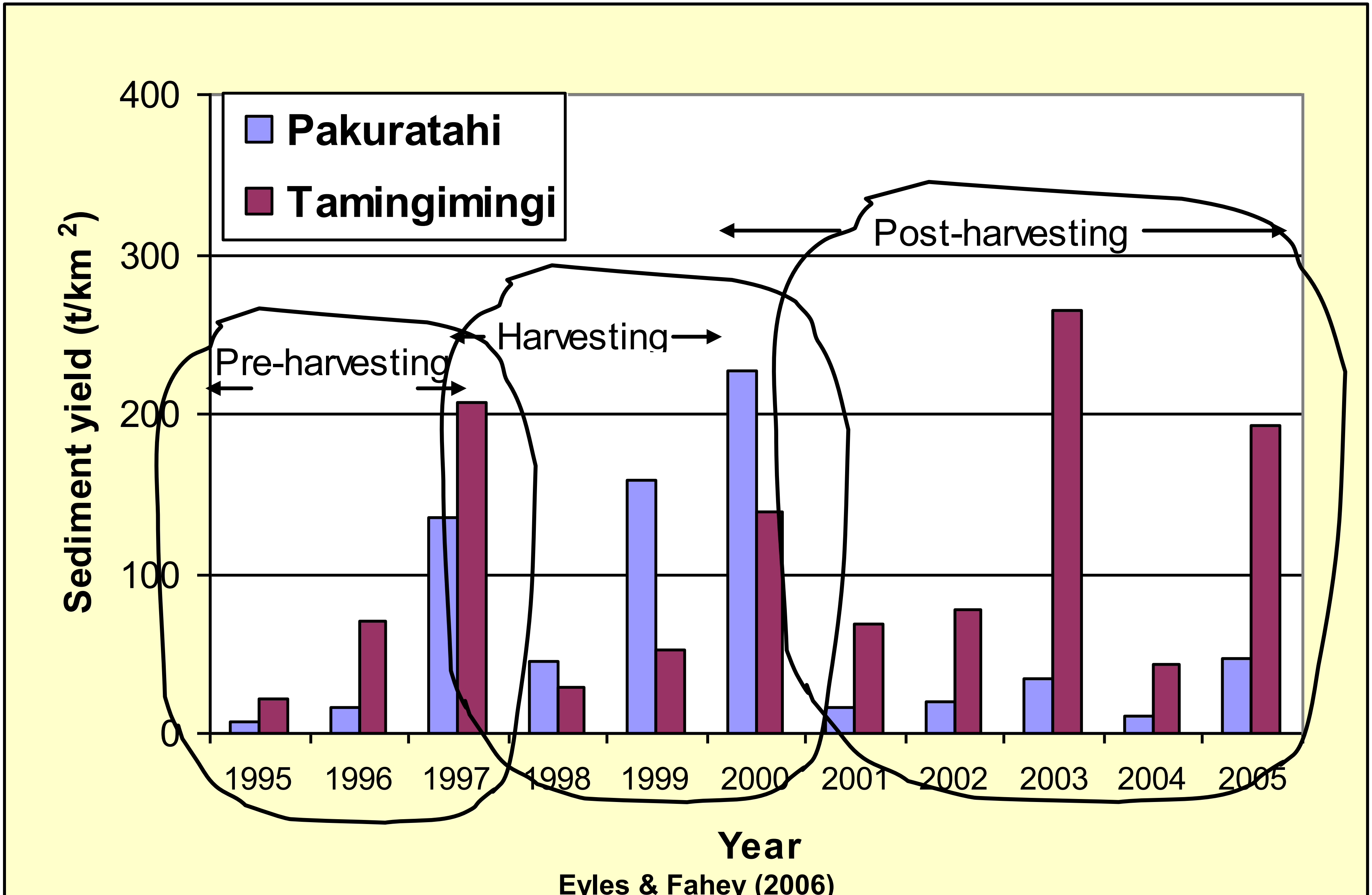
Pakuratahi - Napier

Forest   Pasture

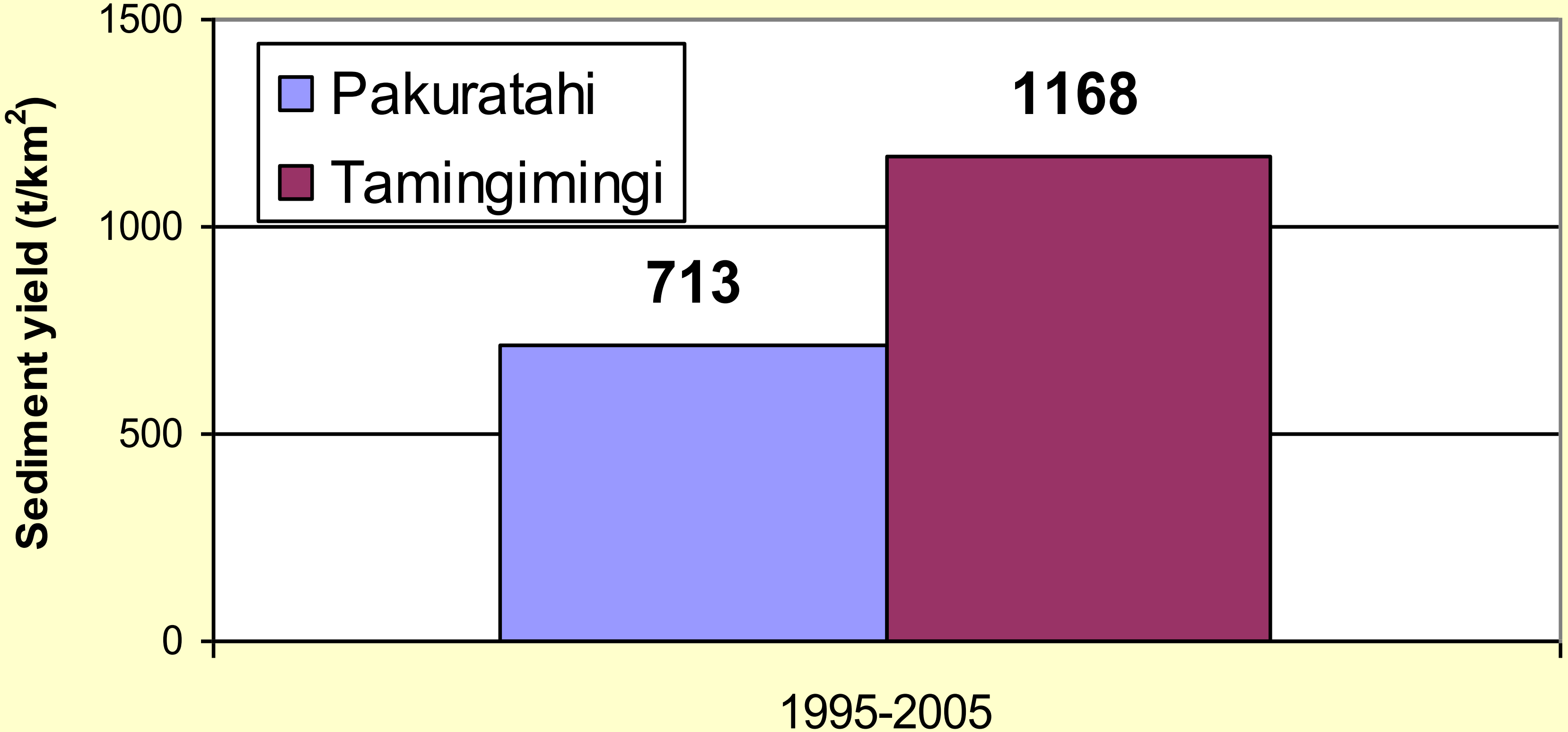


Eyles & Fahey (2006)

Sediment yield by year



Land use comparison



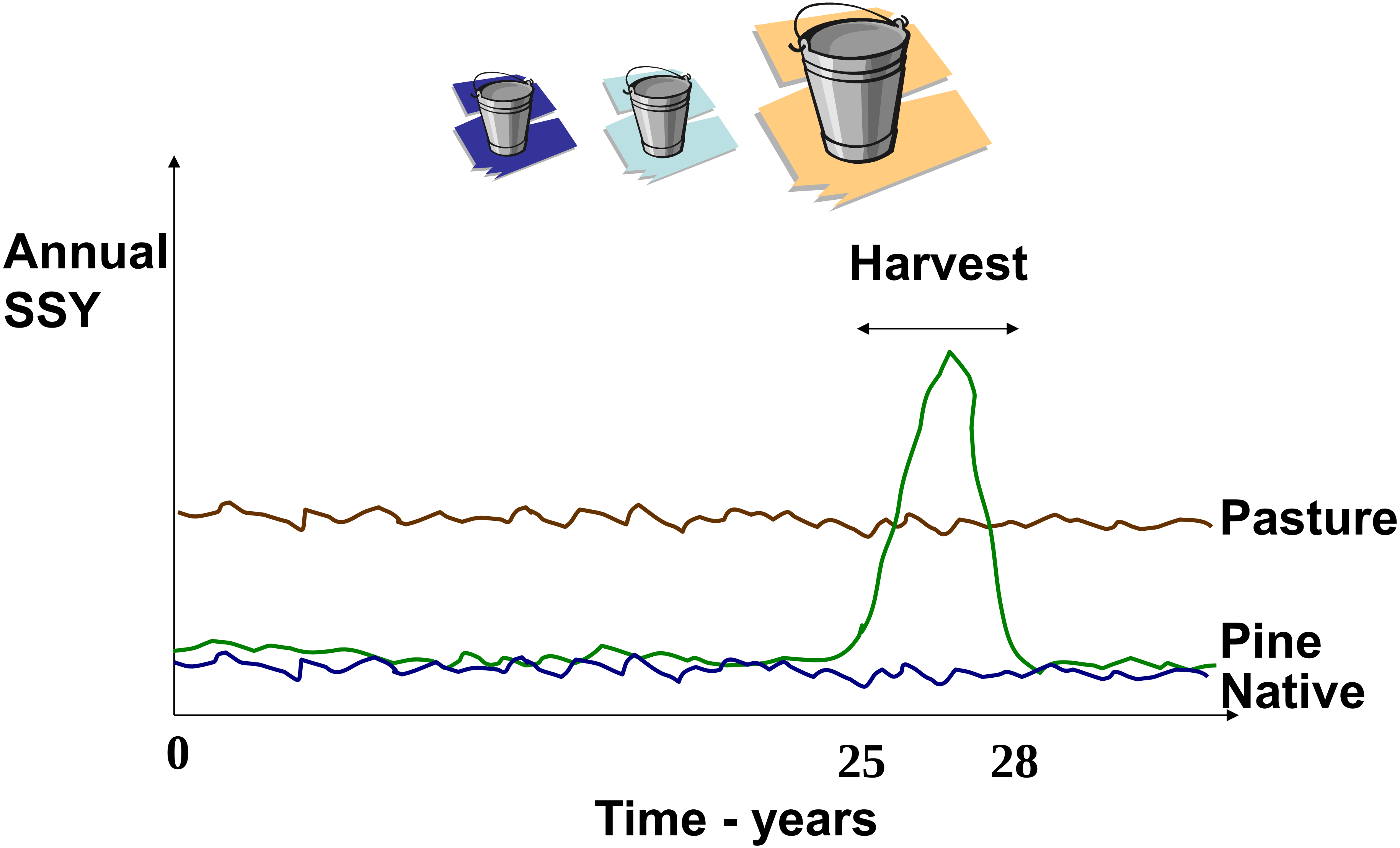
Eyles & Fahey (2006)

Post-harvest sediment yields

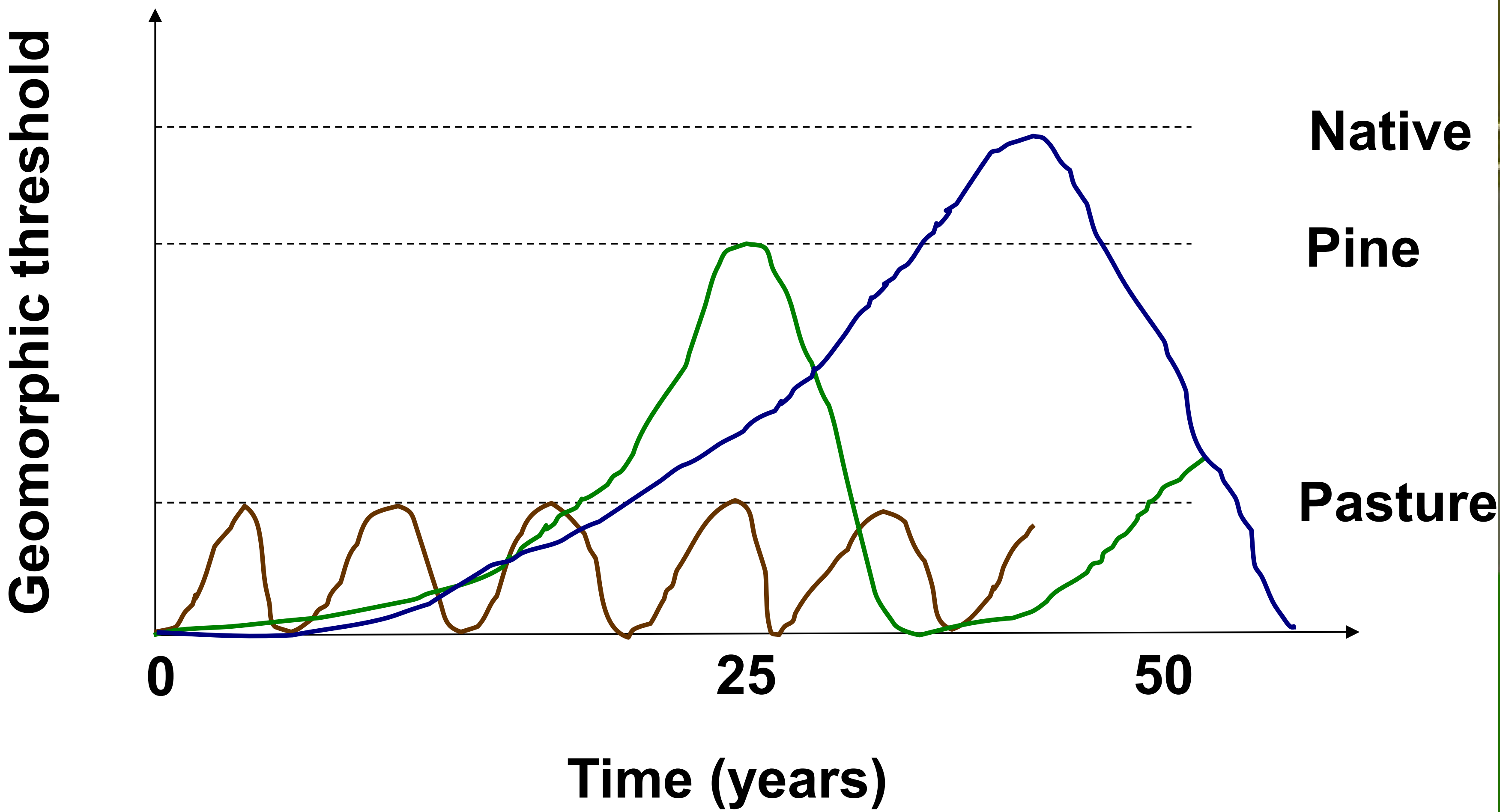
Where	Annual yield t/km²/y	Reference
Maimai (native) - West Coast	**80 - 450**	O'Loughlin et al. (1980)
Glenbervie - Northland	**46**	Hicks & Harmsworth (1989)
Pakuratahi - Hawke's Bay	**18 - 112**	Fahey et al (2003)
Motueka - various Nelson	**21 - 148**	Hewitt (various 2001-2002)
Coromandel - Whangapoua	**59 - 116**	This study Phillips et al (2005)
Coromandel - Opitonui	**10 - 279**	Wild & Hicks (2005)

10's to low 100's $t/km^2/y$

Land use & SSY - Simple view



Why?
Differing storm thresholds



Increased storminess – real or not?

So…. what can we do about it?

1. **Stop sediment being generated**
2. **Break the connection - intercept it before it gets to stream**
3. **Get good numbers – more investigations & research**
4. **Be pro-active rather than reactive – try, share & then tell**

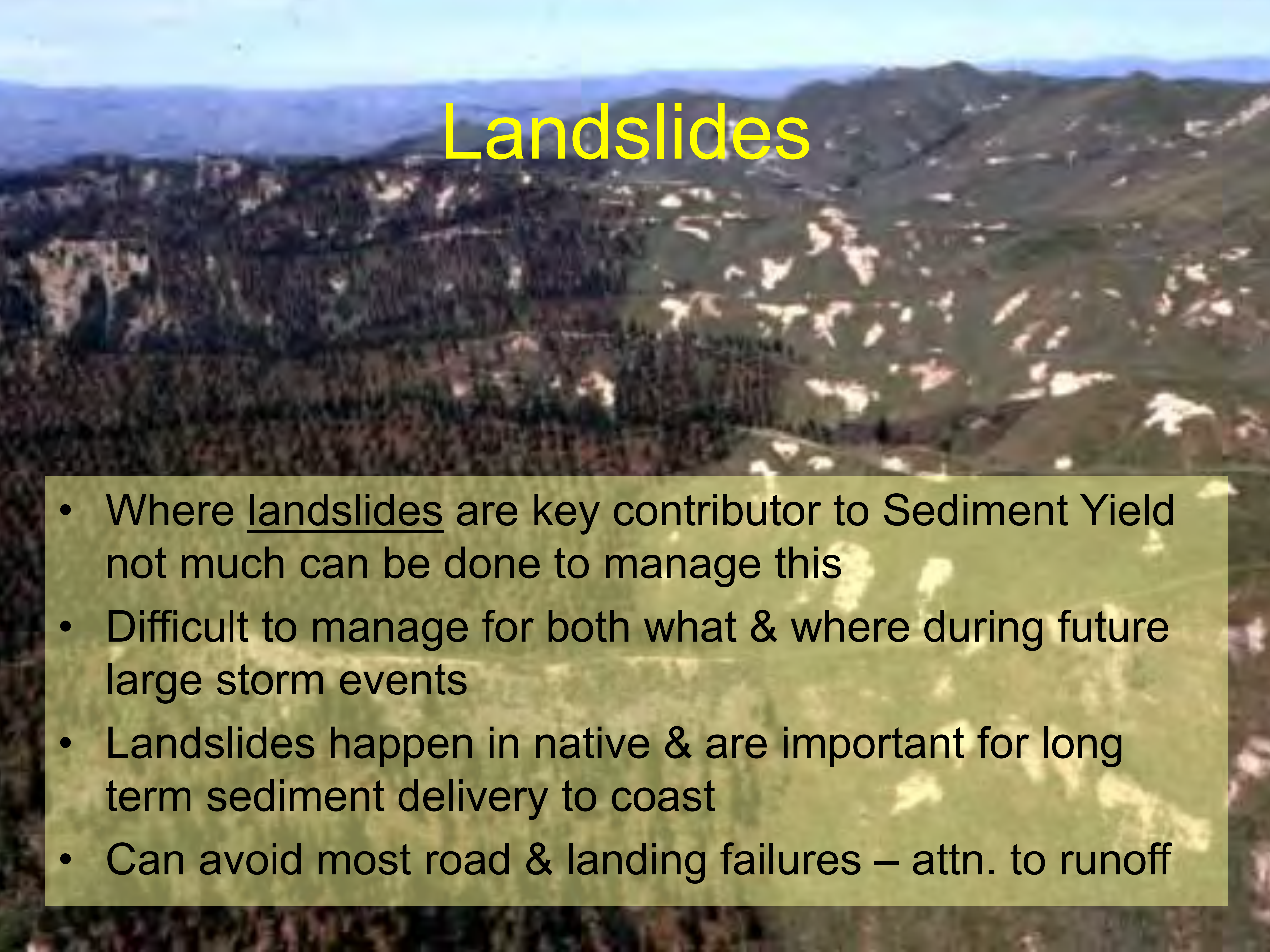
Big storms on the Coromandel

- 1971
- 1995
- Ohui - 1999
- Last year – 2005 April
- This year – April 2006
- Next year??? – you bet
- Fact of life – can’t control the weather
- Hard to control geomorphic “natural” erosion

It will flood!

General conclusion

- storm characteristics are similar to previous landslide-initiating events in the Coromandel and elsewhere in NZ
- level of damage sustained within forested areas is comparable to other storm events
- cutover is more vulnerable to storm-initiated landslides than standing forest


Landslides
• Where landslides are key contributor to Sediment Yield not much can be done to manage this
• Difficult to manage for both what & where during future large storm events
• Landslides happen in native & are important for long term sediment delivery to coast
• Can avoid most road & landing failures – attn. to runoff

Roads

- Use E&SC techniques
- Armour the water table
- Use sediment traps
- Know where the H_20 goes
- Get metal on road surface
- Don’t drive in the wet


Riparian buffers – do they work?
2 examples

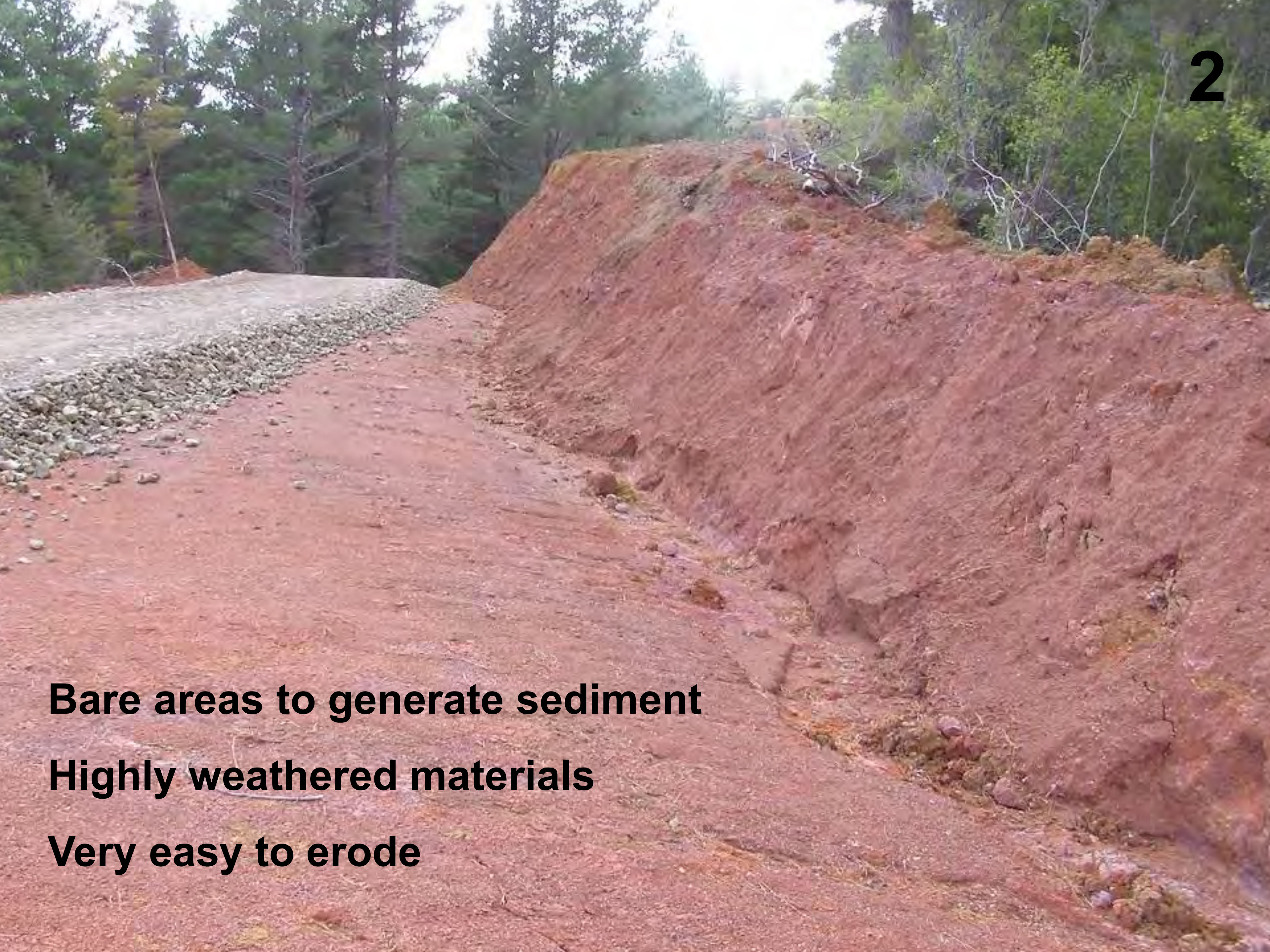

1
Lotsa bare areas to generate sediment
Steep topography


1
Sediment trap full
“Huge” native buffer
Very steep topography into stream

1

Coarse sediment drops out

but sediment will often go <u>through</u> the buffer into stream


2
Bare areas to generate sediment
Highly weathered materials
Very easy to erode

Sediment will often go <u>through</u> the buffer into stream

Slope is a key factor

Micro-topography also impt.

Take home messages

- Surface erosion small cf landsliding & scalping
- Most sediment generated in first 12 months
- Most sediment doesn’t travel far from generation site
- Annual or > storms create & shift most sediment
- Landslides key contributor to Sediment Yield - Coromandel
- Not much can be done to reduce or manage this
- Landslides happen in native & are important for long term sediment delivery to coast

Take home messages cont….

- Annual SSY at Whangapoua & Pakuratahi similar to other parts of NZ
  - 10’s -100’s t/km^2/y
- Connectivity of source to streams **THE** most critical factor for SSY –> cut the connection reduce the sediment yield
- Increased sediment yield at harvest time is a fact of life!
- The key question is: can we improve on this?
- Yes - gains will come from improved source control & runoff management and will cost, ….. BUT
- will NOT be able to stop most landslides occurring.


"One good conversation can shift the direction of change forever"
- Linda Lambert
(Author & founder of Center for Educational Leadership
at California State University)