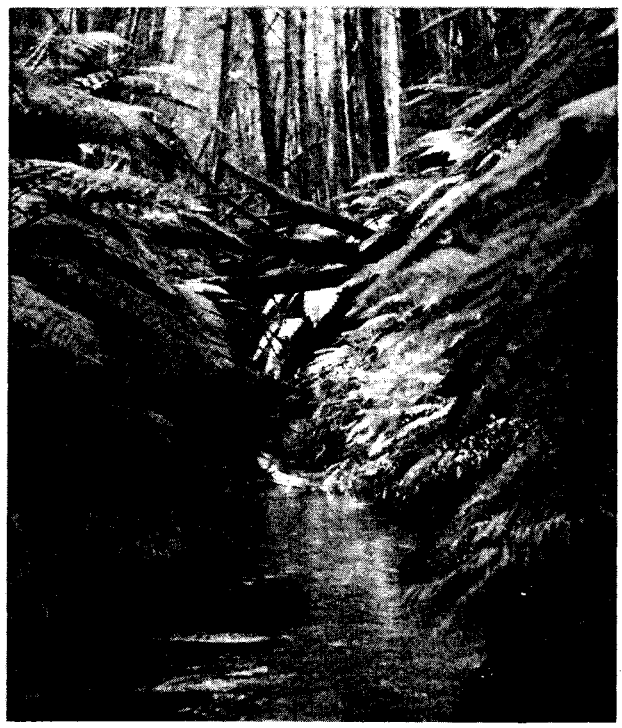
LOGGING INDUSTRY RESEARCH ASSOCIATION

PROTECTION LOGGING CASE STUDY 3



The requirements for environmental protection procedures during streamside logging are becoming increasingly important. A series of case studies aimed at investigating methods, costs and benefits for protective measures is being conducted by LIRA.

This report covers the most recent study where the emphasis was on determining the effect on the cost and production of protective felling compared with normal logging methods, and the relative benefits arising from the two methods. Logging was carried out by contractor Sonny Bolstad in mature Radiata along the banks of the Mangatiti Stream in Southern Kaingaroa Forest. Kaingaroa Logging Company (KLC) personnel conducted work studies on the logging operations and the Forest Research Institute (FRI) monitored the physical condition of stream banks and stream water quality.

← *Fig.1: Pre Logging.*
Photo by D. Neary, F.R.I.

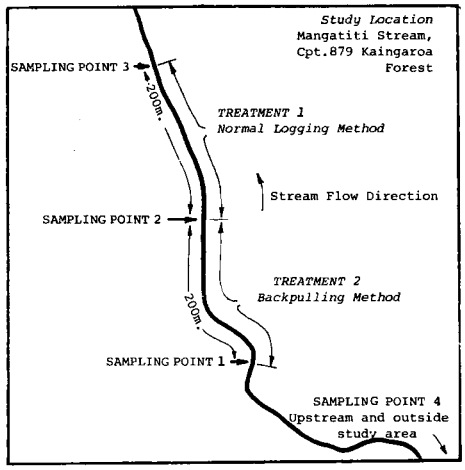
OBJECTIVES OF THIS TRIAL WERE:

- To compare the productivity and costs of conventional felling of trees adjacent to the stream with a back-pulling operation.
- To compare extraction production of streamside logging with a normal clearfelling operation.
- To assess the impact of two streamside logging methods on stream quality and streambank condition.

ACKNOWLEDGEMENTS: LIRA acknowledges the co-operation and assistance of Mr Sonny Bolstad and logging crew; Messrs Bryce Heard and Chris Baigent of KLC for organising the trial; Mr Ray Giddens of KLC for carrying out the work study; and Dr Dan Neary and Mr Pat Hodgkiss of Soils & Site Group, FRI, for the stream survey and water quality analysis.

Study Layout:

This study was conducted in compartment 879 Kaingaroa Forest where the Mangatiti Stream (a tributary of the Rangitaiki River) flowed through a stand of mature Radiata pine. In the trial location the Mangatiti is



moderate to steeply incised into the pumice and ash of the Kaingaroa Plateau, has a fairly gentle gradient, varies in width from 1 to 5 m. and has a depth ranging from 0.5 to 2.0 m. Two 200 m. treatments were set out for the trial. In treatment 1 the down-stream section, the normal felling procedure for a stream of this size was carried out with the trees felled according to their lean and those which fell across the stream were skidded out. In treatment 2, the upstream section, all trees were either felled parallel to the stream or back-pulled away and thus prevented from falling into or across the stream.

← *Fig.2: Map showing study layout.*

STREAM ASSESSMENTS:

An assessment of the impact of logging on the stream was carried out by measuring three stream characteristics before, during, and after logging. These were:

1. Water quality (potassium, conductivity, and suspended sediment).
2. The amount of tree debris in the stream.
3. Source areas of sediment.

Water quality was checked by monitoring the stream at four sampling points *(see Fig.2)*. Samples were collected once weekly for a month prior to logging and three times daily during logging.

A "stream condition" survey was conducted in the two treatments prior to logging. Pre-logging coarse organic debris, such as old Radiata windthrow, in the stream was recorded and classified according to age, diameter, bank of origin, and position in the stream. Potential sources of sediment within 5 m. of the water's edge were also recorded by their exposed soil area and distance from the stream.

LOGGING METHODS:

CONVENTIONAL FELLING METHOD: All trees on either side of the stream in the treatment area that would normally have fallen across the stream by free falling had been left. Two fallers working on separate felling faces were able to reduce the number of trees falling across the stream due to opportune wind direction. The bulk of the debris that entered the stream during this phase came mostly from standing dead trees or from live stems standing some distance from the stream, both of which shattered on impact when felled across the stream bank. Live trees close to the stream fell from bank to bank without shattering although they did contribute to considerable tree ferns being knocked into the stream.

PROTECTION FELLING METHOD: In this treatment, trees were back-pulled from the stream using an Allis Chalmers HD6 tractor and operator, a faller, plus one man for placing the rope. Initially a ladder was used to aid setting the chokers at the height up the tree, however this was discarded and the faller assisted the choker-setter who climbed the trees to place the rope at a suitable height. Most back-pulled trees fell parallel or up to an angle of 30° to the stream edge. There was a tendency for some trees to whip and slide towards the stream after felling on to other trees lying parallel and

near to the stream. Standing Dead trees close to the stream were a safety hazard if back-pulling was attempted and therefore these were felled in their direction of lean. Some of these fell into the stream.

BREAKING-OUT AND EXTRACTION - (Both treatment areas): A Tree Farmer C8 Skidder with two men breaking-out pulled logs to adjacent landings following each of the felling phases. The work study on this phase of the operation gave a production comparison with the normal clearfelling extraction of trees within the same stand. The trees that were felled in Treatment 1 across the stream were mostly head-pulled whereas the trees back-pulled parallel or at an angle to the stream were butt-pulled. Some of the top section and some shattered sections of the butt-pulled trees tended to slide and whip on other trees as they were being turned thus falling into the stream and damaging streamside vegetation..

Study Results: *(Expressed in Observed Time)*

A = Felling Treatment 1 (Normal Method)
One Bushman felling - 1.24 mins/tree or 48 trees/operating hour.
B = Felling Treatment 2 (Back-pulling Method)
i) One Bushman felling - 2.64 mins/tree or 23 trees/operating hour.
ii) One Bushman attach choker - 2.76 mins/tree.
iii) Tractor Activity.

OPERATOR'S ACTIVITY	% of time			
	A	Bi	Bii	Biii
Scarf and Back-cut	62	40		
Wait for tree to fall	8	7		
Assist position choker		21		
Walk next tree / inspect fall direction	11	3	3	
Cut sloven	2	1		
Wait other Bushman/men		11	38	40
Position choker on tree			20	
Position winch rope, attach choker			7	
Saw contingencies: shift gear, cut slash, etc.	17	17		
Wait: tractor positioning			21	
Detaching choker			11	
Clearing tracks for positioning				22
Position tractor				10
Winch tree over				20
Planning operating sequence				8
TOTAL:	100	100	100	100

BREAKING OUT AND EXTRACTION: *(Stump to skid in observed minutes)*

	Normal Clearfell Operation	Streamside Operation (Both Treatments)
Cycle Time (160 m. haul distance)	4.27 mins.	3.95 mins.
Average Drag Size	6.7 m^3.	4.6 m^3.
Average Number of Chokers used per Drag	5.6	3.5

Cycle time for the streamside extraction was 8% faster than the normal operation because:
- faster positioning for breakout (tracks were bladed to the heads),
- stropping of heads is quicker than butts,
- breakout and winch is quicker due to fewer strops.

Travelling loaded from stream edge was slower however due to head-pulling and the contingencies were greater as more time was spent blading tracks with the skidder. The 45% increase in the volume per cycle for the normal extraction over the streamside extraction represented the difference between head and butt-pulling.

STREAM ASSESSMENT RESULTS:

Water Quality - prior to logging all water sampling sites were essentially similar in nature although suspended sediment had considerable variation. During logging, suspended sediment showed the most change, particularly at sampling point 3 where the extreme maximum was 21 times higher than the pre-logging maximum.

Coarse organic debris surveyed prior to logging consisted primarily of old Radiata with Treatment 1 having 63 pieces, and 42 pieces in Treatment 2. Following logging an additional 11 tree-pieces were in the Treatment 2 section surveyed, whereas in Treatment 1, a large number of tops, branches, stems, and tree ferns, created a continuous tangle which made a detailed count impossible.

Sediment sources prior to logging were minimal with stream banks in a stable condition. In the normal felling treatment the exposure of erosion-prone material increased 31 times from 4 to 156 m^2, whereas in Treatment 2 where protective measures were taken the increase was only 28% (or an additional 15 m^2).

Photo by L.I.R.A.

Fig.3: Treatment 1 After Logging

Conclusions:

Felling costs incurred by protective measures increased considerably. One man felling 48 trees per operating hour would cost approx.$0.17 per tree, whereas back-pulling with two men and tractor and operator at 23 trees per operating hour approximates $1.65 per tree, or almost 10 times more expensive. Extraction production rate from a normal logging situation was some 34% higher than adjacent to the streamside.

It is difficult to assign monetary values to the benefits to the Mangatiti Stream that resulted from the protective measure taken. Water quality in Treatment 2 did not change during logging and the amount of woody material falling into the stream was greatly reduced. In Treatment 1 however, suspended sediments rose to five times pre-logging levels and the stream which had been relatively clear before logging was choked by a nearly continuous tangle of organic debris. Treatment 1 had a 10-times greater area of potentially erodable bare soil than Treatment 2 after logging was completed.

Sediment derived from logging in streams such as the Mangatiti which are important tributaries of the Rangitaiki Catchment can affect aquatic life in many ways. The greatest effects however are the reduction in dissolved oxygen which occurs when organic material begins to decompose in water and the blanketing of habitat and food sources with sediment.

For a final comparison of the back-pulling and normal streamside treatments a suitable method and cost must be determined for the removal of debris from the stream in Treatment 1, along with analysing further effects to the stream quality should they occur. LIRA is endeavouring to organise this aspect.

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