

Summary Report

**1840/1850 Roads and Slope
Watershed Rehabilitation Unit**

84-4

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Introduction

The 1840/1850 roads and slope, Unit 84-4, is a side bank hillslope which drains into Redwood Creek along the east slope of Bridge Ridge, and is located between 13 and 15 miles upstream from Orick. The unit boundaries encompass 890 acres and 6.3 miles of logging haul roads, including the 1840, 1841, 1842 and 1850 roads in their entirety, and a section of the 1800 road (Map A and B).

Total relief on this unit is 1,760 feet, ranging from 240 feet along Redwood Creek, to 2,000 feet along the M-2-1-1 road. Slopes tend to be gentle to moderate (20-45%) above the 1800 road with a distinct tread and riser profile. Below the 1800 road the slopes become more uniform and steepen considerably downslope towards the inner gorge of Redwood Creek, averaging between 35 and 65+ percent. Drainages along this hillslope are linear first- and second-order intermittent-perennial streams draining directly into Redwood Creek. Drainage areas average 60 acres along the 1840 road and 83 acres along the 1850 road.

The unit is underlain by the schist of Redwood Creek, part of the Franciscan Assemblage (Hardin, et al, 1982). Soil types in this unit have a well defined distribution pattern. The majority of deep well developed red soils (Trailhead and Fortyfour) occur on the gentle to moderate upper slopes along the 1840 road and slope. Elfcreek soils were also found along the 1840 road at the southern end. The soils of the middle to lower slopes, between the 1840 road and Redwood Creek, are predominantly Coppercreek and Slidecreek. Small pockets of Devils creek soil occur along wet cutbank slumps, and along the lower section of the 1850 road. Soils information was obtained from the in-house report by J. Popenoe, et al., June 1984, "Soils of the 1840 and 1850 Roads, East Slope of Bridge Ridge."

In summary, the grand total rehabilitation project cost was \$73,304.14 (Table 1). Of this total, heavy equipment and labor intensive work accounted for 71 percent and 7 percent, respectively. A total of 4.6 miles of haul roads were eliminated from further rehabilitation. Of this total, 2.8 miles were actually treated: 1.6 miles of the 1840; .4 mile of the 1841; and .8 mile of the 1850. A total of 22,430 yd³ of channel fill was excavated from 23 haul road stream crossings, and 3,785 yd³ from 30 skid trail stream crossings (Tables 1A and 2).

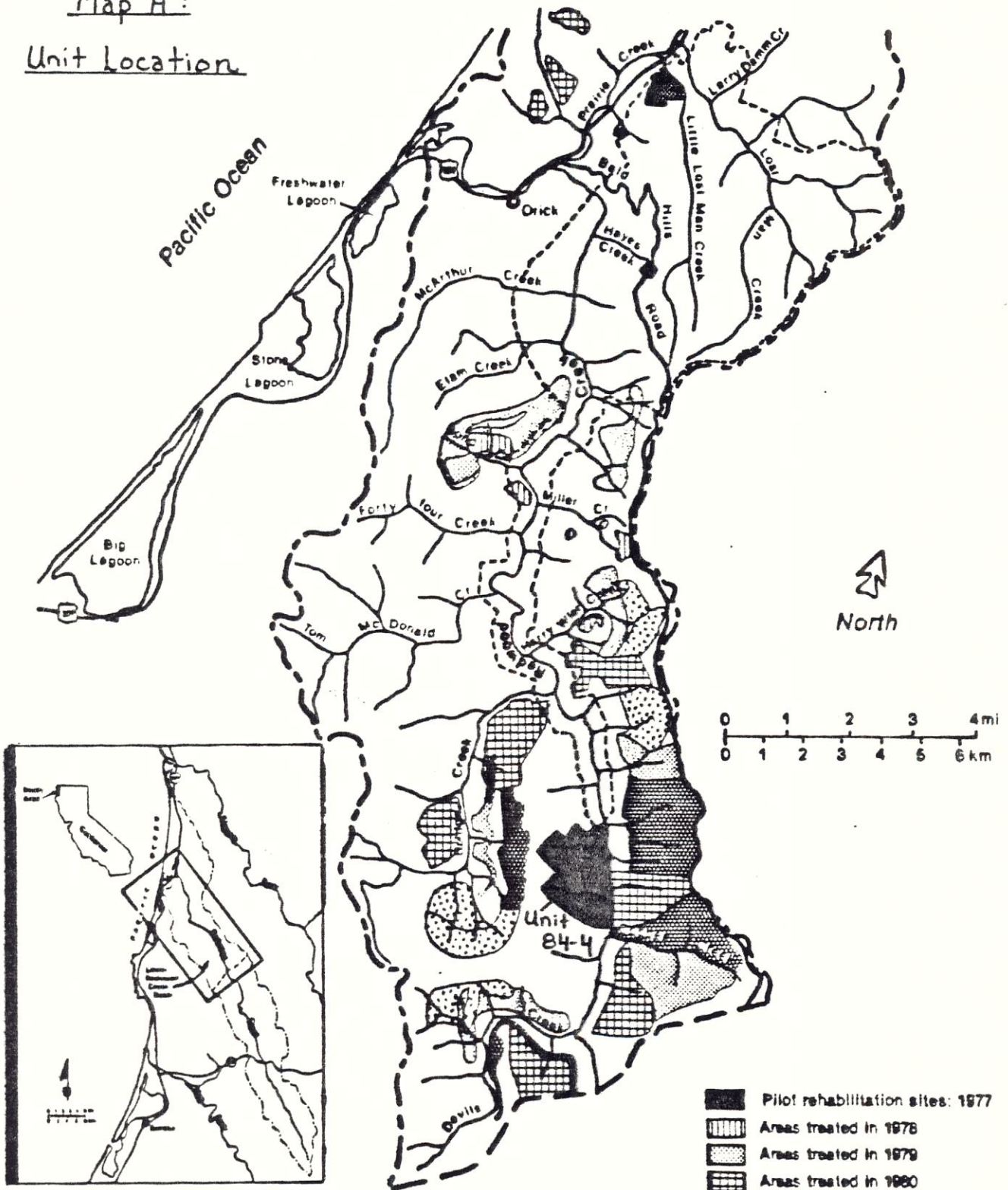
Timber Harvest and Erosion History

Timber harvest and haul road construction activities occurred during two time periods: 1960-1966 and 1974-1977. During August, 1958, the 1800 road was being pioneered from the Redwood Creek crossing up to Elf Creek, but was not completed through Unit 84-4 until 1960. Between 1960 and 1966, 75 percent (670 acres) of the unit was selectively logged and yarded by tractors (some areas twice), and 5.2 miles of logging haul roads were

84-4: 1840 and 1850 Roads and Slope Watershed Rehabilitation Unit

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Map A:
Unit Location



WATERSHED REHABILITATION PROJECTS IN REDWOOD NATIONAL PARK

National Park Service/United States Department of the Interior

3

M-2-1-1 RD

MAP B 84-4

1840/1850 Roads and Slope

Unit Boundary

Scale 1:12000

Slide Case

REDWOOD CREEK

11

LITTLE BLUE COW

1200

1800 62

1650 R.D.

RECORDED

4.7.5.1.4

1849 AD

1841

1600

129

1999

33

1000

2

1

2499

TABLE 1

SUMMARY COSTS OF EROSION CONTROL REHABILITATION WORK
84-4

Task	Geologist & Technician	RNP Employees Laborers	Heavy Equipment Rentals	Materials	Redwoods United	Total Task Costs	% Total Cost	Phase Totals	Phase %
Mapping	\$ 7,277.00	--	--	--	--	\$ 7,277.00	10	\$11,728.00	16
Prescription	4,451.00	--	--	--	--	4,451.00	6		
Primary Treatment	5,166.30 (supervision)	--	\$41,141.25	--	--	46,307.55	63		
Secondary Treatment	--	--	116.25	--	--	116.25	1/2	51,954.80	71
Miscellaneous	--	--	5,531.00	--	--	5,531.00	7 1/2		
Travel	--	\$ 284.34	--	--	\$ 446.25	730.59	1		
Secondary Treatment	--	1,052.55	--	--	952.00	2,004.55	3	5,419.34	7
Miscellaneous	--	1,988.20	--	--	--	1,988.20	2		
Materials (Straw)	--	--	--	\$696.00	--	696.00	1		
Cost Analysis and Report	4,202.00	--	--	--	--	4,202.00	6	4,202.00	6
TOTALS:	\$21,096.30	\$3,325.09	\$46,788.50	\$696.00	\$1,398.25	\$73,304.14	--	\$73,304.14	--
% OF TOTAL:	29%	4%	64%	1%	2%				4

TABLE 1A
REHABILITATION WORK SUMMARY
84-4

Total site cost			\$73,304.14
Heavy equipment cost	\$46,788.50 ¹	64%	
Labor intensive cost	5,419.34	7%	
Total length of haul roads treated.			2.8 miles
and haul roads eliminated from rehab.			4.6 miles
Haul road crossings excavated			23 crossings
			22,430 yd ³
Skid trail crossings excavated			30 crossings
			3,785 yd ³
Landings pulled back			3 landings
(all associated with haul road crossings)			
Cross road drains - total number ¹			80 XRD's
Unit boundaries encompass			890 acres

¹ excludes lowboy costs.

TABLE 2

SUMMARY OF AVERAGE COSTS OF HEAVY EQUIPMENT TREATMENTS

84-4

6

Average Costs:

	Treatment	# of Work-sites	Total Quantity	Total Cost	Work-site	Quantity	Rate yd ³ /hr
Primary Treatments	Opening						
	Haul roads & skid trails	--	--	\$ 1,125.00 1,143.75	--	--	--
	Haul road crossings	23	22,430 yd ³	31,260.75	\$1,359	\$1.39/yd ³	55yd ³ /hr
	Skid trail crossings	30	3,785 yd ³	6,453.00 ¹	215	1.70/yd ³	45yd ³ /hr ⁵
	Landings ²	3	--	--	--	--	--
	Waterbars and inboard ditches	80	--	1,158.75 ³	7.97/WB ³	.14/LF of WB ³	--
	Total Primary Treatments =			\$41,141.25			
Secondary Treatment	Distribution of straw mulch	--	--	\$ 116.25	--	--	--
Miscellaneous	Travel	--	--	2,250.75	--	--	--
	Standby without operator	--	--	246.50	--	--	--
	Misc. work ⁴	--	--	3,033.75	--	--	--
	Total Miscellaneous Costs =			\$5,531.00			

TOTAL HEAVY EQUIPMENT = \$46,788.50⁶

1 Does not include access travel costs, see Table 14.

2 Landing outsloping costs are included in adjacent haul road crossing excavation costs, see Tables 4 and 9.

3 Waterbar costs are only for 24 out of the 80. These 24 were on the 1840 road along the lower 1/4 mile section and were easily timed. Unit costs are based only on these 24.

4 Miscellaneous cost Table 14 shows all misc. categories and cost breakdown.

5 See Tables 10, 11 and 12 for explanation on volumes and rates for the skid trail crossings.

6 Does not include lowboy costs since the equipment was used on more than one

constructed. Between 1974 and 1977, 37 percent (325 acres) of the unit was relogged (206 acres) or newly logged (119 acres), and the remaining 1.1 mile of haul road was completed. During this period all harvest areas were clearcut; most yarding was done by tractors, only 12 acres were cable yarded. Only 12 percent (102 acres) of the unit remains as old growth redwood, and these two patches are located between the 1850 Road and Redwood Creek (Map C).

Erosion features on Unit 84-4 were haul road and skid trail stream crossing fill failures (ranging in size from 5 to 500 yd³ of eroded material), diverted stream flow gullies (ranging in hillslope length from 50 to 1,000 feet), and major stream bank landslides along Redwood Creek (Map D). The majority of these features occurred between 1960 and 1966, and were most likely a result of the December 22, 1964 flood. (These features are visible for the first time on the August 1965 air photos.) Minimal erosion occurred during the 1972 and 1975 storm events.

Haul road stream crossings along the 1840 and 1850 roads were all humboldt-type crossings which were functioning to some degree. Six of these crossings (L-1, L-11, L-16, L-35, T-48, and T-90) had failed in the past, resulting in approximately 1,300 yd³ of eroded fill material. Potential fill failures existed on all 17 of the remaining intact haul road crossings. During the logging activities between 1974 and 1977, 24-inch culverts were installed along the 1850 road at all the stream crossings. These culverts were all undersized and there was still a potential for stream diversion at each due to the constant 7% grade along the 1850 road. The crossings along the 1840 road had little diversion potential due to the road being on contour most of its length.

The stream crossings on the 1841 and 1842 spur roads had diversion potentials when constructed, but were dished out by Simpson Timber Company following their 1974/75 clear cutting activities. These crossings have undergone some erosional adjustments, but appear stable and resemble earlier Redwood National Park rehabilitation efforts. In addition, these roads were thoroughly waterbarred.

The 1800 road and M-7-5 road were connected between 1975 and 1978, resulting in additional erosion. Misplaced culverts caused two major gullies to form between the 1800 and 1850 roads. Several stream crossings along the 1800 road (L-32 and T-24) had failed, probably in 1964, and were later reconstructed (eroded volumes unknown). Additional flow diversions along the 1800 and 1850 roads contributed to hillslope gullying and landslides along Redwood Creek.

Skid trails crossed distinct channels numerous times; indistinct channels and swales which were not recognized as drainages were thoroughly tractorized. Potential erosion on the hillslopes existed as intact crossing fills and possible stream diversions. A total of 136 skid trail stream crossings were mapped within the

1-1AP C: Loading History

Scale: 1:12000

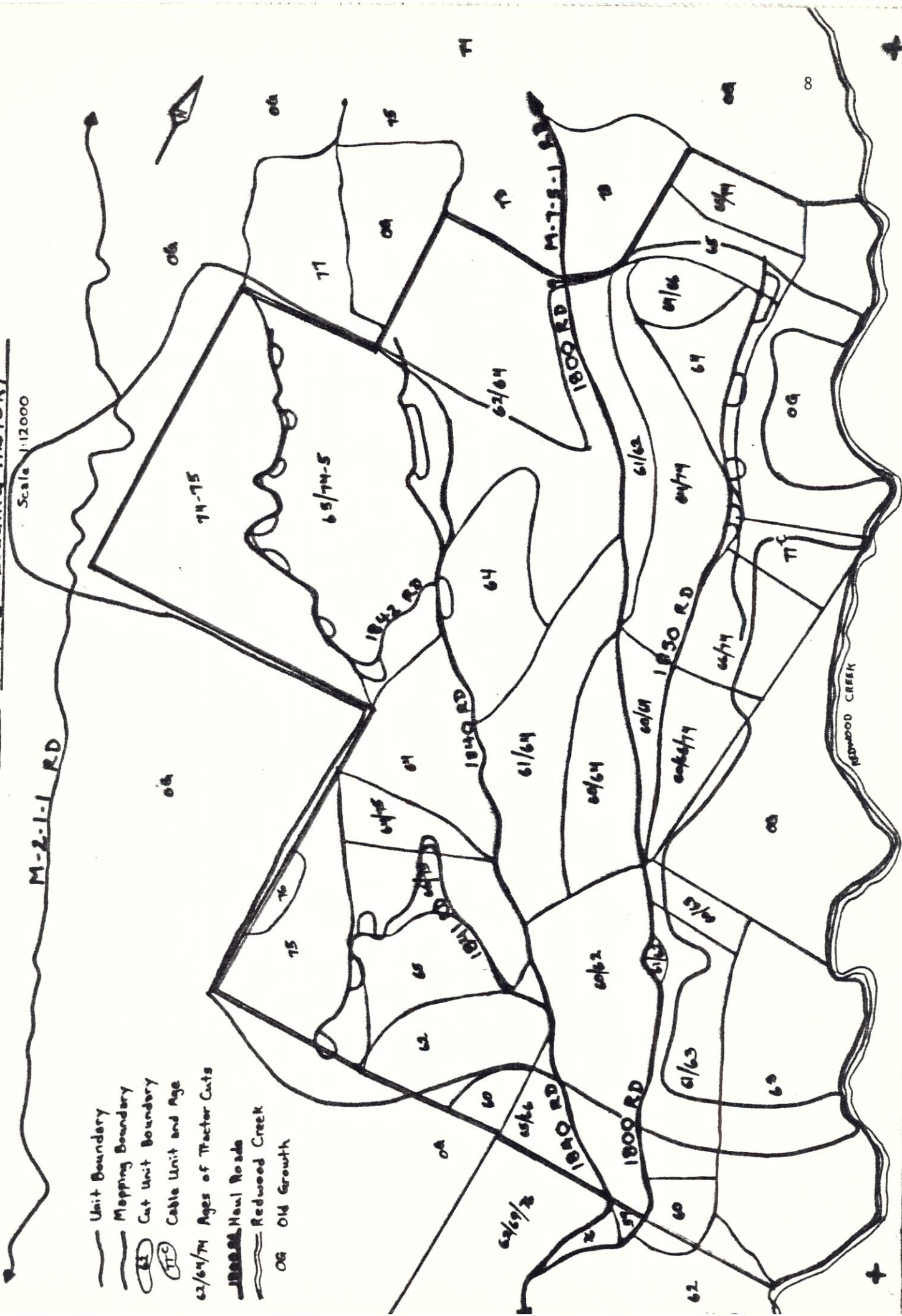
M-2-1-1 RD

Unit Boundary
Mapping Boundary
Cut Unit Boundary
Cable Unit and Age
62/64/74 Ages of Tractor Cut
Haul Road
Redwood Creek
OG Old Growth

1999-2000 Maui No 2ds

Redwood Creek

OG Old Growth



776 acres of tractor yarded slopes, with a density of one crossing per 5.7 acres. Only 30 skid trail crossings were determined to be treatable due to their active and/or potential diversions and fill failures. The remaining 106 crossings had no diversion potential and were in various stages of decay. Many were constructed over 20 years ago and probably suffered most of their erosion during the 1964 flood. They are now densely revegetated and were judged to be fairly stable. Active surface erosion (rilling) was minimal due to the waterbarring in recent cut blocks and the thick regrowth in areas logged in the 1960's.

(For complete descriptions and data on erosion features and erosion potentials for Unit 84-4, please refer to the 184 Erosion Potential forms completed during field mapping by Terry Spreiter and Louise Johnson.)

Erosion Control Rehabilitation Work

Rehabilitation Unit 84-4 contains 890 acres. Approximately 665 acres were mapped requiring 75 person days to complete (Map C shows the mapping boundary). Prescriptions, planning, and documentation required an additional 88 person days to complete. The heavy equipment work was completed between August 2 and September 20, 1984. Worksites on the 1840 road were treated starting at the north end of the road and proceeding towards the 1800 road. Slope work along the 1840 road was done in conjunction with adjacent haul road crossings. The equipment was then moved to the end of the 1850 road where slope work and haul road excavations were done simultaneously proceeding back towards the 1800 road. The last work completed was the slope work above and below the 1800 road. All worksites are located on Map D.

The equipment work on Unit 84-4 was completed by an excavator and one bulldozer. The excavator was a John Deere 690B with a 3/4 yd. bucket and bucket clamp (\$78.00/hour), owned and operated by Larry Lambert. New on the excavator this year were track rock guards to prevent the tracks from coming off when the machine was on steep, unlevel terrain. This proved to be a very cost effective improvement which eliminated all down time. The bulldozer was a Caterpillar D8H 46A with a winch, four-way hydraulic tilt blade, and 28" wide tracks (\$75.00/hour), owned and operated by Jay Franke (Twin Parks Lumber Company). Both pieces of equipment were selected based on anticipated working conditions (steep hillslopes and wet humboldt crossings), and previous experience and knowledge of equipment capabilities.

Primary erosion control treatments concentrated on features capable of delivering sediment directly to streams and ultimately to Redwood Creek. These were haul road and skid trail crossings, and unstable landings and road reaches adjacent to streams. Haul road crossings were excavated as close to their original channel configuration as possible. The general excavation technique was to use the bulldozer to dish out as much fill as possible (25-75% of the volume), and then have the excavator do the finishing

channelization work with the bulldozer assisting. No secondary treatments were performed. Rock and original organic material uncovered during the excavation were left in place as channel armor. A total of 23 haul road crossings were excavated for a cost of \$31,260.75, with an average unit cost of \$1.39/yd³ and an average excavation rate of 55 yd³/hour (Tables 4 through 9).

All skid trail crossings which had active and/or potential flow diversions and fill failures were treated (as described in the Erosion Features Section). The bulldozer first brushed the access skid trails and the crossings, and then partially excavated the crossings. Next the excavator channelized the crossing. Usually on smaller crossings (150 yd³) either the excavator or the bulldozer did the entire excavation. Thirty skid trail crossings were treated with a total cost of \$6,453.00, and an average unit cost of \$1.70/yd³ and a 45 yd³/hour average excavation rate (Table 10, 11 and 12). Access travel time costs are included in the Miscellaneous Heavy Equipment Costs, Table 14. Costs for brushing the access roads is included in Table 2, under opening skid trails.

No road ripping was performed on the site since the road surface did not have a rock layer and was well vegetated in numerous areas. Unstable road reaches (50-150 linear feet long) and landings (100-250 linear feet long) adjacent to streams were pulled back and their volumes and costs were included with the adjacent haul road crossing excavation (Table 9). Several inboard ditches were improved and some road reaches were waterbarred to disperse springflow and concentrated road and hillside runoff. Approximately 80 waterbars were installed (Table 2).

The only secondary erosion control treatment performed was the application of straw mulch to all haul road crossings and several skid trail crossings. This was completed by labor intensive crews which included Redwood National Park (RNP) and Redwoods United Inc. (RUI) laborers. The total cost was \$2,700.55 for 240 straw bales with a unit cost of \$11.25/bale (Table 15). This unit cost was higher than normal, but can be attributed to the longer distances the laborers walked to get to the worksites (up to 1 1/2 miles one way), and the smaller crews spreading the straw. Miscellaneous labor intensive tasks included brushing haul road and skid trail crossings for pre-heavy equipment surveys and photo points, and travel between Orick and the site. Miscellaneous costs totalled \$2,718.79.

Overall, the heavy equipment and techniques used to perform the erosion control rehabilitation work on Unit 84-4 worked well. Only a few problems arose which caused a change in prescriptions and techniques. Every road crossing and many skid trail crossings were flowing at the time of excavation. Because of road conditions, temporary diversions of streamflow down the inboard ditches was possible at only a couple crossings. This

TABLE 3
WORKSITE CATEGORY AND LOCATION
84-4

Worksite	CROSSINGS:		Table Location	Worksite Location
	Haul Road or (RX)	Skid Trail (SX)		
L1	RX		Extra Large	1840 Road
L2	RX		Large	1841 Road
L11	RX		Large	1840 Road
L12	RX		Medium	1841 Road
L13		SX	Extra Small	1841 Slope
L14	RX		Medium	1841 Road
L16	RX		Large	1840 Road
L19	RX	SX	Large	1840 Road
L20	RX		Medium	1840 Road
L24		SX	Extra Small	1841 Slope
L33	RX		Small	1850 Road
L34	RX		Medium	1840 Road
L35	RX		Large	1840 Road
L40	RX		Large	1840 Road
L47		SX	Extra Small	1840 Slope
L80		SX	Small	1800 Slope
L84	RX		Small	1850 Road
T1	RX		RX with Deck	1840 Road
T15		SX	Extra Small	1850 Slope
T16		SX	Extra Small	1850 Slope
T17		SX	Extra Small	1850 Slope
T29		SX	Extra Small	1850 Slope
T30		SX	Small	1850 Slope
T39/42		SX	Small	1800 Slope (below)
T40		SX	Small	1800 Slope (below)
T41		SX	Extra Small	1800 Slope (below)
T44		SX	Extra Small	1800 Slope (below)
T47		SX	Extra Small	1850 Slope
T48	RX		RX with Deck	1850 Road
T49		SX	Extra Small	1850 Slope

TABLE 3 continued
WORKSITE CATEGORY AND LOCATION
84-4

Worksite	CROSSINGS:		Table Location	Worksite Location
	Haul Road or Trail (RX)	Skid Trail (SX)		
T51	RX		Small	1850 Road
T55		SX	Small	1850 Slope
T56		SX	Extra Small	1850 Slope
T58		SX	Extra Small	1850 Slope
T60		SX	Extra Small	1850 Slope
T63	RX		Small	1850 Road
T64		SX	Extra Small	1850 Slope
T65	RX		Large	1850 Road
T67	RX		Extra Large	1850 Road
T72		SX	Extra Small	1850 Slope
T78		SX	Small	1800 Slope (above)
T80		SX	Extra Small	1800 Slope (below)
T81/92		SX	Extra Small	1800 Slope (below)
T83		SX	Extra Small	1800 Slope (below)
T84		SX	Extra Small	1800 Slope (below)
T85	RX		Small	1850 Road
T89		SX	Small	1800 Slope (above)
T90	RX		Extra Large	1850 Road
T94		SX	Extra Small	1850 Slope
T95		SX	Extra Small	1850 Slope
T96	RX		RX with Deck	1850 Road
T97		SX	Extra Small	1850 Slope
T100	RX		Small	1850 Road

TABLE 4
AVERAGE HAUL ROAD CROSSING EXCAVATION COSTS
84-4

Type of Worksite	# of Work-sites	Range: vol. fill yd ³	Equipment (%)	Range: Hours (Total)	Total Sites Cost	Average Cost/ Worksite	Range: Cost	Total Yd ³	Average Cost/ yd ³	Range: Cost/ Yd ³	Average Rate: Yd ³ /Hr.
Small (Big XRD's)	6	28-425	Bulldozer (62%) Excavator (38%)	3/4-4 1/2 (12 1/2) 1/4-3 3/4 (7 1/2)	\$ 1,522.50	\$ 254	\$56-475	1,337	\$1.14	\$1.11-2.01	67
Medium 200-600yd ³	4	240-563	Bulldozer (50%) Excavator (50%)	2 3/4-9 (19 3/4) 4 3/4-9 (19 1/2)	3,002.25	750	281-1,377	1,457	2.06	.82-3.20	37
Large 700-1,400yd ³	7	761-1,307	Bulldozer (51%) Excavator (49%)	5-13 3/4 (67) 5 3/4-14 (65)	10,095.00	1,442	824-2,104	6,895	1.46	.80-1.88	52
Extra Large 1,900-3,100yd ³	3	1,939-3,062	Bulldozer (62%) Excavator (38%)	17-37 1/4 (81 3/4) 13-19 (50)	10,031.25	3,344	2,289-4,198	7,355	1.36	.97-1.83	56
Crossings with adjacent decks	3	457-3,836	Bulldozer (53%) Excavator (47%)	4 1/2-23 3/4 (45 3/4) 5 3/4-24 1/2 (40 3/4)	6,609.75	2,203	786-3,692	5,386	1.23	.96-1.95	62
TOTALS:	23 Crossings	28-3,836yd ³	Bulldozer 55% Excavator 45%	3/4-37 1/4 (226 3/4) 1/4-24 1/2 (182 3/4) 409 1/2 total hrs.	\$31,260.75	\$1,359	\$56-4,198	22,430yd ³	\$1.39/yd ³	\$.80-3.20/yd ³	55 yd ³ /Hr.

TABLE 5
Small Haul Road Crossings (Big XRD's)
84-4

Worksite	Equipment Hours ¹		Total Cost	Volume Yd	Cost ³ Per yd	Excavation Rate yd ³ /hr.	Push Distance Ft.	Comments
	Cat.	Exc.						
L33	1 1/2	1/4	1 3/4	\$ 132.00	117 ²	\$1.13	67	50 --
L84	1	3 3/4	4 3/4	367.50	325 ²	1.13	68	50 --
T51	3/4	3/4	1 1/2	114.75	102 ⁴	1.13	68 ⁵	50 2 ditches
T63	3/4	-	3/4	56.25	28 ³	2.01	37	50 includes 1/4 hr. disc. ⁶
T85	4 1/4 [*]	2	6 1/4	474.75	425 ⁴	1.12	68 ⁵	50 3 ditches
T100	4 1/4	3/4	5	377.25	340 ⁴	1.11	68 ⁵	50 --

TOTALS: 6 crossings 12 1/2 7 1/2 20 \$1,522.50 1,337 yd³ \$1.14/yd³ 67yd³/hr. Ave. 50 ft.

AVERAGES:

Cost per crossing \$253.75
Volume per crossing 223 yd³
Equipment time per crossing 3.3 hours = 62% CAT 38% EXC

- 1 "*" indicates time includes breaks; one "*" per 1/2 hour.
- 2 Volume determined from pre and post surveys
- 3 Volume determined from post survey only.
- 4 Volume determined by using actual hours and excavation rates from similar crossings with accurate surveys. (RXL84 and RXL33).
- 5 Excavation rate assumed to be same as at similar crossings (RXL84 and RXL33).
- 6 If discussion eliminated, cost per yd³ = \$1.34 and rate = 56 yd³/hr.

TABLE 6
MEDIUM HAUL ROAD CROSSINGS (RANGE = 200-600yd³)
84-4

Worksite	Equipment Hours ¹			Total Cost	Volume ² Yd ³	Cost ³ per yd	Excavation ³ Rate yd ³ /hr.	Push Distance Ft.	Comments
	Cat.	Exc.	Total						
L12	2 3/4	4 3/4*	7 1/2	\$ 576.75	310	\$1.86	41	75	Flowing
L14	3 3/4*	-	3 3/4	281.25	344	.82	92	200	Downhill push, dry
L20	9*	9*	18	1,377.00	563	2.45	31 ⁴	100	Flowing
L34	4 1/4	5 3/4	10	767.25	240	3.20	24 ³	75	Flowing
TOTALS:	4	19 3/4	39 1/4	\$3,002.25	1,457yd ³	\$2.06/yd ³	37yd ³ /hr.	Ave. 113 ft.	

AVERAGES:

Cost per crossing \$750.56³Volume per crossing 364 yd³

Equipment time per crossing 9.8 hours = 50% CAT 50% EXC

1 "*" indicates time includes breaks; one "*" per 1/2 hour.

2 All crossings had pre and post surveys.

3 Limited space; often only 1 piece working.

4 Cat and Exc. had to wait for each other for 2 1/4 hr. each, due to limited space. If exclude waiting time, rate increases to 42 yd³/hr.

TABLE 7
LARGE HAUL ROAD CROSSINGS (RANGE 700-1,400yd³)
84-4

Worksite	Equipment Hours ¹			Total Cost	Volume ² Yd ³	Cost ³ per yd ³	Excavation Rate yd ³ /hr.	Push Distance Ft.	Comments
	Cat.	Exc.	Total						
L 2	10 1/4*	9*	19 1/4	\$ 1,470.75	826	\$1.78	43	150	Flowing, diverted
L11	13 1/2*	14*	27 1/2	2,104.50	1,307	1.61	48	100	Flowing, muddy
L16	13 3/4	12 1/2*	26 1/4	2,006.25	1,065	1.88	41	100	Flowing, mudflows
L19	5	5 3/4*	9 1/4	823.50	1,028	.80	111	125	Mostly dry; all downhill push
L35	7 1/2*	6	13 1/2	1,030.50	761	1.35	56	150	Dry
L40	7*	6 1/4*	13 1/4	1,012.50	985 ³	1.03	74	125	Dry; half was downhill push
L65	10**	11 1/2*	21 1/2	1,647.00	923	1.78	43	100	Flowing, diverted

TOTALS: Hours: Ave.
7 65 132 \$10,095.00 6,895yd³ \$1.46/yd³ 52yd³/hr. 121 ft.
crossings

AVERAGES:

Cost per crossing \$1,442.14
Volume per crossing 985yd³
Equipment time per crossing 18.8 hours = 51% CAT 49% EXC

- 1 "**" indicates time includes breaks one "*" per 1/2 hour.
- 2 All crossings (except as indicated below) had pre and post surveys.
- 3 Post survey only.

TABLE 8
EXTRA LARGE HAUL ROAD CROSSINGS (RANGE=1,900-3,100yd³)
84-4

Worksite	Cat.	Equipment Hours ¹		Total Cost	Volume ² Yd ³	Cost ³ per yd	Excavation Rate yd ³ /hr.	Push Distance Ft.	Comments
		Exc.	Total						
L1	37 1/4	18**	55 1/4	\$4,197.75	3,062	\$1.37	55	200	Flowing; downhill push
T67	27 1/2***	19**	46 1/2	3,544.50	1,939	1.83	42	250	Flowing; diverted, still wet; downhill push
T90	17*	13**	30	2,289.00	2,354 ³	.97	79	75	Mostly wet; close downhill push

TOTALS: Hours: Ave.
3 81 3/4 50 131 3/4 \$10,031.25 7,355yd³ \$1.36/yd³ 56yd³/hr. 175 ft.

AVERAGES:

Cost per crossing \$3,343.75
Volume per crossing 2,452 yd³
Equipment time per crossing 43.9 hours = 62% CAT 38% EXC

- 1 "*" indicates time includes breaks; one "*" per 1/2 hour.
- 2 All crossings (except as indicated below) had pre and post surveys.
- 3 Post survey only.

TABLE 9
HAUL ROAD CROSSINGS WITH ADJACENT DECKS
84-4

Worksite	Equipment Hours ¹		Total Cost	Volume ² Yd ³	Cost ³ per yd	Excavation Rate yd ³ /hr.	Push Distance Pt.	Comments
	Cat.	Exc.						
T 1	4 1/2	5 3/4*	10 1/4	\$ 786.00	457 ³	\$1.72	45	125 Dry
T48	17 1/2**	10 1/2**	28	2,131.50	1,093	1.95	39	150 Flowing, diverted; uphill push
T96	23 3/4***	24 1/2**	48 1/4	3,692.25	3,836 ³	.96	80	150 Dry; half was downhill push

TOTALS: Hours: Ave.
3 45 3/4 40 3/4 86 1/2 \$6,609.75 5,386yd³ \$1.23/yd³ 62yd³/hr. 142 ft.
crossings

AVERAGES:

Cost per crossing \$2,203.25
Volume per crossing 1,795yd³
Equipment time per crossing 28.8 hours=53% CAT 47% EXC

- 1 "*" indicates time includes breaks; one "*" per 1/2 hour.
- 2 All crossings (except as indicated below) had pre and post surveys.
- 3 Post survey only.

TABLE 10
AVERAGE SKID TRAIL CROSSING EXCAVATION COSTS
84-4

Type of Worksite	# of Work-sites	Range Vol. fill Yd ³	Equip.	Range: Hours (Total)	Total Sites Cost	Average Cost/ Worksite	Range: Cost	Total ¹ Yd ³	Average: Cost/ Yd ³	Average ¹ Rate: Yd ³ /Hr.
Extra-small 1-150yd ³	23	15-145	Bulldozer (28%) Excavator (72%)	1 1/4-1 1/2 (10 1/2) 1 1/4-2 3/4 (27)	\$2,893.50	\$125	\$19-251	1,710	\$1.70	45
Small 150-450yd ³	7	225-450	Bulldozer (35%) Excavator (65%)	1 1/4-3 3/4 (16) 2 3/4-8 1/4 (30 1/4)	3,559.50	508	383-775	2,075	1.72	45
Medium 450-800yd ³	30 crossings	15-450 yd ³	Dozer 32% Excav. 68%	1 1/4-3 3/4 (26 1/2) 1 1/4-8 1/4 (57 1/4) 83 3/4 hrs.	\$6,453.00 ²	\$215	\$19-775	3,785yd ³	\$1.70/yd ³	45yd ³ /hr.
Large 800-2,000yd ³										
Extra Large 2,000yd ³										

TOTALS:

30 crossings	15-450 yd ³	Dozer 32% Excav. 68%	1 1/4-3 3/4 (26 1/2) 1 1/4-8 1/4 (57 1/4) 83 3/4 hrs.	\$6,453.00 ²	\$215	\$19-775	3,785yd ³	\$1.70/yd ³	45yd ³ /hr.
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¹ skid trail crossings were not field surveyed. Volumes were calculated using an average 45yd³/hr. excavation rate, which is based on previous surveyed data (83-2, 83-5, etc) and field guesses during heavy equipment work. See Table 13 for the comparisons of volume calculation estimates. Also volumes were rounded to the nearest five.

² Does not include access travel costs, see Table 14.

TABLE 11
Extra-Small Skid Trail Crossings
($\leq 3 \frac{1}{4}$ hours of equipment time)
84-4

Worksite	Equipment Hours:			Total Cost	Volume ¹ yd ³	Percent done by the Bulldozer and Excavator	
	D-8	Exc.	Total				
L13	1/2	1	1 1/2	\$ 115.50	70	33	67
L24	1/4	1 3/4	2	155.25	90	13	87
L47	--	2 1/4	2 1/4	175.50	100	--	100
T15	3/4	3/4	1 1/2	114.75	70	50	50
T16	3/4	2 1/2	3 1/4	251.25	145	23	77
T17	--	3/4	3/4	58.50	35	--	100
T29	1/4	2	2 1/4	174.75	100	11	89
T41	1 1/4	3/4	2	152.25	90	63	37
T44	1 1/2	1	2 1/2	190.50	115	60	40
T47	--	2 1/4	2 1/4	175.50	100	--	100
T49	1 1/4	1 1/4	2 1/2	191.25	115	50	50
T56	1 1/2	1	2 1/2	190.50	115	60	40
T58	--	1 1/4	1 1/4	97.50	55	--	100
T60	--	3/4	3/4	58.50	35	--	100
T64	1/4	--	1/4	18.75	15	100	--
T72	--	1/4	1/4	19.50	15	--	100
T80	--	1 1/4	1 1/4	97.50	55	--	100
T81/92	1	1 1/2	2 1/2	192.00	115	40	60
T83	1/4	--	1/4	18.75	15	100	--
T84	3/4	--	3/4	56.25	35	100	--
T94	1/4	2 3/4	3	233.25	135	8	92
T95	--	1 1/2	1 1/2	117.00	70	--	100
T97	--	1/2	1/2	39.00	20	--	100

TOTALS:	Hours:					Bulldozer	Excavator
23 crossings	10 1/2	27	37 1/2	\$2,893.50	1,710yd ³	28%	72%

Unit Costs: \$1.70/yd³ 45yd³/hour

¹ See footnote 1 on Table 10

TABLE 12
Small Skid Trail Crossings
(≥5 hours of equipment time)
84-4

Worksite	Equipment Hours ¹			Total Cost	Volume ² Yd ³	percent done by the	
	D-8	Exc.	Total			Bulldozer	and Excavator
L80	3	3.5	6.5	\$ 498.00	290	46	54
T30	1.75	8.25*	10	774.75	450	18	82
T39/42	2.25	2.75	5	383.25	225	45	55
T40	1.25	4	5.25	405.75	235	24	76
T55	2	3.25*	5.25	403.50	235	38	62
T78	3.75	4.5	8.25	632.25	370	45	55
T89	2	4	6	462.00	270	33	67

TOTALS: Hours:
 7 16 30 1/4 46 1/4 \$3,559.50 2,075yd³ 35% D-8 65% EXC.
 crossings

Unit Costs: \$1.72/yd³ and 45yd³/hour

¹ "*" indicates time includes breaks; one "*" per 1/2 hour.

² See Footnote 1 on Table 10.

TABLE 13
SKID TRAIL CROSSING VOLUME CALCULATION COMPARISONS
84-4

Worksite	Ave. Excav. Rate: 45yd ³ /hr.	Volume From Erosion Potentials:		Summer Field Guess
		Excavatable	Max. Total	
L13	70	60	250	90
L24	90	50	50	--
L47	100	150	250	--
L80	290	150	325	--
T15	70	125	300	100
T16	145	75	270	100
T17	35	50	322	50
T29	100	100	320	125
T30	450	150	643	--
T39/42	225	150	400	--
T40	235	200	600	--
T41	90	100	250	--
T44	115	125	481	--
T47	100	100	274	100
T49	115	125	334	125
T55	235	125	451	200
T56	115	50	233	125
T58	55	250	289	75
T60	35	50	266	50
T64	15	15(WB)	172	--
T72	15	15(WB)	140	--
T78	370	200	422	--
T80	55	100	200	--
T81/92	115	155	325	--
T83	15	15(WB)	50	--
T84	35	75	255	--
T89	270	150	300	--
T94	135	50	125	100
T95	70	75	120	50
T97	20	30	50	50
TOTALS: 30 crossings	3,785yd ³	3,065yd ³	8,467yd ³	1,340yd ³
Rates:	45 cy/hr	37 cy/hr	101 cy/hr	47 cy/hr

TABLE 14
MISCELLANEOUS HEAVY EQUIPMENT COSTS
84-4

Category	Equipment	Hours	Cost	Total Cost
Travel ¹ (between, and to and from work- sites) ¹	Bulldozer	10 1/4	\$ 768.75	\$2,250.75
	Excavator	19	1,482.00	
Paid Down Time (accum. 1/2 hour periods)	Bulldozer	4 1/4	318.75	396.75
	Excavator	1	78.00	
Miscellaneous Time paid in full ²	Bulldozer	18	1,350.00	2,637.00
	Excavator	16 1/2	1,287.00	
Standby Without Operator	Excavator	8 1/2	246.50	246.50
				\$5,531.00

¹ Slope travel time totaled 16 1/4 hours, which included 7 hours CAT and 9 1/4 hours EXC. The remaining travel time included road travel on the 1840 and 1850, and travel between the 1840 to the 1850 road.

² Miscellaneous time paid in full includes assisting stuck equipment, general discussions, waiting for access, shuttling equipment and trucks, move culverts, fueling, stuck in the mud, ending up on the wrong side of a crossing, and breaks not directly billed to a worksite.

TABLE 15
LABOR INTENSIVE COSTS
84-4

Work Types	Type of Laborers	Person Hours	Cost	Total Cost	Quantity	Cost/Quantity
Straw Distribution	RNP	45	\$ 426.25	\$ 426.25	240 bales	\$1.78/bale
Straw Application	RNP RUI	69 1/2 112	626.30 952.00	1,578.30	240 bales	6.58/bale
Straw Acquisition	--	--	--	696.00	240 bales	2.90/bale
TOTAL SECONDARY TREATMENTS =				\$2,700.55	240 bales	\$11.25/bale
Brushing	RNP	225	\$1,988.20	\$1,988.20	20 xings	\$100/xing
Travel (straw work only)	RNP RUI	31 1/2 52 1/2	284.34 446.25	730.59	--	--
TOTAL MISCELLANEOUS TREATMENTS =				\$2,718.79	--	--
TOTAL LABOR INTENSIVE COST =				\$5,419.34	RNP 371 person hours RUI 164 1/2 person hours	535 1/2 person hours

SECONDARY TREATMENT

MISCELLANEOUS

condition resulted in problems with saturated fill during the course of the excavation, thus limiting the use of the bulldozer in preliminary excavations. Therefore, the excavator was required to remove more volume than anticipated, and at several locations it had to move the fill pile 2-3 times before the bulldozer could get to it and move it to the fill site. In addition to this, the equipment occasionally got stuck in the saturated fill which cost a great deal of time. Surprisingly, our excavation rates are very good compared to previous years (Appendix Table 1). This can probably be attributed to our experienced heavy equipment operators, and by utilizing downhill fill sites with short pushes whenever possible.

Prescriptions for worksites should maximize these short downhill pushes, and provide as straight a push as possible. We discovered this year that a downhill push to a fill site will increase the excavation rate by 50 percent (Appendix Table 1). This is invaluable when excavating saturated fill. In tractor yarded areas there are numerous skid trails going down on either side of the haul road crossing. Many of these skid trails lead to dry topographic benches with a push distance being equal to that on the road. Many times the cutbank along the road was too wet to be buried. As you can see by the numbers on the table this proved to be a very cost effective technique.

The initial heavy equipment prescriptions called for the use of the bulldozer for four days to dish down road crossings and open skid trails prior to bringing on the excavator. This was changed due to a scheduling conflict with another rehabilitation unit and both pieces of equipment started on the same day. Thus, from the beginning, the bulldozer was behind in the preparation work, and we ended up having the excavator do some of this work which resulted in a decrease in cost effectiveness, since this work was not best suited for an excavator. Hopefully in the future this problem will not arise again, as it has over the past several years.

On several skid trail crossings, up to 90 percent of the fill volume was excavated by the bulldozer, then the excavator was used to finish the excavation by channelizing the crossing. This is not particularly cost effective, because of the very small amount of sediment saved by bringing in the excavator, but was done due to the scheduling problem mentioned above. Leaving a little fill in the channel for the excavator to clean up allowed the bulldozer more time to open the next set of skid trails and crossings. Normally we would have used either the excavator or bulldozer alone on crossings less than 150 yd³ in size. In excavations completed by only the bulldozer, the amount of channel fill left by a bulldozer and possibly eroded during the first few storms is minimal considering the added cost of the excavator to remove the last 10-25 yd³ of material.

Overall we are very pleased with the quality and cost effectiveness of the erosion control work completed by the heavy equipment operators and labor intensive crews on Unit 84-4.

APPENDIX TABLE 1
EXCAVATION RATE IMPROVEMENTS
84-4

	Rehab. Unit	Size Range	Total Volume yd ³	Equip. Hours	Percent Bulldozer	Excavation Rate
SMALL CROSSINGS	82-1	100-400	1016	39½	61	26
	83-2	100-400	687	9	50	76
	83-5	100-400	1366	33½	44	41
	84-4	100-400	550	17½	40	31
	84-4 ^D	100-400	344	3 3/4	100	92
MEDIUM CROSSINGS	82-1	400-800	3872	122½	60	32
	83-2	400-800	2205	75½	59	29
	83-5	400-800	2964	100	48	30
	84-4	500-800	1324	31½	52	42
	84-4 ^D	none				
LARGE CROSSINGS	82-1	800-2000	4566	265	59	17
	83-2	800-2000	3255	106 3/4	67	30
	83-5	800-2000	2350	53½	77	44
	84-4	800-1400	4121	96	49	43
	84-4 ^D	900-1100	2013	22½	50	89
EXTRA-LARGE CROSSINGS	82-1	1400-1600	4566	265	59	17
	83-2	1300-1800	3100	105½	67	29
	84-4 ^D	1900-3100	7355	131 3/4	62	76

^D = Downhill push crossings.

Equipment used each year:	Bulldozer	Excavator
82-1	CASE 1450	CASE 980B
83-2	two D-8's	JD 690B
83-5	D-7	JD 690B
84-4	D-8	JD 690B

17 > overlaps with
29 large data.



Unit: 84-4 6/18/84 PP#7



Unit: 84-4 10/30/84 PP#7



Unit: 84-4 10/30/84 PP#31



Unit: 84-4 6/27/84 PP#31 NLD



Unit: 84-4 10/30/84 PP#33



Unit: 84-4 6/27/85 Herringbone logs in channel.