

The M-4½ and M-5 Roads and Slope
Watershed Rehabilitation Project

Unit 86-3

Louise E. Johnson

January 1988

TABLE OF CONTENTS

	<u>Page</u>
Introduction	1
Logging and Erosion History	6
Erosion Control Work	8
Evaluation Phase	8
Heavy Equipment Phase	9
Labor Intensive Phase	23
Documentation Phase	23
Conclusion	25
Appendix (Materials on file at South Operation Center)	
- Photo Points and Descriptions	
- Geomorphic Blue Line Maps (Photo Mylars)	
- Survey and Prescription Notes	

LIST OF MAPS AND TABLES

	<u>Page</u>
Map A: Unit Location Map	2
Map B: Topographic Map	3
Map C: Logging History Map	7
Map D: Rehabilitation Treatment Map	Back Pocket
Table 1: Summary Costs of Erosion Control Rehabilitation Work	4
Table 2: Summary of Average Costs of Heavy Equipment Erosion Control Treatments	10
Table 3: Haul Road and Skid Trail Stream Crossing Excavation Costs	12
Table 4: Haul Road Stream Crossing Excavation Costs	13
Table 5: Skid Trail Stream Crossing Excavation Costs	14
Table 6: Exported (Blade Endhailed) Outslope Road Excavation Costs	18
Table 7: Cross Road Drain Costs	19
Table 8: Other Heavy Equipment Rehabilitation Work Costs	21
Table 9: M-6-1 Slope-work Costs	22
Table 10: Labor Intensive Costs	24

The M-4½ and M-5 Roads and Slope
Watershed Rehabilitation Project
Unit 86-3

INTRODUCTION

The M-4½ and M-5 Roads and Slope Rehabilitation Unit, 86-3, is located on the west side of Redwood Creek, roughly 13 miles upstream from Orick, in the Bridge Creek drainage (Map A). The unit encompasses 564 acres, along the northeast facing hillslope of Rodgers Peak, between and including the Chilula Creek (southern unit boundary) and Rodgers Creek (northern unit boundary) drainages. The unit consist of 2.4 miles along the M-4½ and M-5 haul roads, and all slopework between the M-Line haul road (eastern unit boundary) and the West Side Access road (western unit boundary). Eleven slope worksites below the M-Line and above the M-6-1 haul road were also completed.

Total relief on the unit averages 1,000 feet, with elevations ranging from 2,000 feet along the West Side Access road, to 1,000 feet at the lowest point along the M-Line haul road (Map B). Overall hillslope gradients tend to be gentle to moderate, averaging 5 to 55 percent, with a distinct tread and riser profile. Drainages along the hillslope are linear, first, second and third order, intermittent and perennial streams draining into Bridge Creek. Three drainages (Rx 8,9 and 10) along the M-5 haul road near the M-Line are landslide controlled with poorly incised stream reaches. Drainage areas along the M-4½ and M-5 haul road stream crossings (RX) range from 134 acres at RX-4 (M-5 road), to 20 acres at RX-14 (M-4½ road).

The rehabilitation unit is underlain by the schist unit of Redwood Creek. Soil types in this unit have a well defined distribution pattern. The deep, well developed, clay-rich red soils (Trailhead and Fortyfour) occur mostly on the gentle to moderate slopes along the major ridges of the M-5 road. These soils are quite resistant to erosion by surface runoff. Most of the rehabilitation unit is characterized by soils of the Coppercreek, Ahpah and Devils creek series. With the exception of the Devils creek series, these soils are well drained and have a low to moderate landslide potential, though Coppercreek soils are quite susceptible to fluvial erosion. Devils creek soils are very prone to landslides, which is evident along the M-4½ road between RX 12 and 13, and along the M-5 road between RX 8 and 10. A detailed description of these soils may be found in the 1985 inhouse report, "Soils of the M-5 and G-4 Roads and Lower M-Line" and the 1986 inhouse report, "Soils of the M-4½ Road," both by J. Popenoe and R. Martin.

The rehabilitation cost (including the evaluation and documentation phases) for the M-4½/M-5 unit was \$110,689.30 (Table 1). Of this total, hourly heavy equipment and labor intensive costs accounted for 87 percent and 6 percent, respectively. Evaluation and documentation phases comprise the remaining 7 percent. These costs are discussed in detail in the Erosion Control Work section.

A total of 2.4 miles of haul roads were eliminated from further rehabilitation. Of this total, 1.7 mile was actually treated: 0.5 mile of the M-4½ haul road and 1.2 mile of the M-5 haul road. A total of 14, 539 cubic yards of channel

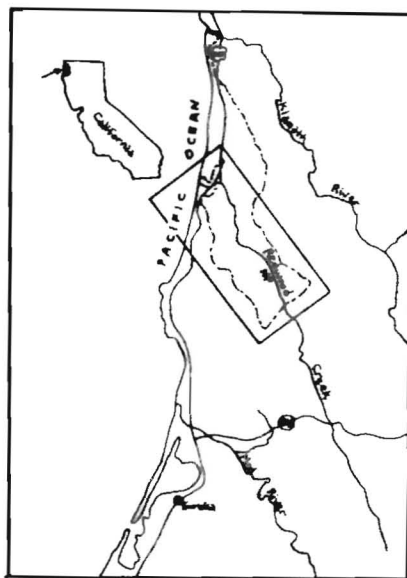
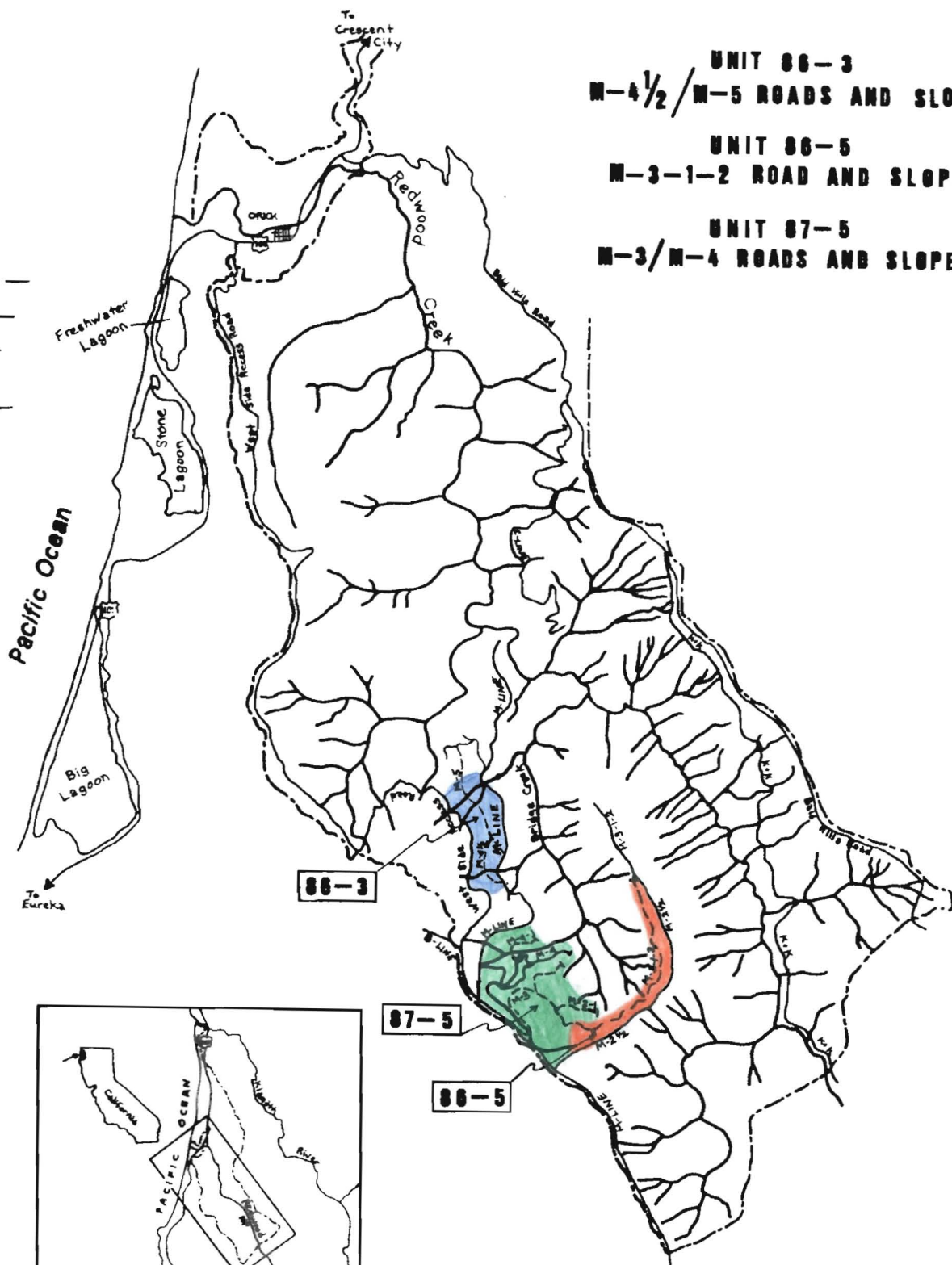
LEGEND:

PARK BOUNDARY -----
DRAINAGES Bridge Creek
ROADS M-LINE
REHABILITATED
ROADS M-3

UNIT 86-3
M-4 1/2 / M-5 ROADS AND SLOPE

UNIT 86-5
M-3-1-2 ROAD AND SLOPE

UNIT 87-5
M-3 / M-4 ROADS AND SLOPE



0 4000 8000 12000 16000 Feet

MAP A

**WATERSHED REHABILITATION
 UNIT LOCATION MAP**

UNIT 86-3

M-4 1/2 AND M-5 ROADS AND SLOPE

MAP B TOPOGRAPHIC MAP

SCALE
1:12000 (11 X 17)
1:19500 (10 1/2 X 11)



LEGEND:

LOGGING HAUL ROADS		M-4
		M-5
CONTOURS		
POINT ELEVATIONS		793
DRAINAGE		
REMARK UNIT		
86-3 UNIT BOUNDARY		

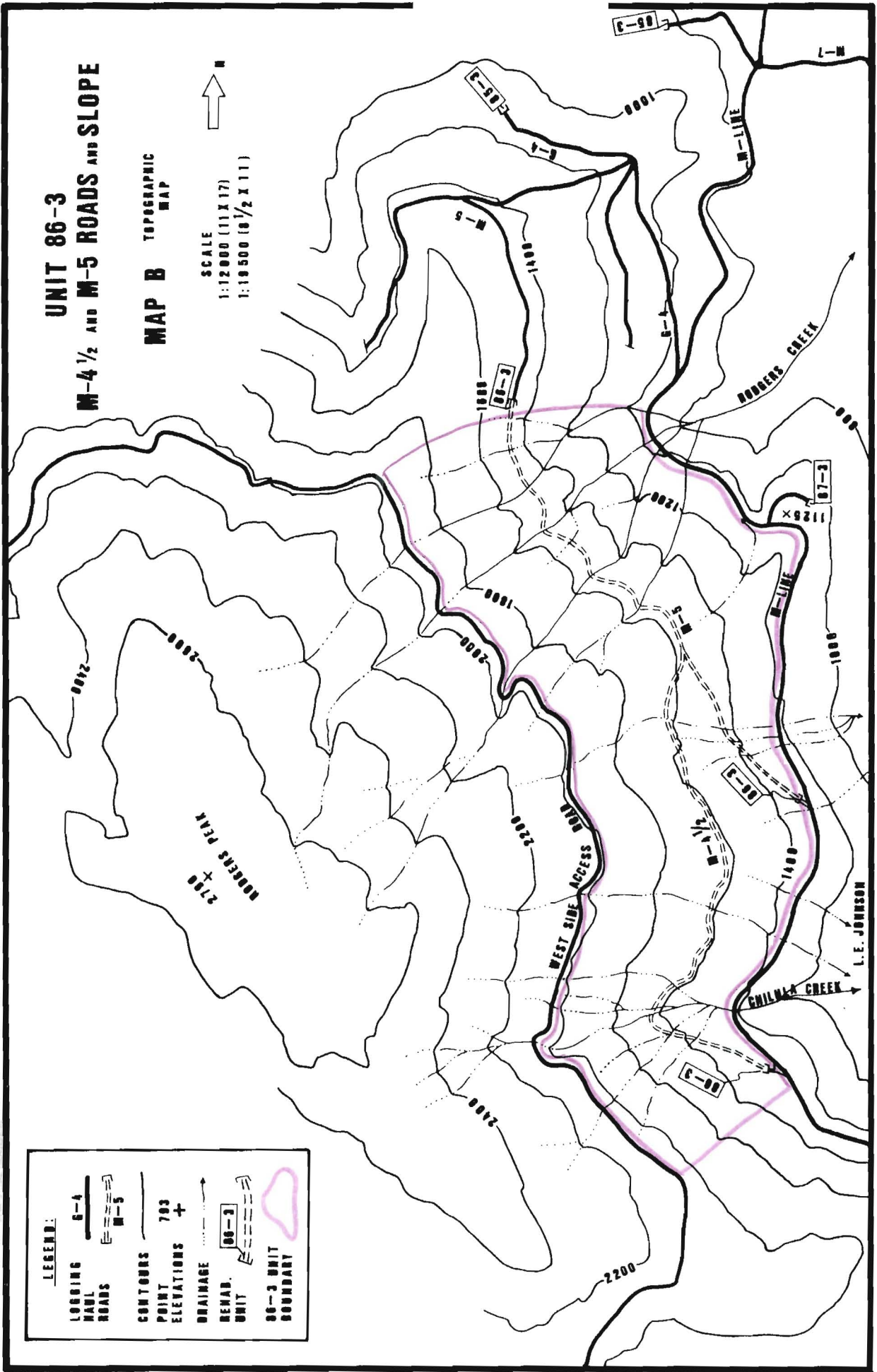


Table 1
SUMMARY COSTS OF EROSION CONTROL REHABILITATION WORK
Unit 86-3

	Task	RNP Employees			Redwoods United	Heavy Equipment	Materials	Total Task Cost	Phase Totals	Phase %
		Geologist & Technician	Laborers	YCC						
EVALUATION PHASE	Mapping	\$2,231.50	--	--	--	--	--	\$2,231.50	\$5,149.60	5%
	Prescription	2,918.10	--	--	--	--	--	2,918.10		
HEAVY EQUIPMENT PHASE	Primary Treatment	5,224.22	--	--	--	\$66,031.00	--	71,255.22	96,422.52	87%
	Other Rehab Work Costs ¹	--	--	--	--	23,711.00	--	23,711.00		
	Move In/Out	--	--	--	--	1,456.30	--	1,456.30		
LABOR INTENSIVE PHASE	Secondary Treatment ² (straw)	--	\$1,847.53	\$117.25	\$642.90	--	\$1,272.00	3,879.68	6,269.22	6%
	Miscellaneous ² (brushing)	--	1,687.74	--	701.80	--	--	2,389.54		
DOCUMENTATION	Cost Analysis and Reports	2,847.96	--	--	--	--	--	2,847.96	2,847.96	2%
TOTALS:		\$13,221.78	\$3,535.27	\$117.25	\$1,344.70	\$91,198.30	\$1,272.00	\$110,689.30	<u>\$110,689.30</u>	
% OF TOTAL:		12%	3%	.5%	1.5%	82%	1%			

¹Refer to Table 8 for a summary of the other rehabilitation work costs.

²All labor intensive costs include travel expenses.

fill was excavated from 13 haul road stream crossings, and 6,678 cubic yards from 18 skid trail crossings. Five total outslope road excavations were completed, totalling 3,077 cubic yards of fill material moved. Twenty-four cross road drains were installed along 0.5 mile of the M-4½ and M-5 haul roads (Table 2 and Map D). This summary does not include the M-6-1 Slope worksites, they are summarized separately in Table 9.

LOGGING AND EROSION HISTORY

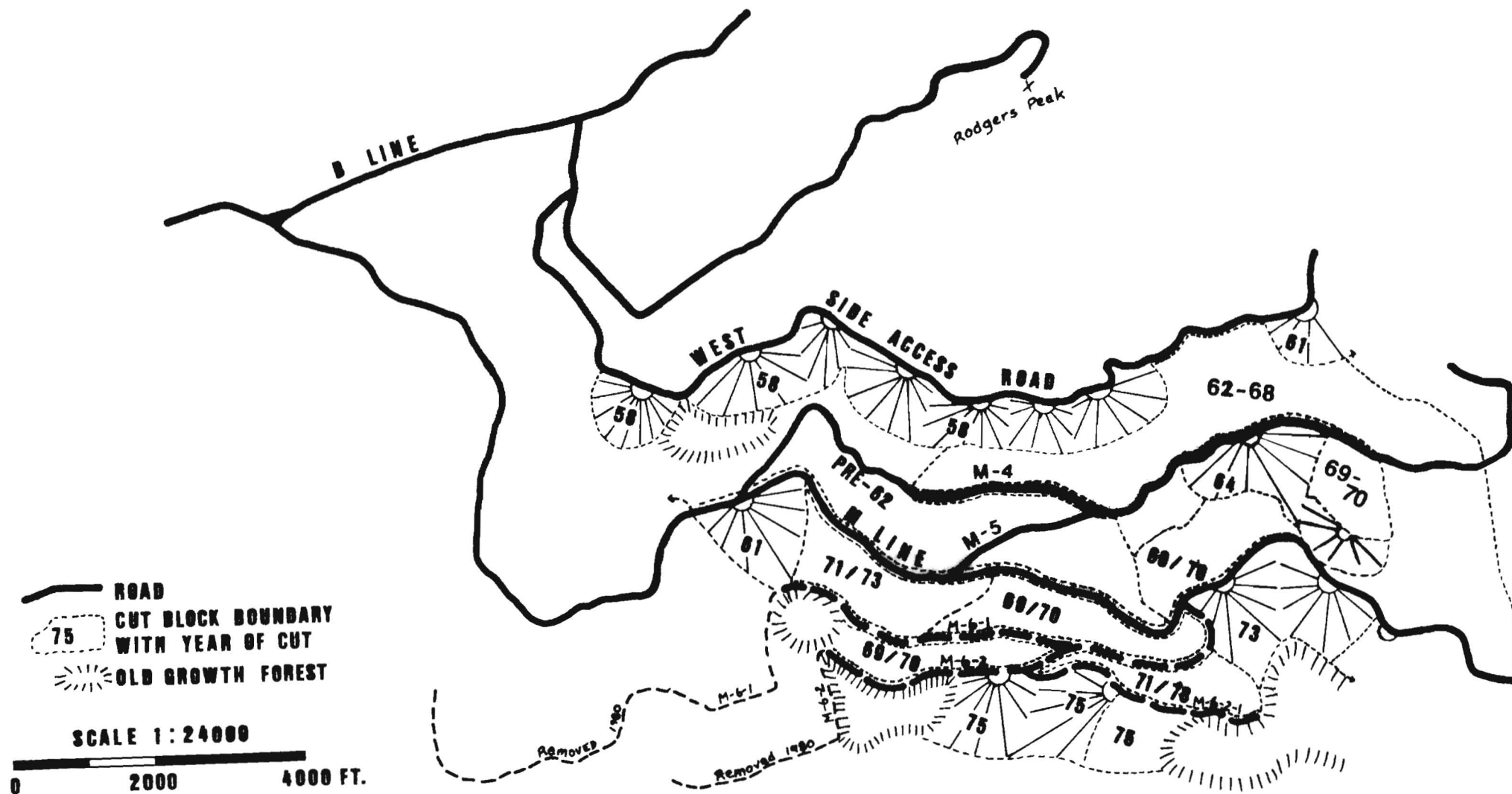
Haul road construction and subsequent timber harvest activities along the M-4½ and M-5 began in the late 1950's and early 1960's (Map C). The entire M-4½ haul road was constructed and adjacent hillslopes were harvested by seed-tree-leave methods and tractor yarded before 1962, totalling 200 acres. During this period, the M-5 haul road had been built from the M-Line to the M-4½ road intersection. Also in 1958, seven cable yarded clear cut units downslope from the West Side access road (B-5) were harvested, totalling 125 acres. From 1962 to 1968, construction of the remaining M-5 haul road was completed and adjacent hillslopes were harvested by seed-tree-leave methods and tractor yarded, totalling 150 acres. This period of logging included a fairly large (35-acre) cable cut, done in 1964, between RX 3 and 4 on the M-5. Renewed timber harvest activities occurred in 1975, prior to park expansion, along the M-5 haul road in the Rodgers Creek drainage. During this year, the seed-tree-leave cuts of 1962-68 were relogged by clear cut methods and tractor yarded, totalling 125 acres. Only one 15-acre grove of old growth redwood forest remains within the boundaries of unit 86-3, in the Chilula Creek drainage.

The most significant erosion features exhibited on unit 86-3 are mass movement and fluvial erosion features (Map D, back pocket). Road building and timber harvest activities have reactivated some landslide features and have contributed to a number of failures. The entire M-4½ road and a portion of the M-5 road had been constructed, and over fifty percent of the unit had been logged prior to the flood events of 1964. Numerous stream crossings that failed during 1964, were later reconstructed during the logging episodes that followed between 1965-1968 and 1975. Since timber harvest activities in 1975, and up until erosion control rehabilitation in 1986, approximately nine haul road stream crossings failed, four of which had major stream diversions and hillslope gullyng. Also, there was renewed activity along two landslide features, one on the M-4½ road at R13, and the other one along the M-5 road between RX 8 and RX 10. Both haul roads were not driveable in 1985, due to there failures.

Since the unit was tractor yarded during past logging activities, the hillslopes are riddled with skid trails, and streams were crossed numerous times. Potential and active erosion on the hillslopes existed as intact or partially eroded crossing fills and stream diversions. A total of 18 skid trail stream crossings were treated on the unit.

Unfortunately, the detailed erosion history notes and mylar overlays by each aerial flight line year were misplaced when D. Burns left the park. Though detailed geomorphic maps for the unit, completed by D. Burns, are on file in the SOC Library.

MAP C: Logging History



EROSION CONTROL WORK

Redwood National Park's watershed rehabilitation and erosion control program is divided into four work phases: Evaluation, heavy equipment, labor intensive and documentation. The evaluation phase includes: Geomorphic and hydrologic field mapping; prescribing erosion control treatments which are accomplished using heavy equipment and labor intensive work crews; volumetric surveying at all proposed worksites; field peer reviews of erosion control prescriptions; establishing photo points that will document the effects of the erosion control work; and planning the erosion control work schedule for both the heavy equipment and labor intensive phases. The heavy equipment phase includes completion of all primary erosion control treatments (direct sediment saving prescriptions) which are haul road and skid trail stream crossing fill excavations, export outslowing of fill material along unstable road sections, and road outslowing (recontouring) and cross road drain construction. The labor intensive erosion control work includes all secondary treatments for surface erosion which comprises distributing and applying straw mulch to critical areas on finished rehabilitation worksites such as stream crossing sidebanks and steep outslows. The final erosion control phase is the documentation process which includes post heavy equipment excavation volumetric surveys, photo points, cost data compilation and the watershed rehabilitation project report.

Evaluation Phase

The evaluation phase for unit 86-3 includes mapping, prescribing erosion control treatments, and volumetric surveying. This phase involved approximately 53 person days, between November 1985 and June 1986. The following is a more detailed cost breakdown for the evaluation phase:

Mapping	\$2,231.50
Prescriptions	2,097.60
Surveying	<u>820.50</u>
TOTAL	\$5,149.60

The mapping for this unit was completed by D. Burns, M. Horns, M. Sandeck and D. Steensen, totalling 24 person days. Prescriptions, surveying and planning the erosion control work were completed by G. Bundros, D. Burns and D. Steensen, totalling 29 person days. Heavy equipment phase project supervisors were L. Johnson and D. Steensen.

Heavy Equipment Phase

Introduction

Primary erosion control treatments concentrated on features capable of delivering sediment directly to the tributary streams of Bridge Creek. These features were haul road and skid trail stream crossings and unstable road reaches adjacent to streams. Nearly two and one half miles of logging haul roads were rehabilitated within the unit, for a total heavy equipment cost of \$91,198.30. A total of 24,294 cubic yards of material was excavated from 13 haul road stream crossings ($14,539 \text{ yd}^3$), 18 skid trail stream crossings ($6,678 \text{ yd}^3$), and 5 export outslope road reaches ($3,077 \text{ yd}^3$). Table 2 summarizes the number of worksites, quantities, total costs, and average unit costs and rates for each heavy equipment erosion control treatment completed on unit 86-3. All worksites are located on Map D.

The heavy equipment erosion control work was done under hourly heavy equipment rental agreements. Three pieces of heavy equipment were utilized on the unit, two bulldozers and a small hydraulic excavator. The excavator was a John Deere 690B with a $3/4$ yard bucket, and a bucket clamp (\$90.00 per hour), owned and operated by Larry Lambert. One of the bulldozers was a Caterpillar D7E with a "U"-blade and winch (\$79.00 per hour), owned and operated by Wendell Larkin. The second bulldozer was a Caterpillar D8H 46A series with a straight blade and winch (\$99.00 per hour), owned and operated by Jay Franke (Twin Parks Lumber Company). The excavator and D7 bulldozer worked from start to finish on the unit as the primary equipment team, working on all erosion control treatments. Whereas, the D8 bulldozer was employed on specific rehabilitation treatments for a limited time during the sequence of heavy equipment work on unit 86-3. This D8 bulldozer was utilized on the large haul road ($>2000 \text{ yd}^3$ in size) and skid trail crossings ($500 - 800 \text{ yd}^3$ in size) as the primary earth mover, dishing out as much volume as possible prior to the D7 bulldozer and excavator's arrival to complete the excavation. The D7 bulldozer and excavator worked together as a team most of the time. Though each worked independently on smaller skid trail stream crossings ($75-250 \text{ yd}^3$ in size).

Heavy equipment erosion control work began on July 14, 1986, and took 9 weeks to complete ending on September 12, 1986 (totalling 1,047 hours of combined heavy equipment time). Equipment work started on the M-4 $\frac{1}{2}$ road and slope area, which took 8 days to complete. Then the M-6-1 slopework below the M-Line was completed in 7 days. The equipment then moved to the M-5 road, and began work at R7 next to blown out stream crossing Rx6, and completed all road and slope work back down road to the M-Line, taking 15 days to complete. At this point, the equipment moved again to the north side of the M-5 road, via the G-4 access route, and work began on R6 and progressed along road and slope to the end of the unit at Rx1, taking 13 days to complete. The remaining sections of the M-5 and G-4 haul roads will be removed in 1989.

The next section will cover heavy equipment techniques and cost effectiveness for each type of erosion control treatment completed on unit 86-3 (e.g., haul road and skid trail stream crossings, export outslope road reaches, and cross road drains).

Table 2
SUMMARY OF AVERAGE COSTS OF HEAVY EQUIPMENT EROSION CONTROL TREATMENTS
Unit 86-3

Treatment	Totals:					Averages:				
	Number of Worksites	Total Quantity	Total Heavy Equipment Hours	Total Cost	Percent of Total	Cost Per Worksite	Unit Cost Per Quantity	Range: Cost per Quantity	Rate: Quantity Per Hour	Rate Range: Quantity Per Hour
Haul Road Stream Crossings	13	14,539 yd ³	422.25	\$37,117.75	41%	\$2,855.00	\$2.55/yd ³	\$.87-3.20 per yd ³	34 yd ³ /hr.	26-109 yd ³ /hr.
Skid Trail Stream Crossings	18	6,678 yd ³	266.75	22,970.25	25%	1,276.00	3.44/yd ³	.45-4.80 per yd ³	25 yd ³ /hr.	19-133 yd ³ /hr.
Exported Outslope	5	3,077 yd ³	59.25	4,955.75	5%	991.00	1.61/yd ³	.54-2.39 per yd ³	52 yd ³ /hr.	35-148 yd ³ /hr.
Haul Road Cross Road Drains	3	24 drains 850 feet of drain	11.0	987.25	1%	41.00 per drain	1.16/ft of drain	.65-1.92 per ft. of drain	77 ft./hr.	47-136 feet of drain/hr.
Other Rehab. Work Costs ¹	See Table 8	--	288.0	23,711.00	26%	--	--	--	--	--
Move In/Out	--	--	--	1,456.30	2%	--	--	--	--	--
TOTALS =	--	24,294 yd ³ of Material Moved	1,047.25 Heavy Equip. Hours	\$91,198.30 Total Heavy Equipment Cost		--	--	--	--	--

¹Other heavy equipment rehabilitation work costs include: The M-6-1 Slopework (\$12,141.50) completed for Unit 86-4, see Table 9; opening haul roads; M-Line culvert installation; paid breaks; paid down time and standby.

Haul Road and Skid Trail Stream Crossings

Thirty-one haul road and skid trail stream crossing excavations were completed on unit 86-3. Table 3 shows average stream excavation costs, unit costs and excavation rates for haul road and skid trail crossings combined in the four size categories listed. Table 4 details this information for each haul road stream crossing. The total cost for the 13 haul road stream crossing excavations was \$37,117.75, with an average unit cost of \$2.55 per cubic yard and an overall excavation rate of 34 cubic yards per hour per piece of equipment. The overall average blade push distance to a fillsite was 205 feet. A total of 14,539 cubic yards of fill material was excavated from the 13 haul road stream crossings. Three of these crossings were greater than 1,000 cubic yards in size, ranging from 1,531 to 5,115 cubic yards in size, with excavation production rates ranging from 31 to 37 cubic yards per hour per piece of equipment and an average fillsite push distance of 300 feet.

Eighteen skid trail stream crossing excavations were completed on unit 86-3, for a total cost of \$22,970.25, with an average unit cost of \$3.44 per cubic yard and an overall excavation rate of 25 cubic yards per hour per piece of equipment (Table 5). These costs include expenses associated with slopework such as brushing and blading skid trails, travel, fueling and constructing waterbars on the access skid trails, all of which amounts to 15 percent of the total cost. A total of 6,678 cubic yards of fill material was excavated from the 18 skid trail stream crossings.

Haul road stream crossings were excavated to prevent erosion due to road fill failures and/or stream diversions resulting from culvert and/or humboldt (logs and fill) constructed crossing failures. Every skid trail crossing which had active and/or potential flow diversions and/or fill failures was treated. All stream crossing excavations were designed to tie into stable base levels at, or near, the original channel bed level, and with sideslopes of 30-45 percent.

The general excavation technique was the same for both skid trail and haul road stream crossing excavations. First, the D7 or D8 bulldozer (depending upon the size of the crossing) would dish out as much fill as possible (25-75% of the volume), and then the excavator would complete the final channelization work with a bulldozer assisting. Usually on smaller crossings (50-250 yd³ in size), either the excavator or bulldozer would complete the entire excavation independently. No secondary heavy equipment erosion control in channel treatments (e.g., rock or check dams) were completed on any of the stream crossings. Only straw mulch was applied to all haul road crossings and several skid trail crossings.

Overall, the heavy equipment and techniques used to complete stream crossing excavations on unit 86-3 worked well. Only a few problems arose which caused a change in prescriptions and techniques. Almost every road crossing and several skid trail crossings had surface and/or subsurface stream flow. Because of road conditions, temporary streamflow diversions down the inboard ditch during excavation was only possible at a couple of crossings. This condition resulted in problems with saturated fill during the course of the excavation. Therefore, the excavator was required to remove more volume than anticipated, and at several locations it had to move its fill pile 2-3 times before a bulldozer could get to it and push it to the fillsite. This material being pushed was saturated mud that refused to mound up in front of the dozer blade,

Table 3
HAUL ROAD AND SKID TRAIL STREAM CROSSING EXCAVATION COSTS
Unit 86-3

Size Category (cu.yds)	# of Work Sites	Range of Volumes (cu.yds)	Equipment ¹ (Percent)	Range of Hours (total hrs)	Total Cost	Range of Actual Costs	Total Volume cu.yds.	Average: cost/ cu.yd.	Range: cost/ cu.yd.	Ave: Exc. Rate (cu.yd/hr.)	Range: Exc. Rate (cu.yd/hr)
Small 1-400	15	75- 350	Bulldozers 58% Excavator 42%	.75-7.25 (33.75) .5-6.75 (24.75)	\$5,043.75	\$45- 775	2718	\$1.86	\$.45- 3.20	46	26-200
Medium 400-800	9	446- 762	Bulldozers 54% Excavator 46%	2.5-14.25 (89.5) 4.5-16.5 (77.5)	\$14,485.50	\$830- 3,600	5100	\$2.84	\$1.06- 4.80	31	19-46
Large 800-2000	5	800- 1,531	Bulldozers 52% Excavator 48%	11-24.25 (83.5) 10.5-25.25 (77.25)	\$13,624.00	\$1,800- 4,200	4743	\$2.87	\$2.24- 3.69	30	23-38
Extra Large >2000	2	3,541 and 5,115	Bulldozers 65% Excavator 35%	68.5-103.25 (171.75) 27.75-63.75 (91.5)	\$23,543.25	\$8,584- 14,959	8656	\$2.72	\$2.42- 2.92	33	31-37
TOTALS:	31	75- 5,115 cubic yards	Bulldozers 58% Excavator 42%	.75-103.25 (378.5) .5-63.75 (271.0)	\$56,696.50	\$45 to 14,959	21,217 cubic yards	\$2.67/ cubic yard Ave.	\$.45- 4.80/ cubic yard range	33 cu.yds. per hour average	19-200 cubic yards per hour range
Total Hours = 649.5											

¹Bulldozer hours include the D7 and D8 combined.

Table 4
HAUL ROAD STREAM CROSSING EXCAVATION COSTS
Unit 86-3

Worksite	Equipment Hours:			Total Cost	Volume ⁴ Cubic Yards	Unit Cost Per Cubic Yards	Rate Cubic Yards Per Hour	Ave. Push Dist. to Fillsite (feet)
	D7W	690B	D8W					
Rx 1	.5	.5	2.0	\$282.50	326	\$.87	109	100
Rx 2	-. -	2.5	2.5	472.50	446	1.06	89	100
Rx 3	34.75	27.75	33.75	8,584.00	3,541	2.42	37	250
Rx 4 ¹	50.0	63.75	53.25	14,959.25	5,115	2.92	31	350
Rx 5	-. -	1.0	3.0	387.00	209	1.94	50	100
Rx 7	24.25	25.25	-. -	4,188.25	1,531	2.74	31	300
Rx 8 ²	11.0	10.5	-. -	1,814.00	809	2.24	38	200
Rx 9	8.75	10.25	-. -	1,613.75	646	2.50	34	250
Rx 10	7.25	2.25	-. -	775.25	330	2.35	35	200
Rx 11	4.25	5.5	-. -	830.75	446	1.86	46	175
Rx 12 ³	11.0	13.5	-. -	2,084.00	762	2.73	31	225
Rx 13	2.5	2.5	-. -	422.50	132	3.20	26	250
Rx 14	3.5	4.75	-. -	704.00	255	2.76	31	175
13 Worksites	157.75 (37%)	170.0 (40%)	94.5 (23%)	<u>\$37,117.75</u>	14,539 cubic yards	Ave: \$2.55	Ave: 34	Ave: 205

Total Hours = 422.25

¹Rx 4 includes hours, costs and volume for a total outslope along the right bank.

²Rx 8 includes hours, costs and volumes for Sx 12 directly below the haul road crossing.

³Rx 12 includes hours, costs and volume for total outslope along the right bank.

⁴All volumes are from post excavation surveys.

Table 5
SKID TRAIL STREAM CROSSING EXCAVATION COSTS
Unit 86-3

Worksite	Equipment Hours:			Total Cost	Volume ³ Cubic Yards	Unit Cost	Rate:
	D7W	690B	D8W			Per Cubic Yard	Cubic Yards Per Hour
Sx 1	5.0	4.5	4.75	\$1,270.25	500e	\$2.54	35
Sx 2	3.0	- -	2.5	484.50	350e	1.38	64
Sx 3	- -	2.0	- -	180.00	<100e	1.80	50
Sx 4	- -	1.0	- -	90.00	<100e	.90	100
Sx 5 ¹	10.5	16.5	13.0	3,601.50	750e	4.80	19
Sx 6	8.25	8.25	- -	1,394.25	450e	3.10	27
Sx 7	17.25	17.75	- -	2,960.25	803s	3.69	23
Sx 8	13.75	13.0	- -	2,256.25	800e	2.82	30
Sx 9	- -	1.0	- -	90.00	<100e	.90	100
Sx 10	- -	1.75	- -	157.50	<100e	1.58	57
Sx 11	7.25	6.0	- -	1,112.75	500e	2.23	38
Sx 12 [included in RX 8 costs]				- -	- -	- -	- -
Sx 13 ²	- -	.75	- -	67.50	<100e	.68	133
Sx 14 ²	- -	.5	- -	45.00	<100e	.45	200
Sx 15	.75	- -	- -	59.25	75e	.79	100
Sx 16	2.75	- -	- -	217.25	100e	2.17	36
Sx 17	13.5	10.75	3.75	2,405.25	800s	3.01	29
Sx 18	6.0	6.75	- -	1,081.50	350e	3.09	27
Sx 19	12.5	10.5	1.75	2,105.75	600e	3.51	24
18 Worksites	100.5	101.0	25.75	\$19,578.75 (85%)	6,678 cubic yards	\$2.93 per cubic yard Ave.	29 cubic yards per hour Ave.
ASSOC. MISC. COSTS							
	D7W	HOURS: 690B	D8W	TOTAL COST			
Opening							
Trails	8.0	- -	2.5	\$879.50			
Travel	4.5	9.25	2.25	1,410.75			
Fueling	1.25	2.25	- -	301.25			
XRD on Trails	5.0	4.5	- -	800.00			
	18.75	16.0	4.75	\$3,391.50 (15%)			
GRAND TOTAL =	119.25 (45%)	117.0 (44%)	30.5 (11%)	<u>\$22,970.25</u>	6,678 cubic yards	\$3.44 per cubic yard Ave.	25 cubic yards per hour Ave.

Total Hours = 266.75

**Footnotes (see next page)

Table 5 - continued
Footnotes

¹Sx 5 was an extremely difficult excavation; the fillsites were either up a 50% skid trail for 200 feet, or 500 feet out another skid trail. Plus the equipment could not work together without one waiting for the other to move out of the way (leap frogging the fill out).

²Both Sx 13 and 14 were dished out when the D7 opened skid trail access, this time was not broken out and therefore not included in the excavation costs. That is why the costs are comparatively low and excavation rates so high.

³Only two skid trail stream crossing excavations were surveyed (Sx 7 and Sx 17). The rest of the volumes listed were estimated in the field before and after excavations were completed:

e = estimated s = surveyed

and instead "flowed" out on either side. The solution to this problem would have been a large perforated soup ladle to transport this oozing mess to the fillsite. In addition, few fillsites were located nearby or on a downhill grade. Many skid trail crossings had fillsites located up 30-50 percent skid trail grades and around tight turns. And on several large haul road crossings the fillsite push distances were greater than 250 feet. On top of all these other problems, it was not uncommon to have one to two pieces of equipment stuck in the "muck" during the course of an excavation, not once but several times. All of these factors added up to a severe reduction in the overall excavation production rates for unit 86-3, which is reflected by the substantially higher unit costs (compared to similar worksites on past rehabilitation units).

Haul Road Treatments

There were two types of erosion control road treatments completed on this unit: Export (blade endhauling) outsloping and cross road draining. No road ripping was performed on unit 86-3 since the road surface did not have a rock layer and was well vegetated in numerous areas. Unstable road reaches adjacent to streams were pulled back and the material was blade endhauling to a stable road bench (Export Outsloped). Five export outslope excavations were completed along 876 feet of the M-4½ and M-5 haul roads, totalling 3,077 cubic yards of fill material moved. Total cost for export outsloping was \$4,955.75, with an overall excavation rate of 52 cubic yards per hour per piece of equipment. The overall average blade endhauling push distance to a fillsite was 200 feet. These costs are detailed for each export outslope reach in Table 6, which also includes average cubic yards per linear foot of road, average road width, and average cut depth for each outslope road section.

The heavy equipment excavation method was the same for all export outslope road reach worksites. First, the D7 bulldozer would excavate out as much road fill material as possible. Then the lower edge material and finishing outslope work was completed by the excavator, while the bulldozer pushed the fill spoils to the fillsite.

Twenty-four cross road drains were constructed along the M-4½ and M-5 haul roads. Cross road drains were constructed at frequent intervals to disperse hillslope runoff and inboard ditch spring flow. These were mostly done by the excavator, which allowed time for the bulldozer to start preliminary excavation work at the next worksite. Total cost for drain construction was \$987.25, with an average unit cost of \$1.16 per foot of drain. These costs are detailed for each drain reach in Table 7.

Table 6
EXPORTED (BLADE ENDHAULED) OUTSLOPE ROAD EXCAVATION COSTS
Unit 86-3

Worksite	Equipment D7W	Hours: 690B	Total Cost	Quantity Cubic Yards	Unit Cost Per Cubic Yard	Rate: Cubic Yards Per Hour	Ave. Push Distance to fillsite (feet)	Ave. yd ³ per Linear Foot of Rd. ¹	Ave. Rd. width/ Cut Depth ² (feet)
R 6	3.75	-.-	\$296.25	150 ^e	\$1.98	40	250	-.-	-.-
R 7	16.25	14.25	2,566.25	1,327 ^s	1.93	44	225	4.44	35/11
R 9	4.75	4.0	735.25	632 ^s	1.16	72	150	3.33	30/12
R 11	6.5	6.25	1,076.00	450 ^s	2.39	35	275	2.35	22/10
R 13	3.0	0.5	282.00	518 ^s	.54	148	100	5.45	15/17
5 Worksites	34.25 (58%)	25.0 (42%)	<u>\$4,955.75</u>	3,077 cubic yards	Ave. \$1.61/yd ³	Ave. 52 yd ³ /hr.	Ave. 200	Ave. 3.89	Ave. 26/13

Total Hours = 59.25

^eEstimated Volume

^sSurveyed Volume

¹Exported outslope road reaches total 876 linear feet of road.

²Average cut depth is measured vertical from road level down to the cut-to-here depth along the fillslope.

Table 7
CROSS ROAD DRAIN COSTS
Unit 86-3

Worksite	<u>Equipment Hours:</u>		Total Cost	<u>Quantity</u>	Cost Per Foot of drain	Rate: Ft. of Drain Per Hour
	D7W	690B		No. of drains/ Ft. of drain		
R8	-.-	7.25	\$652.50	10/355	\$1.84	49
R10	-.-	1.25	112.50	4/153	.74	122
R14	.25	2.25	222.25	10/342	.65	137
3 Worksites	.25 (2%)	10.75 (98%)	<u>\$987.25</u>	24/850	Ave: \$1.16	Ave: 77

Total Hours = 11.0

Other Heavy Equipment Rehabilitation Costs

Other heavy equipment erosion control rehabilitation treatments completed on this unit were the M-6-1 Slopework, M-Line culvert installation, opening haul roads, and assisting Technical Service in filming preliminary excavations on several M-5 haul road stream crossings. Also, general miscellaneous heavy equipment costs include all equipment time which can not be assigned to a specific worksite, which includes travel between haul roads, moving straw bales, general discussions, paid breaks, paid down time, and standby. Table 8 shows the costs for each of the other rehabilitation work and miscellaneous categories, totalling \$23,711.00.

The M-6-1 slopework was completed by unit 86-3's hourly heavy equipment for unit 86-4's contract site. This slopework is located upslope from the M-6-1 haul road and downslope from the M-Line haul road (Map D). Five skid trail stream crossings and six skid trail export outslope reaches were excavated for a total cost of \$12,141.50 (Table 9). Costs include opening skid trails, travel, fueling, breaks, and waterbarring access skid trails.

One culvert was replaced on the M-Line haul road at the north fork of Rodgers Creek crossing, culvert number 27. This replacement pipe was a 48-inch culvert which was too large for the park's backhoe to install, therefore the JD 690B excavator was used. Total cost to install 50 feet of 48-inch culvert was \$2,020.28, which includes the purchase cost of the pipe (\$1,024.28).

Technical Service filmed several preliminary bulldozer excavations on two M-5 haul road stream crossings. They wanted to show on film how to prevent stream diversions, at road crossings where a diversion potential existed, by partially dishing down the crossing using a bulldozer, thus eliminating the diversion potential. Inorder to achieve the proper filming angle and lighting, the two crossings were brushed by the labor crews, and this fallen brush was then moved out of the ditches and off the road surface by the heavy equipment, which cost \$761.00.

Table 8
OTHER HEAVY EQUIPMENT REHABILITATION WORK COSTS
Unit 86-3

Category	Equipment Hours:			Total Cost
	D7W	690B	D8W	
M-6-1 Slopework ¹	78.5	66.00	- -	\$12,141.50
Opening Haul Roads	10.5	- -	- -	829.50
Breaks	18.25	17.25	6.5	3,637.75
Travel ²	3.75	5.0	1.75	919.50
Straw	2.25	.5	.5	272.25
Down Time Paid in Full	1.25	1.5	- -	233.75
"Helping"	1.0	- -	.25	103.75
Standby w/operator	9.0 (49.50) per hr.	17.5 (54.25) per hr.	1.25 (59.50) per hr.	1,469.25
Discussions	1.25	.5	.25	168.50
Haul Road Fueling	1.0	.25	1.5	250.00
Tech. Serv. Movies on the M-5 Road	6.5	2.75	- -	761.00
M-Line Culvert	1.5	9.75	- -	996.00
M-7 Site(86-1)	- -	8.5	11.75	1,928.25
TOTALS =	134.75 (47%)	129.5 (45%)	23.75 (8%)	<u>\$23,711.00</u>

Total Hours = 288.0

¹See M-6-1 Slopework Table 9 for complete cost breakdown.

²Travel is between the three major haul roads (M-4 1/2, M-5 South and M-5 north).

Table 9
M-6-1 SLOPEWORK COSTS¹
Unit 86-3 (for Unit 86-4)

Category	Quantity	Equipment Hours:		Total Cost
		D7W	690B	
Skid Trail Crossing Excavations	5 crossings	31.0	21.75	\$4,406.50
Skid Trail Total Outslopes	6 road reaches	30.5	33.0	5,379.50
Skid Trail Cross Road Drains	- -	.5	.5	84.50
Access Travel	- -	2.75	6.0	757.25
Opening Skid Trails	- -	7.75	- -	612.25
Fueling	- -	2.0	1.25	270.50
Breaks	- -	4.0	3.5	631.00
TOTALS =		78.5 (54%)	66.0 (46%)	<u>\$12,141.50</u>

Total Hours = 144.5

¹The M-6-1 Slopework was worked and completed by 86-3's hourly equipment for 86-4's contract site. This slopework is located upslope from the M-6-1 (86-4) rehab. site and downslope from the M-Line haul road.

Labor Intensive Phase

The labor intensive phase involved two tasks which were road and trail brushing in the spring, and the distribution and application of straw mulch on completed erosion control rehabilitation sites during the summer months. Total labor intensive costs were \$6,269.22 (Table 10). A foot trail was brushed along the M-5 road for improved hiking access during the evaluation phase. The M-5 road was not driveable until the heavy equipment work began. The G-4 road was brushed (widened) to improve driveability and access to the ridge road that connected up with the north side of the M-5 road, providing access for straw distribution. Redwood National Park (RNP) and Redwood United Inc. (RUI) labor crews were responsible for brushing, totalling 253 person hours and costing \$2,389.54. Brushing the M-5 foot trail and G-4 road took 6 days to complete.

Straw mulch was applied to haul road stream crossing sideslopes and moderate to steep finished slopes along export outsloped road reaches. The total area disturbed by erosion control rehabilitation efforts and treated with straw mulch was 7 acres, and a 4000 lbs/acre straw mulch application rate was prescribed. The total number of straw bales used on the unit was 400 bales. The distribution of 400 bales took 1½ days to complete. Straw bales were distributed by RNP labor crews, totalling 60 person hours and costing \$657.45, with a unit cost of \$1.64 per bale. The straw bales were placed in small quantities (4-10 bales) along the inboard ditch at stream crossings and export outslope road reaches. Redwood National Park, Redwood United Inc. and Youth Conservation Corp (YCC) labor crews were responsible for spreading the straw, totalling 235 person hours and costing \$1,950.23, with a unit cost of \$4.88 per bale. The application of 400 straw bales took 4 days to complete. The spreading cost for straw mulch on Unit 86-3, including acquisition, distribution and application, was \$3,879.68, involving 295 person hours, with a total unit cost of \$9.70 per bale.

Documentation Phase

Following completion of the erosion control phase, the work was surveyed where needed, photo points were retaken, cost data was compiled, and the annual report was prepared. Total cost of this phase was \$2,847.96. Work was done by L. Johnson and D. Steensen, and was completed by January, 1988.

Table 10
LABOR INTENSIVE COSTS
Unit 86-3

Work Types	Type of Laborers	Person ¹ Hours	Cost	Total Cost	Quantity	Cost/ Quantity	% of Total
Straw Distribution	RNP	60	\$657.45	\$657.45	400 Bales	\$1.64/Bale	17%
Straw Application	RNP	108	1,190.08	1,950.23	400 Bales	4.88/Bale	50%
	RUI	92	642.90				
	YCC	35	117.25				
Straw Acquisition	--	--	--	1,272.00	400 Bales	3.18/Bale	33%
TOTAL SECONDARY TREATMENTS =				\$3,879.68	400 Bales	\$9.70/Bale	62%
Brushing ²	RNP	153	1,687.74	2,389.54	--	--	--
	RUI	100	701.80				
TOTAL MISCELLANEOUS TREATMENTS =				\$2,389.54			38%
TOTAL LABOR INTENSIVE COSTS =		548 Person Hours		<u>\$6,269.22</u>			

¹Wages used to determine costs for RNP employees include benefits. All person hours and costs include round trip travel time.

²Brushing included a foot trail on the M-5 road and opening the G-4 road from the M-Line.

CONCLUSION

Overall, the quality of the erosion control work completed, on unit 86-3, by the heavy equipment operators and labor intensive crews was excellent. The techniques used, cost effectiveness, and specific site condition excavation problems were discussed in detail under the Heavy Equipment Phase of the Erosion Control Work section of this report.

The combination and size of heavy equipment used on this unit worked pretty well, though the Caterpillar D7 bulldozer and John Deere 690B excavator are not an equally matched team. Their individual estimated production rates (including job condition correction factors) are quite different. The D7 bulldozer has an approximate production rate of 150 cubic yards per hour, whereas the JD 690B excavator has an estimated production rate of only 75 cubic yards per hour. Therefore, it takes twice as much time for the JD 690B excavator to move the same amount of material as the D7 bulldozer, resulting in a large amount of non-productive costly idle time for the D7 when the two are working together. All of this means lower production rates and higher unit costs for overall rehabilitation work. If two or more pieces of heavy equipment will be working together as a team on a rehabilitation unit, they should be closely matched based on their individual estimated production rates, so as to eliminate as much non-productive idle time as possible, thus increasing overall production rates and decreasing unit costs.

Another factor to consider is the unit cost per cubic yard based on the estimated production rates and hourly rental rates for specific pieces of heavy equipment. For example, a JD 690B excavator with a 3/4 yard bucket has an estimated production rate of 75 cubic yards per hour, and an hourly rental cost of \$90.00 per hour. Therefore, the JD 690B's overall unit cost is \$1.20 per cubic yard ($\$90.00 \div 75 \text{ yd}^3/\text{hour}$). Compare this unit cost with a larger "more expensive" excavator, for example the new CASE 125B with a 1 2/3 yard bucket has an estimated production rate of 150 cubic yards per hour, and an hourly rental rate of \$109.50 per hour. The CASE 125B's overall unit cost is only \$.73 per cubic yard, a savings of 61 percent over the "cheaper" JD 690B excavator. When selecting equipment it's very important to look at this unit cost based on the estimated production and hourly rental rates for different types and sizes of equipment.

As has been the case over the past several years, there's no question that Caterpillar D7 and D8 sized bulldozers are perfect for erosion control rehabilitation road removal work, due to the obvious fact that this was the same size machine used to build the road in the first place. In addition, bulldozers equipped with U-blades and wide high floatation tracks are perfect for working in wet, muddy excavations and for pushing fill several hundreds of feet to a fillsite. (Refer to "Caterpillar Performance Handbook", Edition 8, Section 4, pages 6,18 and 20.)

ABBREVIATIONS

CSP = Color Stereo Pair
 B/W = Single B/W Photo
 Color ASA 200 Ektachrome
 B/W ASA 400 Tri-X
 * Post Photo Point
 only

UNIT 86-3 M4½/M5 ROADS AND SLOPE PHOTO POINT LOCATIONS AND DESCRIPTIONS

PHOTO POINT NUMBER	LENSE	TYPE	SITE LOCATION: WORKSITE #	DESCRIPTION:
1	35mm	CSP B/W	Rx 7	FROM Redwood stump on outboard edge of road, left bank. VIEW Across road and up channel. Scale mid-road/thalweg. Stake on stump.
2	35mm	CSP B/W	Rx 7	FROM A large rock in mid-channel upstream from the top of excavation. VIEW Downstream full channel length to bottom of excavation. Stake is 12 feet right of rock on the right bank skid trail. Scale mid-channel in thalweg.
3	35	CSP B/W	Rx 8	FROM Stump next to bottom of culvert gully on right bank from thalweg. Stake on stump. Stump is in lower third of excavation. Post photo uses straw bales for scale. VIEW Looking upstream.
4	35	CSP B/W	Rx 8	FROM Top of cutbank on the left bank 15-20 feet from thalweg. VIEW Of excavation. Scale mid-channel. Stake in ground at that location.
5	35	CSP B/W	Rx 9	FROM A large Redwood stump on the outboard edge of road, top of left bank. Overview of excavation, VIEW South. Stake on stump. Scale mid-channel.
6	35	CSP B/W	Rx 9	FROM Top of cutbank on left bank between a large Redwood stump and Tanoak. VIEW From top looking down the thalweg. Stake in ground. Scale mid-channel.

PHOTO
POINT

SITE
LOCATION:

NUMBER LENSE TYPE WORKSITE # DESCRIPTION:

7*	35	CSP B/W (includes Sx 12 below)	Rx 8	FROM	Stake on right bank above top of excavation, next to Hemlock stump. Photo taken 7 feet away from stake on edge of vertical cutbank.
				VIEW	From top looking down channel. Scale is mid-channel at lower end of excavation. (SX12).
8	35	CSP B/W	Rx 10	FROM	Stake at base of large Rhododendron on left bank above and back behind the vertical cutbank. Photo taken approx. 15 feet from stake on edge of vertical cutbank.
				VIEW	From top of excavation looking down the thalweg, scale mid-channel in thalweg.
9	35	CSP B/W	Rx 4	FROM	Top of 10' Redwood chunk lying in channel above the top of excavation.
				VIEW	From top looking down the thalweg. Scale mid-channel in thalweg. Stake on Redwood chunk.
10 A/B	35	CSP B/W	Rx 3	FROM	Double Redwood stump on outboard edge of road, top of left bank.
				VIEW	"A" is looking up channel and
				VIEW	"B" is looking up road across the channel to the right bank. Stake on stump. Scale mid-channel.
10 c	35	CSP B/W (Pre only)	Rx 3	FROM	Top of left bank at base of cutbank on the road surface.
				VIEW	Across channel to right bank outslope. No stake - only flagged. Pre and during excavation photo point, no post photo taken.
11	35	CSP B/W	Rx3	FROM	The end of a saw log in thalweg upstream of top of excavation.
				VIEW	Looking down the thalweg. Stake on log. Scale mid-channel.

PHOTO POINT NUMBER	LENSE	TYPE	SITE LOCATION: WORKSITE #	DESCRIPTION:
12*	35	CSP B/W	Sx 6	FROM Hollow Redwood stump next to two 1-foot Redwood trees on outboard edge of skid trail, left bank, at the end of the total outslope section. VIEW Overview of site, Towards top of excavation. Stake on stump. Scale on outslope near channel.
13*	35	CSP B/W	Sx 6	FROM Cut log at top of excavation. Stake on log. VIEW Looking down the thalweg. Scale mid-channel.
14*	35 (M-line slope)	CSP B/W	Sx 7	FROM Stake on log on left bank near end of total outslope of a skid trail. Photo taken approx. 25' from stake in thalweg. VIEW Looking up the thalweg from the bottom of excavation. Scale mid-channel.
15*	35 (M-Line slope)	CSP B/W	Sx 7	FROM Stump on left bank on left side of access trail to Sx6. Stake on stump. Oblique VIEW Of stream channel excavation (Oblique). Scale mid-channel.
16*	35	CSP B/W	Rx 12	FROM Top of excavation in channel near a Redwood chunk. Stake on chunk. VIEW From top to bottom of excavation down thalweg. Scale mid-channel.
17*	35	CSP B/W	Rx 12	FROM Left bank near top third of channel on fillsite. Stake in ground. VIEW Oblique view looking southeast across stream excavation to fillsite on right bank. Scale mid-channel.
18*	35mm	CSP B/W	Rx 12	FROM Bottom of excavation; in thalweg. Stake on left bank near bottom of rock armor approximately 10 feet away. VIEW From bottom looking up thalweg to top of excavation. Scale mid-channel.
19*	35	CSP B/W	Rx 13	FROM Top of excavation in thalweg. Stake approx. 10 feet away on left bank. VIEW From top looking down the thalweg to the bottom of the excavation. Scale mid-channel.

PHOTO POINT NUMBER	LENSE	TYPE	SITE LOCATION: WORKSITE #	DESCRIPTION:
20*	35	CSP B/W	Rx 13	FROM Large fir stump on right bank of Rx 13. Stake on stump. VIEW Perpendicular to Rx 13 channel, looking northwest to total outslope of Rx 13. Scale on outslope.
21*	35	CSP B/W	Rx 13	FROM Bottom of excavation in thalweg. Stake on right bank. VIEW From bottom looking up thalweg to top of excavation. Scale mid-channel.
22*	35	CSP B/W	Rx 14	FROM A log in center of channel above top of excavation. Stake on log. VIEW From top looking down thalweg to bottom of excavation. Scale mid-channel.
23*	35	CSP B/W	Rx 14	FROM Bottom of excavation in thalweg. Stake on rotten stump 3 feet left from thalweg. Scale by log in thalweg. View From bottom looking up thalweg to top of excavation.
24*	35	CSP B/W (M4½ slope)	Sx 19	FROM Bottom of excavation in thalweg. Stake on chunk, left bank. Scale mid-channel near thalweg. VIEW From bottom looking up channel to mid- section of excavation.
25*	35	CSP B/W (M4½ slope)	Sx 19	FROM Top of cutbank on left bank. Stake in ground. VIEW Of upper half of channel excavation. Scale in thalweg.
26*	35	CSP B/W (M4½ slope)	Sx 18	FROM Bottom of excavation in thalweg. Stake in thalweg. VIEW Bottom looking up channel to top of excavation. Scale mid-channel.

PHOTO POINT NUMBER	LENSE	TYPE	SITE LOCATION: WORKSITE #	DESCRIPTION:
27*	35	CSP B/W (M4½ slope)	Sx 17	FROM Left bank near bottom of excavation near a Redwood, fir and alder clump. Stake in ground. VIEW Looking up channel to top of excavation. Scale in thalweg.
28*	35	CSP B/W (M4½ slope)	Sx 17	FROM Bottom of excavation in thalweg. Stake in thalweg VIEW From bottom looking 2/3 of the way up channel. Scale in thalweg.
29*	35	CSP B/W	Rx 11	FROM Large rock in thalweg at bottom of excavation. Stake on left bank near bent alder. VIEW From bottom looking up thalweg. Scale in thalweg.
30*	35	CSP B/W	R 11	FROM Left side of total outslope near Rx 11. Stake in ground VIEW Across outslope towards Sx 19. No scale.
31 A/B*	35	CSP B/W	R 7	FROM Stump on outboard edge or road. Stake on stump. VIEW "A" Looks across total outslope towards R x 6. VIEW "B" Looks upstation (southeast) across the total outslope.
32*	35	CSP B/W	Rx 7	FROM Bottom of excavation on rocks in thalweg. stake on left bank by alder. VIEW From bottom looking up thalweg to top of excavation. Scale in thalweg.
33*	35	CSP B/W (M-5 slope)	Sx 8	FROM Bottom of excavation in thalweg. Stake in thalweg. VIEW From bottom looking up thalweg to top of excavation. Scale mid-channel.
34*	35	CSP B/W (M-5 slope)	Sx 11	FROM Bottom of excavation in thalweg. Stake on right bank. VIEW From bottom looking half way up thalweg (lower half of excavation). Scale in thalweg.

PHOTO POINT NUMBER	LENSE	TYPE	SITE LOCATION: WORKSITE #	DESCRIPTION:
35*	35	CSP B/W (M-5 slope)	Sx 11	FROM Top of excavation in thalweg. Stake in thalweg. VIEW From top looking down channel to middle of excavation. Scale in thalweg.
36*	35mm	CSP B/W (incl. Sx12)	Rx 8	FROM Taken from bottom of excavation in thalweg between two stumps. stake by a stump. VIEW From bottom looking up thalweg to top of excavation. Scale in thalweg.
37*	35	CSP B/W	Rx 9	FROM Bottom of excavation in thalweg. Stake in ground on side bank. VIEW From bottom looking up thalweg to top of excavation. Scale in channel at junction of three drains.
38*	35	CSP B/W	RX 10	FROM Bottom of excavation in thalweg. Stake on side bank. VIEW From bottom looking up thalweg to top of excavation. Scale in thalweg.
39*	35	B/W	R 9	FROM Taken from end of total outslope on right outboard edge of road. No stake, flag only. VIEW Back across outslope. Scale by drain across total outslope.
40*	35	CSP B/W	Rx 1	FROM Taken from right bank of bottom of excavation. Stake in ground. VIEW From bottom looking up thalweg to top of excavation. Scale mid-channel.
41*	35	CSP B/W	RX 2	FROM Taken from bottom of excavation in thalweg. Stake on right bank. VIEW From bottom looking up thalweg to top of excavation. Scale mid-channel.
42*	35	CSP B/W	Rx 3	FROM Taken from bottom of excavation in thalweg. Stake in ground. VIEW From bottom looking up thalweg to middle of excavation. Scale in thalweg.
43*	35	CSP B/W	Rx 3	FROM Taken from top of big rock on left bank near inboard ditch across from highest stump on right bank. Stake on rock. VIEW Looking downstream, photo point number 42 visible below. Scale in thalweg.

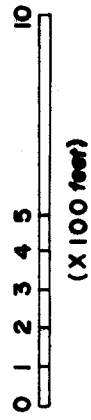
PHOTO POINT NUMBER	LENSE	TYPE	SITE LOCATION: WORKSITE #	DESCRIPTION:
44*	35	CSP B/W	Rx 4	FROM Bottom of excavation in middle of thalweg. Stake on stump on left bank 10 feet away. VIEW From bottom looking up thalweg to rock fall in channel. Scale on top of these rocks.
45*	35	CSP B/W	Rx 4	FROM Taken from top of left bank at road level. Stake in ground at base of cutbank. VIEW Looking across the stream excavation to total outslope on right bank. Scale at junction of two drains on the right bank total outslope.
46*	35	CSP B/W (M-5 Slope)	Sx 5	FROM Taken from top of excavation in thalweg. Stake 5 feet away on left bank by two alders. VIEW From bottom looking half way up the length of the channel excavation. Scale in thalweg.
47*	35	CSP B/W (M-5 Slope)	Sx 5	FROM Taken from top of excavation on right bank. Stake in ground. VIEW From top looking down the thalweg to bottom of excavation. scale on right bank midway down channel.
48*	35	CSP B/W (M-5 Slope)	Sx 1	FROM Taken from bottom of excavation in the thalweg. Stake on left bank 5 feet away. VIEW From bottom looking up thalweg to top of excavation. Scale in thalweg mid-channel.
49*	35	CSP B/W (M-5 Slope)	Sx 1	FROM Taken from the skid trail on the left bank. Stake in ground. VIEW Looking across the channel excavation to the right bank total outslope and seepy cutbank slope. scale standing on outslope.
50*	35	CSP B/W (M-5 Slope)	Sx 2	FROM Taken from bottom of excavation in thalweg. Stake on left bank. VIEW From bottom looking up thalweg to top of excavation. Scale in mid-channel thalweg.
51*	35	CSP B/W (M-6-1 Slope)	Sx 1	FROM Taken from left bank near thalweg. Stake 3 feet away on stump on left bank. VIEW From bottom looking up thalweg to top of excavation. Scale on right bank.
52*	35	CSP B/W (M-6-1 Slope)	Sx 1	FROM Bottom of excavation in thalweg by large alder. Stake is 15 feet away on left bank. VIEW From bottom looking up thalweg to top of excavation. Scale on large rock on right bank.

PHOTO POINT NUMBER	LENSE	TYPE	SITE LOCATION: WORKSITE #	DESCRIPTION:
53 A/B*	35	CSP B/W	ST-3	FROM Taken from the base of a stump in middle of total outslope. View "A" is toward Sx 1. View "B" is toward the northeast. Stake next to stump. scale mid-outslope in both views.
54*	35	CSP B/W	ST-4	FROM Next to stump on right side, outboard edge of road. Stake near stump. VIEW Looking across total outslope. Scale near drain below gully feeding total outslope.
55*	35	CSP B/W	Sx 5	FROM Taken from bottom of excavation on left bank 15 feet from thalweg. Scale in ground. VIEW From bottom looking two-thirds of the way up the thalweg. Scale near large stump on right bank half way up excavation.
56*	35	CSP B/W	Sx 5	FROM Taken from left bank quarter of the way down from top of excavation by a clump of alder. Stake in ground. VIEW Looking up at upper end of excavation. Scale on right bank.
57*	35	CSP B/W	Sx 4	FROM Taken from bottom of excavation in thalweg. Stake in thalweg. VIEW From bottom looking up thalweg to top of excavation. Scale on left bank.

REHABILITATION UNIT

86-3

MAP D:
REHABILITATION
TREATMENT MAP



LEGEND

R17

Rehabilitation site and number.
R - Haul road site, outslope reach.
S - Skid trail site, - x - stream crossing. - T - skid trail outslope reach.

Outline of haul road, including cut banks and sidecast.

Skid trails. Only those used for access to sites are shown.

Intermittent streams.

Perennial streams.

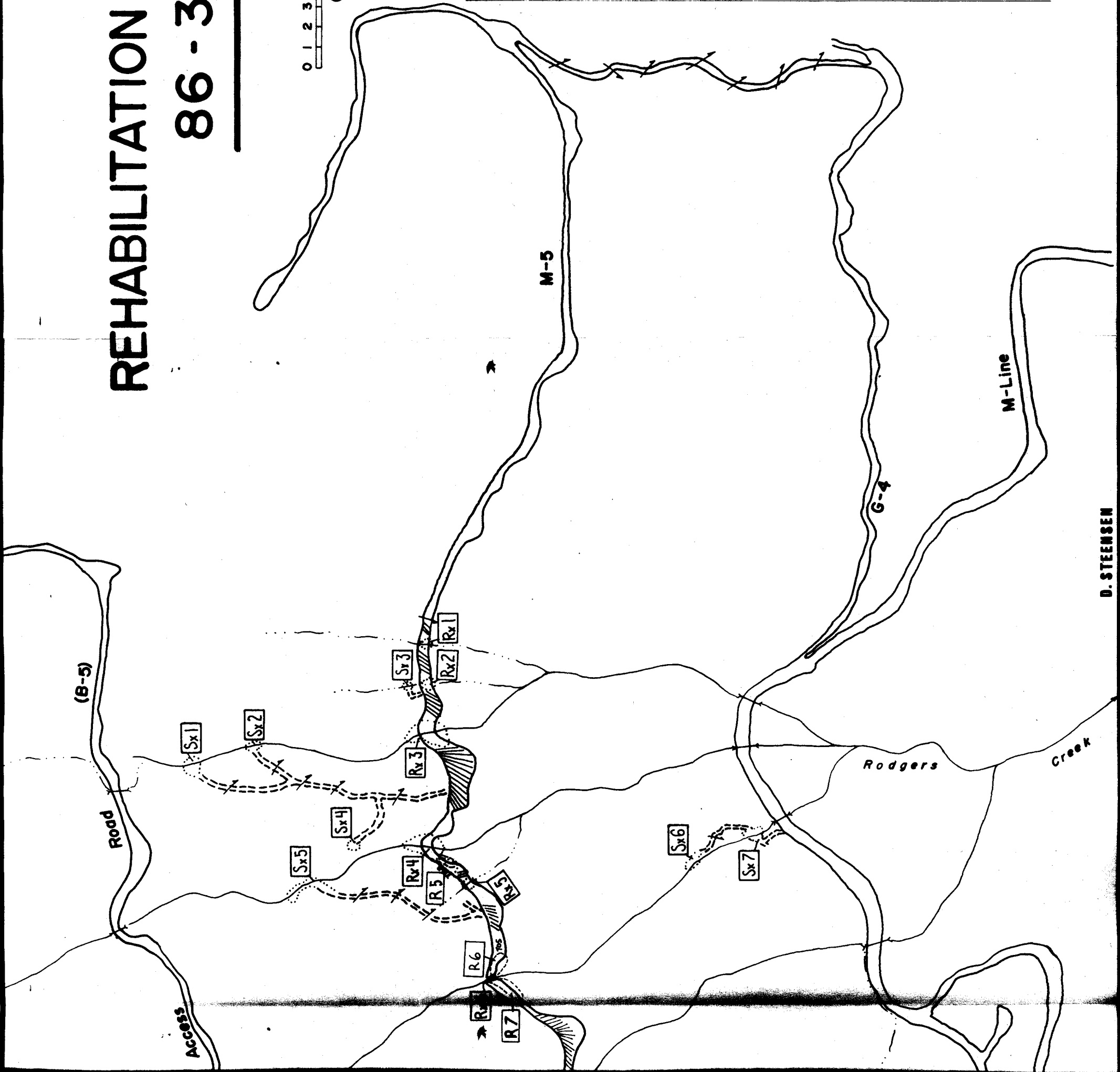
Gullied drainages.

Culvert.

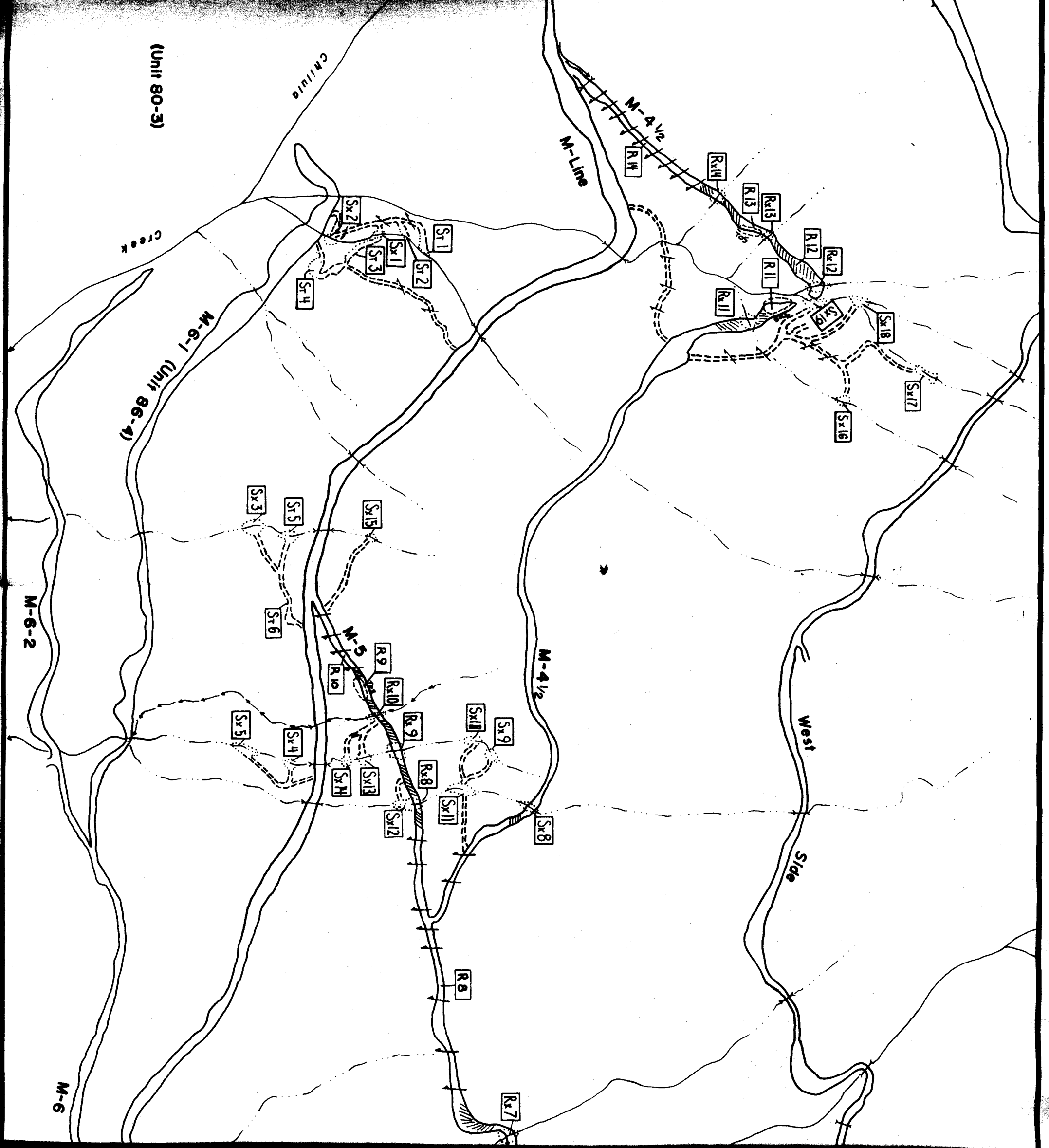
Cross road drain.

Total Outslope

Fillsite



D. STEENSEN



(Unit 80-3)



Unit: 86-3 Date: 8-6-1986, PP1 M-5 Rx-7 pre HE, 35mm, (LEJ)



Unit: 86-3 Date: 12-1-1986, PP1 M-5 Rx-7 post HE, 35mm, (LEJ)



Unit: 86-3 Date: 8-6-1986, PP2 M-5 Rx-7 pre HE, 35mm, (LEJ)



Unit: 86-3 Date: 12-1-1986, PP2 M-5 Rx-7 post HE, 35mm, (LEJ)



Unit: 86-3 Date: 9-8-1986, PP9 M-5 Rx-4 pre HE, 35mm, (LEJ)



Unit: 86-3 Date: 9-5-1986, PP9 M-5 Rx-4 action HE Back-blading "soup", 35mm, (LEJ)



Unit: 86-3 Date: 12-2-1986, PP9 M-5 Rx-4 post HE, 35mm, (LEJ)



Unit: 86-3 Date: 9-8-1986, PP10A M-5 Rx-3 pre HE, 35mm, (LEJ)



Unit: 86-3 Date: 9-1986, PP10A M-5 Rx-3 action HE, 35mm, (LEJ)



Unit: 86-3 Date: 9-1986, PP10A M-5 Rx-3 action HE, 35mm, (LEJ)



Unit: 86-3 Date: 12-1-1986, PP10A M-5 Rx-3 post HE, 35mm, (LEJ)



Unit: 86-3 Date: 9-8-1986, PP11 M-5 Rx-3 pre HE, 35mm, (LEJ)



Unit: 86-3 Date: 9-1986, PP11 M-5 Rx-3 action HE, 35mm, (LEJ)



Unit: 86-3 Date: 12-1-1986, PP11 M-5 Rx-3 post HE, 35mm, (LEJ)