

M-7 Road
and
Chilula Creek Culvert Replacement
Watershed Rehabilitation Project Summary Report

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TABLE OF CONTENTS

	<u>page</u>
List of Maps and Tables.....	ii
Introduction.....	1
M-7 and Associated Roads.....	1
Logging and Erosion History.....	1
Erosion Control Rehabilitation Work.....	2
Introduction.....	2
Heavy Equipment Work.....	2
Heavy Equipment Cost and Discussion.....	3
Labor Intensive Work.....	4
Chilula Creek Culvert Replacement.....	5
References Cited.....	14
Appendix (Materials on Archive File 88-9 at South Op. Cntr., Orick)	
Geomorphic Maps (one 5x of 1:6,000, 1978 color photo # 8-26)	
Field notes	

LIST OF MAPS AND TABLES

	<u>page</u>
Map A Site Location Map.....	7
Map B Logging History Map.....	8
Map C Erosion Treatment Map.....	9
Map D Geomorphic Map (blue line).....	in pocket
Table 1. Rehabilitation Work Cost Summary.....	10
Table 2. Miscellaneous Costs.....	12
Table 3. Summary of Costs for Chilula Ck. Culvert Replacement.	13

INTRODUCTION

This report is divided into 2 sections. The first summarizes the rehabilitation work on the M-7 and associated roads. The second discusses the replacement of the Chilula Creek culvert on the M-Line. These work areas are both within the Bridge Creek drainage of Redwood Creek and are approximately 9 air miles southeast of Orick, California (Map A). A 1,000 foot section of the M-7 road and a 350 foot section of the M-7-2 road were removed late in the 1988 watershed rehabilitation season. The cost of the M-7 rehabilitation project is \$18,842 (Table 1), and the cost of the Chilula Creek culvert replacement is \$3,093 (Table 3), which makes for a total of \$21,935 spent on Unit 88-9. Of this amount \$5,793 or 26% came from fee enhancement funds. The remainder came from funds which unexpectedly became available from other divisions at Redwood National Park during the last few weeks of the fiscal year.

The mapped area of this site encompasses approximately 13 acres of hillslope from Bridge Creek up to the M-6-2-1 road. In this area the M-7 road is quite close to Bridge Creek and is within the inner gorge of the creek. Elevation ranges from about 300 feet at Bridge Creek to 650 feet at the M-6-2-1 road. The area surrounding the M-7 was mapped for the 1986 rehab season, and that summer about a mile of the M-7 and a portion of the M-7-4 road were removed. For details on that site see the summary report for Rehabilitation Unit 86-1, M-7/M-7-5 Roads, Bridge Creek Basin by M. Kenning.

M-7 AND ASSOCIATED ROADS

Logging and Erosion History

Logging in the unit began in the mid 1950s when windfallen and streamside timber was removed using the creek itself as a road (Map B). Access to the creek was from the M-7 road or from some location upstream (Leslie, 1980 in-house report). The M-7 road was constructed through this reach by 1962, and the slopes above the road were harvested with bulldozers in 1972 or 1973 after the M-7-2 (a secondary unrocked haul road) and adjacent skid trails were constructed. Most of the slope was clear cut with only a few old growth trees remaining on the cutover areas.

Soils along part of the 1988 M-7 rehab unit are classified as Devils Creek and Elf Creek. These are described as having imperfect drainage, and as being susceptible to mass movement as well as fluvial transport (Popenoe and Martin, Soils of the M-7 Road at the Bridge Creek Crossing, 1985).

Skid trail construction had exposed many seeps along the cutbanks, which lead to the development of gullies and rills down the slope, most of which were less than 6 square feet in cross-

sectional area (Map D, 1:1200 scale blue line). The high density of skid trails above the M-7 and lack of natural channels made it difficult to find natural flow courses for all the emerging groundwater. The area along the road is underlain by a sheared black schist which, because of its relative impermeability and high clay content, tends to restrict the downward movement of groundwater. The saturated or near saturated condition of the overlying soil during the wet season causes a reduction in the shear strength of the schist and overlying soil and makes them susceptible to mass movement (Sonnevil et al, 1985). This is one explanation for the lack of natural flow courses in the rehab area. It is also quite probable that the intense logging operations obliterated any small, first order flow courses that may have existed.

EROSION CONTROL REHABILITATION WORK

Introduction

Heavy equipment erosion control work was accomplished by equipment rental contracts from September 19 through September 25, 1988. The two pieces of heavy equipment, a D-8 bulldozer with two rear mounted ripper teeth and a Case 220-B hydraulic excavator with a 2.75 yd³ bucket, were transported on a lowboy from the B-5-1-1 road (Unit 88-8). Equipment operators were Bill Campbell on the D-8 (owned by Twin Parks Lumber Co.) and Wendell Larkin on the excavator (a machine he rented from the local Case equipment dealer). These two operators have worked in the rehabilitation program for several years and are quite familiar with their machines and the type of work being done here at Redwood National Park.

Heavy Equipment Work

The starting point for this year's heavy equipment work was on the last exported outslope (EOS) reach of the 1986 site, where work was suddenly halted due to an unexpected zero in the rehab budget (Map B). Additional funding was allocated in 1986 to complete the remaining high priority work on the M-7, but the last 250 feet of this exported outslope reach was left unfinished. The unfinished part included the original road bench and some of the fill slope, which had survived 2 years of below normal precipitation without failure. The remaining material was approximately 100 feet from the Bridge Creek channel. It was thought highly likely that sediment would be delivered directly into the creek in the event of failure during a major storm. For this reason exported outslipping was again prescribed in 1988 in order to completely remove the remaining unstable material. The top of cut on the outslope was located at the bottom of the inboard ditch. Since steep slopes below the road (generally greater than 50%) and close proximity of the road to the creek

continued for several hundred feet further beyond where the work had been planned to end in 1986, this outslowing prescription was extended for another 600 feet up the road. Because much of the base of the cutbank contained too many seeps to allow local fill storage, the fill was moved 100-400 feet from the excavated area.

Generally the excavator and dozer worked together, with the excavator doing most of the digging and the dozer pushing to the fillsite. When the excavator was busy with hillslope work the dozer lowered the road bench (so the excavator would reach further), and pushed to the fillsite. The fillsites were ripped beforehand to a depth of 2 feet to improve infiltration.

The vertical depth of cut on the M-7 EOS varied considerably depending on the amount of perched, unstable fill, and on the distance of this fill from Bridge Creek. Also important to the cut depth was the location and volume of upslope surface flow. The shallowest cuts of 8 to 10 feet deep were near the north end where the road was veering away from Bridge Creek, and the slopes below were interspersed with benches. The deepest cuts (20-25 ft) were where surface flow from the upslope deep drains came down to the road.

Many bucked logs and stumps were encountered during excavation. Some of these were pushed to the fillsite, and placed on top of the completed fill pile. The large or more unwieldy pieces were placed locally by the excavator. A few large organics were left in place in locations where channelized flow crosses the M-7. Although these logs and root wads were probably pushed there during road construction, they are securely imbedded into the adjacent material and should now act as a stable knickpoint for surface flow.

Some hillslope erosion control work was also done on the M-7-2 road and on a skid trail between the M-7-2 and the M-7 roads. Road surfaces were decompacted using the ripper, then two Deep Drains, one on the M-7-2 road and one on the skid trail, were constructed to consolidate surface flow coming from several gullies and rills. In addition, the last 90 feet of the M-7-2 before its junction with the M-7 was outslowed to remove perched logs and fill and to blend with fillsite material on the M-7.

The excavator was used to move straw bales from several piles at the outboard road edge to the top of the cutbank. The straw was delivered to the site after heavy equipment work had begun. A total of 83 bales were moved in 0.75 hours. This represents a savings in time of several hours (and possibly a small savings in money) compared with using the Park labor crew for the task.

Heavy Equipment Cost and Discussion

This project was 74% funded by money which unanticipatedly became available from other divisions within the Park during the final 2

weeks of the fiscal year. It was one of a few areas needing rehabilitation work that had already been mapped and tentatively prescribed, and was thus able to be implemented at short notice. However, due to this rapid start up schedule and the necessity of finishing all work before the end of September, there was no time to survey the worksites for volume before heavy equipment work began. Therefore accurate cost per cubic yard and cubic yards per hour figures could not be calculated. Table 1 gives the cost of the treatments and the cost per linear foot of road. As can be seen, the vast majority of the cost (and volume) on this site came from the exported outslope (EOS) work on the M-7 road. The push distances on this EOS varied from less than 100 feet to nearly 400 feet, but for the most part ranged from 250 to 300 feet. This corresponds to a cycle time (push time plus return time) of 3.5 to 5 minutes for each pile of spoil provided by the excavator ($\sim 12 \text{ yd}^3$). This gives a production rate range (for both pieces) of 72 to 103 yd^3 per piece-hour which, when multiplied by 91.5 hours of total equipment time on the EOS, gives an excavated yardage range from 6,600 to 9,400 yd^3 .

This production rate estimate of 72-103 yd^3 per piece-hour is fairly good, but it could have been better as the excavator was not kept busy all the time on the EOS. This was due to the large bucket size (2.75 yd^3) on the excavator and the long push distances for the dozer. To have kept all the pieces busy would have required either another dozer or a smaller excavator. Another dozer would have increased the transportation charges (lowboy) as well as the site costs. Since the site was relatively small and was finished in a week no additional equipment was brought in.

Table 2 lists the Miscellaneous costs associated with this site. Access costs includes preparatory work to allow 4WD vehicle passage through a landslide excavation near the M-7-1 $\frac{1}{2}$ road, brushing, and reshaping the fill pile from the landslide excavation. Time spent travelling for refueling and refueling times were paid due to the long but unavoidable distances from work sites to fuel trailer. Fuel from the supplier had to be transferred to the trailer at the landslide excavation because the supply truck could not cross the steep trail over the landslide, which was about a half mile from the work site.

Labor Intensive Work

This work involved delivering and spreading 83 bales of straw along the M-7 by members of the Park labor crew and Redwoods United. Spreading was finished in one day and the total labor cost for delivery, spreading, and travel came to \$733. The cost for straw from the supplier was \$260 (\$3.13/bale). This made for a total labor intensive cost of \$993 or \$11.96/bale (Table 1). This fairly high per bale cost was due to both the small number of bales used and to the large number of people involved in spreading.

Chilula Creek Culvert Replacement

Rehabilitation project Unit 88-9 included the removal and replacement of the culvert located on the M-line at the Chilula Creek crossing. The old pipe was found to be rusted through on the bottom for the entire length. Flow going through the pipe was falling through and reappearing in an eroded channel developed under the half round at the pipe outlet. Due to the large size of the pipe and the depth of the excavation required to remove the pipe it was necessary to do the work with a large hydraulic excavator.

The replacement culvert (5 ft. diam. CMP) was salvaged from a crossing on the 2010 Road during rehabilitation of that site in 1981. The replacement culvert consisted of 3 lengths, each 20 feet long. It was in fine condition with surficial rust and some reshaping toward oval. New bands and bolts were used to secure the lengths together. The original half round at the outlet was salvaged and reattached to the replacement pipe as an energy dissipator.

The drainage area above the culvert is 196 acres. The 50 year storm discharge, determined using methods outlined in Campbell & Sidle (1986), is 104 cfs. The original 5 foot diameter culvert was of sufficient size to pass the 50 year return period storm flow. The fill slope and channel below the culvert outlet is well supported by abundant large (3-6 ft. diameter) logs and some large (3-5 ft. diam.) rock. It was best, both erosionally and economically, to continue using the flow course for the culvert outlet, even though the culvert is offset from the natural flow course. This decision was made assuming that the current plan of removing the M-line in the near future will be realized.

Approximately 400 cu. yds. of road fill was excavated to allow removal and replacement of the culvert. Actual heavy equipment time took 9.5 hours to excavate, remove, replace and fill back in and smooth the road crossing. Miscellaneous tasks (disc., down time paid, moving and breaks) took 2.75 hours (see summary of costs, Table 3).

Total cost for the replacement of the pipe at Chilula Creek was \$3,093. The expenditures are summarized in Table 3.

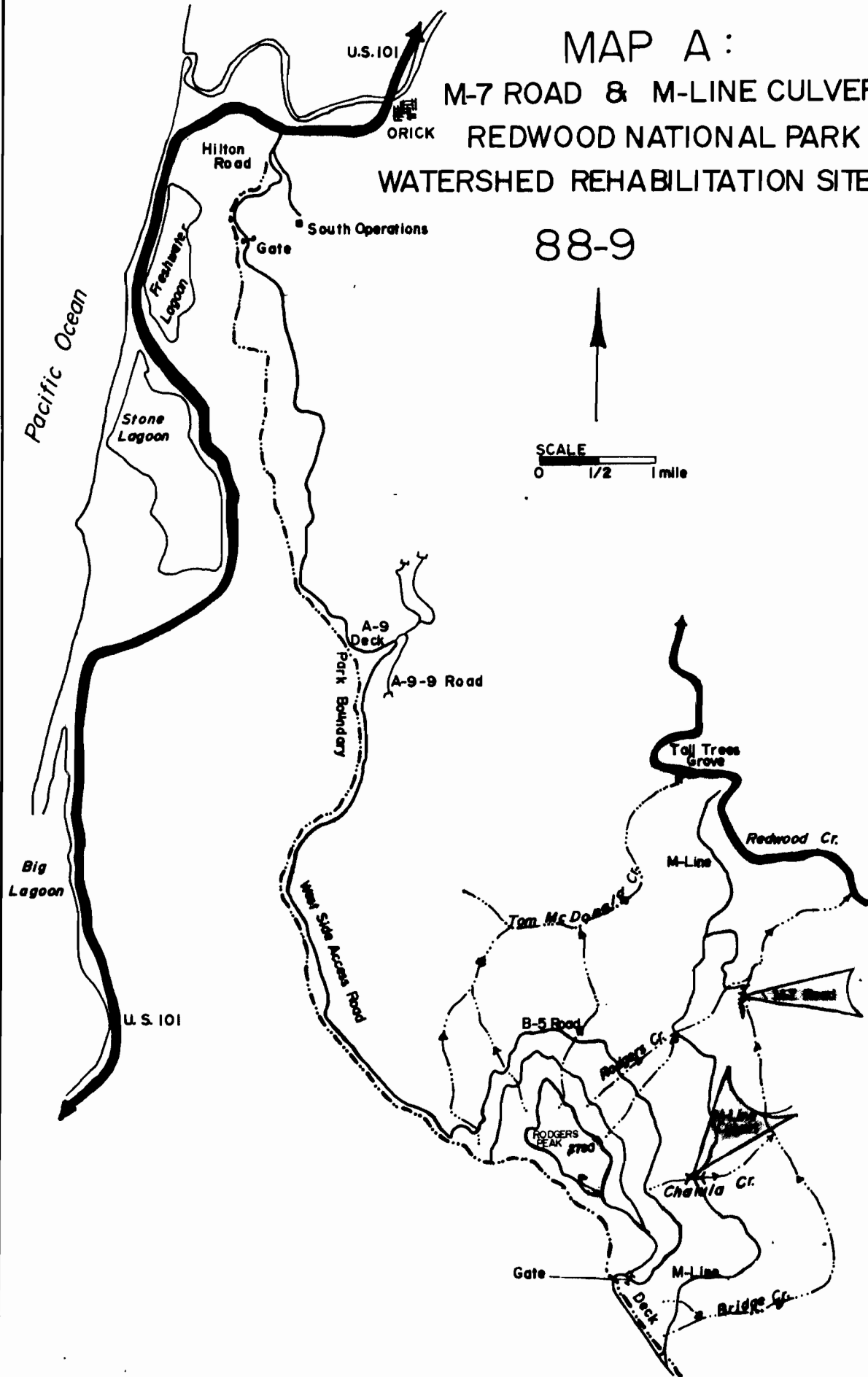
Cost comparison for using new pipe purchased at Hilfiker Pipe Company in 1988 is shown on Table 3. The costs for labor, geologists and delivery of materials is estimated to be less than when using recycled pipe due to easier installation with new pipe. The park saved \$500 by reusing old, good condition pipe at Chilula Creek.

However, complications arose at the project with trying to fit the replacement culvert back together. A large percentage of the total project time was consumed with the difficulty of attaching the collars at the pipe connections and establishing a secure fit with minimal chance of leaking. There was a significant distortion of the pipe due to reshaping over time while buried in the road fill on the 2010 Road. The three sections of the pipe had ends shaped in varying degrees of oval. Effort was made to match up the ends as they had been matched at the 2010 so as to match up the same oval shapes.

We were somewhat successful with the matchup. However, we were challenged with attaching the matching oval ends with new "round" collars. It was necessary to apply a lot of strength and dexterity on the part of the labor crew and very skilled finesse by the excavator operator (Wendell Larkin) to maneuver the pipe fractions of inches into place.

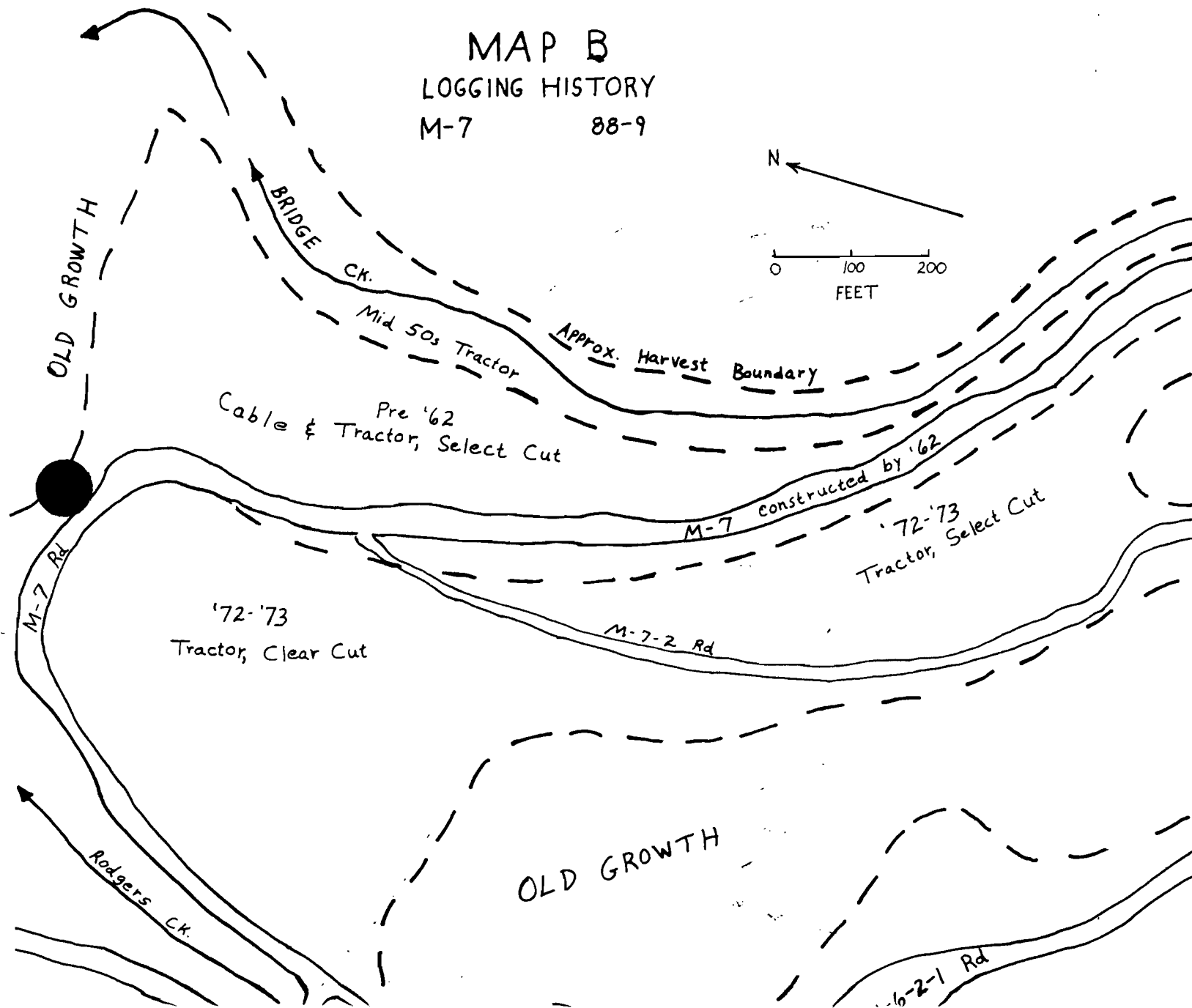
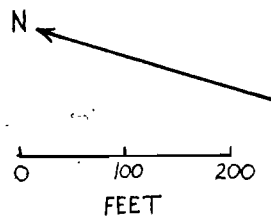
MAP A : M-7 ROAD & M-LINE CULVERT REDWOOD NATIONAL PARK WATERSHED REHABILITATION SITE

88-9



Map 95

MAP B
LOGGING HISTORY
M-7 88-9



MAP C EROSION TREATMENTS

M-7 88-9



TABLE 1

REHABILITATION WORK COST SUMMARY

Rehab Unit 88-9 M-7 Road

HEAVY EQUIPMENT WORK:

<u>Primary Treatments</u>	Equipment D-8	Hours ¹ 220-B	Cost	Road Length Treated	Avg Cost per ln-ft	Avg Dist to Fillsite (one-way)
2 Deep Drains	-	1.75	\$210	-	-	30 ft
Exported Outslope, Blade Endhauled on M-7	52.00	39.50	\$9,652	850 ft	\$11.96	300 ft
Outslope on M-7-2	-	0.50	\$60	90 ft	\$0.67	-
2 Cross-Road Drains	0.50	0.25	\$77	~ 100 ft total length	\$0.77	-
Ripping	1.0	-	\$94	950 ft	\$0.10	-
<u>Total Primary Treatments</u>	<u>53.50 Hrs</u>	<u>42.00 Hrs</u>	<u>\$10,093</u>			
<u>Secondary Treatments</u>						
Move 83 bales of straw with excavator		0.75 Hrs	<u>\$90</u>			
<u>Miscellaneous Costs</u>	(See Table 2)		<u>\$4,414</u>			
TOTAL M-7 HEAVY EQUIPMENT COST:			\$14,597			

¹ Hourly rates are: D-8 = \$94.47; 220-B = \$120

TABLE 1 (Cont'd)
REHABILITATION WORK COST SUMMARY
Rehabilitation Unit 88-9 M-7 Road

	Total Cost	Person-hours
LABOR INTENSIVE WORK:		
<u>Secondary Treatments</u>		
Straw Mulch (83 bales) ²	\$993	94
Total Labor Intensive Work	\$993	94
TECHNICAL WORK:		
<u>Evaluation of Rehab Unit³</u>		
Prescribe Treatments	\$350	24
<u>Supervision of Work⁴</u>		
Heavy Equipment	\$1,110	83
<u>Documentation</u>		
Summary Report	\$1,792	111
Total Technical Work	\$3,252	218
TOTAL M-7 REHABILITATION COSTS:	\$18,842	

² Straw Mulch includes the initial bale cost and delivery @ \$3.13 bale, plus the cost of distribution and spreading by NPS labor crew and Redwoods United.

³ Mapping done by D. Vann as part of Rehabilitation Unit 86-1.

⁴ Supervision and Documentation done by M. Kenning and D. Short.

TABLE 2
MISCELLANEOUS COSTS
Rehabilitation Unit M-7

Category	D-8 ¹ Ripper	220-B ² Excav	Total Cost
Discussion	4.00 hrs	4.50 hrs	\$918
Paid Breaks	3.00 hrs	2.50 hrs	\$583
Travel	2.00 hrs	3.25 hrs	\$579
Access ³	8.00 hrs	2.25 hrs	\$1,026
Fuel	1.00 hrs	1.00 hrs	\$214
Idle	-	0.75 hrs	\$90
Down Time (Paid)	-	1.75 hrs	\$210
Move In/Out ⁴	-	-	\$794
TOTALS	18.00 hrs	16.00 hrs	\$4,414

¹ Hourly rate for the D-8 = \$94.47

² Hourly rate for the excavator = \$120

³ Access includes work on the landslide excavation and clean-up near the M-7-1¹/₂ for vehicle passage, and brushing on the M-7-2 road and skid trail.

⁴ Includes transport to Chilula Creek. Costs split between B-5-1-1 (88-8) and C-20 (88-10). D-8 costs = \$253; 220-B costs = \$541. Part of 220-B move out has been estimated due to delay in receiving invoice.

TABLE 3
Summary of Costs for
Chilula Creek Culvert Replacement

	Actual		Comparison ¹	
	Hours	Cost	Hours	Cost
HEAVY EQUIPMENT				
Excavation and replacement Cost	9.50	\$1,110	4.50	\$540
Miscellaneous Costs	2.70	330	2.75	330
Total Heavy Equipment Costs		\$1,440		
LABOR INTENSIVE				
Labor Support (2 @ 11.5 hrs)	23.00	\$274	13.00	\$155
Geologists (1 @ 18.0 hrs)				
(1 @ 6.0 hrs)	24.00	400	13.00	182
Straw Mulch	8.00	93	--	93
Construct Trash Rack	30.00	341	30.00	341
Total Labor Intensive		\$1,108		
MATERIALS				
Hauling CMP from K&K to M-Line	12.00	\$157	New Pipe	\$1,603
Collars and Bolts	--	130	--	130
Delivery of Collars and Bolts	3.00	39	--	--
Straw (6 bales)	--	19	--	19
Total Materials		\$345		\$1,752
TECHNICAL WORK				
Prescription & Report	14.00	\$200		\$200
Supervision of Work ²				
TOTAL COST FOR PROJECT		\$3,093		\$3,593

¹ Comparison of expected costs if the project had included a new 5 ft. diameter CMP as opposed to recycling a pipe excavated at other rehabilitation project.

² Supervisor functioned primarily as laborer. This item included in labor intensive phase.

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- Sonnevil, R., Klein, R., La Husen, R., Short, D., and Weaver, W., 1985, Blocksliding on Schist in the Lower Redwood Creek Drainage, Northwest California in Redwood Country, American Geomorphological Field Group, 1985 Field Trip Guidebook, p. 139 - 154.

Fee Enhancement Funding: Statement of Accomplishments.

Fee enhancement funds were used in the rehabilitation of a portion of the M-7 and M-7-2 roads (Unit 88-9). These roads were located in the inner gorge, and were a potential sediment source to the creek.

Geomorphic mapping of this area was completed in preparation for other work on the M-7. Erosion control treatments were prescribed in early September, 1988. Heavy equipment was rented in late September to implement the prescriptions. Following heavy equipment work, straw mulch was placed over the disturbed ground using the National Park Service labor crew and Redwoods United. Finally, heavy equipment and NPS labor were used to replace a badly rusted 5 foot diameter culvert on the M-Line at Chilula Creek.

Total costs for Unit 88-9.....\$21,935
Total Fee Enhancement Funds Used for Unit 88-9...\$5,793