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WATERSHED REHABILITATION REPORT

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CREEK (BIG TREE)

(SITE 80-1)

by

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INTRODUCTION

1. Purpose and Scope.

The purpose of this report is to document the rehabilitation work performed on Rehabilitation Unit, Site 80-1, South of Copper Creek (or 1920 Road slope), Redwood National Park. The history and philosophy of the Watershed Rehabilitation Program of Redwood National Park has been summarized by Weaver and others (1979) and Kelsey and others (1979).

The scope of this report is to summarize the cost and evaluate the cost-effectiveness of the rehabilitation work performed. An evaluation of the erosion-control effectiveness will require several runoff seasons in order to be analyzed. The report will briefly describe the physiography and silvicultural history of the Rehabilitation Unit. The rehabilitation work is divisible into three phases: Preliminary, Heavy Equipment, and Labor Intensive Phases. The preliminary phase includes geomorphic mapping, erosional processes and sediment-source areas, erosion control prescription, and photographic documentation. The heavy equipment and labor intensive phases include applications and costs.

2. Location and Description of Rehabilitation Unit.

Rehabilitation Unit, Site 80-1 occurs in the southeast corner of the Redwood Creek Unit of Redwood National Park near the south park boundary (Fig. ____). The rehabilitation unit encompasses most of the physiographic unit on which it occurs. (Fig. ____).

The physiographic unit is a large (____ acres) side slope area which drains directly into Redwood Creek. The unit is bounded on the north by slopes which drain into Copper Creek, and to the south and southeast by slopes which drain into either Redwood Creek or Coyote Creek. Drainage

of the area is westward by a deeply incised 2nd order perennial stream and numerous, intermittent to ephemeral streams (Fig. ____). The hill-slope is extremely steep (30-100+%) in the upper two thirds, but is gentler (20-40%) in the lower on-third (Fig. ____). Total relief is about 2,400 feet from Redwood Creek to the ridge top.

The rehabilitation unit encompasses the portion of the slope between the K & K road and Lyons Ranch road (Fig. ____). Total area within the rehabilitation unit is approximately ____ acres.

3. Timber Harvest History

The timber harvest history of the physiographic site is divisible into four periods. Early harvesting occurred between 1958 and 1962 in the lower hillslope regions below and adjacent to the K & K road. During this period, the K & K construction was completed across the unit (Nolan and other 1979). Some harvesting occurred along the 1900 road system and on slopes adjacent to Copper Creek drainage area. The style of logging appears to have been relatively small clearcut and selective tractor yarding. Virtually all of the hillslope below the K & K and most below the 1900 road were logged during this interval.

The second period of harvesting occurred between 1966 and 1967. Most of this logging was below and adjacent to the K & K road and 1900 road. Only a few new areas were logged and most were re-cutting of residual stands of trees on the previously cut areas. Tractor logging remained the dominant practice.

The third period, 1969-1972, continued the cutting of residual stands along with a few new areas. Tractor logging remained the dominant

practice although some cable-yarding may have occurred in steep slopes adjacent to Redwood Creek.

The final period of logging, 1973-1975, encompasses the largest areas cut at one time on the unit. The entire middle third of the unit was cut during this three year period. The north and south spurs of the 1700 road and the 1920 road were constructed at this time. Tractor yarding was used above the 1920 road, in the southern two cut blocks, and upslope of the north spur of the 1700 road. Cable yarding was done below the 1920 road to the north, although tractors were used to construct some layouts in the downslope regions (Harden and others, 1978). Cable yarding was also used below the end of the north spur of the 1700 road. The only additional areas cut in this period straddled the K & K at the toe of the small prairie at the south end of the unit.

Additionally, the upper slope regions surrounding Lyons Ranch have also been selectively tractor yarded, although when this occurred is not known. (~~1972~~⁻⁷³). Excluding the prairie/oak areas, virtually the entire physiographic unit has been logged at least once and in many areas several times. Except for a few residual stands of Douglas fir adjacent to the prairies, and redwoods adjacent to Redwood Creek, the old growth forest has been completely removed by logging.

REHABILITATION WORK

1. Preliminary Work

The preliminary work phase of rehabilitation is the inventory and evaluation of the geomorphic processes occurring on the site.

From this evolves a site specific rehabilitation plan to address various erosional processes and sediment source areas.

a) Geomorphic Mapping

The geomorphic mapping of this site was done between mid-February and late April, 1980. Survey of the area was initially done using

1:6000 color aerial photographs taken in 1978. Detailed field mapping was done using 5x enlargements of the 1:6000 photos or a scale of 1-inch equals 100 feet. At this scale locations can be made to within five feet, depending upon vegetal cover.

Geomorphic mapping encompassed the entire Rehabilitation Unit from the K & K road to Lyon's Ranch road. Field reconnaissance and some mapping of the area below the K & K was made, but it was decided to exclude this area from the rehabilitation unit. This decision was made because of the complexity of the geomorphic processes, the size of the features, and inaccessibility of the area. This area below the K & K will be mapped in 1981.

b. Erosional Processes

The dominant erosional processes in the Redwood Creek basin are fluvial [?]time and mass wasting. Fluvial erosion is that caused by running water regardless of whether it is flowing in natural channels or not. The main fluvial erosional processes are rilling, gulling, downcutting, side cutting, and undercutting. Mass wasting erosional processes are movement of masses induced by gravity and dependent upon the type of material involved and amount of water present. The dominant mass-wasting processes are creeping, [?]avalanching, slumping, sliding and flowing. Obviously, interaction between and overlapping of fluvial and mass-wasting erosional process is possible.

From the geomorphic mapping, it become apparent that on the Rehabilitation Unit fluvial erosion was of secondary importance to mass wasting. In most cases where fluvial erosion was occurring, mass wasting process were responsible for the continual

supply of erodable material. The one area of exception to this was at the northern end of the unit above the K & K where some marginally active gulleys occurred. Elsewhere on the site, major, active sediment sources were locations where streams were adjacent to or traversing across active mass wasting features.

The reasons for the dominance of mass wasting processes are multifold, and include slope aspect, drainage infiltration rates, and lithology. The slope aspect of the unit is a west facing, triangle whose base is on Redwood Creek and whose apex is on the ridge line above Lyon's Ranch. Because of this the higher elevation (above 2000 feet) headwater area on the prairies is fairly limited (Fig. ____). Additionally, west facing slope orientation may decrease precipitation and/or runoff by micro-climatic and orographic effects.

Drainage on the unit is only moderately developed and relatively poorly integrated. On the central perennial stream, which drains most of the headward area, is well incised. The two, smaller intermittent stream systems at the southern limit of the area and which drain the remaining prairie area, are moderately incised. The remaining intermittent to ephemeral streams are only slightly incised and have much smaller drainage areas. The headwater areas of all these streams occur on the middle slope region.

Infiltration rates are also high for the upper half of the unit from about the 1,000 foot center line upslope. While this area has, relatively, poorly defined drainage, little evidence exists of surface flow or erosion (rilling or gullying) on this portion of the slope. This infiltration rate is apparently controlled by

the underlying lithology which in this upper region is dominated by slightly metamorphosed sandy siltstones, sandstones and argillaceous material. The soil developed on these rocks also tend to be more permeable. The lower half of the slope is underlain by more highly metamorphosed argillaceous material (Francian Schist) with lower infiltration rates and less permeable soils. The contact between these two rock types is defined as the Grogan Fault (Kelsey and other 1979) along which the rocks are highly fractured and sheared. The fault trends nearly due north across the unit and occurs approximately between the 800--1000 foot contour interval ().

In the upper portion of the unit, (above 1000 foot) mass wasting is dominated by shallow, landslides, rock and debris avalanches occurring on steep hillslopes and stream side slope. The stream-side features occur predominately along the perennial and two moderately incised intermittent stream channels. These appear to have been slope failures which were not induced by fluvial processes, but may be presently aggravated by fluvial erosion at their toe. The prairie areas at top of the unit also undergo soil creep and some earthflow movement.

The lower slope areas are dominated by more complex mass movement features, which include landsliding, slumping, and compound earthflows. The features in the upper portion have been caused by combinations of steep terrain and high infiltration rates with decreased transportation, ground disturbance, and declining root strength after timber harvest.

These features, especially the earthflows, have complex processes of slumping and flowing. The activity of these features tends to be long term and somewhat erratic. They have contributed large volumes of sediment into Redwood Creek and continue to be eroded by streams traversing or adjacent to them. Redwood Creek tends to keep, at least their lower portions, active by undercutting their toes.

The causes of these features are probably the combination of highly sheared bedrock (Franciscan Schist) and increased ground saturation by increased infiltration and runoff, and decreased transpiration following timber harvest.

Undoubtedly, this lower portion of the slope has been subjected to older naturally induced mass movements which have been reactivated and accelerated by recent landuse practices. Evidence for previous mass movements in this area has been noted by Coleman (1973) and Harden and others (1978). During the mapping of the rehabilitation unit, evidence of previous mass movement were seen in the form of 'tread and riser' topography, old scarp traces, and hummocky ground. Additionally, the southern-most, moderately incised, intermittent stream channel may be scarp influenced. The stream cuts across the slope trend, appears partially topographically inverted (i.e. occurs along a ridge crest), and was apparently being abandoned prior to timber harvest.

Sediment Source Areas

Active Source Areas

Active sediment source areas on the rehabilitation site occur predominately along the perennial stream and the two southern intermittent stream systems. Along the perennial stream, several adjacent landslide areas are the major sediment sources. These contribute sediments directly through mass movement and by fluvial erosion of their toes.

In the south, the northern stream has secondary sediment sources from partially active landslide features. Additional minor source is where the stream traverses the small earthflow below the south spur 1700 road. The southern most streams had a major source area where they crossed the skid road at the end of the south spur 1700 road. This area was complicated by active slumping adjacent to the stream. Downstream, major sources occurred as small stream bank mass movements and gulling as the stream flowed marginal to the Devil's Creek earthflow.

Potential Sediment Sources.

Potential sediment sources are presently active minor sources which may increase with time, or sources which may form by continued evolution of geomorphic processes. The two types identified on the site are associated with haul roads or on hillslopes. The haul road sources are related to drainages-crossing roads and road drainage. Drainages-crossing roads are areas where streams or gullies cross haul roads either by culverts, humboldt crossings, or depressions. These may cause further

erosion of the road fill or of downslope areas. Road drainage is related to concentration of runoff and saturation both of which can cause erosion of road fill or downslope areas.

Hillslope sources are related to skid trail crossings of flow courses, drainage redirection, and ground saturation. Skid trail fill. Drainage redirection is caused by changes in water flow paths to cause gulling and rilling. Ground saturation may cause initiation of mass movements of any type.

Erosion Control Prescription

From the geomorphic mapping and an evaluation of the erosional processes and sediment source areas, an erosion control prescription was developed for the unit. The three main portions of the prescription were: 1) to improve drainage above the 1700 road, 2) to improve drainage along the 1700 road, and 3) to improve drainage along the 1900 road.

To improve drainage above the 1700 road, a sequence of skid trail crossings were to be excavated along the three intermittent stream channels. Additionally, several ditches were to be excavated to direct spring and stream flow into a more favorable flow courses. The reasons for these prescriptions were to remove skid trail crossings fills, and decrease infiltration from stream channels and springs. It was believed that by redirection and cleaning flow channels increases runoff and decreased infiltration could alleviate some mass wasting processes further downslope.

To improve drainage along the 1700 and 1900 roads, drainage crossings would be excavated and closely spaced drains constructed to decrease runoff concentration. Additionally some drainage of

wet areas could be constructed to alleviate some mass wasting processes occurring along and below the roads.

Site specific areas (Fig. _____) were defined as work sites and size, type of excavation determined. From this, the types of heavy equipment needed were determined and estimated lengths of times required to complete work sites. Additionally, the site specific areas were prioritized in terms of sediment source areas, and difficulty in completion, so that, if necessary, the less critical sites could be deleted. From this, the sequencing of rehabilitation work for the heavy equipment was planned and total time of work estimated.

Photographic Documentation

The final steps in the preliminary rehabilitation work was establishing photo points on critical or representative work sites. The photo points consist of staked, numbered locations from which photographs of the pre-heavy equipment worksites were taken. Generally, an individual Black and White and color photograph was taken. At some sites stereo color photo pairs were taken. Views were generally up and downstream of flow course crossings, and up and downslope along road reaches. Larger features such as landings or outsloping, were taken from advantageous locations for best effect.

Following rehabilitation work, the photo points were reoccupied and another sequence of pictures taken. Several photo points were destroyed during heavy equipment work, i.e. buried or

excavated, and several abandoned for more advantageous views.

Continued photography in the future will be made to document the changes in terms of revegetation and erosion at the work site with time.

2. HEAVY EQUIPMENT WORK

The heavy equipment phase of the rehabilitation work extended for eleven weeks from June 30 to September 11, 1980. The majority of work was done by two backhoes, a D-6 bulldozer, and a crawler crane. Additional equipment used for brief periods was a TEREX bulldozer, a TD-25 bulldozer, a small trailer, and several dump trucks. The types, prices, and total costs of equipment are shown in Table ____.

a. Heavy Equipment Application

The application of heavy equipment on this site was used for four main functions: stream clearance, directional drainage, mass redistribution, and stream protection. The purpose of these four functions are directed at erosional processes and existing, or potential, sediment sources. The processes and sources may overlap between the functions.

1) Stream Clearance

Stream clearance is the physical removal of organic and inorganic debris from flow courses. The debris may have been placed by naturally occurring processes, or by silvicultural processes, or a combination of the two. The flow courses may be natural stream channels or man-induced channels, both of which may range from perennial to ephemeral. The two types of stream clearance performed on this site were skid trail crossings and stream crossings.

a) Skid Trail Crossings

Skid trail crossings are small prisms of debris pushed into flow courses by tractors during timber harvest. Because of steep terrain, narrow tractor trails, and limited work area, access to skid trail crossings for heavy equipment is difficult. On this

TABLE _____
EQUIPMENT LIST, PRICES, AND TOTAL COSTS

Contractor	Equipment	Cost/Hour	Total Cost
David Parr	'65 CAT D6 crawler tractor with hydraulic blade and winch	\$38.00	\$19,356.75
Dale Lesina	J.D. 410 backhoe with 4-in-1 loader bucket and Digmore extension	\$32.00	\$14,527.00
Ben N. Young A-1 Service Company	Case 580B backhoe	\$35.00	\$15,252.50
Cark Kjer and Sons	22-B Bucus Erie crawler crane with dragline and clamshell buckets	\$77.50	\$21,170.50
C & O Construction	TEREX Rip Cat	\$74.50	\$1,117.50
TED Construction	TB-25	\$76.00	\$912.00
David Parr	Trailer	\$50.00/day	\$250.00
TOTAL COST			\$72,586.25

site, treated skid trail crossings were excavated by the backhoes with the assistance of the D-6 crawler tractor. The D-6 tractor was necessary to clear obstacles from and smooth skid trails for the backhoes to move between sites. Additionally, in steeper stretches of skid trails, the tractor was required to assist the backhoes up or down by winching or towing. The tractor cleared the skid trail crossings of brush and debris, and started the excavation. At many skid trails crossings, it was necessary that the tractor push the backhoe-excavated material out of the way. This spoil material was either outsloped along the skid trails or piled in areas outside of the flow course. Often the backhoe would have to move out of the area to allow room for the tractor to work the spoil material.

Some small skid trail crossings required only a backhoe to complete excavation, and several were done using only the D-6 tractor.

- Several larger skid trail crossings required the constant presence of the tractor, and a few needed the two backhoes and the tractor at the same time.

b) Stream Crossings

Haul roads and skid roads crossing natural stream channels or large gulleys are termed stream crossings. On this site, most stream crossings were excavated by the backhoes because of their small sizes. The spoil from these small crossings were generally outsloped on the haul road immediately adjacent to the crossing. Two adjacent, large skid road crossings were excavated using the D-6 tractor and crane. Final channel shaping was done by the backhoes in one, and the D-6 tractor in the other. Because of lack of storage space at these two crossings, the crane-excavated

spoil was pushed to and piled on a nearby landing by the D-6 tractor. The final shaping of one channel was done by the D-6 tractor and the spoil pushed downstream to an out-off channel flat area.

2) Directional Drainage

Directional drainage is the deliberate direction of waterflow away from present flow path. The purpose may be to direct water into a more favorable flow course, remove water from a saturated area, disperse water, or increase infiltration. The four types of directional drainage performed on this site were ditches, crossroad drains, waterbars, and ripping (decompaction) of road fill.

a) Ditches

Ditches are excavated or constructed to direct water into a more favorable flow course. Most ditches on this site were excavated to drain high outflow springs into adjacent flow courses. Several were constructed to direct surface flow into more favorable flow courses. One ditch was excavated to channel stream flow between two skid trail crossings and divert flow out of a gully. Most of the ditches on this site were excavated by the backhoes with assistance by the D-6 tractor. Several were constructed solely by the tractor.

b) Cross Road Drains

Cross road drains are relatively shallow excavations across haul roads to disperse surface flow from the road surface and to minimize concentration of surface flow and cut-bank spring water in the inboard ditch. The drains are constructed at close intervals depending upon the inflow pattern into the inboard ditch. Generally, the spacing is from twenty to fifty feet

apart. The cross road drains are excavated so water will flow across the road fill and energy dispersal of rocks or slash placed at their mouths. The cross road drains on this site were excavated by backhoes except for a few shallow ones constructed by D-6 tractor.

c) Water bars

Water bars are shallow excavations across skid trails or roads to capture surface runoff or spring flow and direct the water off the road surface. At the waterbar outlet, an energy dissipator of rocks or slash is placed. Most waterbars on this site were constructed by the D-6 tractor, although a few were made by a backhoe.

d) Ripping (Decompaction) of Road Fill

The ripping (or decompaction) of road fill is done to increase infiltration and decrease surface runoff decreasing rilling and gulleying. Additionally, decompaction provides a looser soil for more rapid revegetation of road surfaces. Two large bulldozers, TD-25 and TEREX rip cat, were used at separate periods to rip the road surface on the site.

3) Mass Redistribution

Mass redistribution is the removal of material sidecast to form road surfaces and landings where this material's mass is contributing to slope failures or mass movements. The two types of mass redistribution performed on this site were landings and outsloping.

a) Landings

The over-steepened, outward edges of all the landings on the site were pulled back in part. The spoil material was piled at the back of the landing and outsloped. Landing L-1 was only

partially outsloped by the crane. The remaining three landings were outsloped by the backhoes and D-6 tractor. Some preliminary outsloping was done on L-3 by the TD-25 bulldozer.

b) Outsloping

Outsloping was done only on a few small portions of road where the road fill was contributing to and involved in slope failures. This work was done by a backhoe with some preliminary and assisting work by the D-6 tractor.

4) Stream Protection (Rocking)

The only form of heavy equipment stream protection was the placing of rock (rip-rap) into excavated stream crossings. The rock was hauled to the site by several dump trucks and unloaded near stream crossings to be excavated. Along the 1900 road, the rock was placed in the channel by backhoe. At SC-2 the rock was unloaded directly into the excavated stream crossing and placed by backhoe and crane. At SC-3, rock was unloaded on L-1 and moved by the D-6 tractor and backhoe to the crane which placed it within the channel.

b. Heavy Equipment Costs

Heavy equipment costs include the cost of heavy equipment rental, but does not include Redwood National Park costs for personnel and administration. The cost of RNP field personnel will be treated in a later section. Heavy equipment costs are divisible into three main categories: Access, site specific, and miscellaneous costs.

1) Access Costs

Access costs (Table _____) include items not readily divisible between the site specific areas, preliminary work necessary for access to the site as a whole, dispersal of material for labor intensive work, and bridge construction.

TABLE ACCESS COSTS

	D-6		JD 410		580 B		B.E. 22		OTHER		TOTALS
	HRS	COST	HRS	COST	HRS	COST	HRS	COST	HRS	COST	
LOW BOY	Move In	\$ 170.00		\$ 189.00	5.0	\$ 175.00					
	Move Out	148.75		210.00		150.00		\$ 168.00			
	Subtotal	318.75		399.00		325.00		168.00			\$1210.75
ROAD CLEARANCE	1900	228.00									
	1700	380.00									
	Subtotal	608.00									608.00
BRIDGE CONSTRUCTION	1800	114.00									
	Bridge	665.00									
	Subtotal	779.00									779.00
EQUIPMENT ACCESS	18.5	703.00	7.0	224.00	9.0	315.00	5.0	387.50			1629.50
	6.75	256.50	8.0	256.00	8.0	280.00					792.50
MATERIALS ACCESS	32.5	1235.00							TRAILOR		1485.00
									\$250.00		
EQUIPMENT TOTALS		3900.25		879.00		920.00		555.50	250.00		GRAND TOTAL: \$6504.75

a) Move In/Move Out

Move in/move out costs are those of bringing the heavy equipment to the site to begin work and removing the equipment at the end of the work. Some equipment worked solely on this site while several moved between different rehabilitation sites.

b) Road Clearance

Road clearance costs are those of re-opening the 1700, and 1900 roads to provide access for other equipment, material distribution, and rock dispersal. The D-6 tractor did all of the road clearance. the 1900 road needed to be cleared several times in one area (OS-7) because of continued cutbank failures.

c) Bridge Installation

These costs were accrued during the construction and placement of a R.R. flatbed car bridge over Redwood Creek to provide access between west and east side rehabilitation sites. Also, included is the cost of reopening the 1800 road.

d) Equipment Access

The equipment access costs are those of moving the heavy equipment from move/in unloading site to the point of work. For the backhoes this entailed moving from the K & K, up the 1550 and 1552 roads on Simpson Timber Company property, and onto the skid trail system beyond SC-1. The D-6 tractor moved upslope from the end of the south spur, 1700 road, clearing skid trails to the SC-1 crossing, and assisting the backhoes onto the skid trail system. For the crane, this was moving with the assistance of the D-6 tractor to and from the L-1 area.

e) Personnel Access.

Access to the upper slope area entailed moving on Simpson Timber

Company roads which were being used by haul trucks, and which crossed an active cable yarding tail line and a tractor yarding landing. Because of this, it was decided to carpool and convoy to the end of the 1552 road to minimize disruption of the logging activities.

Additionally, because of the inaccessibility of the upper slope area, the personnel were required to hike to and from the various work sites. The D-6 tractor was used to access heavy equipment supplies (lubricants, fuel, tool, etc.). Because of all these complications, it was decided to pay access time from a meeting point to the work specific sites. This averaged out to about a half hour per day. Once access was begun from the 1700 road this practice was discontinued.

f) Material Access

Because of the inaccessibility of the upper slope area, it was necessary to use the D-6 tractor to access labor intensive materials to work sites. These materials included, redwood slabs and boards, straw bales, and bags of fertilizer and seed. A small trailer was rented from the D-6 tractor operator and towed behind the tractor. This trailer proved invaluable for rapid easy distribution of the material. The alternative of dispersal by labor crews or pack-animals would have proved both expensive and time consuming.

2) Site Specific Costs

The following section covers the site specific costs of individual work sites. The equipment hours have been divided into four categories: Excavation, moving, rocking, and sitting. Excavation is the actual time spent digging or constructing at a work site. Included is some unseparated time spent in receiving instructions, evaluating approach to work.

to work, brief rest periods, and manipulating equipment into various work positions. Moving is the time needed to move from one work site to the next where the period was greater than 15 minutes (.25 hours). Included is unspecified time of receiving directions, figuring best route, and brief waits while obstacles are removed. For the D-6 tractor, the time includes moving itself to different work sites, assisting other equipment to move, clearing skid trails of obstacles, and preliminary clean up of work sites. Rocking is the time spent in moving rocks to and placing rocks in excavations. For the D-6 tractor, this time includes making access for dump trucks, moving rocks for continued dumping, and feeding rocks to equipment which is placing them. For the backhoes, this time includes placing rocks, moving rocks to the site from the storage area, and moving rocks to other equipment which is placing them. Sitting is non-operational time caused by waiting for another piece of equipment to finish work, waiting for assistance to move to another site, and sitting where moving to another site was impractical. In the last case, it was deemed more costly to move to another site and then return to the first, than having the equipment be non-operational. All of these cases occurred when a backhoe was in a stream channel, and the removal from and return to the site was deemed more difficult and less safe than to leave the backhoe where it was. These periods will in the future, be considered as standby with or without operator depending upon the duration.

Excavation and rocking time was, obviously, charged to the specific work sites. Moving time was charged to the site to which the equipment was moving. Sitting time was charged to the site at which it occurred or, if waiting to access to another site, to that site. The equipment worked 10 hour days, 5 days a week. A 15 to 30 minute

lunch period was charged to the site and function which the equipment was performing at the time.

a) Skid Trail Crossings

Table _____ shows the hours, functions, and costs for the skid trail crossings excavated. Also listed are the low priority skid trail crossings which were not excavated. These are crossings which were lower sediment sources, difficult to access, and/or too limited in work space for equipment available. Included in some crossings are small, adjacent drains for springs, and up or down slope channel clearance of debris and sediments.

TAB

SKID TRAIL CROSSING COSTS

STC#	Equip.	Function Hours			Total Hours/ Equip.	Total Cost/ Equip.	Total Cost Crossing	Esti. 3 Yards	Cost/ Yard ³	Excav. Cost/ Yard	Notes
		Moving	Exca.	Sitting							
1	D-6 580B	-- --	0.25 5.00	-- --	0.25 5.00	\$ 9.50 \$ 17.50	\$ 27.00	10 54	\$ 2.70 \$ 0.43		
2	D-6	--	0.50	--	0.50	\$ 19.00	\$ 19.00	11 22	\$ 1.90 \$ 0.86		
3	D-6 580B	-- --	-- 1.00	0.50 --	0.50 1.00	\$ 19.00 35.00	\$ 54.00	13 39	\$ 4.15 \$ 1.39		
4	D-6 410	2.00 2.00	-- 1.25	-- --	2.00 3.25	\$ 76.00 \$ 104.00	\$ 180.00	30	\$ 6.00	\$ 1.33	*1
5	D-6 410	0.25 0.25	-- 0.50	0.75 --	1.00 0.75	\$ 38.00 \$ 24.00	\$ 62.00	12	\$ 5.17	\$ 1.33	
6	D-6	--	0.50	--	0.50	\$ 19.00	\$ 19.00	18	\$ 1.06		
7	D-6 410	1.50 1.25	-- 2.75	-- --	1.50 4.00	\$ 57.00 \$ 128.00	\$ 185.00	24	\$ 7.71		
8	D-6 410	0.50 0.50	-- 2.25	-- 0.75	0.50 3.50	\$ 19.00 \$ 112.00	\$ 131.00	37	\$ 3.54		
9	D-6 580	1.00 1.25	8.00 13.50	1.00 3.50	10.00 18.25	\$ 380.00 \$ 638.75	\$ 1,018.75	122 367	\$ 8.53 \$ 2.78		*2

STC#	Equip.	Function Hours			Total Hours/ Equip.	Total Cost/ Equip.	Total Cost Crossing	Estl. Yards	Cost/ Yard	Cost/ Yard	Notes
		Moving	Exca.	Sitting							
10	D-6 410 580B	1.75 1.25 1.50	5.50 4.75 2.75	0.50 -- 1.50	7.75 6.00 5.75	\$294.50 \$192.00 \$201.25	\$ 687.75	77	\$8.93		* Includes adjacent spring drain
11	D-6 410	-- --	1.00 3.00	-- 1.50	1.00 4.50	\$ 38.00 \$144.00	\$ 182.00	26	\$7.00		
12	D-6 410 580B	-- -- --	7.75 3.50 18.50	1.50 -- --	9.25 3.50 18.50	\$351.50 \$112.00 \$647.50	\$1,111.00	83	~~\$11.45~~		
13	NOT EXCAVATED										
14	NOT EXCAVATED										
15	D-6 580B	0.50 1.50	2.50 2.25	1.75 2.00	4.75 5.75	\$180.50 \$201.25	\$ 381.75	26	~~\$8.88~~		
16	NOT EXCAVATED										
17	D-6 410	-- 0.50	3.50 5.50	-- --	3.50 5.50	\$133.00 \$176.00	\$ 309.00	46	~~\$4.75~~		
18	D-6 410 580B	1.75 0.50 1.25	6.50 4.50 4.00	0.50 -- 4.50	8.75 5.00 9.75	\$332.50 \$160.00 \$341.25	\$ 833.75	158	~~\$5.31~~		

STC#	Equip.	Function Hours			Total Hours/ Equip.	Total Cost/ Equip.	Total Cost Crossing	Esti. 3 Yards	Cost/ Yard ³	Exca. Cost/ Yard	Notes
		Moving	Exca.	Sitting							
19	D-6 410	-- 1.00	1.00 3.00	-- --	1.00 4.00	\$ 38.00 \$128.00	\$ 166.00	20 ?	\$ 8.30		
20	D-6 410 580B	2.00 1.00 1.00	16.00 13.00 8.50	-- 3.00 7.50	18.00 17.00 17.50	\$684.00 \$544.00 \$612.50	\$1,840.50	~~235~~ 1	~~\$ 3.07~~		Includes 1 hr. downtime on D-6
21	D-6 410	1.00 1.00	0.50 4.00	-- --	1.50 5.00	\$ 57.00 \$160.00	\$ 217.00	40 ?	\$ 5.43		
22/ 23	580B	--	6.00	--	6.00	\$210.00	\$ 210.00	42 ~~51~~	~~\$ 5.00~~		Adjacent crossing exca. as one
24	D-6 410	3.0 3.0	22.50 38.00	-- 10.00	25.00 51.00	\$950.00 \$1,632.00	\$2,582.00	260 ~~507~~	~~\$ 11.75~~	~~\$ 5.79~~	Includes 3 moves to site of 410 & D-6
25	D-6 410 580B	2.50 0.50 2.50	18.50 18.00 35.00	-- -- 5.00	21.00 18.50 42.50	\$798.00 \$592.00 \$1,487.50	\$2,877.50	396 ~~709~~	~~\$ 7.26~~		Includes 3 moves to site.

NOT EXCAVATED

NOT EXCAVATED

NOT EXCAVATED

NOT EXCAVATED

NOT EXCAVATED

NOT EXCAVATED

STC#	Equip.	Function Hours			Total Hours/ Equip.	Total Cost/ Equip.	Total Cost Crossing	Esti. Yards?	Cost/ Yards	Excav. Cost/ Yard	Notes
		Moving	Exca.	Sitting							
32	D-6	--	1.00	--	1.00	\$ 38.00	\$ 38.00	61	\$6.33		

33 NOT EXCAVATED

TOTALS												
D-6					119.25	31		\$4,531.50				
410					131.50	35		\$4,208.00				
5808					130.00	34		\$4,392.50				

					380.75							
						GRAND TOTAL COST		\$13,132.00		3,164	\$4.15	
								\$13,132.00				

b) Stream Crossings

Table _____ shows the hours, functions and costs of the equipment for the stream crossing excavations. Included in some crossings are small, adjacent drains for springs and up- or downslope channel clearance of debris and sediment. Excavation hours include time needed to remove culverts from the road prism and to remove culvert down to the K & K road.

TABLE _____
STREAM CROSSING COSTS

Function Hours					Total Hours/ Equip.	Total Cost/ Equip.	Total Xing Cost	Est. Yds.	Cost/ Yds	Exca. Cost/ Yds	
SC-#	Equip.	Exc.	Sitting	Rock	Other						
1	D-6	0.50	--	--	--	0.50	\$ 38.00	\$ = 18.00	-83	\$0.46	
2	D-6 410 580B BE 22B	80.00 69.50 14.50 141.50	1.50 23.50 4.50 5.00	8.50 10.00 -- 35.00	M-0.50 *34.00 M-1.00 *12.00 M-0.50 *37.00 --	124.50 116.00 56.50 181.50	\$4,712.00 \$3,712.00 \$1,977.50 \$14,066.25	\$24,467.75	4,620	\$5.30	\$4.57
3	D-6 410 BE 22B	11.50 7.50 60.00	-- -- 3.00	10.00 7.50 13.00	*46.50 -- --	68.00 15.00 76.00	\$2,584.00 \$ 480.00 \$5,890.00	\$ 8,954.00	2600	3.20	
			Rocking	\$3,355.50							
4	410	2.50	--	--	--	2.50	\$ 80.00	\$ 80.00	31	\$2.58	
5	410	4.50	--	0.50	--	5.00	\$ 160.00	\$ 160.00	40	\$4.00	\$16.00 Rockir
6	410	2.00	1.00	--	--	3.00	\$ 96.00	\$ 96.00	25	\$3.84	
7	410 580B	2.00 *1.00	-- --	-- --	-- --	2.00 1.00	\$ 64.00 \$ 35.00	\$ 99.00	29	\$4.13	
8	410 580B	9.50 1.00	-- --	3.00 4.50	-- --	12.50 5.00	\$ 400.00 \$ 192.50	\$592.50	46	\$12.88	

*Remove culv to K & K

*Moving spoil

Removal of Hum xing placed during rehab.

*Moving spoil

+

46 \$12.88 \$9.40 \$253.5
137 \$4.32 \$244
68 \$8.74
rocking

Function Hours

SC-#	Equip.	Exc.	Sitting	Rock	Other	Total Hours/ Equip.	Total Cost/ Equip.	Total Xing Cost	Est. Yd3	Cost/ Yd3	Exca. Cost/ Yd3
9	410 580B	2.00 6.50	-- --	-- --	-- --	2.00 6.50	\$ 64.00 \$ 227.50	\$ 291.50	40 117	\$7.29 \$2.49	
10	580	15.50	--	2.50	--	18.00	\$ 630.00	\$ 630.00	110 249	\$5.73 \$2.53	--

\$87.5 rocking
10.5 hrs-exca
IBD to SC-10

D-6 \$ 7,334.00
410 \$ 5,056.00
580 \$ 3,062.50
BE 22B \$19,956.25

Total Est. Yd3
Av. Cost Yd3
Av. Exc. Cost/ Yd3
Av. Rocking Cost/ Yd3 rk?

GRAND TOTAL

696

\$3,508.75
8,394.43

422

?

?

?

* - Measured by X sections
* - Estimated from FIELD NOTES
* - Estimated length & width.
a channel

c) Ditches

Table _____ shows the hours, functions and costs of the equipment
for the various ditches on the rehabilitation site.

TABLE
DITCH CONSTRUCTION COSTS

D#	Equip.	Function Hours			Total Hours/ Equip.	Total Cost/ Equip.	Total cost Crossing	Esti. Yards	Cost/ Yard	Excav. Cost/ Yard	Notes
		Moving	Exca.	Sitting							
1	D-6	--	0.50	--	0.50	\$ 19.00	\$ 19.00	~~OKM~~ 15	\$1.27	--	
2	D-6 410	2.25 2.25	2.25 16.75	-- 2.00	4.50 21.00	\$ 171.00 \$ 672.00	\$ 843.00	~~OKM~~ 223	\$3.78		
3	D-6 410	1.00 1.00	3.00 10.50	1.00 4.50	5.00 16.00	\$ 190.00 \$ 512.00	\$ 702.00	~~OKM~~ 151	\$4.65	\$3.48	
4	D-6 410 580 B	-- -- --	1.00 6.00 12.00	-- -- --	1.00 6.00 12.00	\$ 38.00 \$ 192.00 \$ 420.00	\$ 650.00	~~182~~ ~~450~~	\$ 3.57 ~~\$1.42~~		
5	NOT EXCAVATED										
6	NOT EXCAVATED										
7	D-6	--	1.50	--	1.50	\$ 57.00	\$ 57.00	~~OKM~~ 42	\$1.36		
8	D-6 410 580 B	-- -- --	14.50 4.00 18.00	1.00 -- 1.50	15.50 4.00 19.50	\$ 589.00 \$ 128.00 \$ 682.50	\$1,399.50	~~150~~ ~~275~~	\$ 9.33 \$5.09		Great Deal of Slash in Excavated fill
9	INCLUDED IN COSTS OF L-3										
10	NOT EXCAVATED										
11	D-6	--	1.50	--	1.50	\$ 57.00	\$ 57.00	~~86~~	\$ 0.66		

45 \$ 1.27

D#	Equip.	Function Hours			Total Hours/ Equip.	Total Cost/ Equip.	Total cost Crossing	Esti. 3 Yards	Cost/ Yard ³	Excav. Cost/ Yard	Notes
		Moving	Exca.	Sitting							
12	D-6	--	5.00	1.00	6.00	\$228.00	\$228.00	~~148~~	\$0.51		Ditch an Earthflow 1.0 hr. sitting=st
								92	\$ 2.48		
13	D-6	--	3.50	--	3.50	\$133.00	\$133.00	~~242~~	~~\$3.14~~		
TOTALS								25	\$ 5.32		
	D-6				39.0		\$1,482.00				
	410				47.0		\$1,504.00				
	580 B				31.50		\$1,102.50				
								117.5			
Grand Total						\$4,088.50		1240	\$ 2.33		

d) Cross Road Drains

A total of _____ cross road drains were constructed or excavated on the rehabilitation site. Several, small, water bar-like drains constructed by D-6 tractor on 1700 road below the North and South spur junction.

TABLE _____

Road	Equip.	Hours Excava.	Cost/ Equip.	Total Cost.	No. Drains	Average Cost/ Drain
1900 Rd	410	21.50	\$ 688.00			
	580B	43.50	\$1,522.50	\$2,210.50	34	\$65.02
1700 Rd	D-6	1.50	\$ 57.00			
	410	7.50	\$ 240.00	\$ 297.00	18	\$16.50
			GRAND TOTAL	\$2,507.50		

- e) A total of 53 water bars were constructed on the skid trails used by heavy equipment during the rehabilitation work. Most of the water bars were constructed by the D-6 tractor near the end of heavy equipment work. Only a few were excavated by the backhoes.

TABLE _____

Equip.	Excav. Hours	Cost/ Equip.	No. Waterbars	Average Cost Waterbars
D-6	7.00	\$266.00	44	\$ 6.05
410	5.50	\$176.00	5	\$35.20
580	1.50	\$ 52.50	4	\$13.13
	TOTALS	\$494.50	53	\$ 9.33

f) Ripping

Only the 1900 Road and the 1700 Road, north spur were ripped during the rehabilitation work. (Table ____). Complications in sequencing equipment resulted in the remainder of the 1700 Road not being ripped. However, the portion of the 1700 Road, south spur, from SC-4 to the end, was deliberately not ripped to prevent infiltration loss by ditch D-____. Ripping probably would have made D-____ non-functional and continued high infiltration to the small, active earthflow downslope. The remainder of the 1700 Road is mostly constructed on shallow bedrock and ripping may have been of limited effect. The L-4 landing previously had a high infiltration rate and was not ripped to prevent aggravation to slope stability problems downslope. Several D-6 drains were constructed on the landing in an attempt to drain excessive water of its surface.

TABLE ____

Road	Equip.	Function Hours		Total Hours	Total Cost	Cost /A
		Moving	Ripping			
1900 Rd	T.D. 25	*5.00	7.00	12.00	\$ 912.00	\$ 706.98/A \$ 0.016/Ft ²
1700 N spur	TEREX	**9.00	6.00	15.00	\$1,117.50	\$1,490.00/A \$ 0.034/Ft ²
				GRAND TOTAL	\$2,029.50	Average Cost /A \$ 994.85/A

* Move In from W-line, Site 80-

** Move In from west side Access Rd. opening west road to bridge. Includes partial outslowing of L2 & 3.

\$ 0.023/Ft²

g) Landings

Table _____ shows the hours, functions, and cost of the equipment for the landings on the rehabilitation site. Because most work done on L-1 was related to the stream crossing, SC-3, those costs have been incorporated into that crossing.

TABLE _____

L-#	Equip.	Function Hours			Cost Hours/ Equip.	Cost/ Equip.	Total Cost	Est. Yd ³	Cost Yd ³
		Moving	Exca.	Sitting					
1	INCLUDED IN COSTS OF SC-3								
2	D-6 410 580B	0.50 -- 1.00	10.50 17.00 39.00	-- -- 2.50	11.00 17.00 42.50	\$ 418.00 \$ 544.00 \$1,487.50	 \$2,449.50	800 ~~2,240~~ ?	\$ 6.12 ~~1.09~~
3	D-6 410 580B	-- 0.50 --	11.00 18.00 28.50	-- 1.50 9.00	11.00 20.00 27.50	\$ 418.00 \$ 640.00 \$ 962.50	 \$2,020.50	400 ~~1,650~~	\$ 5.05 ~~1.22~~
4	D-6 410 580B	-- -- --	4.00 3.50 26.00	-- -- --	4.00 3.50 26.00	\$ 152.00 \$ 112.00 \$ 910.00	 \$1,174.00	~~187~~ 250	\$ 1.71 ~~4.10~~
					90 16 25 59	Hours 26.0 40.5 96.0			
					D-6 410 580B	\$ 988.00 \$1,296.00 \$3,360.00			
								Total Est. Yd ³	Avg. Cost/ Yd ³
GRAND TOTAL								\$5,644.00 4577	1.23
								\$5,644.00	

h) Outsloping

Table _____ shows the hours, functions and costs of the equipment for the various outsloped areas.

TABLE _____

OS-1	Equip.	Function Hours			Total Hours/ Equip.	Cost/ Equip.	Total Cost	Est. Yd ³	Cost/ Yd ³	Notes
		Move	Exca.	Sitting						
1	NOT DONE									
2	INCLUDED IN SC-5									
3	NOT DONE									
4	D-6	--	1.00	--	1.00	\$ 38.00		40	\$ 2.55	
	410	--	2.00	--	2.00	\$ 64.00	\$102.00	~~131~~	\$0.78	
5	INCLUDED IN L-3									
	410	--	3.00	--	3.00	\$ 96.00	\$ 96.00	43 ~~129~~	\$ 2.23 ~~\$0.74~~	
7	410	--	2.00	--	2.00	\$ 64.00	\$ 64.00	30 ~~129~~	2.13 ~~\$0.52~~	
	D-6					\$ 38.00				
	410					\$224.00				
GRAND TOTAL							\$262.00	Total Est. Yd ³ 384	Cost/ Yd ³ \$0.68	

i) Rock

The cost of end hauling rock for stream protection was calculated at \$14.60/yd³. Approximately 780 yd³ was used on the rehabilitation site. The majority of this was placed in SC-2 and 3 (Table).

TABLE

Excavation #	Yardage	Cost
SC-2	330	\$ 4,818.00
SC-3	200	\$ 2,920.00
D-4	40	\$ 584.00
SC-8	50	\$ 730.00
SC-9	60	\$ 876.00
SC-10	80	\$ 1,168.00
NOT PLACED	20	\$ 292.00
TOTAL		\$11,388.00

j) Miscellaneous Cost

These costs are ones which can not be readily divided between sites or occurred on a variety of site.

TABLE _____

	Downtime		OSHA Visit		Other		Equip. Totals	
	Hrs.	Cost	Hr.	Cost	Hrs.	Cost		
D-6	9.0	\$342.00	1.0	\$ 38.00	10.0	\$ 380.00	\$ 760.00	*Final Dressing of areas along K&
410	3.5	\$112.00	1.0	\$ 32.00	3.5	\$ 112.00	\$ 256.00	
580	6.5	\$227.50	1.0	\$ 35.00	16.5	\$ 577.50	\$ 840.00	
22B	2.0	\$155.00	--		6.5	\$ 503.75	\$ 658.75	
TOTALS		\$836.40		\$105.00		\$1,573.25	\$2,514.75	GRAND TOTAL

SUMMARY OF TOTAL HEAVY EQUIPMENT COSTS

Table _____

	D-6	410	580	BE-22	Other	Total
Access Costs	\$ 3,900.25	\$ 879.00	\$ 920.00	\$ 555.50	Trailer \$250.00	\$ 6,504.75
STC King	\$ 4,531.50	\$ 4,208.00	\$ 4,392.50	----	----	\$13,132.00
Stream Crossing	\$ 7,334.00	\$ 5,056.00	\$ 3,062.50	\$ 19,956.25	----	\$35,408.75
Ditches	\$ 1,482.00	\$ 1,504.00	\$ 1,102.50	-----	----	\$ 4,088.50
CRD	\$ 57.00	\$ 928.00	\$ 1,522.50	-----	----	\$ 3,507.50
Water Bars	\$ 266.00	\$ 176.00	\$ 55.50	-----	----	\$ 494.50
Landing	\$ 988.00	\$ 1,296.00	\$ 3,360.00	-----	----	\$ 5,644.00
OS.	\$ 38.00	\$ 224.00	-----	-----	----	\$ 262.00
Misc.	\$ 760.00	\$ 256.00	\$ 840.00	\$ 658.75	-----	\$ 2,514.75
Equipment Total	\$19,356.75	\$14,527.00	\$15,252.50	\$21,170.00	\$250.00	\$70,556.75
Ripping Costs					TEREX	\$ 1,617.50
					IS-25	\$ 712.00
						\$2,329.50
					Rock \$25.00	\$24,288.00

3. LABOR INTENSIVE WORK

The Labor intensive phase of the rehabilitation work extended for a period of twelve weeks from August 11 to October 30, 1980. The majority of work was performed by crews from Redwoods United, of Samoa a non-profit organization employing the handicapped. A single crew of about 6-8 persons was most extensively used for the various tasks on the rehabilitation unit. Additional crews and individuals were added as available and necessary.

a. Labor Intensive Application

The Labor intensive work on this site is divisible into three main functions; strawing, checkdamming, rocking.

1) Strawing

Strawing is spreading straw where the ground surface has been disturbed during heavy equipment rehabilitation work. Prior to laying the straw, fertilizer was spread by a "belly grinder" and slightly raked into the soil. The three areas where straw was spread were the skid trails, the site specific excavations, and along the haul roads.

The purpose of strawing is to protect disturbed ground from micro-geomorphic processes, such as sheetwash erosion, raindrop impact and rilling. Additionally, a straw layer may enhance revegetation by keeping soil moisture higher, decreasing surface compaction, and stabilizing seed distribution.

2) Checkdamming

Checkdamming is the construction of small dams within a flow channel. The material used for these dams can be milled lumber, hand split boards, rock, and slash. The purposes of checkdamming are to decrease sediment load, decrease downcutting. Stabilize flow course direction, and stabilize stream armour (rocks) in steep reaches. Wooden checkdams are of limited

SUMMARY COSTS

Table_____

Total P.H	Total Direct Cost	Total Training	Total Transp.	Total Lunches	Total Admin.	Total Cost	
3,520	\$16,259.48	\$1,626.64	\$2,175.00	\$185.00	\$3,578.54	\$23,920.05	<u>Diff.</u>
				SUM TOTAL		\$23,774.57	\$145.48
% of Total Cost	67.97%	6.80%	9.90%	0.77%	14.75%		0.62%
Av. Cost Total P.H.	\$ 4.62	\$ 0.46	\$ 0.62	\$ 0.05	\$ 1.00	\$ 6.80	

duration (10-20 years) during which time revegetation of the channel sidebanks should stabilize the flow course reach.

3) Rocking

Rocking is placing by hand rocks within flow course channels to armour the bottom and sideslopes against erosion. Rocking may include the final

distribution of rocks placed by heavy equipment, or gathering rocks from the surrounding area where access by dump trucks or heavy equipment was

impossible.

4) Miscellaneous

Miscellaneous labor intensive applications include functions which were done during the course of other activities and which are difficult to separate

from them. These miscellaneous functions include placing energy dissipators (rock, slash) at outboard edge of waterbars, and cross road drains; rocking bottoms of waterbars and cross road drains; and grading and clearance of

excavated channels.

b. Labor Intensive Costs

1) Redwoods United

Table _____ summarizes the person hours and costs of Redwoods United during the course of the Labor Intensive Phase of Rehabilitation. Also shown are the direct (wages), transportation, and indirect costs, and the average percentages of these costs of the total cost. Additionally, the average various costs per person hour are shown.

a) Direct Costs

The largest portion of the total cost of Redwoods United was in direct (wages) costs. However several factors must be considered in order to compare R.W. United costs per hour with other styles of Labor Intensive

contracting. The total person hours include an average 1.5 Hr./day commute time to and from Orick and a half hour lunch break. Subtracting these hours from the total produce total work hours which would be equivalent to Redwood National Park Laborer force. Additionally, 1.5 hr/day is time needed to commute from Orick to the Rehabilitation Site. Subtracting these hours produce the total site hours which would be equivalent to Contractors working on the site. Also, an average of 1 hour a day was spent in hiking on the site to specific work areas. Subtracting these hours produce total Productive Person Hours or the equivalent of a contractor being at the specific work sites. Obviously, as these non-productive hours are removed the total cost per person hour increases (Table ____). The cost effectiveness of R.W. United would be significantly increased with removal of as many non-productive hours (and concurrent indirect costs) as possible. Possible means of doing this will be discussed in a later section of this report.

b) Indirect Costs

Indirect costs are costs charged by Redwoods United for a labor crew in the field. The four costs charged were training and safety, transportation, lunches, and administration/overhead (Table ____). Training and safety was calculated at 10% of the total direct costs (wages). Transportation was charged at an average of \$50.00/day per vehicle. Lunches were charged at \$1.00/day per person until discontinued after seven weeks. Administration overhead was calculated as 18% of the direct and the above indirect costs (Table ____).

Upon closer examination of these costs, several items become were apparent. Consider 1 person hour (Table ____), the direct (wage) cost is \$4.62; safety and training is \$0.46. Transportation averages out to

\$0.46. Transportation averages out to \$0.62 (see TABLE ____) and Lunch averages out to \$0.10. Administration/overhead on direct (wages) costs is \$0.38. Administration/overhead on safety and training is \$0.08; on transportation is \$0.11, and on lunch is \$0.02. Total Administration/overhead is \$1.04. Total Cost per hour is \$6.84. This is higher than the average total cost/hour (\$6.77) because lunches/costs were discontinued and rounding errors. The percentages of the various portions of the Administration/overhead cost are shown in TABLE _____. It is apparent that 20.2% of total Administration/overhead costs is derived from the previous indirect charges of training and safety, transportation, and lunches. Finally TABLE ____ shows the break down of direct cost and transportation and indirect costs. Obviously as for direct costs mentioned earlier, 45% of the total indirect costs are related to non-productive hours. Possible means of decreasing this will be discussed in a later section of this report.

The percentages of the various costs per total hourly cost are shown in TABLE _____.

2) Site Specific Costs.

The following section covers the site specific (or function) costs. The topics and costs are divided into strowing; channel reeking; and trackman construction. The hour break downs have been determined from field notes and daily time sheets. The difficulty of maintaining accurate notes on person hours for various functions increases with the numbers of laborers involved. Therefore the following sections tend to be more statistical than actual measured times.

a) Strowing

TABLE ____ shows the person hours and costs for strowing the slope areas 1900 RD., and 1700 RD. Undifferentiated within there figures are times

ANALYSIS OF DIRECT COSTS

Table ____.

Total Person Hours	Travel to Orick @ 1.5 Hr/Person a day	Lunch @ 0.5 Hr/per day	Access to Site @ 1.5 Hr/per day	Work Hours	
				Site Access @ 1.0 Hr/per day	Productive Person Hours
3520	528.0	176.0	528.0	352.0	1936.0
% Total Per. Hours	15.0%	5.0%	15.0%	10.0%	55.0%
TOTAL DIRECT COST - \$16,259.48					
Total Cost	\$2,438.92	\$812.97	\$2,438.92	\$1,625.95	\$8,942.71

Total Direct Cost	Total Per. Hrs.	Prod. Per. Hrs.	Site Hrs.	Work Hours	Direct Cost Prod. Per. Hrs.	Direct Cost Site Hrs.	Direct Cost Work Hrs.	Direct Cost Total Person Hrs.
\$16,259.48	3520	1936.0	2288.0	2811.0	\$8.40	\$7.12	\$5.78	\$4.62

ANALYSIS OF INDIRECT COSTS

Table _____

ADMINISTRATION/OVERHEAD @ 18.0%

Person Hour	Av. Direct Cost	Training & Safety @ 10%	Transp.	Lunch	On Direct Cost	On Train.	On Transp.	On Lunch	Total	Total Cost Per. Hour
1	\$4.62	\$0.46	\$0.62	\$0.10	\$0.83	\$0.08	\$0.11	\$0.02	\$1.04	\$6.84
% OF TOTAL ADMINISTRATION										
					79.8	7.7	10.6	1.9		
% of Total Cost/Person Hour										
	67.5	6.7	9.0	1.4	12.1	1.2	1.6	2.9	15.2	-----
Direct Cost/ per hour	Trans.		Total Direct Cost		Total Cost Per Hour		Diff.	Diff. x 100 (Indirect Cost %)		
\$4.62	\$0.62		\$5.24		\$6.84		\$1.60	34.6%		

involved in rocking [Crossroad drains] months and excavating of [Crossroad drains].

Also not separated are the person hours involved in spreading fertilizer and raking the fertilizer into the soil.

SUMMARY OF PERSON HOURS AND COSTS OF STRAWING

Table ____.

Area	# of days	Prod. P.H.	Non-prod. P.H.	Total Cost	Prod. P.H. Cost	Total Area Covered	Total Cost Area	Prod. P.H. Cost Area
Slope	8	255.5	211.5	\$3,261.09	\$1,785.01	4.3A 187,308	\$ 758.39/A \$.017/ft ²	\$415.12/A \$.001/ft ²
1900 RD.	4	48.5	48.5	\$ 603.83	\$ 331.44	1.3A 56,628	\$ 464.48/A \$.011/ft ²	\$254.95/A \$.006/ft ²
1900 RD.	9	189.5	156.0	\$2,320.17	\$1,271.27	2.2A 95,832	\$1054.62/A \$.024/ft ²	\$577.85/A \$.013/ft ²
TOTALS		493.5	407.5	\$6,185.09	\$3,387.72	7.7A 336,105	\$ 803.26/A \$.018/ft ²	\$439.96/A \$.010/ft ²

*Includes rocking cross-road drains, and some stream crossings clearing cross road drains, D-12, and closing off Jeep trail on 1700 RD.

b) Rocking

TABLE _____ shows the person hours and costs of rocking various site specific channels and some cross road drains. Not included is rocking channels between checkdams which is dealt with later, and rocking most cross road drains, and all waterbars. Most of the rocking involved final distribution and placement of rocks placed by heavy equipment. Water bar and cross road drain rocking involved gathering rocks from the immediate area.

Table _____.

Area or Excavation	# of days	Prod. P.H.	Non-Prod. P.H.	Total Cost	Prod. P.H. Costs	TC Drain	Prod. Cost Drain
1900 SRD's 18 drains 18 yd	3	54.0	52.5	\$ 833.56	\$ 457.44	\$46.31	\$25.41
SC-2	2	62.0	53.0	\$ 765.63	\$ 412.86		
SC-3	3	81.0	56.0	\$1,036.05	\$ 570.87		
SC-4 4 yds	2	62.0	50.0	\$ 667.65	\$ 370.95		
SC-8 4 yds	1	10.0	9.0	\$ 138.89	\$ 73.10		
SC-9 4 yds	1	10.0	9.0	\$ 138.89	\$ 73.10		
SC-10 (IBD) & CRD above 10 yd	3	100.0	81.0	\$1,376.00	\$ 702.46	*IBD manually rocked from stockpiled rocks.	
D-4 4 yds	1	18.0	15.0	\$ 216.81	\$ 118.26		
<u>18</u> <u>10</u> <u>16</u> <u>44</u>	TOTAL	397.0	326.5	\$5,173.48	\$2,779.04		

c) Checkdams

A total of 61 checkdams were constructed on eight site specific areas (TABLE___). The checkdams constructed were not the larger strange type where ponding and sedimentation is induced behind the structure. Rather, smaller partially submerged dams with an effective height of 6-12" were made. They were constructed to centralize flow to protect stream banks, to retain channel armour in steep reaches, and to protect channel reach from downcutting. A variety of splash board, splash lip, and staked rock energy dissipators were placed below the spillway to inhibit plunge pool formation. These types of checkdams required less material, less weight, and wider spacing than for more conventional checkdams.

Checkdams

A total of 61 checkdams were constructed on eight site specific areas (Table ____). * Add more?

Excavation #	Prod. P.H.	Non-Prod. P.H.	Total Cost	Prod. P.H. Cost	# X-dam	Total Cost X-dam	Prod. P.H. X-dam	
SIC 10	31.0	25.0	\$ 358.56	\$ 198.47	3	\$119.52	\$ 66.16	6
SIC 12	104.0	82.0	\$1,217.78	\$ 680.77	15	\$ 81.19	\$ 45.85	5
SIC 15	132.0	109.0	\$1,557.13	\$ 852.84	13	\$119.78	\$ 65.60	7
SIC 20	80.5	67.5	\$ 985.02	\$ 535.94	9	\$109.45	\$ 59.55	8
SIC 21	50.0	38.0	\$ 581.22	\$ 310.49	2	\$290.61	\$145.31	*Includes repair 1st. checkdams constructed.
*SIC 25	227.5	187.0	\$2,965.12	\$1,627.10	7	\$423.58	\$232.44	2nd. checkdams *includes repair
SC-2	113.5	87.0	\$1,387.82	\$ 784.36	7	\$198.26	\$112.05	Includes rocking 4 between checkda
SC-3	95.5	77.5	\$1,230.50	\$ 679.09	5	\$246.19	\$135.82	Included rocking 3 between checkda
TOTALS	834.0	673.0	\$10,283.15	\$5,669.06	61	\$168.55	\$ 92.94	

*Large dams, incompletely excavated crossing, and rocking upslope.

d) Miscellaneous Costs

Function		Prod. P.H.	Non-Prod. P.H.	Total Cost	
Seeding	10/20	33.0	20.0	\$ 346.62	\$215.82
	10/21	33.0	28.5	\$ 406.52	\$218.13
	10/22	33.0	27.0	\$ 396.60	\$218.13
	10/23	33.0	27.0	\$ 394.20	\$216.81
		132	102.5	\$1,543.94	\$868.89

TOTAL Area	Cost Area
7.7A	\$200.51/A
336,105 ft. ²	\$.005/ft. ²

STC-15	8/19	12.0	11.0	\$ 151.11	\$ 78.84
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Clearing slash in channel mouth.

05-7	9/10	4.0	2.0	\$ 43.86	\$ 29.24
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Hand dug drain on 05-7 area.

Instructions on checkdam building	8/21	15.0	12.0	\$ 177.39	\$ 98.55
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TOTALS		163.0	127.5	\$1,916.30	
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Discussion

The cost of labor intensive work was higher than anticipated because of several factors. The cost of Redwoods United was not fully realized due to the misconceptions in terms of overhead billing, hours, and contractual arrangement. I would recommend the following changes:

1. Travel time to Orick be eliminated or limited to one hour.
2. Work hours be established as 7 a.m. to 5:30 p.m., or 7:30 arrival at and 5:00 departure from Orick if one hour travel time is to be retained.
3. Billing procedure be established as follows:
 - a. Direct cost (wages)
 - b. Transportation or vehicle charges
 - c. Safety and training as 10% of a Direct Cost (wages).
 - d. Lunches deleted.
 - e. Administration and overhead be charged as 18% of Direct Cost (wages).

C. Conclusions

Heavy Equipment Work

The heavy equipment work will be discussed in terms of the slope work and the haul road removal. The slope work was directed at opening the channels of the two intermittent streams and redistribution of water into more stable flow courses. This was done to increase runoff and decrease infiltration which contributed to downslope mass wasting. Several problems became apparent during the course of the slope work. Limited access and steep terrain caused increased costs in moving equipment between work sites and accessing personnel, fuel, and materials. Additionally, more ground disturbance was caused than anticipated because of clearing the skid trail system. Because of the type of equipment available and the limited work area, more costs and time was involved in repositioning

equipment, removal of spoil and the ability to complete excavations to a stable grade was limited. Because of the inability or high costs to protect excavations with end hauled rock, labor intensive work was required to protect steep reaches of excavations.

For extensive slope work in steep terrain, I would recommend using track-mounted backhoes with 4-in-1 buckets (if available) and extendable booms, or small excavators. The track-mounted backhoes would allow greater equipment mobility on the slopes and increased effectiveness in excavating. The small excavators would also increase mobility and ease of spoil removal. In conjunction with these would work either a crawler tractor for skid trail clearance and site preparation, or a track-mounted loader with 4-in-1 bucket and winch for spoil and debris removal. If a loader is used, preliminary work by a crawler tractor may be required.

The cost effectiveness and erosion effectiveness of extensive slope work may be difficult to ascertain. The actual yardage removed by excavation may be very small and may be offset by ground disturbance and excavation saturation, and the resulting decrease in potential gullying, or mass movement may be quite high. Obviously, not all skid trail crossings on a hillside should be removed, but alternatively they should not be completely ignored.

The removal of haul roads on this site was of relatively secondary importance. The two largest and most costly work sites were SC-2 and 3. The largest volume of material was moved at these crossings. The most expensive equipment on these excavations was the drag line crane. The most expensive practice on these crossings was the excavating by crane of the spoil and removal of spoil by the crawler tractor to landing L-1. The cost of SC-2 in particular could have been reduced considerably. The crawler tractor should have been used to contour the crossing and ridge crest. The spoil would have been pushed downslope and out of the channel to an stable area. A backhoe should then have completed the excavation. This practice was used on SC-3 and proved

considerably more rapid and effective than using the crane.

The remaining costs for the road seem reasonable and cost effective. More extensive outslping and drainage should have been done in O.S.-7 area to stabilize the slope failure in that area.

Labor Intensive Work

This was the first time Redwoods United was used for practically all of the labor intensive work on a rehabilitation site. The costs for functions and check dams appear to be competitive with other forms of labor intensive work. However, the cost effectiveness of R.W.U. would be enhanced if certain overhead costs and hours would be established by contract or agreement.

On the whole, individual employees of Redwood United are hard working and industrious. Crew productivity is highly dependent upon the crew supervisor. Using several crews on a single task, especially checkdamming, reaches a point of counter productive. Providing a variety of work decrease boredom and should be attempted whenever possible. Redwood National Park employee supervision and direction for checkdamming is probably a necessity.

The logistics of keeping accurate person hour production for tasks becomes difficult with large crews and several tasks occurring simultaneously. More accurate recordkeeping is a necessity.

The total costs of the rehabilitation work is shown in Table _____. Included are estimates of Redwood National Park personnel costs. An evaluation of these costs in relation to costs of other contracting arrangements should be made.

TABLE

SUMMARY OF COSTS

Heavy Equipment Rental	\$ 72,586.25
Labor Intensive Work	\$ 23,920.05
RNP Personnel Costs	
Preliminary Work (Geologist & Phy. Sc Sci. Techs)	\$ 6,034.40
Heavy Equipment Work	
Geologist & Tech.	\$ 6,495.20
Laborers (2)	\$ 3,599.16
Labor Intensive Work	
Geologist & Tech.	\$ 3,333.60
Laborers (3)	\$ 2,796.00
TOTAL R.N.P. Personnel Cost	\$ 21,957.96
R.N.P. Materials	
7 Straw app. 742 742 bales?	\$ 1,814.86
TOTAL	\$ 120,279.12

Not included in R.N.P. costs is the administration and logistical support. Checkdam material cost (i.e., lumber, nails, equipment), and other expenses. These costs should also be evaluated to compare with alternative methods of contracting.

While the foregoing discussion of site specific costs approximates the actual cost. A comparison with the actual costs shows some slight discrepancies.

(Table)

Table _____.

<u>Function</u>	<u>Cost</u>
Strawing	\$ 6,185.09
Rocking	\$ 5,173.48
Checkdams	\$10,283.15
Miscellaneous	<u>\$ 1,916.30</u>
TOTALS	\$23,558.02

Difference	\$362.03	w/Total Cost
with totals	\$216.55	w/Summ. Total
% of	1.51%	w/Total Cost
Difference	0.91%	w/Summ. Total

Rehabilitation Site 80-1: South of Copper Creek
General Vegetation Prescription

Stream Crossings

Side slopes of stream crossings(STC) were fertilized, seeded(dry or wet mix) and strawed. They were planted with Baccharis pilularis D.C.(coyote brush), and Whipplea modesta Torr. Row one, immediately adjacent to the drainage, was planted with B. pilularis at one foot spacings. All succeeding rows were planted at two foot spacings. Rooted W. modesta cuttings were planted in shaded areas at one foot spacings at STC with suitable habitat conditions. Sequoia sempervirens(D. Don) Endl.(Redwood) seedlings were planted at five foot centers.

Stream Channels

Side slopes of stream channels(SC) were fertilized, seeded(wet mix) and strawed. The slopes on either side of the channel were planted with B. pilularis, row one at one foot spacings and rows two and three at two foot spacings. The remainder of the slope was planted with P. menziesii alternating with B. pilularis at five foot spacings.

Check Dams and Planter Boxes

Alnus oregona Nutt.(Red Alder) seedlings were planted only on wet STC or SC at one foot spacings at the front and back edge of planter boxes and between check dams.

1700 Road

The upper and lower stretches of the 1700 Road were fertilized, seeded (dry mix) and strawed. The upper 1700 Road was planted with P. menziesii at five foot and eight foot centers. W. modesta was planted at the south end of the water bars(wb) at two foot spacings. Two to three rows of B. pilularis was planted at two foot spacings along the side ditch. Soil on the lower 1700 Road was heavily compacted for a dibble to penetrate. Only a small section just above the K&K Road was planted in P. menziesii at five foot spacings.

1900 Road

The road surface was fertilized, seeded(dry mix) and strawed. Pseudotsuga menziesii(Mirb.) Franco.(Douglas Fir) was planted at nine foot spacings on the road surface. At either end of the wb and SC, W. modesta was planted at one foot spacings. S. sempervirens and P. menziesii were also planted on the wb and SC at five foot spacings.

Road Surfaces and Skid Trails

The road surfaces and skid trails were fertilized, seeded(dry mix) and strawed. The road surfaces were planted with P. menziesii at five foot and ten foot spacings depending on the steepness of the grade; the steeper the grade, the tighter the spacings. Some of the skid trails were not planted due to the abundant ground cover and seed source(B. pilularis) present at their location.

Landings

Landings were fertilized, seeded(dry mix) and strawed. P. menziesii was planted at an average of 7.6 foot spacings. If down slopes or side ditches were present, B. pilularis seedlings were planted at five foot and two foot spacings respectfully.

Planting prescription. Rehabilitation Site 80-1, South
of Copper Creek, 1980.

Area description	A	Prescription*
D-1	.042	
STC 1	.030	D @ 10' including dry channel Along channel Bp @ 2'
STC 1 to Fork 1552	.250	D @ 5' between wb; at wb Bp @ 2'
Fork 1552 to Gully	.103	
Fork 1552 to STC 8	.112	D @ 8'
STC 3	.004	
STC 4	.030	Bp @ 2' including dry channel
STC 5	.090	D @ 5'
STC 4 to STC 8	.160	D @ 5' between wb. at wb Bp @ 2'
STC 6 & 7 to STC 8	.150	
STC 6	.015	
STC 7	.033	
STC 8	.046	Bp @ 2'
STC 8 to STC 11	.070	D and Bp @ 5'; 2:1
STC 9	.250	D @ 5' includes sideskids Along channel Row 1 Bp @ 1', Row 2 Bp @ 2' R @ 5'-10
Side ditch 9-10 to D2	.090	D @ 5' Along ditch Row 1 Bp @ 1' Row 2 Bp @ 2' at wb Bp @ 2' W/D @ F'
STC 10	.074	Bp @ 2'-3 Rows R @ 5'-12
STC 10 to STC 11	.210	D @ 5' at wb Bp @ 2'
STC 11	.043	D @ 5' Bp @ 2'
STC 9 to STC 11	.090	Bp @ 5'
Landing 9/10	.400	D @ 8' along side channel Bp @ 2'
D 2	.250	D @ 5'; D @ 8' along channel Row 1 Bp @ 1', Row 2 @ 2'
STC 11 to bend above STC 18;	.180	D @ 5'
Bend to STC 18		D @ 10'

Planting prescription. Rehabilitation Site 80-1, South
of Copper Creek, 1980.

Area description	A	Prescription
STC 18 to STC 12	.077	D @ 8'
STC 18 to STC 19	.130	D and Bp @ 5' 2:1
STC 18 to STC 20	.110	
STC 20 to STC 21	.060	D @ 8'; D and Bp @ 5' 1:1
STC 17 to STC 21	.230	D @ 8'
STC 12	.150	Along channel Bp @ 2'; At STC W @ 1'.
STC 15	.180	Along channel Bp @ 2' 2 small landings D and Bp @ 8' 1:1 Shaded channel R @ 5' 20. A @ 1' at check dams 50.
STC 18	.016	Bp Row 1 @ 1'; Row 2 & 3 @ 2' R @ 5'-10 Shaded channel W @ 1'.
STC 17	.060	Bp @ 2' Shaded channel W @ 1'
STC 19	.018	N side D and Bp @ 5', 1:1 S side D and Bp @ 8' 1:1
STC 20	.206	At S slope Bp @ 2' Along channel W @ 1'; R @ 5'-30, at checkdams and in channel A @ 1'. Small landing D and Bp @ 8'. 1:1. Upper skid D @ 5'
STC 21	.025	N skid landing to STC channel W @ 1'
STC 21 to STC 25	.090	D @ 5', D @ 8'
Stc 25	.160	E side STC R @ 5'-10. along channel Row 1 Bp @ 1', Row 2 Bp @ 2' at checkdams A @ 1' Small landing D and Bp @ 5', 1:1.
STC 25 to STC 24	.158	(1) D and Bp @ 5', 2:1 at wb-Bp @ 2'. (2) Along channel Row 1 Bp @ 1' Row 2 Bp @ 2'.

Planting prescription. Rehabilitation Site 80-1, South
of Copper Creek, 1980.

Area description	A	Prescription
		(3) Skid to small landing D and Bp @ 8', 1:1. (4) Top of skid D and Bp @ 8', 1:1
Small landing STC 24	.044	Along channel Row 1 - Bp @ 1', Row 2-Bp @ 2' D and Bp at 8', 1:1
STC 24	.085	Along banks W @ 1' E side channel R @ 5'- 10.
STC 22	—	Along channel and drainage Bp @ 1', W @ 1'. D @ 5'
STC 25 to Landing 1	.084	D @ 5'
Landing 1	.230	D and Bp @ 5' to 8' 1:1, W of landing Bp@ 2' below skid. Top of landing D @ 8'.
SC 3	.190	Small landing at base Sc 3, R and D @ 8' along lower channel R @ 5' E slope R @ 5' 10 At check dams and planter boxes A @ 1' above check dams W @ 1' along channel 2 Rows Bp @ 1', next row Bp @ 2'. Sides of slopes D and Bp @ 5' 1:1 level area above slope D @ 8'
SC 2	included in SC 3	Small E slope R @ 5'-9 W @ 1'. W slope R @ 5'-10. at check dams A @ 1' above channel on either side Bp @ 2' channel banks W @ 1'. Slope D and Bp @ 5' 1:1.
Upper 1700 Road	.270	At channels Bp @ 2' Road D @ 5' to 8' between wb. At S end wb W @ 1'
Landing 4	.310	D @ 8' & 272 fertilizer tablets. along channel Bp @ 2'.

Planting prescription. Rehabilitation Site 80-1, South
of Copper Creek, 1980.

Area description	A	Prescription
Landing 3	.140	D @ 6.5' & 228 fertilizer tablets. Side ditch Bp @ 2' W @ 1'
1700 NS	.370	Either end of channels and wb W @ 1' Along channel and wb Bp @ 2'. D @ 5' to 8'.
Landing 2	.240	D @ 9' at S down slope Bp @ 5' along channel Bp at 2', along channel banks D at 5', along upper channel W @ 1'.
Lower 1700 Road	.220	No planting except at bottom of Road D @ 5' & along 1st wb. ground extremely hard.
1900 Rd	1.160	D @ 9' at either end wb & channels W @ 1' R @ 5', D @ 5'
1900/1700 Channel	.140	Along channel Bp @ 1' additional Rows Bp @ 2' open areas D @ 5'.

Total 7.875

SC- Stream Channel

STC- Stream Crossing

D#- Ditch or Drain

D- Pseudotsuga menziesii

Bp- Baccharis pilularis

R- Sequoia sempervirens

A- Alnus rubra

W- Whipplea modesta

wb- water bar

*Example:

Species at tree spacings (ft.)

D @ 6.5'

VEGETATION MANAGEMENT

Summary of numbers of planted trees and shrubs.
Rehabilitation Site 80-1. South of Copper Creek, 1980

<u>Species</u>	<u># Planted</u>
<u>Pseudotsuga menziesii</u>	7740
<u>Baccharis pilularis</u>	7690
<u>Whipplea modesta</u>	4080
<u>Alnus rubra</u>	500
<u>Sequoia sempervirens</u>	350
Total	20,360

Activity Operation Dates. Rehabilitation Site 80-1.
South of Copper Creek. 1980.

Activity	Operation dates
Strawing	8-12 to 9-23
Fertilizing	9-4 to 9-23; 10-23
Seeding	10-20 to 10-23
Planting	12-2; 12-8 to 12-18; 1-6-81

Dry seed mix application at 50lbs/A (56 Kg/ha).
 Rehabilitation Site 80-1: South of Copper Creek, 1980.

Species	% Mix	lbs/A	Kg/ha
Durac Hard Fescue	17.8	8.9	10.0
Highland Colonial Bentgrass	0.6	0.3	0.3
Blando Brome	28.5	14.2	16.0
Mt. Barker Subclover	30.3	15.1	17.0
Lana Vetch	22.8	11.4	12.8
Total	100.0	49.9	56.1

Wet seed mix application at 50lbs/A (56 Kg/ha).
 Rehabilitation Site 80-1: South of Copper Creek, 1980.

Species	% Mix	lbs/A	Kg/ha
Fawn Tail Fescue	26.0	12.9	14.5
Creeping Red Fescue	9.0	4.5	5.0
Blando Brome	27.5	13.8	15.5
Mt. Barker Subclover	21.5	10.8	12.1
Lana Vetch	16.0	8.2	9.2
Total	100.0	50.2	56.3

Seed and fertilizer application - Rehabilitation Site 80-1
South of Copper Creek - 1980

Area Description	A	ha	Seed Application lbs ** (dry mix)	Broadcast Fertilizer lbs ***
D1	.042	.017	2.1 + 1.7	11
STC 1	.030	.012	1.5 + 1.7	8
STC 1 to Fork 1552	.250	.102	12.5 + 1.7	63
Fork 1552 to Gully	.103	.042		26
Fork 1552 to STC 8	.112	.045	5.6	28
STC 4	.030	.011	1.5	8
STC 3	.004	.002	.2	1
STC 4 to STC 8	.160	.065	8.0	40
STC 5	.090	.040	4.7	23
STC 8 to STC 6 & 7	.150	.060	7.3	37
STC 6	.015	.006	.75	4
STC 7	.033	.013	1.7	9
STC 8	.046	.019	2.3	12
STC 8 to STC 11	.070	.028	3.5	18
STC 9	.250	.100	12.5 ^w	63
STC 10	.074	.030	3.7 ^w	19
STC 11	.043	.018	2.2	11
STC 11 to STC 9	.090	.038	4.5	24
STC 11 to STC 10	.210	.085	10.5	53
D 2	.250	.100	12.5	63
Side Ditch STC 9 & 10	.090	.038	4.5 ^w	--
STC 10 to Typha	.090	.038	----	24
STC 11 to STC18	.180	.074	9 ^w	45
STC 12	.150	.060	7.5 ^w	38
STC 15	.180	.070	9 ^w	45
STC 17	.060	.023	3 ^w	15
STC 18	.016	.007	0.8	4
STC 19	.018	.007	0.9	5
STC 20	.206	.083	10.0	52
STC 18 to STC 12	.077	.031	3.85 ^w	19
STC 18 to STC 19	.130	.053	6.5	33
STC 18 to STC 20	.110	.045	5.5	28
STC 17 to STC 21	.230	.095	11.5	59

Seed and fertilizer application - Rehabilitation Site 80-1
South of Copper Creek - 1980

Area Description	A	ha	Seed Application lbs ** (dry mix)	Broadcast Fertilizer lbs ***
STC 20 to STC 21	.060	.026	3.0	16
Junction STC 21 to STC 25	.090	.037	4.5	23
STC 21	.025	.010	1.25	7
STC 25	.160	.063	22.00*	40
STC 25 to L1	.084	.034	4.2	21
STC 24	.085	.034	4.2 ^w	21
STC 25 to STC 24	.158	.064	7.9	40
Small Landing at STC 24	.044	.018	2.2	11
Landing 1	.230	.094	12.0	58
Landing 2	.240	.095	12.0	60
Landing 3	.140	.057	7.0	35
Landing 4	.310	.126	16.0	78
Landing 9 & 10	.400	.162	20.0	100
Upper 1700 Road	.270	.110	14.0	68
Lower 1700 Road	.220	.090	11.0	14
1700 North Spur Road	.370	.150	18.5	93
SC 2 & SC 3	.190	.078	9.5 ^w	48
1900 Road	1.160	.470	58.0	
Landing Top of 1900 Road	.130	.054	6.5	290
Landing 1552	.180	.070	----	---
Small Landing at SC 3	.086	.035	4.3 ^w	22
1900 & 1700 Road Channel	.143	.058	----	---

* Dry mix	Total	8.364	3.392	412.75	1976.0
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** 50 lbs/A

*** 250 lbs/A

w - wet mix

Redwood United, Inc. Labor Costs Breakdown.
Rehabilitation Site 80-1: South of Copper Creek, 1980.

Activity	Days	Person hrs.	Wages	Indirect Costs*	Total
Strawing	7	430	1943.12	924.81	2867.93**
Fertilizing	5	290	1364.40	675.28	2039.68**
Seeding	3	180	896.60	444.19	1340.79
Planting	9	530	2571.00	1237.13	3808.13
Total	24	1430	6775.12	3281.41	10056.53

*Includes training and safety @ 10%;
transportation @ \$50.00/vehicle/day;
administration and overhead @ 18%.

**Estimated costs



Unit: 80-1 1-A 7/9/80 PP#36 Pre Equip, K.W.U.



Unit: 80-1 1-B 11/3/80 PP#36 Post Equip, W.D.B.



Unit: 80-1 1-C 7/29/81 PP#36 R.G.L.



Unit: 80-1 1-D 8/9/82 PP#36 L.T.



Unit: 80-1 1-E 6/30/83 PP#36 L.T.



Unit: 80-1 2-A 7/9/80 PP#26 K.W.U.



Unit: 80-1 2-B 11/3/80 PP#26 W.D.B



Unit: 80-1 2-C 7/29/81 PP#26 R.G.L.



Unit: 80-1 2-D 8/9/82 PP#26 L.T.



Unit: 80-1 3-A 8/16/84 PP#26 L.T.