

Summary Report of Erosion Control Work

85-3 G-Line/G-2/G-4 Roads

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INTRODUCTION

Site Description

The G-Line'85 site (#85-3) is located about 15 miles southeast of the town of Orick on the west side of Redwood Creek, within the drainage basin of Tom McDonald Creek. The unit encompasses about 935 acres of the slope above and below the G-Line, G-2, and G-4 roads, with a total removal of 4.1 miles of haul road. The elevation ranges from 440 feet in Tom McDonald Creek, at the northern boundary of the unit, to a maximum of 2,170 feet, along the B-5 "Access" road, which crowns the unit's southern boundary.

The slope gradients are steepest below the upper end of the G-2 road, and at the downstation end of the G-Line road, where the road lies within the inner gorge of Tom McDonald Creek. Here the slopes range from 45% to 90%, averaging 65%. The gradients on the upper hillslopes are more gentle, averaging about 35% above the G-2.

The site is underlain by the schist unit of Redwood Creek, which outcrops on the nose of ridges and along some reaches of the perennial streams. Soils along the G-Line are predominantly from the Coppercreek Series. Devils Creek soils and other imperfectly drained soils occur in isolated wet areas, along fill failures, and on both sides of the major tributary crossing at station G163+90. The soils of the two upslope roads, the G-2 and G-4, consist generally of the red, well-drained Trailhead and Fortyfour series. (Information on the Park's indigenous soil series is given in: Popenoe and Martin, 1984, "Soils Of The G-Line", unpubl. in-house rpt.)

The 85-3 project continued the rehabilitation work on the G-Line which had begun with the 84-1 project the previous year. This year's site began at the eastern end of the 84-1 site, and proceeded easterly for 2.8 miles of rock-surfaced road to the G-Line deck. Twelve road crossings and 9 skid trail crossings above the road were excavated. The drainage area for streams above the G-Line averages 47 acres.

The other two roads treated were the G-2 and G-4 roads. The entire length of the G-2 (0.9 miles) was removed, and a 0.4 mile portion of the G-4 was removed down to the intersection with the G-Line. Four road crossings were excavated on the G-2 and 6 skid-trail crossings were pulled above the G-2 road. One road crossing is at the intersection of the G-Line and G-2 roads. The drainage areas for streams above the G-2 road average 35 acres.

Land Use History

Timber was harvested from the northern slope of Rodgers Peak during the period from 1949 to 1977. The earliest interval (1949 to 1954) saw the removal of approximately 790 acres of virgin Redwood/Douglas Fir forest covering the area between the future location of the B-5 "Access" road

and Tom McDonald Creek, and extending from the G-Line/C-Line junction to the G-Line/M-Line junction. (Map B)

505 acres of the hillslope above the G-Line were selectively cut with crawler tractors during this early period. Additional (tractored) select cuts of about 475 acres in old growth above the G-Line began in 1959 and continued through the 1960s as the G-2, G-4, and B-5 roads were constructed. Re-entry for seed tree removal using tractors began before 1962, and usually included some harvesting in adjacent old growth. The acreage of these reharvested units increased in the 1970s. A 94 acre block above the G-Line and extending above the G-2 road was relogged with tractors in the early 1970s.

With the exception of one cut block, the entire hillslope below the G-Line, totalling about 285 acres, was clearcut in the late 1940s and early 1950s using cable yarding methods. These cable cuts extended down to Tom McDonald Creek along the western quarter of the area encompassing this year's project. However a 300-800 foot wide strip of timber above the creek was left standing along the eastern reach of the creek. More cable yarded timber was removed in the late 1950s and early 1960s after construction of part of the B-5 road along the northern slope of Rodgers Peak. These units, located in steep terrain between the G-Line and B-5 roads, total about 110 acres. In the mid 1960s a 40 acre cable yarded unit was harvested in the area below the junction of the G-Line and G-2 roads. A final cable yarded unit of 18 acre was cut in 1977 below the terminus of the G-2 road. All of the cable yarded units have a few skid trails around their perimeter. Tractor yarding may have been used on the '77 cable cut to remove the largest trees.

The entire G-Line, from the C-Line junction to the M-Line junction was constructed prior to 1954. Road rock was obtained both from Redwood Creek and from a rock pit located at the G-Line/C-Line junction. The G-2 and G-4 roads were constructed in the mid 1960s to provide access to tractor harvested timber above the G-Line. River-run gravel was placed on the upper portion of the G-4, while no road rock was placed on the G-2. The G-2 was extended an additional 600 feet in 1977 for the cutting of the cable yarded unit below the road. Timber from the area of the future G-Line deck was harvested in the early 1950s, using crawler tractors. The deck was constructed in the early 1970s.

The G-6 road was constructed in 1975, but the park boundary was expanded before the remaining old growth beneath this road could be logged, leaving a fine grove of oldgrowth redwood. In addition to this grove, this drainage is one of the few in the Park which supports anadromous fish, including native cutthroat trout in its upper reaches, and salmon and steelhead in its lower reaches. Completion of work in this basin is high on the priority list, as the creek already has quite a sediment load. Additional slugs of sediment from accelerated erosion have the capacity to interact with the many active and quasi-stable mass movement features which toe-out along the creek, causing their movement rate to increase. For this reason, work in the Tom McDonald Creek drainage offers the opportunity for "erosion abatement

leveraging". Each cubic yard of man-caused sediment that can be kept from reaching the stream can mean the "savings" of many more additional yards of material which it could have triggered during its passage down to Redwood Creek.

EROSION FEATURES

Many of the erosion features below the G-Line are mass movements caused in part by diverted water from plugged or misplaced culverts. The downstation end of this road has the heaviest concentration of scarps. This section has steep slopes, Devils Creek and Copper Creek soils, and is within the inner gorge of the main stem. The outer edge of the road prism here had failed, making passage by vehicles marginal. Some scarps were below poorly defined flow courses whose headwaters are only a few tens of feet above the road. These small, first order and zero order streams are often not defined below the road. Some failures below the road are visible on the 1954 aerial photos, and show continued instability in more recent photos. The toes of many of these slides are in Tom McDonald Creek, where they have caused aggradation and bank failures. In general, the more stable areas above and below the G-Line alternate between steep and relatively gentle slopes which probably indicate ancient mass movements.

Although all haul road stream crossings were intact at the time of mapping, the potential of road failure was present. Old culverts were found below some crossings and many crossings had cracks or small scarps at the outer edge of their fill prism. All the crossings of the roads were equipped with CMPs. The major tributary crossing (DD G163+90) contained large logs parallel to the thalweg, and underlying the 36 inch culvert.

The skid trail crossings are all of the Humboldt type, some of which were partially eroded. The crossings on slopes tractor-logged in the 1960s and 1970s were treated because they tended to have more intact fill prisms and higher diversion potentials than crossings on slopes tractor-logged in the 1950s. These old crossings were either stable, or had enough fill eroded to greatly reduce the possibility of diversion.

EROSION CONTROL REHABILITATION WORK

Introduction

The mapping of most of this site was carried out the previous year, as part of the upper G-LINE site investigation and preparation. This year's work thus began with the prescription phase. (Figure 1) This site was originally intended as a contract site, so all prescription and plan sheet preparation was done with this goal in mind, resulting in the production of explicit, carefully detailed plan sheets covering all phases of the work, so as to make sight-unseen

bidding possible (a required aspect of contract plansheets). Very high bids were received, and the Park administrative staff chose to do the work by directed rental equipment instead, so as to keep the site cost within reasonable bounds.

The G-Line site was high on the list of sites needing work. It had a large number of high-volume incipient failures which were capable of either reaching an active stream or impacting old growth redwood (or both). Since the majority of these problem areas were treatable as well as being man-caused, it was felt that timely action was called for before they failed.

Wet subsurface conditions and other complications were not expected over most of the site, so the use of the contract format seemed plausible. In addition, all of the proposed work was prescribable via the Park's in-house erosion control rehabilitation software, which is geared to facilitate the production of contract plan sheets. The extra time required to finalize the prescription within this restrictive (contract) format was undertaken so as to fulfill this park's commitment to doing work by contract wherever possible.

The work was laid out by a two-person surveying crew, using the field computer to finalize the treatment in the field, as the surveying progressed. Much of the work consisted of fill-exporting type prescriptions, yet there were few viable local fillsites. This resulted in much of the exported volume having to be truck-endhauled for over 1/2 mile. Such approaches are avoided where possible, due to the greatly increased cost and complexity they entail. When no other fillsite could be found, the G-Line deck was used. The fill-exporting work on the G-2 and G-4 roads, as well as all of the slopework jobs entailed only short endhauls, permitting inexpensive "blade-endhauling" by crawler tractor.

All of the rehabilitation work was carried out by rental heavy equipment, under the direction of Park staff. Table 2 summarizes the total site costs incurred during all phases of the actual rehabilitation work, including the labor-intensive straw spreading and site preparation work (but not the G-4 work and culvert compacting)

Heavy Equipment Phase

Heavy Equipment Applications

Two teams of heavy equipment were used during the initial phase of the project, so as to shorten the duration of the work. The secondary team consisted of a Caterpillar D6 Crawler Tractor (with winch), plus a Case 980B Hydraulic Excavator. This team completed the entire G-2 road as well as all of the slopework. The main team did the work along the G-Line and G-4 roads. It consisted of: a Caterpillar D8 Crawler Tractor (with rippers); a Case 980B Hydraulic Excavator; a Caterpillar 950 Wheel Loader (3 cu yd bucket); a water truck; and various dump

trucks. From two to four trucks were in operation simultaneously during the endhauling work (Table #1).

Both equipment teams started at the same time. The main team worked straight through for eight weeks. The secondary team completed their work in the first three weeks, and was then dismissed.

The main team worked strictly in a station-sequential manner along the G-Line road, beginning at the eastern terminus of the previous year's G-Line work and proceeding upstation toward the G-Line deck. The only deviation from this was when the D8 and Excavator completed the G-4 road work during a period when the trucks and loader were busy trying to catch up on a huge backlog of stockpiled fill, ready for endhauling.

The secondary team worked its way along the G-2 road beginning at its upper end and finishing where it meets the G-Line. Along the way, they did the assigned slope crossings accessible from the G-2 as they arrived at each slope access location. Following the completion of the G-2 road, this team traveled upstation along the G-Line to Station G153, where they accessed and completed a number of slope crossings above the road. Once these were done, this team was dismissed, leaving the main team to complete the remaining work. The fact that this site had two main roads (G-Line and G-2) permitted the autonomous operation of two equipment teams, shortening the duration of the heavy equipment season by three full weeks.

Heavy Equipment Costs

The G-Line site was totally accessible by vehicle for all the mapping, contract prescription and heavy equipment work, thus the only "access" costs incurred were for equipment In/Out expenses using lowboys. These totalled \$3,300.00 (Table 2) for the 5 non-roadable pieces. (2 bulldozers, 2 excavators, and loader) Dump truck In/Out costs are included in the Primary Treatments.

Table 2 also shows that the total heavy equipment cost for all primary treatments totaled \$112,880.03. The cost breakdowns of each of the component treatments contributing to this total are given as follows: Table 3, Haulroad Stream Crossing Summary; Table 4, Skidtrail Crossing Summary; Table 5, Exported Outsloping Summary; Table 6, Outsloping Summary; Table 7, Rip & Drain Summary For G-Line; Table 8, G-2 Drain Summary. Each line item in the tables mentioned above is broken into the actual cost incurred during the rental equipment work and the equivalent lowbid contract cost for that same item.

The comparison of these relative costs is given in its own separate section, later in this report.

There is no separate table for miscellaneous costs, since this could not be compared on a contract-versus rental equipment basis. The \$2,944.20 (Table 2) miscellaneous cost for the work as done (by rental equipment) represents the cost of general equipment standby time which was not attributable to any given job, lunch and discussion breaks, assisting stuck equipment, and other minor costs associated with the work. The parenthesized miscellaneous costs, which would have occurred

under a contract (\$3,220.05) represented the bidder's cost for the camp setup, hand tools, and other non-heavy-equipment costs not covered by specific line items in the contract's schedule of work. The "miscellaneous" heading thus does not cover the same items in the rental cost analysis as it would have if the work had been done by contract. Nevertheless, the two "miscellaneous" costs are included in Table 2 because they represent the actual, accountable "miscellaneous" costs for the two methods of work.

Evaluation Of Heavy Equipment Application

This year's equipment and operators were all of top quality. Everything possible was done to take the fullest advantage of this expertise. For example, the large amount of spoil to be truck-endhauled (over 13,000 cu yd!) meant that the ability to efficiently load and endhaul would have the greatest effect on the unit cost. High excavation rates would have been of little value without the commensurate ability to haul it away before it got in the way of those doing the excavating. The roughness of the G-Line road's surface would have kept the truck speeds down to around 5 to 7 mph, requiring a great number of trucks. At the same time, this great number of trucks could not efficiently pass one-another, so a tremendous decrease in efficiency would have resulted, perhaps doubling the unit cost.

The solution to this problem was to have the D8 Cat blade the "fines" out of the inboard ditch and onto the roadway. It also cleared vegetation so as to increase the effective roadwidth, making it possible for trucks to pass each other. In the narrower locations, turnouts were created. All of this work was done when the D8 just happened to be traveling along the road, such as when it was required for spreading fill at a fillsite to make room for another matrix of truck-dumps. The water truck kept the dust down and the compactability up. The D8 did some crude preliminary grading of the material it had brought back up onto the road. Following this, the Park grader came in and applied the finishing touches to the road. A quick follow-up run with the grader was required a couple of weeks later, but that was all. The road remained VERY smooth. Special thanks for this grader work are extended to John Wilson, who loaned the grader, and Gary Sherwood, who's fine operation of it did so much to lower the site's unit cost.

This road treatment was so effective that the trucks averaged around 15 mph, cutting their required number to between 1/2 and 1/3 of what would have been required. The minimal extra cost of the water truck more than paid for itself, since it was the water which made the grading have a lasting effect, and kept the dust down as well.

The work went as planned, without many snags. One of the two real deviations from the plans was the fact that a number of the larger truck-endhauled Exported Outslope (EOS) prescriptions were greatly diminished in size, due to the fact that solid rock was encountered well before achieving the intended grade. This had little effect on the unit cost, but greatly depressed the morale of the truck drivers, since their length of employment was cut short. The EOS sites so effected were: EOS G95+58 (decreased from 1152 to 238 cu yd); and EOS G211+95 (reduced from 1140 to 602 cu yd). The EOS at Station G98+00

was included as part of the crossing immediately downstation (DD G97+65), due to the fact that the two treatments were excavated and endhauled as a single unit. This EOS (though tabulated as part of the DD excavation) was reduced from 1720 to less than 200 cubic yards, due to again encountering a rock shelf. It is likely that these shelves were excavated into solid rock during the course of the roadmaking, since they are not a common, naturally occurring feature elsewhere in this watershed.

The second significant change from the plan sheets was the decreased extent of excavation at stream crossing DD G161+80. This "stream crossing" was in reality no such thing, since it connected a recently developed spring/gully system (originating in a block glide feature up the hill) with a main tributary to Tom McDonald Creek. This tributary lies just downslope from and convergent with the road at this point, finally crossing the road just upstation (@ DD G163+90). There was no other way to get this new "stream" to properly reach this tributary stream other than to excavate a "crossing" through the virgin ground under the roadway. The channel's planned grade was VERY steep (50% slope). During excavation, emergent ground water was encountered at depth. When combined with existing surface flow and the extremely steep channel gradient, the effect was to greatly limit the depth reachable by the excavator/tractor combination. The option of bringing in a crane for this one job, on the spur of the moment, was rejected as being unfavorable, from a cost/benefit standpoint, so the excavation was left partially completed. The final grade was only around 30% slope, resulting in its emerging from the fillslope 20 feet higher than the tributary it was supposed to tie-in to! The volume of excavation decreased from a planned value of roughly 3200 cu yd to a bit over 1000 cu yd. This underexcavation will cause roughly 100 to 300 cu yd of material to be slowly released to the tributary as the gully works its way down to the stream, which is its new base level. The decreased volume of endhauled material precipitated a predictably opprobrious response from the truck drivers, since it added to the work loss they were already sustaining from the decreased EOS excavations mentioned above.

Neither of the above plan changes were foreseeable, yet both resulted in a greatly decreased volume of (expensive) truck-endhauled material. The money thus saved was partly used to complete the G-4 road work and to eliminate the culvert problem on the G-Line Deck. Since these costs were subsidiary to the planned work (on the bid schedule), they are discussed in a separate appendix, and their incurred costs are included only in Table 1. This exclusion results in a more realistic data base for making contract/rental-equipment cost comparisons, since these "extra" jobs would not have been done by a contractor.

New Site Synopsis Table Proposed

The following volume-weighted mean statistics are a condensation of all non-slope work done on this site.

TABLE 9: Volume-Weighted Mean Statistics For G-Line '85

<u>Volume- Weighted Statistic</u>	<u>Truck- Endhauling (DDR, EOS)</u>	<u>Blade- Endhauling (DDR, EOS)</u>	<u>In Place (OS only)</u>
\$/cu yard	: \$4.86	\$1.37	\$1.11
Endhaul Dist. (1-way)	: 0.60 miles	163 feet	approx 50'
cu yard/pc hr	: 52	77	94
yardage basis	: 13,362 cu yd	15,850 cu yd	11,071 cu yd

Synopsis Of Essential Conditions

Excavation: mostly dry at depth; few organics encountered at depth.
Endhauling: large terminal fillsite for most truck endhauling; no fillsite cat; level, wide road, well graded & watered (water truck used) = 15 mph mean truck speed; fast, 3yd wheel loader.
Other: experienced, efficient operators using well-maintained equipment.

It is proposed that the above sort of statistical table be made a part of all future annual reports, since it permits any user to quickly glean the essential production figures and site conditions at a glance. These would be extremely helpful in making future cost estimates, since a large number of such tables could be referred to in short order. One would first choose a site where the expected conditions mimic those briefly described on the table. If several such tables applied, a composite table of all could be easily made (using the "yardage basis" line and base statistics to create a new table of volume-weighted means, effectively merging the statistics of all applicable sites). One's cost/time estimates could then be made on the basis of these tabulated statistics, applying the rates to all but the most deviant of worksites. This process would give the lowest possible variation between the site leader's "bid" and the actual final cost, even if the individual items did vary above and below the predicted value. This variation tends to average out over a site, but can compound into a large potential cumulative error, statistically speaking, if separately based estimates are made for each worksite. The important thing is to accurately predict the overall site cost, so this individual variation would be no problem. Another advantage of such a "bid" basis is that it is statistically well founded upon a large data base, rather than just upon the site leader's "feeling". This could be of extreme value in any litigation.

LABOR-INTENSIVE PHASE

Labor-intensive work on this site can be broken into two phases:

the vegetation-clearing operation completed prior to the contract bidding process, and; the straw handling and spreading. The costs for these are given only in Table 2, since the secondary treatment portion (strawing costs) is too small to warrant its own table.

"Site Preparation" was a fairly extensive operation. It consisted of total vegetation removal within the limits of excavation below the roads. This was considered to be necessary in order to keep the bid prices down, since the area had a dense cover of second-growth forest.

It was thought that the bids would rise extremely high on the fill-exporting portions of the work, since the organic component of the endhauling fill would be increased so much, causing great difficulty in clearing the dump beds. Once one has experienced a clogged dump, a general aversion to the problem develops in short order. Medications which are effective for treating humans with this problem are notoriously ineffective with trucks. The only solution is a humiliating trip back to the loader, with the truck dragging the protruding dump in its wake, tailgate unabashedly raised. There the entire endhauling process is stopped while all site personnel stand by and watch the loader assist in the deliverance of the poor truck. Once the fetid mass clears the bed, the tailgate slams home in gleeful appreciation. Meanwhile the site cost has risen another jump!

The clearance work was done by in-house labor crews (1531 person hours) assisted by a backhoe (291 equipment hours). The backhoe was fitted with a special clamp fixture which had been purchased, in part, with this sort of work in mind. The downed poles were yarded up the slope, using chains hooked to the bucket, then each pole was grabbed by the bucket clamp and brought up onto the roadway, where it was loaded onto a 2 1/2 ton truck. The truck was equipped with a home-made log cradle for holding the poles, and a dump bed. This permitted it to place the poles in an out-of-the-way location unassisted, by merely driving there with a load, backing into the desired pole-stash location, elevating the bed, and driving out from under the load. Credit for this cost-cutting, efficient system goes to Gary Dasher, Gary Sherwood, and Lou Tirado. The total cost of this work was only \$23,964.00. This same work would have run in excess of \$35,000 if done using the methods employed the previous year.

If no contract had been intended, then none of this preparation work would have been done. The handling of the uncleared organic matter during the heavy equipment work would have raised prices to some degree. How much is rather hard to say. For this reason, the vegetation clearance cost (\$23,964.00) is applied identically to both the rental and the projected contract cost. It would be useful to try such a contract without vegetational clearance, as it may not be as expensive as it was once feared to be. The M-2-1-1 contract, for instance, would be a good test vehicle for this comparison, since it has many areas clear of vegetation, plus some portions that are heavily grown over. A comparison in the unit bids (\$/yd) given by all bidders to these two sorts of areas would be instructive.

The straw spreading was done by three groups of workers: in-house

labor crews (238 pers-hrs); Redwoods United crews (179 pers-hrs); and YCC crews (156 pers-hrs). The actual (unparenthesized) straw work cost shown on Table 2 (\$7,941.77) includes the straw bale cost, plus the labor costs of unloading, distributing and spreading of the straw, and \$340 of heavy equipment rental costs in moving the bales during rehab. The projected contract cost (\$8,792.51) covers the same items except that the bidder's bale placement price was substituted for the documented in-house labor cost and heavy equipment costs for doing the same job. The mean total bale cost of \$8.91/bale is improved over the former in-house costs which typically ran about \$11/bale. The labor crews and crew leaders can be given credit for this savings (approximately \$1,860). Their willingness to think on the job and use innovative ideas has once again proven its value. The entire Resource Management Support unit is showing the effects of good leadership and good attitude. Their help on the G-Line project was absolutely top quality throughout, as reflected in the finished product and the cost figures as well.

The straw treatments turned out well this year. By sticking to a 6000 pound/acre mulch rate and rounding UP the bale figures for each mulched prescription, the full extent of all disturbed areas were properly covered. The ACTUAL surface area disturbed by any treatment is usually between 20% and 30% greater than that predicted, due to overspillage and other factors. I have found that a heavy prescribed mulch rate is necessary to give proper coverage. The "real life" coverage of this theoretical 6000 ppa figure is a bit over 4000 ppa. In future work, I feel it would be wise to simply apply a 7000 ppa mulch rate based upon the theoretical surface area. This would give a little better "fudge factor", assuring that this valuable, relatively inexpensive treatment is as effective as it is intended to be. The 7000 ppa figure would produce an actual coverage of about 5000 ppa for the entire disturbed area, assuring a more lasting, effective protection for the sprouting native and planted vegetation. Resistance to rilling would also be improved.

DISCUSSION AND CONCLUSION

The G-Line '85 rehabilitation site was a high priority erosion control project for the Park. Its documented tendency toward incipient failures, combined with its delicate fluvial, piscatory, and old growth environments qualified it for extensive, immediate treatment. Other, less disruptive roads in this basin (G-6, G-6-1, C-9, and C-Line Roads) will be completed in the coming year or two.

The work went well, though it was rather irritating to have to have gone through all of the preparation required for a contract only to have to turn around and "do" all of the site by equipment rental. This sort of time commitment precludes doing much else except the one site during the year. A similar amount of effort could probably permit the preparation and running of two such sites per year. This is one of the hidden costs of contracting.

CONTRACT/RENTAL-EQUIPMENT COST AND EFFICIENCY ANALYSIS

This section deals only with the comparison of the two methods of doing erosion control work: by IFB contract and by directed heavy equipment rental. It applies to the G-Line'85 site in particular (the data base) and to other such sites by implication. This is not to say that this analysis is thought to be strictly applicable to all such sites, but rather that the lessons learned here should be considered. Conditions change. Some methods which were effective in the past may no longer be so. The implications of such changes, as well as their causes are discussed, since it appears that they will have a strong bearing on the overall effectiveness of the Park's future rehabilitation work.

General costing considerations were handled in earlier sections of this report, permitting this single-subject overview to be made without reference to other, non-causal considerations. This analysis is based solely upon the tables already given in the report. Each cost figure was, where possible, analyzed not only as to its actual rental-equipment cost, but also as to how much THE SAME WORK would have cost had the lowest overall bidder been awarded the contract. These contract-equivalent costs are based upon applying the low bidder's unit cost figures (\$/cu yd, etc.) to the ACTUAL work done at each worksite (volumes removed, bales placed, number of crossroad drains, etc.), rather than to the values as originally estimated. This normalization of the equivalent contract cost places all cost figures on an even basis. The projected contract costs could not have been less than shown, but could have been larger if any litigation had developed. The possibility of such extra costs are not predictable, so are not included in the relative cost considerations, yet the reader should be aware that they are a very possible result of either the contracting or the rental-equipment methods. Both are, after all, contracts. The Park management considers only fixed price contracts to be CONTRACTS, thus the word will be so used in the remainder of this analysis.

Cost Differential Observed

The total amount of money the Park saved by not doing this work by contract is shown on Table 2 as \$19,919.71. Not all treatment types contributed to this differential. For example, the Haulroad Stream Crossings (Tables 2 & 3), and Skid-trail Crossings (Tables 2 & 4) would actually have been slightly cheaper to do by contract. The Crossroad Drain work (Tables 2, 7 & 8) would have cost only slightly more by contract. The main excavation cost difference occurred in the Exported Outsloping (Tables 2 & 5) and Outsloping (Tables 2 & 6), which would have cost (respectively) \$5,332.06 and \$9,362.76 more if done via the low bidder. The total additional contract cost for all heavy equipment (primary) treatments would have been \$14,493.12.

No other contract-versus-rental costs are given in separate tables, but are summarized in the bottom half of Table 2, which deals with non-excavation bid items. These figures show that the contract would have made the following increases to the site cost: straw work = \$850.74

more; mobilization/demobilization = \$3,700 more; record keeping = \$600 more; Site Preparation = no change (not done by contractor); and Miscellaneous = \$275.85 more. These items combine into a \$5,426.59 loss for contracting.

The total loss which would have been suffered via a contract (\$19,919.71) is the sum of the above two phases of the work, and represents 11.7% savings over the contractor's low bid.

Probable Causes Of Excessive Contract Bids

From talking with various contractors, analyzing their respective bids, and viewing these in light of their experience at rehabilitation work, four distinct causes seem to be responsible for the consistently high bids the Park has received recently. The first of these is that the Park now requires that each bidder be licensed as a class A contractor in order to enter the bidding process at all. Much work here on the north coast is done without benefit of such licensing. In fact it is very rare for forest work. This restriction eliminates many potential bidders. Those who do bid are inclined to charge extra for the expertise which their licence implies. The Park's in-house staff if not saddled with such a requirement prior to running a rental equipment show, thus this is a direct add-on factor.

The second factor is that Bonding is now required of the contractor. This insurance requirement, as well as the contracting licence was imposed upon the Park, not generated from within its management staff. Neither of these factors was thought to be necessary, as the government has many powerful recourses of its own to deal with any failure to perform, on the part of the contractor. The bonding adds between 6% and 10% to the contractor's bid. This is not part of his profit structure. It is one of his losses, just as it is for the Park.

The third factor is the government's requirement that the equipment operators be paid the same, higher wage that they would receive if they were working on a construction project. It used to be that the Park's IFB contracts were permitted to use a cheaper wage rate than was required for hired operators on rental equipment, but now both the contracted and rental-equipment personnel are subject to Davis-Bacon wage rates. The bidders thus no longer enjoy the advantage this once gave them.

Perhaps the most powerful incentive toward higher bids is the fourth one: the "scare factor". In reviewing the site, neither the site leader nor the bidder has the benefit of X-Ray vision. The subsurface conditions remain an unknown factor at each site. Only a very careless bidder would assume that the conditions were excellent from the surface all the way down to the grade plane for all excavational bid items. Such people soon are out of business, since they must complete all work that they bid upon, regardless of whether it results in a profit or a loss to them. Defaulting on the contract is really not an option, if they want to stay in business. Every bid is a gamble, with a comfortable safety factor thrown in. If the situation below ground is

difficult (wet conditions, with many large, buried organics, for example), then they must at least break even. If they do not encounter these sort of conditions, then their profit is considerable. In either case they don't lose. By comparison, our own in-house bids are cut very "close to the bone". We can use a substantial data base upon which to make our bid. On the average, the in-house estimate fits very closely with the resulting project cost. If untoward difficulties are encountered, then the scope of the overall project can be cut back, or additional funding can be asked for. If any particular work site proves impossible to do within reasonable cost guidelines, then we can redesign the work or modify the treatment intensity. The contractor has no such freedom. He/she must count upon being forced to do the work regardless of any such considerations. We cannot "go out of business", so this scare factor is not an issue. For the contractor, it is a way of life.

While the data used to make the numerical analysis in this report is drawn from only a single source, the obvious causal factors are applicable to all contracted rehabilitation work within the Park. The 1800 Road site was contracted out this year in spite of a similarly excessive low bid. Hindsight is very accurate, from a cost analysis standpoint. This contract's site leaders (T. Spreiter and L. Johnson) back calculated what their rental-equivalent costs actually would have been (see Johnson and Spreiter, 1985, "The 1800 Road Contract", unpubl. rept.). Their cost differentials were similar in magnitude to that found with the G-Line project. Their contract cost quite a bit more than the same work would have by rental equipment. The same factors prevailed as causative agents for this difference. It is quite likely that future contracted sites will also incur this expense.

Projected Cost Trends For Future Sites

The four present causes of high contract bid costs, as discussed above, are not likely to change in the foreseeable future. The first three are part of the government's successful, intensive campaign to make things more difficult/expensive than reason would dictate. The sweet smell of success, in this regard, is so stimulating that any change in these three policies is quite unlikely. This Park's management has no option but to apply these cost-inducing measures to all IFB rehabilitation contracts. As if that were not enough, they are also forced to implement contracting to the fullest extent possible, regardless of the cost.

The fourth cost-increasing factor (the "scare factor"), is an integral part of the contracting process. Its intensity can be lowered, but not eliminated. The best way to keep this odious factor in line is to only contract out the most simple, straightforward sites, doing the rougher ones by directed rental equipment. This would be best implemented as a gradually phased-in goal, since by definition the "scarier" sites are the ones most needing work. The simple sites, while needing work done to them, are for the most part in little danger of imminent failure, so this approach would not compromise the Park's goals. This solution is not presently possible, since the Park's management is mandated to

implement the maximum amount of contracting possible.

As can be seen, the main impediment to the proper implementation of contracting in the Park is the government itself. The result is that the quality of the work will be lower and the cost higher than if the Park's management were given the latitude to implement such policies in the most pragmatic way possible. One of this country's main advantages over the Soviet Union is that we tend to depend more heavily upon our lower level operatives than they do for minute-by-minute decision making. This simple expedient gives us the profound advantage of dynamic adaptability to changing situations. It is just not possible to run ground level and near-ground level operations efficiently from six levels up the chain of command. This is the key to the entire problem. Fortunately, it is also an issue that is within the purview of the Park Service.

By forcing its ground level professionals to operate in an ineffective, counter-productive manner, the Park Service stands to lose more than just money. The effect on morale is quite bad. This is especially so in these times of fiscal limitations, where positions are in jeopardy. If the financial loss to the Park for having implemented this year's 1800-Road Contract is combined with the amount the Park would have lost by doing the same to the G-Line work, then a total cost differential of roughly \$50,000 is attained. This would be enough to pay two additional GS-9 site leaders. This next year, each of the three rehabilitation teams "gets to do" a contract site, in addition to a rental equipment site. Formerly, a single site per year was done by each team. The rehabilitation staff is not here "for the money"! By forcing excessive work upon these folks and stipulating that it be done in a way that has shown itself inferior, the Park reduces the satisfaction this work normally produces. This policy stands a good chance of depleting the Park's pool of trained personnel.

APPENDIX

As previously mentioned, part of the money saved from reduced truck-endhauling was applied to pulling a segment to the G-4 road and to culvert compacting.

The G-4 road work was accomplished by the D-8 and 980 excavator during the 6th week when the loader and trucks were removing a large pile of fill chiefly from EOS G168+85, and during the 7th week after work on the G-Line was completed to the G-4 junction. The entire portion of the G-4 removed (.4 mi) was ripped and cross-road drained (XRD) except for a blade-endhailed EOS of roughly 800 cu yds along a swale (Map D). The D-8 and excavator each expended 10.75 hours on the G-4 road for a total cost of \$2,150.

Disposal of culverts on the G-Line Deck began at the end of the 4th week. These culverts had been brought there from past rehab work. Both the D-8 and excavator were involved in crushing and burial operations at the deck before the dump trucks and loader returned to resume the

fill exporting work near the main stem crossing of DD G163+90. After finishing the remaining road work on the G-Line and G-4 roads, the team returned to the G-Line Deck to complete the culvert disposal work. A total of 18 D-8 hours and 9.75 excavator hours were spent for a total cost of \$2,775.

Nov. 14, 1984

.....
: Mapping :
: \$384, 5 person days* :
:.....

Feb. 13, 1985

Aug. 23, 1984

.....
: Prescription, Planning, Documentation: :
: \$11,128, 116 person days : :
:.....

Sept. 25, 1985

July 8, 1985

.....
: Heavy Equip. Rental Phase :
: \$4,710, 43 person days : :
:.....

Aug. 26, 1985

Sept. 30, 1985

.....
: Post Heavy Equip. Surveys, Documentation : :
: \$1,115, 12 person days : :
:.....

Dec. 16, 1986

Oct. 23, 1985

.....
: Report Phase : :
: \$3,410, 38 person days : :
:.....

Oct. 23, 1986

*Most of this year's site was mapped in
1983/84 as part of the 84-1 project

KEY:

Start Date

.....
: Work Phase : :
: Cost/# person days : :
:.....

Finish Date

FIGURE 1

Hydrologist/PST Work Schedule

Table # 1 Weekly Work Summary

Main Equipment Team										Trucks				Secondary Team			
(DATES) WEEK #	D6	EXC	LDR	WHITE	COSSART	LESINA	BRNLO	GREEN	D6	EXC #2	H20	Truck					
7/08-7/12	52 hrs	48.25 hrs	22 hrs	18.5 hrs	28.5 hrs				50.0 hrs	47.5 hrs							
1	\$5200.00	\$4825.00	\$1232.00	\$793.84	1182.75				\$3250.00	\$4750.00							
7/15-7/19	51.5	51.25 hrs	19.5 hrs		31 hrs	30.75 hrs		30.5 hrs	47 hrs	44 hrs	22 hrs						
2			+24.5 hrs		+2.5 stby	+2.5 stby		+2.5 stby		+4 hrs							
			stby w/o op		wop	wop		wop		stby w/o op							
7/22-7/26	\$5150.00	\$5125.00	\$1557.50		\$1355.25	\$1344.88		\$1334.50	\$3055.00	\$4561.76	\$792.00						
3	54 hrs	54 hrs							7.5 hrs	7.5 hrs							
	\$5400.00	\$5400.00							\$487.50	\$750.00							
7/29-8/02	54 hrs	54 hrs															
4																	
	\$5400.00	\$5400.00															
8/05-8/09	45.25 hrs	42 hrs	38.5 hrs		40.5 hrs	40.5 hrs	36 hrs	40 hrs			40.5 hrs						
5	+10 stby	+10 stby															
	w/o op	w/o op															
	\$4800.80	\$4475.80	\$2156.00		\$1680.80	\$1680.80	\$1494.00	\$1660.00			\$1458.00						
8/12-8/16	60.5 hrs	54 hrs	48 hrs		50 hrs	50 hrs	50 hrs	50 hrs			51 hrs						
6																	
	\$6050.00	\$5400.00	\$2688.00		\$2075.00	\$2075.00	\$2075.00	\$2075.00			\$1838.00						
8/19-8/23	55 hrs	55 hrs															
7																	
	\$5500.00	\$5500.00															
8/26-8/30	14 hrs																
8	(incl 3 hrs M-line)																
	(road work)																
	\$1400.00																
Equipment	386.25 hrs	358.5 hrs	128 hrs +	18.5 hrs	150 hrs	121.25 hrs	86 hrs	120.5 hrs	104.5 hrs	99 hrs	113.5 hrs						
Totals	+10 stby	+10 stby	24.5 stby		+2.5 stby	+2.5 stby		+2.5 stby		+4 stby							
	w/o op	w/o op	w/o op							w/o op							
	\$38,900.80	\$36125.80	\$7633.50	\$793.84	\$6293.80	\$5100.68	\$3569.00	\$5069.50	\$6792.50	\$10061.76	\$4088.00						

Total Equipment Cost = \$124,429.18 (Includes cost of G-4 road work and curbside compacting on G-line deck, but not lowboy costs)

- Topography
- o o o o o Boundary of Mapped Area plus area downslope from 1979, 1980, and 1981 Site
 - 2000— 400 ft. contour interval from Coyote Peak NW/4 Topographic Map
 - X2002 Point elevation from topographic map
- Streams
- (---) Ridge
 - Perennial stream as mapped on topographic map
 - Intermittent stream added based on geomorphic mapping and aerial photographs
- Haul Roads
- == Major road, still open
 - == Haul road with minor or no treatment
 - == XRD ONLY Cross road drains only (still driveable)
 - == Road ripped and drained, stream crossings excavated, culverts removed, trees planted
 - == M-7-5-2 Road name / direction of work / road work boundary

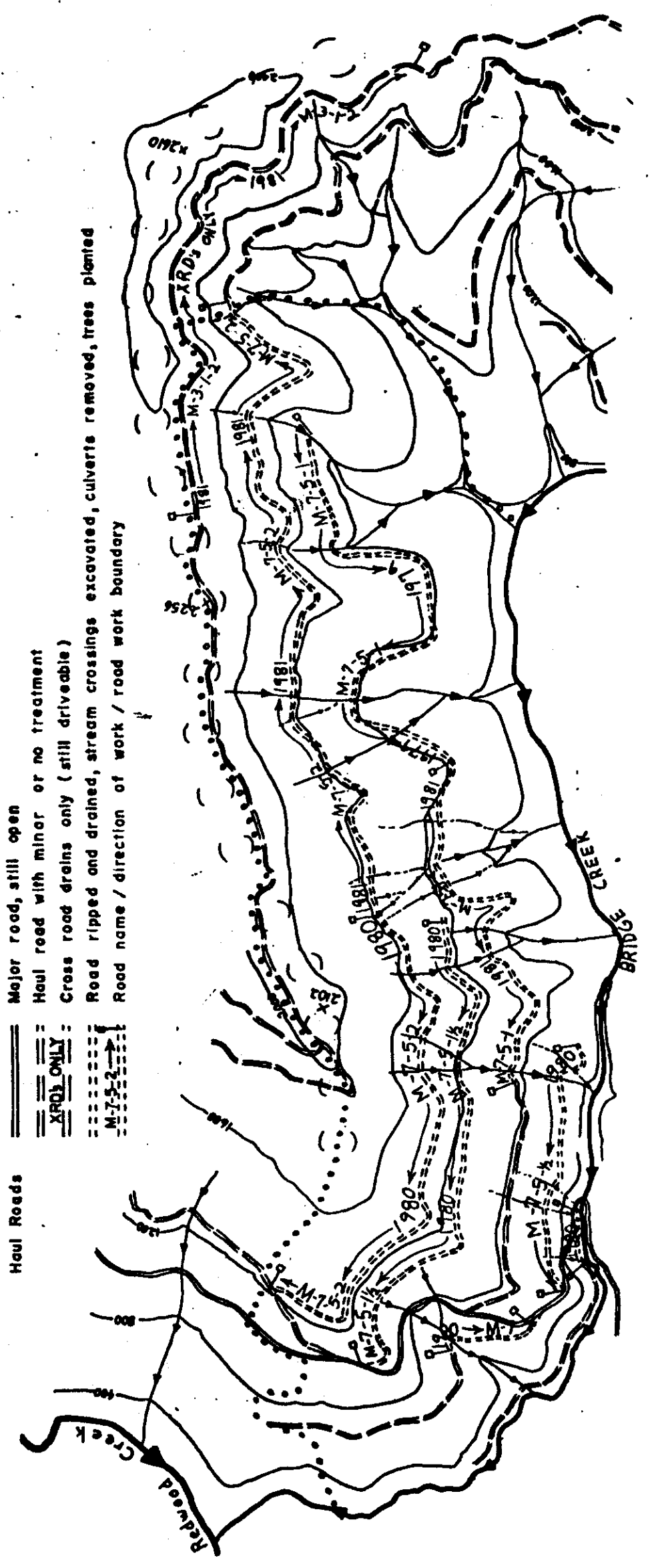
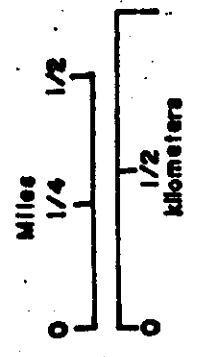




Table 2

Rehabilitation Work G-Line/G-2 Roads

Primary Treatment Costs

<u>Treatment</u>	<u>Equipment</u>	<u># of Worksites</u>	<u>Total Quantity (Cu yd)</u>	<u>Total Cost "()"=Low Bid</u>	<u>X\$ per Worksite "()"=Low Bid</u>	<u>Wtd X per Cu yd "()"=Low Bid</u>
Haul Road Crossing	D-8,D-6, excav., trucks, loader	17	15,819	\$51,100.30* ✓ (50,071.85)	\$3,005.90* (2,781.77)	\$3.23* (3.17)
Skid Trail Crossing	D-6 excav.	15	3,455	\$7,106.25 ✓ (6,072.50)	\$507.59 (433.75)	\$1.75 (1.68)
Exported Outsloping	D-8 excav. D-6 loader, trucks	9	13,393	\$35,539.74 (40,871.80)	\$3,855.18 (4,541.31)	\$2.65 (3.05)
Local Outsloping	D-8 excav.	5	11,071	\$12,256.24 (21,619.00)	\$2,451.25 (4,323.80)	\$1.11 (1.95)
Rip & XRD	D-8, D-6 excav.	15	6,956 ft drn 2.2 mi. rd	\$6,877.50 (8,738.00)	\$458.50 (582.50)	\$3,115.14/mi.rd. (3,957.85)

TOTAL PRIMARY COST =

\$112,880.03 Rental

\$14,493.12 savings
over contract

\$127,373.15 Low Bid Contract

(Table 2 continued on next page)

Background

<u>Treatment</u>	<u>Equipment</u>	<u># of</u> <u>Worksites</u>	<u>Total</u> <u>Quantity</u> <u>(Cu yd)</u>	<u>Total Cost</u> <u>"()"=Low Bid</u>	<u>X\$ per</u> <u>Worksite</u> <u>"()"=Low Bid</u>	<u>Wtd X per</u> <u>Cu yd</u> <u>"()"=Low Bid</u>
Straw & Strawing	Excav., D-6 In-house trucks	28	891 bales	\$7,941.77 (8,792.51)	N/A	N/A
Mobilization & Demobilize	N/A	N/A	N/A	\$3,300.00 (7,000.00)	N/A	N/A
Recordkeeping	N/A	all	N/A	\$0.00** (600.00)	N/A	N/A
Site Preparation	B. Hoe. Trucks (all in house)	all	3.6 mi of rd + S/X crossings	\$23,964.00 (23,964.00)	N/A	N/A
Misc.				\$2,944.20 (3,220.05)		

TOTAL OTHER COSTS =	Rental:	\$38,149.97	\$5,426.59 savings over contract
	Low Bid:	\$43,576.56	

GRAND TOTAL =	Rental:	\$151,030.00	\$19,919.71 savings over contract
	Low Bid:	\$170,949.71	Total Savings over contract
			low bid = 11.7%

** Additional contract cost = \$600. We take notes regardless.
* Not included PP 0115 00.

* Not included DD G115+00, a last minute unsurveyed addition. It's cost = \$1,950.

Table 3

Haulroad Stream Crossing Summary

G-Line (D-8+980B) and G-2(D-6+980B) Roads

<u>Station</u>	<u>Volume</u> <u>Cu yd</u>	<u>End Dist.</u> <u>T=Truck</u> <u>B=Blade</u>	<u>Unit Costs</u> <u>\$/Cu yd</u> <u>LoBid/Rental</u>	<u>Total Cost (\$)</u> <u>Lo Bid/Rental</u>	<u>Cu yd/pc-hr.</u>
DD/BOS G95+25	1,656	475' (B)	4.00/2.14	6,624.00/3,550.00	47
DD/BOS G97+65	2,013	.33mi (T)	*4.27/5.28	8,608.35/10,630.83	51
DDR G107+85	971	50' (B)	1.96/1.08	1,942.00/1,050.00	93
DD G116+00		100' (B)		/1,950**	
DD G126+45	712	82' (B)	1.50/1.40	1,068.00/1,000.00	71
DD G145+90	1,356	244' (B)	2.00/2.21	2,712.00/3,000.00	45
DD G149+51	450	92' (B)	1.75/1.22	787.50/550.00	82
DD G151+00	410	107' (B)	1.50/1.34	615.00/550.00	75
DD G155+25	500	318' (B)	2.50/1.70	1,250.00/850.00	59
DD G161+80	1,070	1.1mi (T)	7.00/5.79	7,490.00/6,349.95	38
DD G163+90	1,490	1.1mi (T)	3.00/5.79	4,470.00/8,619.57	41
DDR G191+70	500	150' (B)	2.00/1.30	1,000.00/650.00	77
DDR G203+45	700	90' (B)	2.00/2.35	1,400.00/1,650.00	42
DD G211+60	1,278	.25mi (T)	4.50/5.37	5,751.00/6,865.28	45
DD G215+60	660	.19mi (T)	4.50/4.94	2,970.00/3,257.60	55
DD H7+59	445	400' (B)	2.00/1.94	890.00/865.00	41
DD H27+55	728	225' (B)	2.00/1.30	1,456.00/945.00	59
DD H33+40	880	60' (B)	1.75/0.82	1,540.00/717.50	101
TOTALS	15,819			\$50,071.85/\$51,100.30	
$\bar{X}$:	931		\$2.84/\$2.70	\$2,945.40/\$3,026.40	60
Wtd $\bar{X}$:			\$3.17/\$3.23		65

* Wtd $\bar{X}$

** Not included so totals can be compared.

Table 4

(980B, D6)

Skid Trail Crossings

Site #	Vol(Cu yd)	(Unit \$/yd)	\$	Cu yd/pc.-hr.
		LoBid/Rental	LoBid/Rental	
2b	220	1.81/1.28	400/281.25	68
2c	120	1.67/1.17	200/140.00	69
2d	150	1.33/1.71	200/256.25	50
*3a		NA/NA	297.50/297.50	NA
3b	300	.66/1.90	200/568.75	43
4a	30	1.67/5.54	50/166.25	60
4c/d	300	1.67/1.62	500/486.25	50
5d	250	1.60/2.71	400/677.50	45
5c	75	1.00/1.88	75/141.25	50
5d/e	450	2.22/1.72	1000/773.75	46
7c	600	1.66/1.08	1000/650.00	73
7d	250	2.00/1.68	500/420.00	48
7f	50	6.00/1.83	300/91.25	50
7g	290	1.21/1.68	350/477.50	48
8d/e	175	2.29/2.14	**400/1208.75	47
				(8e only)
***9d	165	1.21/2.85	200/470.00	29

TOTAL	3455 Cu yd		\$6,072.50/\$7,106.25	
$\bar{X}$:		1.76/2.06	\$433.75/\$507.59	51.7
Volume Weighted Mean		1.68/1.75		53.0

"Savings" = -\$1033.75

* 5X 3a not done....pay for time only in comparing contract/rental
5c = same

** 8d not accessible, 8c redesigned to handle 8d's flows (possible
diversion) 8e & 8d (attempted access costs) costs combined.

*** 1st worksite for this team. Slow work getting used to each other.

Table 5

Exported Outslopes (EOS) G-Line and G-2 Roads

<u>Station</u>	<u>Volume</u> <u>Cu yd</u>	<u>End Dist.</u>	<u>Unit Costs</u>	<u>Total Cost (\$)</u>	<u>Cu yd/pc-hr.</u>
		<u>T=Truck</u> <u>B=Blade</u>	<u>\$/Cu yd</u> <u>LoBid/Rental</u>	<u>Lo Bid/Rental</u>	
EOS G77+30	2,790	.14mi(T)	4.00/2.87	11,160.00/8,008.59	58
EOS G93+30	included as integral part of DD G95+25				
EOS G95+58	238	.36mi(T)	5.00/7.38	1,190.00/1,755.30	27
EOS G98+00	included as integral part of DD G97+65				
EOS G101+40	3,377	75'(B)	3.00/0.98	10,131.00/3,325.00	102
EOS G162+30	554	1.2mi(T)	3.90/5.79	2,160.60/3,062.37	45
EOS G166+30	977	1.1mi(T)	3.50/4.98	3,419.50/4,864.68	60
EOS G168+85	1,690	1.0mi(T)	2.50/4.81	4,225.00/8,132.13	67
EOS G211+95	602	0.2mi(T)	4.10/5.56	2,468.20/3,346.92	45
EOS H8+75	2,740	100'(B)	2.00/0.98	5,480.00/2,686.25	82
EOS H27+92	425	145'(B)	1.50/0.84	637.50/357.50	113
TOTALS	\$13,393			\$40,871.80/\$35,539.74	
$\bar{X}$:	\$1,488		\$3.28/\$3.80	\$4,541.31/\$3,948.86	67
Wtd $\bar{X}$:			\$3.05/\$2.65		75

Table 6
Outsloping Summary

<u>Sta.</u>	<u>Vol (Cu yd)</u>	(Unit \$/yd) <u>LoBid/Rental</u>	\$ <u>LoBid/Rental</u>	<u>Yd /pc.-hr.</u>
G71+00	2467	3.00/1.35	7401/3325	74
G104+60	2816	1.75/0.89	4928/2506.24	113
G164+40	1216	2.00/1.32	2432/1600	76
G167+50	400	1.50/1.81	600/725	55
G171+30	4172	1.50/0.98	6258/4100	102
Total	11,071.00	NA	\$21,619.00/\$12,256.24	NA
$\bar{X}$	2,214.20	\$1.95/\$1.27	\$4323.80/\$2451.25	84
Wtd $\bar{X}$	NA	\$1.95/\$1.11	NA	94

Table 7

G-Line

Rip & Drain Summary

<u>Sta.</u>	<u>\$/Mi.</u> <u>LoBid/Rental</u>	<u>\$</u> <u>LoBid/Rental</u>	<u>Ft. Rd.</u>	<u>Ft. Drain</u>	<u>Hrs.</u> <u>D8/Ex.</u>
81+00	3392/3630	257/275	400	257	1/1.75
88+20	4158/4125	126/125	160	126	.25/1
91+20	4249/8800	169/350	210	169	1.25/2.25
100+00	4262/1886	113/50	140	113	0/0.5
107+00	2497/2854	350/400	740	350	2/2
122+80	3748/2640	*355/250	500	355	.75/1.75
126+60	2479/3032	695/850	1480	695	4.25/4.25
146+22	5013/3342	150/100	158	150	.5/.5
153+00	5253/6270	796/950	800	796	4.75/4.75
179+00	3254/2441	2000/1500	3245	1486	7.5/7.5
214+00	4048/4180	460/475	600	460	2.5/2.25
		\$5471/5325	8433	4957	24.75/28.5
				Total Hours	53.25

Drain Length = 59% of road length

Most Cost = in drain length, so road length \$ is ignored

X Site Cost = \$3334.05/mile of road

Drain Production Rate = 93 ft. of drain/per hr.

"Savings" over low bid = ~~+~~\$146

* Original bid was 175. Prorated up due to increased drain length.

Table 8

G-2 Rip & Drain Summary

<u>Sta.</u>	<u>\$/Mi.</u> <u>LoBid/Rental</u>	<u>\$</u> <u>LoBid/Rental</u>	<u>Ft. Rd.</u>	<u>Ft. Drain</u>	<u>Hrs.</u> <u>D8/Ex.</u>
H0+40	3940/2798	500/355	670	376	2/2.25
H12+60	7581/1582	2102/438.75	1464	638+1464 ft of IBD	1.75/3.25
H31+80	2234/9139	55/225.00	130	55	0/2.25
H34+40	3355/2771	<u>610/503.75</u>	<u>960</u>	<u>570</u>	<u>2.75/3.25</u>
		\$3267/1552.50	3224	1639	6.5/11.0

Drain Length = 51% of road length

Drains = \$.95/linear ft. (no ripping)

$\bar{X}$ Cost = \$2542.56/mile of road

"Savings" over low bid = \$1714.50

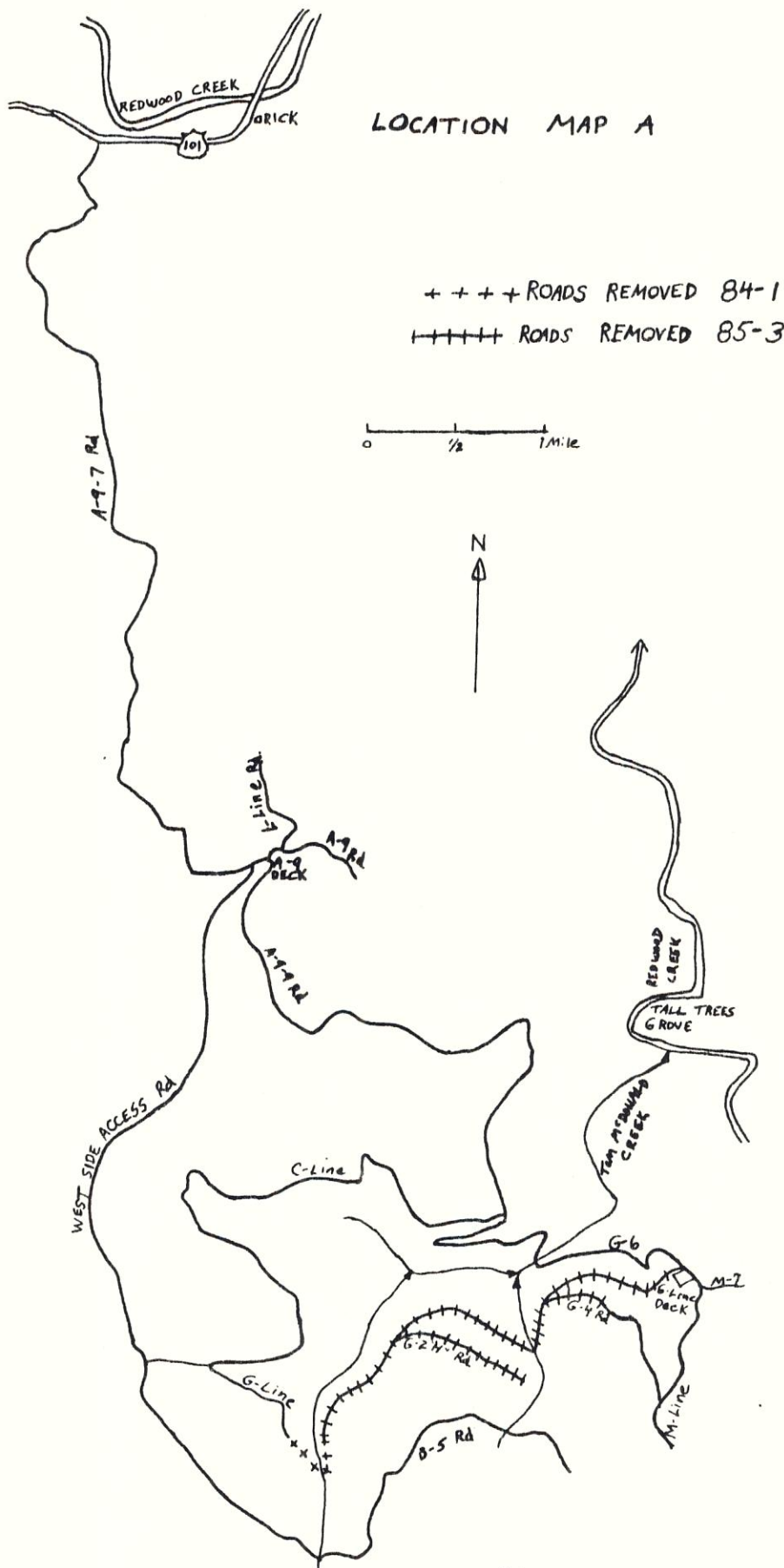
TOTALS	\$8738/6,877.50	11,657	6596	31.25/39.5
FOR BOTH ROADS				Total = 70.75 eq. hrs.

Drain Length = 57% of road length

Drains = (LoBid = \$1.26/ft)/\$.99 ft. rental

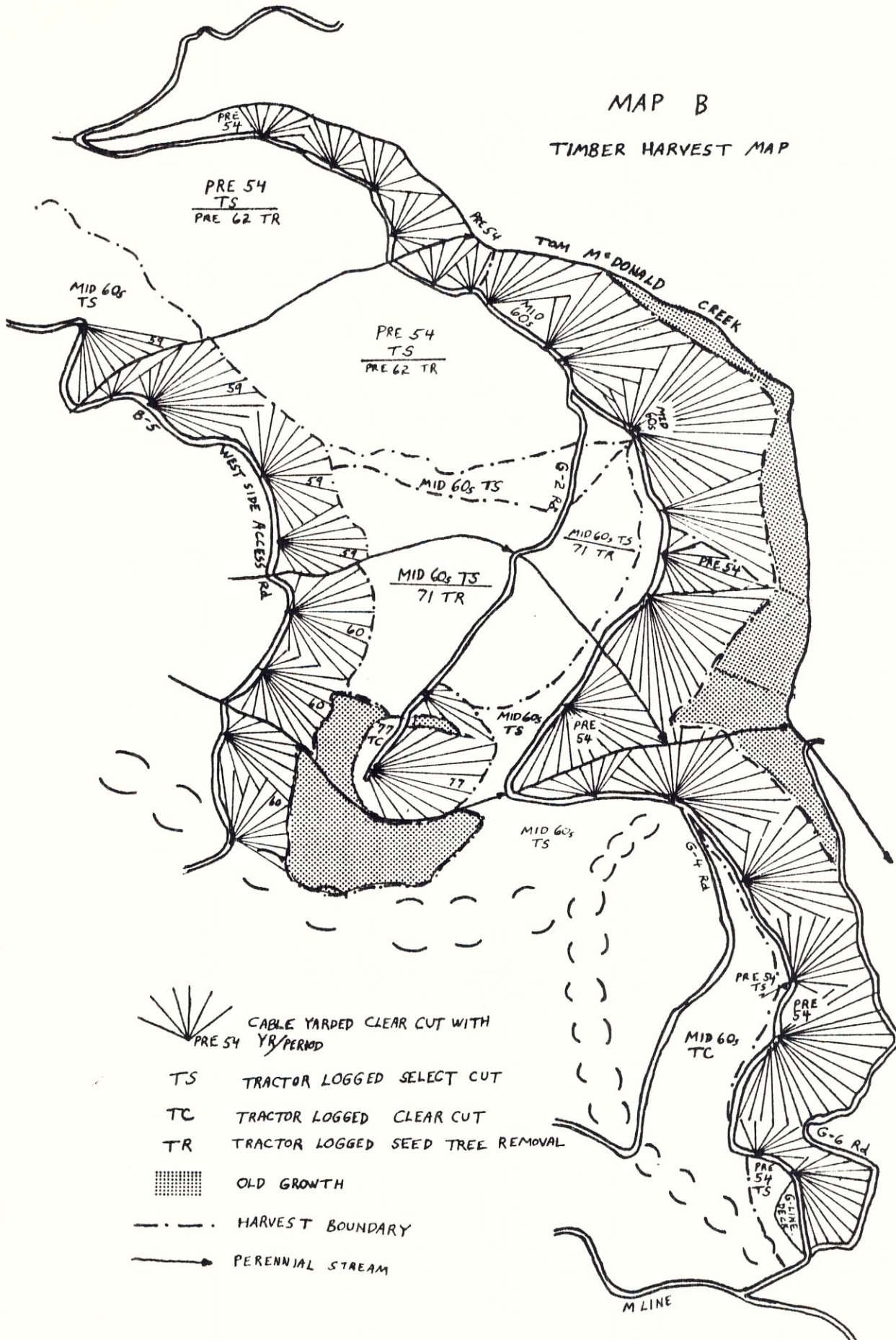
$\bar{X}$ Cost = (LoBid = \$3,957.85/mi)/\$3,115.14/mi. rental

Drain Production Rate = 98 ft/pc hr.



MAP B

TIMBER HARVEST MAP



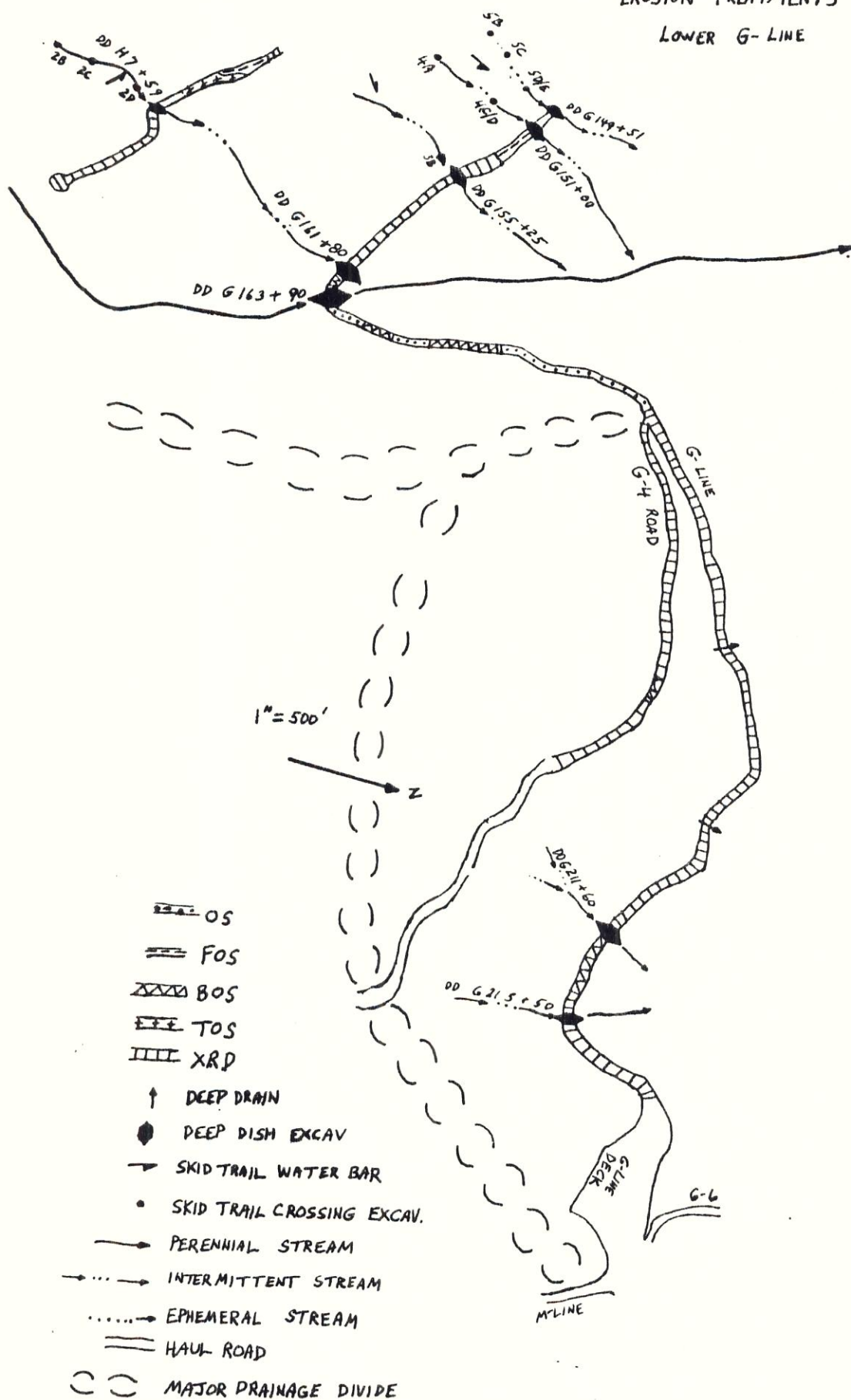
MAP D
EROSION TREATMENTS
UPPER G-LINE

1 inch = 500 feet

- SKID TRAIL WATER BAR
- 76 • SKID TRAIL CROSSING EXCAV & #
- OS OUTSLOPE
- FOS FILL OUTSLOPE
- BOS BENCHED OUTSLOPE
- TOS TOTAL OUTSLOPE
- XRD CROSS ROAD DRAIN
- ↑ DEEP DRAIN WITHIN XRD REACH
- DEEP DISH EXCAV W/STA LOC
- PERENNIAL STREAM
- INTERMITTENT STREAM
- EPHEMERAL STREAM
- HAUL ROAD

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MAP D EROSION TREATMENTS LOWER G-LINE





Unit: 85-3 PP 5C Pre- HE



Unit: 85-3 PP 5C 10/29/85



Unit: 85-3 PP 15 Pre- HE



Unit: 85-3 PP 15 10/31/85