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VOLUME 7 NUMBER 12

Field Notes

Protecting Steep Terrain During Excavation Operations

Delay Costs Involved in Alternatives Between One- and Two-Lane Standards

Cost of Road Maintenance on the Mt. Hood National Forest

Washington Office News

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FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE
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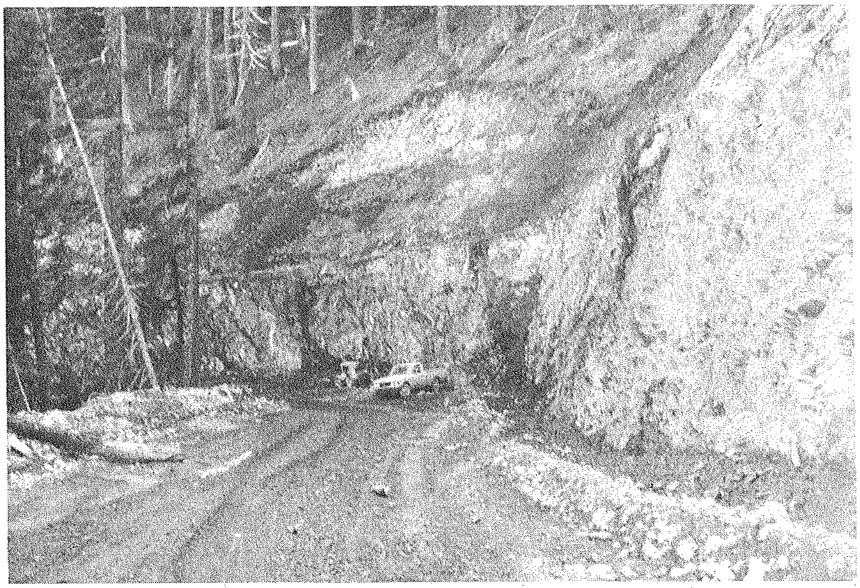

Figure 1. – Typical steep terrain. Note retention ridge at shoulder.

Figure 2. – Barrier trees in place during excavation operation.

PROTECTING STEEP TERRAIN DURING EXCAVATION OPERATIONS

John E. Best
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Six Rivers National Forest
Region 5

Because of the ever-increasing emphasis on environmental protection the construction inspector faces a real challenge to control spillage of material down steep sideslopes during excavation operations. Loss of material over the side of excessively steep terrain results in objectionable scars, and even minor amounts of excavated material on a hillside may kill existing vegetation. In some cases, this loss of vegetation results in erosion and consequent sedimentation of streams.

During previous excavation projects, considerable amounts of material were lost over the side of sideslopes through carelessness. Even when the utmost care was exercised, some spillage still occurred. A project was set up to employ and test construction techniques on steep slopes which would prevent or minimize loss of excavated materials.

The project consisted of a one-mile section of the Gasquét-Orleans Road traversing sideslopes averaging 60-90 percent. In draws, slopes were as steep as 150 percent; Figure 1 shows typical steep terrain. The plans called for a full bench road with a 32-foot wide subgrade. The geology consisted of slates and schists rippable at the surface. Seismic testing indicated possible blasting depths. Specifications for our project very emphatically stated that there would be no sidecasting or spillage of excavated material. Faced with the problem of obtaining access to do the clearing and to start the earthwork, the contractor was in a dilemma, since we would not allow any sidecasting, even for a pioneer cut. Power shovels would not work too well because of the rock, and the slopes were too steep for equipment operation.

After careful consideration, we decided to modify the clearing specification by a change order and allow the contractor to fell the right-of-way timber and build the pioneer road, provided that the trees near the lower clearing limits be felled parallel to the center line. The change order resulted in no additional cost to the Government; we simply allowed the contractor to leave the felled trees in place until excavation reached them.

These lower trees, supported by trees at or below the clearing limit, would provide a screen to catch the excavated material that would be spilled over the side during the pioneer operation (fig. 2). The screen would hold the material inside the excavation limits until grade reached that point, and it could be removed without going down the slope. After the pioneer road was constructed, the balance of the right-of-way timber was hauled out and scrapers and D-9's began excavation, leaving retention ridges on the outside as the grade was brought down. When the grade reached the lower clearing limits, the retention ridges were removed by undercutting and allowing the material to fall toward the roadway. The remaining felled trees were then pulled.

The operation, we felt, was quite successful and resulted in very little damage to the sideslopes (fig. 3). Pre-existing vegetation was not killed, and in only one draw a minor amount of material ran under the logs in violation of the "no sidecast" specification. The contractor showed some reluctance to cutting trees shorter than the normal hauling lengths. Shorter lengths would have been better to fill depressions in the ground, because longer trees simply spanned these and created holes for material to spill through; however, these were filled with slash and brush. Draws were a problem; the use of logs resulted in the one spill mentioned. Felling trees over draws and irregularities resulted in some breakage of good timber and some financial loss to the contractor.

The method outlined herein has merit; however, it might be improved upon as follows:

(1) Machine-place the trees at the lower clearing limit in draws and irregularities to eliminate or prevent gaps in the screen.

(2) Perhaps, in critical areas, the installation of a chain link fence to prevent spillage would be a good investment. The fence could be salvaged at the end of the project.

Before making the decision to use either of these methods, the dollar costs and the aesthetic values have to be carefully weighed.

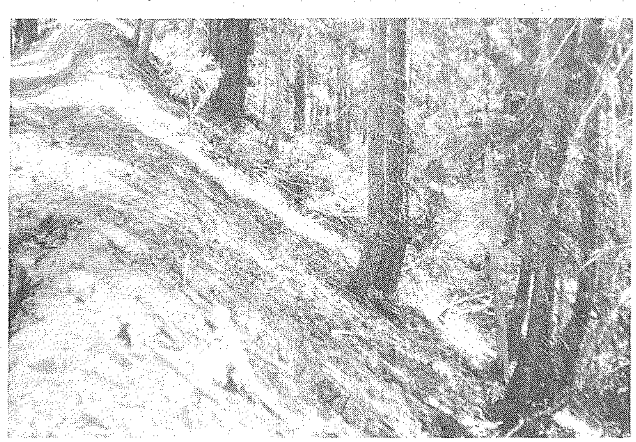

Figure 3. – Slopes picked clean leaving no evidence of excavation spillage.

DELAY COSTS INVOLVED IN ALTERNATIVES BETWEEN ONE- AND TWO-LANE STANDARDS

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Forest Engineers and Transportation Planners often must decide whether a road should be constructed to a one- or two-lane width standard. Too often, selection of the standard is based on a liberal interpretation of the guidelines given in FSM 7721.1 or an intuitive decision, rather than on a sound analytical approach.

Construction, operating, and maintenance costs which can be considered by an analyst, and the relationships of such factors to the one- or two-lane standard are shown below.

Cost	Relationships
Construction	1-lane < 2-lane
Operating Vehicle	1-lane > 2-lane
Driver	1-lane > 2-lane
Safety	(see closing paragraphs)
Maintenance	1-lane < 2-lane
Environmental	1-lane < 2-lane

For a two-lane road to be economically feasible, the cost of delay attributed to a single-lane road must be greater than the combined increased costs of construction, maintenance, and environmental protection for the double-lane road. The safety comparisons have not been reliably determined. This paper is concerned with that portion of the operating costs that is attributable to congestion and delay on one-lane roads.

Considering only vehicle operating and driver costs, and using the timber appraisal figure (applied by Region 6 for operating costs of logging trucks) of 25 cents per minute, then:

$$\text{ADDED VEHICLE OPERATING COST FOR LOGGING TRUCKS, SINGLE LANE VS. DOUBLE LANE, PER YEAR, PER MILE} = \left\{ \begin{bmatrix} \text{AVERAGE DELAY FOR LOADED LOGGING} \\ \text{TRUCKS, IN MINUTES PER MILE} \end{bmatrix} + \begin{bmatrix} \text{AVERAGE DELAY FOR EMPTY LOGGING} \\ \text{TRUCKS, IN MINUTES PER MILE} \end{bmatrix} \right\} \times [\text{NUMBER OF LOADS PER YEAR}] \times [0.25]$$

However, in the 25-cents-per-minute figure there are included several fixed charges (these include such costs as insurance, depreciation, and overhead) that usually are not charged against the delay factor. Data from the Oregon Truckers' Association indicates that approximately 30 - 40% of the 25-cents-per-minute figure is for fixed charges. Therefore, the correct cost per minute for use in the above should be 15 - 18 cents per minute.

The charge for passenger cars, pickups, and other small vehicles used for logging, forest administration, and other business is as follows:

(1) Fuel, 3 cents/mile @ 35 mph . . . . ~ 2 cents/minute
(2) Labor, @ $5.00/hr . . . . ~ 8 cents/minute
(3) Tires, Oil, Lubrication, Maintenance . . . . ~ 2 cents/minute

The 2-cents-per-minute figure for item (3) is based on the assumption that these costs are approximately equal to the cost of the fuel; this relationship is suggested in Winfrey, *Economic Analysis of Highways,* International Textbook Company, 1970. The combined cost of (1) and (3) is 4 cents/minute; this converts to approximately 7 cents/mile @ 35 mph, which seems reasonable.

The operating costs for passenger cars, pickups, and other small vehicles used for recreation is assumed to be 4 cents/minute; that figure includes fuel, tires, oil, lubrication, and maintenance. Although this is a real cost attributable to recreation vehicles, that fact is not perceived generally by the motorist. Conversely, the time lost by delay is an inconvenience that is easily perceived, but no real cost is attributed to it.

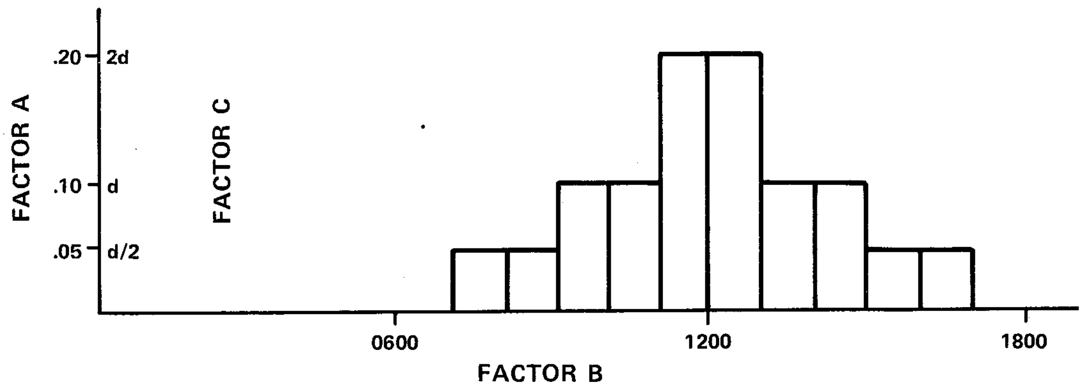
Delay time was estimated by using the Forest Service Single Lane Simulator model.[1] The analysis assumed:

Traffic was comprised of

- 20% loaded logging trucks;
- 20% unloaded logging trucks, opposing the loaded trucks;
- 30% associated logging and administrative vehicles;* and
- 30% recreation vehicles.*

(*15% moving in the same direction as loaded logging trucks; 15% opposing)

Since delay is a function of traffic volume, the assumed distribution of traffic may be displayed as follows:



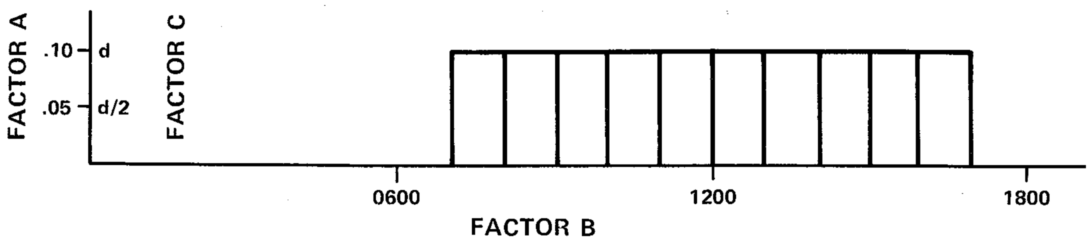
where Factor A = Hourly volume divided by daily volume (v); daily volume is average daily traffic *or* a specific daily volume measure; and
Factor B = Hour of the day, assumed traffic distribution.
Factor C = Delay time.

Results obtained from the Single Lane Simulator indicate that for a given road and composition of traffic, and for the range of traffic volumes in which we are interested (less than 100 vehicles per hour [VPH]), delay is almost directly proportional to volume (fig. 1).

[1]Dimitri P. Petropoulos, ***Stanford University Report EEP-35***, as modified by Computer Sciences Corporation.

Therefore, if the average delay per vehicle is:
d, for a volume of V/10 (.10V on chart, above), then
delay for V/20 (.05V on chart, above) = d/2, and
delay for V/5 (.20V on the chart, above) = 2d.
The total daily delay, distributed as illustrated, is:
(0.5V) (d/2)4+(.10V)(d)4+(.20V)(2d)(2) = 1.3Vd.

If the distribution were constant over a long period, then the traffic may be displayed as follows:

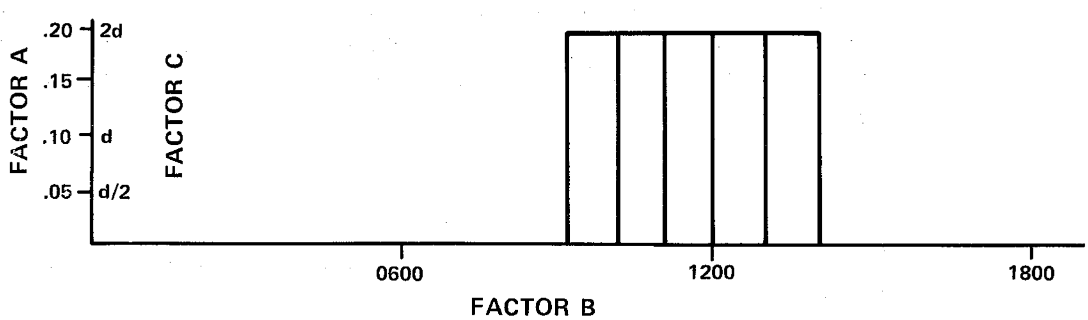


where Factor A = Hourly volume divided by daily volume;
Factor B = Hour of the day, with constant distribution over long period; and
Factor C = Delay time;
then, for the same total daily traffic volume, delay would be

$$(.10V)(d)10 = 1.0Vd,$$

or 23% less than for the assumed distribution.

For constant distribution over a short period, the traffic may be displayed as follows:



where Factor A = Hourly volume divided by daily volume;
Factor B = Hour of the day, with constant distribution over short period; and
Factor C = Delay time;
then, for the same total daily traffic volume, delay would be

$$(.20V)(2d)(5) = 2.0Vd,$$

or 54% greater than for the assumed distribution.

The latter two distribution examples seem much less likely than the first (assumed) distribution, and indicate that the error in estimating delay is not very sensitive to the assumed distribution of traffic.

Assuming a total daily traffic volume (V), the daily cost of delay (C_d) in dollars is:

$$C_d = \left\langle \begin{array}{l} \begin{bmatrix}\text{Delay, loaded} \\ \text{Truck, in sec}\end{bmatrix} \times (.18) \times (.2) \\ + \\ \begin{bmatrix}\text{Delay, empty} \\ \text{Truck, in sec}\end{bmatrix} \times (.18) \times (.2) \\ + \\ \begin{bmatrix}\text{Delay, Asso. \&} \\ \text{Admin, OPP*}\end{bmatrix} \times (.12) \times (.15) \\ + \\ \begin{bmatrix}\text{Delay Asso. \&} \\ \text{Admin, SAME*}\end{bmatrix} \times (.12) \times (.15) \\ + \\ \begin{bmatrix}\text{Delay, Rec.} \\ \text{OPP}\end{bmatrix} \times (.04) \times (.15) \\ + \\ \begin{bmatrix}\text{Delay, Rec.} \\ \text{SAME}\end{bmatrix} \times (.04) \times (.15) \end{array} \right\rangle \left\{(1/60)\ (V)\right\}$$

(*OPP = Direction opposing loaded logging trucks.
SAME = Direction same as loaded logging trucks.)

which reduces to

$$C_d = \left\{ .036 \left[\begin{pmatrix}\text{Delay,} \\ \text{loaded} \\ \text{truck}\end{pmatrix} + \begin{pmatrix}\text{Delay,} \\ \text{empty} \\ \text{truck}\end{pmatrix}\right] + .024 \left[\begin{pmatrix}\text{Delay,} \\ \text{Pass*} \\ \text{OPP}\end{pmatrix} + \begin{pmatrix}\text{Delay,} \\ \text{Pass} \\ \text{SAME}\end{pmatrix}\right] \right\} \left\{ \frac{V}{60} \right\}$$

(*Since delay times of associated logging and administrative and recreation traffic are the same, these categories have been combined.)

If we assume a 150-day season, which would seem to be on the high side, then cost of delay per year, in dollars, is 150 C_d; and, if we assume a 20-year life and an 8% interest rate, the present worth of the total delay cost($C_{T_{PW}}$) in dollars, is expressed as:

$$(C_{T_{PW}}) \cong (150\ C_d)\ (10.00) = 1500 C_d$$

Assume a daily volume of 500 vehicles. The average delays for the different types of vehicles for this volume are shown in Table 1; the values for delay are taken from Figure 2, and are the values from Petropoulos' paper, rather than those derived from Sullivan's test figures. Petropoulos' values are based on more test runs, and are considered to be more accurate.

Thus, using those figures:

$$(C_{T_{PW}}) = \left\{ .036\ (22.4 + 19.4) + .024\ (25.8 + 22.8) \right\} \left(\frac{500}{60} \right) (1500)$$

$$= \$33{,}500/\text{mile.}$$

Therefore, for a daily volume of 500 vehicles, 150 days per year, the present worth of eliminating delays (using the double-lane standard rather than a single-lane standard) is $33,500/mile. This figure is high enough to consider the use of the double-lane standard for most of the terrain in Region 6; however, the volume of 500 vpd is extremely high. Assuming a more reasonable daily volume of 250 vehicles gives the average delay times shown in Table 2.

Using those figures:

$$(C_{T_{PW}}) = \left\{ .036\ (10.4 + 9.0) + .024\ (12.0 + 10.8) \right\} \left(\frac{250}{60} \right) (1500)$$

$$= \$7800/\text{mile.}$$

This delay cost, under most of the conditions encountered in Region 6, would be less than the extra cost of applying the double-lane standard.

The validity of the above results rests on the validity of the model. However, even if the results are considerably in error, they indicate that the value of average daily traffic (ADT), at which two lanes are recommended in FSM 7721.1 is set far below the volume which a single-lane road can accommodate, or which is economically feasible.

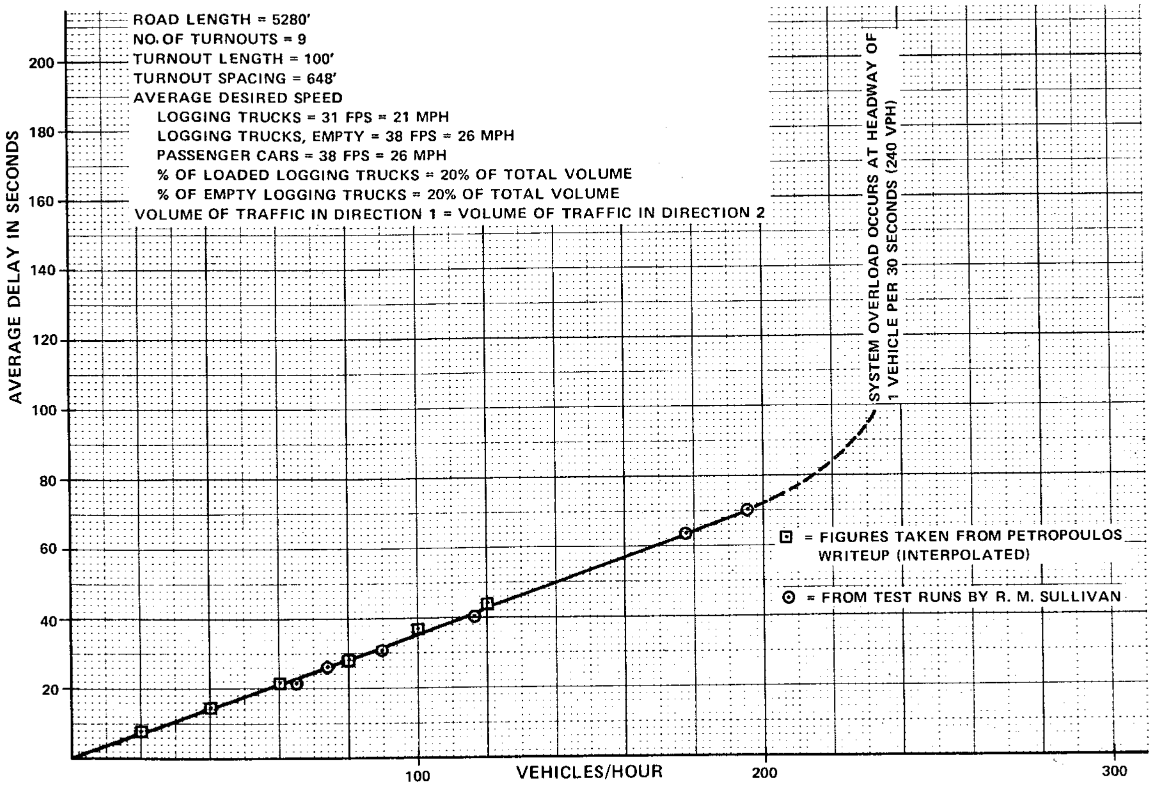


Figure 1. – Average delay for a daily volume of 500 vehicles.

HOUR	HOURLY VOL. ÷ ADT (ASSUMED DISTRIBUTION)	HOURLY VOL. FOR ASSUMED ADT	LOADED LOGGING TRUCKS 20% OF ADT		EMPTY LOGGING TRUCKS 20% OF ADT		PASSENGER CAR SAME DIRECTION AS LOADED TRUCK 30% OF ADT		PASSENGER CAR OPP. DIRECTION FROM LOADED TRUCK 30% OF ADT	
			NO.	AVG. DELAY IN SECS	NO.	AVG. DELAY IN SECS	NO.	AVG. DELAY IN SECS	NO.	AVG. DELAY IN SECS
0700 – 0800	.05	25	5	8	5	7	7	8	7	9
0800 – 0900	.05	25	5	8	5	7	8	8	8	9
0900 – 1000	.10	50	10	16	10	14	15	17	15	19
1000 – 1100	.10	50	10	16	10	14	15	17	15	19
1100 – 1200	.20	100	20	36	20	31	30	36	30	41
1200 – 1300	.20	100	20	36	20	31	30	36	30	41
1300 – 1400	.10	50	10	16	10	14	15	17	15	19
1400 – 1500	.10	50	10	16	10	14	15	17	15	19
1500 – 1600	.05	25	5	8	5	7	8	8	8	9
1600 – 1700	.05	25	5	8	5	7	7	8	7	9
	1.00	500	100	22.4	100	19.4	150	22.8	150	25.8

Table 1. – Average delay per mile by vehicle type for 500 ADT.

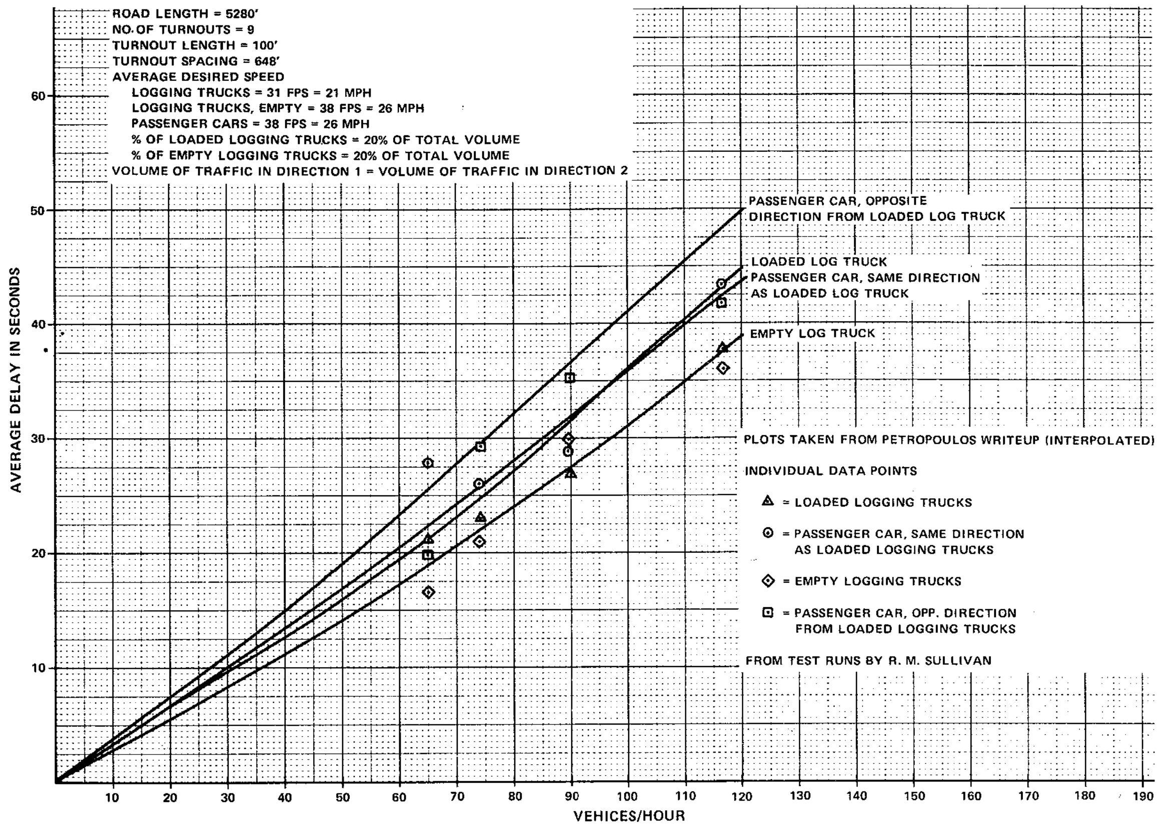


***Figure 2.** – Delay time vs. traffic volume curves.*

HOUR	HOURLY VOL. ÷ ADT (ASSUMED DISTRIBUTION)	HOURLY VOL. FOR ASSUMED ADT	LOADED LOGGING TRUCKS 20% OF ADT NO.	LOADED LOGGING TRUCKS 20% OF ADT AVG. DELAY IN SECS	EMPTY LOGGING TRUCKS 20% OF ADT NO.	EMPTY LOGGING TRUCKS 20% OF ADT AVG. DELAY IN SECS	PASSENGER CAR SAME DIRECTION AS LOADED TRUCK 30% OF ADT NO.	PASSENGER CAR SAME DIRECTION AS LOADED TRUCK 30% OF ADT AVG. DELAY IN SECS	PASSENGER CAR OPP. DIRECTION FROM LOADED TRUCK 30% OF ADT NO.	PASSENGER CAR OPP. DIRECTION FROM LOADED TRUCK 30% OF ADT AVG. DELAY IN SECS
0700 – 0800	.05	12	2	4	2	3	4	4	4	4
0800 – 0900	.05	13	3	4	3	3	4	4	4	4
0900 – 1000	.10	25	5	8	5	7	7	8	7	9
1000 – 1100	.10	25	5	8	5	7	8	8	8	9
1100 – 1200	.20	50	10	16	10	14	15	17	15	19
1200 – 1300	.20	50	10	16	10	14	15	17	15	19
1300 – 1400	.10	25	5	8	5	7	8	8	8	9
1400 – 1500	.10	25	5	8	5	7	7	8	7	9
1500 – 1600	.05	13	3	4	3	3	4	4	4	4
1600 – 1700	.05	12	2	4	2	3	3	4	3	4
	1.00	250	50	10.4	50	9.0	75	10.8	75	12.0

***Table 2.** – Average delay per mile by vehicle type for 250 ADT.*

That a single-lane road can handle in excess of 100 vehicles per day is intuitively obvious: 100 vehicles per day is equivalent to about 10 vehicles per hour, or one vehicle every six minutes. Figure 1 indicates that even at volumes of 200 vehicles per hour the single-lane road will function and not become blocked, although — admittedly — the cost of congestion would be very high at this point.

The only other factor which may favor using the double-lane standard is safety; however, there is a question as to whether single-lane roads are significantly less safe than double-lane roads. It has even been suggested that single-lane roads may actually be safer than double-lane roads, because drivers tend to travel more carefully on the single-lane roads.

It seems certain that, from an economic point of view, a single-lane road can handle several hundred vehicles per day (certainly 200), and that in setting the limit at 100 we are implicitly putting a very high value on the factors of convenience and of a safety hazard which may or may not exist.

Editor's Note

With this article, we have introduced a new procedure. The article was reviewed by Ron Tangeman of Region 10; he presents his impression of the techniques used and their application to Forest problems.

The Washington Office will appreciate readers' comments on whether they would wish to continue this procedure with selected future articles.

The managers of National Forest lands would do well to consider the analysis technique set forth in this article when establishing standards for Forest Development Roads. Although the traffic distribution and split used here looks suspiciously "theoretical" and is unlikely to be encountered in the "real world", it serves well to make Mr. Sullivan's point about the reliability of the criteria currently used to set Forest Service road standards.

I see the value of this technique as being threefold. First, it enables the Forest Manager to make road development investments based on data that can be measured, evaluated, and documented, instead of on arbitrary standards. Second, the standard for a road can be tailored to its own unique traffic volume and distribution characteristics (determined from traffic volume counts and classification studies). Third, the analysis is relatively simple and calculations can be made at the engineer's desk (assuming that delay time vs. traffic volume curves are available).

The main drawback to applying this technique is the use of delay time vs. traffic volume curves, such as shown in Figure 2; currently, these are not readily available. A family of standard curves, similar to Figure 2, covering the range of the variable values (traffic volume, speed, composition, and turnout spacing) experienced on Forest Development roads could be generated using the Single Lane Simulator model and published in book form. The analyst would then be able to interpolate between the standard curves to obtain delay times for the road being analyzed. This would free the analyst from the time-consuming and somewhat expensive process of generating delay curves for each analysis, and would greatly simplify and enhance the analysis process.

— Ron Tangeman
Region 10

COST OF ROAD MAINTENANCE ON THE MT. HOOD NATIONAL FOREST

Ted Picket
Mechanical Engineer

Mike Cisneros
Industrial Engineer

San Dimas Equipment Development Center
Region 5 — ?

Reuben Kurtti
Engineering Analyst
Mt. Hood National Forest
Region 6

Recently, the San Dimas Equipment Development Center (SDEDC) learned that the Mt. Hood National Forest, Pacific Northwest Region (R-6), had collected and computerized cost data on all road maintenance work performed on the Forest in FY 1974. These data were of value to two ongoing Equipment Development projects, one at San Dimas and the other at the Missoula EDC. It was felt that if these data were summarized properly, the resulting summary would be of value to Forest Service road maintenance engineers across the nation.

The activity code numbering system used in the tables is the same as that in Section 13 of the proposed Forest Service "Transportation System Maintenance Handbook" (FSH 7709.15). Cost figures shown are "project," and general administration and program management costs are not included. All unit costs have been rounded off to three significant figures. The methods and equipment used by different forests to do the same task vary considerably. To make the tabular data as meaningful as possible, the equipment typically used to perform each task is listed. The Mt. Hood's service trucks (typically referred to as stakeside trucks under the "Equipment Used" heading) are 1½- or 2-ton trucks. Rates for equipment usage vary and depend on whether the equipment is forest Service-owned or used under contract.

The data show that the cost of specific tasks usually varied considerably through a large minimum/maximum range. Maximum unit costs shown in the table are actual and could (in some cases) be caused by unforeseen events such as adverse weather, equipment breakdowns, or even errors in posting activity codes. Sometimes, high maximums are caused by long travel distances. For example, if two signs needed work and they were 20 miles apart, the average unit cost would be much higher than if 30 signs needed repair in a 5-mile section of road.

The flood repair efforts in FY 1974 sometimes required a considerable amount of extraordinary work for a given activity. For example, in activity code 114 (spot surface repair, aggregate-surfaced roads), a flood repair project could require several dump trucks and a loader to fill a slump or remove a slide, with a grader to level the grade prior to repairing the spot.

Differences in road designs and in the environment itself (i.e., a steep mountainous terrain vs. gently rolling country; rocky conditions vs. easily handled soil, etc.) can cause differences in the expense of performing a task at different locations. In fact, there are many factors which make these data far from absolute. But, even though the data can not be considered as absolute, they are the only known summary of maintenance costs on Forest Service roads and, therefore, should be valuable to road maintenance engineers in defining minimum/maximum costs that might be incurred when performing the listed tasks.

Now forest managers on all 155 National Forests can look at an "open book" on road maintenance costs that were incurred on a single Forest. The value in this sharing of cost data is simply to give managers a feel for what happened in a not too typical place under not too typical circumstances.

FY 1974 ROAD MAINTENANCE COSTS, Mt. Hood National Forest

ACTIVITY CODE NO.	ACTIVITY DESCRIPTION	TOTAL FY 74 EXPENDITURES ($)[5]	TOTAL NO. OF UNITS	AVG. COST PER UNIT($)	MAX. UNIT COST ($)	MIN. UNIT COST ($)	EQUIPMENT USED IN TYPICAL PROJECT
100-199	TRAVELED WAY						
101	Blading, non-aggregate roads	3,015	65 lane mi	46.40	85.50	16.80	A motor grader and a personnel transporter. (Sometimes a water tank truck was also used.)
103	Dust abatement, non-aggregate roads	317	1 lane mi	317.00	1	–	A pickup and tank truck with distribution capability.
105	Spot surface repair, non-aggregate roads	503	60 cu yd of matl	8.38	8.38	–	There was only one project; a pickup, a dump truck, an end loader, and a motor grader were used.
109	Slide removal, non-aggregate roads	1,064	520 cu yd of matl	2.05	3.20	1.57	An end loader, a dump truck, and a pickup. (Sometimes a motor grader and a tank truck were used.)
110	Blading, aggregate surfaced roads	50,479	1,069 lane mi	47.20	223.00	8.72	A motor grader and a personnel transporter. (Sometimes water trucks were also used.)
111	Logging out, aggregate-surfaced roads	8,829	277 mi	31.90	235.00	–	One or two personnel transporters. (Sometimes an end loader was used.)

FY 1974 ROAD MAINTENANCE COSTS, Mt. Hood National Forest (continued)

ACTIVITY CODE NO.	ACTIVITY DESCRIPTION	TOTAL FY 74 EXPENDITURES ($)[5]	TOTAL NO. OF UNITS	AVG. COST PER UNIT($)	MAX. UNIT COST ($)	MIN. UNIT COST ($)	EQUIPMENT USED IN TYPICAL PROJECT
112	Dust abatement, aggregate-surfaced roads	32,211	254 lane mi	127.00	602.00	9.13	One or two personnel transporters, one or two tank trucks with distribution capability, or a distributor and a motor grader with scarifier. (Occasionally a roller and miscellaneous water pumps were used.)
114	Spot surface repair, aggregate-surfaced roads	33,764	8,840 tons of aggregate surfacing	3.82	97.70[2]	–	One or two dump trucks, one or more personnel transporters, a motor grader, and an end loader. (Sometimes a crawler tractor was used.)
115	Surface replacement, aggregate-surfaced roads	23,184	3,156 tons of rock	7.35	47.50	2.20	One or two dump trucks, an end loader, a motor grader, a personnel transporter, and a tank truck.
119	Slide removal, aggregate-surfaced roads	31,974	13,302 cu yd of debris	2.40	9.34	–	An end loader, one or two dump trucks, and one or more personnel transporters. (Sometimes a motor grader or several other miscellaneous pieces of equipment were used.)

FY 1974 ROAD MAINTENANCE COSTS, Mt. Hood National Forest (continued)

ACTIVITY CODE NO.	ACTIVITY DESCRIPTION	TOTAL FY 74 EXPENDITURES ($)[5]	TOTAL NO. OF UNITS	AVG. COST PER UNIT($)	MAX. UNIT COST ($)	MIN. UNIT COST ($)	EQUIPMENT USED IN TYPICAL PROJECT
120	Spot premix patching, paved surfaces	80,098	3,660 tons of mix	21.90	112.00	–	One or more personnel transporters, liquid asphalt applicating equipment, and one or more dump trucks. (Sometimes a motor grader or an end loader, for removing old material, was also used.)
122	Chip seal, paved surfaces (This activity is commonly done in conjunction with activity 133 and/or for restoring aged pavement. It is also used in conjunction with activity 131 for surface protection and rideability.)	152,965	136 lane mi	1,130.00	–	–	A distributor, a roller, one or more personnel transporters, one or more dump trucks, an end loader, a power broom, several tank trucks, a pump, and equipment transporters.
123	Surface overlay of paved surfaces	31,774	10 lane mi	3,180.00	–	–	One or more dump trucks, one or more personnel transporters, a distributor, a roller, a motor grader, a paver, equipment transporters, and a power broom or flusher.

FY 1974 ROAD MAINTENANCE COSTS, Mt. Hood National Forest (continued)

ACTIVITY CODE NO.	ACTIVITY DESCRIPTION	TOTAL FY 74 EXPENDITURES ($)[5]	TOTAL NO. OF UNITS	AVG. COST PER UNIT($)	MAX. UNIT COST ($)	MIN. UNIT COST ($)	EQUIPMENT USED IN TYPICAL PROJECT
124	Rock removal from paved surfaces	2,410	372 mi	6.48	111.00	0.93	Every project included a pickup truck. About half also included a motor grader or an end loader and dump truck.
125	Sweeping material from paved surface	3,621	357 lane mi	10.10	130.00	2.17	One or more personnel transporters, a power broom, and either a motor grader or an end loader.
126	Level surfaces with premix, paved surface	33,247	3,279 tons of premix	10.10	10.90	9.51	One or more dump trucks, one or more personnel transporters, a distributor, a roller, a motor grader, a paver, equipment transporters, and a power broom or flusher.
127	Fog seal, paved surfaces. (Used as part of 126, 131, and 133)	4,168	77 tons of asphalt	54.10	62.40	–	One or more personnel transporters, a tank truck with distribution capability, or a distributor and a power broom were available. (Occasionally, an end loader, a roller, or other miscellaneous equipment was used)
128	Sand blotting	702	90 tons of sand	7.80	11.20	–	A dump truck with spreader.

FY 1974 ROAD MAINTENANCE COSTS, Mt. Hood National Forest (continued)

ACTIVITY CODE NO.	ACTIVITY DESCRIPTION	TOTAL FY 74 EXPENDITURES ($)[5]	TOTAL NO. OF UNITS	AVG. COST PER UNIT($)	MAX. UNIT COST ($)	MIN. UNIT COST ($)	EQUIPMENT USED IN TYPICAL PROJECT
129	Slide removal, paved surfaces	16,365	10,676 cu yd of matl	1.53	27.20	0.35	A dump truck, one or more personnel transporters, and one or two end loaders. (Sometimes a power broom or flusher was used.
131	Asphalt stabilization with pulvimixer (Rock in place on roads)	66,241	1,405 tons of liquid asphalt in place	47.20	84.90	10.40	A tank truck, pickup trucks, a grader with scarifier, a roller, a stabilizer, and miscellaneous pumps. (Sometimes one or two dump trucks and equipment transporters were used. Sometimes, and increasingly, additive spreaders for lime and cement were also used.)
132	Asphalt stabilization with motor grader (Rock in place on roads)	945	25 tons of liquid asphalt in place	37.80	37.80	37.80	Every project used two motor graders. About half included a personnel transporter, a roller, and a tank truck with distribution capability.
133	Asphalt stabilization with pugmill mix	62,927	440 tons of liquid asphalt in place	143.00	162.00	133.00	One or more dump trucks, an equipment transporter, personnel transporters, an end loader, a tank truck and/or distributor, a roller, a power broom, a paver or grader, a pugmill or mixing plant. (Sometimes a sand
			9342 tons of mix including aggregate	6.74			

FY 1974 ROAD MAINTENANCE COSTS, Mt. Hood National Forest (continued)

ACTIVITY CODE NO.	ACTIVITY DESCRIPTION	TOTAL FY 74 EXPENDITURES ($)[5]	TOTAL NO. OF UNITS	AVG. COST PER UNIT($)	MAX. UNIT COST ($)	MIN. UNIT COST ($)	EQUIPMENT USED IN TYPICAL PROJECT
133 (cont)							spreader and miscellaneous pumps were used. Sometimes, and increasingly, additional feeders for lime or cement were used.)
	Subtotal	640,803					
200-299	SHOULDER						
210	Grade or reshape graveled shoulders (normally a paved travel way)	2,010	41 shoulder mi	49.00	424.00	7.04	A motor grader and a stakeside truck or pickup. Sometimes a stabilizer, a tank trailer, and end loader, or other miscellaneous equipment was used.
211	Bring gravel shoulders to grade	3,699	734 tons of aggregate	5.04	18.50	4.81	A dump truck, an end loader, three other trucks, or a personnel transporter and a motor grader.
212	Repair sloughed shoulders on gravel-surfaced roads	10,647	5,012 tons of matl	2.12	6.38	0.98	One or two personnel transporters, a dump truck, another truck (such as a stakeside) and a crawler tractor.
223	Surface overlay on paved shoulder	1,946	3 shoulder mi	649.00	649.00		There was only one project; a pickup, a dump truck, a motor grader, an end loader, and a tank truck with distribution capability were used.

FY 1974 ROAD MAINTENANCE COSTS, Mt. Hood National Forest (continued)

ACTIVITY CODE NO.	ACTIVITY DESCRIPTION	TOTAL FY 74 EXPENDITURES ($)[5]	TOTAL NO. OF UNITS	AVG. COST PER UNIT($)	MAX. UNIT COST ($)	MIN. UNIT COST ($)	EQUIPMENT USED IN TYPICAL PROJECT
224	Sweeping material from paved shoulder	448	34 shoulder mi	13.20	166.00	3.43	A personnel transporter, one or two motor graders, and a power broom. (Sometimes an end loader and a dump truck were used.)
	Subtotal	18,750					
300-399	DRAINAGE						
301	Clean and reshape ditches. (Can be combined with 302.)	10,763	213 ditch mi	50.50	632.00	6.09	One or two motor graders, one or more stakeside trucks, and one or two end loaders. (Sometimes personnel transporters were also used.)
302	Slough removal from ditches with end haul	9,971	4,485 cu yd of debris	2.22	5.61		One or two end loaders, a dump truck, and one or more personnel transporters.
303	Slough removal from ditches without end haul	1,824	1,135 cu yd of debris	1.61	11.50	0.72	An end loader and a pickup truck. (Sometimes a motor grader was used.)
304	Machine cleaning of culverts	22,855	2,130 culverts	10.70	195.00	1.78	All of the projects included one or two backhoe/loader combinations, one or more personnel transporters, and a dump truck. (Sometimes a motor grader and a stakeside truck were used.)

FY 1974 ROAD MAINTENANCE COSTS, Mt. Hood National Forest (continued)

ACTIVITY CODE NO.	ACTIVITY DESCRIPTION	TOTAL FY 74 EXPENDITURES ($)[5]	TOTAL NO. OF UNITS	AVG. COST PER UNIT($)	MAX. UNIT COST ($)	MIN. UNIT COST ($)	EQUIPMENT USED IN TYPICAL PROJECT
305	Hand cleaning of culverts	18,098	3,490 culverts	5.19	–	–	One or more personnel transporters or a stakeside truck.
306	Culvert repair	12,557	184 culverts	68.20	–	–	One or more personnel transporters, an end loader, and a dump truck. (Sometimes a stakeside truck with a power wrench, a crawler tractor, or a motor grader were used.)
307	Clean and repair special drainage structures (French drain, perforated pipe gabion, crib bid walls).	6,368	68 structures	93.70	832.00	–	One or more personnel transporters, a dump truck, and an end loader.
308	Culvert replacement	18,783	32 culverts	587.00[3]	–	–	One or more personnel transporters, one or two backhoe/loader combinations, one or two dump trucks, and a motor grader. (Sometimes a stakeside truck was also used.)
309	Maintaining interceptor dips on nonpaved roads	1,104	232 dips	4.76	21.70	2.98	A motor grader and a stakeside truck. (Sometimes a pickup or end loader and crawler tractor were used.)

FY 1974 ROAD MAINTENANCE COSTS, Mt. Hood National Forest (continued)

ACTIVITY CODE NO.	ACTIVITY DESCRIPTION	TOTAL FY 74 EXPENDITURES ($)[5]	TOTAL NO. OF UNITS	AVG. COST PER UNIT($)	MAX. UNIT COST ($)	MIN. UNIT COST ($)	EQUIPMENT USED IN TYPICAL PROJECT
300-399	DRAINAGE						
	Subtotal	102,323					
400-499	ROADWAY						
402	Brush cutting machine	22,161	137 mi brushed	162.00	630.00	50.90	All the projects used a brush cutter and a utility truck.
406	Brush disposal, burning	296	5 mi	59.20	83.90	42.70	Every project included a pickup or stakeside truck.
412	Slide and slump repair of fill slopes	27,321	13,880 cu yd of matl	1.97	6.00	–	One or two dump trucks, one or more personnel transporters, one or two end loaders, a motor grader, and a stakeside truck. (About half the time a crawler tractor was also used.)
	Subtotal	49,778					
500-599	ROADSIDE						
501	Logging out	7,541	189 mi	39.90	159.00	9.20	A personnel transporter or a stakeside truck. (Sometimes a motor grader or an end loader were used for skidding.)

FY 1974 ROAD MAINTENANCE COSTS, Mt. Hood National Forest (continued)

ACTIVITY CODE NO.	ACTIVITY DESCRIPTION	TOTAL FY 74 EXPENDITURES ($)[5]	TOTAL NO. OF UNITS	AVG. COST PER UNIT($)	MAX. UNIT COST ($)	MIN. UNIT COST ($)	EQUIPMENT USED IN TYPICAL PROJECT
505	Stump removal	585	56 stumps	10.40	60.20	9.16	An end loader, a dump truck, a crawler tractor, and a stakeside truck or a pickup.
	Subtotal	8,126					
600-699	STRUCTURE	0					
700-799	TRAFFIC SERVICES						
702	Shop repair of signs (remove and install)	2,549	63 signs	40.50	87.50	–	Only a personnel transporter was used.
703	Repair and replace hazard markers	2,998	383 markers	10.60	41.50	–	Every project used a personnel transporter or a stakeside truck.
705	Restriping of center and edge lines	19,364	293 mi of line	66.10	96.00	60.90	All of the projects included a County striping truck and two personnel transporters.
708	Snow plowing	8,084	325 lane mi	24.90	347.00	–	One or two motor graders and either pickups or a stakeside truck. (Sometimes an end loader was used.)
712	Construction of new signs	9,607	495 signs	19.40	55.10	–	None.

FY 1974 ROAD MAINTENANCE COSTS, Mt. Hood National Forest (continued)

ACTIVITY CODE NO.	ACTIVITY DESCRIPTION	TOTAL FY'74 EXPENDITURES ($)[5]	TOTAL NO. OF UNITS	AVG. COST PER UNIT($)	MAX. UNIT COST ($)	MIN. UNIT COST ($)	EQUIPMENT USED IN TYPICAL PROJECT
713	Installation of new signs	7,982	274 signs	29.10	95.20	–	A stakeside truck. (Sometimes a pickup truck or backhoe/loader combination was used.)
714	Construction of barricades	8,583	166 barricades	51.70	63.30	–	None.
	Subtotal	59,167					
800-899	SPECIAL						
802	Hauling rock to stockpile	49,963	6,397 cu yd	7.81	10.50[4]	–	A dump truck and an end loader. (Sometimes a tractor was also used.)
	Total	928,910					

[1]Indicates the value could not be determined.
[2]This activity in FY 74 was predominantly flood damage and frequently included subsurface repair.
[3]Costs varied greatly, depending on the size of the fill the culvert was installed in.
[4]There were very few projects completed under this activity, and they were long hauls with chip seal rock.
[5]Costs of general administration and program management are not included.

WASHINGTON OFFICE NEWS

OPERATIONS

Harold L. Strickland
Assistant Director

TECHNICAL INFORMATION CENTER

The Technical Information Center (TIC) is a part of Engineering's Technical Information System. Other components in this system are: Publications; the Remote Sensing Information Center; and an information bank — now in the planning stages — which will contain specific technical data concerning Engineering projects and the staff associated with those projects. These components of the Technical Information System facilitate the flow of information throughout Engineering, both in the field and in the Washington Office (WO).

The specific function of TIC is to provide ready access to published technical information. The staff acquires both hard (paper) and microform copies of current books, periodicals, reports, and pamphlets. In addition to publications stored in TIC, the staff has access to information resources in the Washington area and throughout the nation.

REFERENCE SERVICE

The objective of TIC's reference service is to answer requests for information from the WO, and from the Regions through the Regional Information Coordinators. To answer an urgent need, field personnel may send requests directly to TIC; the staff will then inform the cognizant Information Coordinator of the request. WO Engineering staff make their requests directly to TIC.

Requests for information sent to TIC can be requests for complete publications or sections of publications; bibliographies; or computer-based searches. If requestors do not have specific titles of books or documents they need, they can ask for publications on a certain topic; TIC will locate and send them to the requestor.

Once a request for information is initiated, the staff first draws upon TIC's resources. If necessary, TIC requests material from the National Agricultural Library or other libraries in the area; if a government publication is needed, the originating agency is contacted for assistance in obtaining the document. The library and information specialists in TIC also consult with WO engineers, who recommend information resources in their areas of interest.

When TIC processes a request for information, the requestor receives an end product in one of the following forms:

(1) **A publication** (book, journal, or pamphlet in hard copy or microfiche). If the publication has been obtained on loan, it is sent with the requirement that it be returned to TIC within a period of two to three weeks. If the publication has been purchased (or a free copy has been secured), it is sent to the requestor for his retention. Publications received for the WO are indexed, catalogued, and stored in TIC.

(2) **A copy of a section of a publication.** This can be a reprint or Xerox copy of an article from a journal, or of a chapter from a book. If the item is available on microfiche, the whole document can be reproduced as hard copy.

(3) **A bibliography** of books and articles written on a certain topic; the information necessary to obtain each item is included in the list of items. After the requestor receives a bibliography, he may ask TIC to furnish either the publications or photocopies of them.

(4) **Results of a computer-based search.** A search of one or more computerized data bases is generally the best means of providing comprehensive coverage of a particular topic. Upon receiving such a request, the TIC staff performs the search in-house, or arranges to have it done through one of a number of government, non-profit, or commerical information services. Some of these are:

—NTIS (National Technical Information Service), through which 400,000 reports generated from government-sponsored research are available for searching. Published searches in 29 fields of interest can also be ordered.

—NASA Scientific and Technical Information Facility has a computerized data base of over one million documents on aerospace research topics. Many of these are pertinent to information needs of Forest Service Engineering (for example, the extensive collection of documents on remote sensing).

—HRIS (Highway Research Information Service) at the Transportation Research Board contains descriptions of 10,000 current research projects, and almost 35,000 abstracts of highway research publications. HRIS also provides a "current awareness" service, through which users are regularly informed of recently-published documents in their fields of interests.

—RECON at ERDA (U. S. Energy Research and Development Administration) is a system to which Engineering has "on-line access" (we can interact directly with the data bases by means of a computer terminal). Included among RECON data bases are Water Resources Abstracts, Nuclear Safety Information Center, and The Energy Data Base.

REMOTE SENSING INFORMATION CENTER

The Remote Sensing Information Center has been established in TIC in order to support the activities of the recently-established Forest Service Remote Sensing Management Committee, and to facilitate the flow of technical information concerning remote sensing. This center will facilitate the acquisition and retrieval of all remote sensing material.

The TIC staff is currently preparing a bibliography on remote sensing which will list publications according to originating source. Subject areas covered in each publication will be identified.

TIC also depends on outside services to handle queries in the area of remote sensing. Besides the NASA Scientific and Technical Information Facility, the TIC staff contacts — among others — the American Society of Photogrammetry, the Center of Remote Sensing Information and Analysis at the Environmental Research Institute in Michigan, and the International Remote Sensing Institute.

PACFORNET

In addition to TIC's resources, engineers in Regions 5, 6, and 10 have available to them the Pacific Coast Forest Research Information Network (PACFORNET). PACFORNET is a network of libraries, components of which include:

PSW Science Literature Service
Berkeley

Computer Services Library, PSW
Berkeley

Forestry Library
University of California
Berkeley

Library, Geotechnical and Materials Lab
R-5, Pleasant Hill, CA

Library, Forest Science Lab
Juneau

Forest Resources Library
University of Washington
Seattle

Through PACFORNET, the following services are available:

The Monthly Alert, a list of new publications received at PACFORNET libraries.

Document delivery service, through which users can request any publication. If not available at PACFORNET, the publication is borrowed from another source. The document, or a copy, is sent directly to the requestor.

Reference service, through which the PACFORNET staff answers specific questions, both general and technical. If they do not have the information needed, they contact other sources.

Literature searches, both manual and computer-based, which provide the user with a list of references on a specific topic.

PACFORNET service units may be accessed by mail or phone:

California and Hawaii:
PACFORNET (South)
U.S. Forest Service
P.O. Box 245
Berkeley, CA 94701
FTS: 449-3687 document delivery
FTS: 449-3688 for literature searches

Oregon, Washington, and Alaska
PACFORNET (North)
Forest Resources Library AR-10
University of Washington
Seattle, WA 98195
206-543-7484
FTS: New number will be assigned in December.

In addition, people in Alaska may contact:

PNW
P.O. Box 909
Juneau, AK 99802
907-586-7301

To use the information resources in TIC, phone or write Technical Information Center, (Inez Fitzgerald, Technical Information Specialist, or Joyce Sarkisian, Library Technician), Engineering Staff Unit, Forest Service, USDA, Washington, D.C. 20250; 703-235-1424.

CONSULTATION AND STANDARDS

Charles R. Weller
Assistant Director

DISPOSITION OF FPC LICENSED PROJECT FACILITIES AT EXPIRATION OR SURRENDER OF LICENSE

When a Federal Power Commission (FPC) license expires, is surrendered voluntarily, or is abandoned, Engineering Staff members are often called upon to provide input to Forest or Regional recommendations for the disposition of dams and other project works.

Some typical items, among many, which should be considered in connection with these actions are the following.

Recommendations are directed to the FPC, not to the licensee. We have no authority to order a licensee to perform work, and may incur legal and financial liability if we do so.

We should indicate what we want done — not provide design drawings. FPC and the licensee are responsible for design sufficiency.

Remember the consequences of recommendations for acquisition or removal of the dam.

(1) Acquisition brings with it legal and financial responsibilities for the safety of the dam. The Forest Service becomes responsible for conducting inspections, and maintenance and repair of these dams. When the Dam Safety Act is fully implemented, these responsibilities may become much more regimented and costly; while in Federal Power Commission custody, they are exempt from the Dam Safety Act.

(2) Removal of the dam can also create liabilities — for environmental damages to downstream resources from release of sedimentation, and for property damages due to radical changes in stream flow characteristics of flood control.

If the recommendation is for acquisition of the dam, every effort should be made to have the dam put in structurally-sound and mechanically-operational condition before transfer. As-built drawings, calculations, and inspection records should be requested from the owner. The recurrent costs incident to operation and maintenance of the dam, as well as any operational water level and delivery agreements pertaining to the reservoir, should be "priced out" for inclusion in annual budgets.

Carefully consider, from the engineering point of view, the feasibility of removing siltation deposits, sites for disposal of sediment and debris resulting from removal, timing of the proposed actions, and cost factors incident to removal.

The engineering aspects are only one of the host of organizational, environmental, legal, jurisdictional, resource management and financial considerations which need to be evaluated in arriving at a decision on disposition of licensed project structures. However, engineers should be alert to provide professional input regarding the problems as well as the opportunities which are inherent in these decisions.

REGIONAL FPC COORDINATORS

Regional Office staff members currently designated by Regional Foresters to coordinate matters pertaining to Federal Power Commission licensed projects are:

Region/Area	Name	Phone No.	Staff
R-1	Phil Yovetich	(406) 585-3601	R&L
R-2	Jack Mead	(303) 234-4405	E
R-3	Bob Bates	(505) 766-3656	R&L
R-4	Bill Rozynek	(801) 399-6261	R&L
R-5	Jim Allen	(415) 556-6924	E
R-6	Dick Bryant	(503) 221-3019	WM
R-8	Tom Smith	(404) 526-3367	E
R-9	Dave Hedrich	(414) 224-3706	L&WM
R-10	Bill Kinworthy	(907) 586-7266	E
NA	Karl Davidson	(215) 596-1620	Area Planning Staff
SA	Paul Buffam	(404) 526-3734	Area Env. Coord.

TECHNOLOGICAL IMPROVEMENTS

Heyward T. Taylor
Assistant Director

REGIONAL ED&T BOARD MEETINGS

During October both Region 8 and Region 9 held Regional Equipment Development and Test Board meetings for FY 77 planning. Farnum Burbank, Chief Equipment Development Engineer, attended the R-9 meeting and Donald Sirois, Staff Engineer, attended the R-8 meeting to provide an overview of the FY 76 Service-wide ED&T program, and to obtain first-hand a better understanding of field needs. The

Regional ED&T Board meetings provide a useful and needed forum for providing field input to the Service-wide program. The meetings are an excellent opportunity for NFS, S&PF and Research Staffs to come together to discuss problems that may be solved by new or improved equipment, materials, or methods.

Extra benefits can be obtained from board meetings if the attendance is broadened to include cooperators from other federal, state or local agencies, as well as supervisors from key National Forests. In many cases, these individuals bring with them additional information that can be used to identify the true problems and help set down realistic goals for proposed projects, and add insight as to the scope of the problems.

The more involved the field becomes in helping to establish areas of need and the setting of goals for the ED&T program, the more the field will benefit from the program.

We believe that improvements have been made over the past several years for making the ED&T program more responsive to field needs, but more improvement is needed.

For more information see Section 7120 of the manual.

CHANGE TO AUGUST FIELD NOTES

Volume 7, Number 8

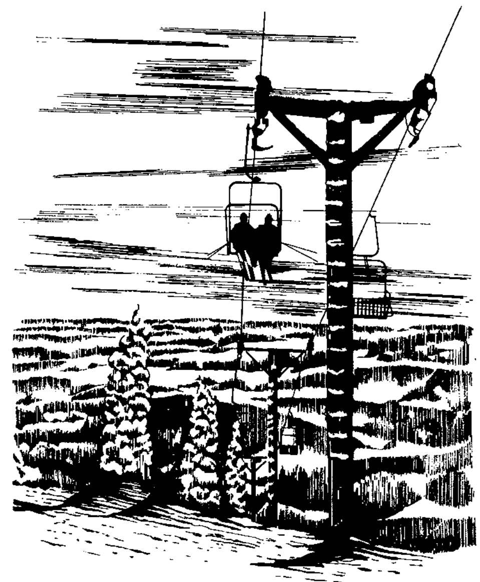
Interactive Road Design System (IRDS)

Correct the last paragraph of this article (page 19) to read as follows:

Presently, IRDS has been introduced to field personnel in Regions 1, 2, 3, 4, 6, 9, and 10. The system was designed by engineers and adheres strictly to field users' specifications; consequently, comments from the field have been consistently favorable.

CHANGE NOTICE

CUT HERE



AERIAL TRAMWAYS, SKI LIFTS and TOWS

Description and Terminology

EM-7320-1 June 1975

INSERT THIS PAGE in front of the "CONTENTS" (page vii).

On page 7; Figure 6 caption; line 2;

Change: *"system has tabular, mast-type towers."*
To read: *"system has tubular, mast-type towers."*

On page 67; *Figure 59* and *Figure 60;*

The figure numbers and captions were reversed in copy make-up. Mark to indicate *upper* illustration as Figure 59, and *lower* one as Figure 60, with respective captions.

CUT HERE

On page 91; under **Horsepower**; line 2;

Change: "U.S. and metric horsepower: 500 foot-pounds . . ."
To read: "U.S. and metric horsepower: 550 foot-pounds . . ."

CHANGE NOTICE

GPO 896-712

INVITATION TO READERS OF FIELD NOTES

Every reader is a potential author of an article for FIELD NOTES. If you have a news item or short article you would like to share with Service engineers, we invite you to submit it to FIELD NOTES for publication.

Material submitted to the Washington Office for publication should be reviewed by the respective Regional Office to see that the information is current, timely, technically accurate, informative, and of interest to engineers Service-wide (FSM 7113). The length of material submitted may vary from several short sentences to several typewritten pages; however, short articles or news items are preferred. All material submitted to the Washington Office should be typed double-spaced, and all illustrations should be original drawings or glossy black and white photos.

Each Region has an Information Coordinator to whom field personnel should submit both questions and material for publication. The Coordinators are:

R-1	Bill McCabe	R-4	Ted Wood	R-9	Norbert Smith
R-2	Allen Groven	R-5	Jim McCoy	R-10	Bill Vischer
R-3	Bill Strohschein	R-6	Kjell Bakke	WO	Al Colley
		R-8	Ernest Quinn		

Coordinators should direct questions concerning format, editing, publishing dates, and other problems to:

Forest Service, USDA
Engineering Staff, Washington Office, Editorial Services
Attn: Gordon L. Rome or Rita E. Wright
Washington, D.C. 20250

Telephone: Area Code 703-235-8199

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