ENGINEERING TECHNICAL INFORMATION SYSTEM

FIELD NOTES • TECHNICAL REPORTS • TEXTS
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Field Notes

Volume 6 Number 6 June 1974

Bridge Stakeout

How to Stop Reinvention of the Wheel

Stream Pollution Control During Roadway Clearing, Pioneering, and Culvert Installation Operation

Washington Office Division of Engineering News

FOREST SERVICE • U.S. DEPARTMENT OF AGRICULTURE

ENGINEERING FIELD NOTES

This publication is a monthly newsletter published to exchange engineering information and ideas of a technical or administrative nature among Forest Service personnel. The text in the publication represents the personal opinions of the respective author and must not be construed as recommended or approved procedures, mandatory instructions, or policy, except by FSM references.

This publication is not intended to be exclusively for engineers. However, because of the type of material in the publication, all engineers and engineering technicians should read each issue.

This publication is distributed from the Washington Office directly to all Regional, Station, and Area Headquarters. If you are not now receiving a copy and would like one, ask your Office Manager or the Regional Information Coordinator to increase the number of copies sent to your office. Use Form 7100-60 for this purpose. Copies of back issues are also available from the Washington Office and can be ordered on Form 7100-60.

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 sentences to several typewritten pages. However, short articles or news items are preferred. The Washington Office will edit for grammar only. 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:

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R-3	Bill Strohschein	R-9	Ron Pokrandt
R-4	Fleet Stanton	R-10	Bill Vischer
R-5	Jim McCoy	WO	Al Colley

Coordinators should direct questions concerning format, editing, publishing dates, etc., to Fran Owsley, Editor, Division of Engineering, Forest Service, USDA, Washington, D. C. 20250.

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FIELD NOTES

BRIDGE STAKEOUT

By Allan A. Johnson
Civil Engineer, Rogue River National Forest

INTRODUCTION

A good bridge stakeout is one of the first and most important items needed to construct a bridge. An accurate well-laid-out stakeout can do much to aid the project engineer and inspectors, as well as the bridge contractor, in successfully completing the bridge. Such a stakeout will allow rapid establishment of lines and grades needed for various elements of the bridge. This article will discuss the how and why of a good bridge stakeout.

PROCEDURE

Office Preparation. First, make a thorough office review of the plans for the bridge. It is far better to become familiar with the plans in the office than to do so in the field, which could waste valuable stakeout crew time. Items to check in the office review are:

1. Centerline control points. How does the bridge stationing tie into the road stationing? What road stationing points are in and referenced and can be used to establish needed bridge reference lines and stationing? (Reference lines are the longitudinal centerlines of the piers or abutments).

2. Distances between reference lines, at 90 degrees to reference lines as well as along bridge centerline for skewed bridges.

3. Skew angles between bridge centerline and reference lines for piers and abutments.

4. Bench marks. What are the closest bench marks that can be used to establish grades and elevations for the bridge?

Editors Note: Mr. Johnson has described a good method for a bridge stakeout. Variations will be necessary at many sites as the topography and road alinement become more complicated. Regional policy concerning the staking provided for the contractor will also control the amount and method of staking.

5. After all the above items have been determined, prepare a tentative bridge stakeout plan. Use the bridge site plan to help determine the most advantageous location for reference and centerline points. These should be placed in locations easily accessible during the stakeout survey and also of maximum accessibility during bridge construction. Try to envision what areas the bridge contractor will need to disturb during construction and locate survey points out of these areas.

Field Stakeout. We are now ready to proceed to the bridge site to make the bridge stakeout. Items of importance in the field work are:

1. Make sure you have all needed equipment to perform the bridge survey. All normal survey equipment to perform an accurate survey is needed. Accuracy will vary with the complexity and size of the bridge, but the following would be needed for an average Forest Service bridge:

- 20-second transit as a minimum (theodolite preferred)
- Engineer's level and level rod (needed only if bench marks need relocation)
- 100-foot chain
- Tension scale and clamps for chain
- Thermometer (to compute temperature corrections)
- Supply of hubs and guard stakes
- Hollow-head survey tacks, 8d nails
- Ribbon and marking pens for stakes
- Mall (8-pound)
- Axe or machete
- Three plumb bobs
- Hand level
- Engineer's 6-foot rule
- Notebook to record stakeout data

2. After arriving at bridge site, locate all points from original survey that will be used to make the bridge stakeout. Stationing on road centerline points and bench mark elevations should be checked against other survey points before using them.

3. First, establish points of intersection between bridge and/or road centerline and reference lines for piers and abutments. (On line No. 1 in Fig. 1.) The reference lines are established by accurate chaining from the road and station points located in 2 above. (See Fig. 1.)

4. At one of the end pier or abutment reference lines and centerline intersection points set up the transit and turn the angle between the reference line and centerline. (60° 00'00" in Fig. 1.) As a minimum, the angle should be double turned and an accurate split obtained. Then project the reference line (from the turned angle) to the other side of the centerline. This should be by double centering for accuracy.

5. Establish hubs at advantageous locations on the reference line established in item 4. These hubs will be used to turn 90-degree angle lines. (Line No. 2 and Line No. 3 in Fig. 1.) At least two 90-degree lines to reference line need to be established. These angles should also be doubled.

6. On the 90-degree lines to reference line established in 5 above, chain the right angle distance to each pier and abutment. Place hubs at each of these points.

7. We now have at least three points established on each reference line. These are the intersection point between reference line and bridge centerline and the points established in 6 above. We now can set up on each reference line and check the points to see if they line up. If they don't line up, recheck each line until the error is located. If only a slight discrepancy is noted, but within acceptable accuracy, adjust the hub tacks so all points are on the same line. All reference lines should be checked in this manner. (The advantage of running one set of points on the bridge centerline and reference line intersection and other points on right angles to the reference lines is readily apparent. By doing so you have a good check on the accuracy of your turned angles when the check is made on the three points.)

8. When all reference lines and centerline points necessary to control the construction have been established and checked, the distances between each point on reference lines should be measured and recorded. The measurement can be to the nearest foot. This is done so that the hub can still be located if the guard stakes are lost. The distances should be recorded in the field book. A rough sketch of the stakeout points should be drawn in the field book. All measured distances, angles, temperature corrections, etc., should also be recorded in the field book. A description of survey stakes and points should also be made, i.e., hub and tack, etc.

Draw Bridge Stakeout. A drawing of the bridge stakeout should now be made as shown in Figure 1. The stakeout drawing is useful both for the construction survey to follow as well as in checking the stakeout against the bridge plan. The stakeout and bridge plans should be given a thorough check to see that they are compatible.

Our bridge stakeout is now complete, referenced, and documented. We are now ready for construction to proceed. Enough copies of the bridge stakeout should be made so anyone involved with the project can have one. This would include Project Engineer, Inspector, Contractor, Survey Crew, etc.

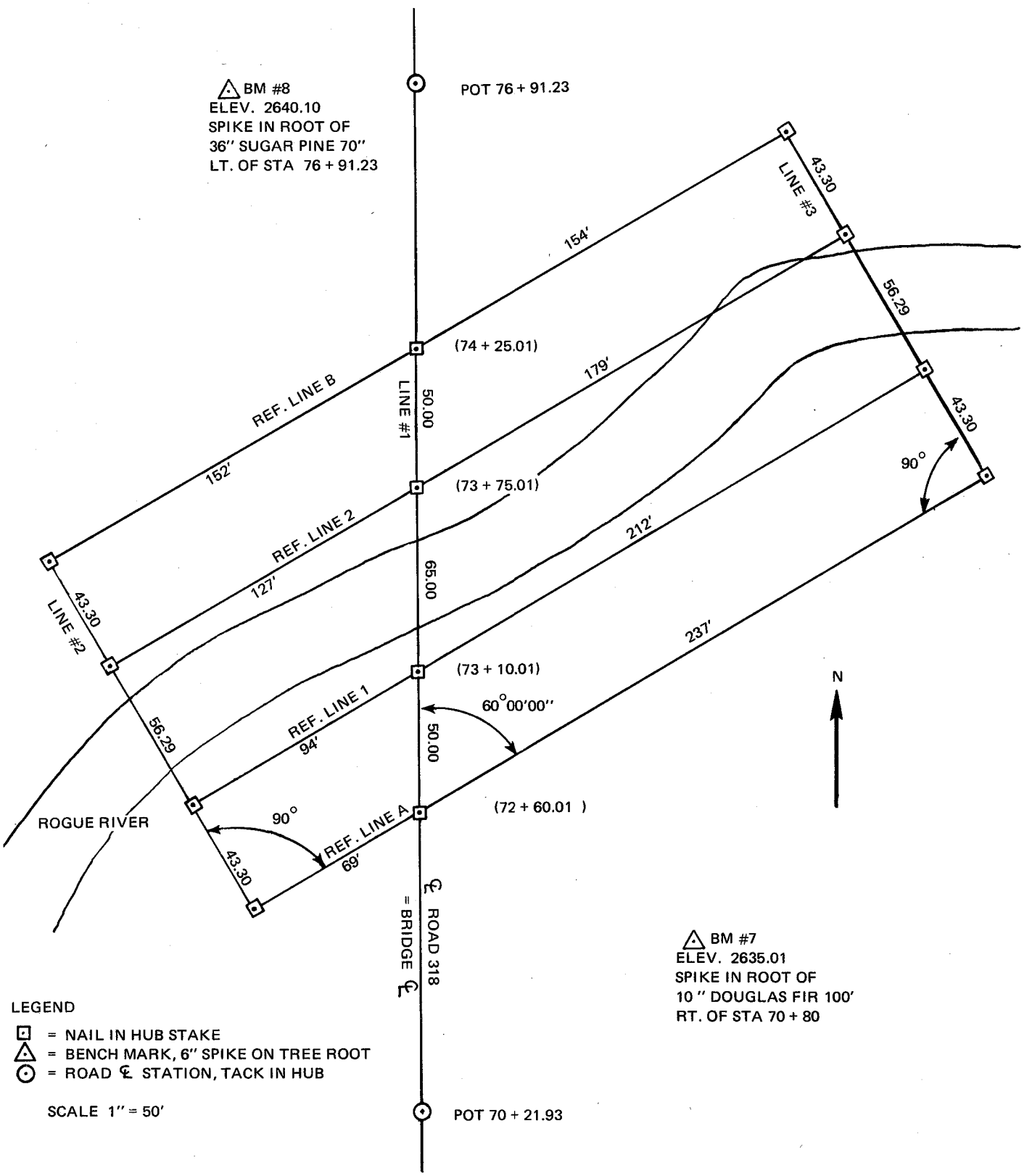
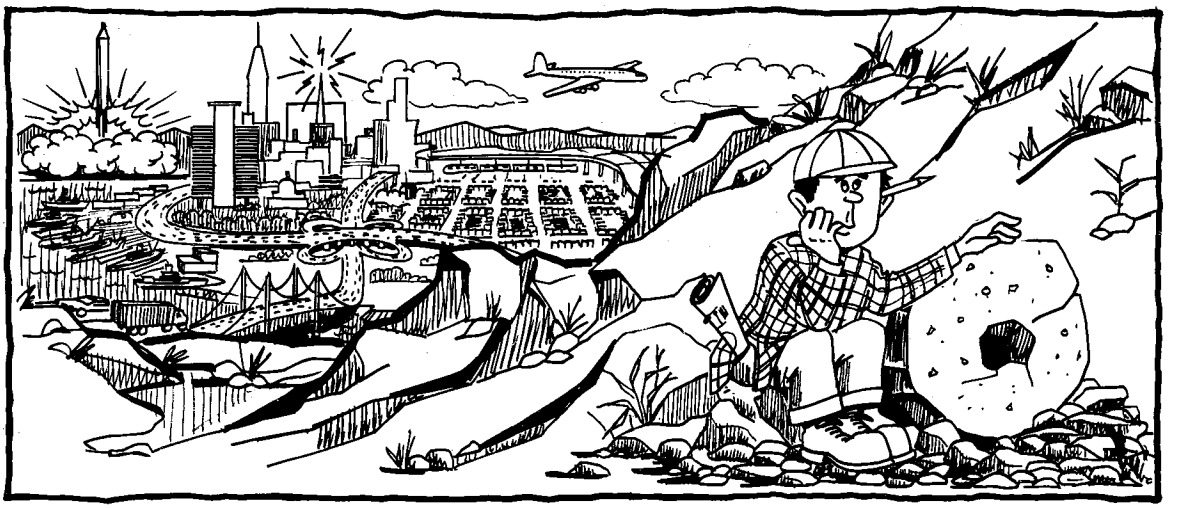


Figure 1. — Rogue River Bridge Stakeout

HOW TO STOP REINVENTION OF THE WHEEL

By A. L. Colley
Information Coordinator, Washington Office



If our friend, Charlie, the wheel maker, were only aware of the experience and technology just over the hill and had access to it, he could save himself a lot of time, effort, and money. Unfortunately, he is aware only of his immediate problem and is doing the best he can with it. If he knew who to call for assistance and could get down-to-earth practical help when he did call, he could avoid "reinventing the wheel" and get on to bigger and better things.

Have you reinvented the wheel lately? If not, you are probably a rare exception. In our highly complex and decentralized engineering organization, numerous technical and administrative problems of a common nature continually pop up. If the problem has not occurred on your District, in your Zone, on your Forest, or in your Region, it is a good bet that it has surfaced somewhere else within the Forest Service, and if not, at least somewhere in the world. We cannot do a lot about the world's solutions to problems except to access reliable technical information sources through our Washington Office Technical Information Center, direct contact with local sources, technical publications, and self study. We can, however, do something about sharing Forest Service solutions through the full use of our Engineering publications.

A conservative estimate indicates that we are spending in excess of $625,000 per year in manpower alone by duplicating each other's efforts. The costs in materials, equipment, and project failures or shortcomings conceivably triple this amount, especially where solutions are developed through trial and error. If this is a valid estimate, we are losing $1.8 million annually and perhaps a lot more. During a recent field trip to two Regions, I had the pleasure of meeting approximately 150 engineers and engineering technicians from all levels of their respective organizations. The purpose was, in part, to explore the general issue of technology transfer. The group consensus was that they felt they were to some extent having to "reinvent the wheel" simply because they had no way of knowing who else in the organization had come up against their particular problems. There was one incident where an individual cited a problem he was working on in the presence of someone from the adjoining Forest and discovered that the identical problem had been resolved by his neighbors two years ago.

Applying engineering principles in a Forestry environment presents some unique problems not encountered by others. Therefore, solutions to our problems frequently must come from within our own organization and in all probability it is our best source for applied information. Unfortunately, it is difficult, at best, for you to find time to think about passing on your experiences to others when it is about all you can do to keep up with the day-to-day demands of your job. On the other hand, how often have you experienced the need for someone else to have shared his experience or information with you?

We have, at our disposal, three publications which were designed to help meet your needs for information. These are (1) Engineering Field Notes (EFN), (2) Engineering Technical Reports (ETR), and (3) a new series - - Engineering Management (EM).

Engineering Field Notes (EFN) is a monthly in-house newsletter. Its purpose is to provide a format for the exchange of engineering ideas and information and it is not a media for lengthy, detailed technical reports. When you have a unique problem, solution, experience or other information you feel may be of value to others, you have four basic choices for publishing it in EFN. These are:

1. A short article (one or more pages).

2. A short news item (a paragraph to a couple of pages).

3. A letter to the Editor - - commenting on published material or Engineering publications in general.

4. A short paragraph or two for a section to be entitled "Readers Exchange." Here you can briefly describe an issue you have dealt with or one you need help on.

In all cases where you are providing information for use by others or are seeking information, you should include a name, address, and phone number for follow-up. Items (2) through (4) received in the Washington Office by the first of a given month will appear in the following month's issue; i.e., received by May 1 - - published in June issue.

By sharing your experience with others through EFN, you can make a substantial organizational contribution and set an example for others to follow. By doing this, you will receive direct benefit in return in the form of personal recognition and useful data from others. This publication is for you and you can make it as meaningful as you wish. Next time you complete a report or review one that involves a problem or a unique solution, think about it!

The Engineering Technical Report (ETR) series is designed to provide a detailed format for conveying an in-depth understanding of an engineering procedure or process which is suitable for application in a forestry environment.

Somehow we have partly lost sight of the objective for this publication by having published some very good material but of the kind that is of interest to only a few specialists and is so complex in nature that even the specialists have a difficult time with some of it. Material of this sort is needed; however, ETR is not the place for it. This publication is for down-to-earth practical applications of engineering technology and this requires that our specialists take the time to seek out and translate current specialized information into meaningful applied procedures which will help the man "up to his neck in alligators" drain the swamp if that is what needs doing.

You can help this series in two ways; one, is to produce ETRs and the other is to spell out in a letter to the Editor what subjects you feel should be included in an ETR. The latter is a very real opportunity for you to make a contribution - - all it takes is a speed memo through your Regional Information Coordinator.

Engineering Management (EM) is a new series which you will see for the first time around June of this year. Its purpose is to provide a format for all engineering materials which do not meet the criteria for EFN or ETR publications. The first edition will be in four parts and is simply a direct reproduction of some self-study materials produced by Region 5 for its engineering certification program.

This medium provides an excellent opportunity for the sharing of organizational, personnel, training, and other administrative studies or procedures. It is also a good place for detailed summaries of litigation and contract administration problems. If you have anything of a substantial and meaningful nature that you have developed for use by your unit or have experienced that you feel would be of value to others and that does not meet the criteria for EFN or ETR, this publication is the place to share it.

Although this series will usually be published under a distinctive cover, it will also be used for special publications which require a unique size and illustrative cover. In the latter case, the publication will be given an EM designation on the inside of the cover.

There are currently no limits on the volume of material or length of the articles submitted for publication in this series. It may be necessary, however, to accumulate several articles for inclusion under one cover prior to publishing. All materials, as are those for the ETR, will be subject to intensive review by respective Regions and/or the Washington Office prior to release.

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During the past year, we have had a steady growth in the volume of our publications and we anticipate this growth will continue. With limited staff in the Washington Office it is imperative that all materials submitted for publication be presented in a manner that will expedite the process. This involves two things: 1) since all original material will be retyped, a double-spaced typed draft is all we need - - legible corrections (ball-point pen) are acceptable - - and 2) line drawings, photographs and other illustrations require much more attention. These must be either neat originals or good sharp photographs. Color photography of good quality is acceptable for black and white reproduction; however, special authorization must be obtained for a publication involving reproductions in color. Glossy black and white pictures are, therefore, preferred. If computer printouts are to be used, please send only original copies. Carbons or Xerox copies are very hard, if not impossible, to reproduce. Examples of executed forms should involve a standard printed form with data entered in black ink or by a typewriter.

If you and I, along with our Regional coordinators, will actively seek out, identify, and prepare appropriate data for all of our Engineering publications, we can, without reservations, minimize our duplicative efforts. By doing so on a collective basis, we can create greater opportunities for individual growth, increased production, and substantial savings. Let's stop the "reinvention of the wheel."

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STREAM POLLUTION CONTROL DURING ROADWAY CLEARING, PIONEERING, AND CULVERT INSTALLATION OPERATIONS

By Larry Pearson
Wallowa-Whitman National Forest

One of the problems facing the engineer with today's ever-increasing emphasis on environmental protection is that of controlling stream pollution resulting from roadway construction.

In 1972, the Wallowa-Whitman National Forest in northeastern Oregon began construction on approximately 11 miles of single-lane timber access roads in the Trail Creek drainage near Anthony Lakes. The drainage is one of the more important spawning grounds for anadromous fish in the John Day River basin, and also contains an abundance of native trout. Initial construction activity disclosed that previously acceptable construction techniques resulted in a measured sediment level (measured by use of automatic water sampler and Turbidimeter) in the streams that was too high to be tolerated. Something had to be done to control the amount of sediment placed in the streams by the clearing and culvert installation work.

To eliminate the need for heavy equipment and vehicles to ford the streams repeatedly during clearing and pioneering operations, temporary stream crossing pads were used. Heavy timbers and/or logs (12-inch minimum diameter) were bolted and/or cabled together to form the 12- x 16-foot pads. Construction equipment was allowed to ford the streams one time in order to place the pads in position. At longer stream crossings, two or more pads were fastened together to provide the length needed. The pads were left in place until the permanent culverts were installed.

Twelve pads met the needs for the entire 11 miles of construction by moving them along with the clearing and pioneering activity as it progressed. The pads were transported from one crossing to another by dragging them with crawler tractors. The cost of the pads was $750 each (cost included initial fabricating, maintenance or periodic replacement as applicable, transportation on the job site, and final removal from the project site). Use of the pads resulted in no measurable increase in the sediment level of the streams during initial construction activity. See Figure 1 for photographs showing the pads in use.

In order to control sedimentation during the installation of permanent culverts, the flow of the streams was pumped past the work site. Immediately after the temporary crossing

pads were removed, a sandbag and rock catch basin was constructed in the stream bed above the culvert inlet, and a rock splash basin was constructed in the stream bed below the culvert outlet. A pump and hoses were then used to transport the stream flow from the catch basin to the splash basin. The pump was kept in constant operation from the time initial culvert bedding work began until backfilling work was completed. The only measurable increase in sediment level occurred briefly just after stream flow was turned into the new culvert. Costs for the bypass pumping varied somewhat, depending on the site, size of stream, etc., but averaged approximately $700 per installation (cost included all work relevant to bypass pumping, plus compensation for reserve pump required). The cost would no doubt be considerably less had the work been part of the original bid rather than a change order item. See Figure 2 for photographs of bypass pumping in use.

The preceding methods of stream pollution control have proven quite successful. The use of these methods, or modifications of them, is highly recommended in areas where maintenance of delicate natural stream conditions is essential.

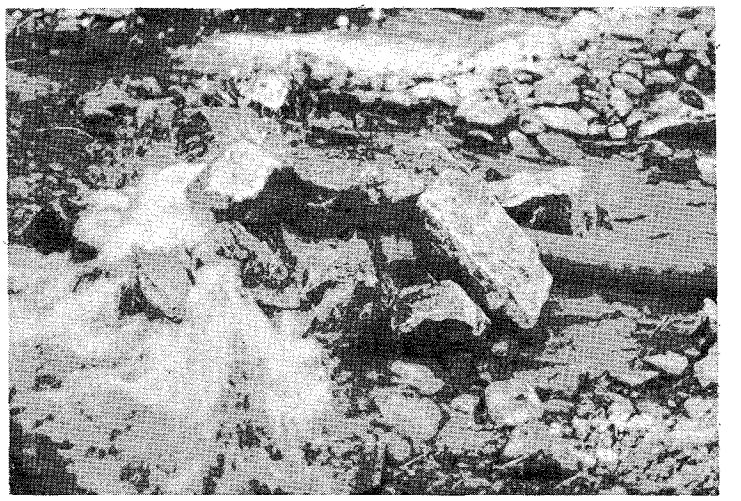
Condition of natural stream immediately above the stream crossing pad.

Condition of stream immediately below crossing pad. No damage done to stream.

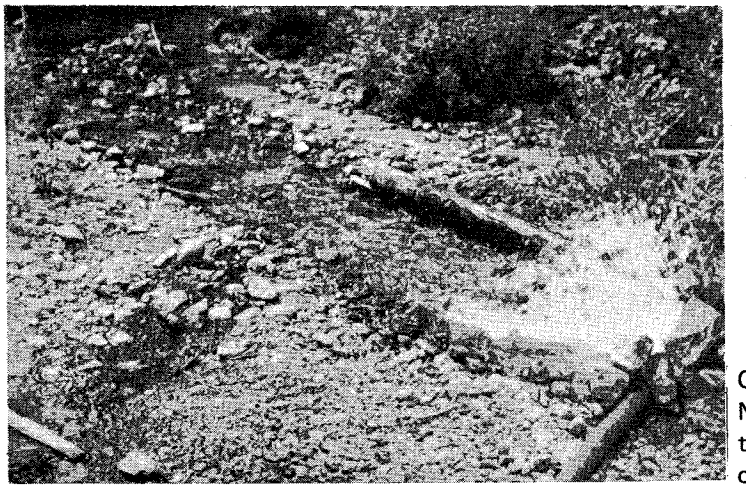
Overall view of crossing pad in use. Pad on right is for later use at another crossing.

Figure 1. — Pads in Use

Construction of catch basin above culvert inlet. Pump is just out of site on right. Culvert bed is in upper right hand corner of photo.



Close-up of rock splash basin in stream bed below culvert outlet.



Overall view of rock splash basin in use. Note lack of stream sedimentation due to pumping. Sedimentation on far side of stream is from natural causes.

Figure 2. — Bypass Pumping

WASHINGTON OFFICE DIVISION OF ENGINEERING NEWS

TECHNOLOGICAL IMPROVEMENTS

Heyward T. Taylor
Assistant Director of Engineering

Equipment and Development Publications

The annual Equipment Development and Test Program, Progress and Plans publication for FY 73-74 has been published. Since the publication of this report, requests have been received and filled for some 700 ED&T Reports and Equip Tips. Approximately 150 copies of specifications and standards have also been requested.

ED&T publications issued since the publication of the annual Plans and Progress are:

Equip Tips

- A Helicopter Serviced Toilet System - 2300, SDEDC, January 1974
- Microphor Model H-12 Flush Toilet Treatment Unit - 2300, SDEDC, February 1974
- The New Look in 2- and 4-Quart Canteens - 5100, MEDC, February 1974
- Hearing Protection for Off-road Vehicle Operators - 7100, SDEDC, March 1974

ED&T Reports

- Sound Propagation and Annoyance Under Forest Conditions - 7120-6, SDEDC, March 1974

Specifications

- Cleaning Unit, Rest Room, Slip-on; FS Spec. 2300-003, SDEDC
- Cleaning Unit, Rest Room, Slip-on, for 1/2-Ton Pickup Truck; FS Spec. 2300-004, SDEDC
- Compass, Magnetic, Unmounted; FS Spec. 5100-100a, MEDC

- Nozzle, Screw Tip, 1-1/2 inch; FS Spec. 5100-242a, SDEDC
- Nozzle Tips, Straight Stream and Spray; FS Spec. 5100-244, SDEDC
- Gloves, Leather, Forest Worker; FS Spec. 6170-5a, MEDC
- Signs, Sheet Metal, Flat; FS Spec. 7160-0010, MEDC

Standards

- Threads, Gaskets, and Rocker Lugs, Connections & Fittings, Fire Hose; 5100-00190, SDEDC
- Belt, Weather Kit (Assembly Of); 5100-150b, MEDC

Modular Airborne Fire Fighting System

ED&T personnel, both in the WO and at the San Dimas Center, are becoming quite involved in the engineering aspects of contracting, award, and production of the Modular Airborne Fire Fighting System (MAFFS). This is a 3,000-gallon fire retardant drop system designed to "slip in" to Air Force C-130 aircraft. A contract has been let at approximately $1.4 million for seven of these systems.

Forest Service Team Receives Award

The Forest Service team which responded to the request for assistance in emergency spraying of the Pakistan rice crop received a Departmental Superior Service Award. The Pakistan rice crop was damaged by the most disastrous floods in recorded history in August 1973; the remaining crop was further threatened by infestation of rice stem borer, which could have seriously affected the country's food supply. The team, using two spray systems previously designed and built by MEDC and installed in Air Force C-47 aircraft successfully sprayed 100,100 acres in 8 days. The Forest Service team receiving the award consisted of:

Ernest Amundsen, Team Leader, MEDC

John Cavill, MEDC

Tony Jasumback, MEDC

Jim Larkin, R-4

Lynn Marsalis, MEDC

OPERATIONS

Harold L. Strickland
Assistant Director

Energy Conservation

We are now aware that the energy crisis is real and it does have a direct impact on our programs. In fact, we can say that fuel is a program input which directly affects program output. To minimize program impact, we have to manage this program input (fuel) better than ever before. During our Fleet Equipment Work Conference in February, the following criteria were developed as guides to help us conserve energy and continue to meet our program objectives.

Fleet Composition

1. Analyze vehicle replacements and use smaller vehicles where possible.

2. Increase passenger carrying vehicle fleet and reduce light truck fleet where possible to get better gas mileage.

3. Replace 4x4 vehicles with 4x2 vehicles.

4. Manual transmission in lieu of automatic.

5. Eliminate air conditioning.

6. Eliminate mountain terrian differential.

7. Use radial tires.

8. Use fan clutches.

9. Use solid-state ignition systems.

10. Use minimum size engines.

11. Eliminate energy consuming optional equipment.

Maintenance and Service Standards

1. Engine tune-up every 12,000 miles or annually whichever occurs first.
2. Periodic oil and oil filter changes.
3. Periodic air and fuel filter changes.
4. Inflate tires to proper air pressure.
5. General lubrication.
6. Prompt maintenance if engine consumes oil excessively.
7. Properly adjusted brakes.
8. Keep engine compartment clean.
9. Keep radiator filled with clean coolant.
10. Proper front-end alignment.
11. Vehicle loading relative to gross vehicle weight.
12. Drive correctly.

Driver Improvement

1. Employee attitude, positive acceptance.
2. Do not exceed 50 mph (speed limit for Government vehicles).
3. Application of driver techniques to conserve fuel.
    a. Conservative *acceleration* and deceleration.
    b. Avoid idling engine.
        (1) Proper engine warm-up at start.
        (2) If stopped over one minute, turn engine off.
    c. Shift properly, don't lug the engine.
    d. Anticipate traffic signals.

4. Match payload to job; avoid carrying unnecessary tools and supplies.

5. If possible, travel at low-density traffic periods.

With the help of every individual doing his part in work planning and programming, maintaining and operating necessary equipment to support our work projects, we are confident that our program objectives will be met at a reduced rate of consumption of energy.

CONSULTATION AND STANDARDS

C. R. Weller
Assistant Director of Engineering

Certification of Blasters

An amendment to FSM 6179.19 is due to be published in July 1974 covering blaster training and certification. In summary, the amendment will require a regional blaster examiner who will coordinate training and certification for the forest blaster examiners and blasters. A procedure for Regional Forester approval of explosive materials is also covered. The emphasis is on reducing the number of personnel handling explosives to that level at which competency can be maintained and on restricting explosive materials to those that have been proven to be safe and to those materials for which training has been accomplished.

Transportation Structure Inventories

The coding forms for inventorying bridges and major culverts will be available in July 1974. An amendment to FSH 7709.11 is now being processed to update the existing inventorying procedures to include results of the bridge safety inspection program and to coordinate the inventories with other data gathering efforts.

Booklet on Retracement and Corner Evidence

Mr. Don Lappala, land surveyor on the Ottawa National Forest, has written a most informative

booklet entitled "Retracement and Evidence of Public Land Surveys." The booklet will be helpful to anyone interested in the techniques of making retracements and evaluating remaining corner evidence.

If you are interested, please write to: Mr. Vic Hedman, USDA, Forest Service, Division of Engineering, 633 W. Wisconsin Avenue, Milwaukee, Wisconsin 53203 (Phone: 414-224-3570) for information or copies of this excellent work.

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