ENGINEERING TECHNICAL INFORMATION SYSTEM

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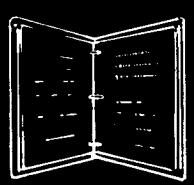
VOLUME 10 NUMBER 2

Field Notes



Figueroa Mountain Rubberized (Chipseal) Bituminous Surface Treatment

Skyline Analysis Program

Washington Office News

FOREST SERVICE FEBRUARY 1978

U.S. DEPARTMENT OF AGRICULTURE

Cut along this line and insert this copy in the cover of January Field Notes

ERRATA TO JANUARY FIELD NOTES

Volume 10, Number 1

Correct page 4 to read:

In the box labeled SANITARY ENGINEER, *add* Bill Opfer *between* Sanitary Engineer *and* Leon Lehr

Correct page 7 to read:

Change William *to* Bill Opfer

Correct page 11 to read:

Change William Cournay *to* William Gournay

ENGINEERING FIELD NOTES

Volume 10 Number 2

FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE
Washington, D.C. 20013

FIGUEROA MOUNTAIN RUBBERIZED (CHIPSEAL)

BITUMINOUS SURFACE TREATMENT

Jim Penzkover[1]
Civil Engineer

Chuck Sheen
District Engineer

Sheldon Perkins
Project Inspector

Los Padres National Forest
R-5

PROJECT DESCRIPTION

A worn, cracked asphalt pavement was successfully coated with an aggregate surface chipseal with a latex rubber additive. The seal is now over a year old, and a 10-year life expectancy or greater is predicted.

The project had alligator cracks throughout the 2-1/2 mile length of road (fig. 1). Cracks up to 1/4 inch wide had developed with little serious deformation of the surface. It was the consensus that most of this cracking was due to either subgrade consolidation or expansion during wet periods. Therefore, removal and repair were not performed. Basement soils consisted of mixed expansive shales and clays.

The traffic using this road consisted of autos and light trucks, with an occasional (one per month) full HS-20 load. Daily traffic averaged between 120 and 150 vehicles with maximums exceeding 500 vehicles during hunting season, snow-play weekends, and early spring weekend.

DESIGN CONSIDERATIONS

A small test strip of rubberized chipseal located near Vandenburg Air Force Base was examined. Indications were that the rubber additive greatly improved low temperature flexibility of the mat, and drastically increased the tackiness of the asphaltic emulsion. Aggregate, that was

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[1] *Jim Penzkover has been transferred to the Idaho Panhandle National Forest.*

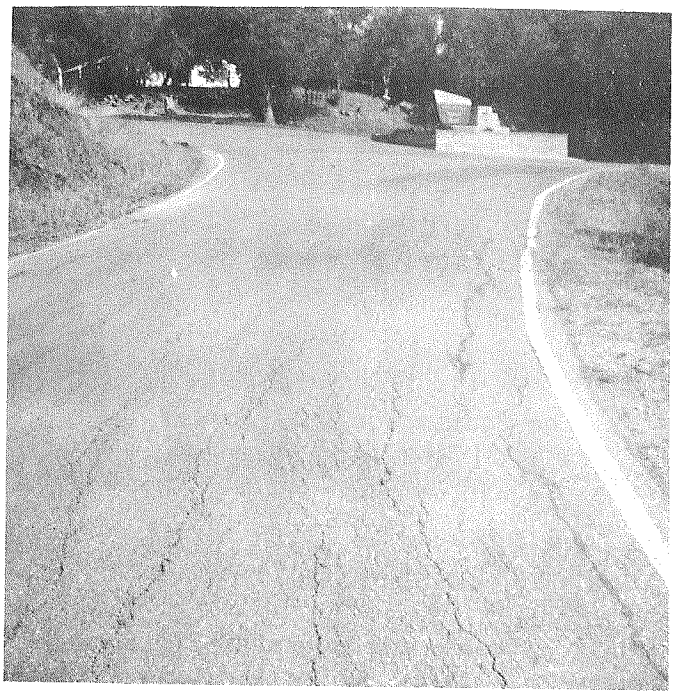

Figure 1. Alligator cracks in 2-1/2 mile road.

slightly imbedded in the rubberized emulsion, could be pulled as much as one foot out of the mat with a "rubber band"-like string of rubber adhering to it, and the string pulled the stone back when released. No excess chips remained on the surface. After conferring with the Santa Barbara County Department of Public Works, who placed the test strip, a specification was developed for the Figueroa Mountain Project.

COST COMPARISONS

The following table shows annual cost and present value when compared against conventional aggregate, aggregate chipseal with latex rubber, and slurry seal at 6-1/8 percent interest.

Alternatives	Annual Cost	Present[1] Value	Expected[2] Life
1. Conventional aggregate (chip) seal	$2,780	$31,540	6-2/3 yrs.
2. Aggregate (chip) seal with latex rubber	2,160	24,480	10 yrs.
3. Slurry seal	2,770	31,480	4 yrs.

[1]Present value represents a 20-year need for this road surface.

[2]Expected life of the aggregate seal with latex rubber is considered conservative. The city of Chula Vista, California, has chipseals over native soils still in good condition with 15 years of service. Expected life on alternatives 1 and 3 are maximums based on similar roads.

Alternative number one has a replacement calculated at 6-2/3 years and 13-1/3 years. Alternative number two has a replacement calculated at year 10, and alternative number three has a replacement every 4 years.

PROJECT DESIGN

Project specifications called for complete brooming and washing cracked and dirty areas, sealing the cracked areas with SS-1 at 0.08 gallon/yard^2, and applying a single chipseal 3/8 inch x No. 4 chips and RS-2 with latex at the rate of 22 pounds/yard^2 and 0.35 gallon/yard^2. Six gallons of latex rubber were added per ton of asphalt emulsion (about 2-1/2% by volume). Added cost of the latex rubber, shipping to Santa Maria from La Mirada, California, and associated expenses cost the contractor about $9 per gallon of additive. This amounts to about a 7 percent increase to project cost above a conventional chipseal.

CONSTRUCTION

Preparation work began by power brooming the old pavement surface. Cracked areas were hosed to remove imbedded dirt. SS-1 asphalt emulsion tack coat was applied and allowed to cure. The latex rubber, TEXAPAVE, was added to the RS-2 by pouring it from 5-gallon factory containers into the loaded distributor truck. The distributor truck agitated the mixture by pumping it through its pressure pump for about 15 minutes. The mixture was spread, and the aggregate was immediately placed and rolled with a pneumatic roller. There was little appreciable difference in appearance or workability from a conventional chipseal. The first noticeable difference appeared when traffic drove over the freshly

rolled aggregate with virtually no stone pickup. The mat was immediately ready for slow traffic and appeared set enough for normal traffic within 1 hour (air temperature was approximately 78 degrees).

All chips were attached to the mat, even those with only a very small amount of asphalt adhering to them. The latex rubber/asphalt mixture remained in the distributor truck during aggregate application for approximately 6 hours. The asphalt mixture will not set up prematurely providing the temperature remains within specification tolerances.

The chipsealed surface today still has its original elasticity, and the old cracks have not reappeared (fig. 2). Small, but strong, strands of rubber adhere to the stone when pulled from the surface; however, all stones are firmly imbedded into the mat.

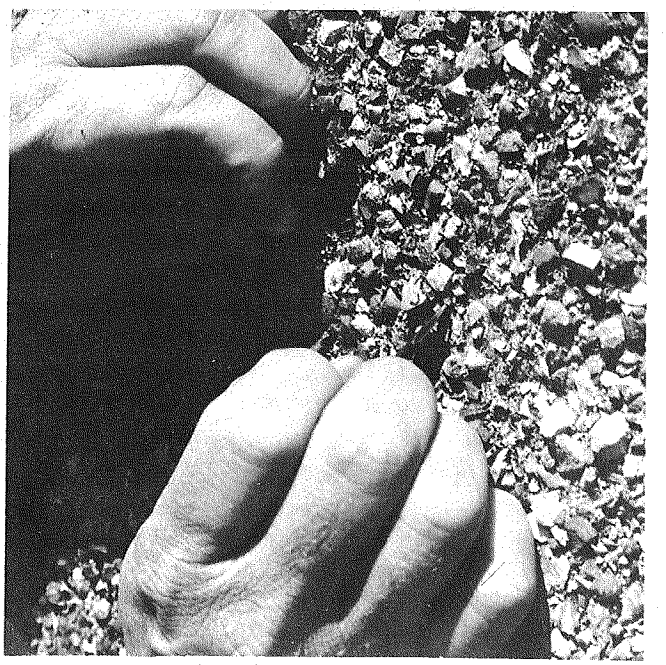

Figure 2. Chipsealed surface 1 year later. Note the surface roughness.

ADVANTAGES OF USING LATEX RUBBER ADDITIVE

1. Mat durability and strength is greatly improved.
2. Skid resistance is much better than a conventional chipseal.
3. Chip retention is almost 100 percent.
4. No bleeding or summer softening occurs.
5. Life expectancy is double or more.

DISADVANTAGES OF USING LATEX RUBBER ADDITIVE

1. Some inconvenience is encountered in adding latex rubber.
2. Excess asphalt mixture (overrun) must be disposed of, since supplier will not allow it to be returned.

GENERAL COMMENTS

We have chipsealed 17 miles of native and gravel surfaced roads using both single and double seal coat applications with latex additives. On double seal coats, we have required 7 days between applications so as to ensure that all moisture has evaporated from the emulsified asphalt. The manufacturer recommends using the latex within 48 hours after opening and mixing with asphalt. One local plant has not installed bulk storage and blending facilities for latex additive to reduce the costs of handling and purchasing 5-gallon cans.

Our experiences have thus far indicated that normal design and construction practices for typical bituminous surface treatments also apply to surface treatments with the latex additive. A prime coat must be used because the asphalt-latex mixture provides little penetration into the aggregate. The mixture bonds very well to the prime coat. The increased flexibility and elasticity derived should make the use of latex very desirable in climates subject to frost heave. In addition, on low speed roads where some surface deformation can be tolerated (or where the total design thickness of the pavement structure cannot be constructed due to a lack of supplemental funds in timber sales contracts), a chipseal with the latex additive may provide a sufficient, relatively maintenance free surface that will protect the basic investment in the road surface and prevent surface erosion much more economically than other methods, i.e. multiple dust oiling, watering, and associated blading.

The latex manufacturer recommends adding latex to hot mix and all other asphalt concrete mixes and seals subject to freeze-thaw conditions.

Although we have no experience with asphalt-latex mixtures other than that described here, it is our opinion that they may very well be successfully used in other asphalt mixtures, particularly when increased cohesion or flexibility is desired.

The latex rubber manufacturer, TEXACOTE, claims their product, TEXAPAVE, modifies asphalts to improve low temperature flexibility, increases summer temperature viscosity, cohesion, and softening point, and enhances aging properties. Rubber, in latex form, amalgamates easily with emulsified asphalts to form a reinforced rubber-bitumen lattice. TEXAPAVE lattices are particles of unvulcanized synthetic rubber in a waste base emulsion. The rubber particles are extremely small and uniform. Thus, a very large amount of surface area is exposed to the bitumen during mixing which promotes rapid and thorough dispersion of rubber. The latex rubber easily blends into emulsified asphalts at temperatures between 140 and 150 degrees Fahrenheit.

TEXAPAVE looks like and has the consistency of cream-colored latex paint, but it is very sticky, like glue. The shelf life is similar to latex paint. It is essential to use the cationic latex rubber, TEXAPAVE 65k, with cationic asphalt emulsions and anionic TEXAPAVE 70 with anionic asphalt emulsions.

Information may be obtained from TEXACOTE, INC., Textile Rubber and Chemical Company, 14241 East Alondra Boulevard, La Mirada, California 90638.

The Special Project Specifications used for this project were as follows:

SPECIAL PROJECT SPECIFICATIONS

FIGUEROA CHIP SEAL

Forest Service Standard Specifications for Construction of Roads and Bridges (1972 Editions) and Section 100 General Specifications, 11/13/73, (incorporated by reference) is modified as follows:

SECTION 407 - TACK COAT

407.04 Preparation of Surface to be Treated. Delete entire paragraph and substitute the following:

The Forest Service will patch and clean the existing asphalt pavement prior to applying tack coat.

407.05 Application of Bituminous Material. Add:

Emulsified Asphalt, Grade SS-1, shall be spread uniformly at the rate of 0.08 gallon per square yard.

SECTION 410 - BITUMINOUS SURFACE TREATMENT

410.02 Bituminous Materials. Add the following:

An anionic rubber additive, TEXAPAVE 70, or equivalent, shall be added at the rate of six gallons of additive for each ton of emulsified asphalt. The additive shall be added prior to application and agitated thoroughly according to manufacturer's published specifications.

410.04 Construction Requirements - General. Add the following:

Building paper shall be placed on all Portland cement concrete surfaces such as sidewalks, driveways, and curbing to prevent asphalt from coating concrete surfaces adjacent to areas to be sealed. After application of chips, paper is to be removed, leaving a straight edge. Excess asphalt materials on concrete shall be cleaned, and building paper shall be disposed of by the Contractor.

410.08 The first sentence is deleted and the following is substituted:

The accepted quantities of bituminous surface treatment determined as provided above will be paid for at the contract price per ton for bituminous material and rubber additive, and per ton for aggregates complete in place, which price and payment will be full compensation for the work in this Section.

SECTION 702 - BITUMINOUS MATERIALS

702.05 Application Temperatures. The first sentence is deleted and the following substituted:

Temperature of asphalt emulsion at the time of application shall be not less than 150 degrees F. nor more than 180 degrees F.

SECTION 714 - RUBBER ADDITIVE FOR ASPHALT EMULSION

714.1 Rubberized additive for asphalt emulsion shall conform to the following requirements:

Monomer Ratio, Butadiene/Styrene	70/30
Solids Content, min. %	67*
Solids Content, min. lbs./gal.	5.3*
Coagulum on 80 mesh screen, max. %	0.1
Mooney viscosity of Polymer (ML4 @ 212°F.) min	100
Ph of Latex	9.4-10.5
Surface Tension, dynes/cm	28-42
Brookfield Viscosity, cps	1000-2000

* For formulation purposes, average solids content runs 68% and 5.4 lbs./gal.

714.2 Rubber additive shall be added to the asphalt emulsion at the specified rate in the Supplemental Construction Specifications.

714.3 Rubber additive shall be blended according to manufacturer's recommendations.

714.4 The rubber additive shall be in sealed containers and shall be opened just prior to adding into the emulsion.

SKYLINE ANALYSIS PROGRAM

J. Robert McRae
Six Rivers National Forest[1]
R-5

A new set of skyline programs have been developed for live, standing, running, and multiple span skyline analysis and are on file for your use at the Fort Collins Computer Center (FCCC). The topographic data for load analysis and calculations of the net payloads for either flying or dragging loads are prepared from these programs.

The multiple span skyline analysis program has been revised from the Carson formulation outlined in PNW Research Note 31 (1975) and expanded by John Sessions to include mainline effects. The live, standing, and running skyline programs were also developed by John Sessions using the rigid link formulation proposed by Carson in PNW Research Note 205 (1976). The programs do not require the use of a plotter; however, for the most efficient use and minimum cost, it is advantageous to have the critical points. The programs are interactive in that they can be run in the demand mode rather than batch. This allows the operator to examine the output and changing input information to adjust the geometry for recalculation of the loads.

The cost of running the live, standing, and running skyline analysis programs is approximately $0.06 per profile. The cost of running the multiple span skyline analysis program is approximately $1 per profile. Note that the above costs are approximate only and are dependent upon the number of options exercised.

For further information, documentation, input instructions or interpretation of the output of these programs, please write John Sessions, Forest Service Advanced Logging Systems Training Program, Department of Forest Engineering, School of Forestry, Oregon State University, Corvallis, Oregon 97331 (FTS 8-420-4420).

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[1]*Formerly Advanced Logging Systems Training Program Oregon State University.*

WASHINGTON OFFICE NEWS

CONSULTATION AND STANDARDS

Walter E. Furen
Assistant Director

MONTHLY BILLING FOR ELECTRIC SERVICE

The monthly billing for electric service for large industrial, commercial, and government customers usually consists of two parts:

1. Energy Cost. This varies directly with the amount of energy used during the billing period, measured in kilowatt hours (kWh).

2. Demand Cost. This is based on the maximum power demand during the billing period, measured in kilowatts (kW). The reason for this cost can be illustrated by comparing two customers with equal energy use but different demands. Customer A has a load of 5 kW which he operates 200 hours per month, making his monthly energy use 1,000 kilowatt hours. Customer B has a load of 10 kW which he operates 100 hours per month, making his use also 1,000 kilowatt-hours per month. However, the power company must have more or larger equipment, i.e. generators, transformers, and transmission lines to supply customer B compared to that required for customer A.

Another way of illustrating the relative cost of electric demand is by analogy with other kinds of power. For example, if you want to haul 10 tons of material in one trip, you will need a 10-ton truck; but if you are willing to make two trips, you can get by with a 5-ton truck. The amount of work accomplished in each case is the same, but the investment in equipment is less when the work is spread out over a longer period of time.

Billing demand can often be reduced by rescheduling operations to spread the use of energy over a longer period of time, or by using equipment with a lower horsepower or kW rating. Time clocks, interlock controls, and other devices can also be used to prevent simultaneous operation of equipment.

Managers of Forest Service facilities should review their electric bills to monitor and, wherever possible, to reduce energy use and see if the bills include any significant demand charges. If so, efforts should be made to reduce the maximum demand. The best approach to this is to contact the electric utility company and request their assistance. The utility companies generally have knowledgeable staff people who will be glad to help. Assistance is also available from the Washington Office.

TECHNOLOGICAL IMPROVEMENTS

Heyward T. Taylor
Assistant Director

MONITORING OF TURBIDITY LEVELS IN SURFACE-SOURCE DRINKING-WATER SYSTEMS

In 1974, the Safe Drinking Water Act (P.L. 93-523) was enacted to ensure that the public is provided with safe drinking water. The Act directed the Environmental Protection Agency (EPA) to establish national drinking-water regulations. The National Interim Primary Drinking Water Regulations (40 CFR Pt. 141) were promulgated in 1975. These regulations, contained in FSM 7420, require the Forest Service to monitor and control turbidity levels in surface-source drinking-water systems. A recent potable water supply inventory revealed that about 787 Forest Service facilities utilize surface-source supplies that fall under the regulations.

A water sample must be taken each day a water system is in use and tested for turbidity within 24 hours. Additionally, if any single water sample tested exceeds a maximum level of one nephelometric turbidity unit (NTU)[1], a repeat sample must be taken, preferably within 1 hour. In view of these time limitations, it is often impossible or very costly to have certified independent laboratories measure the turbidity of water samples obtained from remote field locations.

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[1]*Nephelometric turbidity units correspond to the method of turbidity measurement when using a nephelometric turbidimeter--an instrument for determining the concentration or particle size of suspensions by means of transmitted or reflected light.*

In FY 1977, turbidimeters were investigated and tested by San Dimas Equipment Development Center (SDEDC) engineers to determine if they could be adopted for field use in remote locations. Parameters examined included accuracy, cost, portability, and reliability.

Seven turbidimeters were tested at two independent laboratories and at San Dimas to determine if the meters met EPA design criteria and to determine their overall operating characteristics. The Monitek® Portable Model 21 Turbidimeter (Monitor Technology, Inc., Redwood City, CA) was found to be the most practical for remote field locations, since it was the only one found that was battery operated and portable. However, tests are now being conducted on two additional battery-operated, portable turbidimeters; one made by Bausch & Lomb (Rochester, N.Y.) and the other by HF Instruments (Bolton, Ontario, Canada). Other turbidimeters tested can be used wherever turbidity of water is to be measured and there is a source of power.

During the test program, variations in data obtained from the two laboratories and at San Dimas occurred because of different methods of measuring turbidity. Differences were also encountered in turbidity readings between the turbidimeters because of differences in the spectral response of the optics systems in each turbidimeter. Thus, it is expected that different turbidimeters will produce different results. To minimize discrepancies in turbidity readings, a specific methodology for turbidimeter calibration, sample taking, and operation should be adopted, recorded, and included with any report of turbidities. A suggested methodology will be provided in a San Dimas Project Record to be issued upon project completion.

In general, all of the turbidimeters tested operate the same, each consisting of a light source for illuminating the water sample and one or more photoelectric detectors located 90 degrees to the incident light path. A meter connected to the photoelectric detectors provides a reading of the intensity of light scattered by particles in the water sample.

Each turbidimeter is supplied with one or more reference standards that are used for calibration purposes. A reference standard consists of a sealed glass tube with a liquid suspension of known turbidity inside. The glass tube is designed to fit in an enclosure called a cell that is part of the turbidimeter. After the turbidimeter is turned on and allowed to warm up, the reference standard is placed in the cell. A cover is placed over the standard that keeps out stray light and the turbidimeter is then adjusted to read the same as the known standard. The standard is then taken out of the cell and replaced by a sample tube that contains the water to be measured. The cover is replaced over the sample tube and turbidity of the water sample is read from the meter in NTU's.

OPERATIONS

Harold L. Strickland
Assistant Director

ORGANIZATIONAL STUDY

Currently, a consultant is studying the Washington Office organization to determine the effectiveness of the organization. In conjunction with this study, Engineering was asked to provide a discussion on the effects of recent legislation and/or administrative decisions on the WO Engineering Staff. We think our response, which follows, may be of interest to you.

To achieve a good understanding of the effects of recent legislation and/or administrative decisions on our staff, it is important to the following discussion that we have a common understanding of the mission and role of the Engineering Staff Unit. The following is intended to show the relationship of legislative matters and administrative decisions to the total job we are required to accomplish.

First, the role of Engineering in the Forest Service is to provide the technical and professional leadership in all fields of engineering which are needed to accomplish Forest Service programs in Research, State and Private Forestry and the protection, management, and development of lands in the National Forest System. This leadership involves the setting of policies, programs, objectives, providing systems, standards of performance, and performing review, evaluation, and accountability.

Included in this mission is specific responsibility for:

1. Providing timely and competent engineering consultation to line and staff managers as required for new programs, solution of engineering problems in on-going programs, or developing more effective methods for handling the engineering aspects of Forest Service operations.

2. Providing the required engineering capacity by use of In-Service forces or through technically supervised consultants to accomplish the planning, design, construction, operation, and maintenance of all physical facilities built by the Forest Service regardless of purpose to be served, or source of funds used. This includes basic responsibility for providing design criteria, technical standards, review, and technical acceptance of designs and specifications for facilities whether developed by a consultant or by In-Service forces.

3. Providing engineering direction and management of engineering support activities including management of the transportation system, fleet equipment, surveys and maps, cadastral surveying and technical drafting, solid waste and waste water treatment and disposal, dam safety, engineering applications, computer systems, and technical and economic input to administrative and recreation facility management and operations.

4. Providing professional engineering consultation and review for the engineering aspects of improvements proposed, under construction, or being operated on lands in the National Forest System by others whether under easement or special use permit. This includes review of alternative means of accomplishing the proposed installation which would better meet National Forest management objectives, and review of designs, specifications, operating procedures, and maintenance requirements. This also includes consultation on determining land management objectives that will best meet public needs where engineering considerations are involved.

5. Keeping abreast of current technological advances in the engineering field through contacts and association with professional societies, engineering research groups, universities, and other professionally oriented organizations. Where it appears that these materials, processes, equipment or systems may make major contributions to the furtherance of the objectives of the Forest Service, institute the necessary investigations or studies to provide the basis for implementation.

6. Providing professional engineering liaison and representing the Forest Service, as assigned, for staff studies, meetings, and work conferences with other Government and private organizations.

Interwoven into all of these responsibilities are the engineering-related aspects of legislation and administrative decisions. Engineering expertise and experience are continually called upon to contribute to the formulation of legislative material as well as certain administrative direction. This is generally only the beginning of our involvement.

As an example, the Engineering Staff was required to contribute a great deal of effort to the preparation of the National Trails System Act of October 1968. Our initial effort was to identify and furnish the Department of Agriculture's data concerning existing and needed trails to the Bureau of Outdoor Recreation in conjunction with their responsibility for conducting the nationwide trails study. Their assessment was in response to President Johnson's Natural Beauty Message of February 8, 1965. The preliminary effort related to the need for legislation and extended from February 1965 until the passage of the legislation on October 2, 1968.

This was just the beginning. Following passage of the legislation, working agreements between the Departments of Agriculture and Interior and between agencies (Forest Service, Park Service, and BLM) had to be established. Advisory councils were required by the legislation and staff support for them was required. In October of 1972, the Congress passed the Federal Advisory Committee Act which created additional staffing needs to support the continued activities of the trail councils.

Secretary's regulations governing use of those trails included in the Trails Act were another requirement of the legislation. The identification and acquirement of rights-of-way for the trails in addition to location, design, construction, and management were all requirements associated with the legislation. It is accurate to state that the effort associated with the National Trails Act required a minimum of one full-time staffman in this office during the period of February 1965 until April 1975, when the management responsibility for trails was reassigned to the Recreation Staff Unit. This manpower requirement was met by requesting the Regions to furnish detailers to this office, by farming out individual work assignments to various Regions and by individual staff support located here within Engineering.

As a result of this diversified method for acquiring sufficient manpower, it is difficult to determine with accuracy the actual man-years of work associated specifically with legislative and administrative requirements. It becomes evident, however, that there can be a tremendous impact before, during, and after the passage of laws which govern management of the National Forests. Sometimes the impact is clearly defined and manpower is devoted to the effort on a full-time basis. Generally, the effort prior to enactment is not as great as it was for the Trails Act; however, it is quite common that after passage, a similar effort is generally required in formulating work agreements with other Federal agencies and preparing Secretary's regulations along with Forest Service policy and direction for implementing the requirements of the enacted legislation.

APPROVAL TO ATTEND MEETINGS

Administrative Management has advised us that more attention should be paid to the justification statement when we fill out a form AD-179 - Request to Attend Meeting. Apparently, we frequently do not clearly state why the attendee(s) needs to go to the meeting.

In addition, FSM 1360 specifies some time requirements for requests that have to be cleared by the Washington Office. Most of our trouble has been with National meeting attendance requests, which must be received 30 days in advance of the travel date. If you are late with a request, be sure to explain why.

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 send it for publication in *Field Notes.*

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; all illustrations should be original drawings or glossy black and white photos.

Field Notes is distributed from the Washington Office directly to all Regional, Station, and Area Headquarters, Forests, and Forest Service retirees. If you are not currently on the mailing list ask your Office Manager or the Regional Information Coordinator to increase the number of copies sent to your office. Copies of back issues are also available from the Washington Office.

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

R-1	Melvin Dittmer	R-4	Ted Wood	R-9	Fred Hintsala
R-2	Royal M. Ryser	R-5	Jim McCoy	R-10	F. W. Baxandall
R-3	Bill Strohschein	R-6	Kjell Bakke	WO	Al Colley
		R-8	Bob Bowers		

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

USDA Forest Service
Engineering Staff, Rm. 1108 RP-E
Attn: Gordon L. Rome or Rita E. Wright
P.O. Box 2417
Washington, D.C. 20013

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