ENGINEERING TECHNICAL INFORMATION SYSTEM

FIELD NOTES ● TECHNICAL REPORTS ● TEXTS
DATA RETRIEVAL ● CURRENT AWARENESS

Field Notes

Volume 5 Numbers 1 and 2 January-February 1973

FOREST SERVICE ● U.S. DEPARTMENT OF AGRICULTURE

ENGINEERING FIELD NOTES

This publication is a monthly newsletter published to exchange Engineering information and ideas among Forest Service personnel.

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

The publication is distributed from the Washington Office directly to all Forest, Regional, Center, Station, Area, Laboratory, and Research Offices. Adequate copies are printed to provide all who wish a personal copy. If you are not now receiving a personal 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.

It is intended that the material in the Field Notes be primarily written and used by Forest Service Field Engineers; however, material from other publications may be used.

Field Note material should always be informative and cannot contain mandatory instructions or policy. The length of an article may vary from several sentences to several typewritten pages. Material need not be typed (neatly written or printed is acceptable) nor edited before being submitted to the Washington Office. The Washington Office will edit and prepare the camera copy to accommodate our format and allowable space.

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

R-1	Gary Stensatter	R-6	Kjell Bakke
R-2	Allen Groven	R-8	Ernest Quinn
R-3	Dan Roper	R-9	Ron Pokrandt
R-4	Fleet Stanton	R-10	Gerald Coghlan
R-5	Jim McCoy	WO	Al Colley

PLANNING AND SCHEDULING FOREST OPERATIONS USING A RESTRICTED RESOURCE ALGORITHM

By: J. Doyle Burke, Civil Engineer
Ward W. Carson, Mechanical Engineer
Pacific Northwest Forest and Range Experiment Station

INTRODUCTION

Forest operations such as timber harvesting, timber sale planning, and road construction have unique features that are not often found in other industries. As with most large projects, these operations involve many activities and resources where responsibilities overlap. Logging and road building are generally conducted in a remote and difficult environment. The personnel, which include only a few key full-time employees, and the equipment used may be transitory and seasonal. It is important that the personnel remain flexible, in regards to changing site conditions and operating procedures. The scheduling and planning of such forest operations must include consideration of all these characteristics.

Managers and planners of forest operations must have a planning and scheduling tool that assists them with the two major aspects of the project:

1. accountability for various phases of the project, and

2. determination of whether existing resources are satisfactory in order to complete the project or how much of the total project program can be accomplished with existing resources.

A planning and scheduling tool should be easy to use, fast, simple to change and update, and inexpensive to implement and operate.

Resource Allocation Program, Version 1 (REAP1) is such a tool and is available to Regions using the National Bureau of Standards UNIVAC 1108 Computer. It can also be made available to Regions using CDC 3100 Computers.

PECULIARITIES OF FOREST OPERATIONS

Timber harvesting and forest road construction are examples of operations that are usually restricted by their available resources rather than by time. Projects are generally working from a limited resource pool. Working from a limited resource does not mean that time is of no importance in these operations, but rather that time is not the controlling element in planning. The major time

restriction is the seasonal nature of the work. If a delay occurs, an increase in production usually necessitates additional equipment and manpower that are not ordinarily justified from an economic standpoint.

In these restricted resource operations, a need exists for a tool that evaluates a proposed project against a fixed resource pool and optimizes time, rather than evaluating a project against time and establishing resource requirements.

METHODS AVAILABLE

Several time-oriented techniques, such as Critical Path Methods (CPM) and Program Evaluation and Review Technique (PERT), are available in various computer packages or modified manual systems. The basis of the resource allocation algorithms is *time* where the basic assumption is that *time* is critical. To adjust for these restricted resources under a limited time schedule does not provide for optimum project durations without complicated mathematical programing which requires specialized input and output interpretation. Under these conditions acceptance, at the field level, has been low.

There are two major criticisms of the available resource allocation methods:

1. Resources are simply assigned after the schedule is generated using time constraints.

2. The input/output is so complex that it is seldom used.

CHARACTERISTICS OF PROGRAM REAP1

REAP1 is a computer program that helps to solve scheduling problems which involve projects with restricted resources. The basic assumption is that the project or operation being planned is subject to limited resources. Due to these limited resources, the time spent on the project will probably be different from one that had a limited time schedule.

Resource allocation on restricted resource operations is more complicated than on projects which must be completed within a given time. If the resources are insufficient to mobilize the project to its full capacity, then it is necessary to decide which activities must be delayed and for how long. The object is to minimize the project duration or decide the approximate duration of the project, subject to the resource restrictions. REAP1 accomplishes this by identifying a critical resource usage path through the project and

by allocating resources, scheduling activities, and monitoring progress based on this path.

REAP1 can operate on unordered lists of activities (those without precedent or successor relationships). The priorities of the activities which make up the project can remain unspecified, or can be assigned by administrative decision, or calculated by a subroutine of REAP1 for optimum allocation of resources.

ALGORITHM OF REAP1

Only the macro-structure of the REAP1 algorithm will be discussed. The details of the micro-structure are beyond the scope of this article.

The REAP1 program arranges execution of the algorithm into a main program and two subroutines. The main program handles the scheduling of activities and assignment of resources. This is supported by a subroutine Priority Determination (PRIDET) that provides a computation of priorities if this option is selected. The other subroutine (DATE) processes the results of a completed schedule and provides the calendar output.

Main Program

1. Enter, store, and print out the information of activity descriptions, durations, priorities (optional), precedent activities, resource requirements, and resource descriptions.

2. Initialize and call subroutine PRIDET (if selected) to establish priorities.

3. Establish the workday being planned.

4. Establish a priority to be examined (if the priority option is exercised).

5. Search the activity list for one with

   a. the specified priority,

   b. all its precedent activities complete (if applicable), and

   c. necessary resources that are available for assignment to the activity.

6. Schedule a start and finish workday for all activities discovered in step 5, and assign the necessary resources to these activities.

7. If all priorities have been examined, continue to step 8; if not, keep returning to step 4 until all priorities have been examined.

8. Test for completion for all activities. If complete, then continue to step 9; if not complete, search for the next workday on which an activity will be completed and resources are available and then return to step 3 to begin the assigning procedure again.

9. Prepare bar chart and resource assignment report and call subroutine DATE (if selected) to prepare and print the calendar for the schedule.

Subroutine PRIDET

1. Establish activity factors which reflect the resource requirements of each activity.

2. Use the precedent activity information for each activity to determine all successors of each activity.

3. Use the "activity factors" and successor information to establish priorities for each activity.

4. Return to main program.

Subroutine DATE

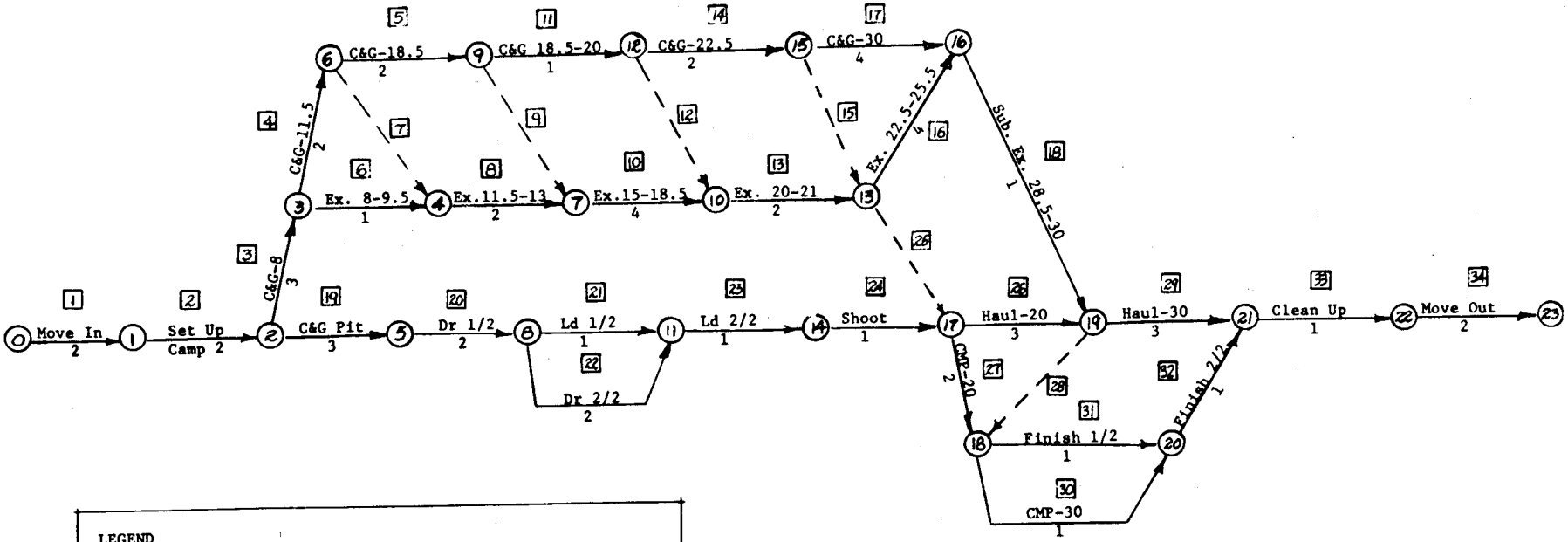
1. Enter, store, and print out information describing schedule start date and day, length of workweek, and list of nonproductive workdays.

2. Locate the initial workday in the calendar and sequentially assign workdays to calendar days while allowing for the workweek length and nonproductive workdays.

OUTPUT FROM REAP1

The network diagram of an example project is shown in figure 1. This example, a section of forest road, will be used to illustrate the output of REAP1. Some knowledge of project management and network diagraming will be assumed.

The data from the network diagram (fig. 1) plus the resource data are supplied to REAP1. The output from the program shown in



LEGEND

□	:	Activity Number
C & G	:	Clear and Grub
Ex.	:	Excavate
Dr.	:	Drill
Ld.	:	Load
CMP	:	Install Corr. Metal Pipe
Finish:		Grid Roll and Blade
Sub.Ex:		Sub-excavate

Note: The numbers following the activity description refer to the stations involved.

Example -- Ex.11.5-13 means "Excavate from Sta. 11+50 to Sta. 13+00."

Figure 1.--Network diagram of example project.

figure 2 is arranged for convenient display as follows: project title (upper right), bar chart schedule (upper left), resource allocation table (lower left), and workday calendar (lower right).

The title shows there are 34 activities, eight resource types (containing 12 resources), and priority of -1, indicating the priority assignment is being optimized by the program. If priorities were manually assigned, this number would be the largest priority number in the project.

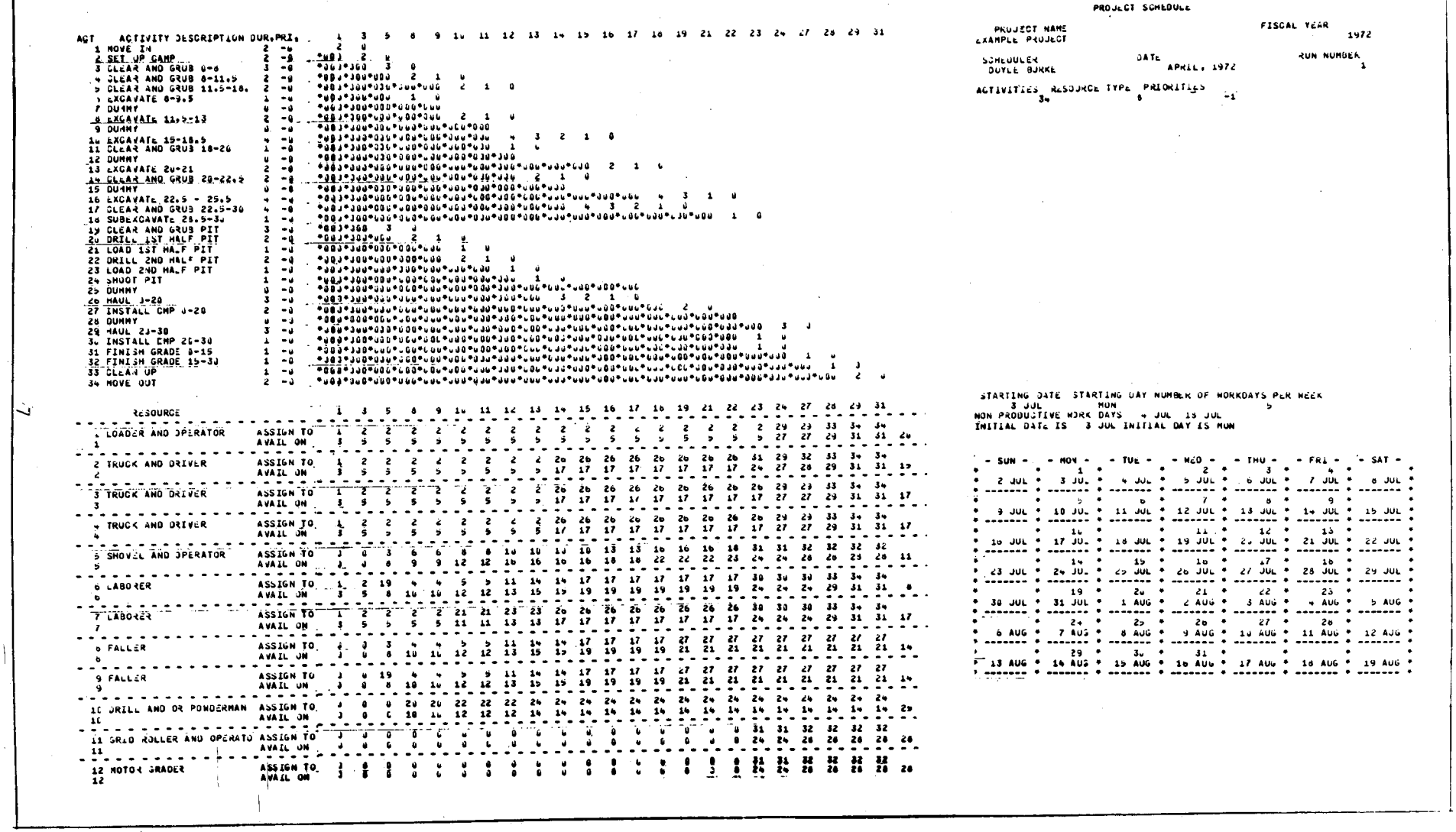
The bar chart schedule is arranged with the activity number and activity description along the left-hand side (fig. 2). The duration and priority (-0 in the example) are given for each activity. The numbers above the bar chart correspond to actual workdays on which an activity is started or completed. The bars in the bar chart are made up of 0's and *'s (*000) and continue until the workday of the activity in question is started. At that time, its duration is brought forward, with succeeding numbers indicating the time remaining on any given workday. A zero (0) on the bar indicates that the workday that resources assigned to that activity will be available for reassignment. For example, activity No. 26, Haul 0-20, with a duration of 3 days, commences on workday 14, has 2 days remaining on workday 15, and the resources assigned to this activity will be available for reassignment on workday 17.

The resource allocation table is arranged to correspond with the bar chart on a workday basis (fig. 2). The resource description is listed on the left-hand side, followed by two numbers appearing under each workday column. The upper number indicates the activity to which the resource is assigned, and the lower number is the workday on which the resource will be available for reassignment. The last number appearing to the extreme right is the number of days the resource in question was not used during the project. For example, resource number 5, shovel and operator, is not used until workday 5; at that time, it is assigned to activity No. 3 and will be available for reassignment on workday 8. On workday 8, it is reassigned to activity No. 6 and will be available on workday 9. This process continues across the table until the completion of the project. The number 11 indicates this resource was not used on 11 days during the project.

The workday calendar provides the calendar day corresponding to the workday, taking into account the number of workdays per week and nonproductive workdays (holidays, shutdowns, etc.)

USE OF OUTPUT

After the first run, the scheduler can adjust the number of resources or resource types and add, delete, or change activities.



PROJECT SCHEDULE

PROJECT NAME
EXAMPLE PROJECT

FISCAL YEAR
1972

SCHEDULER
DOYLE BURKE

DATE
APRIL, 1972

RUN NUMBER
1

ACTIVITIES 34 RESOURCE TYPES 8 PRIORITIES -1

STARTING DATE 3 JUL STARTING DAY MON NUMBER OF WORKDAYS PER WEEK 5
NON PRODUCTIVE WORK DAYS 4 JUL 15 JUL
INITIAL DATE IS 3 JUL INITIAL DAY IS MON

- SUN -	- MON -	- TUE -	- WED -	- THU -	- FRI -	- SAT -
	1		2	3	4	
2 JUL	3 JUL	4 JUL	5 JUL	6 JUL	7 JUL	8 JUL
	5	6	7	8	9	
9 JUL	10 JUL	11 JUL	12 JUL	13 JUL	14 JUL	15 JUL
	12		11	12	13	
16 JUL	17 JUL	18 JUL	19 JUL	20 JUL	21 JUL	22 JUL
	14	15	16	17	18	
23 JUL	24 JUL	25 JUL	26 JUL	27 JUL	28 JUL	29 JUL
	19	20	21	22	23	
30 JUL	31 JUL	1 AUG	2 AUG	3 AUG	4 AUG	5 AUG
	26	27	28			
6 AUG	7 AUG	8 AUG	9 AUG	10 AUG	11 AUG	12 AUG
	29	30	31			
13 AUG	14 AUG	15 AUG	16 AUG	17 AUG	18 AUG	19 AUG

Figure 2.--Output from program REAP1.

Adjustment of activities or resources will, in general, change overall project duration. The bar chart and resource allocation table aid the designer in identifying activities and resources which need to be altered to meet his requirements.

The resource allocation table is useful in accounting for daily resource usage and predicting resource requirements, and can be used for cost estimating or cost accounting once costs are assigned. The bar chart is a useful and easily understood device for presenting and discussing the overall project.

SUMMARY

REAP1 offers a planning and scheduling tool for restricted resource operations that provides for:

1. accountability for various phases of the project, and

2. determination of whether existing resources are satisfactory to complete the project or how much of the total project program can be accomplished with existing resources.

REAP1 is user-oriented, fast, easy to change and update, and simple to implement and operate.

. . . . . .

MANPOWER PROGRAMS AND THE CARSON NATIONAL FOREST

By: Faustin B. Padilla, Land Surveyor
Carson National Forest

The Forest Service, as an agency of the United States Department of Agriculture, is committed to help individuals and communities in rural areas to improve their quality of life.

The manpower programs, which have been established in recent years under the administration of several Federal agencies, offer the Forest Service unparalleled opportunities to implement these programs.

Northern New Mexico is one rural area in need of help to improve its quality of life. The majority of the population in this area is dependent on the Forest in some way for firewood, water, grazing, lumber or employment. The Carson National Forest is striving to help the area overcome its needs in the following ways.

To help alleviate the unemployment in this area, the Carson National Forest has utilized the manpower programs. We have found in utilizing these programs that we not only help the unemployment problem, but in training many young people we gained skilled employees.

In 1971, the Carson National Forest was host to and trained 86 persons under the following programs:

Program		Number of Enrollees
Neighborhood Youth Corps	(NYC)	64
Youth Opportunity Corps	(YOC)	4
Operation Mainstream	(OMS)	14
Concentrated Employment Program	(CEP)	2
Supplemental Training and Experimental Program	(STEP)	2

Work performed by enrollees is varied. It includes typing, filing, timber marking, distributing mail, and landline location duties.

On landline location projects, enrollees from Operation Mainstream, Supplemental Training and Experimental Program, Concentrated Employment Program, and Neighborhood Youth Corps were combined and used on survey crews under the title of survey aids.

The enrollees who participate in the Landline Location Program are taught the use of surveying equipment, safety principles, and simple surveying computations.

Each concept is taught a step at a time to all enrollees and each has an opportunity to work at the various positions on a survey crew. Each enrollee becomes acquainted with correct procedures of staying on line, brushing line, and measuring distances by horizontal chaining, slope chaining and using distance meters. The enrollee is taught the correct use of the plumb bob, hand level, and clinometer. **Subsequently,** the enrollee is taught how to operate transits and theodolites and how accuracy can be obtained from each instrument.

Once he has acquired the basics in field work, the enrollee is taught some of the fundamental calculations necessary to compute his field notes. The enrollee acquires most of his knowledge while actually doing the work. Any question that may arise during the course of a working day will be answered on the spot, or marked down to be discussed with all enrollees at the next safety meeting.

Safety meetings are held weekly. Instructions are given on sharpening tools, and how to carry and use equipment, along with other safety information. After the safety session, discussions are open on the previous week's work and questions from the enrollees are answered. A quick summary of the next week's work is also given.

As enrollees are placed, or find other employment, new enrollees are acquired. To date, 18 enrollees from the manpower programs have been used on the Landline Location Program. The Forest is making a planned effort to employ these enrollees on regular appointments when their training ends.

On the whole, participants' work has been satisfactory. The use of these men has accelerated the Forest Landline Location Program. These programs have helped to reduce the cost of surveys and allowed the Forest to stay within its allotted budget and organizational ceiling.

. . . . . .

"MORE ON LAND SURVEYING 1/

During the past year the Board has had many complaints about unqualified people performing land surveying work. At a recent Board meeting considerable time was devoted to hearing from practitioners. A typical complaint was that unregistered individuals working for industry, the Highway Department, Government Agencies, or others were performing land surveying on weekends, holidays, and off time.

"Many of these unlicensed people performing surveys explain to the client that they were not registered and that they could not certify nor let it be recorded. In spite of this disavowal of legal status by the unregistered surveyors, still in the course of time their surveys are accorded some degree of recognition and acceptance.

"The complaint then continues that when qualified and licensed surveyors discover the errors, in many instances damage has been done to the property owners and they are both confused and angry. When the errors committed by these unlicensed people are discovered part of the adverse publicity and blame probably ttansfers to the employer of these unlicensed people even though unjustified.

1/ Quoted from the STATE OF ALABAMA BOARD OF REGISTRATION FOR PROFESSIONAL ENGINEERS AND LAND SURVEYORS NEWSBULLETIN, November 15, 1972, Issue No. 4.

"We consider this matter of real concern to the citizens and land owners in Alabama and for this reason we are bringing it to the public attention hoping that employers will discourage their unlicensed surveyors or engineers from making land surveys, and we would hope that this portion of the NEWSBULLETIN will be displayed on bulletin boards and other appropriate places."

. . . . . .

A Sub-Routine for Use with the Monroe Epic 3000 Programmable Printing Calculator
by Leroy E. Lewis, Cadastral Surveyor, Supervisor's Office, Francis Marion-Sumter National Forest
January-February 1972, Volume 4, Numbers 1 and 2

Investigation and Development of New Cadastral Surveying Procedures and Equipment
by Daniel M. McVay and James D. Hogan, Washington Office
June 1969, Volume 1, Number 2

Managing the Time of Survey Crews in the Eldorado National Forest
(News Item) taken from an article by Ed Tomm, Civil Engineer, and Sam Fischer, Forest Engineer, Eldorado National Forest
March-April 1972, Volume 4, Numbers 3 and 4

North Seeking Gyro System
by Victor H. Hedman, Regional Cadastral Surveyor, Eastern Region
January 1971, Volume 3, Number 1

North Seeking Gyro Systems
by Victor H. Hedman, Region 9
January 1970, Volume 2, Number 1

North Seeking Gyro Systems
by Victor H. Hedman, Regional Cadastral Surveyor, Eastern Region, and Daniel M. McVay, Staff Engineer, Washington Office
June 1969, Volume 1, Number 2

Preservation of Tree Land Corners
by George F. Butts, Registered Land Surveyor, Green Mountain National Forest
October 1972, Volume 4, Numbers 9 and 10

Remote Computer Processing in Regions 2, 3, 8, and 9
by Jim Hogan, Washington Office
September 1969, Volume 1, Number 4

The H. D. 3800A Distance Meter
(News Item) by Daniel M. McVay, Washington Office
October 1970, Volume 2, Number 10

The St. Joe Cadastral Engineering Program
submitted by Daniel M. McVay, Washington Office
November 1969, Volume 1, Number 6

Trees that Bear Witness
by L. Bruce Sumner, Regional Cadastral Surveyor, Region 5
November 1969, Volume 1, Number 6

Computers

Computer Time Sharing
by C. J. Montgomery
February 1970, Volume 2, Number 2

Contracting

Material and Workmanship – Construction Contracts
(Reprinted from June 1969 Administrative Service News Digest)
October 1969, Volume 1, Number 5

Network Analysis System
by James M. McCoy, Construction Staff Assistant, Region 5
March 1971, Volume 3, Number 3

Environment

A Quick Cure for Rock Defacements
(News Item) submitted by Region 10
February 1971, Volume 3, Number 2

Getting Involved in Environmental Planning
by John Daly, Region 8
January 1970, Volume 2, Number 1

People and Environment
by R. D'Arcy Bonnet
October 1971, Volume 3, Number 10

Testimony at the Environmental Protection Hearing
by Robin Harrison (Denver, Colorado – October 1, 1971)
December 1971, Volume 3, Number 12

Geometronics

A 3-Dimensional Plotting System
by Olin Bockes, Washington Office
November 1969, Volume 1, Number 6

Combined Right-of-Way and Road Design Aerial Photography
by Max C. Montgomery, San Bernardino National Forest
May 1971, Volume 3, Number 5

Contracting for Aerial Photography
by Clair L. Arneson and Richard L. Bradley, Washington Office
August 1969, Volume 1, Number 3

Hand Held Platen for Relative Orientation of Stereo Models
by Richard Brush, Engineering Technician, Boise National Forest
January-February 1972, Volume 4, Numbers 1 and 2

Special Report on the First Earth Resources Technology Satellite
(News Item) by Ray P. Allison, Washington Office
July-August 1972, Volume 4, Numbers 7 and 8

Stereo Projection System
by Larry Huston, Region 3
September 1969, Volume 1, Number 4

Utilization of 5-Drawer Flat Map Cabinets as a Layout Table
by Richard G. Harris, Civil Engineer, Uinta National Forest
April 1971, Volume 3, Number 4

Hearings and Laws

House Subcommittee Hearing on the Federal Aid Highway Act of 1970
by F. J. Hammond
June 1970, Volume 2, Number 6

Testimony at the Environmental Protection Hearing
by Robin Harrison (Denver, Colorado – October 1, 1971)
December 1971, Volume 3, Number 12

Traffic Regulations and Law Enforcement on the National Forest Development Road System
by Dave Trask, Washington Office
September 1969, Volume 1, Number 4

Miscellaneous

An Easy Solution to Skylining
(News Item) by C. D. Swarthout, Division of Engineering, California Region
July-August 1972, Volume 4, Numbers 7 and 8

Development of Maintenance Work Standards
by John Platt, San Bernardino National Forest
May 1971, Volume 3, Number 5

ED&T Report – 7160-2 – Field Maintenance of Rotted Wood Signs
(News Item) by Reg Pragnell, Washington Office
May 1970, Volume 2, Number 5

Engineering Geology in a Massively Unstable Region
by Thomas K. Collins and Billie G. Hicks, Klamath National Forest
September-October 1972, Volume 4, Numbers 9 and 10

Lined Cavity Shaped Charges
by James Lott
July 1970, Volume 2, Number 7

The Effects of Deicing Salt on Coniferous Trees
(News Item) by Byron E. Foss
July-August 1972, Volume 4, Numbers 7 and 8

Use of a Rotary Drilling Rig for Investigation and Repair
of an Earthfill Dam
by John S. Boyd, Staff Geologist, Region 3, and John P. Haynes,
Staff Engineer, Region 3
December 1970, Volume 2, Number 12

Multiple Use

Multi-Discipline Planning Teams
(News Item) by D. C. Turner, Assistant Director, Division of
Engineering, Washington Office
August 1970, Volume 2, Number 8

Public Support Through Multiple Use Coordination of Engineering
Projects – A Fable and a Fantasy
by D. C. Turner, Washington Office
July 1970, Volume 2, Number 7

News Items: General

A Note to Authors of the 1970 Engineering Field Notes
by Fran Owsley, Editor, Washington Office
March 1971, Volume 3, Number 3

Letters from Engineering Retirees
December 1970 Special Christmas Edition

Q's and A's on Copyright and Public Domain Publications
by Jeff Sirmon and Boone Richardson, Washington Office
March 1970, Volume 2, Number 3

Who's Who in the Washington Office Division of Engineering
Compiled by Fran Owsley, Editor, Washington Office
July-August 1972, Volume 4, Numbers 7 and 8

Washington Office Division of Engineering Directive Progress
by Fran Owsley, Editor, Washington Office
August 1969, Volume 1, Number 3

Proceedings

Proceedings – RO Divisions of Engineering Meeting, Washington, D. C.
September 27 – October 1, 1971
May-June 1972, Volume 4, Numbers 5 and 6

Recreation

Boat Dock at Atherton Creek Campground
by Thomas G. Grant
July 1970, Volume 2, Number 7

Bryants Fork – A Temporary Campground
by Richard G. Harris, Civil Engineer, Uinta National Forest
May 1971, Volume 3, Number 5

Reservoir

Guidelines for Evaluation of Small Reservoir Sites
by Stanley A. Thorn, Region 6
February 1971, Volume 3, Number 2

TIS

Technical Information System
by Norman Sears, Washington Office
August 1969, Volume 1, Number 3

The Technical Information System
by Norman G. Sears, Washington Office
May 1969, Volume 1, Number 1

Training Programs

Advanced Engineering Technical Specialty Training Program
by Walter E. Furen, Washington Office
June 1969, Volume 1, Number 2

Region 2 Materials Training Conducted in Region 4 Materials Laboratory
(News Item) by Martin Everitt, Materials Engineer, Region 2
May 1971, Volume 3, Number 5

Transportation (Roads and Trails) – General

A Meter/Recorder to Measure Logging Road Roughness
by Ross A. Phillips and Cleveland J. Biller
September 1971, Volume 3, Number 9

A Method for Elimination of Double Counting by Electronic Traffic Counters
(News Item) by John Sessions, Willamette National Forest
August 1970, Volume 2, Number 8

Appalachian National Scenic Trail Study Program
by Tom Fendley, Region 8
January 1971, Volume 3, Number 1

Applications of Network Analysis to National Forest Transportation Problems
by William F. Schnelle, Civil Engineer, USDA Forest Service
March-April 1972, Volume 4, Numbers 3 and 4

Blower to Assist with Burning During Clearing and Grubbing Operation
by Thomas Dooley, Zone Engineer, Ottawa National Forest
April 1972, Volume 3, Number 4

Combined Right-of-Way and Road Design Aerial Photography
by Max C. Montgomery, San Bernardino National Forest
May 1971, Volume 3, Number 5

Control That Survey
by W. H. Boley, Forest Engineer, Manti-LaSal National Forest
and Carl Fonnesbeck, Supervisory Civil Engineer, Region 4
January-February 1972, Volume 4, Numbers 1 and 2

Economic Analysis in Transportation Planning
by David B. Trask, Washington Office
March 1970, Volume 2, Number 3

Engineering Stability Study of a Waste Area in Steep Topography
by Mel Dittmer, Preconstruction Engineer, Siuslaw National Forest
November 1971, Volume 3, Number 11

Forest Service Road Safety Program
by D. C. Turner, Washington Office
March 1971, Volume 3, Number 3

Highway Safety Study
(News Item) by Del Beedy, Washington Office
May 1970, Volume 2, Number 5

House Subcommittee Hearing on the Federal Aid Highway Act of 1970
by F. J. Hammond
June 1970, Volume 2, Number 6

Installation of a Prefabricated Aluminum Bin Wall
by D. D. McCarthy, Angeles National Forest
April 1971, Volume 3, Number 4

Methods of Improving Traffic Counter Reliability
by Gerald L. Ames, Construction Inspector
January-February 1972, Volume 4, Numbers 1 and 2

Road Design by Photogrammetric Methods
by J. M. Cultice, Washington Office
November 1969, Volume 1, Number 6

Roadside Ditch Cleaners
(News Item) by S. J. Wilcox, EDC, San Dimas
May 1970, Volume 2, Number 5

Roadway Structural Section Design Using Elastic Theory
by David L. Jones
April 1970, Volume 2, Number 4

Running Levels on Class II 'P' – Line Survey
by Jon Anderson, Kootenai National Forest
March 1970, Volume 2, Number 3

Soil Compaction Mold Reamer
(Recognition of Roy Chapin, Sierra National Forest,
Region 5, for his suggestion)
October 1969, Volume 1, Number 5

Some Experience in Stepping Slopes
by Joseph A. Todd, Division Engineer, Bureau of Public Roads,
U. S. Department of Transportation
December 1969, Volume 1, Number 7

Stabilization of Roadside Banks with Annual Grasses
by Ernest K. Ellersick
July 1970, Volume 2, Number 7

Stepped Cutback Slopes
by Clinton Peterson, Wallowa-Whitman National Forest
June 1971, Volume 3, Number 6

Testing Traffic Counters
(News Item) by the Missoula Equipment Development Center
May 1971, Volume 3, Number 5

The Advanced Transportation System Planning Programs of the USDA, Forest Service
(Submitted by the Study Team)
November 1969, Volume 1, Number 6

The Current Status of Guardrail Standardization
by Richard A. Richter (Reprint from Highway Focus)
May 1970, Volume 2, Number 5

Traffic Regulations and Law Enforcement on the National Forest Development Road System
by Dave Trask, Washington Office
September 1969, Volume 1, Number 4

Trail Machine Cattleguard
by Harold L. Greer
April 1970, Volume 2, Number 4

Trail Traffic Counter
by Loren F. Deland, Missoula Equipment Development Center
January 1971, Volume 3, Number 1

Trail Traffic Counters and Detectors
by David B. Trask, Washington Office
August 1969, Volume 1, Number 3

Transportation Planning – A New Approach
by Conrad Mandt and Ross Carter
November 1970, Volume 2, Number 11

Transportation System Analysis and Resource Planning
by Victor M. DeKalb
September 1971, Volume 3, Number 9

Transportation (Roads and Trails) – Drainage

A Method of Determining the Construction Grade in a Road Drainage Dip
by Lester M. Pence, Jr., George Washington National Forest
March 1971, Volume 3, Number 3

Culvert Band Installation Tools
by Sterling J. Wilcox, EDC, San Dimas
January 1970, Volume 2, Number 1

Culvert Length Computations
by Harwell Adams
May 1970, Volume 2, Number 5

Development Report on 24-inch Rectangle Overside Drain
by D. D. McCarthy, Angeles National Forest
December 1971, Volume 3, Number 12

Effect of Sideslopes in Culvert Length and Location
by John Host, Region 1
July-August 1971, Volume 3, Numbers 7 and 8

Energy Dissipators for Flumes and Culverts
by Sterling J. Wilcox, EDC, San Dimas
October 1969, Volume 1, Number 5

Installation of a Bottomless Culvert on Glade Creek
by Thomas G. Grant, Teton National Forest
February 1971, Volume 3, Number 2

Two-Layer Subdrain System
by Walt Wieland and Greg Watkins, Six Rivers National Forest
July-August 1971, Volume 3, Numbers 7 and 8

Transportation (Roads and Trails) – Materials

Classification of Crankcase Oils
by Thomas W. Stockdale, Region 3
October 1972, Volume 4, Numbers 9 and 10

Evaluation of "Liqui-Road"
by Adrian Pelzner, Washington Office
June 1969, Volume 1, Number 2

Trial Use of New Products and Materials
by Adrian Pelzner, Washington Office
February 1970, Volume 2, Number 2

Use of Rubber Additive in Asphalt Materials for Surface Treatments
(Reprint from Highway Focus)
March 1970, Volume 2, Number 3

Transportation (Roads and Trails) – Paving

Effects of Rubber Additives in Asphalt Concrete
by Edward Stuart III
August 1970, Volume 2, Number 8

Transportation (Roads and Trails) – Structural, Design

An Analysis of the Failure of a Longitudinal Laminated
Timber Bridge Deck
by Hildegard Oswald, Region 6
February 1971, Volume 3, Number 2

Computation of Vertical Offsets of a Parabolic Curve Using
a Slide Rule
by David K. Crigger, Ashley National Forest
July-August 1971, Volume 3, Numbers 7 and 8

Timber Crib Retaining Wall Study
(News Item) by Adrian Pelzner, Washington Office
July-August 1972, Volume 4, Numbers 7 and 8

Water, Sanitation, and Solid Waste

A New Method for Water and Wastewater Sampling
by H. A. Smallwood, Washington Office
September 1969, Volume 1, Number 4

A Nontechnical Discussion of Sewage Treatment and Pollution Control
by Herbert Smallwood, Washington Office
January 1970, Volume 2, Number 1

Determining Cost, Air, and Power Requirements for Aerating Sewage
by H. A. Smallwood, Washington Office
December 1969, Volume 1, Number 7

Solid Waste Management – a List of Available Literature
(News Item)
June 1971, Volume 3, Number 6

Wilderness

Engineering in Wilderness
by J. J. Byrne
April 1970, Volume 2, Number 4

Winter Sports (Tramways and Ski Lifts)

Coefficients of Friction for Ski Lift Drive Sheave Liners
by Charles F. Dwyer, Washington Office
October 1971, Volume 3, Number 10

High Capacity Chair Lifts – Loading and UnLoading Considerations
by Robert E. Kinney
October 1970, Volume 2, Number 10

Ski Lift Thruster Brake Problem
by Charles G. Bovey, Engineer, Caribou National Forest
October 1971, Volume 3, Number 10

Supplemental Procedures used in Load Testing of Chair Lifts,
Gondola Lifts and Tramways
by Verne L. Despain
November 1970, Volume 2, Number 11

Wire Rope Considerations in the New American National Standard
Safety Requirements for Aerial Passenger Tramways
by Charles F. Dwyer, Washington Office
September 1970, Volume 2, Number 9

. . . . . .

EDITOR'S NOTE: Due to technical difficulties beyond our control, the November-December, 1972 issue of the Field Notes will not be distributed.