

Library

**ENGINEERING
TECHNICAL
INFORMATION
SYSTEM**

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

Field **Notes**

Volume 2 Number 1 January 1970

Getting Involved in Environmental Planning
John Daly, R-8

North-Seeking Gyro Systems
Victor H. Hedman, R-9

A Nontechnical Discussion of Sewage Treatment
and Pollution Control
Herbert Smallwood, WO

→ Culvert Band Installation Tools
Sterling J. Wilcox, EDC, San Dimas



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), or edited before being submitted to the Washington Office. This will be done in the Washington Office 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	Kenneth Yeager	R-6	Don Loff
R-2	Marshall Fox	R-8	Rollie Bailey
R-3	Dan Roper	R-9	David Jones
R-4	Fleet Stanton	R-10	Gerald Schauwecker
R-5	Chuck Paletti	WO	Norman Sears

DISCLAIMER

Information contained in this report has been developed for the guidance of employees of the U. S. Department of Agriculture - Forest Service, its contractors and its cooperating Federal and State agencies. The Department of Agriculture assumes no responsibility for the interpretation or use of this information by other than its own employees.

The use of trade, firm, or corporation names is for the information and convenience of the reader. Such use does not constitute an official evaluation, conclusion, recommendation, endorsement, or approval of any product or service to the exclusion of others which may be suitable.

F I E L D N O T E S

GETTING INVOLVED IN ENVIRONMENTAL PLANNING

by John H. Daly, R-8

The quality of our environment has come more and more under public scrutiny. Pressure from a more informed public has led to the extensive use of the design team concept in the solutions of many diversified and extensive engineering problems.

With this idea in mind, the R-8, Division of Engineering, developed the concept of an ideal design team. They envisioned an endeavor encompassing many of the various disciplines in the Forest Service. A 4-day seminar was held to promote a true inter-disciplinary approach toward creating and projecting the design team concept in the Forest Service. Participants -- other than engineers -- ranged from forester, architect, hydrologist, biologist, and soil scientist, to public information specialist.

The main purpose of the seminar was to bring these varied disciplines together; create an awareness of the functions and capabilities of each; motivate them to the problems and challenges of environmental planning and the design team concept; and participate together in the analysis and solution of two existing environmental field problems.

The theme of this seminar was a new approach to planning, and guest lecturers provided 6 hours of informative and thought-provoking discussion on diverse aspects of ecology, pollution, and other factors affecting our environment. These guest lecturers were as varied in career backgrounds as were the Forest Service participants.

The guest lecturers were:

Dr. Eugene P. Odum -- Director, Institute of Ecology, University of Georgia; a delegate to the first "Atoms for Peace" Conference and Georgia's Scientist of the Year in 1968; considered by many as one of the world's foremost ecologists.

Dr. William W. Eckenfelder, Jr. -- Professor of Civil Engineering in Environmental Health Engineering, University of Texas; outstanding consultant and researcher in the sanitary engineering field; and author of over 100 papers and nine books on the biological treatment of wastes.

Mr. Michael Frome -- One of the country's leading authoris on travel and conservation; winner of the Thomas Wolfe Memorial Award and columnist for the "American Forests" and "Field and Stream" magazines. Mr. Frome recently co-authored with Orville L. Freeman, a book entitled "The National Forests of America."

Mr. William R. Kidd -- Consulting engineer and president of Moorehead Engineering Company, Ocala, Florida. Mr. Kidd has been responsible for several major recreational projects in Florida including the redevelopment of Rainbow Springs. Under former Florida Governor Farris Bryant, Mr. Kidd served as Administrative Assistant, responsible for the development of conservation and recreational programs for the State of Florida.

Many Forest Service participants presented brief talks. Subject matter ranged from road design and waste disposal to timber management -- all with the intention of creating an awareness of each discipline's capabilities and how these capabilities fit into environmental planning.

After the lectures and speeches were completed, the last phase of the seminar began. Participants were grouped into design teams. Four teams of 10 participants each were established. Two of the teams were made up of engineers only; the other two teams consisted of all disciplines attending the meeting. The environmental planning problems at the Cradle of Forestry were outlined for the teams, and field work was arranged so that each team could visit each project problem, inspect topography, gather existing data, and discuss the proposed project with both Forest Service personnel and local citizens. After the field exercise, all groups met separately for approximately 3 hours to discuss and analyze each project and to develop action plans supporting the views and ideas of each group.

The last day each design team presented its problem analysis and proposed solution. At this presentation, the one main purpose of the seminar was evident to all. The teams composed of only engineers went about the problem analysis and solution in the analytical and technical way common to all engineering and scientific disciplines. Their technological approach to the problems used engineering sciences as a base, and cost as the criteria. Their solution was design-oriented -- pointing out such factors as size, cost, capacity, and useful life.

The teams composed of dissimilar occupations proved several things. Their varied backgrounds provided different ideas, rational objectives, and consideration of different alternatives. These objectives and their alternatives involved decisions, not only on what to design, but why, and social, economic, ecological and esthetic factors as well.

The comparisons between these teams pointed out the need and advantages of the inter-disciplinary approach to the problem-solving process in environmental planning. This broad approach forces the planner and designer to seek out the most favorable and not the maximum solution on how to plan and build -- and then how to incorporate these answers into their design decisions.

This seminar was a great success. The participants gained not only insight into special problems, but also motivation to use the multi-disciplinary concept in solving these problems. The participants departed with a noticeable eagerness to "get involved."

.

NORTH-SEEKING GYRO SYSTEMS

By Victor H. Hedman, R-9

(The June 1969, Volume 1, Number 2 issue of the Field Notes introduced the Eastern Region's plans for actual field use of the North-Seeking Gyro System for surveying. This is a follow-up on the project.)

In September 1969, the Eastern Region initiated the use of the Fennel TK-4 North-Seeking Gyro under field conditions on a cadastral survey photogrammetric project in northern Minnesota. Project planning included the use of the north-seeking gyro to determine precise orientation control in restoring and establishing land corners from ground targets.

Preliminary testing of the gyro prior to field use indicated that precise orientation requirements can be accomplished with this instrument. The unknown to be determined was the performance over the entire project requiring orientation control from 70 targets.

The initial phases of the project permitted a check on gyro orientation from ground targets by comparison with independent offsets from transit-traverse control lines. Good results were obtained.

Unfortunately, less than 10 percent of the project was completed when a failure occurred in the power source. For reasons unknown, the nickel-cadmium battery in a special metal housing burned and disintegrated in a backpack sack while being carried to the next target location. After replacement with a new battery a malfunction was detected in the performance of the gyro.

A preliminary shop inspection of the gyro (by the authorized company dealer) and a testing of the power source pointed to an internal gyro defect. The gyro has been returned to the Fennel Company for a complete check.

An insufficient number of readings were made with the gyro to establish the range of performance. The test on a complete project is now rescheduled for next field season. We expect it to provide performance results under a variety of conditions. Generally, we are well satisfied with the results attained, but will be alert to performance failures and the reasons for them.

Because of the problem encountered with the gyro, our complete report promised you in the June 1969 issue of the Field Notes will be delayed until the end of the next field season.

.

A NONTECHNICAL DISCUSSION OF SEWAGE TREATMENT AND POLLUTION CONTROL

by Herbert Smallwood, WO

"Why can't we settle on one kind of sewage treatment and use it at all of our sites?" This question is asked so frequently of sanitary engineers that it merits serious attention. Any direct answer will be inadequate because it will exclude from consideration many of the bordering influences which are vital to an understanding of the problem. These may require considerable study or investigation. In fact, the lack of basic data concerning the quantity, quality, and periods of sewage flow is one of the greatest handicaps we have in designing efficient treatment facilities for the Forest Service. We have hopes of undertaking a project to satisfy this need in the near future.

The considerations affecting the design are exactly the same as though we had all the needed data, but they cannot be treated as rigorously. Thus, the designer is far from assured that the result meets the objectives in

an optimal manner. Matters which concern the designer are: (1) Water quality standards, (2) effluent quality, (3) economics, and (4) environmental influence.

Water Quality Standards. The maintenance of specified water quality standards for a stream into which an effluent is being discharged requires a knowledge of the quality and quantity of both the stream and the effluent. Aside from practicality and cost, the ideal situation would be for the quality of the effluent to match the quality of the stream. This is hardly possible.

Since there will be a difference in the quality of the two sources, the question arises, where will the resultant characteristics be measured? Practically, the point must be after complete mixing has occurred and before a change in characteristics would be significant. If the measurement is made prior to complete mixing, a representative sample will not be obtained and the results are certain to be misleading.

To this extent, the setting of effluent standards is more rational and equitable than the setting of water quality standards. The latter is less difficult and puts the responsibility for maintaining the water quality upon the discharger. In establishing water quality standards, the establishing agency is saying, "We don't know the effect of multiple effluent discharges on water quality, but it is the discharger's responsibility to maintain the quality of the receiving waters." It is very comparable to writing a performance specification as opposed to the "recipe" approach.

It is paradoxical that water quality standards have received so much attention by the Federal Government and by the various States, and yet the selection of an appropriate waste water treatment design to meet the standards is largely "intuitional" for all but the larger installations. Basic data and a computational approach are needed to replace intuition.

Within the general design considerations previously mentioned, there are certain characteristics which can be expected of the effluents of various sewage treatment processes. Lagoons, aerobic (complete mix) and aerated (incomplete mix) lagoons can be expected to yield high suspended solids although those from the latter two are easier to remove. Extended aeration and contact stabilization can normally remove 85-95 percent -- both 5-day biochemical oxygen demand (BOD₅) and the suspended solids. To achieve this level of solids removal with our variable flows, both of these processes require careful consideration of peak flows in the clarifier (solids removal) design.

Effluent Quality: Factors influencing the quality of the effluent are the quantity and quality of the influent and the treatment given it. The quantity and quality in turn are determined by the kind of use, the

numbers of people, and the time pattern of use. It is necessary that the ultimate plan of development be established prior to deciding upon the waste treatment design. The treatment given is determined by the process, which is a design matter, and by the skill, or application of the skills, of the operator. The major portion of the designer's objectives can be defeated and the investment wasted if the operator is either unskilled or burdened with other responsibilities to the detriment of the plant operation.

Unfortunately, the usual specification for plant performance is stated in terms of percent removal. The Federal Water Pollution Control Administration now defines the criteria of "secondary treatment or its equivalent" as 85 percent removal of both BOD₅ and suspended solids. Used in this sense, as a criteria of performance to define a term, or to match performance against capability, percent removal is meaningful. As a measure of effluent quality, it leaves much to be desired since the influent quality and quantity is not mentioned. As a measure of influence on water quality, it is meaningless.

Since influent quality is not mentioned in relation to treatment efficiency, other design criteria must be sufficiently flexible to discount its effects. To help accomplish this, most State agencies set required detention time, which is a direct measure of the physical size of the plant, at the greatest possible period. For the sake of economy, we need better criteria.

Economics: With the large numbers of sewage treatment facilities being (and remaining to be) installed, it is most important that we make every effort to assure that each installation represents the most economical choice to produce the needed quality of effluent. The economical choice represents the optimum total cost after consideration of initial investment, operational cost, interest, depreciation, land cost, and the cost of any foregone opportunity.

There are many pitfalls in making an economic choice of treatment systems. It is very easy to overestimate or underestimate operation and maintenance costs. As an example, earth lagoons are often constructed as hardly more than holes in the ground. When constructed in this manner, they represent a very low initial investment. It is a great misconception that after construction lagoons can be left to operate by themselves. As a result, they are usually neglected in both operation and maintenance. Yet for proper and continued functioning, earth lagoons require dike maintenance such as seeding, fertilizing, removal of long rooted plants, and protection against burrowing animals. They also require removal of bottom growing plants or maintenance of the lining, if any; operational control according to loading and volume; skimming; removal of algae deposits on the banks;

breaking up and dispersal of floating algae and sludge mats; control of mosquitoes, psychoda, midges, gnats and flies, and occasional control of algae growth.

Other economic pitfalls include the tendency to consider too narrow a range of alternatives and the reluctance to undertake stage construction. As an example of alternatives, consider the case of a highly variable flow. Possible alternatives may include parallel or multiple-chambered extended aeration plants; a convertible extended aeration-contact stabilization unit; an aerobic or aerated lagoon, or combination of both followed by solids removal; an oxidation ditch; inclusion of a surge tank; and under some circumstances batch operation as opposed to continuous flow.

The advantages of stage construction are obvious when it is associated with increasing use or development, but less apparent is the advantage when the needed degree of treatment is unknown. An example of this need frequently occurs when an "intuitive design" is either proposed by ourselves or requested by another authority to achieve some degree of nutrient removal. Usually the need for the nutrient removal is problematic, in the sense that neither the specific nutrient contribution nor its relationship to other nutrient sources has been evaluated either in amount or impact. Therefore, a design which incorporates nutrient removal without this evaluation is "intuitive." Under these conditions it is better to adopt a stage approach, the first step of which would not include the nutrient removal phase. Subsequent monitoring would then establish the need, or the lack of it, for the second stage.

It must be recognized that dollars used in building too much plant, or too little plant, detract from the progress of the overall effort.

Another economic aspect is the reduction of either initial investment or maintenance costs through layout and design features which reduce the extent of the facility or the man-hours required for operation or maintenance. The latter may incur additional initial costs which have to be included in the economic appraisal to determine their actual worth.

Environmental Influences: Most of our concerns with the relationship between sewage disposal and the environment have been directed toward the impact of one upon the other. Once the effluent quality needs have been cared for, surely we then have the engineering and architectural ingenuity to prevent the method of disposal from creating an undesirable environment.

Engineers generally regard their productions somewhat paternally. Such paternalism should extend to insistence upon appropriate settings and external presentations, in the case of treatment facilities, to make them compatible with their surroundings. This is simple salesmanship.

Another aspect of the relationship, however, is the impact of the environment upon the treatment facility. This may have considerable economic as well as esthetic importance. Environmental factors may eliminate some of the alternatives for treatment, and certainly will influence the particular design which is undertaken. These factors include soil, geology, and topography; wind direction, strength and duration; sunlight and temperature; water table characteristics; surface drainage, ground cover and area development; humidity and precipitation.

One of the fallacies we embrace is the notion that only the treatment facility be selected on the basis of economic appraisal. Yet this facility is only one end of a system within a system. Perhaps cost-wise it is even a minor part. If we are truly cost-conscious, any appraisal will extend to the collection system, water system, the solid waste collection and disposal, and the development of the area served. These should all be treated as parts of a single unit for serving people, influencing and influenced by the same environment and subject to the same cost considerations. It is not reasonable that physical arrangement is entirely dependent upon topography and esthetics and independent of cost. Thus the arrangement of the development should not be considered separately from the arrangement of its utilities and services.

Granted that safe and adequate sewage collection, treatment and disposal are necessary, these efforts cannot, in themselves, be expected to control water pollution in water-oriented recreation areas. The pollutants reaching the water body, even from a faulty sewage system, may be only a small portion of that contributed by surface runoff from use areas, from meadows and pastures, by human and animal litter, from construction and maintenance, and by seasonal drainage of otherwise stagnant areas. We should not be surprised to see continued algae bloom after the installation of an expensive sewage system if we have not invoked an area policing program, used ditch and area sweeping, provided for dispersal of surface runoff, stabilized ground surfaces, and drained adjacent land areas.

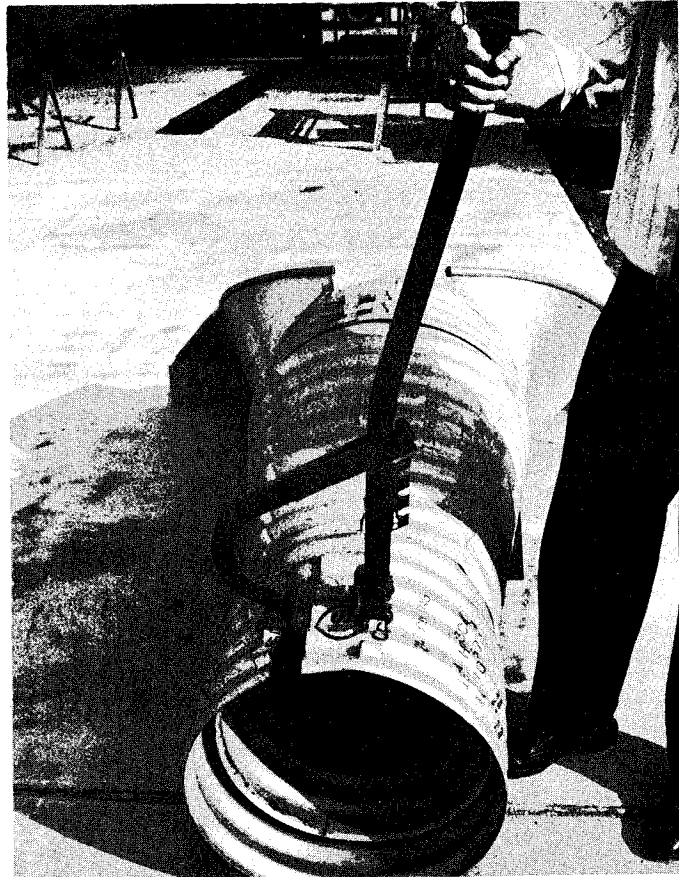
In spite of all this, pollution and eutrophication will continue in some degree. People mean pollution. The only sensible course is to establish an effective continuing water monitoring system, at every valuable recreation water, to measure the progress of our impacts and to devise counter measures to offset them.

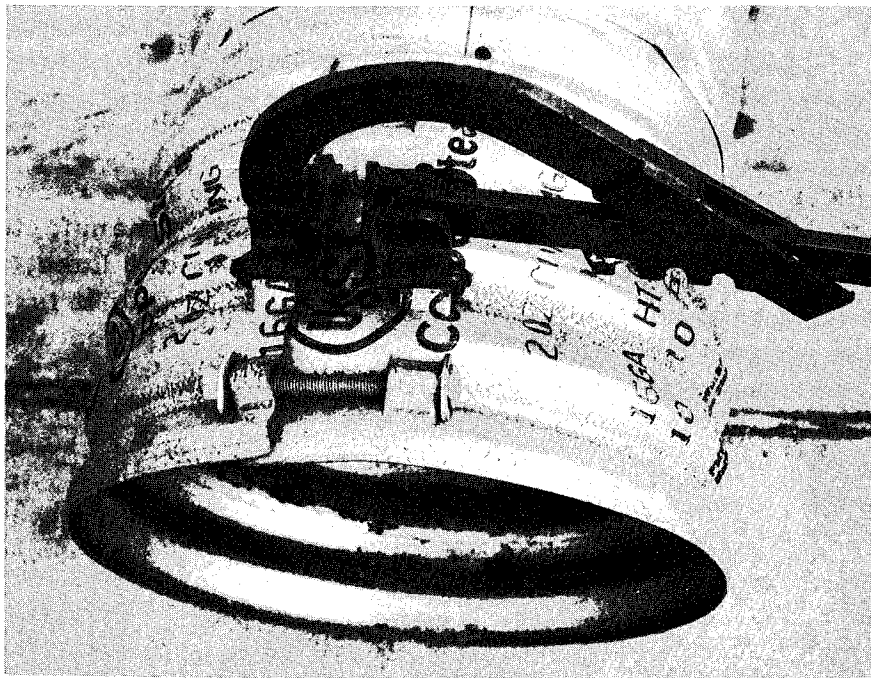
CULVERT BAND INSTALLATION TOOLS

by Sterling J. Wilcox, EDC, San Dimas

Several methods are presently being used to aid in installing connecting bands on corrugated metal pipe culverts. Asphalt coatings make the bands especially tough to squeeze together in order to insert the bolts for fastening. In addition to safety hazards (skinned knuckles, etc), present methods are quite time-consuming.

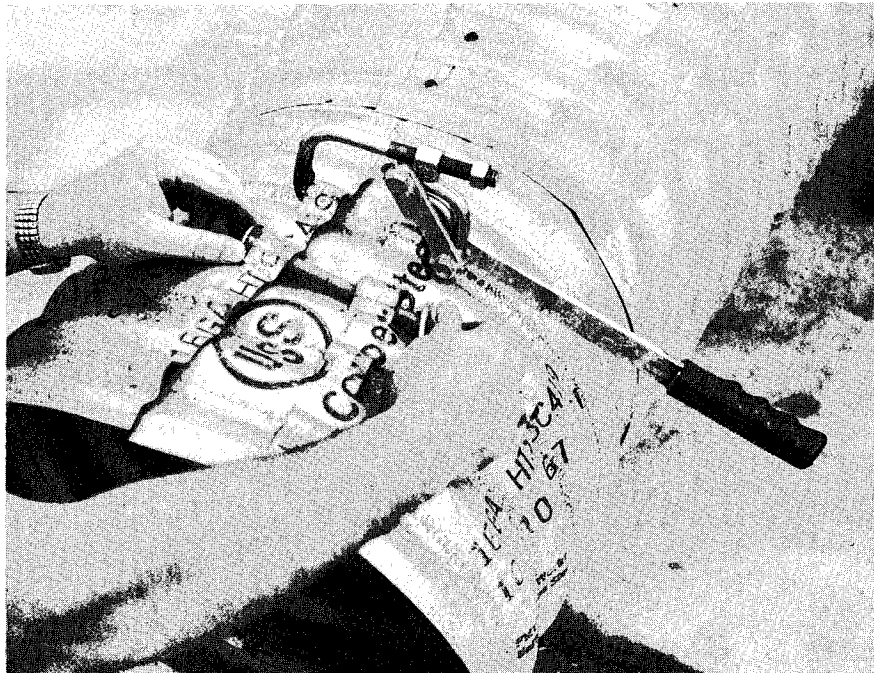
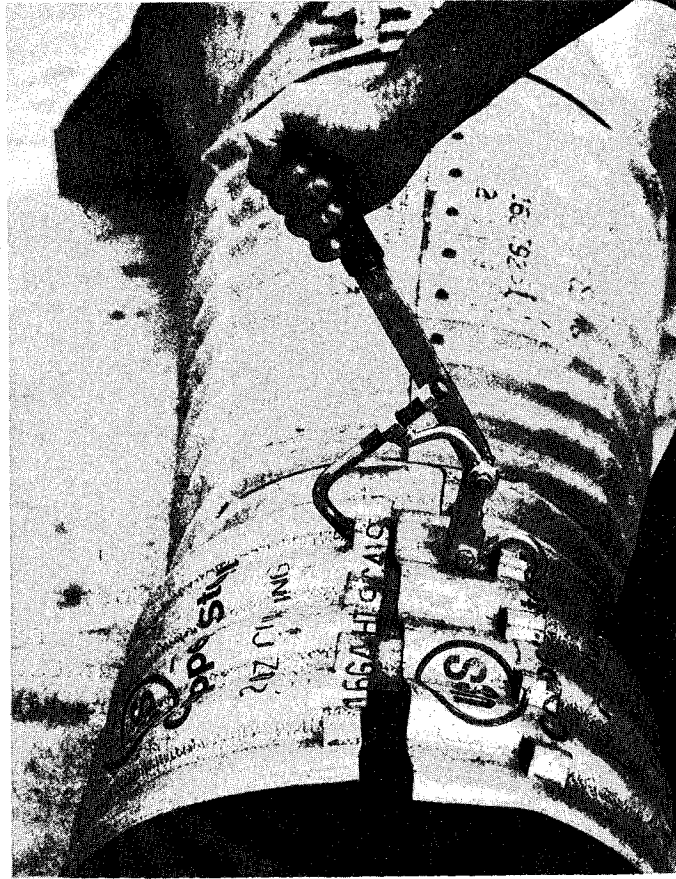
Two available devices which seem to work quite well have come to our attention. The first is called the "Ban-Squeeze," manufactured by the Fowler Manufacturing Company, Route 1, Crystal Lake, South Sioux City, Nebraska 68776 (Phone 402-494-3555). It is priced at \$42.50 plus freight.





This connector can be used on various types and sizes of bands. One problem with it is that on coated bands it is difficult to insert the clamp between the angle iron and the corrugations if this area is filled with bituminous material. We welded an additional tooth on the arm which enabled us to use the tool on 18-inch culverts and draw the band tighter.

The second device is a smaller tool manufactured by Hatcher Enterprises, P.O. Box 2612, Napa, California 94558 (Phone 707-255-4655). It is priced at \$27.50 FOB destination. (Price includes a spreader tool used to loosen bands when disassembling culvert sections.)



This connector can also be used on various types and sizes of bands. It works especially well on bands with angle iron connector brackets. It attaches in the bolt holes rather than between the bracket and corrugations, as does the Fowler device.

Additional sources of supply for these devices may be available from the manufacturer.

.

EDITOR'S EPITOME

We have received requests for the chart "Costs, Air and Power Requirements for Aerating Sewage," printed in an article in December 1969, Volume 1, Number 7, Field Notes. The WO, Division of Engineering has a limited number of glossy prints of this chart.

National Engineers Week is February 22-28, 1970 and the theme is "Engineering . . . Environmental Design for the 1970's." This is a good opportunity to prepare displays for your Regional Office or Supervisor's Office as the case may be. Let's not miss this chance to project to the public the role of the Forest Service Engineer in planning and design within the rural environment. Let your imagination be your guide!

