

$10^6 \times 0.61 \times 1.27 \times 10^{-2} / [(206.8 \times 10^6 \times 0.500^3) + (3 \times 0.103 \times 8274 \times 0.61^3)] = 39.446 \text{ MPa (5742 lbf/in}^2\text{)}$ .

3.  $S_r = 198.706 + 39.446 = 238.152 \text{ MPa (34 542 lbf/in}^2\text{)}$  and the specified minimum yield =  $238.152/413.700 = 57.6$  percent.

#### CONCLUSIONS

It appears obvious to many pipeline operators that the use of uncased pipeline at highway crossings is preferable to the use of cased pipeline in the present conditions of pipeline design, construction, testing, and operating technology. There are proven design procedures and criteria that will assure the operating safety of uncased crossings. Cathodic protection of uncased carrier pipe is much greater than that of cased pipe, which significantly reduces a major cause of pipeline leaks. Uncased crossings have definite economic advantages to both highway departments in terms of initial costs and pipeline operators in terms of initial and operating costs. The use of uncased crossings has been recommended by the NTSB and is being favorably considered for recommendation by NARUC. Technologically outmoded objections against the use of uncased pipeline at highway crossings should be put aside, and procedures for the approval of the use of uncased pipeline should be implemented.

#### ACKNOWLEDGMENT

The procedure described in this paper has been accepted by the West Virginia Department of Highways and the Gas Pipeline Safety Division of the West Virginia Public Service Commission, and was developed through a joint effort of the Gas Pipeline Safety Division of the West Virginia Public Service Commission, the Design Division of the West Virginia Department of Highways, the Consolidated Gas Supply Corporation, the Equitable Gas Company, and the Columbia Gas Transmission Corporation.

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## Coordinating Utility Relocations as a Function of State Highway Agencies

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Coordinating the relocation of utility facilities from the construction area for new highways and accommodating them on existing rights-of-way is an important consideration of state highway agencies. Data on the various divisions, bureaus, departments, sections, and units of the highway agencies that have the responsibility for this particular area of work were obtained from a questionnaire submitted to all 50 states and the District of Columbia. The results were tabulated and analyzed on the basis of 45 replies. It was concluded that all utility-related functions, such as preliminary engineering, estimates, liaison, coordination, plan development, and review and approval, for both highway projects and new utility installations should be referred to one central office or one

individual in each district office for those agencies that are so structured.

The utility-relocation function has various concepts, levels of responsibility, and locations in different state highway agencies. Some agencies have a central office that is responsible for the required liaison with utility companies throughout the entire state. Others have divided the function on a geographical or political basis.

## THE PROBLEM

All state highway agencies engage in projects that necessitate the adjustment or relocation of utility facilities. Liaison is the necessary coordination that allows the work to be performed and is the relation between the agency and the public utilities and between the divisions within the framework of the organization and the Federal Highway Administration (FHWA). Liaison between the utilities and the consulting engineers employed by the state during the highway design stage is also necessary. Liaison can be defined as a form of appreciation; that is, appreciation of the views and problems of others and taking the necessary steps toward making an overall plan that resolves or compromises differences.

In many instances, there is insufficient coordination between highway planning and utility planning. The utilities must provide service to meet the needs of changing patterns of land use and transportation. If economic efficiency is to be realized, utility impacts must be considered during the design stage of the highway planning process.

To avoid unnecessary delays and costs in the construction and maintenance of highway improvements and to protect existing facilities, utility companies should be advised sufficiently in advance as to the effects of such construction on existing or proposed facilities so that they will have time to design the required adjustments, budget the required money, procure the necessary materials, supplies, and equipment, and schedule and perform the work.

One major problem encountered in clearing utilities from a construction area is the coordination of highway-contractor activities and utility-company work schedules. Labor difficulties, material shortages, and difficult construction also complicate the situation. The wish by utilities to use the highway right-of-way is desirable, so long as the capacity, safety, and appearance of the highway can be preserved. To ensure these, such use and occupancy must be authorized and reasonably regulated by each agency. The dual interests of the states and the utilities in the matter of multiple use of highway rights-of-way have been discussed by the American Association of State Highway and Transportation Officials (AASHTO) (1), and most agencies have adopted specific policies and procedures for this purpose. A summary of these policies and procedures has been given in another report (2), and the FHWA policy on accommodation of utilities is contained in the Federal-Aid Highway Program Manual (3).

Within the various state agencies, the existing concepts, regulations, policies, and responsibilities are not clearly defined, and control over the coordination of utility relocations is usually fragmented.

## TREND

Certain states, FHWA, and the Transportation Research Board (TRB) consider the utility-relocation function to be one of great importance. In 11 states, this function is considered to be of sufficient importance for the listing of a representative in the AASHTO Directory of Member Departments. In FHWA, this function has branch status, and TRB has a Committee on Utilities. The American Public Works Association has a National Utility Location and Coordination Council.

FHWA has established policies and procedures for adjusting and relocating utility facilities on federal-aid highway projects and prescribes the extent of federal-aid participation in costs incurred by utility companies in such relocations. It also provides for an alternate simplified procedure for processing utility relocations

or adjustments that may be implemented at the election of a state.

By requiring the states to submit written policies and procedures for the administration and processing of federal-aid utility adjustments and requiring each state to develop a utility-accommodation policy, FHWA has brought additional importance to the utility-relocation function. Prior to this, some states had no formal policies, and others had conflicting policies.

## QUESTIONNAIRE AND ANALYSIS

The coordination of utility relocations as a function of the state highway agency was studied by analysis of the replies to a questionnaire that was submitted to the highway departments of all 50 states and the District of Columbia. The cover letter specifically directed the questionnaire to the person in charge of utility relocations and adjustments. The results tabulated and the analysis given are based on 45 replies. The following subjects were evaluated.

1. Do the same or different offices handle liaison for utility relocations caused by highway projects and for new utility installations on existing rights-of-way?
2. What states have an FHWA-approved utility-accommodation policy and utility-relocation-procedure manual or both?
3. How many states use or plan to use the alternate procedure provided by FHWA for federal-aid projects?
4. What states use a master utility or blanket agreement with utility companies?
5. On which utility relocations is federal aid requested?
6. At what level and in which division does the utility-relocation function best belong?
7. With what other divisions in the agency are the most contacts made?
8. What is the purpose of type of contact made with other divisions?
9. What is the basis for the organizational arrangement?
10. Have any states recently changed the location of the utility-relocation function?

(Division as used in this paper is defined as a subunit, such as design, construction, maintenance, legal, or finance, of the highway agency.)

## Titles

The various titles of persons in charge of utility relocations include utilities engineer, chief of utilities bureau, chief of utilities section, development engineer, right-of-way engineer, right-of-way agent, manager, supervisor, administrator, and others. The distribution of titles is shown in Figure 1. Seven agencies have separate bureaus or divisions to handle the total utility-relocation function. The distribution of titles of persons in charge of processing permits for new utility installations is shown in Figure 2. The most commonly used are maintenance or permit engineer or utility engineer. In 19 agencies, the same individual is in charge of both permits for new utility installations on existing highway rights-of-way and highway-related relocations.

## Division Contacts

The distribution of divisions in charge of utility relocations is shown in Figure 3. The right-of-way division is in charge in 16 states, the design division in 13, and the utilities division in 7. Figure 4 shows the distribu-

tion of divisions in charge of permits for new utility installations on existing highway rights-of-way. Maintenance divisions most frequently have this function.

Policies and Procedures

All of the agencies surveyed have a utility-accommodation policy, and 42 of them have received FHWA approval. Thirty-five agencies have prepared utility-relocation procedure manuals and 28 of these have received FHWA approval. The data collected from the questionnaire have been updated by the Washington office of FHWA.

The FHWA-approved alternate procedure is used by 11 states, and 5 more plan to use it. Several agencies were undecided. In most states, the reason for not using the alternate procedure was the fear that a later audit or review would result in nonparticipation for certain items over which there might be a difference of opinion.

Some form of a master or blanket utility agreement is used to reduce repetitious paper work by 21 agencies.

Federal aid was requested for most utility-relocation expenses by all but two of the agencies responding. The number of agencies requesting federal aid for various types of utilities is shown in Figure 5.

All but one agency indicated that utility companies were permitted to use consultants to design highway-related relocations, but seven agencies did not have a formalized procedure for this purpose.

Utility-Relocation Function as a Separate Division

To the question of whether the utility-relocation function

should be at the division level, 19 agencies responded yes. Some of the reasons are given below:

1. Putting all utility functions together would increase efficiency and provide better management control.
2. The utility-relocation function is a major activity with great responsibilities and varied and complex problems.
3. The complexity of this function requires greater and more uniform controls to improve overall utility operations.
4. Because utility relocation affects many areas of other divisions, there would be better coordination if there were a broad intradivisional relationship that gave better staff and line relations.
5. Being at division level would ensure that the utility-relocation function was included in all planning stages.
6. The utility-relocation function involves all stages of highway projects, and the procedures and inspections used are specialized and do not relate to other divisions.
7. The utility-relocation function is usually independent of other divisions.
8. The utility-relocation function should be combined with the railroad-relocation function and be all inclusive—before, during, and after construction.

Twenty-five agencies responded negatively to the idea of upgrading the function to a division level. One agency did not answer this question. Of the 25, several of these were departments of transportation, some of whom evidently misinterpreted the question as implying that the utility function would be on the same level as, for example, the division of highways, rather than be a subunit of the highway division.

The reasons given for not upgrading the function to division level are summarized below.

Figure 1. Distribution of titles: person in charge of utility-relocation function.

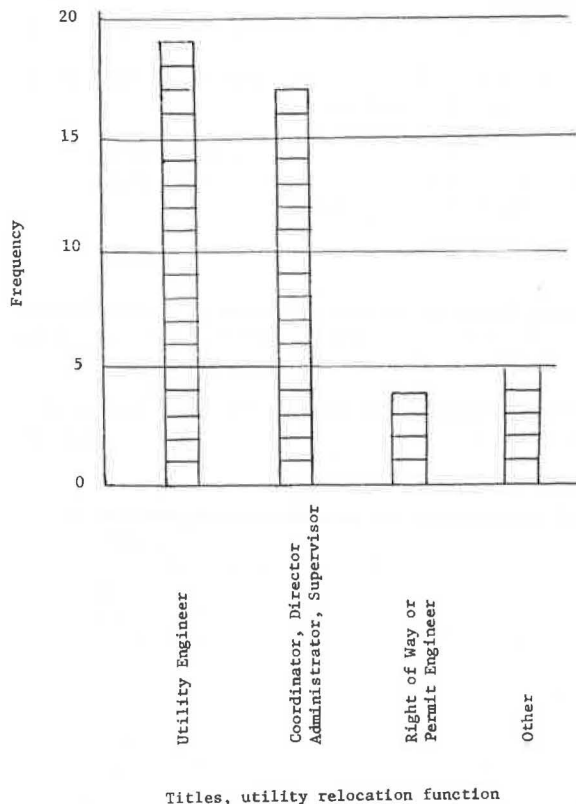
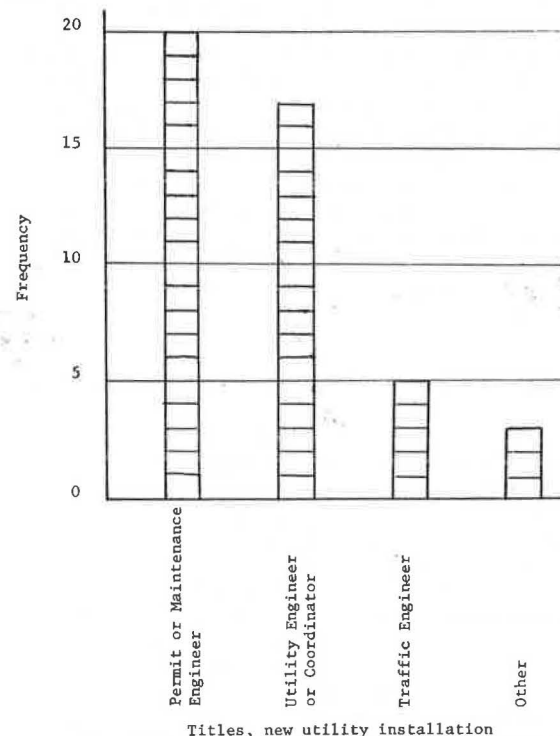


Figure 2. Distribution of titles: person in charge of permits for new utility installations.



1. Benefits would be minimal.
2. The coordination of the function is better if it is in, for example, the right-of-way division or the design division.
3. Utility relocation is a support, not a regulating or operating, function.
4. The present situation is satisfactory (this was the most commonly given reason).

The replies to the question, "If the utility function were not at a division level, in which division should it

be?", are shown in Figure 6. The 14 replies that recommended the right-of-way division gave the following reasons:

1. Mutual benefits would accrue from joint use of the right-of-way.
2. The right-of-way division, by its nature, crosses intradivisional lines, and this would be conducive to better communications.

Figure 3. Distribution of divisions in charge of utility relocations.

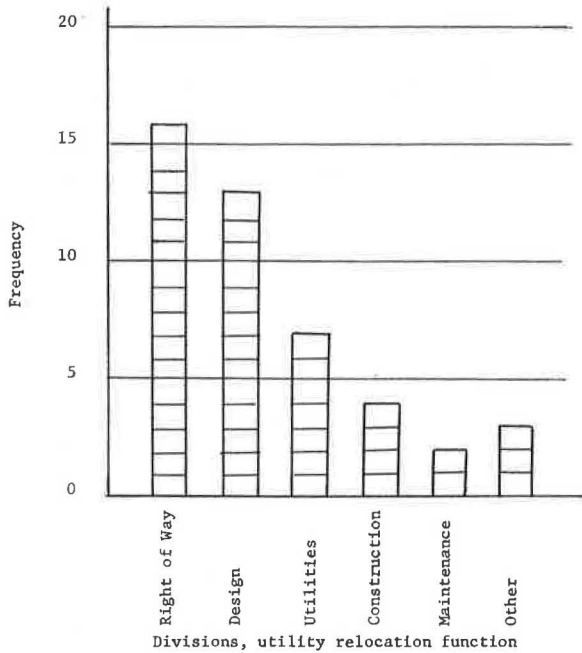


Figure 4. Distribution of divisions in charge of permits for new utility installations.

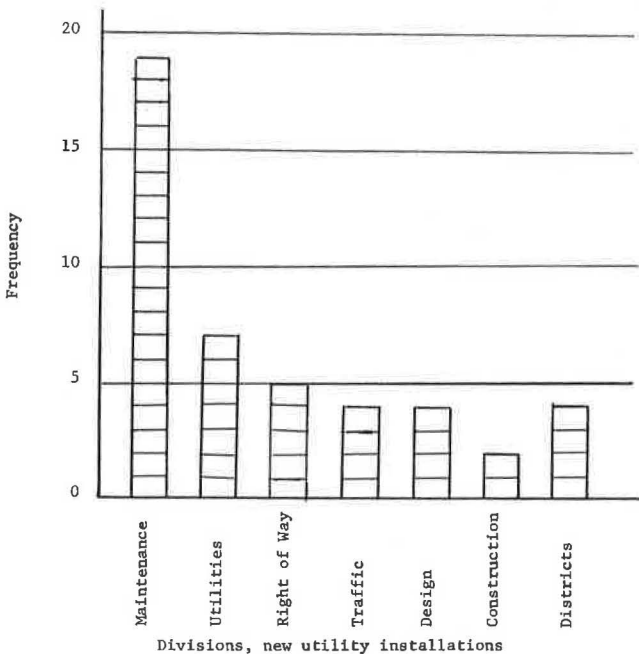


Figure 5. Number of agencies requesting federal aid for various types of utilities.

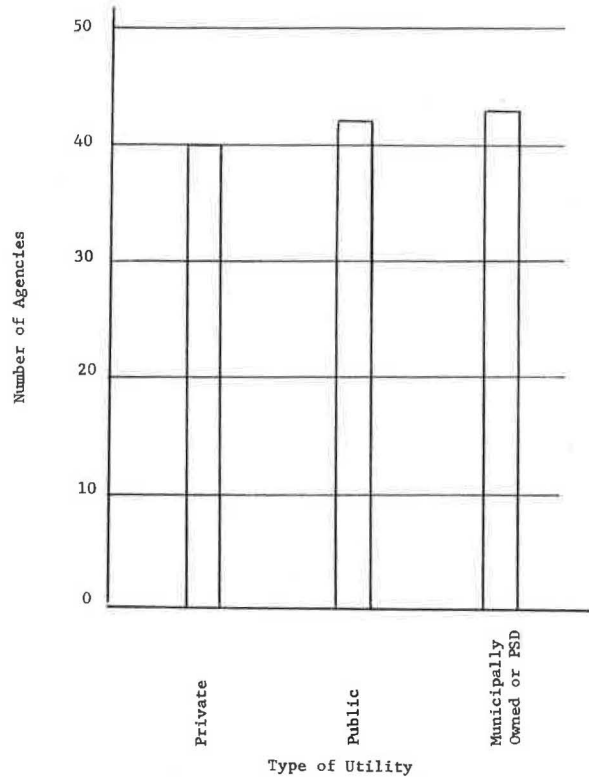


Figure 6. Distribution of recommendations for divisions to best handle utility-relocation function.

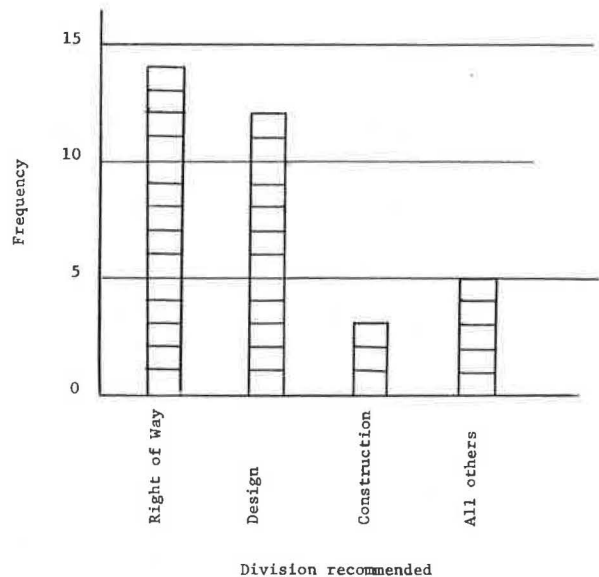
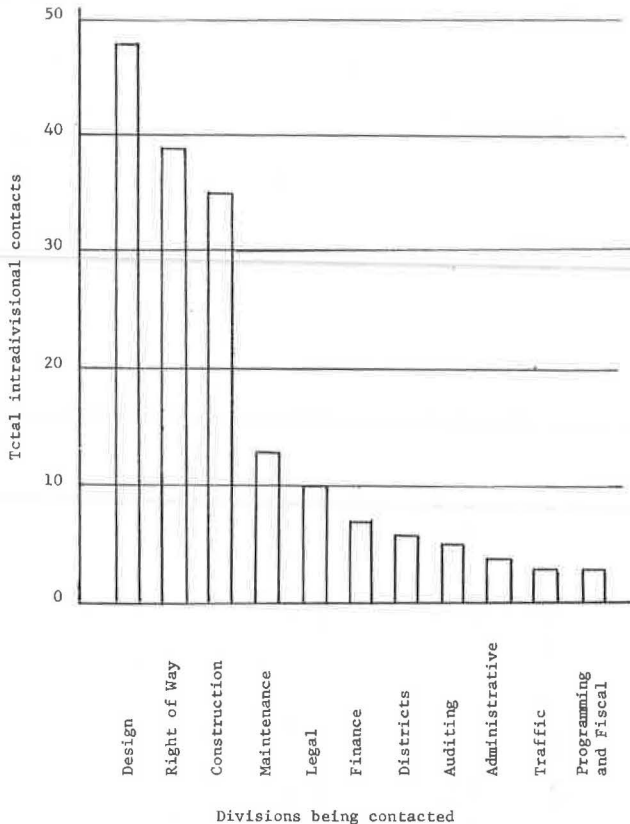


Figure 7. Distribution of intradivisional contacts concerning utility-relocation function.



3. Certain items of relocation are normally considered a part of acquisition, and the cost of appraisals could be similarly considered.

4. The right-of-way division is the most efficient in associating and negotiating with utilities because many utilities are represented in the American Right-of-Way Association.

5. Relocating utilities is a part of clearing the right-of-way.

Design and plans-development divisions had 12 recommendations. Some reasons given were that

1. Closer contact with the development division can affect changes and reduce costs by minimizing utility relocations,

2. Better liaison between plans and utility cost estimates could be maintained,

3. A closer working relation with plan development would be realized, and

4. Correlation of development priorities and anticipation of the work load would be facilitated.

Construction divisions had three recommendations: The main reason given was that a closer, more direct line of communications could be developed at the district level.

Divisions that received single recommendations were engineering services, road operations, traffic, information and liaison, and facilities development.

#### Intradivisional Contacts

The grouping of involved divisions shown in Figure 7 was derived by combining the division in which the utility-

relocation function is now located with the list of its most frequently contacted divisions. The closest contacts were those with the design, the right-of-way, and the construction divisions, and second closest contacts were those with the maintenance, legal, and auditing or finance divisions. There was much less involvement with district offices and traffic-operations divisions.

#### Location of Function

In four states there is a legal basis for locating the utility-relocation function in a specific division, and in three states there is a partial legal basis for doing so. In all other cases the primary reason for the location of the function is organizational in nature. In one state, Texas, utility relocations are defined by law to be a right-of-way cost and expense, which requires the utility section to be in the right-of-way division.

During the last 5 years, 13 agencies have changed the location of the utility-relocation function. These moves are summarized below.

Division Moved From	Division Moved To	No. of States
Right-of-way	Design	5
Right-of-way	Construction	1
Right-of-way	Utilities	1
Design	Right-of-way	2
Construction	Right-of-way	1
Construction	Design	1
General services	Design (and back again)	1
Utilities	Maintenance	1

The frequency of changes suggests that trial and error attempts are being made to locate the optimum position for this function.

#### SUMMARY AND CONCLUSIONS

Because of geographical, political, and organizational variations, it is impossible to recommend a specific location for the utility-relocation function that is appropriate for every agency. However, a number of factors can be considered.

1. The early involvement of utilities in the project planning process is desirable to determine the optimum final solution and best overall plan.

2. A reduction in the number of offices with which utilities must coordinate is desirable.

3. A reduction of the number of interdepartmental review contacts would reduce processing time, which would reduce delay and costs and increase lead time for utility relocations.

4. A single source of informational memorandums and regulations will limit conflicting requirements, which will put installation processes and procedures on a more uniform basis.

5. One well-organized utility group can achieve better working conditions, such as flow of communications, coordination, effort, and working relationship, than can a fragmented group working independently.

6. A well-organized utility group can review and process relocations on a more consistent basis, which provides better public relations.

7. More efficient processing review of utility proposals can reduce internal cost by minimizing duplication of effort.

8. More efficient processing of utility proposals will enable faster highway construction work, which will cause fewer traffic conflicts, delays, accidents, and detours.

9. Better coordination of workschedules will result in

fewer pavement cuts on both new and old projects.

The purpose of the questionnaire was to gather data about and identify common traits of the utility-relocation function in various agencies in order to identify the optimum location for this function. All but one state, Hawaii, had a specific unit established for the purpose of utility coordination, and in 19 agencies, one office handled the function for relocations required by both highway projects and new installations.

In most agencies, the right-of-way or the design division is considered the most appropriate location for the function if there is no separate utilities division. Utility relocation and accommodation are closely related to design details and joint uses of the highway right-of-way.

All of the states now have a statewide utility-accommodation policy, and 35 states have prepared a relocation procedure manual. Approximately 50 percent of them have some form of master agreement, and 25 percent use or plan to use the FHWA-approved alternate procedure to provide more lead time and reduce processing time.

The recommendations to make the utility-relocation function a division were outnumbered by the recom-

mendations to not do so. However, the reasons for separating the utility function into a separate division were numerous and convincing. A separate utilities division could incorporate many of the desirable factors listed above.

This study is primarily a state-of-the-art finding and can be used as a basis for other studies, such as that of combining railroad relocations and utility relocations into one section.

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## Standard Color Markings for Underground Facilities

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The one-number-to-call system is the latest and most effective tool in the continuing campaign to prevent damage to underground facilities by excavating equipment. Another project that should help to reduce such damage is the use of standard colors for the stakes that are used to mark the locations of underground facilities. In such a system, each type of utility is assigned a color for marking its facilities. (Unless the colors are standardized, utilities that serve more than one state, county, or area would need to stock all colors of markers, which could lead to errors in staking.) Contractors and highway maintenance workers would recognize the uniform colors and be able to identify the type of facility.

More and more utility facilities are being placed below ground every day, and considerable attention has been directed to the danger of damage to them during subsequent excavations. This damage can be caused by earth-moving or excavating equipment and other construction or digging activities, and identifying the responsibility for its prevention is complex. Contractors maintain that if engineers would accurately locate the utility lines on their construction plans, damage could be avoided.

But, before looking for a solution, consider the source of the problem: About 20 utilities, such as water, sanitary sewers, gas, electric power, telephone, telegraph, cable television, street lighting, traffic-signal cables, police-signal cables, fire-signal cables, steam lines, and drainage systems, can be found beneath the streets and highways. Each year, various corporations spend large sums of money to locate and mark their below-ground facilities to help

prevent accidental damage. They have had some success, but more information is needed. Where does most of the damage occur? The problem appears to be most serious in areas that are growing rapidly and are highly populated. Naturally, construction activity increases in growing areas and, if they are densely populated, they will have a higher concentration of utilities.

There have been many attempts to identify the general group that is responsible for most of the dig-ins. One study found that private contractors constructing streets and highways, residences, industrial and commercial buildings, and sewer and drainage systems were responsible for 75 to 80 percent of the damage to buried gas systems. Another study blamed 78 percent on other utilities (including their contractors) or landscaping and fencing contractors (1). A recent survey showed that 25 percent of those interviewed considered the underground-damage situation very serious or critical. This is a reflection of the high cost of repairing damages and also of its severe impact on public opinion. The public normally is not aware of the reason why service is interrupted, and most utilities do not consider it a good policy to identify the specific individual or company who caused the situation. However, this policy is beginning to change, especially with regard to chronic offenders who are careless with underground facilities.

The one-number-to-call concept is being implemented in a number of locations. This is a system in which an excavator planning to dig in a given area can, with one telephone call, advise all participating utilities of his