

# Systematic Cleaning and Maintenance of Streets

ROBERT D. BUGHER  
Executive Director  
American Public Works Association  
Chicago, Illinois

## INTRODUCTION

Few, if any, officials responsible for street maintenance or cleaning start from scratch. Instead they inherit a given problem—types of streets, quality of construction, drainage patterns, and many other factors which affect programming. Many of these factors are controllable and steps should be taken to remedy causes as well as repair existing deficiencies. For instance, ordinances may be passed restricting heavy truck traffic to certain streets designed to take heavy loads. Runoff from unpaved driveways is a source of a considerable amount of street dirt; passage of an ordinance requiring paved driveways could reduce future cleaning costs considerably. In other words, with limited funds available, more and more agencies competing for these funds, and with continuing growth of urban areas, we *must* consider all means of minimizing the magnitude of the job.

Although this paper is about cleaning and maintenance, we cannot eliminate consideration of new construction. How we build and what we build will directly affect the required maintenance and cleaning. This implies a feed-back of knowledge gained through experience for incorporation in future designs and specifications. As an example, spacing and design of catch basins affect the street cleaning programming as does the placing of curbs and sidewalks. Standard plans and specifications should reflect these effects. As experience with a cleaning program is gained, standards should be changed accordingly.

The public works official must also decide what quality of construction is justified in the light of maintenance costs. Sometimes the desired results may be most economically achieved through lower levels of initial construction and higher levels of maintenance; however, the reverse is generally true.

A particularly important area of control is the regulation of subdivision construction. Lack of strong control measures in placement

of utilities and pavements in such areas will almost assure excessive maintenance and cleaning costs in the future.

In their job of maintaining and protecting street systems, public works engineers and administrators are also faced with the problem of minimizing pedestrian and vehicular traffic interference caused by sub-street utility operations. It is obviously in the public interest for all utilities, publicly and privately owned, to participate in city planning discussions and to coordinate their activities as much as possible. Such coordination not only saves money and inconvenience to motorists but to the utility user as well.

Several methods are used to regulate and control utility uses of streets. Such control usually resides with the municipality either under applied home rule provisions of state constitutions or by actual state statute. If such control is not maintained, the results would be chaotic as well as expensive. There are many varied ordinances and regulations controlling excavations in paved areas. Desirability of uniformity of provisions within a given area needs no elaboration. Local chapters of the American Public Works Association have served as vehicles for developing such standard or uniform ordinances. The model street-excavation ordinance developed by the APWA Southern California Chapter is a good example.

Another area that should be reviewed by the alert public works official is the relative costs between contract maintenance and cleaning and the use of municipal forces. I will not attempt here to elaborate on the philosophy of private enterprise versus force account work, but I would like to mention that sometimes slight rearrangements in procedures can result in economies. As an example, Saginaw, Michigan, has all of its street openings temporarily sealed at the completion of the work. When there is a sufficient quantity of temporarily closed excavations, specifications are written and a contract let for the permanent closing of all the excavations. I recognize that there may be drawbacks to this kind of operation; however, it illustrates how one community has organized its maintenance work to permit competitive pricing of the operation.

Legal considerations are today taking on significance as never before in history. Not only is adequate street maintenance a desirable service to the populace but the liability from accidents derived from improper maintenance is becoming greater and greater. Accident and liability avoidance must be foremost in our thinking, from the planning stage through construction, down to and including the routine maintenance and repair stages of any given project. Increased interest in this phase

of the subject is due, in part, to the steady erosion of the doctrine of governmental immunity from tort liability by both the courts and legislatures. Today in 23 states, almost one-half the country, the rule of governmental immunity has been seriously attacked, if not abrogated outright. In a very real sense, the extra dollars spent in improving maintenance and repair operations is insurance against the increasing awards being made in our courts today.

One of the significant factors in mid-20th century life is the increasing automation and mechanization of virtually every area of productive effort. Public works is no exception. This again adds a new dimension to the development of economic, efficient, and systematic street maintenance and cleaning programs. First, if we are to get the most out of our equipment, care must be exercised in this selection of this equipment and the evaluation of its performance. Purchase specifications must be carefully drawn to assure that the necessary ruggedness and durability are built-in. A deadlined snow plow or salt spreader is not combatting snow. In addition, the public works official is faced with the increasingly difficult job of adequate training for equipment operators. Frequently municipalities do not have the capacity within their own organizations to provide adequate training and development necessary to operate efficiently. Such communities can and do rely on associations such as the APWA, which is capable of bringing together the best brains in the country to answer recurring community problems. As an example, the American Public Works Association has been able to develop a training film, with the cooperation of the several manufacturers, on street sweeping. This training film, which specifically covers the proper adjustment of the brooms, has already been found useful to many communities.

The purchase of good equipment and thorough training of operating personnel are not enough, however, to achieve the optimum economy of operation. Equipment must be maintained. Centralized maintenance of equipment and preventive maintenance programs are all a part of the public works official's life. Other factors should also be considered. Clean, well-painted equipment instills pride in the municipal employees operating the equipment. It also improves the public's confidence and pride in the workings of its government.

Paramount to efficient programming is the coordination among all agencies, both public and private, using the street right-of-way either above ground or below ground. This is one area in particular where systematic programming pays big dividends. If we know well in advance what we are going to do to a given street and when, then all other agencies concerned with facilities in that sector can bring their plans

together in a coordinated effort, reducing, for instance, the number of street openings required and the consequent public inconvenience.

Coordination need not be restricted to agencies within a given governmental unit. It may extend between state highway jurisdiction and municipalities. It is possible, for instance, that a state may retain full responsibility for a state highway in an urban area because it can more economically perform maintenance or cleaning than the city. On the other hand, it may well be that the state should contract with the municipality to perform such work because the municipality may have the required specialized equipment which the state does not possess. There is no fixed answer. However, study of these relationships will almost assuredly result in economies.

Sometimes coordination of programs within the public works agency itself is slighted. It would make little sense, for instance, to resurface a section of street adjacent to an area that will soon be the site of heavy construction. Large dump trucks would play havoc with the recently renovated roadway. Drainage programs should certainly be coordinated with street widening programs to eliminate the amount of time the street areas are disrupted. And, of course, any time a street is opened up, a number of agencies and utilities become involved. The relationship between public works departments and private utilities such as the telephone company, as an example, are close. The planning and the construction of facilities must necessarily be carefully integrated. The American Telephone and Telegraph Company is well aware of this and encourages its people to participate in associations such as APWA.

To properly perform all these broadly related functions will require the accumulation of a vast amount of data. Inevitably, record keeping stands at the heart of effective programming. It means therefore that we must streamline our public works organizations, utilize modern cost accounting and record systems to produce the kinds of information needed to make intelligent decisions, adopt progressive personnel policies, establish sound purchasing and equipment management policies, and adopt adequate laws and regulations to facilitate management of public works activities in the most efficient manner possible.

Speaking before the APWA Congress in New Orleans, S. L. Lundwall, an engineer for the Univac Division of Sperry-Rand, stated that, "Unless public works organizations master the application of computers, they will not be able to remain afloat in the flood of new duties and responsibilities that await them in the future. There are numerous explanations for the circumstance—the population explosion,

the collapse of time, and quite specifically federal grant-in-aid programs.”

He went on to state that, “Even though it were possible to accomplish the sheer volume of future public works business by other means, budgetary considerations would compel the adoption of automated means once policy makers, legislators and the public became aware of the economies in program costs.”

After these broadly related aspects of street maintenance and cleaning are given full consideration and full weight, we can then realize the advantages of systematic maintenance and cleaning programs. The advantages are many. The more obvious include (1) a more adequate basis for programming, (2) more complete and accurate data for budget preparation, (3) a better basis for the assignment of personnel, (4) better service to the public—therefore fewer complaints, (5) improved appearance of the city’s facilities, (6) a better return from capital expended.

## MAINTENANCE

Keeping city streets safe, operable, and clean is more than economic prudence, it is an essential element of community survival. Yet it is too often given secondary status to capital improvement in the budgeting and planning process. Too frequently, maintenance funds are used principally to quiet “squeaky wheels.” Too frequently, it is the maintenance budget that first feels the axe under economy drives and the street cleaning equipment is “made-to-do” another year.

The problem of maintenance is a growing one. While efforts are being made to limit truck loadings, in many cases they are still heavier than designs that were anticipated 30 or 40 years ago. As contributing factors increase, so will the rate of deterioration of existing facilities. In addition, each year, thousands of miles of new roads are being added to the system. Clearly, we can no longer afford the luxury of stop-gap planning and jerry-built organization in our maintenance and cleaning operations.

### *Analysis of the Problem*

Development of a long-range plan for thoroughfare improvement requires the collection and analysis of a large body of basic information. Some communities have such data; many have not. While the data required for a planned maintenance program is not identical with that required for a systematic cleaning program, they both involve an inventory of existing facilities. Obviously, the public works engineer or other public official responsible for a program must know what

the problem is before he can come up with an effective plan for its solution.

In maintenance work, one of the first things to be considered is the classification of the street—expressway, freeway, major arterial, collector, or local. Coupled with this, travel desire lines, both present and future, should be studied. Existing traffic on a road, including whether the route is used by public transit systems, is pertinent to proper maintenance programming. Technical information such as types and causes of pavement failures should also be recorded, as well as the type of pavement (rigid or flexible wearing course) and type of base. The inventory of existing street facilities must be done systematically and in such a way as to provide for keeping it up-to-date on a continuing basis. Rates of deterioration vary. Traffic patterns vary and land use may also change. All these factors will affect priorities of maintenance work. For effective planning, data must be current. The manual of the National Committee on Urban Transportation outlines procedures for making such an inventory.

Riding quality is another factor in evaluating the suitability of streets for various uses and in setting priorities for resurfacing or other maintenance. This may not be a reliable index of structural condition, however. A perfectly sound pavement may be excessively slippery. A "Pavement Skid-Test Trailer" has been developed in the United States to determine the coefficient of friction of pavement surfaces. The British are developing a portable tester operating on the pendulum principle.

Pavement roughness is another quality which may be quantitatively measured. The Bureau of Public Roads has developed a "Road Roughness Indicator" which measures vertical movements of the axle of a towed wheel. Vehicle speed is standardized at 20 mph and vertical movement is totaled by an electric counter. It should be noted, however, that qualitative evaluations require the establishment of standards—slipperiness would be based on standards of safety, roughness on desired ease and comfort and what the public is willing to pay for.

Once the basic street system information has been assembled, it is possible to firm up construction and maintenance programs. Decisions are based on comparisons of existing conditions with desirable or tolerable standards for each type or class of street system.

In order to insure that funds be expended in a proper manner and where they are most needed, a number of jurisdictions have adopted sufficiency rating systems of varying degrees of refinement. Such systems minimize personal judgment evaluations and, when adequately publicized, tend to forestall pressure from special interest groups.

In summary then, the steps in developing a maintenance program are:

- a. completely inventory existing conditions
- b. establish standards for several systems
- c. determine deficiencies on the basis of these standards, taking into account future development.

Analysis on this basis will permit the development of a program balancing construction and maintenance which will place the emphasis where needs are greatest. Financial limitations require such an approach.

As a corollary thought you will notice that I have repeatedly coupled construction with maintenance in programming. The two are inseparable. The quality of construction directly affects the required amount of maintenance. The funds for each come out of the same pot. The public thinks of a street as either satisfactory or unsatisfactory, not whether it merely needs patching or the structure of the pavement is so far gone that complete replacement is more economical.

Once the problem has been analyzed, a general program can be developed. An "ideal" program should be developed first, then tailored to the financial capability of the community. Long-range program projection should be made. This is generally longer for large communities than for smaller ones. Maintenance costs should be weighed against capital requirements and future development plans. Stop-gap maintenance measures should be avoided where possible but may, in some cases, be necessary. Generally, though, maintenance should be on a scheduled or preventive basis.

Once a capital program has been adopted in general long-range terms, priorities must be established and detailed maintenance projects set up. This necessitates breaking down the long-range program into smaller components of 2, 3, or 5 years.

The National Committee on Urban Transportation recommends a five-step evaluation for establishing priorities.

1. Estimated time and cost requirements
2. Administrative considerations (availability of key personnel, etc.)
3. Service considerations which include:
  - 1) structural conditions, 2) travel time or capacity, 3) cost index in dollars per vehicle-mile, 4) community benefits, and 5) safety
4. Project priority grouping (economics)
5. Programming considerations such as coordination of public improvements (water and utility extensions), continuity of

service, geographic distribution, engineering considerations and alternatives.

Well-planned systematic programs have many advantages in public works operations.

1. Available manpower and equipment will be used more efficiently, thereby providing more work per maintenance dollar.
2. Ordering of materials can be scheduled in advance so that deliveries of important items will be on time.
3. Public relations will be improved and complaints reduced because ample time will be available for advance notice through the mass communication media.
4. Systematic scheduling enables good coordination among city departments and utilities whose services may be affected.
5. Proper programming insures the preparation of more accurate and realistic budgets.
6. Job organization is facilitated, assuring proper routing of traffic on detours and a more orderly project appearance.
7. Systematic programming permits a uniform standard of maintenance throughout the jurisdiction so that all areas may be treated alike.
8. Scheduled maintenance planned in advance serves as a guide to other agencies concerned with streets, thereby facilitating the coordination of operations.
9. Equipment needs can be determined more accurately.

Systematic planning and programming of street maintenance requires good, timely fiscal information and control. Conversely, good maintenance planning and programming help the public works official obtain his budgetary requests.

## CLEANING

Up to this point, I have referred almost entirely to maintenance, while the title of the paper includes both maintenance and cleaning. I have separated the two, not because the approach to the two problems is different, but because the operations are somewhat different and the problems themselves are not identical. For instance, a pavement that has failed is obvious and must be replaced. But how clean is clean? We have, thus far, no suitable way of measuring degrees of public cleanliness. The municipal official, on the basis of his own judgment, must decide frequency and methods of cleaning, then judge public approval or disapproval on the basis of legitimate complaints.

In maintenance, the problems largely arise from the physical behavior of the materials involved. In cleaning, most of the problem derives from human behavior. True, some street dirt comes from the abrasion of tires and paving materials, run-off from vacant lots, leaves in the fall, etc. However, a substantial amount comes from newspapers, cigarette wrappers, candy wrappers, and the like. In congested slum areas and marketing areas, garbage and rubbish also are found in the streets.

There are a number of factors which affect the planning of a street cleaning program and the choice of methods. Some of these parallel those pertinent to maintenance. Badly defective pavements are difficult and expensive to clean. Traffic volume has as direct a bearing on cleaning as it does on maintenance operations. Other factors must likewise be considered, such as character of the population, one-way streets, and climate.

The important point to remember is that, whether you are dealing with maintenance or cleaning, an organized systematic approach will result in higher levels of performance for given expenditures. This approach involves the gathering of data, analysis, and evaluation of method.

It is in the collection of data that many communities fall short. Yet it is here that any orderly approach must begin. Without sufficient facts, proper balancing of method and scheduling must fall short.

If fact-gathering is the first step, then what facts are pertinent? What information should be recorded in the data-collecting process?

Probably foremost among these factors is climate or weather. Heavy rains carry quantities of sand and dirt into the streets. Catch basins may be over loaded. High winds litter the street with broken branches and debris. Snow brings its attendant problems of cleaning. Length of winter season affects choice of method. Because of our general dependence on automotive transportation in urban areas, the problem of snow and ice removal has assumed major proportions. The APWA Research Foundation is at present conducting a \$100,000 research project into the many facets of the problem, including techniques, storm prediction, cost-benefit ratios, ordinances, enforcement, and planning. In the United States alone, it is estimated that over \$100,000,000 is spent annually in combating the problems occasioned by snow and ice. Indeed, weather must be considered in all phases of street cleaning, from planning and appropriations to the execution of the work.

*Topography* has an important bearing on the selection of street cleaning methods to be used, and on the establishment of routes. The question of whether flushing should be undertaken before or after

the streets are swept is somewhat affected by street grades. If the city is hilly and sewers can be built on grades that make them self-cleaning, the necessity for catch basins is largely eliminated and street dirt may in some cases be disposed of through inlets into the sewer system.

*Character of districts* is another factor. Within a city, the amount of street cleaning needed will not be uniform in all districts. In a business district, a large amount of cleaning will be necessary because of the greater concentration of pedestrians, usually resulting in large quantities of litter. Manufacturing districts usually also require a large amount of street cleaning work. Areas where there are concentrations of trucking also create dirt from spillage and from tracking dirt from unpaved areas. Residential streets usually require the least amount of cleaning. Seasonal loads predominate—leaves in the fall, grass clippings in the spring and summer. Low income districts of large cities usually present special problems. Overcrowding produces relatively large quantities of waste and often the lack of orderly methods of handling rejected materials aggravates the problem.

*Character of population* must also be considered. In some low-income districts, the residents do not seem particularly concerned about the appearance of either their own premises or of the streets. Household wastes readily find their way to the streets in great quantity and streets in such areas require frequent cleaning. On the other hand, very little waste material is deposited on the streets of the better residential areas, and cooperation of householders is more readily obtained.

*Type and condition of pavement* will also have a significant effect on the efficiency and effectiveness of street cleaning operations. Defective or badly repaired street surfaces are almost impossible to clean satisfactorily by ordinary methods and the cost of adequate methods may well be prohibitive. Type of pavement is as important as pavement condition. Modern continuous-type pavements are relatively easy to clean, but there are still in use many miles of sand-filled block pavements, water-bound macadam, and other types not readily suited to the cheaper, more effective methods. In fact, they cannot be really cleaned by any method. Lack of crowns, gutters, and adequate drainage will hamper sanitary surface cleaning. A street cannot be kept clean if water stands in puddles on the surface or in gutters, or if there are cracks and pot-holes where dust and dirt can accumulate. Absence of paved gutters also impedes manual or machine sweeping.

*Traffic conditions and parking* will also add to the burdens of those public officials responsible for the cleanliness of our streets. It is true

that the passing of the horse-drawn vehicle has eliminated at least one of the problems, but the presence of large volumes of moving or standing vehicles is one of the critical factors in scheduling cleaning operations. In some business districts, cleaning can only be performed during the middle of the night. In others where almost continuous cleaning is required—wholesale market districts for instance—cleaning becomes most difficult, inefficient, and dangerous to the personnel.

Many of the larger municipalities have practically given up trying to control night parking. This is particularly true of those cities that failed to attack the problem when it first arose. The effect of continuous parking on street cleaning is extremely serious. Parking precludes the use of the more economical methods of sweeping. In fact, no method has been found to clean street surfaces under parked vehicles satisfactorily. The only workable solution has been the growing acceptance of ordinances prohibiting parking during certain hours and the provision of additional off-street parking facilities.

*Refuse collection* is another contributor to the problems of street cleaning. Careless or inadequate garbage and refuse handling can greatly hamper a community's efforts to keep its streets clean. Suitable ordinances should be adopted and enforced to prevent spillage, overturning of cans, and overloading of containers. The refuse that is spilled as the containers are emptied into the collection vehicles or is blown about because the vehicles are improperly covered represents inexcusable carelessness that costs the taxpayers large sums annually in the form of added cleaning expense. Reasonable care and the use of adequate equipment will result in cleaner streets and substantial savings in cleaning costs.

These factors represent the basic data upon which decisions concerning methods and programming are based. You are probably saying to yourselves, "Now, what about financing?" Isn't that basic to the whole problem? The answer is yes, with one qualification. It has generally been found that the best approach to the problem is to take all data and develop a maximum plan that is as efficient as possible, then cut back as available funds dictate. Many street sanitation officials have been surprised at how close to a maximum program they can come if their service is efficiently planned and operated. A corollary consideration is that a well-drawn program adequately documented with facts and figures stands a far better chance before city councils than one based in large part on intuition.

How should we handle this data once it has been collected? One good method is to record the pertinent information on a master set of street plans—grade, traffic direction, pavement conditions, and the

other factors mentioned. The next step is to analyze sections of the city or town one at a time. A common error is to take too large a section at one time. It is best to work with manageable areas individually and then put the pieces together into a coordinated plan.

Once the data has been assembled and recorded, the next step is to weigh the methods available against prevailing conditions. It would be well at this time to consider these methods. It should be borne in mind that usually no one method is best suited to all conditions prevailing in the city or town.

*Beat or Route Patrol* is one method familiar to almost everyone. It consists of a patrolman (white wing or other names are used in different parts of the country) equipped with cleaning implements and some sort of container or receptacle. He usually functions during the normal working day on a fixed route or beat to which he returns each day. According to a predetermined schedule he may cover his route from once a week to six times a day. Generally he will sweep the gutter and only spot clean out in the street itself.

This method is customarily used for supplemental cleaning, although in some communities it constitutes the major cleaning effort.

Gang sweeping is another method, somewhat similar to the "route patrol" except that groups of sweepers are sent out together and they usually are followed up by a truck which is part of the "gang." At one time the men used to line up across the street, but now "gang" activities are usually confined to curb work with spot cleaning out in the center of the street. Size of gang may vary from 4 to 25, but usually averages about 6-10. It has advantages over the route patrol method in that heavier accumulations of dirt can be handled more easily, supervision is easier and more effective, and it is better adapted to alley cleaning.

*Hose flushing*, as its name implies, involves attaching a hose to a nearby fire hydrant, using the pressure to loosen dirt and propel it to sewer inlets or catch basins. This method is not now generally used, although under some circumstances it may be the only effective means available. It is useful in market areas where large accumulations of dirt adhere to the pavement, and in streets where large numbers of vehicles are parked continually, precluding other methods of cleaning gutters.

Thus far the methods mentioned have been manual ones. In street cleaning, as in other areas of industry, however, operations are becoming increasingly mechanized. Today there is a wide array of specialized machines for cleaning streets.

*Machine sweeping.* The most commonly used piece of equipment for machine sweeping is the motor pickup. Basically it consists of revolving brooms, a conveying apparatus, a sprinkling system, and a storage hopper. Gasoline motors propel the machines, rotate the brushes, and operate the conveyor which carries the dirt from the brooms to the storage hoppers. One sweeper can usually pick up from 15 to 30 cubic yards of dirt per shift, covering from 13-30 curb miles. Operations will vary widely depending on dead-head time to and from the garage, volume of dirt, amount of water required, speed of the machine in operation, and interference from parked vehicles, traffic lights, and moving vehicles.

Sweepers are generally operated on two shifts both for economy and from a practical standpoint. The best time of operation in the business district is at night when traffic is lightest; in residential areas the best time is during the day. When properly managed, cleaning by pick-up sweepers is one of the most economical ways of cleaning streets. The method has a number of advantages, including minimum nuisance to pedestrians and vehicles. Street sweepers do increase the equipment maintenance load within the department and require skilled operators.

*Machine flushing* is the process of washing pavements and forcibly pushing the street dirt toward the curbs by directing streams of water under pressure across the pavement surface. This type of equipment consists primarily of a truck or trailer chassis, a tank, pumps, and spray nozzles. There are many operational variables in the use of flushers—some cities flush first and sweep gutters second, others do the reverse; some do not sweep at all. Speed of operation will vary widely, depending upon water capacity and use and other factors affecting vehicular equipment. One unit can clean up to about a 22-ft street in one pass. Wider streets require other arrangements. One unit cleans during an 8-hr shift an average of 22 miles of street, according to a survey reported in the APWA manual "Street Cleaning Practice."

Flushing, as with other methods, is best done during periods of light traffic. Parked vehicles do not interfere greatly with flushing, although a better job is done when fewer vehicles are standing at curbs. Flushers are particularly effective after a rain when pavements are wet and accumulated dirt is moist and soft and can be flushed more easily.

Dependence on flushing is largely governed by climate or the freezing weather season of the year. For obvious reasons, flushing is not practical when the temperature is below freezing. Flushing usually requires supplemental cleaning, particularly on flat grades, and usually tends to fill catch basins even when precautions are taken.

There are other specialized street cleaning machines available on the American market. Various types of vacuum cleaners are prominent among these. Some may be carried by an individual in covering a route, others are jeep-mounted for use where there is heavy pedestrian litter. Larger vacuum machines are also being sold. Machines working on the squeegee principle have been used by some street cleaning agencies, but their acceptance has been limited because they require pavements in excellent conditions (no pot holes) and a street completely free of cars. In a modern city such conditions rarely exist.

In all the methods I have covered, means for disposing of the collected litter, debris, and dirt must be taken into account in planning the systematized street cleaning operations. While today very little of the street debris is organic matter, it still should be collected as promptly as possible after being swept up for esthetic reasons.

In any systematized approach to street cleaning, we should not only try to pick up all that is on the street, but should also endeavor to reduce the amount reaching the streets. Reduction of the amount of litter directly reduces the cost of street cleaning. A significant proportion of the volume of material that must be picked up off the streets and carted to some disposal site is there because of public carelessness, ignorance, or apathy. You have probably seen anti-litter campaigns of one kind or another. Usually they involve the use of several advertising media, such as billboards, local newspapers, and local TV stations. They usually appeal to local pride. "This is your city, keep it clean" is a common slogan. Sometimes the campaign is backed up by ordinances which call for fining litterers. Such a program should always be accompanied by the plentiful provision of trash receptacles along the street. There is little question that a well-organized and well-conducted anti-litter campaign will pay for itself many times over in reduced cleaning costs and in a cleaner city.

In analyzing the method or methods to be used, it is important to keep an open mind during the entire study. This is perhaps an obvious statement. But too frequently each of us over the years develops his own little prejudices and fixed ideas about the problems we daily face. But time does not stand still, and ideas and programs soundly conceived in the past may not represent the optimum solution in the light of current conditions and public attitudes.

As stated earlier, in the planning phase no weight should be given initially to inadequate appropriations or lack of equipment. The study should begin with the assumption, lacking directives to the contrary, that the public officials and citizens want all the streets to be made as clean as practicable. The time to start cutting back from an ideal

service is after the program has been developed and estimates of operating costs have been made and it is determined that the required funds cannot be made available. Experience has shown that we can usually come much closer to an ideal service than was originally thought possible.

What are the main points to consider in selecting the proper method for cleaning each section of a street? Here are some main questions which should be answered:

1. How much dirt normally must be removed?
2. Must sidewalks and adjoining park strips be cleaned?
3. Is the street normally free from parked vehicles at any time of day or night? If so, at what hours?
4. Is the pavement in suitable condition for motor sweeping or motor flushing?
5. Can the element of noise be disregarded?
6. Do the streets have permanent curbs and gutters?
7. Is the sewer system capable of carrying off the street dirt?
8. Is the pavement grade sufficient to give adequate gutter velocity to flushing water?
9. Can the dirt be removed from catch basins as inexpensively as from the street surface?

After the foregoing questions have been answered, another consideration in planning street cleaning operations is to determine what time of day or night each street should be cleaned. If the operation is not a daily one, which day of the week should also be considered. In the survey mentioned earlier, it was generally reported that for business districts the preference was strongly for night and early morning cleaning. The same held true for arterial highways although not to the same extent. (This would not necessarily apply to smaller communities.) In market and residential areas the preference was strongly for daytime cleaning. The trend in the last 30 years, however, has been to early morning and daytime cleaning on all classes of streets and away from night cleaning.

Preferably, cleaning should be done when the streets are most free of vehicles. There is, however, some objection to night or early morning cleaning in residential districts because of noise; also at these times there are usually more parked cars. Poor visibility and less efficient supervision are other negative factors.

The final, and key, step in a systematic approach to street cleaning involves the determination of routes. It is a laborious and complicated

task. Numerous efforts have been made to simplify the process but essential factors have been overlooked and results have been unsatisfactory. Carefully and intelligently done, the task of laying out routes will pay rich dividends. It should be remembered that if an extra day is spent in preparing routes and it will save a half hour a day for a piece of equipment—the effort is decidedly worthwhile. The following are some pertinent considerations in preparing routes.

1. Select a logical starting point and stopping point. Both points should be as near as possible to the storage garage or headquarters.
2. Eliminate all possible “dead-heading.”
3. Allow time for travel to and from the garage at the beginning and ending of shifts.
4. Make routes as compact as possible.
5. When the cleaning operation includes two or more trips along a section, complete the cleaning of that section of street reasonably soon after it is started.
6. Follow the direction arrows indicated on the map wherever it is possible to do so.
7. Arrange to have streets cleaned at the time indicated unless it is absolutely impossible.

The amount of productive work that can reasonably be expected of each type of gang and each type of equipment should be known in advance so that the length of the routes can be fixed accordingly. If operating records do not show these figures, time studies should be made on each crew or gang to give a fairly close estimate of the work that can be done during each shift.

It is at this point that an estimate of annual cost should be made to see if the plan can be operated within the funds available, taking into account the length of the operating season for each cleaning method. Following this it is customary to prepare route sheets for each route showing the sequence of cleaning operations on each street and the order of the streets on the routes. Routes for the collection of street sweepings should also be developed in a similar manner. Finally, schedules for each route should be prepared. These schedules should show the order in which the various routes are cleaned or the specific days on which the cleaning of each is to be undertaken.

There is some difference of opinion among street cleaning officials as to whether the schedule should be based on the sequence in which routes are to be cleaned or the specific days on which the cleaning

of each is to be undertaken. Scheduling cleanings on regular days has the advantage that street cleaners, public officials, and citizens know the exact time when the street is to be cleaned. Supervision is easier. However, it is more difficult to prepare routes when they have to conform to weekly cycles and schedules are more vulnerable to interruption from storms.

On the other hand, when routes are scheduled in a definite order, regardless of the day of the week or month, there will be no break in the sequence of the work if a day's cleaning is lost. A disadvantage of the scheme, however, is that if residents cannot easily know when a street is to be cleaned, they can't be expected to cooperate—by not parking their cars on the streets on cleaning days, for example.

As with all plans, street cleaning plans should be checked and reviewed regularly. Changes in street use, street condition, or residential conditions may be gradual. However, over long periods they may have significant effects on the efficiency of a street cleaning program.

## SNOW REMOVAL AND ICE CONTROL

While snow removal and ice control are not actually a part of the street cleaning program, it is appropriate here to add a few words about them. Snow programs differ from street-cleaning operations in that they obviously cannot be handled on a routine, scheduled basis. By their very nature they are most frequently handled as emergency programs. This is not to say, however, that proper planning, organization, and control are not necessary to efficient, economic operation. Much of the data gathered for organizing a systematic street cleaning program are applicable to the adequate programming of snow removal operations. Street use, traffic density, parking, and traffic direction are all pertinent. Indeed some of the equipment used in street cleaning can be readily converted to use in removing snow from streets and highways.

Because of the great dependence on vehicular transportation in urban areas, the problem of snow control is taking on added significance. Snow removal is probably more highly valued by the average citizen because the inconveniences arising from lack of an adequate program are more readily apparent. Although the need for the removal of snow occurs continually, it is necessarily treated as an emergency activity, much the same as fire fighting. From an operating point of view, the work has to be done at any time of day or night when that need occurs. From an administrative point of view, special organization plans must be developed, personnel must be supplied, operations must

be capably planned and directed, and the functioning of the plans must be carefully watched throughout the emergency period.

There are a number of factors which make the programming of snow control operations difficult. Rate of snowfall, for instance, has a significant affect on operations. A light snowfall following a prolonged warm period may quickly disappear without any effort on the part of a public agency. On the other hand, a similar snow storm falling during a prolonged cold period will remain on pavements for a considerable length of time. Heavy snow storms during prolonged cold periods create problems of where to store the snow that is plowed from the middle of the streets. Such circumstances usually require extensive hauling. The amount of snow falling annually may vary widely. This latter fact makes budgeting for snow operations an extremely tenuous science. A light snowfall followed by a quick freeze creates a different problem than the handling of a heavy snowstorm.

Because of these variables, the best procedure for a city or town is to establish, through the local governing body, broad policies of desired service. Given sufficient latitude, the public works official can then tailor his program to specific needs of a given situation. Although the costs resulting from a snow storm have never been precisely measured, it is generally believed that they are considerable. Therefore, it would seem that expenses incurred in snow removal are well justified, if only to minimize the results of weather-induced traffic accidents.

Because snow control almost always is handled as an emergency operation, careful prior planning is essential. There is little if any opportunity during a storm to adjust operations and organization. Furthermore, if operations are not going right, minor difficulties can quickly get out of hand.

Virtually all snow control plans are phased. That is, at some given point after a snow storm alert, spreading of salt, abrasives, or both is begun. As the intensity of the storm increases, the snow plows move out. Most commonly the initiation of plowing is predicated upon depth of snowfall and usually begins at about two inches, provided more snow is anticipated. A final phase involves the hauling away of snow from critical areas such as intersections on main arteries.

Usually these operations are concentrated on a limited street mileage—main feeder routes from residential areas to the main business district and main arteries through the central area of the city. These routes are frequently designated as snow emergency routes, with signs placed along them either permanently or when a storm is imminent.

In developing a snow control plan, there are a number of factors which must be considered. Proper study of these factors will result in effective and efficient snow fighting operations.

How do we know a storm is coming our way? What sources are available to us and how accurate are their predictions? There are several sources of information available. Most communities use the services of the United States Weather Bureau. Larger communities have their own limited meteorological and climatological facilities. A number of communities use the services of private consultants. One of the most useful sources of information, and oddly enough not frequently used, is direct contact with neighboring cities and towns in the path of the storm. All of these sources provide good information with a reasonably high degree of accuracy. It should be remembered that money spent in refining the accuracy of storm prediction will usually be saved many times over in reducing either man-hours spent in alert when a storm does not materialize or in reducing the amount of time necessary to prepare for a storm.

The methods most commonly used in combating snow storms include melting of the snow either by chemicals or through applied heat. Streets are commonly cleared by plowing and, in business districts or heavily congested areas, by picking up the snow and hauling it to some disposal point. Abrasives such as sand and cinders are used to reduce pavement slipperyness.

The most common method for melting snow through chemicals is the use of salt. Some public agencies use a combination of salt and calcium chloride to increase the effectiveness of the melting at lower temperatures.

Thermal methods of eliminating snow and ice have attracted the attention of a number of public agencies and associations concerned with the products and materials used. Such devices as pipes buried in the slab which carry steam or hot water have been used successfully, as have electric cables. There is at least one installation that I know of, and probably a number of others, where the wire fabric reinforcing in the slab has been used as a conductor for heating the pavement. All these methods suffer from the disadvantage that should the slab crack or fail, repair is difficult and expensive. Another thermal technique is the use of infra-red energy. In this technique, light energy in the infra-red range is directed at pavements or sidewalks, warming them so that as the snow falls it is immediately melted. Limited experience indicates that the moisture on the slab evaporates and there is no serious problem of runoff. There is much to be learned about the infra-red system, although current thinking is that it must be used

before snow accumulates. Efficiency of light energy directed against light snow is relatively low and consequently costs per cubic yard of snow eliminated would be too high if the snow were allowed to accumulate. In general, thermal methods have been found feasible only where cost is a secondary consideration to the necessity of keeping a particular piece of pavement (either an intersection, or a ramp of an expressway) clear of snow and ice at all times. We hope in our APWA research project to establish more precisely the parameters involved in determining the feasibility of thermal snow control methods.

An integral part of effective, economic snow removal involves the development of suitable ordinances. Parking of vehicles along snow emergency routes or stalled vehicles along the routes can seriously hamper plowing operations, possibly doubling or tripling costs. Inadequate communication with the public, not informing them of what is expected of them during snow emergencies, can also be a costly oversight.

Planning a snow control operation is much like planning a military operation. All contingencies should be anticipated, and the role of each individual and piece of equipment should be clearly defined beforehand. A good snow control plan should include the following considerations:

1. Establish priorities so that the more critical arteries are cleaned first.
2. Establish fixed routes of operation for each individual and piece of equipment.
3. After routes and priorities have been established, the plan should be put in writing in the form of a manual so that operators and supervisors know exactly what they are to do and how their activities will be coordinated.
4. A regular training program for equipment operators should be established to train new personnel being brought into the operation and to periodically refresh employees that have been involved in the program in the past.
5. At the end of the season, equipment should be checked and necessary repairs made. Needed replacement parts should be ordered at this time.
6. Early in the fall, equipment and supplies should be rechecked to make sure that they are in operating condition when an emergency arises.
7. Clearing of snow and spreading of chemicals and abrasives is rough work and hard on equipment. Adequate provision should

be made in the plan for refueling of vehicles and rapid repair of damaged equipment. A snow plow that is out of gas is not clearing streets.

8. A final consideration of the plan should be control. Adequate supervision of operations of this type are absolutely essential. Two-way radios, at least in supervisors' cars, have been found to be a great help in keeping close contact between the operating forces and central headquarters. Such control is almost essential when it becomes necessary to redirect snow control efforts because of changing storm and traffic patterns.

## PERSONNEL AND TRAINING

No discussion of this sort would be complete without some reference to personnel. The execution of any plan or program is only as good as the skills and abilities of those performing the work. I will not discuss here one of the real problems of the public works field, recruitment of top-level people, engineering graduates, for instance, to careers in public works. What I will refer to is what might be called the public works official's principal training responsibility, which is the development of the employee after he has assumed his position in the organization. Many examples could be given to show why more attention should be devoted to the training and development of public works employees. The training of equipment operators, for example, results in increased efficiency and consequent saving of time. Greater quantities of work can be performed by a trained operator. He will need less supervision and, since he will cause less damage to equipment, it should be possible to realize substantial savings through reduced maintenance costs and longer equipment life.

Today we find that many new devices have been and are being developed to streamline public works operations. Attention must therefore be given to the need for retaining employees whose existing positions are materially changed by technological improvements.

We should all realize, of course, that training is not just a matter of choice—some form of instruction is continually being carried on. In order that this be done intelligently, it is necessary for each administrative and supervisory official to understand and accept his responsibility to see that his employees are properly trained for their jobs. This means that he should be continually analyzing the deficiencies and skill of his subordinates in terms of the immediate long range objectives of his unit and should be looking for ways to overcome these deficiencies through training.

This does not mean that he must be an expert in training methods. It does mean that he should define the objectives of the training program for his subordinates and call upon specialists in training methods to help make that program most effective.

How does one go about the task of determining what his training needs are? This requires a careful analysis of each employee's job. These questions should be raised about each position.

1. What does the employee do? What are his duties and responsibilities in detail?
2. Should he be doing what he is doing?
3. How does he do it? What are the steps in performing each of his assigned tasks?
4. What must he know and what skills must he have to do his job properly?
5. Does each employee doing his job possess this knowledge and skill?
6. Can this lack of knowledge and skill be supplied by training?

It is extremely important to get the active support and cooperation of those who are to be trained, the employees themselves. To this end it is important that the learner know why it should be done as well as how it should be done. The why is a motivating factor. A fact, a skill, or an attitude can be learned more easily when there is present in the learner a feeling that it will result in satisfaction to him. Showing the learner why he should learn usually increases his interest and efforts.

The American Public Works Association is acutely aware of this need. We have just recently developed instructional material for a training course in public works construction inspection. In time we hope to develop training courses covering other public works functions such as the cleaning and maintenance of streets and highways. Excellent textbooks on these subjects have already been prepared and published. One is titled—"Street Cleaning Practice," the other "Street and Urban Road Maintenance." Both are available from the APWA (1313 E. 60th Street, Chicago, Illinois, 60637).