DESIGN CRITERIA FOR SOLID WASTE MANAGEMENT IN RECREATIONAL AREAS

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FOREWORD

Solid waste systems in recreational areas, as elsewhere, are normally designed for maximum use. Because of the periods of low usage that occur in recreational areas, the overall system cost on a unit basis (dollars per ton or per can) is much higher than in areas with constant use. The proper design of a solid waste system in a recreational area is, therefore, even more critical than in an urban area where continuous use tends to reduce the unit cost.

Most of the information available to planners and designers of solid waste systems in recreational areas has been limited and dated (the basic data were gathered between 1955 and 1960).[1,2] Recently, however, the Office of Solid Waste Management Programs (OSWMP) began collecting new data suitable for design purposes in recreational areas.[3] This report is an attempt to bring together additional data from recent studies, demonstrations, and research projects and to relate them to the problems of solid waste management in recreational areas.

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Deputy Assistant Administrator
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C O N T E N T S

List of Figures

List of Tables

DESIGN CRITERIA FOR SOLID WASTE MANAGEMENT IN RECREATIONAL AREAS

The six basic elements of a solid waste management system, be it urban, rural or recreational, are administration, storage, collection, transport, processing, and disposal.

A combined or regional, solid waste management system will usually operate more efficiently and at less cost than a fractionalized, piecemeal operation. This applies to recreational solid waste management systems, particularly in the area of economical and satisfactory disposal. This will often require coordination with and cooperation of recreational area administrators, city and county officials, and various State and Federal agencies.

Storage in recreational areas is usually accomplished by the use of 32-gal, galvanized steel containers. There has been increased use of larger, bulk containers, and as labor costs continue to rise, these mechanically loaded receptacles will become more prevalent.

The predominant collection vehicle in recreational areas is the 1-ton pickup truck, which is often equipped with wooden stake sides and a hydraulic dumping mechanism. If collection personnel have no other duties, such as campground maintenance and cleaning, it is usually more economical to have only one collector on each truck. If they perform other functions, the general practice is to assign two men to a truck.

As regional disposal systems become more common in recreational areas, there will be a rise in the number of small transfer stations where solid wastes from widely dispersed areas are concentrated, then periodically removed to disposal sites. If private contractors in adjacent communities possess the necessary equipment to service these transfer stations, contracting with them can often prove to be an economical way to remove solid wastes from the area.

Because a sanitary landfill can accomodate widely varying amounts of waste at low operating costs, it is usually the most efficient disposal method for recreational areas.

In isolated areas and where suitable land is not available, small incinerators can provide adequate volume reduction and organic removal as long as they are capable of meeting prevailing air and water quality standards. Incinerators are somewhat limited, however, by capacity requirements and by the need to dispose of the residue satisfactorly.

Administration

Recreational areas, particularly the larger public ones, are often divided into several districts, each reporting to a central headquarters. The headquarters staff is responsible for overall planning, budgeting, and support services, but personnel are usually assigned to collect and dispose of solid waste at the district level. This arrangement normally works quite well for collection, but no one district is usually large enough to economically and adequately process and dispose of the solid waste it has collected. It is often advisable,

therefore, that districts join together and cooperate under the leadership of the area headquarters in operating the more costly systems and facilities necessary to properly treat and dispose of solid waste in this age of environmental awareness.

In the interest of effective solid waste management, it is often desirable, even necessary, to cross jurisdictional lines and establish jointly operated, regional solid waste systems with other recreational areas and nearby communities. A permanent population, such as a city, will allow continual use of processing and disposal facilities and result in a lower unit cost for disposal than is possible with only intermittent use, as would be provided by a strictly recreational area. If it is at all possible, therefore, the administrators of solid waste systems in recreational areas should attempt to coordinate their efforts with those of other agencies in the region so that all parties can more effectively meet the mounting problems caused by increasing amounts of solid waste.

The objectives of good solid waste management are to remove and dispose of all solid waste in a manner that maintains high standards of sanitation at the lowest cost. The first objective requires an awareness of the importance of proper waste handling by management, on both the district and headquarters levels, so that the necessary personnel, equipment, and facilities can be provided. The second objective requires continuous supervision over each element in the system and a constant flow of information between all levels of responsibility.

An awareness of proper solid waste management practices and a commitment to them can be achieved only through experience and training. Training is important at all levels: (1) general sanitation and waste handling practices for area administrators and supervisors; (2) process and system design for those responsible for design; (3) operation and maintenance of equipment for those charged with its operation.

The most effective method of attaining an information flow is the use of a well-designed accounting system that provides for frequent reporting of all costs and operating parameters associated with the various elements of the system (Appendix A). Several such systems have been developed by the OSWMP for use under various conditions, and all have several features in common:[4-7]

(1) They facilitate the orderly and efficient collection and transmission of all revelant data.

(2) Reports are clear, concise, and present only data required for effective control and analysis.

(3) Data are grouped in standard accounting classifications.

(4) They account for all relevant costs of operations.

(5) Accumulated data from them can, over a period of time, lead to standards of performance and efficiency.

(6) They include automatic provisions for accountability.

(7) Collected data aid in short- and long-range forecasting of operating and capital budgets.

The actual cost items collected will depend to some extent on the system under consideration; in general, however, they are classified

as operating expenses and capital costs (Figure 1). The costs assigned to each element of the system can be further divided and allotted to cost centers within the element. For example, processing costs might be assigned to cost centers such as receiving and storage, volume reduction, and effluent handling and treatment.

Amounts Collected

Before discussing collection and disposal, it is necessary to determine both the amounts and the characteristics of the solid waste collected in recreational areas. It must also be remembered that there is a distinction between wastes generated and collected. Some waste is not collected by recreational area personnel; it is taken out of the area by the visitor, left where collection is not provided (wilderness areas and lake bottoms), or burned in campfires. Subsequent discussions and designs will be concerned only with those wastes that are collected and end up in the handling and disposal systems.

In general, the amounts and characteristics of the solid waste collected depend on the habits of the individual visitor, the length of his stay, the activities he engages in, and the policies of the collecting agency. While it is difficult to catalog personal habits and their effect on waste production, it is possible to record both the length and activities of individual visits. Many recreational area managers do this continually, others frequently, and some infrequently or not at all. Where such data have been gathered, it is usually found that the length of visits depends on the activities of the visitors.

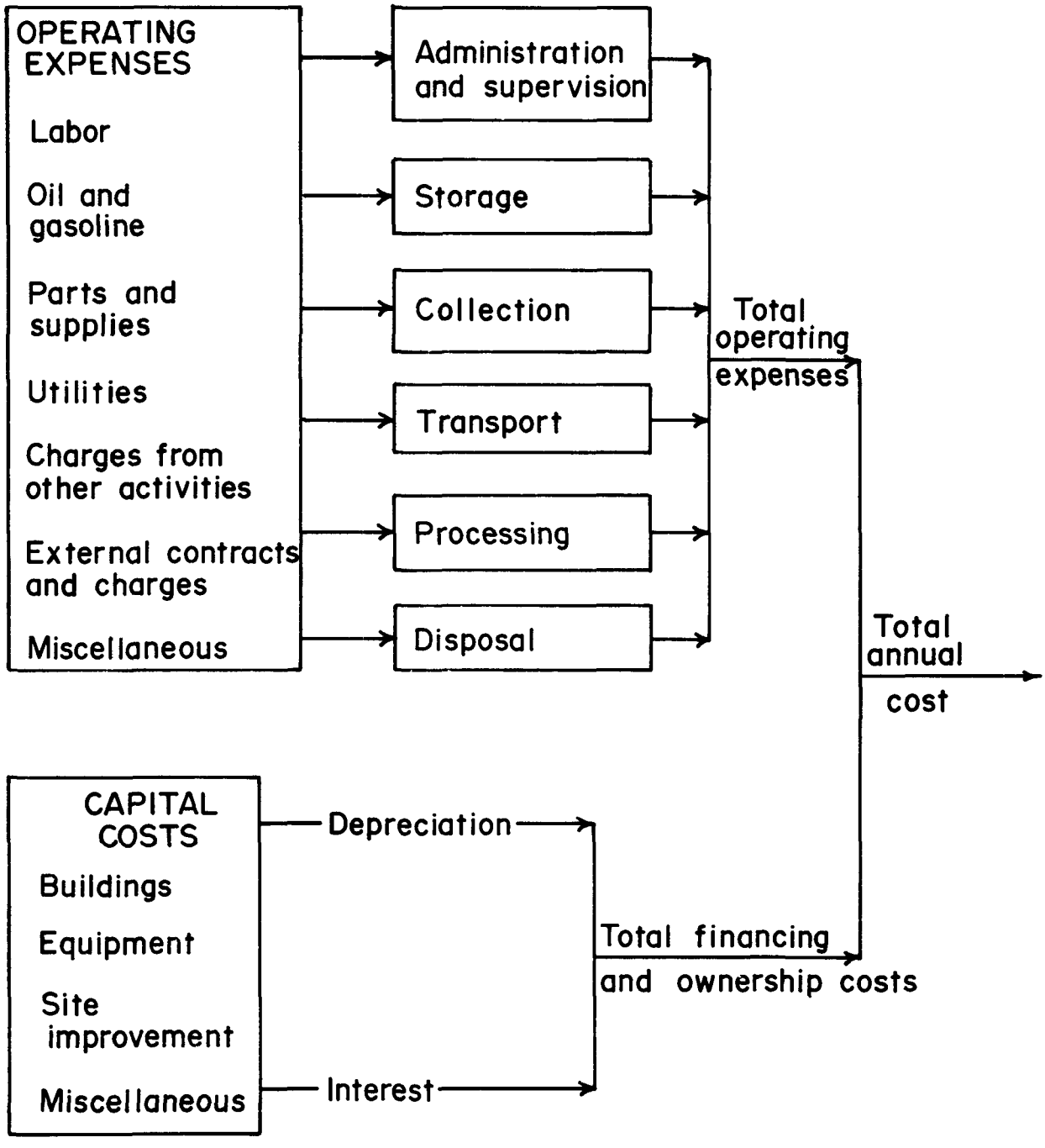


Figure 1. Cost allocation in a general solid waste cost accounting system.

TABLE 1

SOLID WASTE COLLECTION RATES FOR RECREATIONAL AREAS

Recreational site	Average amount of solid waste collected (90% confidence interval)[3]
Campground	1.26 ± 0.08 lb/camper/day
Family picnicground	0.93 ± 0.16 lb/picnicker
Group picnicground	1.16 ± 0.26 lb/picnicker
Organization camp	1.81 ± 0.39 lb/occupant/day
Resort area	
Rented cabin (w/kitchen)	1.46 ± p.31 lb/occupant/day
Lodge room (wo/kitchen)	0.59 ± 0.59 lb/occupant/day
Restaurant	0.71 ± 0.40 lb/meal served
Residence	2.13 ± 0.54 lb/occupant/day
Ski area	
Overnight lodge (all facilities)	1.87 ± 0.26 lb/visitor day*
Day lodge (all facilities)	2.92 ± 0.61 lb/visitor day*
Observation site	0.05 ± 0.03 lb/incoming axle
Visitor center	0.02 ± 0.008 lb/visitor
Swimming beach	0.04 ± 0.01 lb/swimmer
Concession stand	0.14 lb/patron†
Administrative residence	1.37 ± 0.035 lb/occupant/day

*Reporting unit often used in recreational areas; it is defined as the equivalent of one visitor doing one activity for 12 hr.

†No confidence interval possible because of limited data.

It is possible, therefore, to predict the amount of solid waste collected from visitors engaged in various recreational activities (Table 1). The characteristics of the collected solid waste also vary by the type of activity carried out (Table 2).

TABLE 2

CHARACTERISTICS OF SOLID WASTE COLLECTED FROM RECREATIONAL AREAS

Site	Average values (% by weight)[3]		
	Food waste	Other combustibles	Noncombustibles
Campground	37	30	33
Family picnicground	44	29	27
Group picnicground	29	31	40
Organization camp	59	18	23
Recreation residence	24	41	35
Ski area			
Overnight lodge	34	33	33
Day lodge	17	59	24

Storage

Solid waste storage containers must be durable, easy to clean, provided with tight-fitting lids to protect the waste from rodents, insects

and other disease-carrying vectors, and small enough to allow easy handling. Animals often cause problems by scavenging in storage containers and special provisions must, therefore, be made. In addition, there should be sufficient capacity to contain all the waste generated between collections, and the containers must be conspicuous enough to discourage littering.

Solid waste storage containers generally fall into two groups: individual-size and bulk containers. The first may be constructed of metal or plastic or can be paper or plastic sacks with a holder. They vary in capacity from 5 to 55 gal, but the use of 20 to 32 gal-types is recommended. Bulk containers are normally unloaded by mechanical hoists or lifting arms and have from 1 to 50 cu yd capacities. They can be further divided into those that are emptied into a collection vehicle and those that are taken to disposal areas to be emptied. The first group usually ranges in size from 1 to 10 cu yd, while the second group includes 3- to 15-cu yd sizes, as well as 30- to 50-cu yd containers.

As a rule, individual-size containers are used because collection trucks capable of handling bulk containers cannot be economically justified in isolated areas. Bulk containers have been successfully used, however, in some large recreational areas and near urban centers where such equipment is available. Bulk containers have also been used in some campgrounds, but it has not been determined how far people will carry their waste to place it in a container, so most administrators and planners prefer to place a single, small container at each campsite.

Until such data on bulk containers have been gathered, design will have to center around the use of individual-size containers, as is done in this report.

When individual-size containers are used, factors to consider are: (1) the need to provide a tight-fitting lid; (2) the use of a rack to hold the container; (3) the durability and appearance of the receptacle (Figures 2,3). The container must be secured in position so that it will not be knocked over or carried off by scavenging animals or by destructive visitors. There are almost as many designs for racks and stands as there are recreational areas, but if they are to work properly, they should hold the container upright and stationary, keep the cover with the container, and provide surroundings that are easily kept clean and free of litter (Figures 4-9).

Rigid plastic containers, although acceptable from a sanitation viewpoint, are normally not used because it is difficult to secure them to racks without damaging them. They are also easily cut and ripped by bears and vandals. Similarly, paper and plastic bags are not acceptable unless placed in a locked cabinet to keep them from being ripped and destroyed.

The container most widely used is a 32-gal, galvanized steel can having a tight-fitting lid. Plastic liners are often placed in the cans and removed with the deposited waste at the time of collection.

Plastic liners have been used in recreational areas for a relatively short time, but their employment is now almost universal. They have been accepted because: (1) they improve general sanitation by keeping

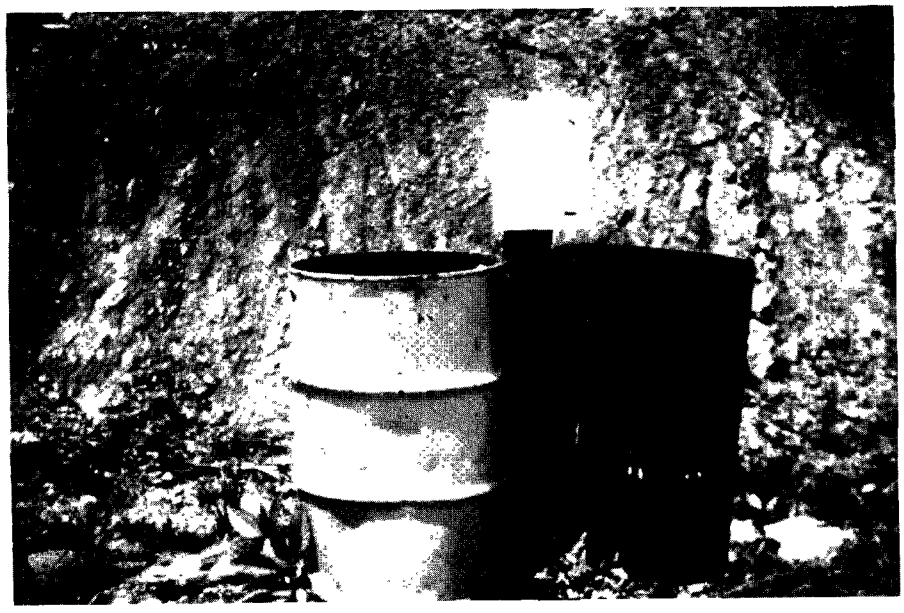


Figure 2. Use of 55-gal drums for storage (note lack of lids).

Figure 3. Minimum acceptable storage container.

Figure 4. Acceptable storage container.

Figure 5. Alternate container design.

Figure 6. Alternate container design.

Figure 7. Underground storage container.

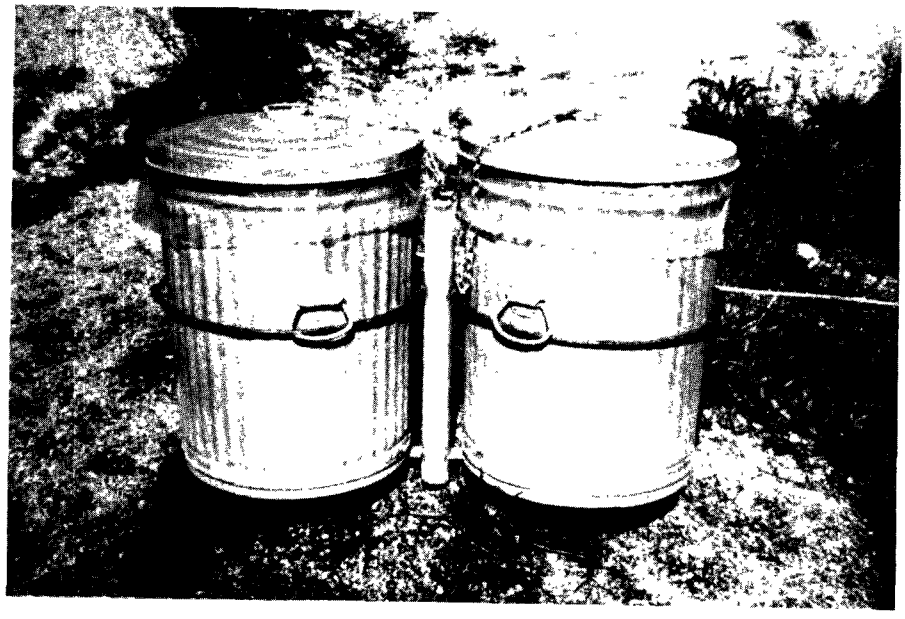


Figure 8. Rotating "bearproof" container rack.

Figure 9. Reinforced "bearproof" container.

the storage containers from accumulating encrusted waste; (2) they speed up collection by eliminating the need to lift each container to empty it into the truck. Liners come in several sizes, colors, and thicknesses. Color is not too important in recreational areas, and clear bags are commonly used. The size employed depends on the capacity of the containers, but other than that is not a critical factor. Thickness, however, is something that needs to be considered. Most manufacturers market bags having nominal thicknesses of from 1.25 to about 3.00 mil. It has been found that bags about 2.00 mil thick give reliable service; thinner bags often tear and spill waste.

Four items are needed for designing solid waste storage systems: (1) the number of containers (Table 3); (2) the amount of waste; (3) the cost of all system elements; (4) the expected life of all elements (Table 4). In determining the number of containers, a minimum collection frequency of once a week was used. In most cases, however, at least two collections should be provided each week, especially during warm weather to reduce the possibility of fly breeding in the containers. Twice-weekly collection requires but 0.72 containers per site in a campground, provided that all of those placed there are used. When capacity is less than maximum, fewer containers are needed. For example, in a campground with one container per site, collection more than once each week is needed only when the capacity exceeds 70 percent of maximum.

TABLE 3

ESTIMATED NUMBER OF 32-GALLON STORAGE CONTAINERS

NEEDED IN RECREATIONAL AREAS

Site	Number of containers*
Campground	1.43 per site
Family picnicground	1.10 per site
Group picnicground	1 per 20 people†
Organization camp	1 per 1.8 people
Resort area	
Rented cabin (w/kitchens)	1 per 2.5 people
Lodge room (wo/kitchens)	1 per 6.0 people
Restaurant	1 per 7.5 meals‡
Residence	2.75 per residence
Ski area	
Overnight lodge (all facilities)	1 per 1.8 people
Day lodge (all facilities)	1 per 1.2 people
Observation site	1 per 150 visitors
Visitor center	1 per 180 visitors
Swimming beach	1 per 7.3 swimmers
Concession stand	1 per 24 patrons
Administrative residence	1.65 per residence

*Based on a minimum of once-a-week collection and 170 lb per cu yd waste density in storage containers.

†Collect after each use.

‡Based on a density of 350 lb per cu yd.

TABLE 4

COST OF SOLID WASTE STORAGE USING 32-GALLON CONTAINERS*

Item	Amount
First cost of container	$ 7.00
Cost of rack or stand	15.00
Jost of installation	20.00
Total first cost per container	$42.00
Estimated life	10 yr
Annual cost per container	$ 4.20
Annual maintenance cost	0.50
Annual cost of plastic liners (125 used)	4.30
Total annual cost per container	$ 9.00

*Note: Cost estimates presented here and elsewhere in this report are based on information available to the author when he conducted this investigation during the period 1968-1970.

Certain sites will be used more frequently than others, and unless the visitors are willing to take their waste to an unused (or less frequently used) container, littering and overflowing containers will result.[3] Additional containers are, therefore, normally placed in the area, or collection is provided more frequently. The collection frequency required for a particular area should be determined on the basis of prevailing temperatures, visitation, and insect and animal problems. Once the collection frequency is chosen, the total storage requirements can be calculated.

Collection

The purpose of collection is to remove the waste from storage areas where it is close to human habitation and activity and to transport it to a disposal site. This is done in order to reduce the chance of contact between people and the waste and with the insects and animals attracted by the waste. Collection, therefore, should be frequent and thorough. Normally, the interval between collections should be no longer than 1 week, but it will often have to be much shorter because of high usage, waste loads, and climatic conditions.

The total storage capacity required in an area can be calculated based on the frequency of collection as previously described and compared with the expected quantity of solid waste for the week (based on visitation and use). One 32-gal container holds about 0.15 cu yd, or 25 lb, of typical solid waste.

Collection vehicles used are normally of three types: pickup trucks, stake-body trucks, and packer trucks (Figures 10-12). Some areas, however, use more unconventional equipment (Figures 13,14). Aside from their low first and operating costs, pickup and stake-body trucks can often be shared with other activities when waste collection is not required, ensuring full utilization of equipment and a low cost assigned to collection. Packer trucks are specialized pieces of equipment and cannot be assigned to other tasks. When compared to open trucks, they have a high annual cost, but they can carry from 5 to 10 times as much waste. They are very useful in high-use areas remote

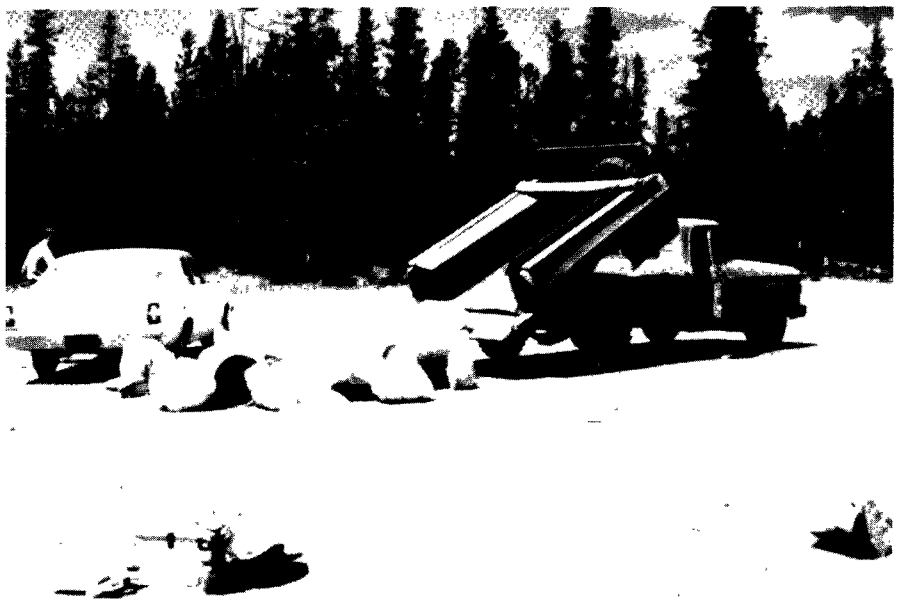


Figure 10. Pickup truck (with dumping body) used for collection.

Figure 11. 1½-ton truck with stake body.

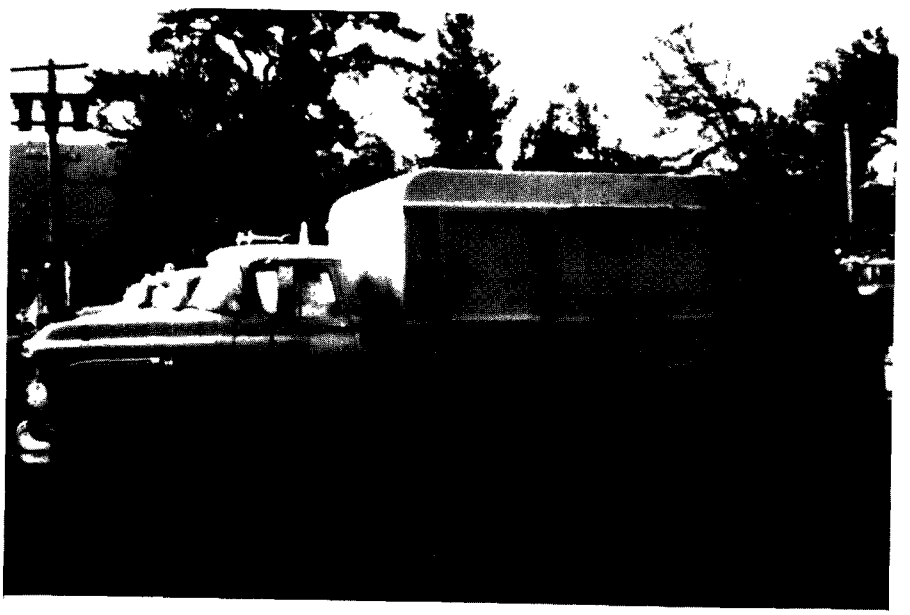


Figure 12. 13-cu-yd packer truck.

Figure 13. Use of small trailer for collection.

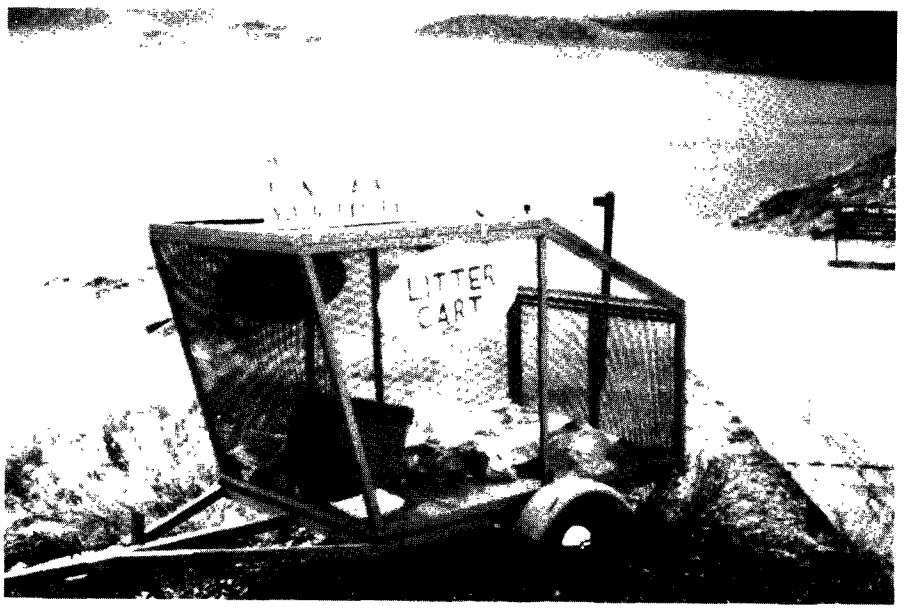


Figure 14. Temporary storage container that doubles as collection vehicle.

from disposal sites, and as many dumps in and near recreational areas are closed, packer trucks will come into more widespread use.

The primary considerations in selecting a collection vehicle are that it be: (1) capable of enclosing the waste; (2) easily loaded and unloaded; (3) of a size to negotiate all necessary roads and to provide economical operation. As long as the solid waste is contained in tied-off plastic bags, the truck itself need not be enclosed. In the following discussions, four trucks will be considered: (1) 1-ton pickup truck (with 4-ft sides added); (2) 1½-ton stake-body truck; (3) 13-cu yd packer; (4) 20-cu yd packer. In computing collection costs, the time needed for collection, labor costs, and vehicle costs must all be considered. Labor presently costs about $4 per man per hr (including fringe benefits), and vehicle costs vary from $0.80 to $2.50 per hr (Table 5). The time required for collection, however, varies significantly in different areas, depending on local characteristics.

Collection is assumed to consist of three operations: (1) travel to and from the area to be serviced; (2) travel to and from the disposal site; (3) collection within the area. The total time required to collect from an area can be expressed as:

$$T_C = t_{TT} + t_{TF} + t_{TD} + t_{DS} + t_{FD} + t_C$$

where:

T_C is the total time required for collection,

t_{TT} is the time required to travel to the area,

t_{TF} is the time required to return from the area,

t_{TD} is the time required to travel to the disposal site,

TABLE 5

AVERAGE COSTS AND DESIGN CHARACTERISTICS FOR SELECTED SOLID WASTE COLLECTION VEHICLES

Item	Collection vehicle			
	1-ton pickup	1-1/2-ton stake	13-cu yd packer	20-cu yd packer
Initial cost	$3,000	$4,000	$10,000	$15,000
Depreciation (assume 7-year or 14,000-hr life)	$35/mo $0.20/hr	$45/mo $0.30/hr	$120/mo $0.70/hr	$180/mo $1.10/hr
Operation cost	$0.60/hr	$0.70/hr	$1.10/hr	$1.40/hr
Total vehicle cost	$0.80/hr	$1.00/hr	$1.80/hr	$2.50/hr
Maximum capacity (cu yd)	10	15	13	20
Maximum payload (tons)	1	1.5	5	10
Normal payload (tons)*	0.85	1.28	3.25	5.00
Normal payload (containers)*	70	100	250	400

*Expected amount of solid waste per full load.

Note: Table is based on the most recent costs reported from many sources and is presented for discussion only.

t_{DS} is the time spent unloading at the disposal site,

t_{FD} is the time required to travel from the disposal site to the garage area,

t_C is the time required to collect in the area.

The travel times can easily be determined for most areas and can be replaced by the sum of the terms, or t_T. The distribution of the different travel times within t_T will depend on local conditions (e.g., travel to several areas before going to a disposal site, disposal site adjacent to a collection area).

The time spent unloading at the disposal site (t_{DS}) depends on the type of vehicle used, its size, and the number of men who unload it. This time can usually be determined by making a few observations or by questioning the collectors.

The time required to collect solid waste in an area (t_C) is a function of the amount of waste, its concentration, and the number of men collecting. Expressed mathematically for any given crew size, this is:

$$t_C = a_1 c + a_2 m_c + a_3 d_c$$

where:

c is the number of containers serviced,

m_c is the number of miles driven within the area,

d_c is the distance (in feet) walked by the collectors in the area,

a_1, a_2, a_3 are constants.

The number of containers should be easily determined, and the time to service one of them (remove the waste and install a new plastic

bag) should be between 0.50 and 1.00 min based on observations during field studies in recreational areas. The time to service one container is assumed to be 0.75 min, and a_1 is, therefore, equal to 0.0125 hr per container.

The number of miles traveled within an area (m_c) is also easily determined. If an average travel speed within the area to be collected is assumed to be 5 mph, then a_2 is 0.20 hr per mile.

A collector must walk a certain distance (d_c) within an area even when using a vehicle. The actual distance depends on the placement of the containers and the number of men in the collection crew. The average walking speed is about 240 ft per min; a_3 is, therefore, 0.0000714 hr per ft. The distance that must be walked averages about 10 ft per container when the containers are located on or at the road and the collector works directly from the truck. If the containers are located back from the road, the distance to and from each of them must be included. If a collector does not work with the truck and walks through the area, the distance he walks will be essentially the same as the road distance covered, plus any distance to containers located back from the road.

The total time needed to collect in any given recreational area is therefore:

$$t_C = 0.0125c + 0.20m_c + 0.0000714d_c$$

As mentioned previously, the number of men collecting will influence this time and should be evaluated. Let us assume that collection is needed in a 100-unit campground having one container per unit and that the receptacles are located on the road. The total road mileage within

the area is 0.50 mile, and three collection strategies are investigated: (1) one man collecting by himself; (2) two men working together (at each stop each man will service one container and return to the truck); (3) two men working independently (each man will walk through the area emptying containers and leaving filled plastic liners on the road; both men will then drive through the area loading the bags into the truck).

The time required under each of these strategies can be determined from the general equation. Strategy 1:

$$t_{C1} = 0.125(100 \text{ containers}) + 0.20(0.50 \text{ mile}) + 0.0000714 \left(\frac{10 \text{ ft}}{\text{container}}\right) (100 \text{ containers})$$

$$t_{C1} = 1.25 + 0.10 + 0.07$$

$$t_{C1} = 1.42 \text{ hr}$$

Strategy 2 must be analyzed a little differently. Each man is assumed to collect from 50 sites and to walk an average of 50 ft per site (more walking is done per site because the truck stops between sites). The time required by each man, and also the elapsed time, is:

$$t_{C2} = 0.0125(50 \text{ containers}) + 0.20(0.50 \text{ mile}) + 0.0000714 \left(\frac{50 \text{ ft}}{\text{container}}\right) (50 \text{ containers})$$

$$t_{C2} = 0.62 + 0.10 + 0.18$$

$$t_{C2} = 0.90 \text{ hr}$$

Strategy 3 must also be analyzed differently. If each man services 50 containers, walks 0.25 miles, and then rides through the area collecting bags (no additional time is assumed for loading bags into the truck) the time for each man, and also the elapsed time, is:

$$t_{C3} = 0.0125(50 \text{ containers}) + 0.20(0.50 \text{ miles}) + 0.0000714\ (1{,}320 \text{ ft})$$

$$t_{C3} = 0.62 + 0.10 + 0.09$$

$$t_{C3} = 0.81 \text{ hr}$$

There are many other variations that can be applied to collection procedures. Each would have to be analyzed in a manner similar to those presented here. In general, however, it can be shown that two collectors are able to service from 1.5 to 2.0 times as many containers as a single collector in the same amount of time. The economy of using a second collector drops, however, as travel time to the area increases (Figure 15). The amount of time available for and the total cost of collection depend on the time needed to travel between areas and to disposal sites. The total collection cost should be determined for each area, with the four collection vehicles discussed, and for both one- and two-man crews. This allows selection of the most economical collection system.

Some recreational areas have areas that are accessible only by boat. Small pontoon barges or motorboats (either inboard or outboard) are normally used if collections are made in these areas. (Backpack or horseback collection is sometimes carried out but is not discussed in this report.) The cost of using these two types of collection "vehicles" is about $3.40 and $6.00 per hr (Table 6).

The time required to collect the solid waste in a boat-access-only area can be calculated in a manner similar to that for vehicle collection; there will, however, be only servicing time and walking time:

$$t_C = 0.0125c + 0.0000714d_c$$

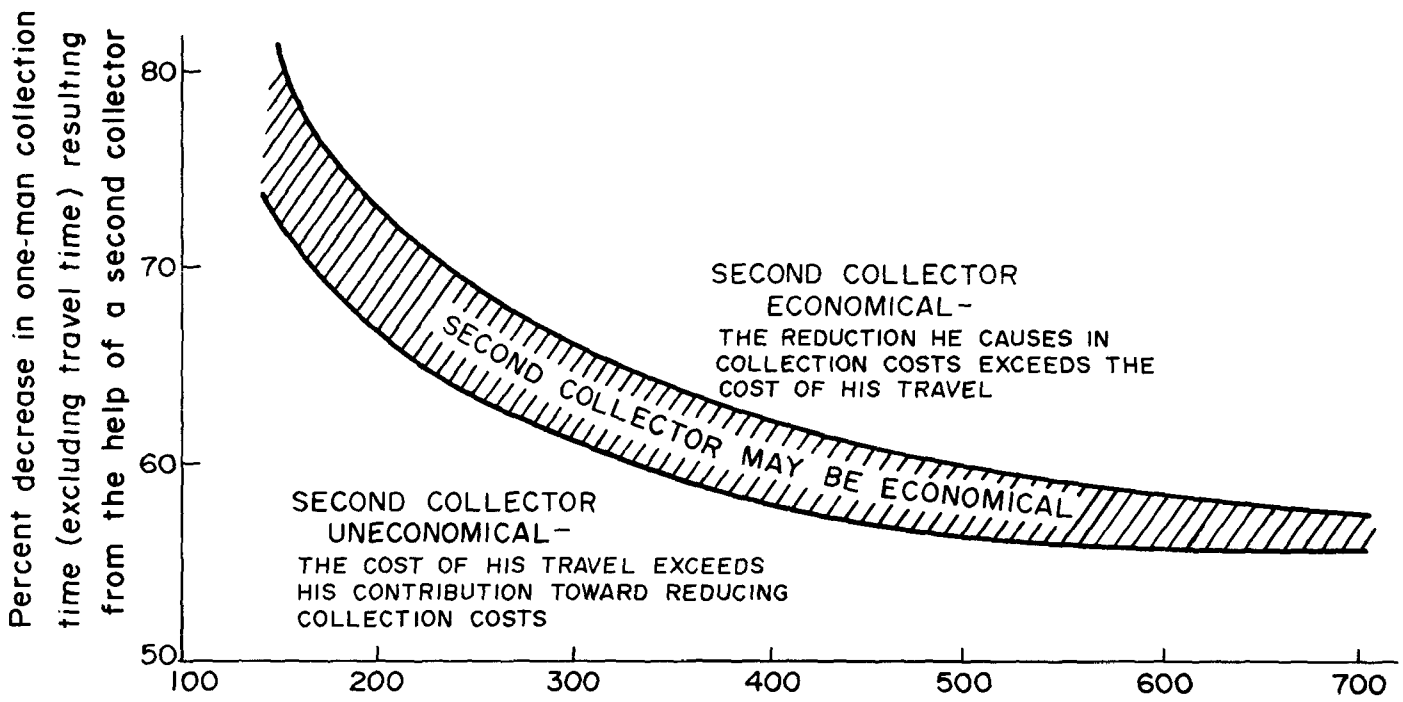


Figure 15. Economic effect of employing a second collector.

TABLE 6

AVERAGE COSTS AND DESIGN CHARACTERISTICS

OF BOATS AND BARGES USED FOR COLLECTION

Item	Pontoon barge (about 20 ft)	Boat (about 20 ft)
Initial cost (including motor)	$2,000	$5,000
Depreciation (assume 8-yr or 5,000-hr life)	$20/month $0.40/hr	$50/month $1.00/hr
Operation cost	$3.00/hr	$5.00/hr
Total hourly cost	$3.40/hr	$6.00/hr
Normal capacity*	10 cu yd	8 cu yd
Normal capacity*	70 containers	50 containers
Average speed of travel	10 mph	20 mph

*Expected amount per full load.

Note: This table is based on the most recent costs reported by many sources and is presented for discussion only.

For a 10-site campground, where the sites are spaced as in the larger one discussed previously, one man requires:

$$t_c = 0.0125(10 \text{ containers}) + 0.0000714(500 \text{ ft})$$

$$t_c = 0.12 + 0.06$$

$$t_c = 0.18 \text{ hr}$$

Two men would require one-half as much time.

Travel time between areas by barge and boat can be extremely long. Since most boat-access-only campgrounds are small, it is usually more economical to use only one man to collect.

If boat or barge collection is being considered, the total cost (including travel time) should be calculated. It is usually found that the cost is extremely high, and it may be advisable to require that boaters using the areas bring out their solid wastes, as is done in wilderness areas. This requires increased awareness of the problem by the boaters and increased surveillance by the area managers to ensure compliance with the regulation. In the long run, however, the increased effort lowers the cost of solid waste management.

Transfer Stations

Transfer stations are sometimes used at which waste is transferred from small collection vehicles to larger trucks and hauled to a distant disposal site. They can be elaborate facilities that have baling or compaction equipment, or they can be simple containers designed to hold the waste until pickup. Transfer stations in recreational areas are more often of the latter type; they range from wire holding pens (in which the waste collected daily from campgrounds is stored in their original bags for weekly removal to a disposal site) to standardized, bulk containers serviced by a transfer truck.

Two relatively simple types of transfer stations provided with readily available components appear adaptable to recreational areas. The first uses medium-size containers (6, 8, or 10 cu yd) (Figure 16), and

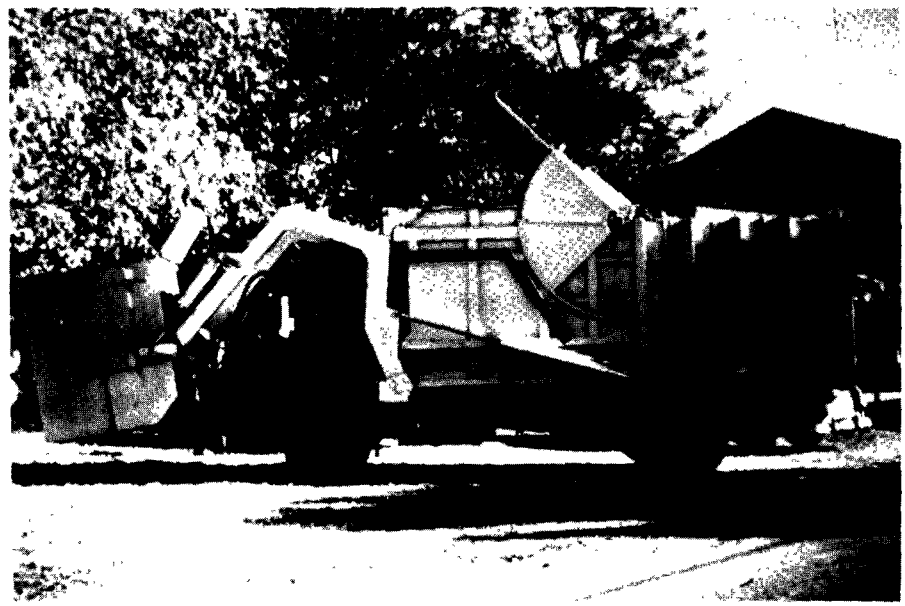


Figure 16. Front-loading packer truck servicing 8-cu-yd container.

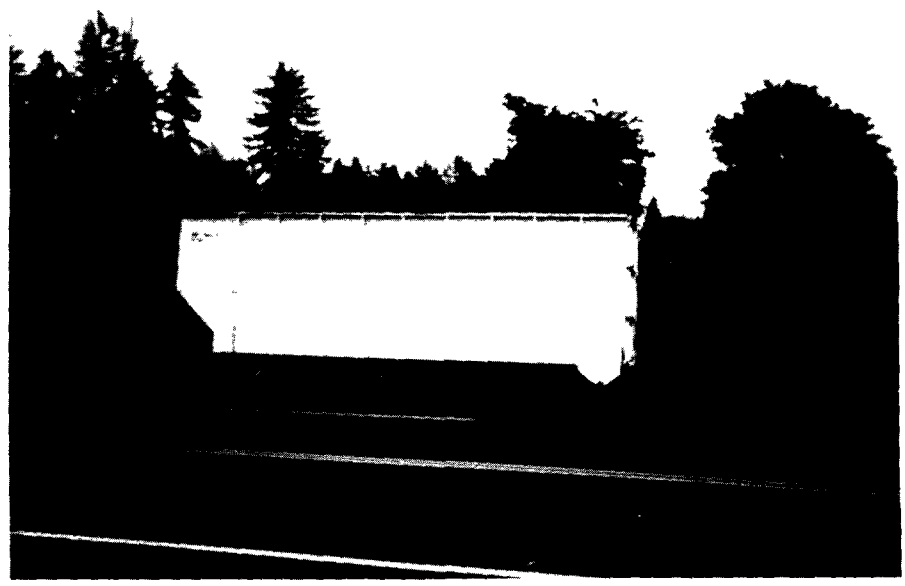
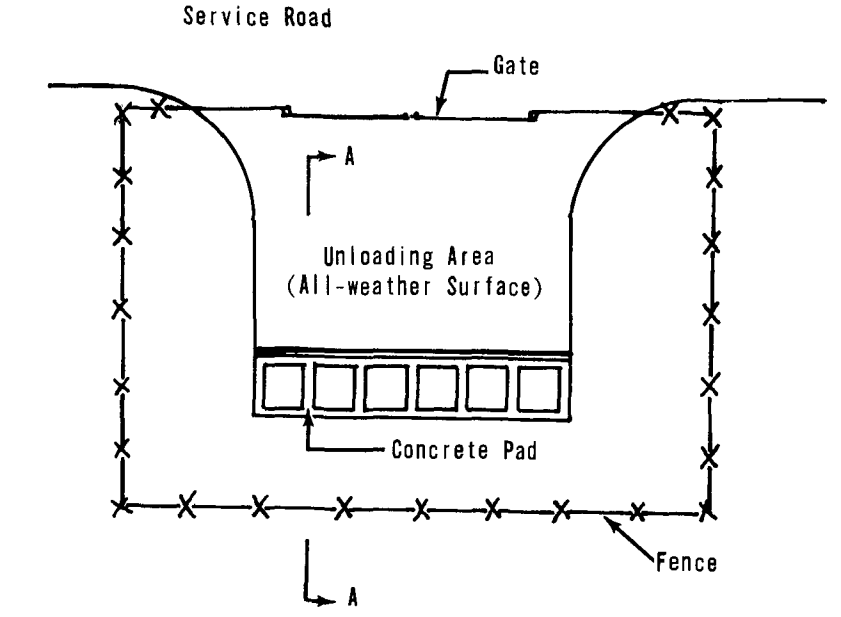


Figure 17. 40-cu-yd pull-on container.

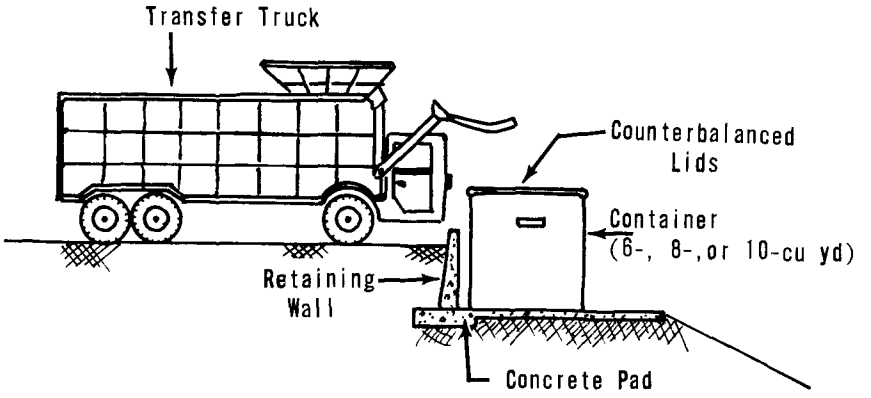
the second has large containers (30, 40, or 50 cu yd) (Figure 17). Each system might involve the appropriate number of containers placed on a level area without any other facilities, or it might have special structures designed to protect and hide the receptacles. The costs of ownership and operation would vary widely, depending on the amount of site preparation and sophistication inherent in the design. Basically, however, transfer containers should be placed in an area where: (1) they can be serviced by the transfer vehicle; (2) individual collection vehicles can unload their waste; (3) they are hidden from general view; (4) they are protected from wildlife and inquisitive visitors. These four basic requirements are all that are considered in subsequent discussions.

The number of containers used by either system would depend on the amount of waste and the frequency of transfer. The density of waste in the bulk containers, if no compaction were applied, would be about 170 lb per cu yd. If a packer truck were used for collection, the density in the transfer containers would be about 300 lb per cu yd because of the increased density achieved in the truck.

In the system using medium-size containers, the receptacles are lifted and emptied into a packer truck, normally a front-loading type (Figure 18). The truck empties many containers and uses its compaction equipment to reduce the volume of waste picked up. The basic transfer station is large enough to accommodate the proper number of containers. The tops of the containers are about 3 ft above the groung to facilitate unloading from pickup and stake trucks, and each receptacle has channels welded along its sides to allow the forks of the transfer vehicle to



SITE PLAN



SECTION A-A

Figure 18. Transfer station utilizing medium-size bulk containers.

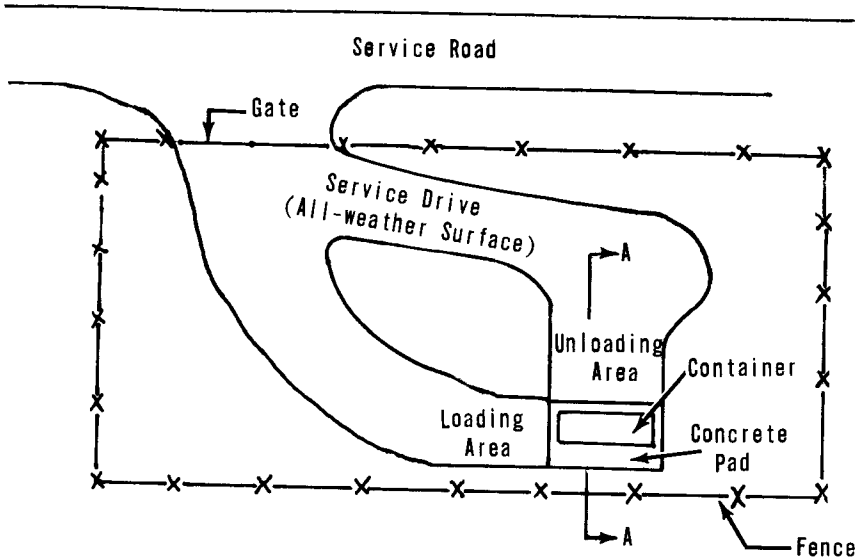
lift it. An alternative method would be to have the top of the containers level with the ground and to provide an area behind them where the transfer vehicle could manuever and service them. This arrangement would require more land, but the containers would not be so visible from the road. The design shown in Figure 18 would cost approximately $6,000 and, with an estimated life of 25 years, would have an annual depreciation cost of about $240.

Large containers are loaded directly onto a truck carriage and transported to a disposal site for emptying. Normally, an empty container is carried on the truck to the transfer station to replace the full container. A typical transfer station using a large container consists of a dumping area and an area needed to change the containers (Figure 19). This type would cost approximately $15,000 and, with a 25-year life, have an annual depreciation cost of $600.

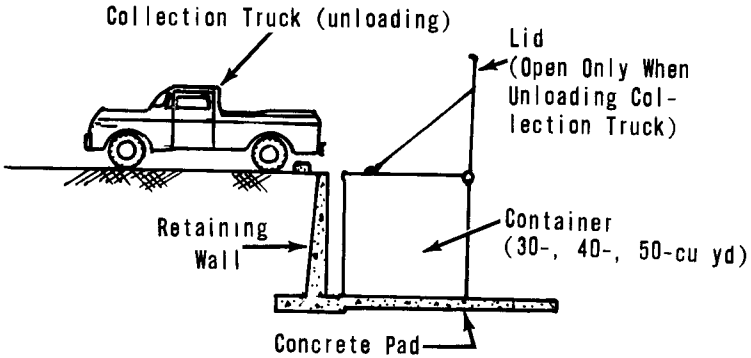
The cost of using a transfer station (Table 7) should be compared with that for direct haul to a disposal site. Because of the seasonal variation in most recreational areas, the costs associated with using a transfer station are often not justified when compared to direct haul. If it is desirable, however, to remove the solid waste totally from the area for disposal, the increased costs might be acceptable.

Disposal

The principal method of solid waste disposal in recreational areas has historically been the open, burning dump. With increased environmental awareness and more stringent regulations on all types of waste disposal,



SITE PLAN



SECTION A-A

Figure 19. Transfer station utilizing pull-on containers.

as expressed in Executive Order No. 11507 (Appendix B), the old method is no longer considered satisfactory, but it still endures (Figures 20-23).

TABLE 7

ESTIMATED COST FACTORS FOR TRANSFER STATIONS IN RECREATIONAL AREAS

Item	Medium-size container type transfer station	Large container type transfer station
Capital cost of one container	$900*	$2,000†
Annual cost of containers (Estimated life = 10 years)	$90	$200
Capital cost of transfer truck	$30,000	$20,000
Annual depreciation of truck (Estimated life = 8 years)	$3,750	$2,500
Operational cost of transfer truck	$2.50/hr	$1.50/hr

*For an 8-cu yd container.
†For a 40-cu yd container.
Note: Costs are typical of those reported by manufacturers.

The only ways to dispose of solid waste that meet present local and Federal standards are the sanitary landfill and incineration followed by the landfilling of residue. At a sanitary landfill, the waste is spread and compacted (to decrease the volume) and is covered with an earth layer to seal it from insects and rodents.[8] Incineration was in disfavor for some time in recreational areas because the small units used did not meet air pollution standards (Figures 24, 25) but it is staging

Figure 20. Air pollution from open dump in recreational area.

Figure 21. Water pollution from open dump in recreational area.

Figure 22. Water pollution from open dump in recreational area.

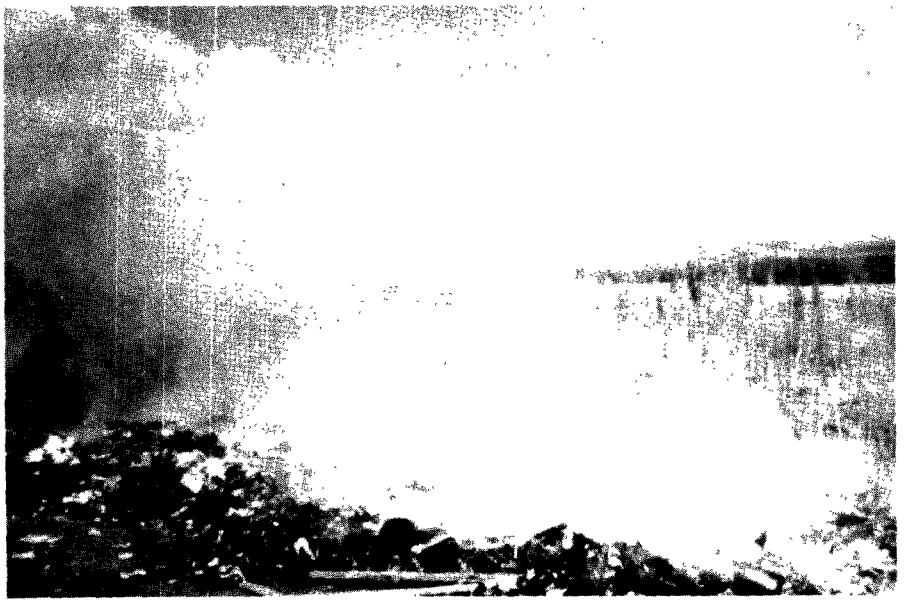


Figure 23. Air and water pollution from open dump in recreational area.

Figure 24. Unacceptable incinerator operation.

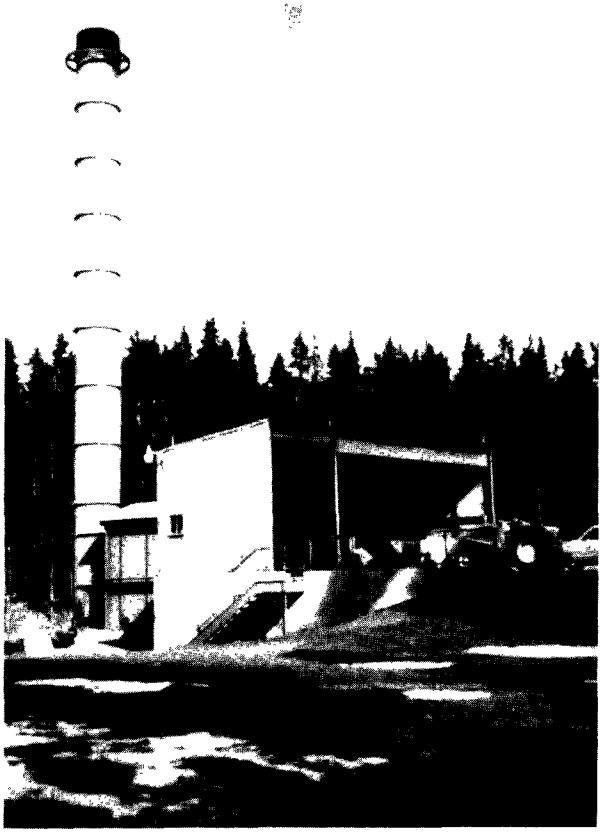


Figure 25. Large incinerator without adequate air pollution control devices.

a comeback; a new type "starved-air" combustion unit is now being employed (Figures 26, 27). These incinerators recirculate hot combustion gases to sustain high temperatures and reduce the total amount of air used in combustion. Units are available that can burn from 200 to 1,200 lb of solid waste per hr. Operational costs are low because auxiliary fuel is only used to start combustion and because the units are usually operated by one man. A number of them have been approved for use on Federal facilities. A listing of such types can be obtained from the Office of Air Programs (OAP).

The three basic methods of operating a sanitary landfil are area, ramp, and trench (Figures 28-30). The area method is commonly used when excavation is impossible, and cover material is frequently brought in from other areas. The waste is dumped at the bottom of the fill, and each load is then spread up the working face in thin layers and compacted (Figure 31). The slope of the working face should be maintained at about two to one, and all cells should be between one and two blade widths across. Before the operator leaves the site at the end of the day, all the waste is covered with at least 6 in. of compacted soil[9] (Figure 32). The ramp method differs from the area in that cover material is excavated from in front of the fill, and waste is subsequently placed in the excavation. A trench landfill is operated by excavating a trench as deeply as soil and ground water conditions allow (less if desired); it should be about twice as wide as the landfill equipment used (Figure 33). Waste is then dumped into the trench (from the side, on top of the working face, or at the bottom of the

Figure 26. Starved-air type incinerator.

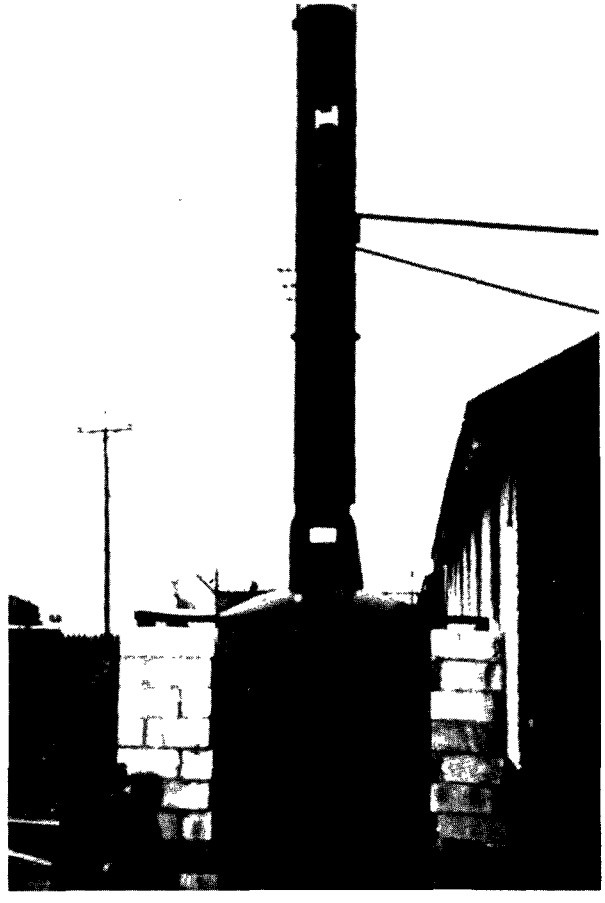


Figure 27. Starved-air type incinerator.

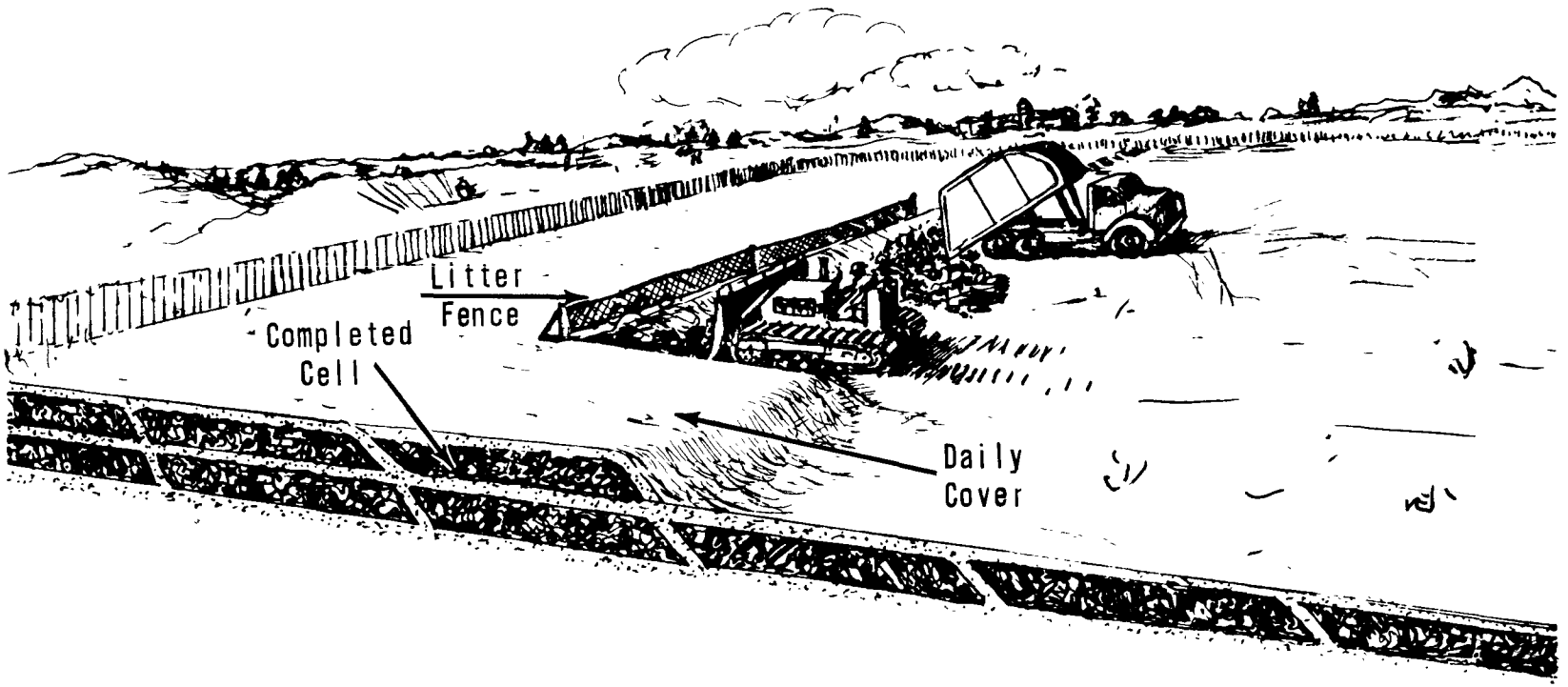


Figure 28. Area operation of a sanitary landfill.[8]

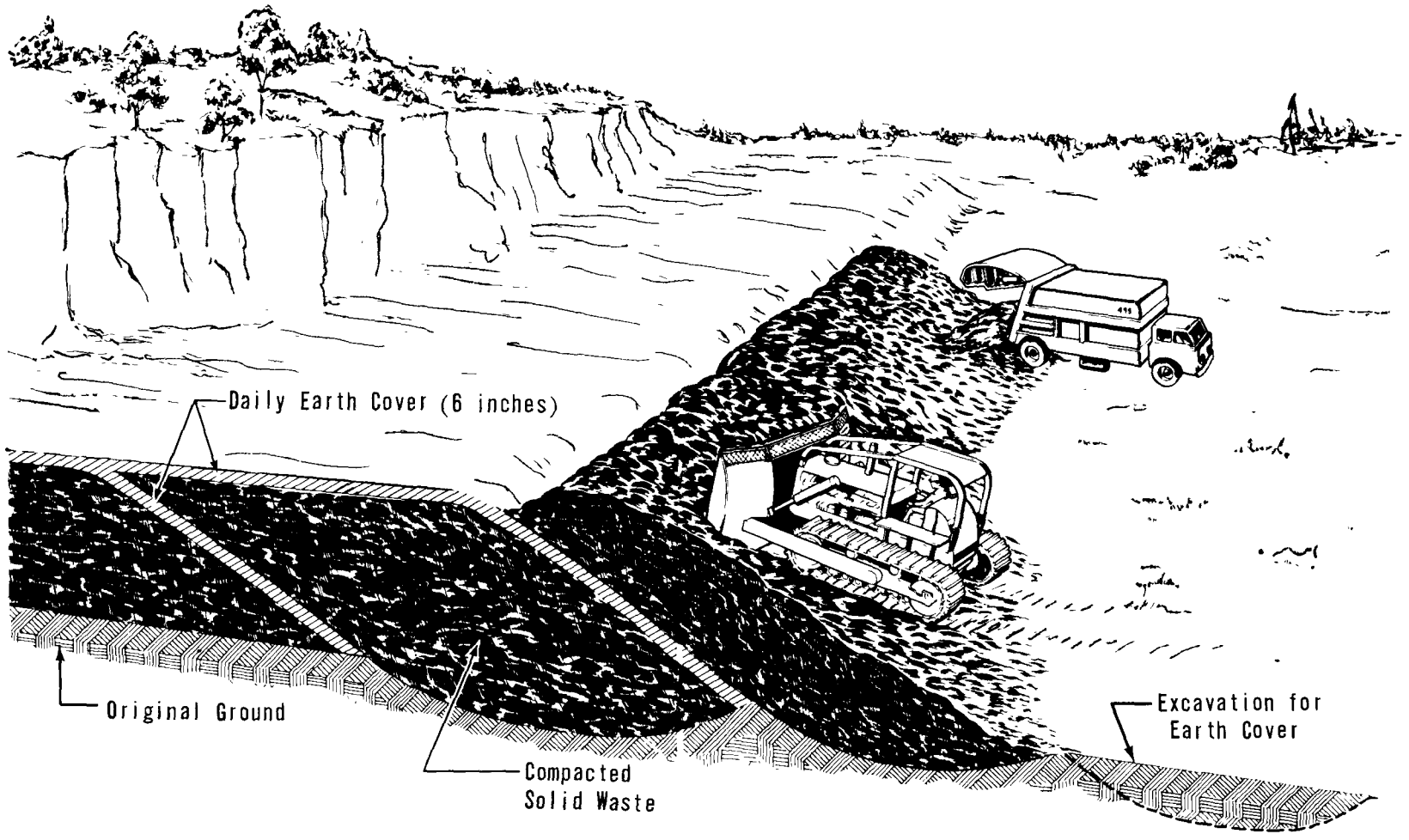


Figure 29. Ramp operation of a sanitary landfill.[8]

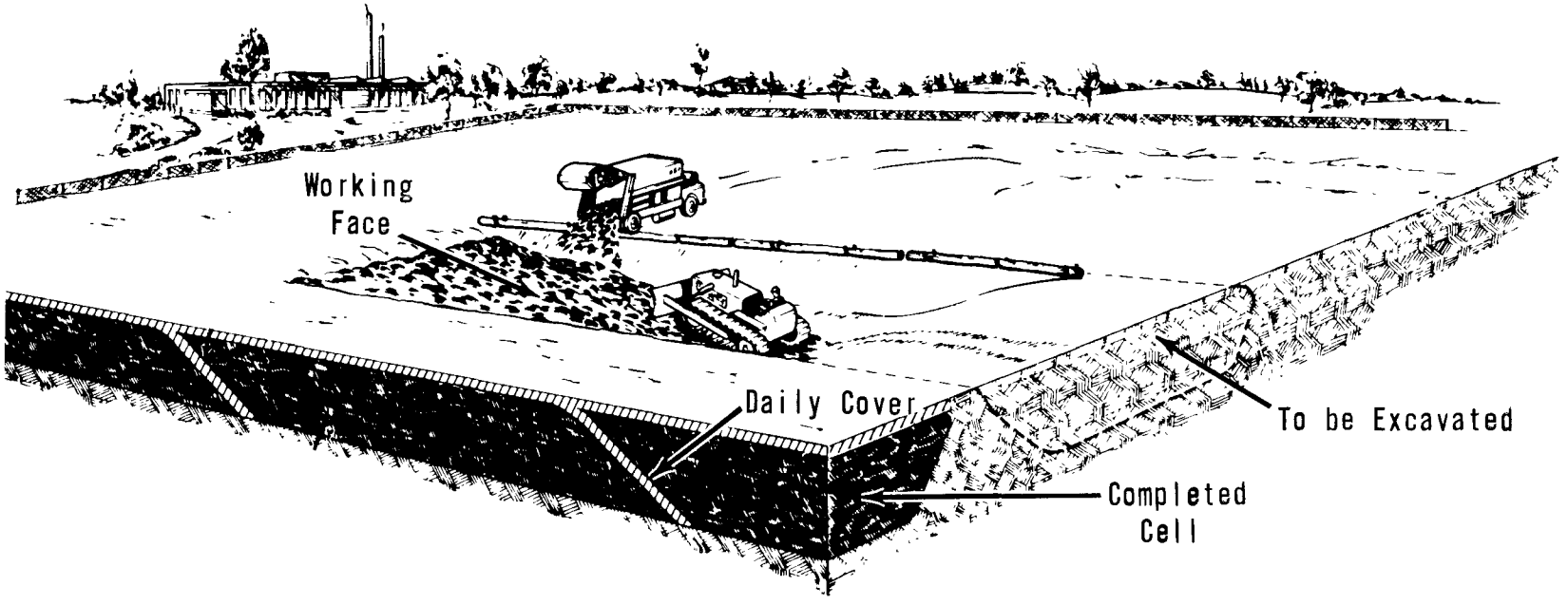


Figure 30. Trench operation of a sanitary landfill [8]

Figure 31. Spreading and compacting waste on a slope in an area fill operation.

Figure 32. Waste being covered at the close of operation.

Figure 33. *Trench prepared for landfill operations.*

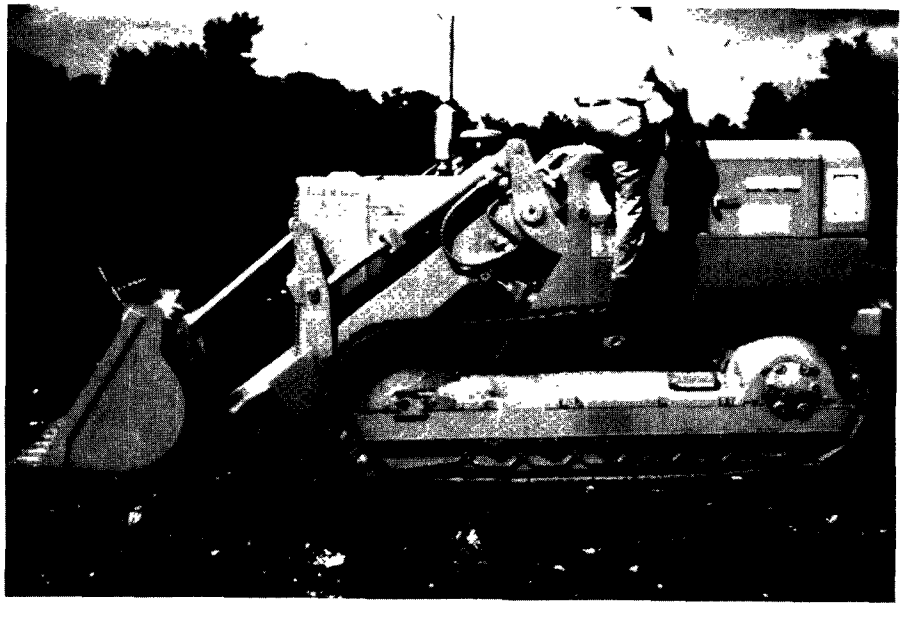


Figure 34. Small front-end loader suitable for use on a sanitary landfill in recreational areas.

face), compacted, and covered. The soil from the trench can be used as cover material.

The density of solid waste in a sanitary landfill varies with the type of waste, the skill of the compacting operator, and the size and weight of the equipment used. For an average landfill serving a recreational area, a density of 600 lb per cu yd is a reasonable value for design purposes. The amount of cover material used varies between 20 and 40 percent; recreational area landfills use about 40 percent because of the small quantities of waste that are received each day. The volume needed for any period[3] can be computed as:

$$V = \frac{P}{0.6 \times 600} = \frac{P}{360}$$

where:

V is the volume in cubic yards,

P is the amount of waste in pounds.

The cost of sanitary landfill equipment varies as much as any of the other factors discussed. In general, cost is related to the size of the operation and equipment. Sanitary landfills in recreational areas are usually small and are operated seasonally. It is not economical, therefore, to use as large a piece of machinery as would be employed in a year-round operation. At present, reasonable costs for equipment used in recreational areas are about $110 per month and $1.50 per hr for a small, under 20,000 lb and 70 hp, loader or dozer[10] (Figure 34).

The amount of waste that can be handled per hour is a function of the experience of the equipment operator, the size of the equipment, and the quantities received. Considering that small equipment is normally

used in recreational areas and that small quantities of waste are handled, about 1 ton of waste can generally be placed, compacted, and covered in 1 hr (Figure 35). As the amount received increases, the time required will rise; at about 35 tons of waste per day, the capacity of the small equipment will be exceeded, and larger equipment will be needed.

The first cost and operating expenses of the previously mentioned package incineration units are influenced by the size of the unit selected. For purposes of discussion, two units (500 lb per hr and 1,000 lb per hr) have been investigated. First cost is about $10,000 (installed) and about $20,000 (installed), respectively. The assumed life of each unit, 10 years, results in annual costs of $1,000 and $2,000.

Manufacturers say that because auxiliary fuel is needed only until operating temperatures are reached fuel costs are low. In the absence of well-documented operating costs, assumed costs have been assigned, based on observations made by OSWMP and OAP personnel. These are $0.50 per day for the 500-lb-per-hr unit and $1.00 per day for the other.

After the solid waste is incinerated, the residue must be disposed of. In recreational areas, it frequently amounts to as much as 30 percent of the weight of the waste (Table 2). The volume of the waste is reduced by a greater amount, and the residue may occupy only 10 to 20 percent of the space occupied by the original waste. The best way to handle the residue is to dump it into a prepared trench and cover it at the end of a season's operation. If all the organics are not destroyed

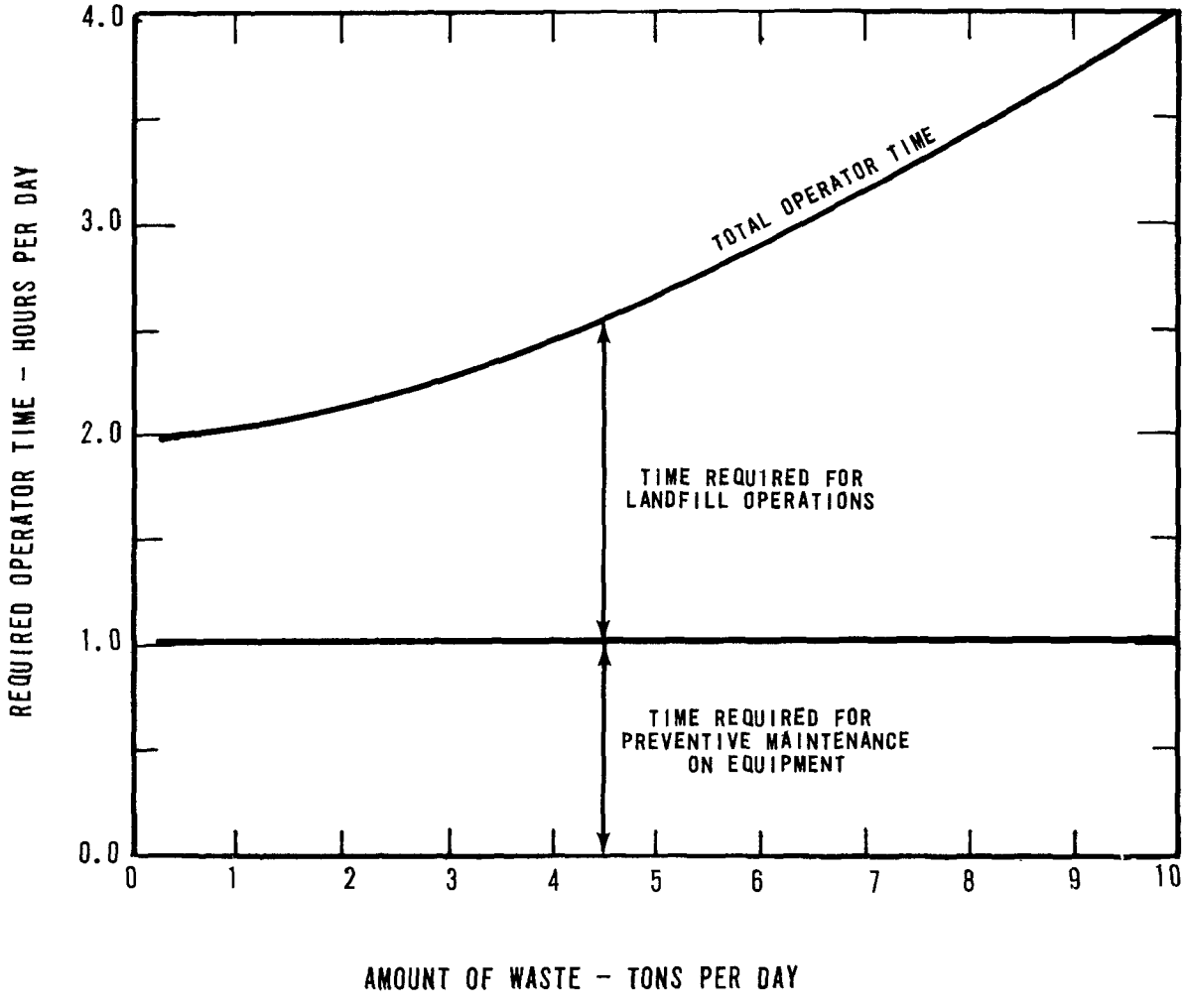


Figure 35. Equipment operator time for sanitary landfills using small equipment (less than 20,000 lb and 70 hp).

Source: This data has been compiled from manufacturers' literature, experience in similar operations, and personal observations by the author.

by incineration (as may happen if a unit is overloaded), daily cover must be applied and the trench operated as a sanitary landfill. Assuming, however, that complete combustion occurs and that only annual cover is needed, the annual cost of preparing the trench and covering the residue is about $300.

REFERENCES

1. Pacific Southwest Inter-Agency Committee and Columbia Basin Inter-Agency Committee. Suggested design criteria for refuse storage, collection and disposal in recreational areas. Washington, U.S. Department of Health, Education, and Welfare, 1963. 19 p.

2. Environmental health practice in recreational areas. Public Health Service Publication No. 1195. Washington, U.S. Government Printing Office, 1965. 134 p.

3. Spooner, C. S. Solid waste management in recreational forest areas. Public Health Service Publication No. 1991. Washington, U.S. Government Printing Office, 1971. 96 p.

4. Zausner, E. R. An accounting system for incinerator operations. Public Health Service Publication No. 2032. Washington, U.S. Government Printing Office, 1970. 17 p.

5. Zausner, E. R. An accounting system for sanitary landfill operations. Public Health Service Publication No. 2007. Washington, U.S. Government Printing Office, 1969. 18 p.

6. Zausner, E. R. An accounting system for solid waste collection. Public Health Service Publication No. 2033. Washington, U.S. Government Printing Office, 1970. 24 p.

7. Zausner, E. R. An accounting system for solid waste management in small communities. Public Health Service Publication No. 2035. Washington, U.S. Government Printing Office, 1970. 18 p. (In press.)

8. Sorg, T. J., and H. L. Hickman, Jr. Sanitary landfill facts. Public Health Service Publication No. 1792. Washington, U.S. Government Printing Office, 1968. 26 p.; 2d ed., 1970. 30 p.

9. Sanitary landfill operation agreement and recommended standards for sanitary landfill design and construction. National Solid Wastes Management Association and Bureau of Solid Waste Management. [Cincinnati], U.S. Department of Health, Education, and Welfare, 1969. 44 p.

10. Little, H. R. Solid waste disposal in Yellowstone National Park; a Division of Technical Operations open-file report (TO 1.1.101/0). [Cincinnati], U.S. Department of Health, Education, and Welfare, 1970. 82 p. [Restricted distribution.]

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The author wishes to thank all the people who cooperated in making this report possible. Aside from the personnel of the OSWMP who reviewed and edited it, the U.S. Public Health Service Consultants to the National Park Service also reviewed early drafts. Personnel of the National Park Service, the Forest Service, and OAP who were contacted in connection with this effort should be commended for their cooperation and concern about the problems of solid waste handling in recreational areas.

APPENDIX A

AN ACCOUNTING SYSTEM FOR SOLID WASTE HANDLING IN RECREATIONAL AREAS

This accounting system is intended for use by those who have the responsibility for collecting and disposing of solid waste in recreational areas. It is designed as a series of forms to be completed by different levels of operation so that control can be exercised over the system, costs can be identified for planning and budgeting, and operating and design parameters can be established.

Form 1 is to be filled out daily by the driver of each collection truck and turned in to his supervisor. It should be filled out completely and accurately. Those items that are not self-explanatory on the form are the following.

"Area," which is the individual campground, visitor center, etc. that is being serviced. Collection from roadside containers should be listed as a separate entry.

"Task," which is the service being performed, such as solid waste collection, restroom cleaning, general maintenance, etc. All services performed by the crew should be listed so that the percent of time spent on solid waste collection can be determined.

"Comments," where items that should be reported to the supervisor can be listed. These might be missing or damaged storage containers,

needed maintenance, or some problem within the area.

"Time to disposal," which is the time that an identified area was left in order to haul solid waste to the disposal site.

"Time at disposal," which is the time of arrival at the disposal site.

"Amount of waste," which can be expressed in pounds, tons, cubic yards, or number of containers collected. The units used should be listed.

"Time from disposal," which is the time of departure from the disposal site.

"Time at area," which is the time of arrival at an identified area.

Form 2 is to be filled out daily by the operator of a sanitary landfill and turned in to his supervisor. The item that is not self-explanatory on the form is the following.

"Activity," which is landfilling (spreading, compacting, and/or covering waste), excavating, maintaining of equipment, or other. All activity marked other should be explained under "Remarks".

Form 3 is to be filled out daily by the operator of an incinerator and turned in to his supervisor. The form should be self-explanatory.

Form 4 is intended for use at medium to large-size disposal facilities where either a foreman is on duty and can gather the data or charges are made to several users of the site on the basis of the amount of waste received from each. Form 4 should be filled out daily and turned in to the supervisor. Those items that are not self-explanatory on the form are the following.

"Wastes, Source," which is the predominant area serviced by the truck, such as campground, roadside containers, or resort.

"Wastes, Type," which is refuse, kitchen waste (garbage), brush, lumber, etc.

"Weight in," which can only be used if there are scales at the disposal site.

"Weight out," (same as above).

"Net amount, Wastes," which is the number of pounds, tons, cubic yards, or equivalent storage containers on the truck.

"Net amount, Residue," can only be used for an incinerator and is the amount to be disposed of by burial. This is not necessarily associated with an incoming truck, and it should be weighed or measured to help evaluate incinerator performance.

Form 5 is to be completed each week by the district supervisor from daily Forms 1 and 2. This information is submitted to the appropriate department for payroll purposes. Each employee may be listed as doing more than one job if he spends only part of his time on solid waste collection or disposal. Listing the time on each job separately will allow calculation of the total amount of time spent on solid waste collection and disposal.

Form 6 is to be maintained by the supervisor for each piece of equipment detailed to solid waste collection and disposal. Entries should be made whenever costs for repairs or maintenance are incurred. This information should be totaled annually and summarized for the area solid waste director.

Form 7 can be completed monthly, quarterly, or annually. The more frequently it is filled out, the better the control that will be maintained over the system. Either quarterly or annually, the supervisor should forward this information to the area director.

Form 8 is to be filled out annually by the area director so that this information will be available, along with that submitted by the district supervisors, for planning and budgeting purposes.

FORM 1

COLLECTOR'S DAILY REPORT

Driver _____ Date _____

Helper _____ Truck No. _____

Time in _____ Mileage in _____

Time out _____ Mileage out _____

Area	Task	Time @ start	Time @ finish	Comments

Gas purchased (gal) _____

Check if abnormal:

- Eng. temp. ☐
- Oil press. ☐
- Ammeter ☐
- Packer ☐
- Brakes ☐
- Lights ☐
- Other ☐

Check if relevant and report to supervisor:

- Personal injury ☐
- Automotive accident ☐
- Property damage ☐

Time to disposal	Time at disposal	Amount of waste	Time from disposal	Time at area

FORM 2

SANITARY LANDFILL OPERATOR'S DAILY REPORT

Operator _____ Site _____

Helper _____ Date _____

Time begin _____ Time end _____

Activity	Time begin	Time end	Remarks

Equipment hour meter reading: begin _____ end _____

Fuel consumed (gal) _____

Oil added (qt) _____

REPAIRS AND MAINTENANCE DATA

Equipment description	Cause	Hours down	Labor hours	Labor cost	Parts cost	External costs	Total cost

FORM 3

INCINERATOR OPERATOR'S DAILY REPORT

Operator _____ Facility _____

Helper _____ Date _____

Time begin _____ Time end _____

Incinerator:

Start time _____ End time _____

Auxiliary fuel:

Start time _____ End time _____

Fuel consumed _____

Amount of solid waste incinerated _____

Residue disposal:

Amount of residue _____

Time required for disposal _____

Equipment used for disposal _____

Cost of equipment _____

REPAIRS AND MAINTENANCE DATA

Equipment description	Cause	Hours down	Labor hours	Labor cost	Parts cost	External costs	Total cost

FORM 4

DISPOSAL FACILITY

DAILY TRUCK RECORD

SIGNATURE: _____ DATE: _____

No.	Truck identification	Time	Wastes		Weight in	Weight out (or tare weight)	Net amount	
			Source	Type			Wastes	Residue
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
12								
15								
16								
17								
18								
19								
20								
Totals		X	X	X	X	X		

FORM 5

WEEKLY LABOR RECORD

DISTRICT: _____ DATE: _____

SIGNATURE: _____

Employee ident.	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7		Individual totals	Note causes of absences, extra hours to be paid, etc.
	Job	Hrs.	Job	Hrs.	Job	Hrs.	Job	Hrs.	Job	Hrs.	Job	Hrs.	Job	Hrs.		
Totals	X		X		X		X		X		X					XXXXX XXXXX

FORM 6

REPAIR AND MAINTENANCE RECORD

VEHICLE IDENTIFICATION _____ PERIOD: from _____ to _____

Date	Odo. mileage	Type service or repair	Hours down	Labor hours	Parts description	Labor cost	Parts cost	Outside charge	Overhead charge	Total cost
Totals		X			X					

FORM 7

SOLID WASTE COST SUMMARY

District _____ Period: from _____ to _____

Factor	This period	Year to date	Total budgeted amount
Amt. of waste collected			X
Amt. of waste transferred			X
Amt. of waste disposed			X
Storage containers replaced			
Cost of maintenance			
Cost of plastic liners purchased			
Number of liners used			X
Collection labor cost			
Collection equipment cost			
Collection overhead cost			
Total collection cost			
Collection cost/amt. collected			
% time on route			X
% time hauling			X
Number of accidents			X
Transfer labor cost			
Transfer equipment cost			
Transfer overhead cost			
Total transfer cost			
Transfer cost/amt. transferred			
Number of accidents			X
Disposal labor cost			
Disposal equipment cost			
Disposal overhead cost			
Total disposal cost			
Disposal cost/amt. disposed			
Number of accidents			X

FORM 8

EQUIPMENT AND FACILITY INVENTORY

DATE: _____

Type	Identification No.	Capacity (cu yd)	Model No.	Model year	Manufacturer	Date of purchase	Purchase price	Estimated life	Salvage value	Percent of time	Annual depreciation	Monthly depreciation
Total	X	X	X	X	X	X		X				

FACILITY INVENTORY

Facility	Description	Date put in use	New cost	Estimated total life	Other comments	Annual depreciation	Monthly depreciation
Totals	X	X		X	X		

Executive Order 11507

PREVENTION, CONTROL, AND ABATEMENT OF AIR AND WATER POLLUTION AT FEDERAL FACILITIES

By virtue of the authority vested in me as President of the United States and in furtherance of the purpose and policy of the Clean Air Act, as amended (42 U.S.C. 1857), the Federal Water Pollution Control Act, as amended (33 U.S.C. 466), and the National Environmental Policy Act of 1969 (Public Law No. 91-190, approved January 1, 1970), it is ordered as follows:

SECTION 1. *Policy.* It is the intent of this order that the Federal Government in the design, operation, and maintenance of its facilities shall provide leadership in the nationwide effort to protect and enhance the quality of our air and water resources.

SEC. 2. *Definitions.* As used in this order:

(a) The term "respective Secretary" shall mean the Secretary of Health, Education, and Welfare in matters pertaining to air pollution control and the Secretary of the Interior in matters pertaining to water pollution control.

(b) The term "agencies" shall mean the departments, agencies, and establishments of the executive branch.

(c) The term "facilities" shall mean the buildings, installations, structures, public works, equipment, aircraft, vessels, and other vehicles and property, owned by or constructed or manufactured for the purpose of leasing to the Federal Government.

(d) The term "air and water quality standards" shall mean respectively the quality standards and related plans of implementation, including emission standards, adopted pursuant to the Clean Air Act, as amended, and the Federal Water Pollution Control Act, as amended, or as prescribed pursuant to section 4(b) of this order.

(e) The term "performance specifications" shall mean permissible limits of emissions, discharges, or other values applicable to a particular Federal facility that would, as a minimum, provide for conformance with air and water quality standards as defined herein.

(f) The term "United States" shall mean the fifty States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, and Guam.

SEC. 3. *Responsibilities.* (a) Heads of agencies shall, with regard to all facilities under their jurisdiction:

(1) Maintain review and surveillance to ensure that the standards set forth in section 4 of this order are met on a continuing basis.

(2) Direct particular attention to identifying potential air and water quality problems associated with the use and production of new materials and make provisions for their prevention and control.

(3) Consult with the respective Secretary concerning the best techniques and methods available for the protection and enhancement of air and water quality.

(4) Develop and publish procedures, within six months of the date of this order, to ensure that the facilities under their jurisdiction are in conformity with this order. In the preparation of such procedures there shall be timely and appropriate consultation with the respective Secretary.

(b) The respective Secretary shall provide leadership in implementing this order, including the provision of technical advice and assistance to the heads of agencies in connection with their duties and responsibilities under this order.

(c) The Council on Environmental Quality shall maintain continuing review of the implementation of this order and shall, from time to time, report to the President thereon.

SEC. 4. *Standards.* (a) Heads of agencies shall ensure that all facilities under their jurisdiction are designed, operated, and maintained so as to meet the following requirements:

(1) **Facilities shall conform to air and water quality standards** as defined in section 2(d) of this order. In those cases where no such air or water quality standards are in force for a particular geographical area, Federal facilities in that area shall conform to the standards established pursuant to subsection (b) of this section. Federal facilities shall also conform to the performance specifications provided for in this order.

(2) Actions shall be taken to **avoid or minimize wastes** created through the complete cycle of operations of each facility.

(3) **The use of municipal or regional waste collection or disposal systems** shall be the preferred method of disposal of wastes from Federal facilities. Whenever use of such a system is not feasible or appropriate, the heads of agencies concerned shall take necessary measures for the satisfactory disposal of such wastes, including:

(A) When appropriate, the installation and operation of their own waste treatment and disposal facilities in a manner consistent with this section.

(B) The provision of trained manpower, laboratory and other supporting facilities as appropriate to meet the requirements of this section.

(C) The establishment of requirements that operators of Federal pollution control facilities meet levels of proficiency consistent with the operator certification requirements of the State in which the facility is located. In the absence of such State requirements the respective Secretary may issue guidelines, pertaining to operator qualifications and performance, for the use of heads of agencies.

(4) **The use, storage, and handling of all materials**, including but not limited to, solid fuels, ashes, petroleum products, and other chemical and biological agents, **shall be carried out so as to avoid or minimize the possibilities for water and air pollution.** When appropriate, preventive measure shall be taken to entrap spillage or discharge or otherwise to prevent accidental pollution. Each agency, in consultation with the respective Secretary, shall establish appropriate emergency plans and procedures for dealing with accidental pollution.

(5) No waste shall be disposed of or discharged in such a manner as could result in the **pollution of ground water** which would endanger the health or welfare of the public.

(6) Discharges of **radioactivity** shall be in accordance with the applicable rules, regulations, or requirements of the Atomic Energy Commission and with the policies and guidance of the Federal Radiation Council as published in the FEDERAL REGISTER.

(b) In those cases where there are no air or water quality standards as defined in section 2(d) of this order in force for a particular geographic area or in those cases where more stringent requirements are deemed advisable for Federal facilities, the respective Secretary, in consultation with appropriate Federal, State, interstate, and local agencies, may issue regulations establishing air or water quality standards for the purpose of this order, including related schedules for implementation.

(c) The heads of agencies, in consultation with the respective Secretary, may from time to time identify facilities or uses thereof which are to be exempted, including temporary relief, from provisions of this order in the interest of national security or in extraordinary cases where it is in the national interest. Such exemptions shall be reviewed periodically by the respective Secretary and the heads of the agencies concerned. A report on exemptions granted shall be submitted to the Council on Environmental Quality periodically.

SEC. 5. *Procedures for abatement of air and water pollution at existing Federal facilities.* (a) Actions necessary to meet the requirements of subsections (a)(1) and (b) of section 4 of this order pertaining to air and water pollution at existing facilities are to be completed or under way no later than December 31, 1972. In cases where an enforcement conference called pursuant to law or air and water quality standards require earlier actions, the earlier date shall be applicable.

(b) In order to ensure full compliance with the requirements of section 5(a) and to facilitate budgeting for necessary corrective and preventive measures, heads of agencies shall present to the Director of the Bureau of the Budget by June 30, 1970, a plan to provide for such improvements as may be necessary to meet the required date. Subsequent revisions needed to keep any such plan up-to-date shall be promptly submitted to the Director of the Bureau of the Budget.

(c) Heads of agencies shall notify the respective Secretary as to the performance specifications proposed for each facility to meet the requirements of subsections 4 (a) (1) and (b) of this order. Where the respective Secretary finds that such performance specifications are not adequate to meet such requirements, he shall consult with the agency head and the latter shall thereupon develop adequate performance specifications.

(d) As may be found necessary, heads of agencies may submit requests to the Director of the Bureau of the Budget for extensions of time for a project beyond the time specified in section 5(a). The Director, in consultation with the respective Secretary, may approve such requests if the Director deems that such project is not technically feasible or immediately necessary to meet the requirements of subsections 4 (a) and (b). Full justification as to the extraordinary circumstances necessitating any such extension shall be required.

(e) Heads of agencies shall not use for any other purpose any of the amounts appropriated and apportioned for corrective and preventive measures necessary to meet the requirements of subsection (a) for the fiscal year ending June 30, 1971, and for any subsequent fiscal year.

SEC. 6. *Procedures for new Federal facilities.* (a) Heads of agencies shall ensure that the requirements of section 4 of this order are considered at the earliest possible stage of planning for new facilities.

(b) A request for funds to defray the cost of designing and constructing new facilities in the United States shall be included in the annual budget estimates of an agency only if such request includes funds to defray the costs of such measures as may be necessary to assure that the new facility will meet the requirements of section 4 of this order.

(c) Heads of agencies shall notify the respective Secretary as to the performance specifications proposed for each facility when action is necessary to meet the requirements of subsections 4(a) (1) and (b) of this order. Where the respective Secretary finds that such performance specifications are not adequate to meet such requirements he shall consult with the agency head and the latter shall thereupon develop adequate performance specifications.

(d) Heads of agencies shall give due consideration to the quality of air and water resources when facilities are constructed or operated outside the United States.

SEC. 7. *Procedures for Federal water resources projects.* (a) All water resources projects of the Departments of Agriculture, the Interior, and the Army, the Tennessee Valley Authority, and the United States Section of the International Boundary and Water Commission shall be consistent with the requirements of section 4 of this order. In addition, all such projects shall be presented for the consideration of the Secretary of the Interior at the earliest feasible stage if they involve proposals or recommendations with respect to

the authorization or construction of any Federal water resources project in the United States. The Secretary of the Interior shall review plans and supporting data for all such projects relating to water quality, and shall prepare a report to the head of the responsible agency describing the potential impact of the project on water quality, including recommendations concerning any changes or other measures with respect thereto which he considers to be necessary in connection with the design, construction, and operation of the project.

(b) The report of the Secretary of the Interior shall accompany at the earliest practicable stage any report proposing authorization or construction, or a request for funding, of such a water resource project. In any case in which the Secretary of the Interior fails to submit a report within 90 days after receipt of project plans, the head of the agency concerned may propose authorization, construction, or funding of the project without such an accompanying report. In such a case, the head of the agency concerned shall explicitly state in his request or report concerning the project that the Secretary of the Interior has not reported on the potential impact of the project on water quality.

SEC. 8. *Saving provisions.* Except to the extent that they are inconsistent with this order, all outstanding rules, regulations, orders, delegations, or other forms of administrative action issued, made, or otherwise taken under the orders superseded by section 9 hereof or relating to the subject of this order shall remain in full force and effect until amended, modified, or terminated by proper authority.

SEC. 9. *Orders superseded.* Executive Order No. 11282 of May 26, 1966, and Executive Order No. 11288 of July 2, 1966, are hereby superseded.

Richard Nixon

THE WHITE HOUSE,
February 4, 1970.

[F.R. Doc. 70-1506; Filed, Feb. 4, 1970; 12:33 p.m.]

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