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SOLID-WASTE DISPOSAL IN THE SAN FRANCISCO BAY REGION, CALIFORNIA

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INTRODUCTION

Solid-waste disposal is a problem for all communities. Because it is not nearly as pervasive a problem as air or water pollution, it usually suffers from austerity budgeting and low public priority. Historically, solid-waste disposal has been considered in land-use planning only after prior lack of consideration has caused water pollution or public health hazards (California Department of Public Health, 1971, p. V).

This report is written for use by San Francisco Bay region planners and the public. It emphasizes potential regional solid-waste disposal problems and the need for considering solid-waste disposal in land-use planning. Population growth and solid-waste production in the bay region are projected to the year 2000. Present methods of solid-waste disposal in the nation and the bay region are described, and criteria for locating solid-waste disposal sites are presented. These criteria are based on land-use practices, optimum water-quality protection, and sanitary disposal methods. Alternate methods of solid-waste disposal and management are described. These methods may have to be given serious consideration by planners in the near future.

This report was prepared under the supervision of Loren E. Young, chief, Menlo Park subdistrict and Lee R. Peterson, district chief, California District, U.S. Geological Survey.

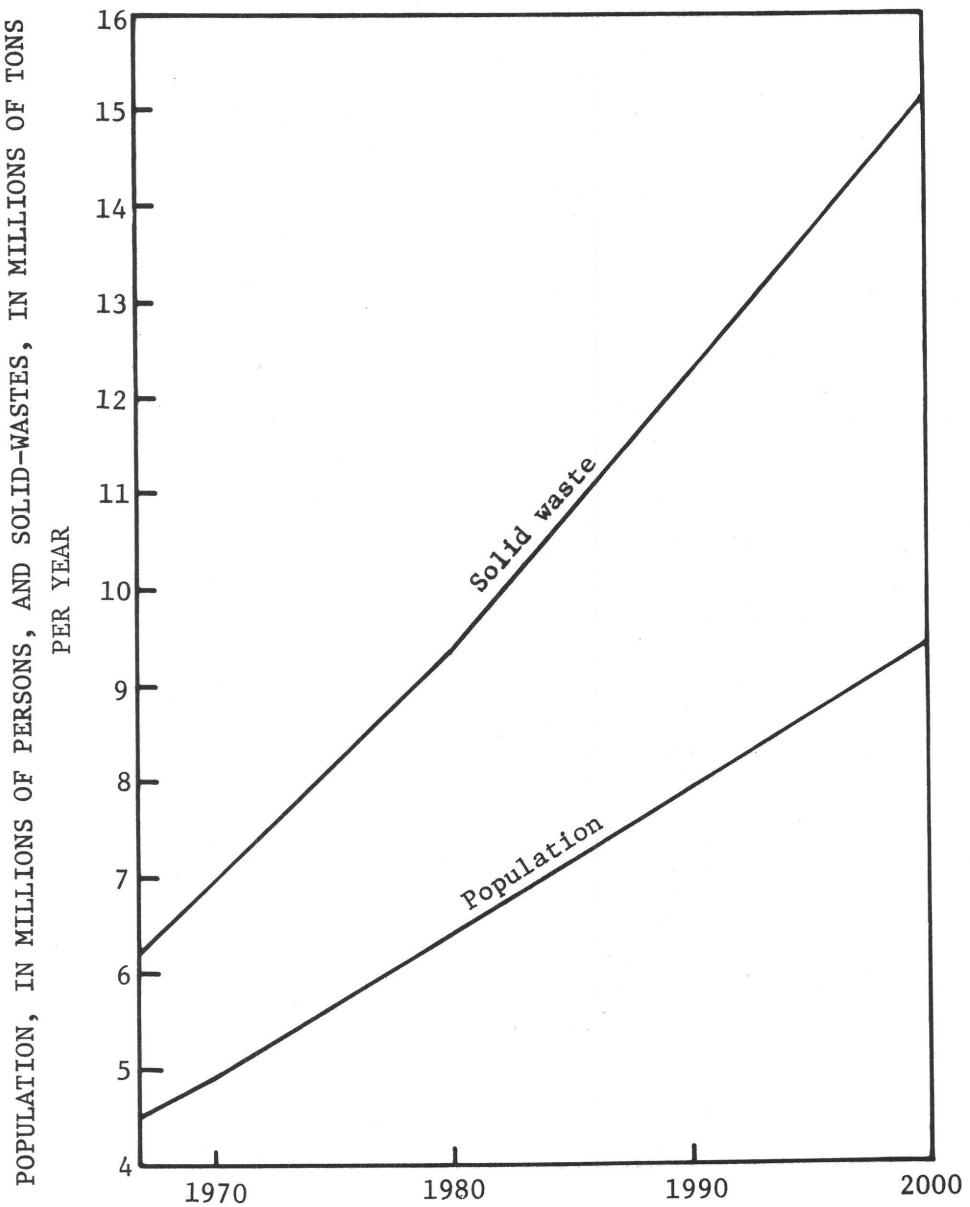

FIGURE 1.--Projected population growth and solid-waste production in the San Francisco Bay region, 1967-2000. [Compiled from information supplied by the California Department of Public Health. Solid-waste quantities include municipal, industrial, and agricultural wastes, but do not include livestock manure, cannery, and petroleum refining wastes.]

SOLID-WASTE PRODUCTION RATES

Per capita solid-waste production is increasing annually nationwide. For example, between 1959 and 1970, national per capita production rates for residential solid wastes alone (primarily paper, cans, glass, garbage, and other household wastes) increased from about 2 to 3 lbs/cap/day (pounds per capita per day) (American Society of Civil Engineers, 1959, p. 6) to more than 5 lbs/cap/day (Sorg and Hickman, 1970, p. 4). These rates correspond to a nationwide per capita annual production of approximately 913 pounds in 1959 and 1,825 pounds in 1970. Residential solid-waste production in the San Francisco Bay region was estimated in 1967 to be 5.7 lbs/cap/day (California Department of Public Health, 1968, p. 1-3). Figure 1 shows the projection of regional solid-waste production in relation to population growth through the year 2000.

SOLID-WASTE DISPOSAL METHODS

Many methods of solid-waste disposal are used in the United States. *Landfilling* is the most commonly used method. Landfills vary from unsightly open dumps to strictly managed sanitary landfills (figs. 2 and 3). A sanitary landfill is the most desirable type of landfilling method known when properly designed and managed (California Department of Public Health, 1971, p. VI-7). Ideally the site is located and designed to minimize chances for surface- and ground-water pollution; the wastes are covered and compacted daily. A modified sanitary landfill differs from a sanitary landfill only in that the wastes are not covered with earth as frequently and some burning or salvaging may be allowed. Burning is prohibited at landfills in the bay region.

Incineration is the combustion of solid wastes at high temperatures. This reduces the volume of the wastes, but the ashes and noncombustible materials remain and are not easily disposable. Air-pollution problems may also occur. Incineration is used widely in the eastern United States but, because of strict air-pollution control standards, burning is prohibited in the bay region.

Composting is the aerobic (with oxygen) decomposition of organic material to a humus-like end product, which can be used as a soil amendment. This requires that wastes be sorted either at their source or following collection. Little solid-waste composting is done in the bay region because of high costs and a limited market for the final products.

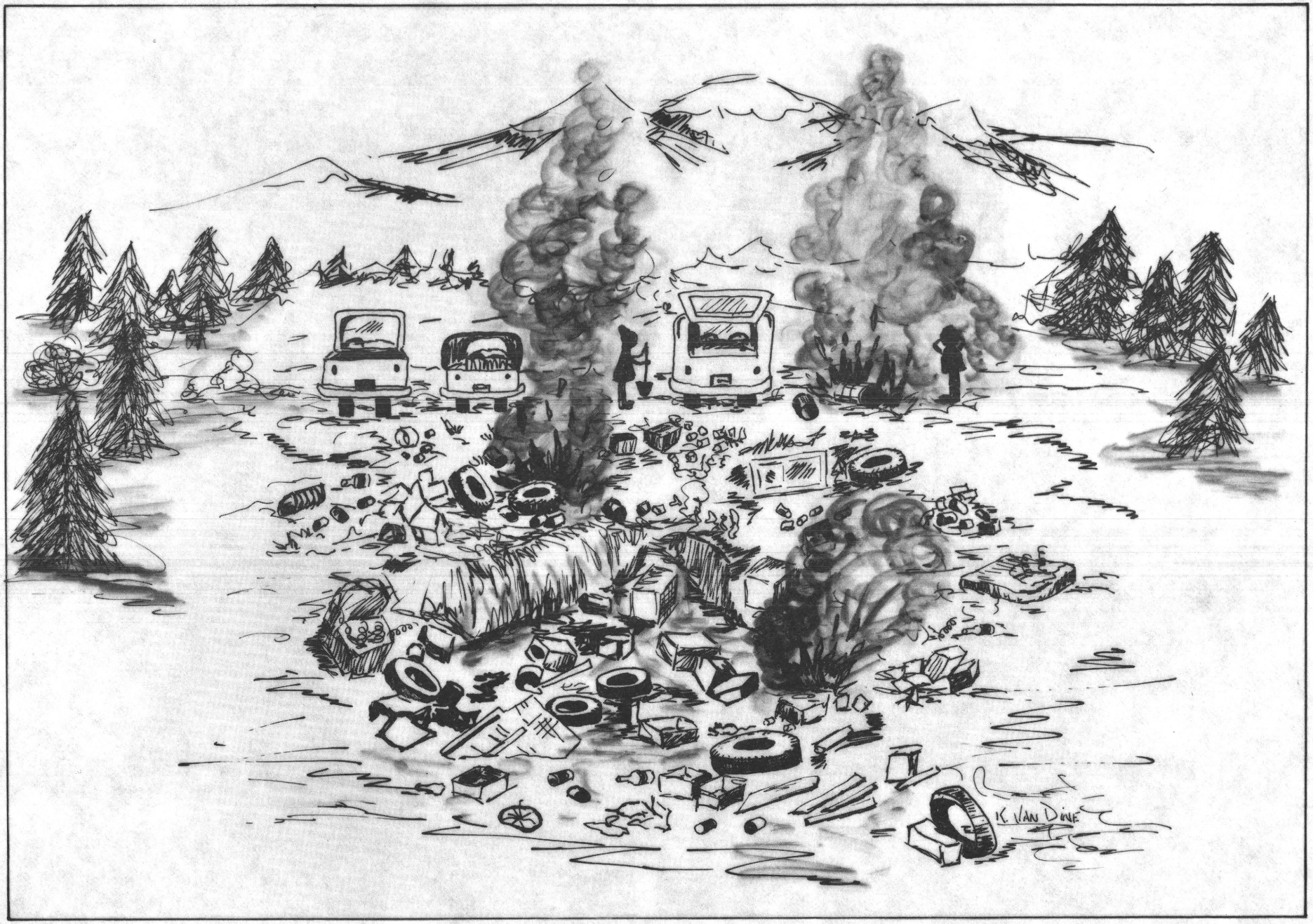

FIGURE 2.--Open dumping and burning with wastes indiscriminately spread over a large area blighting the land and fouling the air and water.

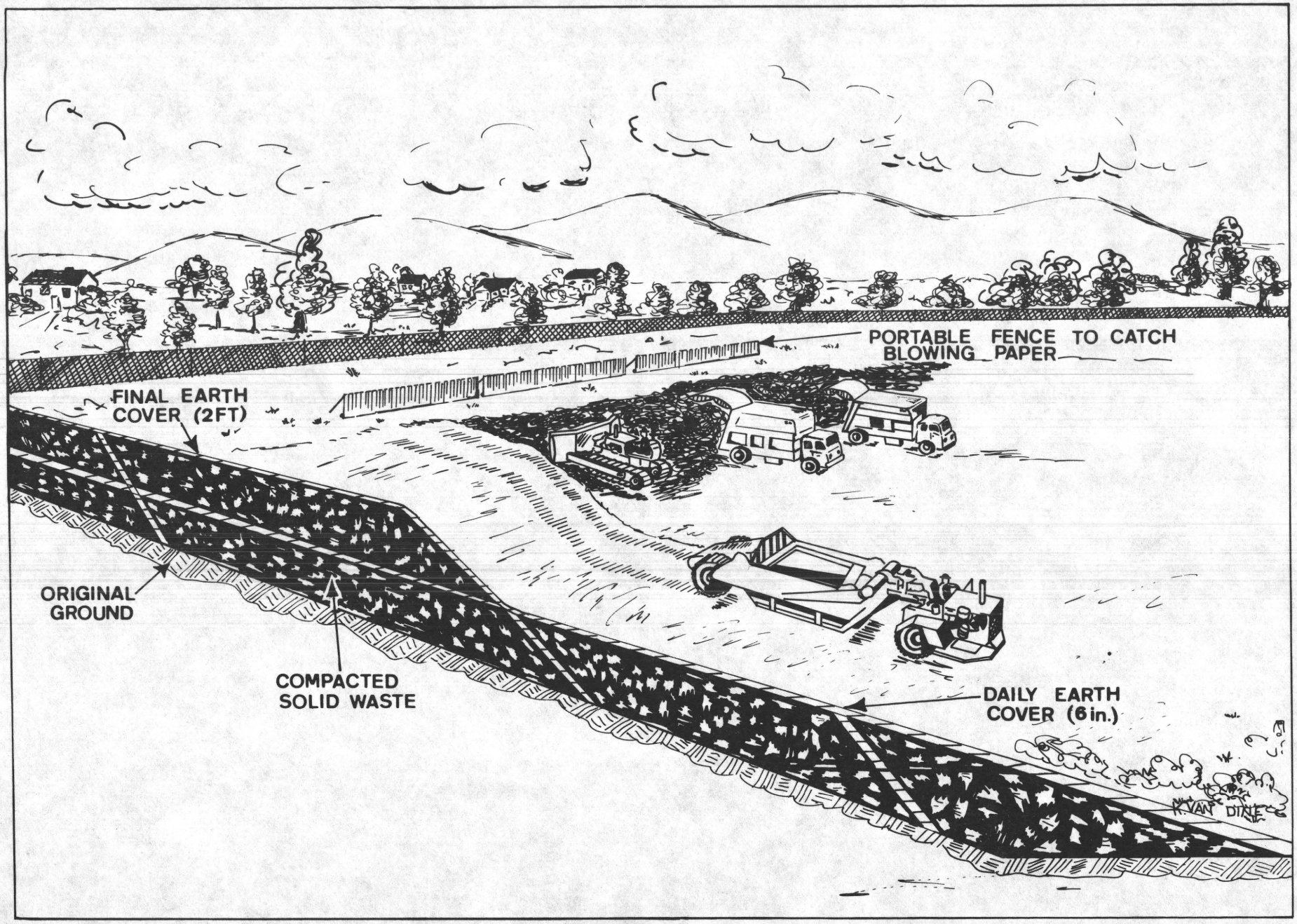

FIGURE 3.--Sanitary land filling with scraper (foreground) hauling the cover material at the end of the day's operation (modified after Sorg and Hickman, 1970, fig. 1, p. 9).

Grinding of garbage in home disposal units and subsequent discharge to municipal sewers and treatment plants is widely practiced in the bay region. This method reduces solid-waste disposal problems somewhat, but it puts a heavier load of suspended solids and organic material on municipal sewage-treatment plants. Kaiser Engineers (1969) predicted that the carbonaceous and nitrogenous component of municipal wastewater in the bay region would increase in the future as the use of home garbage grinders becomes more common. Water-pollution problems may place limiting restrictions on the feasibility of large-scale garbage grinding operations.

Salvaging of metals, cardboard paper, and other materials which have a local market is practiced to a limited extent in the bay region. Salvaging of scrap iron is sometimes part of a landfilling operation. Organic wastes are sometimes salvaged for hog feeding. A limited amount of salvaging is accomplished through the solid-waste recycling operations carried on by residents of some cities of the bay region. For example, some Palo Alto residents voluntarily sort their own household wastes into various fractions and deliver them to a facility located at the Palo Alto landfill site (site 111 on plate 1 and in table 1).

Ocean disposal is not desirable because debris eventually returns to beaches and there is also the danger of damaging the marine environment. In the bay region, the only solid wastes that can be released to the ocean are cannery wastes and bay dredge materials. State laws and the San Francisco Bay Regional Water Quality Control Board prohibit the disposal of other solid wastes in the ocean (California Department of General Services, 1969).

Onsite disposal of solid wastes consists of burning or spreading and plowing in agricultural wastes and incineration of institutional refuse and industrial wastes. Open agricultural burning is no longer practiced in the bay region because of air-pollution control standards. Incineration of institutional refuse is practiced to a limited extent.

FUTURE SOLID-WASTE MANAGEMENT

In the near future, full sanitary landfill operations will be used to a greater extent for solid-waste disposal in the bay region. This will result from the currently tightening governmental restrictions on solid-waste disposal, and the exhaustion of older and unsatisfactorily operated waste-disposal sites. Most new landfill sites will be large and will be located in rural inland areas owing to the lack of suitable land near population centers. The Ox Mountain site in San Mateo County (site 110, plate 1) is an example of one of the large new inland sites. In Santa Clara County, a land-based waste-disposal site suitability study (W. G. Hines, written commun., 1972) is being undertaken by the Geological Survey to aid planners in developing the methodology necessary for finding suitable new sites.

Incineration of solid wastes may also become more common in the bay region if the resulting air-pollution problems are solved. Other technological advances in solid-waste disposal may include more efficient solid-waste sorting equipment, pneumatic conveyance pipelines, solid-waste combustion and power-generation facilities, and large solid-waste reclamation plants.

It will continue to be expensive to handle solid wastes, even with the anticipated technological advances in waste-disposal methods. Source control of wastes will become a necessity in keeping this expense down. The public and industry must be made aware of the need for reducing the quantity of solid waste generated in the home and at work. Separating reclamable materials and delivering them to municipal recycling centers will help somewhat to reduce per capita generation of solid wastes. Solid-waste management will improve greatly if such cultural changes can be fostered together with the implementation of technological advances and efficient land-use planning in waste disposal.

SOLID-WASTE DISPOSAL SITES IN THE BAY REGION

Plate 1 shows the approximate location of most of the active, inactive, and proposed solid-waste disposal sites in the nine-county bay region. The sites are keyed by number to tabular information in table 1, which shows the type of operation, the quantity and nature of wastes, and the present and potential water-quality impairment characteristics of each site. The information presented on the map and in the table should not be considered current in every detail, because changes are constantly taking place. The information was checked recently with information available at the California Department of Public Health, Bureau of Vector Control and Solid Waste Management. All sites were being resurveyed by that department at the time this report was being prepared.

CLASSIFICATION OF SOLID-WASTE DISPOSAL SITES IN CALIFORNIA

The California Water Resources Control Board (written commun., 1972) classifies solid-waste disposal sites according to the sites' potential for water-quality impairment and its danger to public health and wildlife resources.

A Class 1 waste-disposal site is one where the deposited wastes cannot contaminate usable ground water or surface water. Such sites require a geologic or manmade barrier between the waste materials and any ground-water or surface-water bodies. This barrier must be effective for all time. Further, if manmade barriers are constructed, they must be used only to prevent lateral movement of waste or leachate. All types of municipal, agricultural, and industrial wastes, except radioactive materials, can safely be disposed of at Class I sites.

A Class II-1 waste-disposal site is one having the same characteristics as a Class I site except manmade barriers can be used to prevent both vertical and lateral waste or leachate movement. Class II-1 sites must afford protection from inundation by a 100-year flood and high tides. Some toxic solid and liquid wastes may be permitted at Class II-1 sites.

A Class II-2 waste-disposal site is one which lies over usable ground water where the lowest elevation of the site can be kept several feet above the highest anticipated ground-water level. The site must afford protection from inundation by 100-year floods and high tides. Any water collected at the site is subject to regional waste-discharge requirements. Nontoxic solid wastes and decomposable materials, such as wood, certain metals, sewage-treatment residue, and food wastes, can be disposed of in Class II-2 sites. This is the most common type of site found in the bay region.

A Class III waste-disposal site is one which can only afford protection to water quality by preventing erosion of deposited wastes. Only nontoxic, nonsoluble, nondecomposable solids such as earth, rock, concrete, glass, and plastics can safely be placed in Class III sites.

REQUIREMENTS FOR SELECTION AND MANAGEMENT OF LANDFILL DISPOSAL SITES AND RELATION TO WATER-QUALITY IMPAIRMENT

The selection and management of solid-waste disposal sites is a consideration in land-use planning. This section describes some important aspects of site selection and management of landfills, the most widely used disposal method in the bay region.

New sites for landfill disposal must be given careful consideration to reduce potential health hazards, air and water pollution, and the public nuisances of odor, scattered debris, and unsightliness. In the past, sites were often selected solely for convenience or economy where land was cheap and unpopulated. In the bay region this type of land is now scarce. New landfill sites will have to be located in areas remote from urban centers. Moreover, protection of water resources from pollution requires that potential sites be fully evaluated as to topography, soils, geology, hydrology, and suitability for sanitary operation.

Ideally, a sanitary landfill disposal site should be located on nearly impermeable land to prevent percolation of leachate to a ground-water reservoir. The site must not be subject to flooding. Depressions with ground water at or near their surfaces should be avoided. Steep slopes should be avoided because of their erosion potential. The site should be of sufficient size for the wastes received, be accessible by arterial roads, and have enough earth available for daily covering of the refuse. Few ideal sites are available and therefore site alterations will probably be necessary in most cases.