CHAPTER 13

STRIP MINE RECLAMATION AND SOLID WASTE LANDFILL

13-1. General. Two beneficial uses of dredged material that are still fairly new concepts have proven to be feasible in laboratory, field, and District tests (items 4 and 75). These are the reclamation of abandoned strip mine sites that are too acidic for standard reclamation practices, and the capping of solid waste landfills (item 75). Both uses would require large quantities of dewatered dredged material that could be moderately contaminated and still be acceptable. Both uses would ultimately provide nonconsumptive vegetative cover to unsightly areas, and the areas could be further reclaimed for minimal-use recreation sites and/or wildlife habitat. Item 75 provides excellent discussion of both types of beneficial uses. The techniques discussed in this chapter also apply to pyrite soil reclamation, gravel pits, and rock quarries. St. Paul District has reclaimed an abandoned gravel pit, and Portland District has reclaimed a rock quarry using these techniques.

13-2. Strip Mine Reclamation. Various techniques have been developed to control acid mine drainage from surface mine spoils. The primary purpose of these techniques is to reduce air and water contact with the acid-generating mine spoils. Methods which accomplish this are reducing slopes, thereby lowering runoff velocities and erosion, and establishing plants on the mine spoils. A balance must be struck between slope reduction and increased infiltration capacity. Attempts to establish vegetative cover on highly acidic mine spoils have usually resulted in low survival rates. The lack of a vegetative cover on mine spoils will result in erosion and further exposure of acid-generating pyrites to air and water (item 75). In order to reduce adverse effects of mine spoils, placement of a topsoil or topsoil substitute suitable for vegetative growth such as dredged material is recommended. Application of dredged material to surface mine spoils will provide a cover that will reduce the infiltration of water and the diffusion of air to the pyrite material, and provide a suitable growing medium for vegetation. Planning must be coordinated with the landowner and, if the mine is an active surface mine, the mining operator. Before reclamation activities can commence, State reclamation laws which include the final grade of the area, cover requirements, and vegetation requirements must be assessed. Assistance for various aspects of surface mine reclamation can be obtained from state reclamation departments, county agricultural extension offices, the SCS, and the U.S. Office of Surface Mining.

a. Dredged Material Requirements. Dewatered dredged material can be used for surface mine reclamation in much the same way as topsoil or agricultural soil. If construction on the site is considered as the final land use for the reclaimed mining area, tests for consolidation, shear strength, and permeability should be performed on the dredged material as well as the mine spoil. Fractions of dredged material having different grain sizes can be mixed to provide a surface with desirable physical and engineering properties.

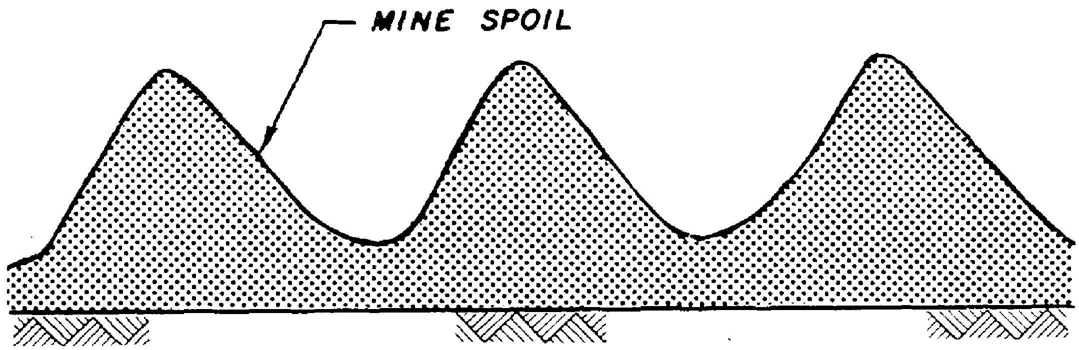
Almost any desired soil property can be obtained by dewatering, mixing, and compacting dredged material (item 4). Fine-grained or sandy silt dredged material can be used as a cover on mine spoils for the establishment of vegetation. Dewatered dredged material having a loam texture is the most desirable for best vegetation growth. The dredged material should be tested for pH, organic content, and soluble salts. It should have a nearly neutral (6.0 to 7.5) pH, a minimum organic content of 1.5 percent by weight, and a low amount of soluble salts (500 ppm or less) to allow optimum plant growth.

b. Site Preparation and Dredged Material Placement. The amount and method of site preparation needed at surface mines are dependent on the topography, the method of mining performed (area, contour, open pit, etc.), and the final land use. Site preparation consists chiefly of regrading the surface mine to a configuration that will accommodate a dredged material cover at a desired thickness and slope to support vegetation. The two principal surface mining techniques are area and contour mining. The potential for ground water percolation and contamination should be determined for both the mine spoil and the dredged material.

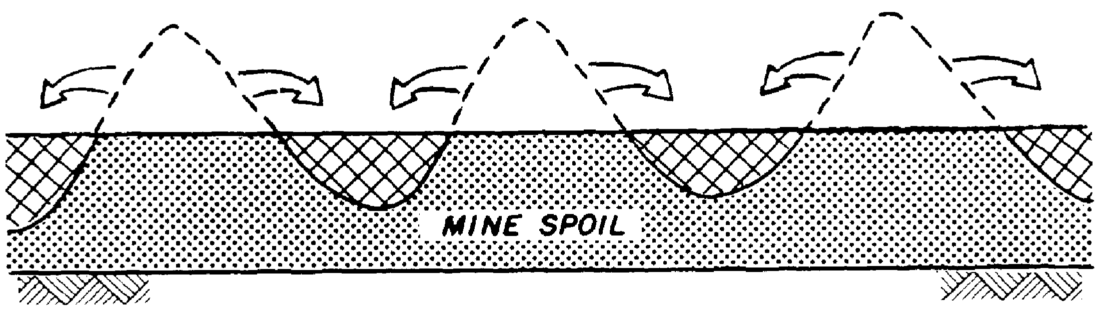
(1) Area mining reclamation.

(a) The area mining method produces the characteristic topography of a series of parallel ridges or piles of mine spoil. Site preparation consists of leveling mine spoil ridges or piles to a width specified by law and/or final land use. Leveling or “striking off” mine spoil ridges is accomplished by bulldozing the ridges into the valleys between ridges. The mine spoil piles should be leveled to a topography where conventional earthmoving equipment can spread dewatered dredged material to a desired thickness (Figure 13-1). This method of leveling was field tested by the Chicago District at Ottawa, Illinois. The mining site was leveled, capped with dewatered material, mixed, soil amendments added, and planted in a grass mixture. The site established vegetative cover rapidly, and is a very successful site (item 63). It has still maintained good vegetation cover 8 years after planting.

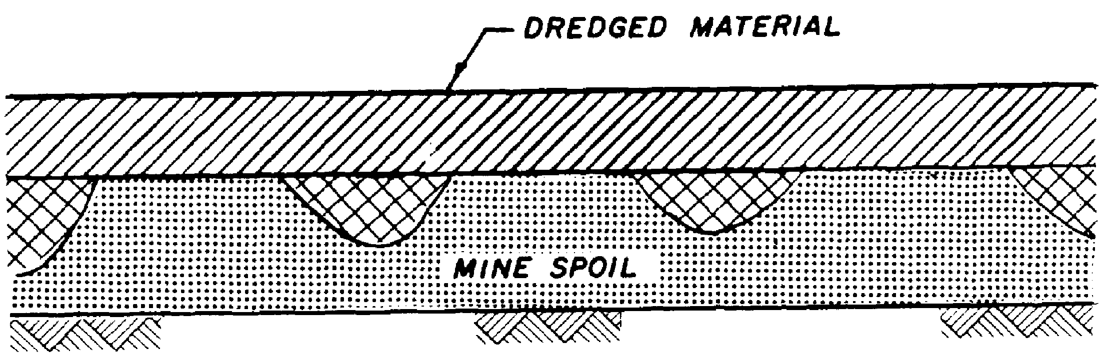
(b) An alternate concept of reclaiming area mines is the use of slurried dredged material. This method to date has not been field tested, but appears promising. It consists of hydraulically pumping dredged material in a pipeline onto a prepared area mine. This form of reclamation is only feasible for area mines located within pumping distance of an active dredging operation or rehandling basin. Preparation of the site consists of grading mine spoils to a fairly uniform level and constructing dikes around the area to contain the slurried dredged material. Because of the slurry’s high water content, it must be pumped in lifts and allowed to dewater before adding the next lift. The depth of each lift is dependent upon the final land use and time constraints (item 57). If the area is to be used for foundation material to support lightweight structures, the lifts of slurried dredged material should be limited to about 36 inches so that drying will be enhanced (item 52). The dredged material should be allowed to dry to a moisture content near its



a. Prereclamation



b. Grading the mine spoil



c. Application of dredged material

Figure 13-1. Schematic diagram showing operational techniques used to reclaim a surface mine spoil with dredged material plastic limit before adding the next lift (item 57). If the area being reclaimed is not planned to support structures and is mainly being reclaimed for recreation or vegetation establishment, the depth of each lift can be increased and the amount of time between lifts can be shortened.

(2) Contour mined land reclamation.

(a) The reclamation of contour mines is more difficult due to the hilly terrain in areas where this type of mining occurs. This technique of mining requires removal of the overburden by starting at the outcrop of the coal seam and proceeding along the contour around the hillside. The highwall is located on the uphill side, while a rim and steep downslope are covered by the spoil material cast down the hillside. Being above the grade of local drainage, water from the pits flows directly into natural waterways. Reclamation of contour mines involves backfilling and terracing the disturbed land to the approximate original contour or to a contour compatible with the surrounding terrain. This requires placing dredged material into strip pits and over the mine spoil which was cast downhill (Figure 13-2).

(b) The choice of which regrading technique to use for reclamation depends on many variables, including final land use, terrain, amount of dredged material, and state and Federal reclamation requirements. Concepts for using dredged material on contour mine backfill are shown in Figures 13-2, 13-3, and 13-4. The use of dredged material to reclaim the mine to the original ground surface level and contour is demonstrated in Figure 13-2. The mine spoil on the downslope is also covered with dredged material to provide a vegetative media. Figure 13-3 shows the use of the Georgia V-ditch technique which does not fill to the original soil surface but leaves a highwall and fill section to be leveled to support vegetative as well as agronomic production. The slope reduction technique, as shown in Figure 13-4, permits stockpiling of dewatered dredged material before final grading to original slopes and contours.

c. Vegetation Establishment.

(1) Establishment of a quick vegetative cover is important at reclamation sites for it is one of the most effective erosion control methods (item 63). It must be known whether the area is ultimately to be used for farming, grazing, construction, temporary soil stabilization, restoration for aesthetics, or other purposes. When selecting vegetation, plant species should be chosen that will be able to adapt to dredged material conditions, such as low pH, high moisture, grain-size distribution, and fertility level. The species selected should be adaptable to the climatic conditions (sunlight exposure, temperature, wind exposure, rainfall) found at the site. It is best to choose vegetation native to the area which can be easily propagated. A species mixture should be planted to ensure successful establishment of a vegetative cover (item 63).

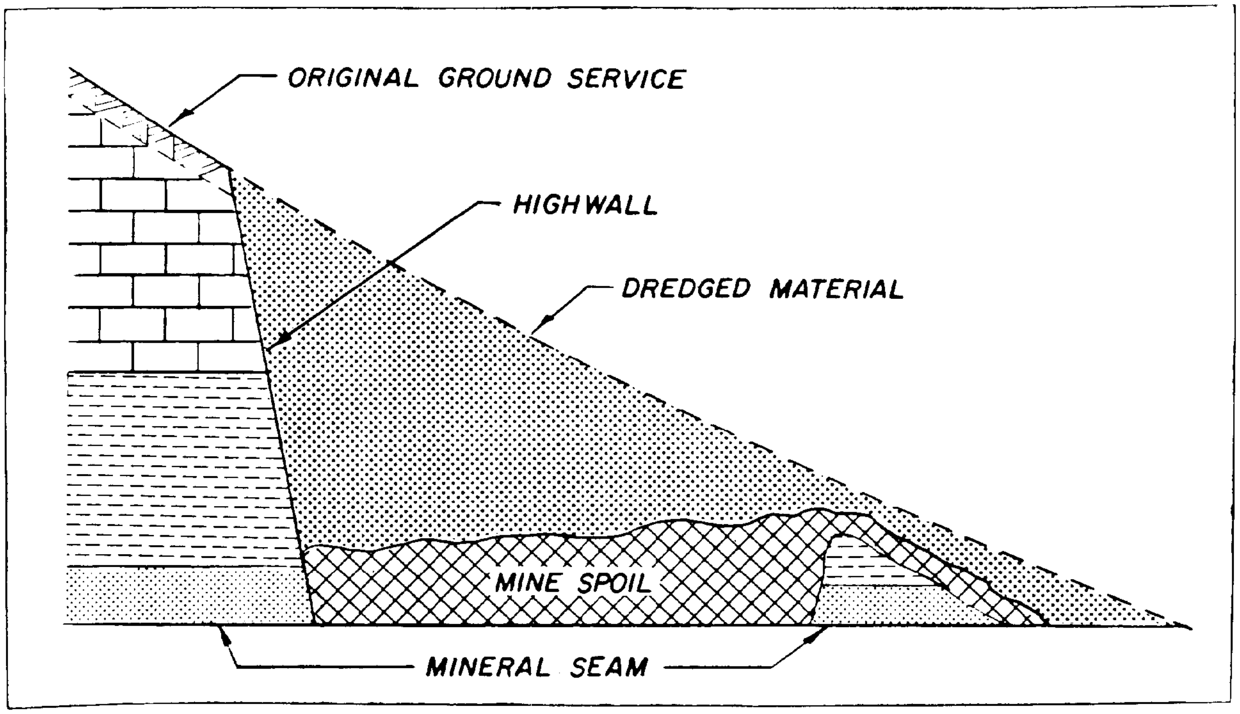


Figure 13-2. Gross-sectional view of contour backfill technique (itme 75)

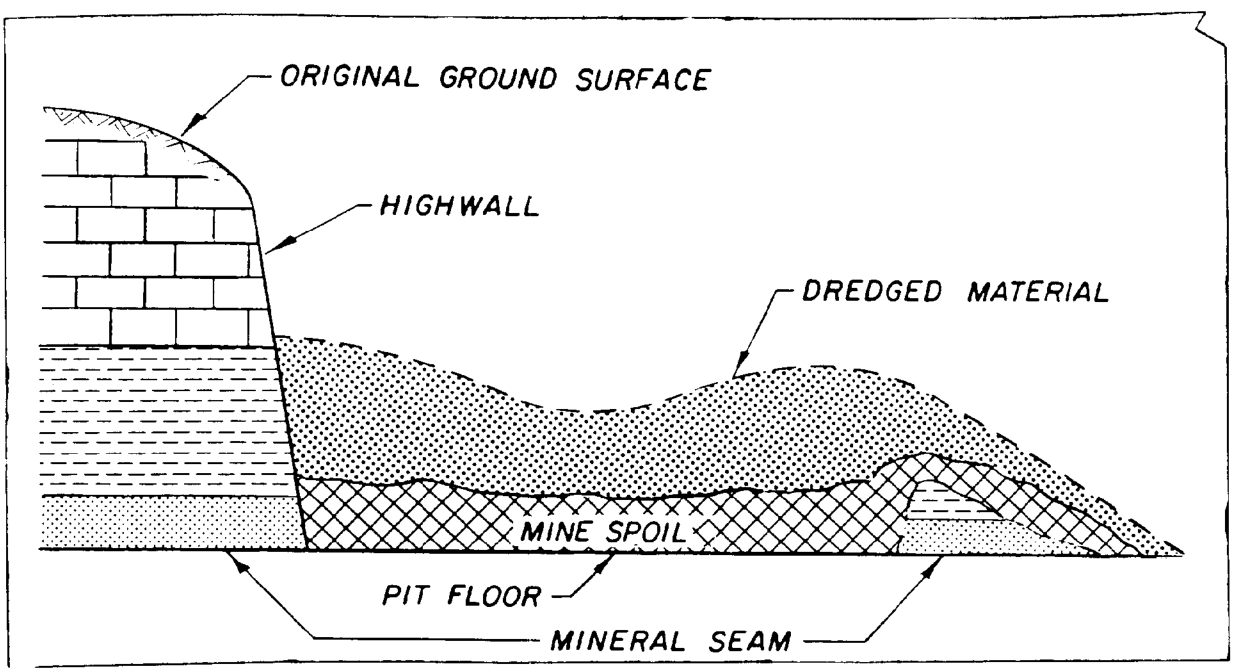


Figure 13-3. Gross-sectional view of the Georgia V-ditch backfill technique (item 75)

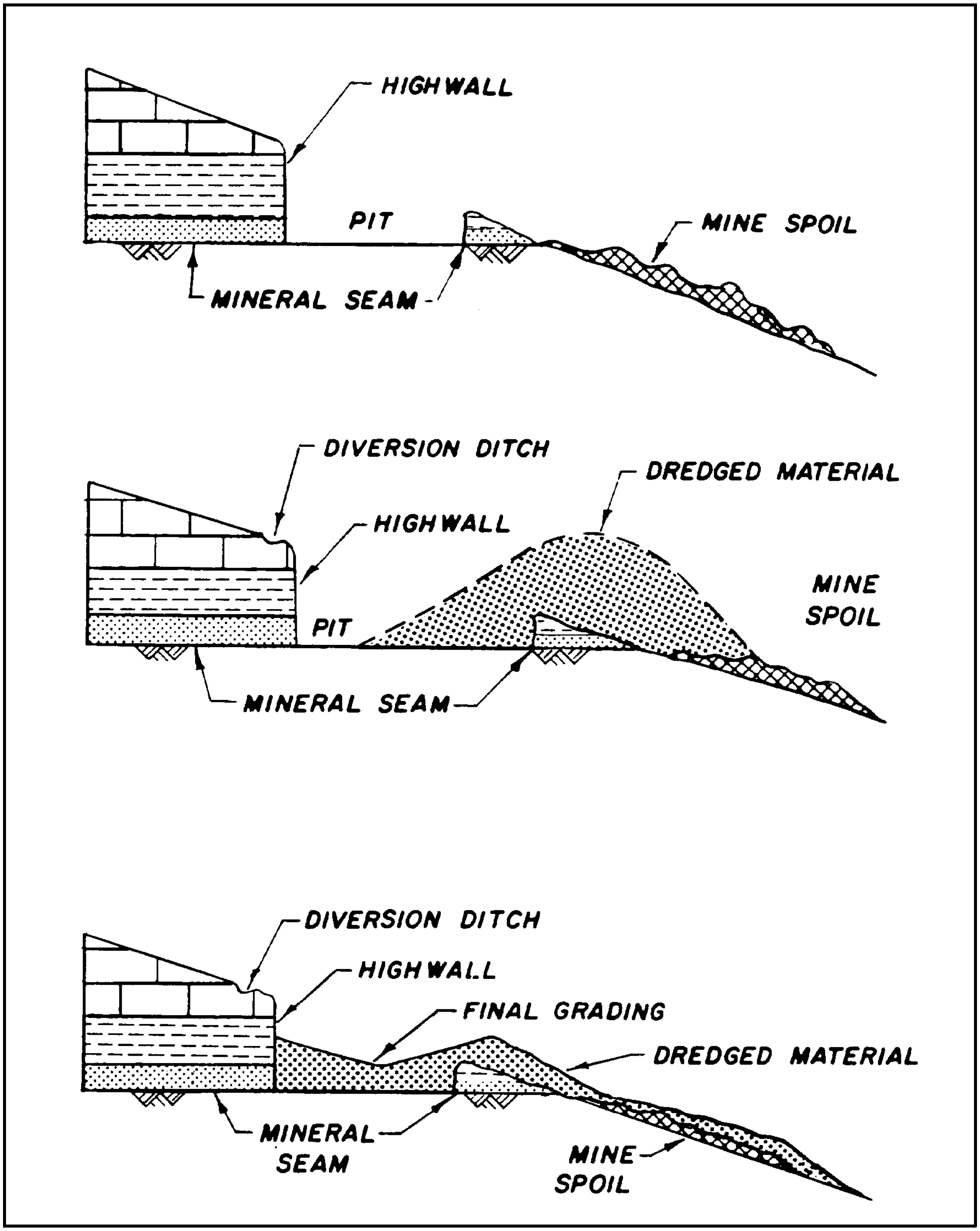


Figure 13-4. Schematic of slope reduction technique (item 75)

(2) It is desirable to roughen or cultivate the dredged material surface before seeding in order to reduce the velocity of rainfall runoff and increase water infiltration to seedbed depth. The surface of the dredged material should not be compacted because this impedes seedling emergence. Common methods for preparing the surface of the dredged material are scarification, tracking, and contour benching or plowing using disks, harrows, and tractors. Tracking grooves made by the cleats of a tractor should run parallel to the contour. Contour benching is performed on long slopes to build terraces to reduce the velocity of rainfall runoff (item 75). Terracing is performed with a bulldozer running parallel to the contour and allowing the soil to dribble off the edge of the blade. Furrowing of a terrace is performed by repeated plowing parallel to the contour. Other methods for planting such sites are available in items 16 and 32. Dredged material should not be placed on a slope that is in a frozen or muddy condition or when the subgrade is excessively wet or in a condition that may be detrimental to proper grading and the proposed seeding. Hydromulching or mechanical mulching on new cuts, revetments, dikes, and terraces is also usually required to prevent erosion.

d. Site Selection. Mining sites that would be suitable for dredged material disposal for reclamation purposes must meet certain criteria. The mined areas should be assessed for transportation capabilities as well as qualitative considerations such as social and environmental concerns. Field investigations of potential sites should include such general factors of the site as geology, ground water, effluent standards, ambient water quality, land costs, drainage, surrounding land use, and vegetation of adjacent lands. Permission for site use must also be obtained. Transportation costs are a major consideration, and are generally at sponsor expense. For this reason, mines that are near disposal sites and/or suitable transportation systems are probably the only ones feasible for consideration.

13-3. Solid Waste Landfills. Governmental agencies responsible for the management of solid waste are experiencing difficulties in obtaining suitable sites on which to operate environmentally sound solid waste disposal operations. A major portion of the solid waste generated in this country is ultimately placed on land in sanitary landfills. The location of a sanitary landfill is often constrained by the cover material requirements and availability and the site characteristics related to potential adverse environmental impact. Item 3 reports that dredged material can satisfactorily perform the functions of a cover material, thereby making it possible to locate sanitary landfills at sites previously considered unsuitable due to a lack of native cover soil. St. Paul and Mobile Districts have both used clean dredged material as caps for urban landfills. This section is intended to aid planners in determining the suitability of dredged material for productive use in solid waste management schemes and to provide guidance for development of possible landfill projects (items 3 and 75).

a. Dredged Material Characteristics. The potential uses for dewatered dredged material in a sanitary landfilling operation are as a material for covers, liners, gas vents, leachate drains, and gas barriers. Chapter 2 presented a discussion of physical and chemical characteristics to be considered when using dredged material in a land improvement project. Some dredged material grain-size distributions are generally more suitable than others.

(1) Cover. The solid waste in a sanitary landfill is covered daily with at least 6 inches of material to prevent an unsightly appearance, control vectors at the site, prevent internal fires, and control surface water infiltration. Landfills with two or more lifts must have intermediate covers 12 inches deep between lifts. The intermediate cover must fulfill all functions of a daily cover for up to 12 months and must be trafficable to assist vehicle support and movement. Dredged material characteristics of a desirable cover material are easy workability, moderate cohesion, and significant strength. A mixture of sand, silt, and clay has been shown to be a suitable cover material; if a gravel is fairly well graded with 10 to 15 percent sand and 5 percent or more fines, it can make an excellent cover. The only types of dredged material eliminated for use as cover are highly organic materials and peat. Due to the difficulty in handling, dredged material should not be used in the slurry state. On the other hand, the use of dewatered dredged material as cover is operationally feasible because the material can be easily hauled, spread, and compacted by conventional earth-moving equipment.

(2) Liners and barriers. Barriers and liners serve the same purpose, i.e., to prevent the migration (lateral and vertical) of leachate water or decomposition gases. The suitability of the dredged material for this use is determined by the permeability of the material. Dredged material with classifications of CL or CH is likely to be suitable for use in constructing a liner or barrier. Attempts should be made to keep these barriers and liners saturated to prevent cracking and to keep pore spaces filled with water to prevent gas leaks.

(3) Gas vents and leachate drains. Gas vents are used to direct the flow of gas to the atmosphere where it is harmlessly dissipated, and leachate drainage layers are used to intercept leachate and drain it to an area where it can be collected for treatment or recirculation (item 3). The controlled ventilation of gas requires that the vent be more pervious than the surrounding soil, and a leachate drain must also be very pervious so that leachate will be drained quickly away from the solid waste. To be suitable for venting gas or draining leachate, the dredged material must consist of sand or gravel with little or no fines and must be much more pervious than the soils at the site.

b. Site Considerations.

(1) Site selection. The selection of the solid waste disposal site will be the decision of the governing sanitary district. Site suitability and site management options will be evaluated by the sanitary district. The offer of dredged material to these districts allows them to consider sites initially screened out due to the lack of natural soil cover. It should be remembered

that in this beneficial use, the CE is simply providing a useful material to a sanitary district; therefore, site selection and construction and operation of the landfill are not the responsibility of the CE.

(2) Preliminary dredged material data collection. The dredged material source (dredging operation or containment area) should be defined in terms of location and quantity. Critical dredged material characteristics should be determined by examining physical and engineering characteristics and settling properties and by noting any evidence of contaminants. The available dredged material should be viewed in terms of suitability for sanitary landfill use, i.e., as covers, liners, barriers, vents, and drains. The dredging area should be assessed for available transport modes.

(3) Transport systems. For dredged material uses in solid waste management to be economically attractive, the landfill site must be within a reasonable distance of the dredged material supply. Not more than 50 miles is recommended in order to keep the unit cost of shipment down. Truck haul is the only mode of transport recommended because of its convenience, feasibility of operation, and ease of fitting into landfilling schemes (item 40).

(4) Economics. The success of any attempt to use dredged material in solid waste management will be dependent upon the economic feasibility of the project for each of the agencies concerned. Since each operation involving the use of dredged material in solid waste management is unique, economic feasibility is evaluated on a case-by-case basis. There should be a net benefit to all agencies involved.