CHAPTER 7

OPERATION AND MANAGEMENT OF CONTAINMENT AREAS

7-1. General Considerations. This chapter presents procedures for the effective management and operation of containment areas. Management activities are required before, during, and following the dredging operation to maximize the retention of suspended solids and the storage capacity of the areas. These activities include site preparation, removal and use of existing dredged material for construction purposes, surface water management, suspended solids monitoring, inlet and weir management, thin-lift placement, separation of coarse material, dredged material dewatering, and disposal area reuse management. Management activities described in this part are not applicable in all cases, but should be considered as possibilities for improving the efficiency and prolonging the service life of containment areas.

7-2. Predredging Management Activities.

a. Site Preparation. Immediately before a disposal operation, the desirability of vegetation within the containment area should be evaluated. Although vegetation may be beneficial because it helps dewater dredged material by transpiration and may improve the effluent quality by filtering, very dense vegetation may severely reduce the available storage capacity of the containment area and may restrict the flow of dredged slurry throughout the area, causing short-circuiting. Irregular topography within the containment area will directly affect resulting topography of the dredged material surface following the dredging operation. It may be beneficial to grade existing topography from planned inlet locations toward the weir locations to facilitate drainage of the area.

b. Use of Existing Dredged Material. If dikes must be strengthened or raised to provide adequate storage capacity for the next lift of dredged material, the use of the dried dredged material or suitable construction material from within the containment for this purpose will be beneficial. In addition to eliminating the costs associated with the acquisition of borrow, additional storage capacity is generated by removing material from within the area. Consideration should also be given to the use of any coarse-grained material present from previous dredging operations for underdrainage blankets or for other planned applications requiring more select material.

c. Placement of Weirs and Inflow Points.

(1) General placement for site operation and management control. Outflow weirs are usually placed on the site perimeter adjacent to the water or at the point of lowest elevation. The dredge pipe inlet is usually located as far away as practicable from these outflow weirs or at a location closest to the dredging areas. However, these objectives may sometimes be conflicting. If the disposal area is large or if it has irregular foundation topography, considerable difficulty may be encountered in properly distributing the material throughout the area and obtaining the surface elevation gradients necessary for implementation of a surface trenching program. One alternative is to use interior or cross dikes to subdivide the area and thus change the large

area into several smaller areas. Effective operation may require that the dredge pipe location be moved periodically from one part of the site to another, to ensure a proper filling sequence and obtain proper surface elevation gradients. Also, shifting inflow from one point of the site to another and changing outflow weir location may facilitate obtaining a proper suspended solids concentration in disposal site effluent.

(2) Installation and operation of multiple outflow weirs. In conjunction with provisions for moving the inflow point over the disposal site, it may also be worthwhile to contemplate installation of more outflow weirs than would be strictly required by design methods. Availability of more outflow points allows greater flexibility in site operation and subsequent drainage for dewatering, as well as greater freedom in movement of dredge inflow points while still maintaining the flow distances required to obtain satisfactory suspended solids concentrations in disposal site effluent. Also, a higher degree of flexibility in both disposal site inflow and outflow control will allow operation of the area in such a manner that desired surface topography can be produced, facilitating future surface trenching operations.

d. Interior Dike Construction.

(1) Need for interior dike construction. The basic rationale behind the construction of interior disposal area dikes is to subdivide the area into more manageable segments and/or to control the flow of dredged material through the disposal area. Control of material placement is normally to facilitate future disposal site operations, such as dewatering, or to provide proper control of disposal area effluent. Interior dikes may also be used as a haul road and access for movement of material for dike construction or other beneficial uses.

(2) Economics of interior dike construction. As a general rule, the use of interior cross dikes in any disposal area will increase the initial cost of construction and may result in increased operating costs. However, facilitation of disposal site operations, particularly future dewatering, may result in a general reduction in unit disposal cost over the life of the site. The benefit derived from dikes should be evaluated against the amount of disposal volume required for their construction. If the dikes can be constructed from dredged material or material available in the disposal site foundation and subsequently raised with dewatered dredged material, the net decrease in storage capacity will be approximately zero.

(3) Disposal site operation using subareas in series.

(a) Cross dikes may be used to control and direct the inflow and are normally built to allow site subcontainment area (subarea) operation either in series or in parallel. In series, the flow is routed first into one subarea, with sedimentation producing segregation of larger particles, and the overflow from the first subarea is routed to a second subarea where finer particles fall from suspension and then perhaps into another subarea, etc., with the outflow point being located at the end of the last subarea. In some instances, cross dikes are built across the entire site width, and a long overflow weir is provided to allow outflow into the next subarea in the series. In other instances, spur dikes are built into the containment area to cause a twisting path for the flow.

(b) In general, the use of series-oriented subdisposal areas should be considered carefully, since the actual result of such use may be the opposite of that desired by the designer. During disposal, coarse-grained sand and gravel will settle very quickly around the disposal pipe location. Other material will remain in suspension, depending on its effective particle size, water salinity, and flow velocity. A subarea can be effective in separating coarse material in an area where later recovery for other use will be easier. As a practical matter, a subarea or containment basin to trap or separate specific silt and clay sizes is rather impractical. A rational design for a series of subareas might require an initial subarea to trap sand and gravel, with the remainder of the material, i.e., the fine-grained fraction, going to a larger subarea. Then, if desired, a final subarea could be used for retention of fine material in conjunction with use of chemical flocculants, to maintain proper water quality in the disposal area effluent. When designing the series of subdisposal areas, care must be taken to obtain adequate size. If the first subarea in the series is filled, it will no longer function and provide the required residence time, and its function must be assumed by the next unit in the series.

(4) Disposal site operation using subareas in parallel. To facilitate site dewatering, operation of interior compartments on a parallel basis may be used. In this concept, flow is initially routed into one compartment; then, when it is filled to the proper depth or when suspended solids concentration standards in the effluent are exceeded, the flow is routed to another portion of the site. This procedure allows more carefully controlled placement of material to the desired thickness throughout the site. Parallel compartments also allow more efficient drying to occur in compartments not in active use since the water ponded for sedimentation is confined to the active compartment (see Figure 7-1).

(5) Sequential dewatering operations. If the disposal site is large enough to contain material from several periodic dredgings, each compartment may be used sequentially for a separate operation. In this manner, a sequence such as the following may be developed. The first compartment is filled, and, after decant, dewatering operations are initiated. As dewatering operations proceed, the next disposal is placed in the second compartment and subsequent disposal in the third, etc. While fresh material is being deposited in part of the site, the dewatered material from the initial placement may be borrowed and used to raise perimeter dikes, facilitating reuse of the initial subarea. This sequence of operations is shown in Figure 7-2.

e. Improvement of Site Access.

(1) Adequate provisions for site access are essential when the long-term operation and management plan for a disposal site includes provision for future dewatering activities and/or removal of dewatered material for dike raising or other productive use. General considerations for site access may include:

(a) Access roads on or adjacent to perimeter and interior dikes.

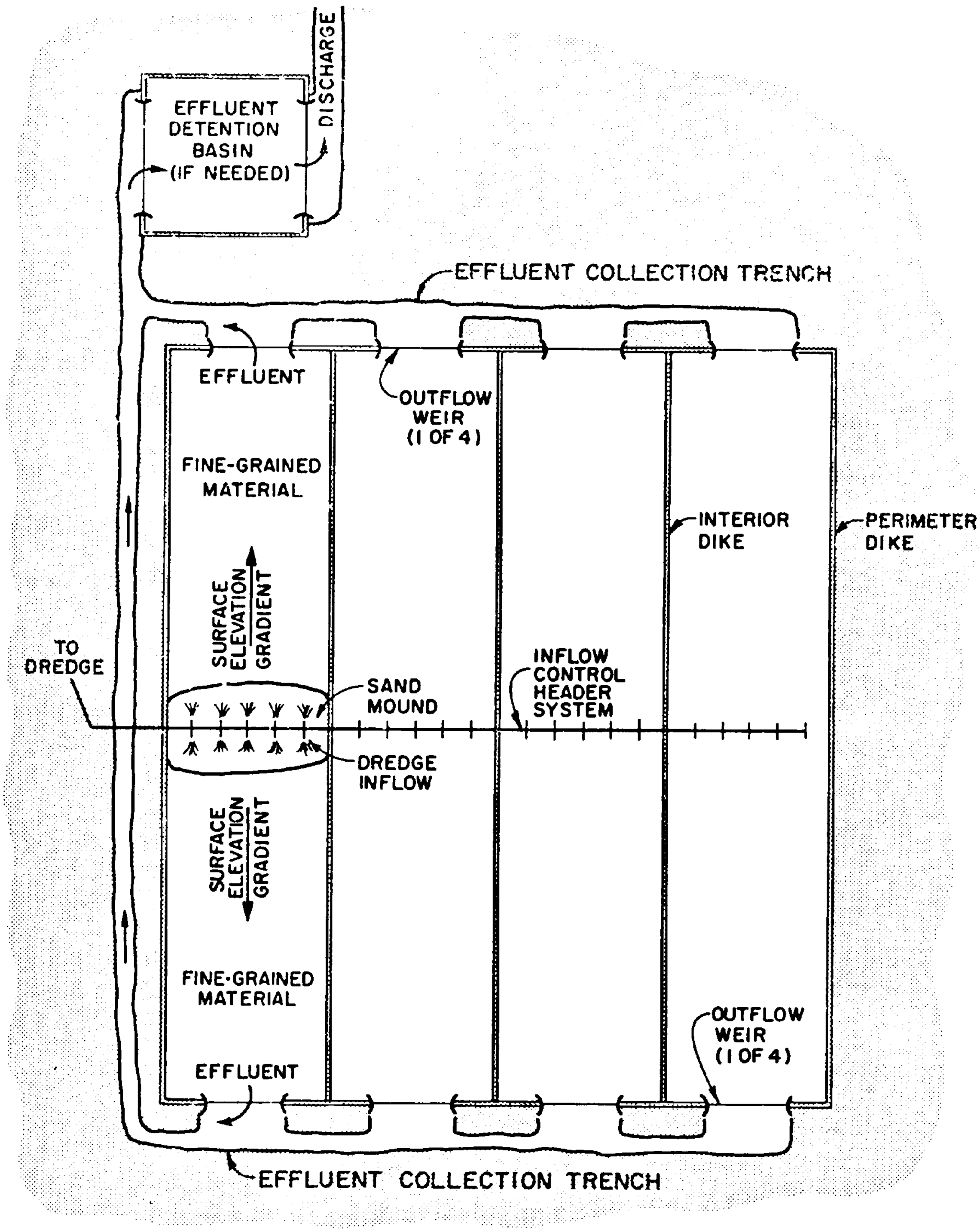


Figure 7-1. Conceptual illustration of disposal site layout to permit parallel compartment use and produce surface topography facilitating future dredged material dewatering

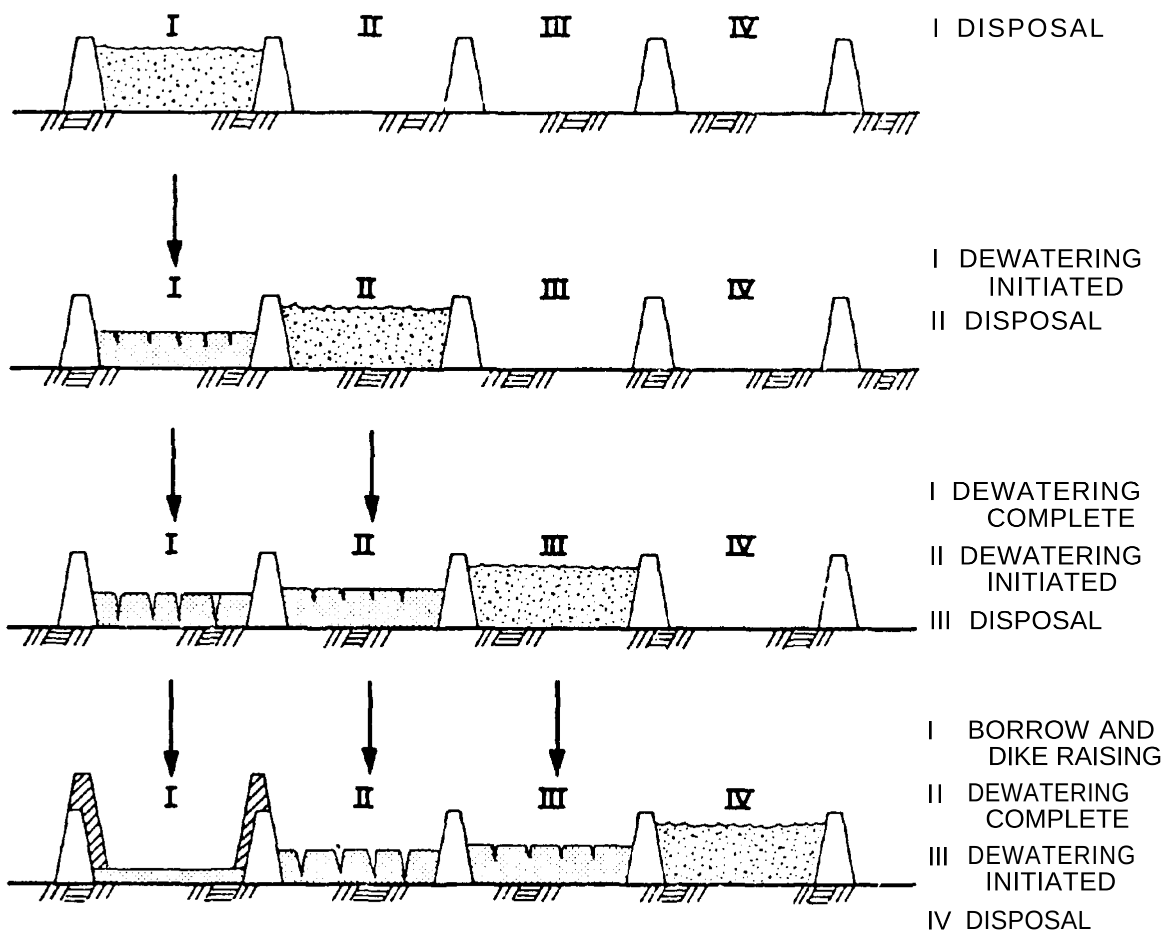


Figure 7-2. Conceptual illustration of sequential dewatering operations

(b) Crossing points on interior ditches used for drainage or dewatering.

(c) Access for equipment and personnel to reach weir structures for repair or maintenance.

(d) Ramps for access onto dikes from both inside and outside dike faces.

(e) Ramps for pipelines leading to inflow points.

(f) Equipment turnarounds.

(g) Stockpiles of materials for sandbagging and emergency dike repairs.

(h) Offloading ramps for equipment transported by water.

(2) If future borrow of interior dewatered dredged material is contemplated, it may be most cost-effective to construct small access roads into the area, as a substructure for future haul roads or dragline access. Such stable platforms may be covered with some fine-grained dredged material, but

their emplacement in the disposal area will allow subsequent equipment operation without immobilization.

f. Scheduling of Dredging Operations to Take Maximum Advantage of Climatic Conditions. Many nonengineering considerations affect the actual time during which disposal operations are conducted. They include:

(1) Expenditure of funds with respect to fiscal year.

(2) Relative priority of the operation with respect to other work.

(3) Lag time necessary to obtain proper specifications preparation and contract advertisement.

(4) Variation in time when the contractor must move on the job.

(5) Size of dredge.

(6) Existing weather conditions.

(7) Environmental considerations (i.e., dredging windows).

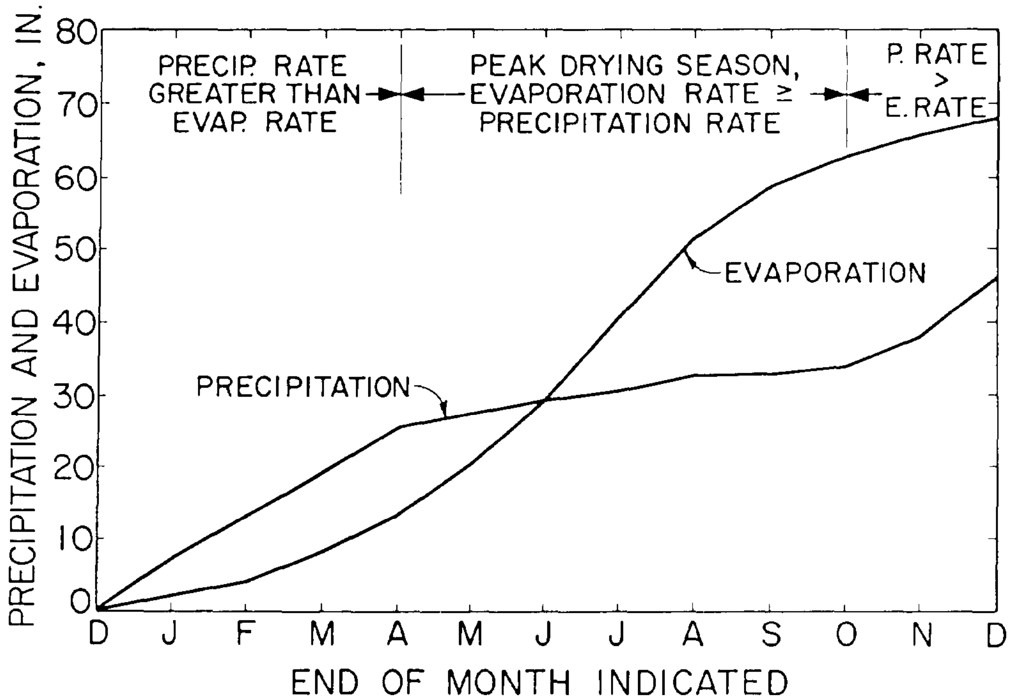
(8) Lag time required for preparation of the disposal site.

Nevertheless, considerable advantage may be gained, in an engineering sense, from scheduling disposal operations to occur at appropriate periods of the calendar year, depending upon prevailing climatic conditions. By conducting the disposal phase during a period of relatively low evaporative demands, the initial postdisposal activity (i.e., decanting and gradual reduction of ponded water depth) will occur when minimum evaporative forces are available for dewatering. If the disposal operation can be scheduled so that the material reaches the approximate decant-point water content when seasonal evaporation rates begin to be maximized, evaporative dewatering will be facilitated. Dramatic results can occur over short time periods when conditions are prime for drying. Estimation of the calendar period for optimum evaporation, based on projected climatic conditions, is illustrated in Figure 7-3. Examples are from the San Francisco, California, and Mobile, Alabama, areas. If possible, disposal operations should be terminated, ponded water removed, and the material sedimented/consolidated to the decant point by the time (calendar month) when the evaporation rate begins to increase.

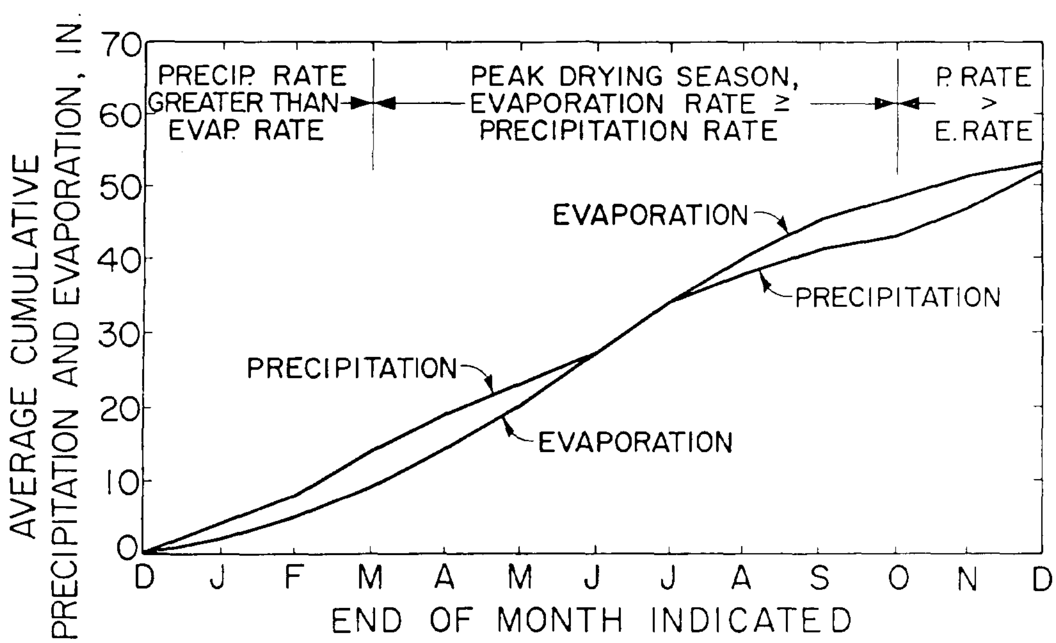
7-3. Management During Disposal.

a. Surface Water Management.

(1) The management of surface water during the disposal operation can be accomplished by controlling the elevation of the outlet weir(s) throughout the disposal operation to regulate the depth of water ponded within the containment area. Proper management of surface water is required to ensure containment area efficiency and can provide a means for access by boat or barge to the containment area interior.



a. San Francisco, California, area



b. Mobile, Alabama, area

Figure 7-3. Illustrations of method for estimating calendar periods when evaporation rates are maximized

(2) At the beginning of the disposal operation, the outlet weir is set at a predetermined elevation to ensure that the ponded water will be deep enough for settling as the containment area is being filled. As the disposal operation begins, slurry is pumped into the area; no effluent is released until the water level reaches the weir crest elevation. Effluent is then released from the area at about the same rate as slurry is pumped into the area. Thereafter, the ponding depth decreases as the thickness of the dredged material deposit increases. After completion of the disposal operation and the activities requiring ponded water, the water is removed as quickly as effluent water quality standards will allow. Figure 7-4 illustrates the concept.

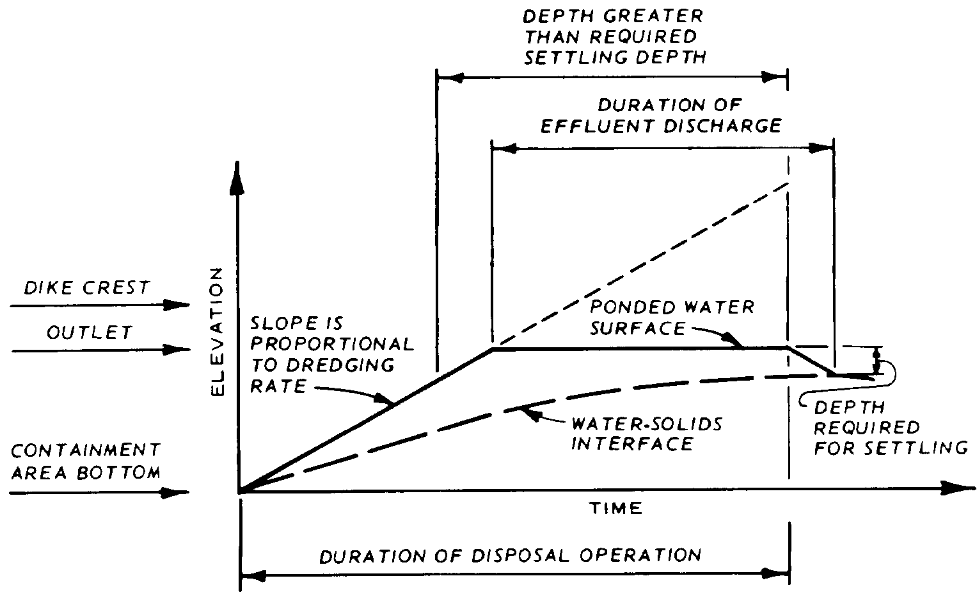


Figure 7-4. Surface water management

b. Suspended Solids Monitoring. A well-planned monitoring program during the entire dredging and decanting operation is desirable to ensure that effluent suspended solids remain within acceptable limits or to verify conditions for future design or site evaluations. Since suspended solids concentrations are determined on a grams per litre basis requiring laboratory tests, it is desirable to complete a series of laboratory tests during the initial stages of operation. Indirect indicators of suspended solids concentration, such as visual comparison of effluent samples with samples of known concentration or utilization of a properly calibrated instrument, may then be used during the remainder of the operation, supplemented with laboratory determination of effluent solids concentrations as needed for record purposes.

(1) Samples of both inflow and outflow can be taken for laboratory tests. The solids determination should be made on the samples using the procedure described in Chapter 3.

(2) When the dredging operation commences, samples should be taken from the inlet pipe at approximately 12-hour intervals to verify design assumptions. Effluent quality samples should be taken periodically at approximately

6-hour intervals during the dredging operation for laboratory solids determinations to supplement visual estimates of effluent suspended solids concentrations. The sampling interval may be changed based on the observed efficiency of the containment area and the variability of the effluent suspended solids concentrations. More frequent sampling will be necessary as the containment area is filled and effluent concentrations increase.

c. Inlet and Weir Management.

(1) If multiple weirs are used, discharging the weirs alternately is sometimes useful for preventing short-circuiting. As the area between the inlet and one outlet fills or as the inlet location is moved, the flow may channelize in a more or less direct route from inlet to weir. If this occurs, the flow should be diverted to another weir. Simultaneous discharge of slurry from several inlets located on the perimeter can also be advantageous, because the lower velocity of the slurry flow results in more pronounced mounding around the edge of the containment area. This mounding in turn increases the slope from inlet to outlet, and drainage will be improved.

(2) The removal of water following the dredging operation can be somewhat expedited by managing inlets and weirs during the disposal operation to place a dredged material deposit that slopes continually and as deeply as practical toward the outlets. Figure 7-5 shows a containment area with a weir in one end and an inlet zone in the opposite end. Inlets are located at various points in the inlet zone, discharging either simultaneously (multiple inlets) or alternately (single movable inlet or multiple inlets discharging singly). A common practice is to use a single inlet, changing its location between disposal operations. The result of this practice is the buildup of several mounds, one near each inlet location. By careful management of the inlet locations, a continuous line of mounds can be constructed, as shown in Figure 7-5. When the line of mounds is complete, the dredged material will slope downward toward the weir. If the mound area is graded between disposal operations, the process can then be repeated by extending the pipe over the previous mound area and constructing a new line of mounds, as shown in Figure 7-5.

d. Thin-Lift Placement of Dredged Material. Gains in long-term storage capacity of containment areas through natural drying processes can be increased by placing the dredged material in thin lifts. Thin-lift placement also greatly enhances potential gains in capacity through active dewatering and disposal area reuse management programs.

(1) One approach to placing dredged material in thin lifts is to obtain sufficient land area to ensure adequate storage capacity without the need for thick lifts. Implementation of this approach requires careful long-range planning to ensure that the large land area is used effectively for dredged material dewatering, rather than simply being a containment area whose service life is longer than that of a smaller area.

(2) Large containment areas, especially those used nearly continuously, are difficult to manage for effective natural drying of dredged material. The practice of continuous disposal does not allow sufficient time for natural drying. However, dividing a large containment area into several compartments

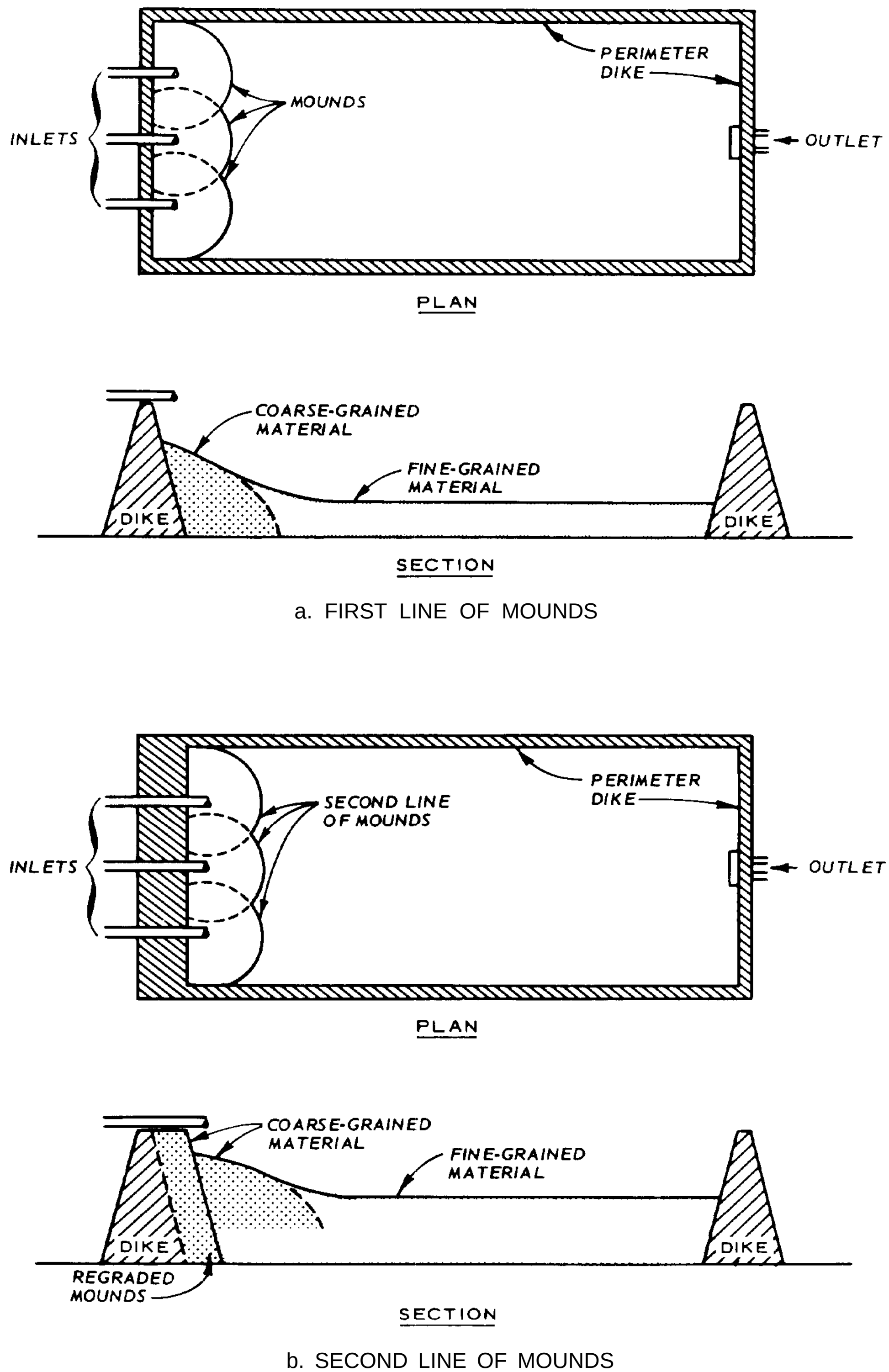


Figure 7-5. Inlet-weir management to provide smooth slope for inlet to weir

can facilitate operation because each compartment can be managed separately so that some compartments are being filled while the dredged material in others is being dewatered.

(3) One possible management scheme for large compartmentalized containments is shown conceptually in Figure 7-2. For this operation, thin lifts of dredged material are sequentially placed into each compartment. The functional sequence for each compartment consists of filling and settling, and surface drainage and dewatering, and dike raising (using dewatered dredged material). The operation must be designed to include enough compartments to ensure that each thin lift is dried before the next lift is placed.

7-4. Postdredging Management Activities.

a. Periodic site inspections and continuous site management following the dredging operation are desirable. Once the dredging operation has been completed and the ponded water has been decanted, site management efforts should be concentrated on maximizing the containment storage capacity gained from continued drying and consolidation of dredged material and foundation soils. To ensure that precipitation does not pond water, the weir crest elevation must be kept at levels allowing efficient release of runoff water. This will require periodic lowering of the weir crest elevation as the dredged material surface settles.

b. Removal of ponded water will expose the dredged material surface to evaporation and promote the formation of a dried surface crust. Some erosion of the newly exposed dredged material may be inevitable during storm events; however, erosion will be minimized once the dried crust begins to form within the containment area.

c. Natural processes often need man-made assistance to effectively dewater dredged material since dewatering is greatly influenced by climate and is relatively slow. When natural dewatering is not acceptable for one reason or another, then additional dewatering techniques should be considered.

d. Removal of coarse-grained material and dewatered fine-grained material for productive uses through Disposal Area Reuse Management (DARM) techniques will further add to capacity and may be implemented in conjunction with dike maintenance or raising. In the case of fine-grained dredged material, DARM is a logical follow-up to successful dewatering management activities. This concept has been successfully used by CE Districts and demonstrated in field studies. Guidelines for determining potential benefits through DARM are found in WES Technical Report DS-78-12 (item 24). Additional information on productive uses of dredged material is found in EM 1110-2-5025.

7-5. Long-Term Management Plans for Containment Areas.

a. Adequate dredged material disposal areas are becoming increasingly difficult to secure in many areas of the country. For this reason, it is necessary that the remaining resources of confined disposal sites be properly utilized and managed. A management plan is a vehicle that can be used to assure the most effective use of containment in future years.

b. The following objectives would normally be set in the plan development:

(1) Maximize volumetric disposal capacity.

(2) Dewater and densify fine,-grained material to the greatest extent feasible.

(3) Reclaim and remove useable material for productive use.

(4) Maintain acceptable water quality of effluent.

(5) Abide by all legal and policy and easement constraints.

c. Development of a management plan should include an extensive evaluation of management alternatives based on data accumulated through field investigations and laboratory testing. Integration of the disposal plan with overall navigation system needs is essential. The plan should be developed using the latest available technical approaches for evaluation of the benefits of management practices. A management plan developed for the Craney Island disposal area in the Norfolk District (item 27) is a well-documented example that illustrates how the procedures described in this manual can be used in developing management approaches.

d. A working group or management plan committee is an effective means to ensure that the plan benefits from the input of all District elements. The committee would logically be composed of representatives from Planning, Engineering, and Operation elements, Once a management approach is selected, a monitoring program should be initiated for use in evaluating the effectiveness of management techniques, especially dewatering activities. A monitoring program serves to verify benefits attained and to form a basis for updating or modifying the management approaches.