CHAPTER 2

CHARACTERIZING THE BYPASSING SYSTEM

Section I. Problem Identification

2-1. The Bypassing Problem. Any coastal zone construction activity that impounds or diverts littoral sediment creates the potential for sand bypassing. The earliest planning stages of such an activity should include consideration of ways to accomplish sand bypassing. When consideration for bypassing is not made prior to construction, the need for such a capability must be determined and necessary remedial action taken.

a. Problem Indicators. There are several indicators of the need for a sand bypassing system. Navigational problems caused by channel shoals and downdrift beach erosion coupled with updrift beach accretion (Figure 2-1) are the most common indicators that natural processes are being altered and that mechanical bypassing of some type may be needed. In many circumstances, complaints of local citizens and navigation interests will be voiced.

Figure 2-1. Aerial view of Indian River Inlet, Delaware, showing updrift accretion, downdrift erosion

b. Determining the Need for a Bypassing System. Confirmation that a situation does exist which may be alleviated with a bypassing system can be determined by personnel versed in coastal engineering. The following steps should provide sufficient information to decide whether a problem exists that might require further site study and investigation:

(1) Review of site history. A review of aerial photographs, nautical charts, and topographic and bathymetric maps provides an excellent indication of problems at the site. General beach recession or accretion can often be diagnosed. Such studies are helpful in diagnosing problems and may later prove invaluable in establishing magnitudes. For instance, comparisons of high-water marks in aerial photographs of a jetty accretion fillet may help identify the rate of littoral drift accretion for a particular period.

(2) Site visits and inspections. First-hand, visual inspections of a site will usually provide evidence of updrift accretion/downdrift erosion, indicative of littoral interruption. Visual inspection may even show evidence of channel shoaling or offshore bar formation by unusual breaking wave patterns in or near channel areas.

(3) Hearings and interviews. Federal navigation interests should be consulted first. Dialogue with local citizens who have observed the site over an extended period is helpful in establishing behavioral patterns. Such discussions may define events that occur during and immediately following severe storms. Extent of wave runup or overtopping, extent of beach damage, rate of beach rebuilding following storms, areas of concentrated wave attack, etc., are examples of site characteristics this method might identify. Reports of wind speeds, wave heights, and water levels should be used judiciously since these parameters are extremely difficult to quantify by casual observation.

Section II. Problem Classification

2-2. Site Study and Problem Formulation.

a. Coastal Processes. Successful design and operation of a sand bypassing system require a specialized coastal processes study of the site (as described in Chapter 4). Results of such a study provide the basis on which to select the most appropriate sand bypassing approach. If the preliminary coastal processes study identifies the need for a field data collection program, the seasonal nature of many coastal phenomena requires that the collection period be at least 1 year. Periods exceeding 1 year usually give more complete results. Because of this relatively long collection period, active data collection should be implemented as soon as possible following the identification of potential socially/environmentally/economically feasible mechanical bypassing solutions.

b. Site Investigation. Other information that is needed for preliminary design of a bypassing system but would not necessarily result from a coastal processes study includes:

(1) Potential social/environmental constraints. These factors will often influence the design of a bypassing system as much as or more than the coastal processes. Often the optimum engineering solution will have to be

modified considerably to take into account social/environmental constraints. Prior to investing considerable time and funds in the engineering aspects of a potential sand bypassing project, the social/environmental limitations should be identified. For example, public use of a beach will often limit the period during which bypassing can be accomplished. The presence of endangered species (e.g., the piping plover bird) or commercially valuable shellfish (e.g., blue crab spawning season) can limit the bypassing window. Aesthetics in addition to noise levels, air emissions, etc., can exert an influence on the type of bypassing system selected. Another potential limitation to sand bypassing is litigation. In at least one instance, downdrift property owners have sued a private inlet district with a sand bypass plant. The suit alleged that the downdrift owners suffered excessive erosion of their property. This erosion was alleged to have been caused by bypassing of insufficient amounts of sand by the inlet district's bypass plant. Planners should be aware of this potential limitation when considering sand bypassing projects.

(2) Above-water layout of bypassing site, to include plan views and cross sections of structures, topographic features, and rights of way.

(3) Physical description of areas to which bypassed material will be pumped.

(4) Location of utilities and affected facilities.

(5) Grain size distribution of material to be bypassed and the presence of unusual amounts or types of debris.

2-3. Consideration of Bypassing Alternatives. A number of bypassing methods and approaches should be considered for any given bypassing problem. Very rarely will a problem be so well defined and limited in scope that it can be alleviated by only one type of system. The designer then has the task of selecting the system that best satisfies the bypassing requirements of that site.

2-4. Bypassing System Classification. Many ways of classifying sand bypassing systems are possible. However, aside from capacity, the single characteristic of any system that most affects its suitability for a particular project is the degree of mobility it possesses. Mobility in this sense is defined as the ease with which the system can reach various areas of the project site. Mobility also reflects the flexibility of the system in reacting to changing conditions, either operational or physical.

a. Fixed systems. A fixed system is one in which the entire physical plant is fixed as to location. Examples are dredge pump systems operating from a house or platform or jet pump systems using fixed jet pumps. Such systems require a high degree of predictability of littoral transport vectors, movement paths, and deposition patterns. Before installing a fixed system, the results of an effective coastal processes study must be well understood.

b. Mobile systems. A mobile system is one in which the entire physical plant can be relocated readily to reach various areas of the bypassing site or other sites. Examples are floating dredges or jet pump systems mounted on trailers. Such systems may be more vulnerable to the physical environment than other types. Dredges, for instance, may be affected by wave action.

However, mobile systems do have the advantage of being able to be moved out of danger if there is sufficient warning of a storm.

2-5. Classification Overlap. An important aspect of the classification system described in the preceding paragraphs is that a particular piece of equipment may fit more than one category, depending on the site conditions and the equipment's use. For instance, a land-based clamshell crane might be used in one location only, making it essentially fixed. If a suitable roadway exists on a jetty, the clamshell might be moved back and forth along the jetty's length, in which case it could be termed a semimobile system. Driven onto a barge, the clamshell crane could become the major part of a mobile system. While this situation may appear confusing at first, in fact a mobility-type classification is useful to the designer. Since it is based not just on system characteristics but on the interrelationship between these characteristics and project conditions and requirements, it deals directly with the problem at hand: choosing the best system for a particular situation.

2-6. Equipment. The list of equipment that can be used to form a bypass system is extensive. Conceivably, anything from a dragline to a hopper dredge could be employed. The following list, not at all complete, gives items of equipment that exist at present and that have been or could easily be used in a bypass system:

a. Floating Dredges:

(1) Trailing suction hopper.
(2) Cutter suction.
(3) Plain suction.
(4) Bucket ladder.
(5) Clamshell.
(6) Dipper.
(7) Backhoe.

b. Land-Based Mechanical Equipment:

(1) Dragline.
(2) Clamshell.
(3) Backhoe.
(4) Bulldozer.
(5) Dump truck.

c. Hydraulic Equipment:

(1) Dredge pump.
(2) Jet pump.
(3) Other types of solids-handling pumps.

2-7. System Purpose. There are two basic purposes for which any bypassing system can be designed: reduction of navigation shoaling caused by littoral drift and alleviation of undesirable beach changes caused by interruption of littoral drift. The purpose that the system is to serve should be specifically identified so that requirements pertaining to that purpose can be satisfied. For example, a bypassing system whose purpose is to reduce channel

maintenance will be designed, installed, and operated so as to bypass material causing shoals in the navigation channel. On the other hand, a system whose purpose is to provide periodic nourishment for a downdrift beach may be installed and operated quite differently. Mitigating beach erosion is usually more easily performed with artificial sand bypassing than reducing navigation channel maintenance costs. Reasons for this include the following (Richardson 1990):

a. Beach erosion is usually a function of the magnitude and direction of net littoral drift (see Chapter 4), whereas channel shoaling is a function of gross transport. Consequently, bypassing for a channel-related project may have to consider sand coming from both directions in larger total amounts. A beach erosion system may deal with only one direction of transport with correspondingly smaller quantities of sand.

b. A channel-related bypassing system functions by intercepting sand before it deposits in the channel. The optimum location, particularly for a remedial project, is adjacent to the channel. Wave action will often make this a difficult area to operate a bypassing system. A beach-erosion system can operate some distance away from the channel or inlet without reducing effectiveness, allowing a wider variety of potential system locations.

c. A beach-erosion system’s basic requirement is just to transfer a given amount of suitable sand over a predetermined period. This mode of operation allows more flexible operating schedules. A channel-related system’s operating schedule is more closely tied to short-term sand transfer rates, producing greater restrictions and uncertainty in the operating schedule.

2-8. Design Cautions. The designer should be especially wary of attempting to design a "dual-purpose" bypassing system: i.e., one that tries to reduce navigation shoaling and alleviate beach changes at the same time. Although the problems of shoaling and beach changes are often interrelated at a particular site, attempting to solve both simultaneously with one bypass system can be difficult for the following reasons:

a. The interrelationship between the two problems is often far more complex than it appears.

b. The optimum approach to solving one of the two problems with a bypass system can be very different from the optimum approach to solving the other problem. The end result of such a compromise design will often be a bypass system that solves neither problem very well. A better approach is to design the system to help solve the highest priority problem only while keeping in mind the secondary problem. The designer should review the projected effects of the system on the other problem throughout the process. Many times it will be found that a system designed for one problem will have significant beneficial effects on the other as well. A review may also suggest some modifications to the system design that would aid in solving the other problem without affecting performance on the primary problem. This approach should provide more realistic predictions of the potential benefits associated with the bypassing solution on both problems, thus allowing reasonable calculations of cost/benefit ratios.