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FACSIMILE HEADER SHEET
(ER 105-1-5)

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COASTAL ENGINEERING RESEARCH CENTER

MEMORANDUM FOR RECORD

SUBJECT: POTENTIAL COASTAL ENGINEERING EFFECTS OF STABLE OFFSHORE BERMS BUILT WITH DREDGED MATERIAL

1. The purpose of this memorandum is to clarify from a coastal engineering standpoint what effects stable offshore berms built with dredged material might have on the nearshore zone. This is a discussion only in general terms encompassing the nationwide range of possibilities. The degree that specific effects might pertain to a particular project or whether they might apply at all has to remain a site-specific determination.

2. For the most part, the potential coastal engineering effects of stable offshore berms are positive or at least neutral. However, a berm-like feature, if it is high and large enough to affect the local wave climate, may also cause noticeable focusing of wave energy in localized areas. Such focusing may or may not be a problem, depending on what is in the localized areas to impact. Negative effects from focusing usually would fall into two categories: a) navigation problems, or b) localized shore erosion. In general, both of these effects can be minimized or avoided at a project site by relatively simple design assessments regarding the berm configuration and distance of the feature from a potential problem area. As an example, both of these conditions apparently were violated unintentionally at a disposal site offshore of Humboldt, California, when a contractor unwittingly constructed a high relief, pile-shaped feature by point dumping within the disposal area. The creation of this feature led to claims by local boat owners of increased wave steepness and resulting navigation problems in the entrance channel immediately behind the pile. As another example, contract dredging for a beach fill at Grand Isle, Louisiana, created deep borrow pits very close to shore. The pits refract waves in an analogous but somewhat "mirror image" fashion to a berm, causing significant and persistent localized erosion at points on the beach fill. Besides wave focusing, the other possible negative effects of offshore berms that can be postulated at this point could occur if one were placed close enough to a tidal inlet or bay entrance to alter the flow patterns of tidal currents. Significant alteration of the flow could lead to effects such as increased shore erosion, changes in channel shoaling patterns, and shifts in water circulation. Again, the potential for such a situation can be minimized or avoided on a site specific basis with some relatively simple design assessments. No cases of such occurrences are known to exist.

3. There are two principal ways in which stable offshore berms

built with dredged material can have positive coastal engineering effects. The nature and trade offs of each are important to understanding the limits of their application:

a. Wave energy dissipation: There are basically two modes of energy dissipation for waves in shallow water. The first, bottom effects (friction and percolation), is not going to be the major mode of energy dissipation for most offshore berms simply because the berm widths will be relatively small for such phenomena to have major effects. The second mode, breaking, most likely will be the predominant mechanism by which berms dissipate wave energy. In an oversimplified form, the maximum wave height that can be sustained without breaking is 0.8 times the local water depth. In other words, a berm 10 ft. high placed in initial water depths of 30 ft. would allow waves up to 16 ft. high to pass without breaking. This doesn't mean that waves less than 16 ft. would not be affected; some energy dissipation due to bottom friction and percolation would occur. It also doesn't mean that the energy of the higher waves is completely eliminated. The broken waves will reform as lower energy waves and move on across the berm toward shore. However, it does mean that whatever wave energy is dissipated by most berms will be that associated with the larger waves caused by storm events. The normal wave climate at such sites will be less affected; it is not likely that berms as a rule will serve to significantly alter variables such as dredge operational time, especially since dredges wouldn't be working during storm events in the first place. The basic reason for this is that energy dissipation, particularly by breaking, is a two-way street. Simply put, if the berm is high enough to break waves, then those waves are high enough to move berm material. For a given placement area and given dredged material, if a berm is built high, initially it will break more and smaller waves, but also will be cut down faster to a lower, more stable configuration. This was shown in the behavior of the Dam Neck, Virginia, demonstration mound, which lost several feet of elevation rather rapidly and then subsided to a much less dynamic state for the duration of the relatively short monitoring period. What this means is that attempting to affect the day-to-day wave climate at a site by building a berm high enough to accomplish that purpose may require frequent and possibly large-scale rejuvenation of the berm over the long term. Such a purpose may be feasible at dredging sites with large initial and maintenance quantities. However, for many sites, a berm's real purpose in the long term probably should be oriented toward positive effects on the larger waves generated by storm events.

b. Material stockpile: A relatively stable berm can serve as a sand stockpile for future beach nourishment needs, performing some double service in the meantime in dissipating storm wave energy. This would be particularly useful in cases where a deepening project or port expansion generated more beach-quality sand than was needed at that time. Placing the sand in a planned feature such as a berm promotes its location and recovery at later dates, although the potential users of such material might not be the ones who paid for the initial dredging and berm creation. In addition, such uses should be weighed against the fact that removing material from the berm in large quantities would diminish or eliminate its usefulness for storm wave dissipation. An alternate mode of material stockpiling could be to leave the original berm intact and place subsequent maintenance sand on the immediate shoreward side. The berm could then offer some degree of sheltering to the maintenance sand, possibly reducing dispersal by storm waves. In addition, such an approach could allow the berm to be built of non-beach-quality material. However, it is important to remember that many berms will resemble fat, linear pancakes more than underwater dikes or earthfill dams. Unless a berm is constructed of carefully placed, highly cohesive material not slurried by the dredging operation, there usually will be no steep leeward side for the maintenance material to hide behind. Therefore, the longer maintenance sand remained on the shoreward side of a berm, the more likely it would become dispersed, perhaps mixing with the berm material.

4. A corollary of the preceding discussion is that, as with anything built in the coastal zone, a "stable" berm will degrade with time. Wave energy dissipation should diminish as that capability is exercised by succeeding storms. Dispersal of the berm over time eventually should affect its usefulness as a stockpile. The time scales for such processes are related and may vary from a few years to decades depending on site conditions. However, without periodic maintenance by infusions of new material, such degradation is inevitable. This indicates that a fine line probably should be drawn separating positive effects that are viewed simply as fortuitous by-products of dredged material disposal and those that become features or characteristics of the nearshore environment. The latter situation may create a demand for berm maintenance that is not economically sustainable. To complicate matters, the positive effects may accrue principally to parties that are not paying for berm creation or maintenance in the first place.

5. What may in the long term be the most beneficial aspect of berm construction to the overall Corps dredging program is simply that the dredged material is placed initially in a well-defined location and orientation and with prominent relief over the existing bottom. This fact by itself can do more to facilitate both the initial and long-term monitoring of the dredged material, particularly without resorting to exotic and costly measurement approaches, than any other single policy or method. Both physical and biological monitoring should be enhanced and simplified when the material boundaries are well defined and the material is concentrated in a pre-selected, relatively small area. Better monitoring should in turn lead to better contract inspection, better long-term disposal site management, and optimization of cost factors such as haul distances. For this

reason alone, configured placement of some type probably should be considered for most offshore dredged material disposal operations.

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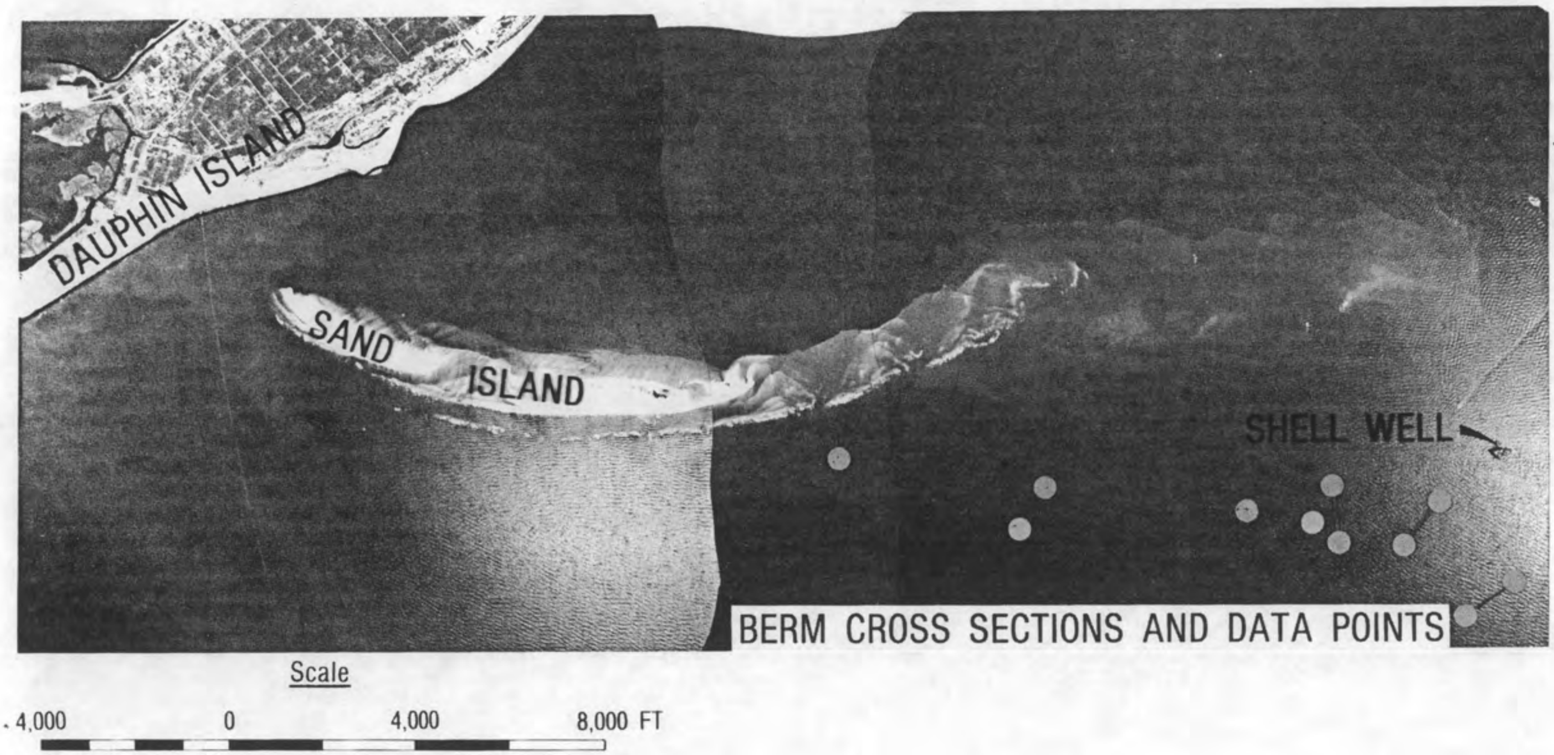
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