CHAPTER 4

HABITAT DEVELOPMENT

4-1. Definition and Application. Habitat development refers to the establishment and management of relatively permanent and biologically productive plant and animal habitats. The use of dredged material for habitat development offers a disposal technique that is an attractive and feasible alternative to more conventional disposal options. Various habitat development alternatives and their applicability to disposal operations and sites will be discussed in this section. Within any habitat, several distinct biological communities may occur. For example, the development of a dredged material island may involve a wide variety of habitats (Figure 4-1). Four general habitats are suitable for establishment on dredged material:

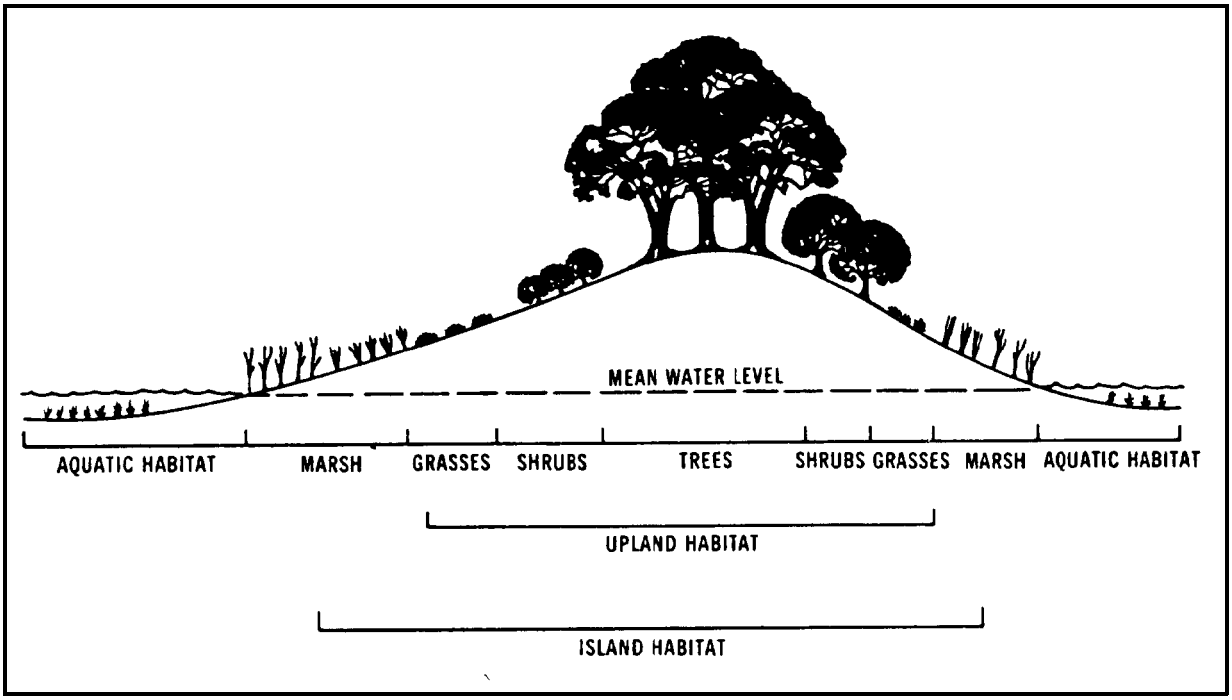

Figure 4-1. Hypothetical site illustrating the diversity of habitat types that may be developed at a disposal site

a. Wetland. Wetland habitat is a very broad category of periodically inundated communities, characterized by vegetation which survives in wet soils. These are most commonly tidal freshwater and saltwater marshes, relatively permanently inundated freshwater marshes, bottomland hardwoods, freshwater swamps, and freshwater riverine and lake habitats.

b. Upland. Upland habitat includes a very broad category of terrestrial communities, characterized by vegetation which is not normally subject to inundation. Types may range from bare ground to mature forest.

c. Aquatic. Aquatic habitats are typical submerged habitats extending from near sea, river, or lake level down several feet. Examples are tidal flats, oyster beds, seagrass meadows, fishing reefs, clam flats, and freshwater aquatic plant beds.

d. Island. Islands are upland and/or high zone wetland habitats distinguished by their isolation and particular uses, and completely surrounded by water or wetlands.

These concepts and their implementation are discussed in detail in items 19, 32, 51, and 72 and in Chapters 5-8 of item 73.

4-2. Case Studies of Selected Habitat Development Sites. Numerous examples of habitat development using dredged material substrates exist; nearly 1,000 are listed in Appendix C and four are presented here to show the diversity of such sites.

a. Buttermilk Sound Salt Marsh.

(1) Buttermilk Sound, a 5-acre intertidal island marsh located in the Altamaha River, Georgia, was created by plantings during 1975-76 on a sandy, infertile dredged material island which had not revegetated since deposition of material a number of years ago. Success of the original plantings was related to the period of tidal inundation and type of propagule. Sprigs were more successful than seeds, and smooth cordgrass was the most successful species planted (item 19).

(2) From the outset, this marsh site has been very successful (Figure 4-2). Since 1979 it has been visually indistinguishable from natural reference marshes. Although tidal scouring initially washed out plantings and eroded the lower part of the intertidal zone, the site quickly stabilized. The established plant community has trapped large amounts of fine material, resulting in a thick layer of silt that now covers the original substrate. Smooth cordgrass dominates the entire lower two-thirds of the intertidal zone. Swards of big cordgrass and saltmeadow cordgrass remain at the middle elevations where they had been planted. The Buttermilk Sound site differs from nearby natural marshes by possessing greater plant species diversity at lower elevations. This is probably due to plant species that were introduced in zones lower than those at which they would naturally occur. Aboveground biomass is similar to natural marshes, but belowground biomass is less. Wildlife use of the marsh is greater than in the natural marshes in all respects, including white-tailed deer, alligators, clapper rails, tern nesting, and migratory shorebird and waterbird use (item 59).

Figure 4-2. Buttermilk Sound habitat development field site, Altamaha River, Georgia, after 6 years of development

Figure 4-3. Salt Pond 3 habitat development field site, South San Francisco Bay, California, after 5 years of development

(3) In 1985, the Buttermilk Sound site continues to represent one of the most successful marshes built by the CE. It appears to be very stable and the marsh area, especially in the upper marsh zone, continues to increase coverage and density to the extent that only one bare sandy spot remains on the entire island. This spot was not shaved down from the original elevation to an intertidal zone, and therefore has been very slow to vegetate.

b. Salt Pond 3 Salt Marsh.

(1) Salt Pond 3, a marsh site is South San Francisco Bay, California, was established on a portion of a 100 acre saltwater evaporation pond that was partially filled hydraulically with clayey dredged material in 1974. It is the only nonisland habitat development site that has been built by the CE. Plantings of Pacific cordgrass and pickleweeds were established during 1976-77. Cordgrass sprigs successfully colonized the lower two thirds of the intertidal zone, and pickleweeds rapidly and naturally colonized the upper one-third (item 59) (Figure 4-3).

(2) The plantings maintained themselves and have spread slowly into adjacent unvegetated areas. Production is somewhat less than in nearby natural marshes, perhaps due to the relatively early stage of site succession. The lower cordgrass zone appears visually equivalent to natural marshes, and the entire 100 acres with the exception of an occasional small mudflat and the tidal channel have become densely vegetated (item 59).

(3) Wildlife use is predominantly by birds, especially shorebirds which feed along the channel, and terns and other waterbirds. Peregrine falcons and other raptors frequent the area and feed on songbirds and rodents in the upper marsh zone. This site appears to be stable and has survived the excessive rainfall and severe storms that pounded the west coast in 1983 without apparent damage. The rainfall actually seemed to improve appearance of the marsh by increasing growth in the upper marsh zone.

c. Gaillard Island Confined Disposal Facility.

(1) Gaillard Island, a new diked disposal island in lower Mobile Bay, Alabama, was built in 1981 by the Mobile District (Figure 4-4). The large, triangular-shaped island is being filled with material from the main shipping channel, and its gently sloped dike is primarily silty clay. Waves come into the island dike from all three sides, and erosion is a continuing problem. In 1981, smooth cordgrass was planted on the northwest dike behind temporary breakwaters made of floating and fixed tire breakwaters. Surviving plantings from 1981 grew and spread behind the breakwater, and more plants were set in 1982 with more breakwater designs and tests. Many of these were thriving in 1983 in spite of severe storms in the area over 1982-83 (item 2). Plantings in 1983 and 1984 were primarily coupled with tests of several filter materials and tire configurations, as well as burlap rolls, different size propagules, and various placements in the intertidal zone.

Figure 4-4. Gaillard Island habitat development field site, Lower Mobile Bay, Alabama, after 3 years of development

Figure 4-5. Bolivar Peninsula habitat development field site, Galveston Bay, Texas, after 6 years of development

(2) On the upland portion of the dike, aerially seeded Bermuda grass now dominates, and it has effectively stabilized large portions of the dike. Diversity of invading plant species is increasing, and this colonization process is expected to accelerate over time. Plant succession is already progressing, as areas that were weedy annuals in 1982 are now perennial grasses. Species diversity and populations of both plants and animals increase with each seasonal data collection period; these have been documented since 1981 and will continue to be noted, at least through 1987 (item 2).

(3) Twenty bird species are now nesting on the island; in 1984, 1985, and 1986 the birds numbered approximately 16,000 each year. Laughing gulls dominated the nesting areas; however, large numbers of seven tern species, black-necked stilts, and black skimmers nested with apparent success. Muskrats colonized the island in late 1985; land birds nested there for the first time in 1984. Brown pelicans are nesting on Gaillard Island, and 1983 marked the first recorded nesting for the species in Alabama in this century. In 1983, two chicks fledged from a single successful nest. In the 1984 summer survey, nests had increased to eight; 133 active nests were observed in 1985. In 1986, there were over 200 active nests by May, with more being built. In addition, large numbers of nonbreeding white and brown pelicans are living year-round at Gaillard Island (item 42).

d. Bolivar Peninsula Upland and Marsh Site.

(1) The Bolivar Peninsula field site is located on Goat Island in eastern Galveston Bay, Texas, and includes both marsh and upland planted areas. The original site is 20 acres of sandy dredged material, protected by a sandbag dike and a fence. It was built by the CE and planted in 1976-77. Both smooth and saltmeadow cordgrasses established well on this site (Figure 4-5). In the upland area, shrubs, trees, and upland grasses initially established well, but invasion by other species eventually crowded them out (item 2). Since initial establishment, smooth cordgrass has spread throughout the lower tidal zone and dominates the site. The saltmeadow cordgrass has spread throughout the upper intertidal zone, and has also spread into the upland section of the site. Saltgrass and pickleweeds have invaded the same zone (item 2).

(2) Oysters had densely colonized the dike area by 1982 and now help serve as a breakwater for the marsh. The site has also been heavily colonized by fiddler and blue crabs and has much fish use during high tide. Wildlife use is quite good; large numbers of sea and wading birds use the site. Small mammals live inside the fence that was once built to exclude them, and a number of ground nesting birds use the site. By 1983, conversion of the upland zone from prairie grasses and woody plants to high marsh plants was complete. Cover on the site is dense, and unless it becomes heavily grazed by ranging feral goats on the island, should remain in that condition (item 59). Clapper rail use is also quite heavy (item 42).

(3) Four adjacent dredged material sites are now being compared on Goat Island: the old site planted in 1976-77; a new deposit (1982) to the west of the old site being planted to test two breakwater designs built of low-cost materials; a second new deposit (1982) on the east side of the old site that is serving as a control; and a part of the old site that was covered with a new application of sandy dredged material in January 1986. Part of the original planting was deliberately covered with dredged material to determine the impacts of smothering, and to determine how rapidly a salt marsh could recover from such disturbance. It will also be compared to a site in East Matagarda Bay where silty dredged material was placed in August 1986 over existing high marsh. Data will be collected on these four areas at least through 1987 (item 42).

(4) The Bolivar Peninsula site survived a direct hit by two hurricanes in 1983 and 1986. The only noticeable change was the washing away of the protective fence in the bay in front of the site. All of the natural marshes with which it was compared were changed by washouts of pockets of marsh that created open-water pockets. These types of washouts did not occur on the field site (item 42).

4-3. Habitat Development Selection Process. The diversity of biological communities indicates the potential diversity of alternatives available under habitat development. This wide range of options will usually make using quantitative measures for selecting specific alternatives impractical, and consequently, selecting a given habitat development alternative is likely to be highly judgmental. The best determination will be made by a combination of local biological and engineering expertise and public opinion. Guidelines for the evaluation of individual habitat development situations are summarized below.

a. Conditions Favoring Habitat Development.

(1) The selection of habitat development as a disposal alternative will be competitive with other disposal options and types of beneficial uses when one or more of the following conditions exists:

(a) Public/agency opinion strongly opposes other alternatives.

(b) Recognized habitat needs exist.

(c) Enhancement measures on existing disposal sites are identified.

(d) Feasibility has been demonstrated locally.

(e) Stability of dredged material deposits is desired.

(f) Habitat development is economically feasible.

(g) Extensive quantities of dredged material are available.

Since disposal alternatives are often severely limited and constrained by public opinion and/or agency regulations, with constraints on open-water and other sites, disposal habitat development will be an attractive alternative, and in many cases will have strong public appeal. The need for restoration or mitigation or the need for additional habitat may strongly influence the selection of the habitat development alternative. This is particularly applicable in areas where similar habitat of considerable value or of public concern has been lost through natural processes or construction activities, such as at Pointe Mouillee in Lake Erie. Habitat development may be used as an enhancement measure to improve the acceptance of a disposal technique. For example, seagrass may be planted on submerged dredged material, or wildlife food plant established on upland confined disposal sites. Habitat development has considerable potential as a low-cost mitigation procedure and may be used to offset environmental impacts incurred in disposal.

(2) The concept of habitat development is more apt to be viewed as a feasible alternative if it has been successfully demonstrated locally. Even the existence of a pilot-scale project in a given locale will offset the uncertainties often present in the public and in resource agencies' perception of an experimental or unproven technique. The vegetation cover provided by most undiked habitat alternatives will generally stabilize dredged material and prevent its return to the waterway. In many instances this aspect will reduce the amount of future maintenance dredging necessary at a given site and result in a positive environmental and economic impact.

(3) The economic feasibility of habitat development should be considered in the context of long-term benefits. Biologically productive habitats have varied but unquestionable value (i.e., sport and commercial fisheries) and are relatively permanent features. Consequently, habitat development may be considered a disposal option with long-term economic benefits that can be applied against additional costs that may be incurred in its implementation. Habitat development may be particularly economically competitive in situations where it is possible to take advantage of natural conditions or where minor modifications to existing methods would produce desirable biological communities. For example, the existence of a low-energy, shallow-water site adjacent to an area to be dredged may provide an ideal marsh development site and require almost no expenditure beyond that associated with open-water disposal. Actual dollar values assigned to habitat development has been a controversial topic of discussion among scientists for a number of years. All agree that it has to be done, and that such sites are highly valuable; none agree on valuation estimates.

b. Guidelines. Habitat development presents several options ranging from establishment of upland communities to the development of seagrass meadows. A broad procedural guide to the selection of the habitat development alternative is given in Figure 4-6. The beneficial use planner should ignore categories unrelated to the particular problem, and may wish to add key site specifications.

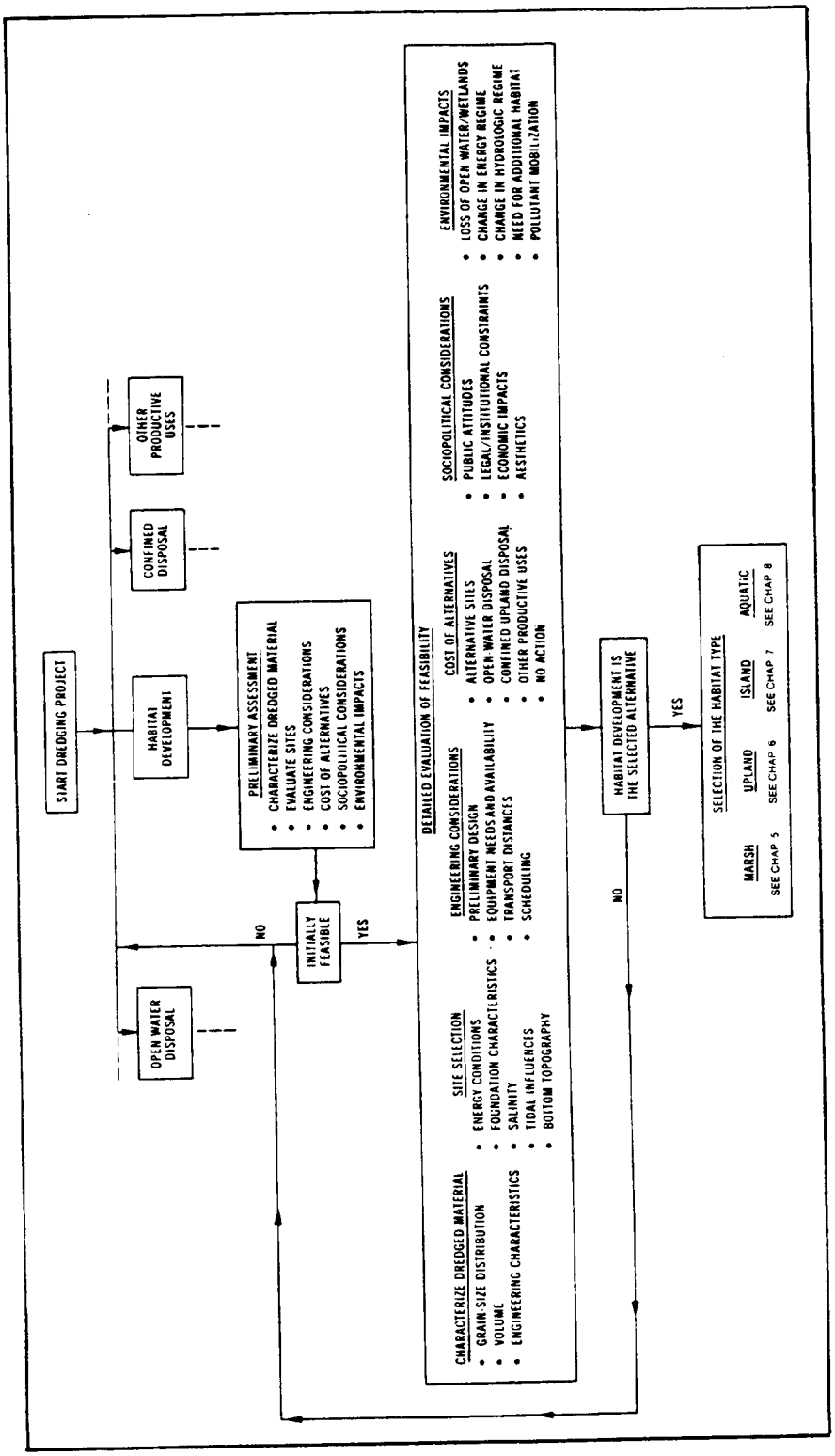

Figure 4-6. Procedural guidelines for selection of habitat development alternatives

(1) Preliminary assessment. The initial consideration of habitat development as a disposal alternative should include a preliminary assessment of feasibility, which involves judgment based on available data. A determination that habitat development is not initially feasible should be based on compelling negative evidence and not merely on a lack of information or specific precedents. In the absence of such negative evidence, one should proceed to the detailed evaluation of feasibility. Factors may arise at several stages in the evaluation that would lead to a determination of infeasibility. Should that occur, other disposal alternatives would be reconsidered.

(a) The detailed evaluation of feasibility includes six major categories beginning with a characterization of the dredged material and arranged generally in the order of need for acquisition of information. In characterizing the dredged material, the physical, chemical, and engineering characteristics of the material to be dredged should be determined. These properties will help define the general considerations of site selection.

(b) Site selection should be based on an adequate knowledge of energy conditions, foundation characteristics, salinity, tidal influences, and bottom topography. Energy conditions will largely influence the feasibility of establishing a stable substrate, or the necessity of protection structures. Foundation characteristics will determine the ability of a given site to support construction activities or structures. Salinity and tidal influences will dictate the plant species composition. A more detailed analysis of these factors will be necessary later for detailed design purposes if the habitat development alternative is selected, but even in this early phase, some field sampling may be necessary if general information is not available.

(c) Engineering considerations at this stage are largely confined to preliminary designs and an assessment of equipment needs and availability. Details such as scheduling to meet critical environmental dates (e.g., spring or summer planting times) and the identification of dredged material transport distances will provide useful planning data. In many projects, the pivotal determination of engineering feasibility or infeasibility can be made at this stage.

(d) Evaluation of the cost of alternative disposal methods is the next essential step. In a number of CE Districts, this is the first step in assessment. Detailed economic analyses must await the further development of design criteria; however, a general cost comparison of the various alternative sites should be possible at the completion of the preliminary assessment of feasibility. This is another critical step because considerable time and effort can be spared by defining the economic limits that the project must satisfy to remain competitive with other alternatives.

(e) Of the sociopolitical considerations, public attitudes and legal and institutional constraints are most likely to prove limiting. Negative public attitudes generally occur when the community views the proposed habitat as a threat to established values. Legal and institutional constraints

frequently arise when there are unanswered questions of ownership and access or when local interests have designated the site for an alternative future use. Direct economic impacts may be identified if the habitat to be developed may alter important shellfishing or recreational areas or block a water view.

(f) The environmental impact of most habitat development projects may be expressed as a loss of open-water habitat or wetland systems and changes in hydraulic and energy regimes. The impacts of these factors tend to be cumulative and are directly related to the perceived need for additional habitat. In general, the need for more habitat is considered more critical in areas that have lost or are losing considerable habitat of that type. Pollutant mobilization by plants growing on contaminated dredged material might be of concern, and its potential should be determined prior to habitat development.

(2) Selection of habitat development as an alternative. Upon completion of the preliminary assessment of feasibility, a determination can be made whether habitat development is applicable. If habitat development is a selected alternative, a decision regarding the type or types of habitats to be developed must be made. This decision will be largely judgmental, but in general, site peculiarities will not present more than one or two logical options. Specific advantages and disadvantages likely to be encountered are evaluated, and items of particular concern during early feasibility determinations are highlighted in Chapters 5, 6, 7, and 8.