CHAPTER 16

BASELINE AND MONITORING STUDIES

16-1. General.

a. Potential beneficial uses of dredged material should be thoroughly examined as part of preproject planning studies. Preliminary surveys of existing and candidate sites should be made during the reconnaissance phase of new studies, and detailed aerial and ground surveillance should be conducted for feasibility studies. Results should be displayed in the appropriate format in feasibility reports, including pre-authorization survey reports. Project environmental assessments and environmental impact statements must include a detailed comparison of alternative sites, including adverse and beneficial impacts.

b. Modern tools such as remote sensing, visual data management systems, and automatic data processing should be employed to help determine the most appropriate locations and best uses for dredged material. High resolution aircraft-collected scanner imagery and color infrared photography can provide detailed land-use information that can be directly analyzed by computer. Information obtained through remote sensing not only provides a valuable database, but can be used to monitor changes in existing conditions with or without the project. A variety of computer systems and software programs are available for analyzing data.

c. Coordination with other Federal and state agencies is essential for projects that include dredging activities. Scoping meetings should be held at regular intervals throughout all phases of project planning. Agencies and organizations that should be involved in scoping activities include the EPA, FWS, NMFS (when operating in coastal waters), state coastal zone management agencies, state fish and wildlife agencies, and state and Federal cultural resource agencies. Other state and local organizations, both public and private, should be included as appropriate. Adequate review time must be provided for agencies to comment on proposed actions.

16-2. Monitoring.

a. Background. This section describes the needs, considerations, and some methods for monitoring dredged material operations prior to, during, and after dredging in order to have a clear picture of the dredging and beneficial use impacts and values, as well as a source of pertinent references on monitoring. Monitoring within this section focuses only on those beneficial uses of dredged material that are derived from vegetation and/or animals.

b. Need for Monitoring. Monitoring of a proposed or existing dredged material site for the purpose of planning appropriate beneficial uses is an absolute necessity to ensure compatibility between or among the proposed uses and the dredged material disposal activities. Monitoring is important for numerous reasons. It provides a framework or database from which logical beneficial use alternatives can be proposed. For example, if waterfowl habitat is desired for hunting use, but monitoring data indicate that marsh cannot be established because of too much wave energy, it makes little sense to consider duck hunting as a beneficial use. Monitoring also documents that appropriate planning of dredged material uses has been implemented and provides a basis from which defensible arguments can be made for selected beneficial uses. Monitoring is useful in obtaining an understanding of potential problems with alternative uses of dredged material, constraints, or possibilities related to dredged material management. It provides a clear picture over time whether the planned beneficial uses develop properly or at all and what changes are taking place that influence those uses or other potential beneficial uses. For example, Miller Sands Island planted as an upland goose resting/grazing pasture in the Columbia River has reverted to use primarily by nutria because the sandy pasture has not been maintained by soil amendments and by trapping of the nutria. The nutria eat the good grasses and herbs planted for goose pasture and leave only horsetail, an unpalatable plant. A monitoring program can indicate if these kinds of situations are developing so that remedial actions can be taken that will preserve the intended beneficial use.

c. Considerations of Monitoring. In planning and initiating a monitoring program of beneficial uses on dredged material, one must consider a variety of factors that are likely to impinge upon both dredging operations and the intended beneficial uses. These impingements may take place prior to, during, and after dredging and can influence decisions as to what beneficial uses should be planned and how they are likely to change over time. The level of attention needed will be greatest in the initial stages (i.e., monitoring the disposal process, overseeing propagule collection and planting, etc.), and will in most cases decrease with time (item 32). Influencing factors that should be monitored include such things as soil or substrate conditions; size and location of site; plants and animals presently on the site or in nearby areas; natural succession typical of the area; existing and future site use; flooding and/or wave energy conditions; tidal conditions; social and economic considerations; and the probability of future dredged material deposition. This section suggests a general monitoring approach to follow after the decision has been made to develop selected beneficial uses on a site. It assumes that legal restrictions, site availability, site capacity, and other legal, administrative, or engineering aspects are favorable.

d. Methods. Beneficial use monitoring may be planned for two kinds of sites: an established dredged material site where deposition has been completed, and a site where proposed or ongoing deposition of dredged material is taking place. In the first case, an established dredged material site may be many years old or relatively new, and may be vegetated or unvegetated. In the second case, the new substrate at any one or more topographic elevations will dictate whether the site will be aquatic or upland or a combination of the two. The approach should be tailored to the kind of deposition. Monitoring of a site involves numerous factors and therefore can be most effectively accomplished by a multidisciplinary team, generally including a wildlife biologist, botanist, soil scientist, engineer, fisheries biologist, land use planner and, in some cases, a lawyer. The team needs to be structured according to the anticipated uses of the site. For example, it makes little sense to include a fisheries biologist if an upland site without any ponds or lakes is the site being considered for beneficial uses unless ponds or lakes are anticipated. Four steps for each item to be monitored should be followed: develop a statement of objectives, identify the population or unit to be sampled and data to be collected, specify the precision of data collection, and select an efficient sampling design.

(1) Physical factors. Physical factors considered important to monitor include such things as: climate; geographic location and size; topography and configuration; physical and chemical characteristics of the substrate to be deposited upon and material to be deposited; tides, currents, and other hydrological data; physical and chemical characteristics of the water in which material is deposited; and land use.

(a) Climate. Climatic data are important to monitor because they will dictate what kinds of plants and animals can ultimately grow and reproduce at the site. In a dredged material disposal project it is usually impractical to personally collect climatic data over a long enough time period to be meaningful. Therefore, resort to the literature and data sources that apply to the site area. First evaluate climate on a large scale because climate changes are relatively slow. Changes in such things as soils and vegetation will usually occur gradually. Soil and plant communities are relatively stable and mutually compatible over extensive land areas. Classification of climates over large areas requires development of parameters such as temperature and rainfall extremes on a macroscale. Maps available from the U.S. Department of Commerce enable determination of approximate limits of average minimum temperatures, rainfall distribution zones, major climatic zones, and other zones that influence types of vegetation that can be grown in an area. Determine climatic conditions on a microclimatic scale, or those climates within the first few feet of the soil. It is important to characterize these because they determine more accurately whether plants and animals will be able to survive drought, chilling, or frosts, or excess moisture. Those microclimates characterized by low precipitation during the growing season will have a deficit of moisture for plant growth, especially if temperatures are high. For example, St. Paul, Minnesota is in a semi-humid grassland-forest transition zone because it has a mean annual precipitation of 25 inches. However, San Antonio, Texas, with the same mean annual precipitation has semi-arid vegetation because of higher temperatures (70°F vs. 44°F). Soil-water losses are greater in Texas than Minnesota. To obtain these temperature and rainfall data at a local level, the planner should refer to local meteorological data furnished by the nearest National Weather Service station or establish an onsite weather station obtainable from scientific instrument supply distributors. If the latter option is selected, data should be collected in the area for as long as considered practical, preferably for at least 2 to 3 years.

(b) Geographic location and size. Geographic location will determine an area’s macroclimate and microclimatic characteristics, which will in turn influence plants and animals. The potential or existing size of a disposal area should be considered in relation to its location; these interrelated factors determine an areaÆs potential value for various beneficial uses. This is particularly true for the development of wildlife habitat. Small areas may offer no appreciable habitat development potential, whereas large areas may offer numerous management possibilities. Location of the site is extremely important, perhaps much more so than the size. Item 13 relates an example that illustrates this. A 2-acre upland site surrounded by marsh and located very close to the mainland may support a greater diversity of wildlife species than a 10-acre island site with similar habitat but isolated by open water from marsh and mainland populations. The smaller site may often be used by marsh inhabitants such as rails, herons, egrets, and raccoons; it may be visited by white-tailed deer and many small land birds; and it may support a high marsh rabbit population due mainly to the abundance of surrounding marsh vegetation. Natural plant succession and dispersal of animal species occur quickly and easily due to the area’s proximity to plant and animal sources. The island site, although larger, may be used only by waterbird species. Natural succession. and animal dispersal to the island are slower due to the island’s isolation. Often dredged material islands are the only areas available for bird colonies, and the isolation keeps predators and human disturbance to a minimum.

(c) Topography, configuration, and land features. A siteÆs topography and configuration must be examined because these factors greatly influence potential beneficial uses. The elevation of the dredged material in relation to mean water level will determine, for example, the kinds of vegetation and habitat that can be developed. Figure 4-1 in Chapter 4 illustrates this point. Configuration of the site plays a large role in determining what uses should be planned. Coves on a dredged material island, for example, can lead to successful marsh establishment (item 2) because protection from long wind fetches is provided. Topography and land configuration also relate to an area’s erodibility, flooding potential, waterway traffic, and future deposition plans. Hills, bluffs, and man-made features will influence accessibility and ease of developing desired beneficial uses. Monitoring of these factors is best achieved with an aerial photograph, topographic map, and diagram as a base. Elevational and bathymetric data may be unavailable and will have to be established by standard survey and geodetic procedures. A map or diagram should show access routes, both land and water, as means of transporting equipment; these routes should be rated. The map or diagram should show dikes, mounds, or other evidence of previous disposal. Note areas of debris accumulation and indications of nearby human activity such as a boat dock, cabin, foot trail, or livestock. See references in item 19 for techniques on reconnaissance mapping.

(d) Soils or dredged material substrate. Analysis of core samples and soil sampling data should be made on existing soils to determine undesirable physical and/or chemical properties that may pose a hazard to potential site use. If proper procedures are not taken, it is possible that buried undesirable materials could migrate upward through the water column. See item 47 for procedures to be used in sampling and analyzing soils, and for ways to handle any potentially hazardous soils. If the dredged material sediments already in place are to be used for beneficial uses, some physical and chemical tests must be conducted. Soil properties influence kinds of plant species that can be grown on the site or that will invade the site. These plants, in turn, will ultimately affect other beneficial uses to be planned. Similar physical and chemical soil tests will also be necessary for dredged material sediments, since these materials will be the growing medium for plants. See item 47 for the determination of soil or sediment properties. After soil properties are determined, soil scientists should be consulted to determine which soil treatments are required to ensure adequate plant development. Periodic monitoring of the siteÆs soil properties should be carried out since fertilization and other soil amendments and physical treatments may be necessary to ensure site beneficial uses are not adversely affected by changing soil conditions. The frequency of monitoring will largely be determined by economic and time constraints.

(e) Tides, waves, currents, and other hydrologic data. These factors influence water and nutrient availability to plants and animals and cause erosion. For salt marsh development, vertical elevation of a substrate with respect to tidal fluctuations determines the number of times per year the substrate and plants will be flooded with saltwater. The average number of hours submerged per month and the average number of hours submerged during daylight are important in determining plant distribution (item 10). Because of the energy and potential erosion they exert upon a site, waves can influence plant establishment. Fetch, or the distance wind travels across water to reach land, and the depth of water are primary determinants of the degree of wave energies. Item 37 relates a method for evaluating wave climate based on observed relationships between fetch, shore configuration, grain size, and success in controlling erosion in 86 salt marsh plantings in 12 coastal states. Of course, direct measurements for characterizing tides and waves can be accomplished through electronic gauges or by physically reading tides and waves on staff rods. Currents are normally considered when dredged material is deposited in rivers and streams. Currents have a direct effect on whether plants can become established. Current meters should be installed on the site and monitored for several months throughout the year to obtain a knowledge of maximum and minimum current conditions. Other hydrologic factors such as water table and water levels or depths will directly influence planned beneficial uses due to their effect on plant establishment and zonation. Water table, levels, and depths will influence the ability of plants to carry out their physiological processes (e.g. photosynthesis, respiration). Some plants can tolerate more or less water than others, which will in turn dictate what vegetation can be grown on a dredged material site. The vegetation will largely dictate the kinds of animal habitat that can be developed or the kinds of animals that will use the site. A procedural guide for monitoring such things as depths to water table and other hydrologic factors can be found in Item 47.

(f) Water quality. Salinity, pH, turbidity, dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), and mineral nutrients within the water column will largely influence the kinds of plants and aquatic fauna that will develop on or adjacent to a dredged material site. They should be monitored periodically prior to, during, and after dredging to obtain an idea of how water quality conditions might change over time, which in turn might affect plant and animal development. (See Section 2-4 of this manual for sampling and laboratory requirements and procedures regarding water quality factors.)

(2) Biological factors. Biological factors considered important to monitor include such things as: aquatic, semiaquatic, and upland plant species; all animals species including soil macroinvertebrates, microfauna, and benthos; and shellfish and finfish.

(a) Vegetation. Knowledge of existing plant species on or adjacent to the site will enable plant species selection. Indigenous plants may be desirable for various beneficial uses such as wildlife habitat development, agricultural, forestry, or horticultural purposes. Map the vegetation composition and distribution, either from visual estimation or sampling. Reconnaissance mapping and map use for various purposes, including wildlife and vegetation, and a guide to gaining natural resource information through remote sensing techniques are discussed in item 19. This guide includes vegetation and animal habitat inventory and assessment. Item 27 provides habitat analysis and evaluation methods suitable for vegetation description and other site attributes. Sampling methods are not standardized for vegetation but must be tailored to the type and areal extent of vegetation and the level of information required. Excellent general references for monitoring vegetation include items 10, 26, and 36. Item 61 provides a guide of sampling and summarizing data for plant community surveys and classification, including methods, data sheets, and computer summarization printouts. The specific location of any plants protected by law should be noted when sampling vegetation. A botanist familiar with the area should be consulted for species verification; regional botanical field guides such as items 65 and 70 will be helpful.

(b) Animals. Both aquatic and upland animals on and adjacent to the dredged material site should be monitored. Important economic species such as shrimp and other associated shellfish may be in adjacent waters and could be cultured and developed on the dredged material site. Furbearing animals such as beaver and otter may be in the area and could be attracted to the site for trapping pelts or other beneficial uses. Monitoring of smaller animals is important because they are part of the food web and can provide insight to use by larger predatory animals. Current and future animal use of a site, in general, should be determined through observation of signs such as tracks or browse marks, actual observations, or some form of sampling. For example, in sampling both aquatic and upland animals on dredged material in the intertidal zone of a Texas site near Galveston, monthly observations at exact locations were made. Aquatic invertebrates on the water bottom that may be covered during the dredging process or during beneficial use development should be described by species composition, abundance, and distribution. For information on sampling techniques, consult item 22, which discusses sampling of salt marsh benthos and burrows; item 50, which describes a reconnaissance technique for oysters; and item 85, which describes sampling for fiddler crabs in salt marsh. Other aquatic animal sampling and monitoring methods for plankton, periphyton, macrophyton, macroinvertebrates, and fish are amply discussed in item 83. For purposes of definition, monitoring of upland animals will include in this manual those animal species, such as waterfowl and colonial nesting birds, that use unflooded land for any of their life requisites. Item 69 provide numerous methods of monitoring primarily upland animal species. Another general reference that applies primarily to upland animal monitoring is item 34. Item 27 provides an excellent discussion on estimation of density of primarily upland animals by use of the line transect method. For dredged material that will be or has been deposited in a floodplain, item 78 provides a sampling method for floodplain arthropods although they stated there is no single sampling method applicable to studies of arthropods, as these animals vary in mobility and microhabitat preferences. Additional literature on sampling methods of upland animal populations includes items 5, 8, 35, 55, and 58. A wildlife biologist familiar with the proposed or existing dredged material site can estimate wildlife use of the site and should be consulted about the presence of threatened, rare, or endangered species. Critical habitat and areas of concern for these species must be located, protected, and/or enhanced in every dredging project.

e. Conclusion. Monitoring methodology should be tailored to the nature of the element and the overall reason for monitoring. In this case, it is to ensure that dredged material operations eventually lead to some planned beneficial uses. Monitoring methodology can be as simple as a yearly recording of presence or absence or as intensive as necessary to establish and document a management program or provide statistically reproducible data to protect legal interests.