Beach Nourishment – The Corps Process and Project Performance Issues

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Introduction

The U.S. Army Corps of Engineers is responsible for developing and constructing water resources projects to protect the nation's coastlines from erosion, wave attack, and flooding. In the project development process, beach nourishment is often identified as the optimal method of shore protection from the standpoint of: functional performance, cost effectiveness, environmental consistency, and social acceptance.

Performance of beach nourishment projects is frequently evaluated on functional aspects of the design, such as stability of the project shoreline, ability of the design template to withstand storm damage, and physical impacts to adjacent areas. Although functional performance is central to project success, ultimately, success also depends on performance in terms of project economics, the environment, and social considerations.

Corps Process

The Corps participates in shore protection projects as directed by Congress. Project initiating authorities include Section 111 studies that provide for mitigation of negative impacts of Federal navigation projects on adjacent shorelines, and site-specific studies authorized through public works bills in response to requests at the state or local level. Federal shore protection projects are cost-shared between the Corps and a non-Federal sponsor at a level specified according to project purpose and authorizing language.

The Corps project development process includes four separately-authorized phases: Reconnaissance, Feasibility, Design, and Construction. The Reconnaissance and Feasibility phases constitute the study portion of the process. Principal elements of study include determination of Federal interest, **formulation** of the optimal plan, preliminary design, and environmental coordination. Approved study recommendations are subsequently implemented during the Design and Construction phases. Main elements of the Design phase include detailed project **design** and development of construction plans and specifications. The Construction phase includes initial beach-fill **construction**, project **monitoring**, and periodic **renourishment**. Monitoring and renourishment are continuing construction activities that extend throughout the project design life (typically 50 years). Each element of the Corps process involves a range of issues that can impact overall project performance. Some issues are identified below, and will be further discussed by panel members in subsequent presentations.

Formulation

Central to formulation of Corps beach nourishment projects is the requirement that the selected plan maximize national economic development (NED) benefits based on hurricane and storm damage reduction. Detailed analyses are performed during formulation to estimate future storm damages, economic benefits, and project costs for a range of rational alternatives. Because of the complex nature of coastal processes and the randomness of storm occurrence, project benefits over a 50-year project life are difficult to quantify and contain a certain level of uncertainty. The Corps needs improved tools to better estimate economic performance over the 50-year project life cycle. Present analysis methods employ a frequency-based approach that doesn't represent the natural time variability of storm occurrence and damage/recovery processes. A life cycle modeling approach would better reflect this variability and improve estimates of economic performance by accounting for benefits and costs that vary through time, such as benefits associated with advanced fill and costs of emergency post-storm maintenance.

A related issue concerns the level of risk and uncertainty associated with the recommended plan. Assessment of project risk and uncertainty is required by Corps policy and enables decision makers to better evaluate expected performance. However, presently no definitive guidance exists for addressing risk and uncertainty in beach nourishment projects.

Design

General design features of beach nourishment projects (beach-fill dimensions, project limits, structural measures, and borrow area) are determined during formulation. In the design phase, the beach nourishment plan is developed in detail including: layout of the beach-fill design and construction templates, design of coastal structures (e.g., groins, seawalls, bulkheads), design of infrastructure relocations and beach access, and borrow sand specification. In general, design practices are adequately established for nourishment projects located on sandy beaches typical of the Atlantic and Gulf coasts. However, design issues remain unresolved in other regions and for certain site-specific conditions. Examples of regional design issues include: design consideration of long waves and design for beaches backed by bluffs (Pacific coast), design for shorelines with existing cohesive or cobble sediments (Great Lakes), and design for pocket beaches and reef-protected shorelines (Hawaii and Pacific islands).

Construction

Beach nourishment projects are typically constructed through placement of sand dredged from an offshore borrow source. Some projects include mechanical bypassing of sand from an updrift beach. A major issue in construction relates to timing of dredging activities, which may be constrained by weather conditions and environmental windows that continue to narrow. Often construction funding is spread over two or more fiscal years, which may force phasing of construction. Because of these constraints, project construction may be interrupted or delayed, resulting in increased costs and reduced initial performance.

A technical issue relating to construction and design is use of borrow sand with a grain size different than that of the native beach. There are inconsistencies in Corps guidance for determining required placement quantities when grain sizes of native and borrow materials differ. Incorrect estimates of required placement quantity can significantly impact economic and functional performance. Firm engineering and policy guidance is needed to establish the most technically sound approach.

Monitoring

Beach nourishment monitoring is key to evaluating project performance. Monitoring data is collected to determine condition of the design template, identify erosion hotspots, conduct post-storm assessments, and estimate renourishment requirements. An issue related to monitoring is the need to determine causes of erosion hotspots, and correct the problems to improve functional performance. Another issue involves measuring economic performance of projects. Projects are formulated to maximize net economic benefits (benefits minus costs). Economic performance in relation to cost is relatively easy to measure. However, measuring performance from a benefits standpoint is not straightforward because primary benefits are based on damages *prevented*, which cannot be empirically quantified with monitoring data. Demonstration of successful economic performance is needed to respond to criticism that beach nourishment projects are a waste of tax dollars.

Renourishment

Beach-fill projects require periodic renourishment to maintain design specifications. A fixed renourishment interval is assumed during formulation for the purpose of estimating expected average annual costs over the life of the project. In practice, renourishment requirements fluctuate over time because of variable wave conditions and non-uniform erosion along the project length. The required interval may be longer or shorter than any given cycle. There is a need for methodology that defines when to trigger renourishment so that project function is maintained with maximum efficiency.