



## DHI SOLUTION

# ENSURING SUSTAINABLE COASTAL DEVELOPMENT

Learning from – and working with – nature

## WORKING WITH NATURE

Coastal environments are transient. They are continuously reshaped by the natural forces of waves, tides, storm surges, erosion and deposition. In order to be sustainable, coastal development requires a clear understanding of, and respect for, these natural processes. Sustainable coastal development:

- serves the needs of the developer and society
- has good internal functionality in terms of the marine elements (for example, beaches and lagoons)
- is part of an overall development plan for the area
- aims to have minimal impact on the environment during construction and operation
- utilises natural conditions at the site instead of fighting against nature
- has a well-defined planning horizon that accounts for the expected consequences of climate change, such as sea level rise
- is flexible to allow for adaptation due to the consequences of climate change



Coastal restoration for the City of Marataizes.

## SUMMARY

### CLIENT

- Coastal authorities
- Developers
- Municipalities
- Coastal communities

### CHALLENGE

- Increasing growth of and development pressure in coastal areas
- Preventing coastal megacities from subsiding
- Reduction in the release of sand by erosion due to hard coastal structures, causing loss of beaches
- Preventing lee-side erosion at ports and tidal inlets
- Increasing risk of coastal erosion and flooding due to climate change
- Difficulty identifying the best solutions due to the dynamic nature of coasts

### SOLUTION

Our extensive knowledge of natural processes combined with the application of the most advanced technologies within surveying and monitoring, numerical modelling, and hydraulic model testing.

### VALUE

- Protection of valuable coastal facilities and beach amenities against increasing coastal erosion and flooding risks
- Restoration of the natural coastal processes
- Protection of cities against increased coastal flooding risks, safeguarding valuable infrastructure, public utilities and urban areas
- Enhancement of the natural and recreational value of coastal areas

Competing commercial, recreational and residential interests often put increasing pressure on our coasts. Careful planning and comprehensive assessments are necessary to preserve complex coastal dynamics as well as to safeguard the coast for future generations.

The successful and long-lasting design of marine elements, such as beaches and lagoons, is only possible if the hydraulic, coastal and environmental aspects are taken into account from early on in the planning stage.

Planning, designing and constructing coastal projects require a wide range of hydraulic and environmental engineering services and tools. We have the thorough understanding of the various processes and phenomena of nature needed to ensure viable design, safe and efficient operation, and minimal environmental impacts. We conduct a detailed analysis of natural processes and offer a variety of services, including:

- surveying and monitoring
- numerical modelling
- hydraulic model testing

Our unique combination of expertise, combined with our integrated suite of tools and services, enables us to provide our clients with optimal solutions to complex problems.



*Dredger nourishing the west coast of Denmark. Photo: © Rohde Nielsen A/S*

## INTEGRATING COASTAL ISSUES EARLY

Utilising the possibilities provided by the marine environment at a specific site for the benefit of the project is one of the keys to successful coastal development. Instead of perceiving marine forces, such as waves and tides, as problems against which protection is required, we harness them to maintain high-quality artificial beaches and lagoons.

Coastal elements of waterfront developments are artificial landscape components that develop according to the natural forces in the area. These natural forces constitute boundary conditions for the coastal elements. This puts fixed restrictions on the layout of these elements. As such, it's important that these elements are integrated into the layout of the development at the very start of the process. Consequently, we promote collaboration among the various stakeholders from early on in the project. This ensures proper integration and optimal functionality of the natural elements in the layout of the scheme.

## TAILOR-MADE SOLUTIONS TO MEET YOUR NEEDS

We tailor our solutions to the needs of our clients by utilising the opportunities provided by the marine environment at the project site while taking environmental impact into consideration. Our sustainable and holistic solutions are based on the principle of working with nature. As such, they are adaptable to future climate changes. We've worked on numerous sustainable coastal development projects worldwide. Below, you can read just a few examples of our work.

**Combatting erosion along the west coast of Denmark** – We helped the Danish Coastal Authority combat erosion by transitioning from fixed structures to nourishment. We used modelling and monitoring to maintain natural coastal processes in the area as well as to ensure that beaches were not disturbed by hard coastal structures.

**Management Guidelines for Dubai Coast** – We helped the Dubai Municipality (DM) assess the shoreline response from ongoing large coastal and offshore development schemes. Based on comprehensive numerical modelling, we recommended planning and management methods for the Dubai Coastal Zone. This became the basis for the 'Coastal Development Guidelines for Dubai Coast', which was published by DM in 2010.

**Amager Beach Park** – We assisted Copenhagen Municipality with developing a high-quality recreational beach park. The existing Amager Beach suffered from siltation and poor water quality due to a shallow shoreface and lack of wave exposure. These problems were addressed by:

- constructing an offshore island and creating new exposed beaches on the seaside of the island to secure sufficient wave exposure
- orientating the beaches against the prevailing waves to obtain stable beaches
- securing good water quality in the lagoon by including two openings to ensure good flushing

**Coastal restoration for the City of Maratáizes** – Through our work with Instituto Nacional de Pesquisas Hidroviárias, we assisted the City of Maratáizes in Brazil with developing stable, high-quality recreational beaches with minimal impact along adjacent sections. We helped our client gain local acceptance of a new concept for artificial headlands by developing Shoreline Management Schemes that included streamlined structures supporting sections of filled beaches.

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