

BUILDING WITH NATURE: THINKING, ACTING AND INTERACTING DIFFERENTLY

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INTRODUCTION & OBJECTIVES

INTRODUCTION

OBJECTIVE

1. Approach towards maximizing positive effects in marine infra projects → Building with Nature
2. Best practices in seabed restoration and landscaping → 3 case studies



APPROACH TOWARDS BUILDING WITH NATURE

RECENT OBSERVATIONS FROM THE INDUSTRY:

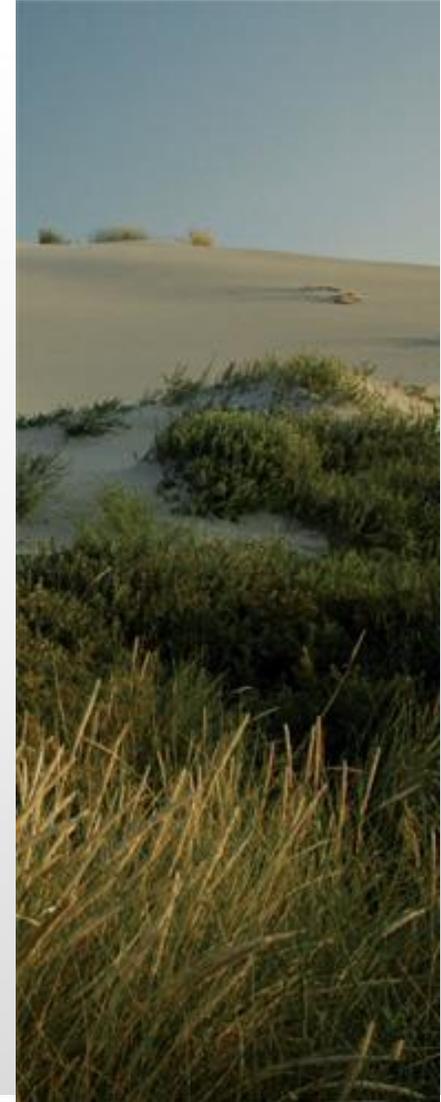
- Projects become more complex
- Contractor more responsibilities, not only for productions and design but also for the surrounding environment (both social and ecological)
- Protection of environment
- Permit responsibility
- During execution:
 - Development and implementation of Environmental Management Plans
 - Extensive monitoring requirements
 - Modelling of source and response



APPROACH TOWARDS BUILDING WITH NATURE

TRADITIONAL ENVIRONMENTAL MANAGEMENT APPROACH

- Reactive → can only respond coral health triggers after the impact is measured
- Conservative → (over- or under-); WQ triggers generally results in unnecessary work stoppages, occasionally provide inadequate protection
- Static → limited opportunity to update trigger levels based on monitoring results and improved understanding
- No segregation → very difficult to segregate impacts (related to dredging activities or a natural/external event?)



BUILDING WITH NATURE? MOTIVATION DREDGING CONTRACTORS

What if we are so focused on minimizing negative effects that we miss opportunities to maximize positive effects?

APPROACH TOWARDS BUILDING WITH NATURE

From: Building *in* Nature

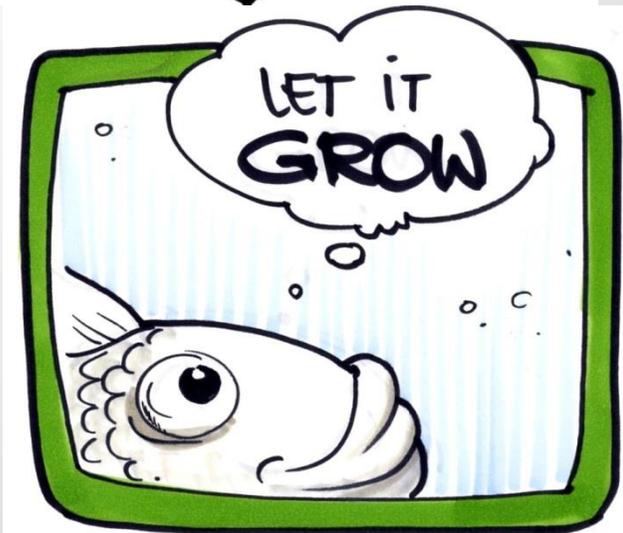


Via: Building *of* Nature



To: Building *with* Nature

- A design process aiming to work with natural processes and providing opportunities for nature as part of the infrastructure development process



APPROACH TOWARDS BUILDING WITH NATURE



LEARNING BY DOING

soft solutions

hard solutions

Temperate



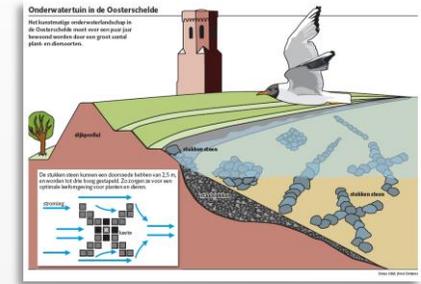
*Pilot Sand Motor
Delfland Coast*



*Lake Marker
foreshore nourishment*



*ES: oyster reefs
as shore protection*



*Eastern Scheldt
Underwater garden*

Tropical



*Coastal protection
Sea grass*



*Coastal mangroves
rehabilitation*



Coral reef restoration



*Singapore
'rich levee'*

focus on ecosystem functioning

focus on infrastructure development

BUILDING WITH NATURE IN PRACTICE

CASE 1: ECOSYSTEM BASED DESIGN OF SAND EXTRACTION SITES

Seabed landscaping of a sand mining pit, creating added value for ecology & economy

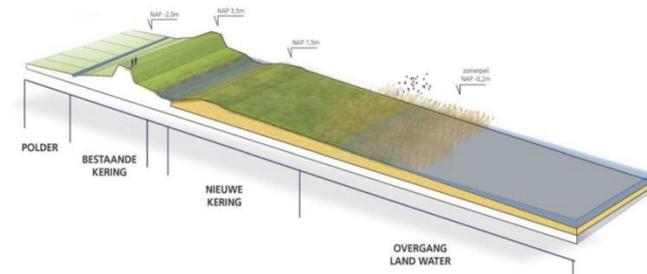


CASE 2: REEF HABITAT DEVELOPMENT

Application of 3D printing techniques to create site specific artificial reefs

CASE 3: MARKERMEERDIJKEN (NL)

Instead of rising dikes, create mildly sloping foreshore to protect existing dikes. Vegetation stabilizes foreshore and yields extra wave attenuation during storms. Beneficial re-use of dredged fine sediments



ECOLOGICAL SEABED LANDSCAPING

- Now: 26Mm³ annually used for nourishment
- Future: Increase up to 40Mm³
- Policy: Shallow seabed mining → top 2 m only
- Results: Pressure on spatial planning



ECOLOGICAL SEABED LANDSCAPING



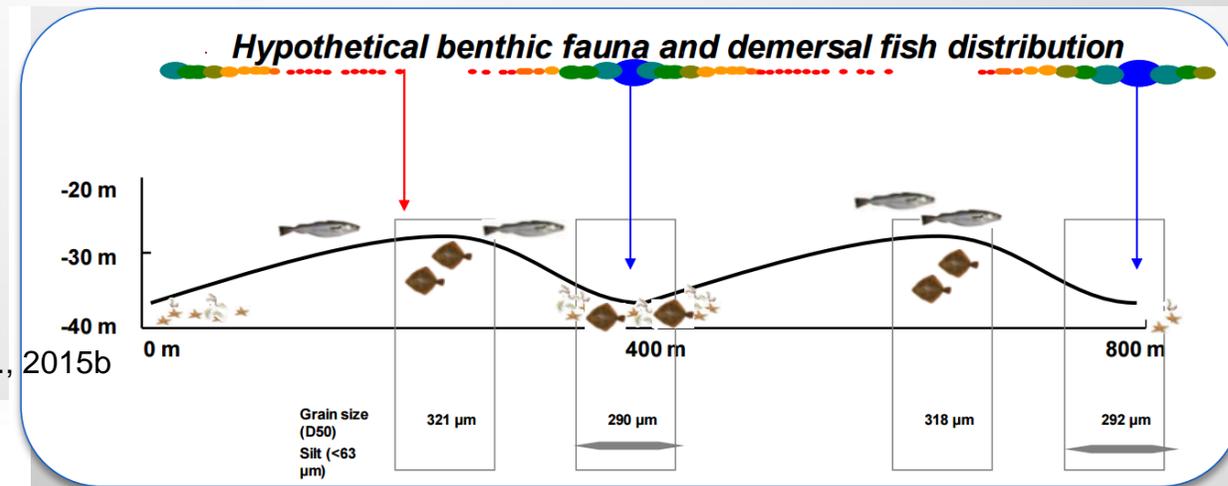
- MV 2 development → additional 220 Mm³ over 4 year.
- To minimise footprint → apply deep sand extraction of 20 m
- To assess impact: effects of different sand extraction depths are compared and ecosystem based design rules for future borrow pits are developed which simultaneously maximize the sand yield and minimize the surface area of direct impact

ECOLOGICAL SEABED LANDSCAPING

- Realization of large-scale bed forms in mining area

HYPOTHESIS:

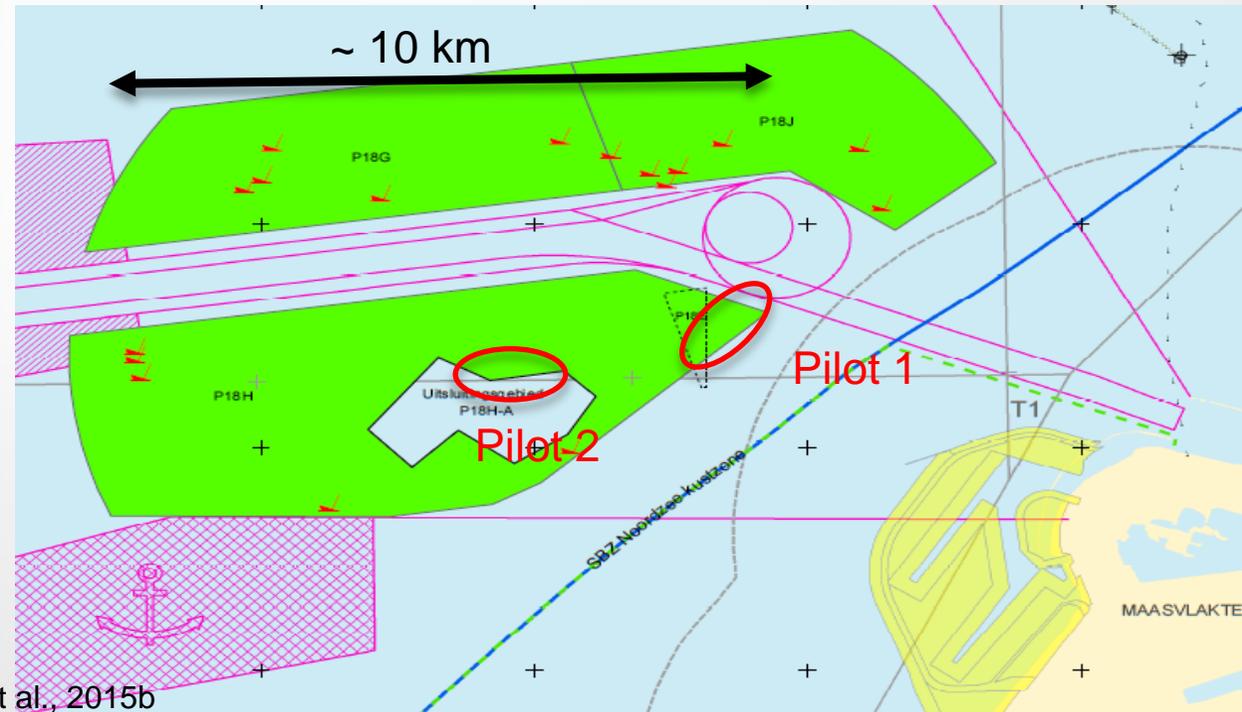
- High potential for ecological development and mutual benefits for stakeholders
 - Habitat diversity (benthos) + faster recolonization
 - Positive effect on populations of fish, birds & mammals
 - increase economical value of a dredging area



Reference: De Jong et al., 2014, De Jong et al., 2015a, Jong et al., 2015b

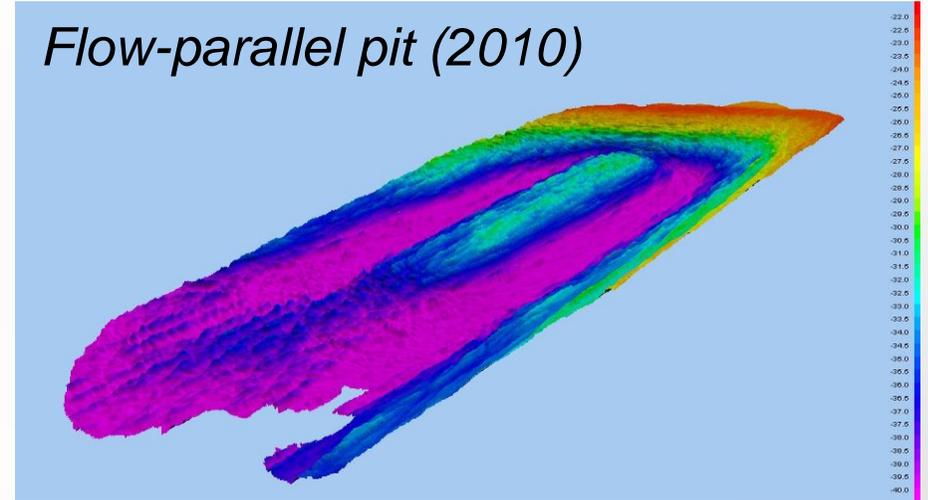
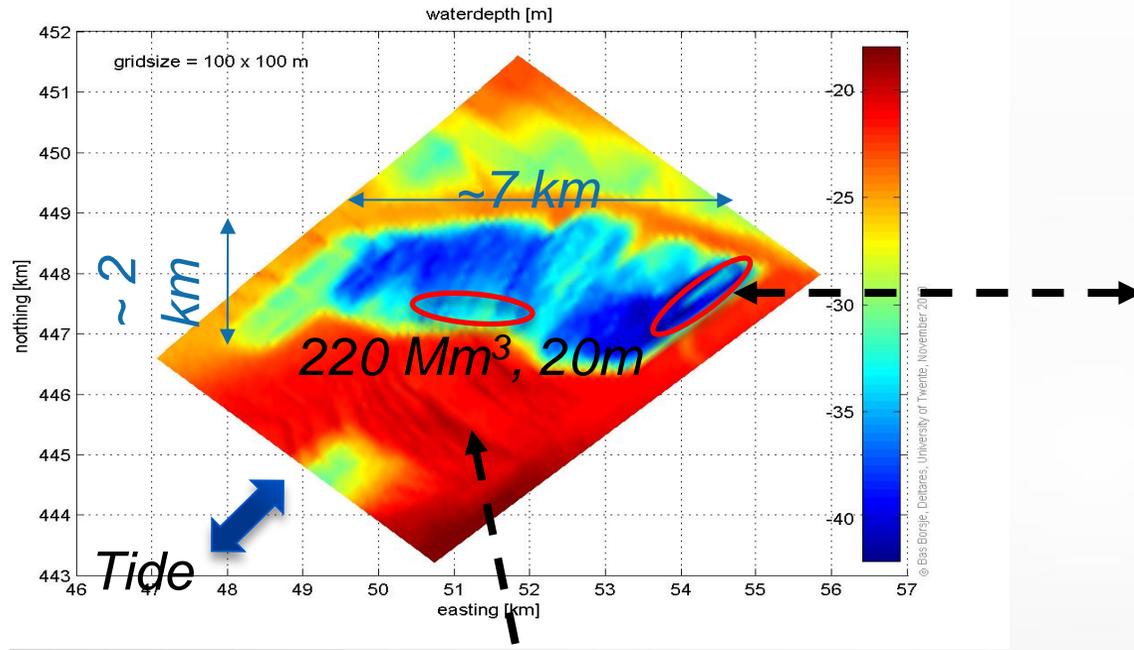
ECOLOGICAL SEABED LANDSCAPING

- Assessment physical dimensions (L ~ 300-400 m, V > 1-10 Mm³)
- Design of monitoring strategies (4-6 yrs after realisation)
- Permanent liaison with stakeholders (PoR, RWS, PUMA, ...)

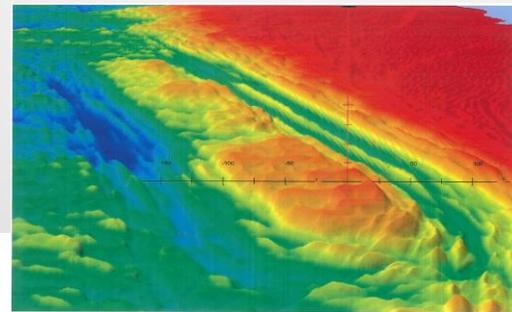
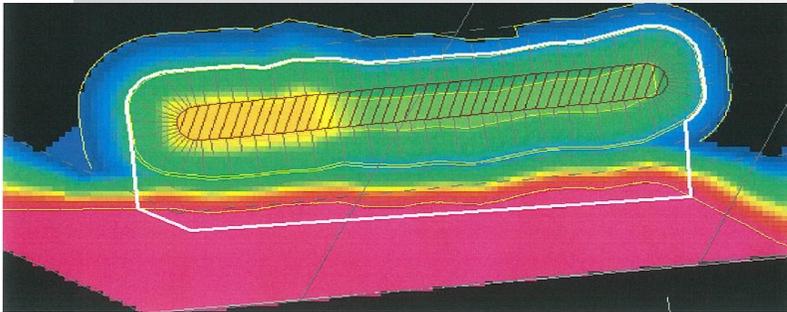


Reference: De Jong et al., 2014, De Jong et al., 2015a, Jong et al., 2015b

ECOLOGICAL SEABED LANDSCAPING



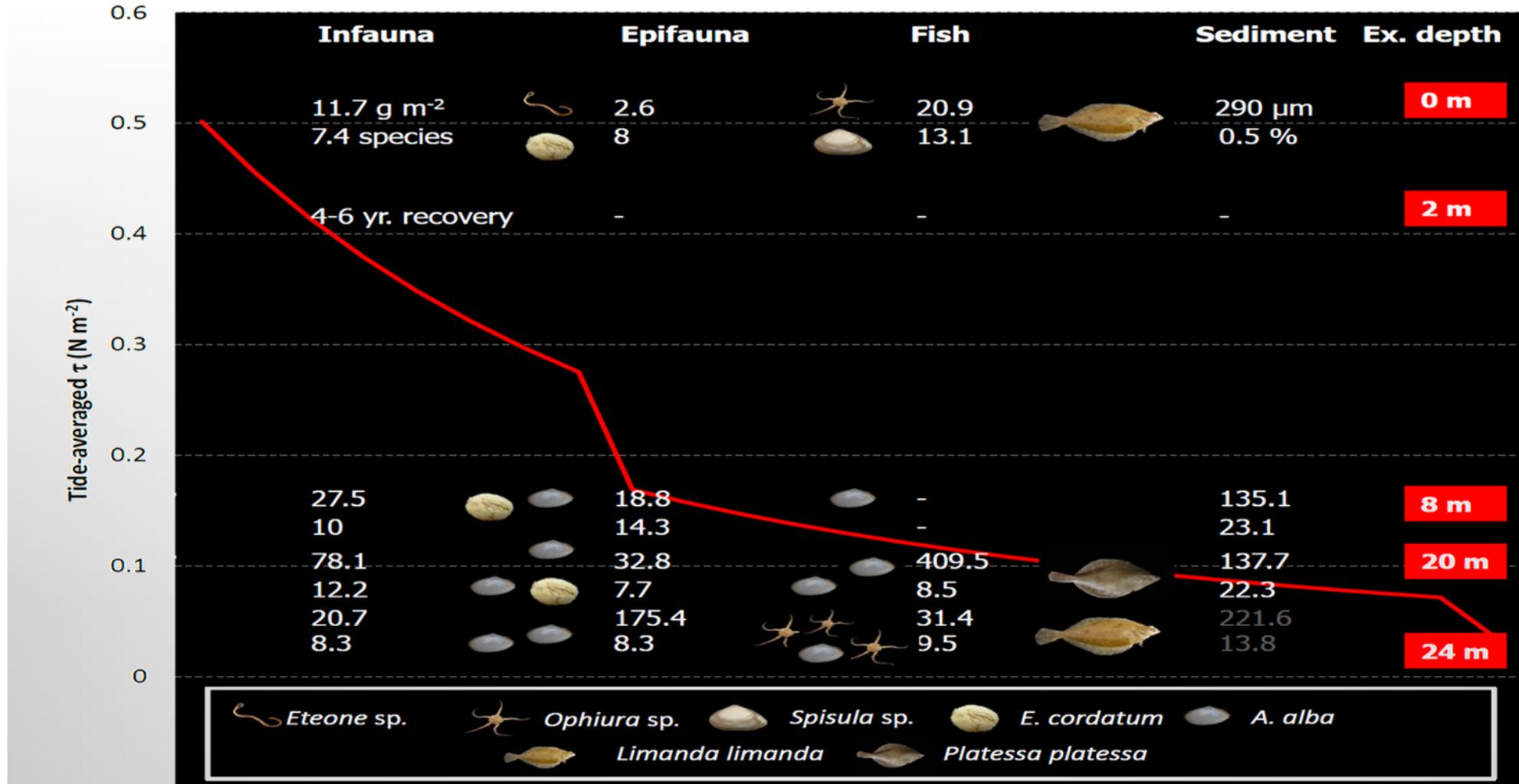
Flow-normal pit (2011)



ECOLOGICAL SEABED LANDSCAPING



ECOLOGICAL SEABED LANDSCAPING



Courtesy: Jong, M. de., The ecological effects of deep sand extraction on the Dutch continental shelf Implications for future sand extraction (2016)

ECOLOGICAL SEABED LANDSCAPING

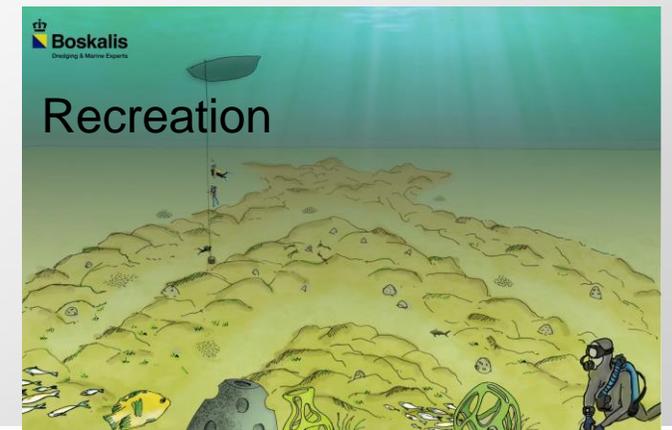
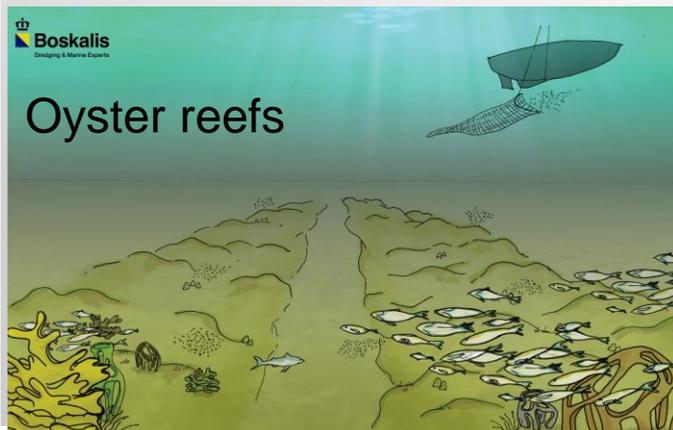
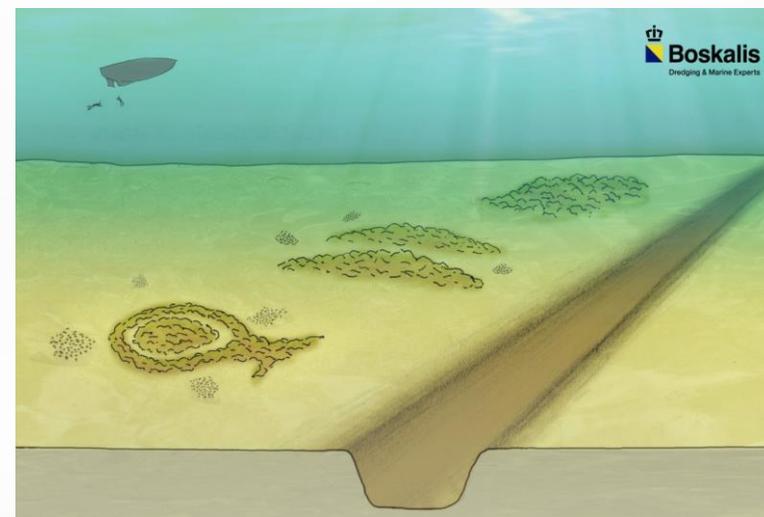
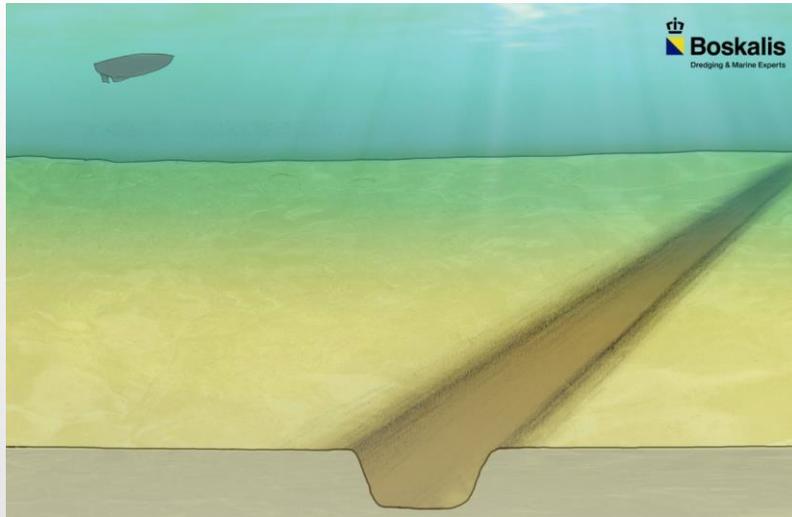
CONCLUSIONS AND LESSONS LEARNED

- Ecological landscaping has high potential
- Stakeholders changed perception into a positive view on opportunities
- Better to refer to „establishing of habitats“ instead of „recovery of habitats“
- Base design on existing ecosystem and local physical conditions
- Cooperate with ecologists, morpho- and hydrodynamic experts, fishermen, dredging contractors, permitting authorities beforehand



ECOLOGICAL SEABED LANDSCAPING

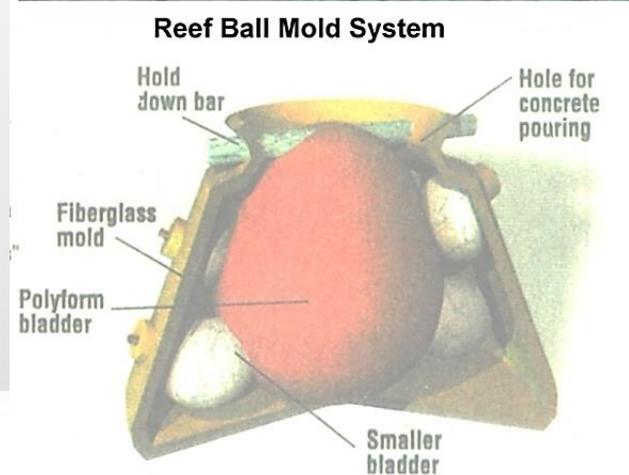
SEABED LANDSCAPING: NEXT STEP

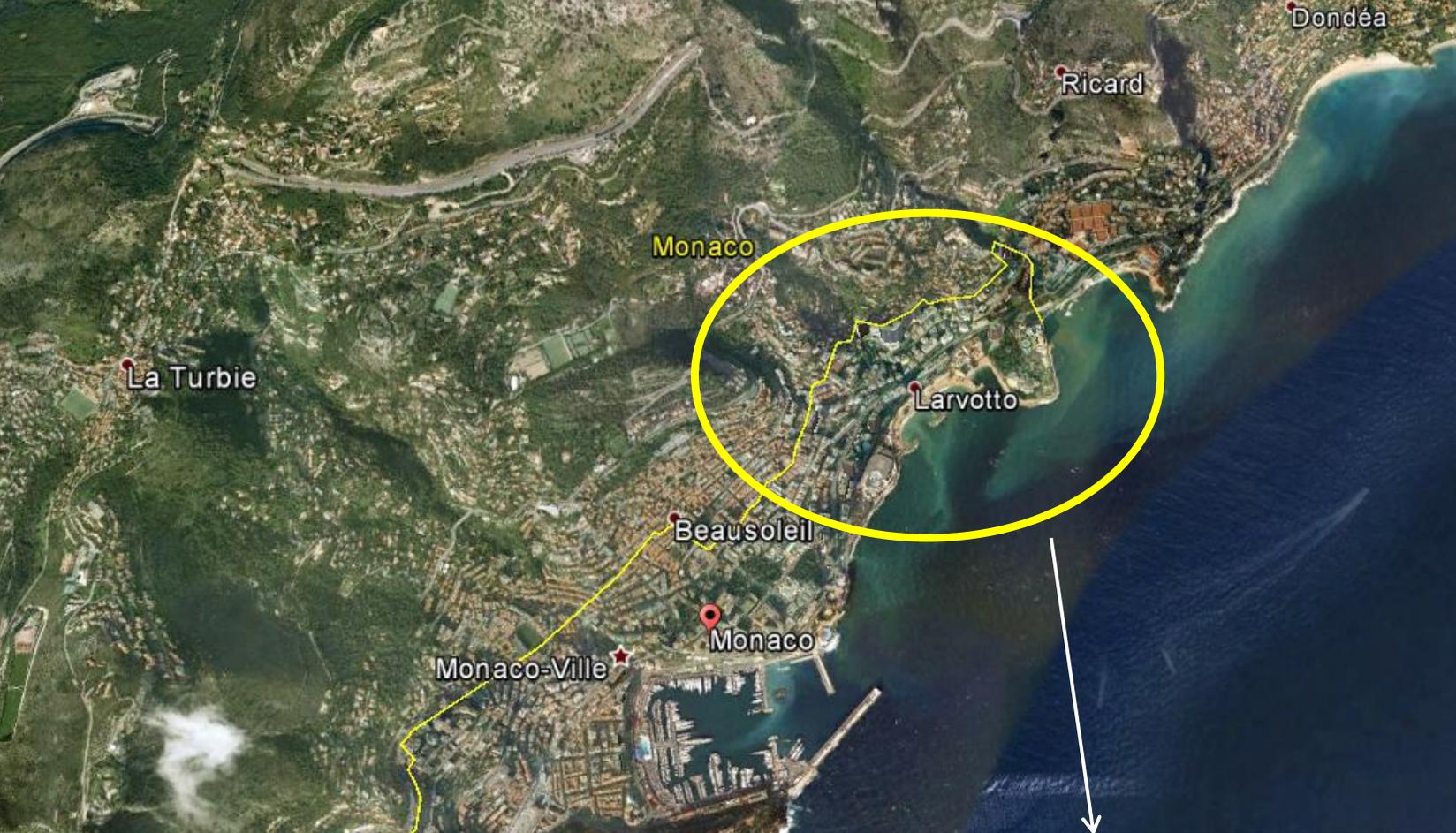


ARTIFICIAL REEF

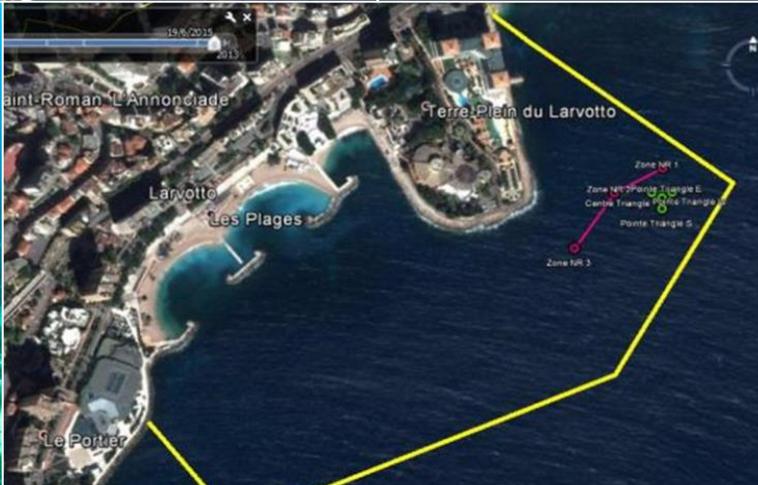
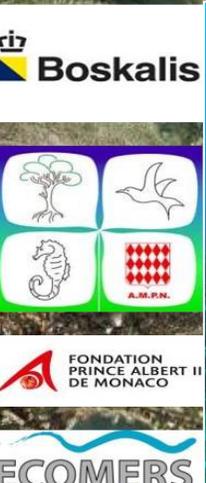
DEVELOP INFRASTRUCTURE AND AT THE SAME TIME USE AND CREATE OPPORTUNITIES FOR NATURE (BUILDING WITH NATURE)

- Why?:
 - Promote marine life in areas with a generally featureless bottom +
 - Control hydrodynamic conditions +
 - Recreation
- Creation of (small scale) reef habitats by making artificial reef units from dredged sediment using 3D printing technology
- Benefits compared to traditional (concrete) reefs: freedom of form and freedom of material



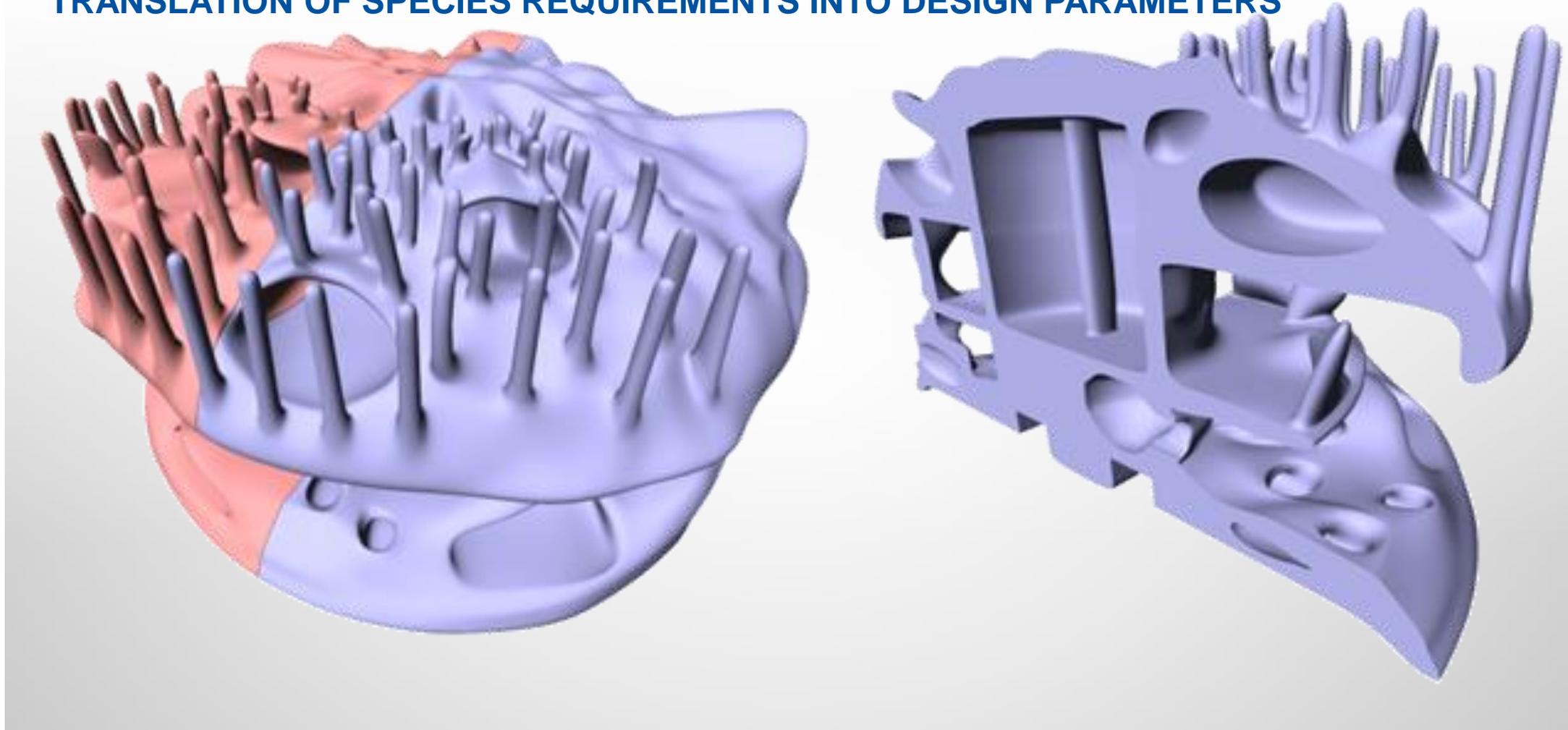


Development of an artificial reef to enhance the rocky reef system by creating habitat for sessile organisms and juvenile fish.

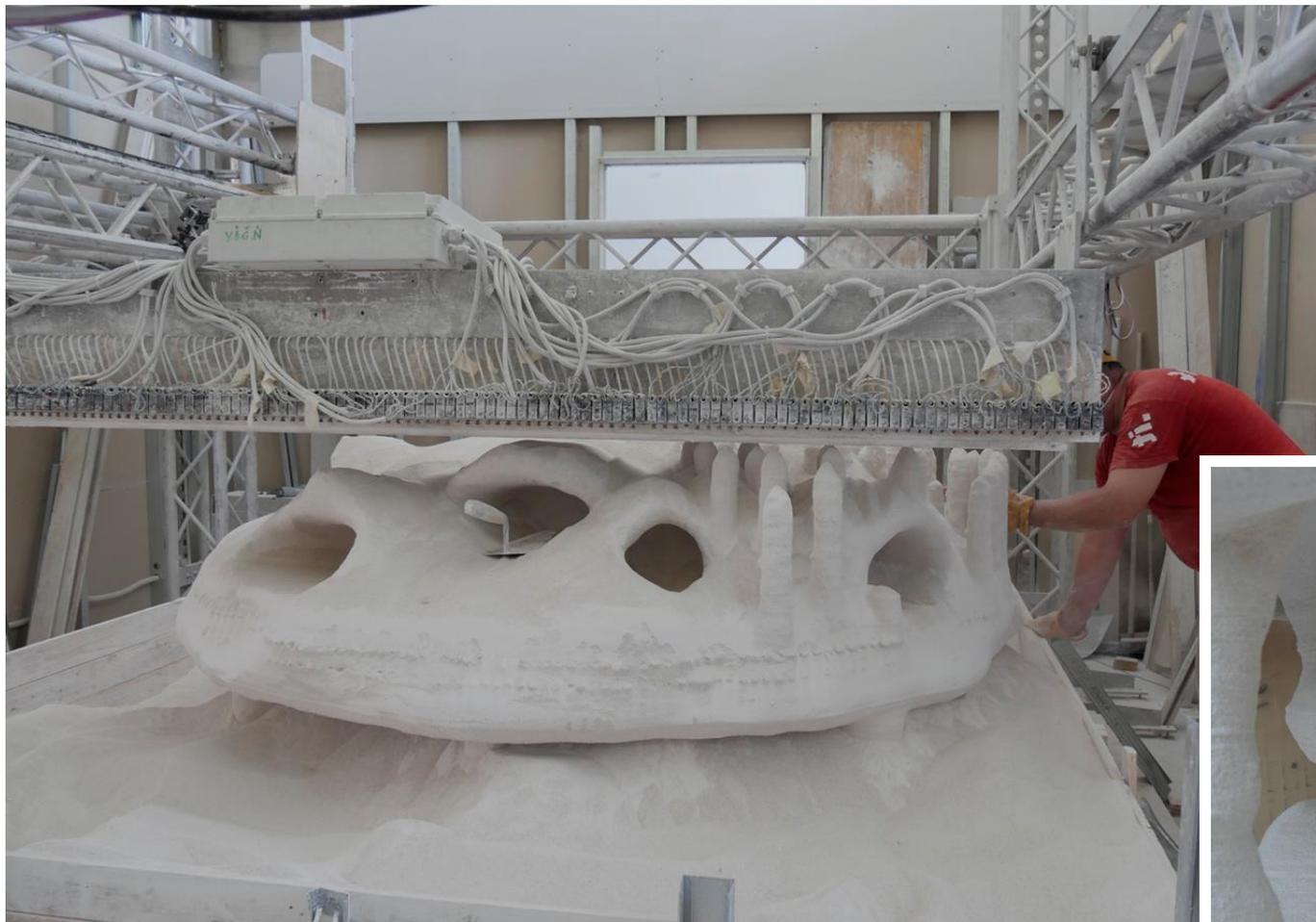


ARTIFICIAL REEF – DETAILED DESIGN

TRANSLATION OF SPECIES REQUIREMENTS INTO DESIGN PARAMETERS

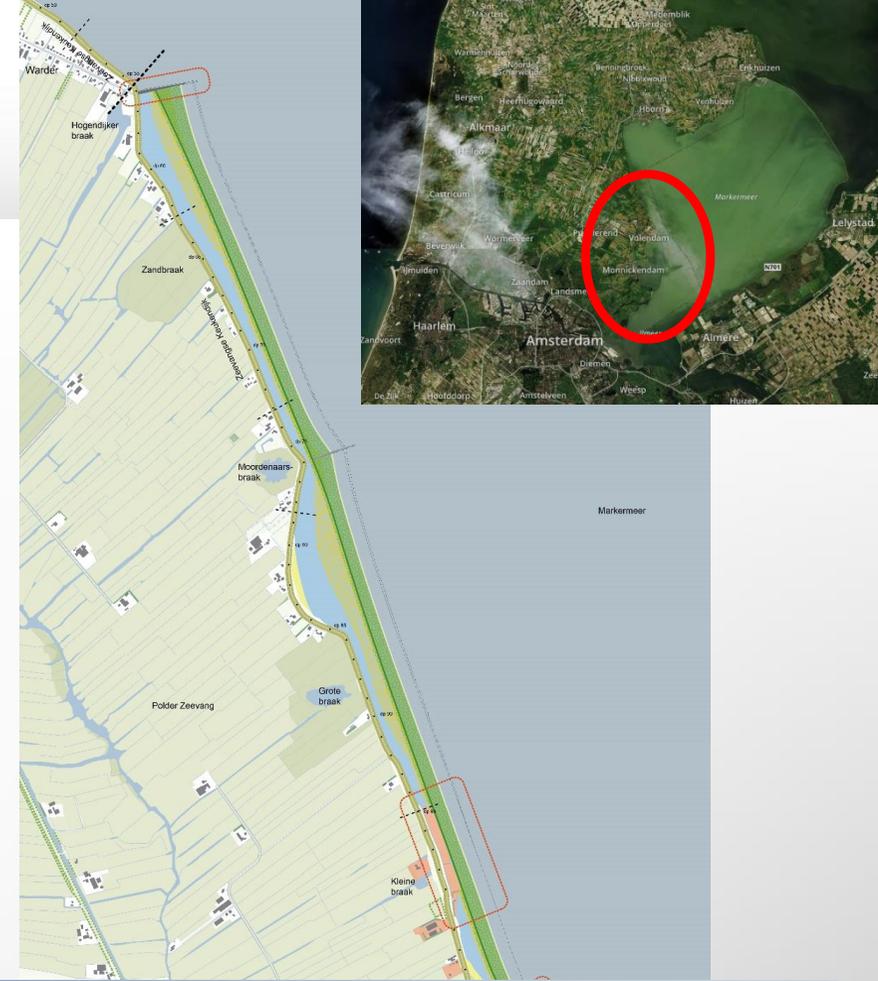


ARTIFICIAL REEF – 3D PRINTING



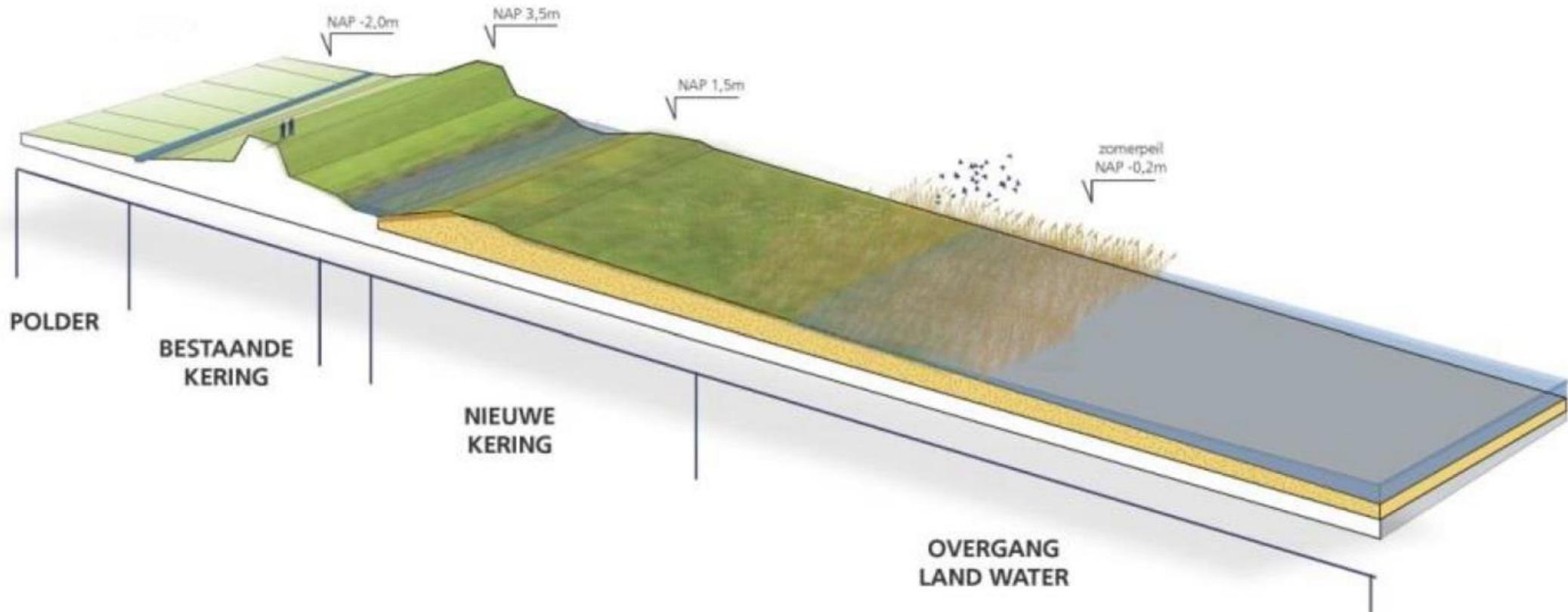
MARKERMEERDIJKEN

- 33 km dyke reinforcement along the Marker Meer
- Alliance contract between Client and Contractor
- Challenging design aspects:
 - Constructing of dykes on peat
 - Constructing limited space
 - Preserve typical Dutch landscape characteristics
 - Many stakeholders



MARKERMEERDIJKEN

- Mildly sloping foreshore protects existing dike
- Vegetation stabilizes foreshore and yields extra wave attenuation during storms



HOW TO MAKE THIS HAPPEN?

KEY ENABLING FACTORS:

1. Eco-system based strategies for design & management of dredging operations
2. Thorough understanding of your system
3. Proven design guidance for natural habitats
4. Valuation tools for nature-based solutions
5. Well-developed environmental legislation
6. Project arrangements that facilitate co-creation of nature-based solutions
7. Effective leadership and mainstreaming among key-stakeholders



DISCUSSION



LINKS

ECOSHAPE FOUNDATION | BUILDING WITH NATURE PROGRAM

[HTTP://WWW.ECOSHAPE.NL/](http://www.ecoshape.nl/)

ECOLOGICAL SEABED LANDSCAPING:

[HTTP://WWW.ECOSHAPE.NL/EN_GB/SEABED-LANDSCAPING.HTML](http://www.ecoshape.nl/en_gb/seabed-landscaping.html)