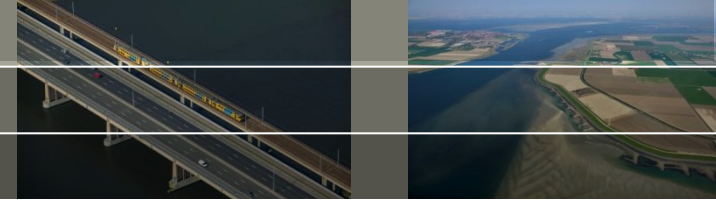




Effective and multifunctional flood safety through Building with Nature

Mindert de Vries and Bregje van Wesenbeek

27 februari 2014



Mindert de Vries

Project coordinator of FAST

**Senior specialist Eco-Engineering Deltares
Lector Building with Nature HZ Uni. Applied Sciences
Leading lector (Professor) of Delta Academy Applied
Research Centre**

Ecosystemservices relevant for flood safety

- Wave dampening
- Reduction of windspeed
- Reduction of currents
- Stabilisation of sediment
- Increase of sedimentation
- Reduced erosion
- Water retention
- Creation of a physical barrier



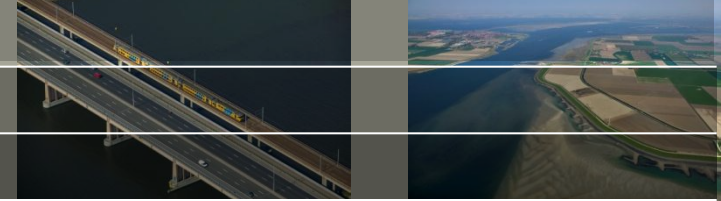
Why should we do ecosystem-based flood defense

Why should we make use of natural processes and ecosystem services in flood risk mitigation in combination with hard engineering?

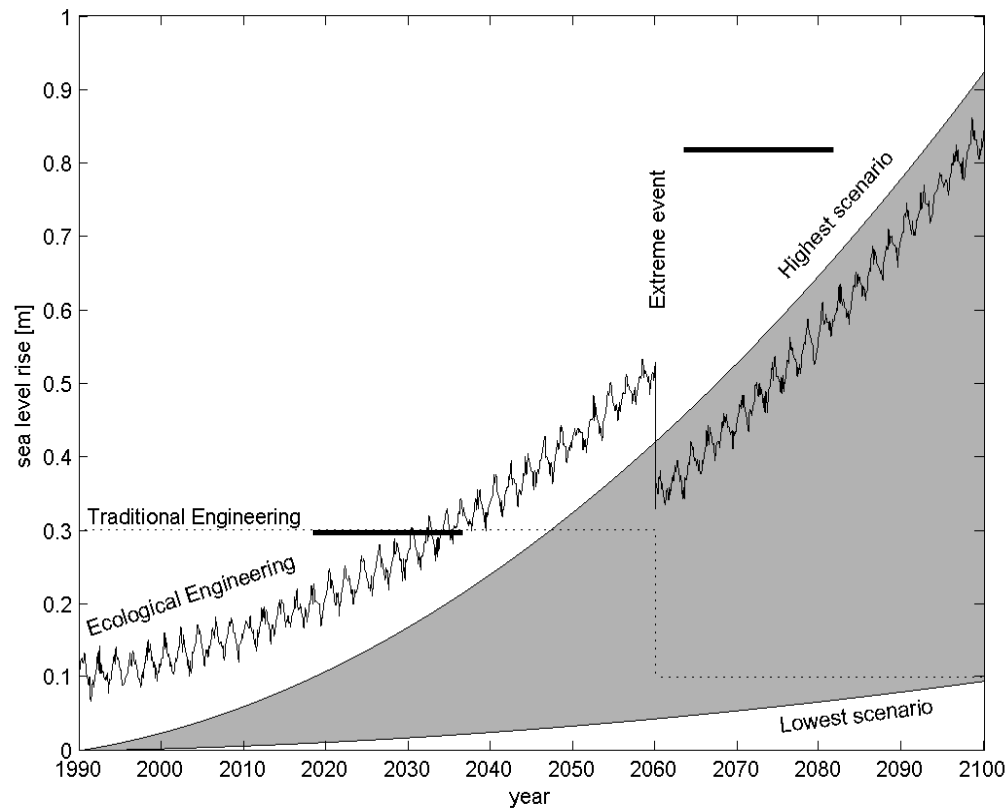
1. Cost reduction
2. Reduces risk on failure
3. Adaptable



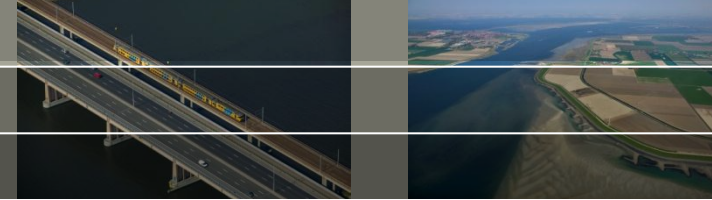
Adaptable



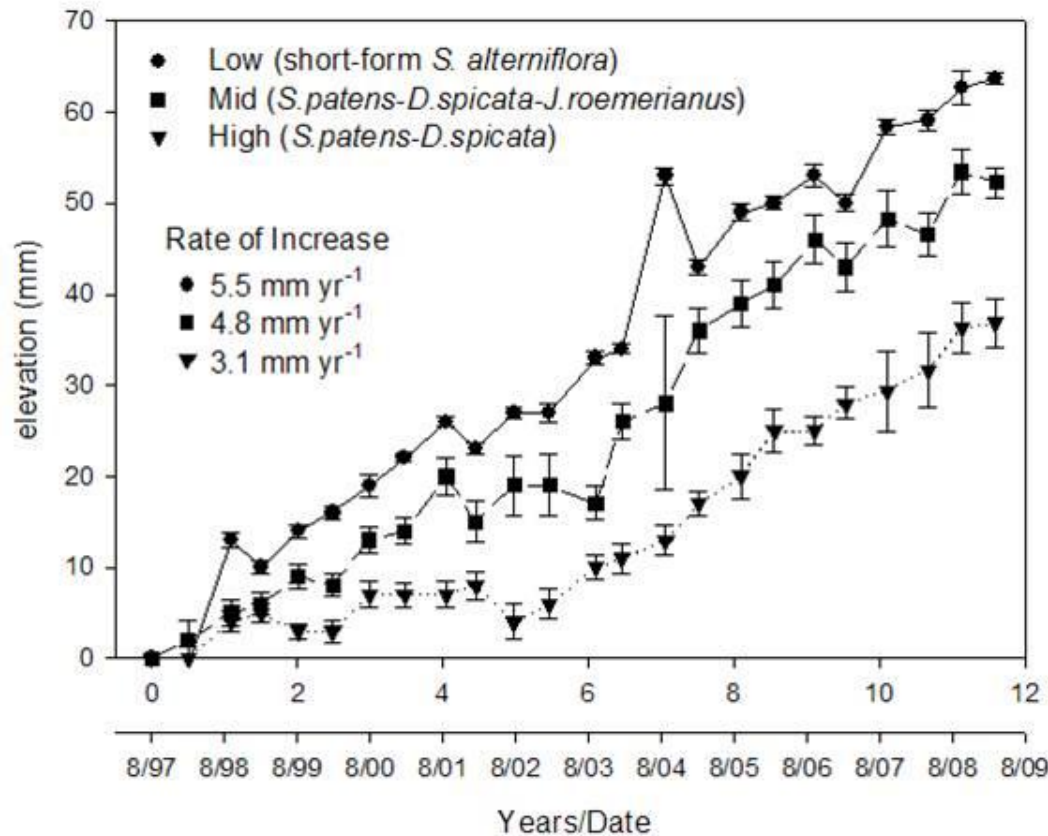
1. Self-sustaining and self-repairing
2. Accretes with rising water levels (peat or sediment)
3. Dampens waves independent on wave height



Adaptable

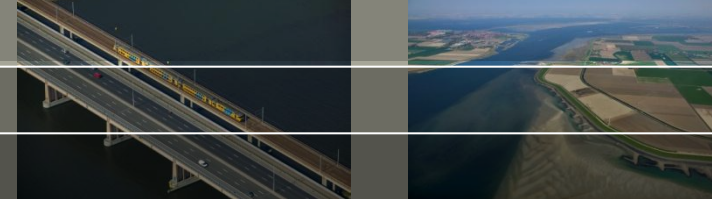


1. Self-sustaining and resilient
2. Accretes with rising water levels (peat or sediment)
3. Dampens waves independent on wave height

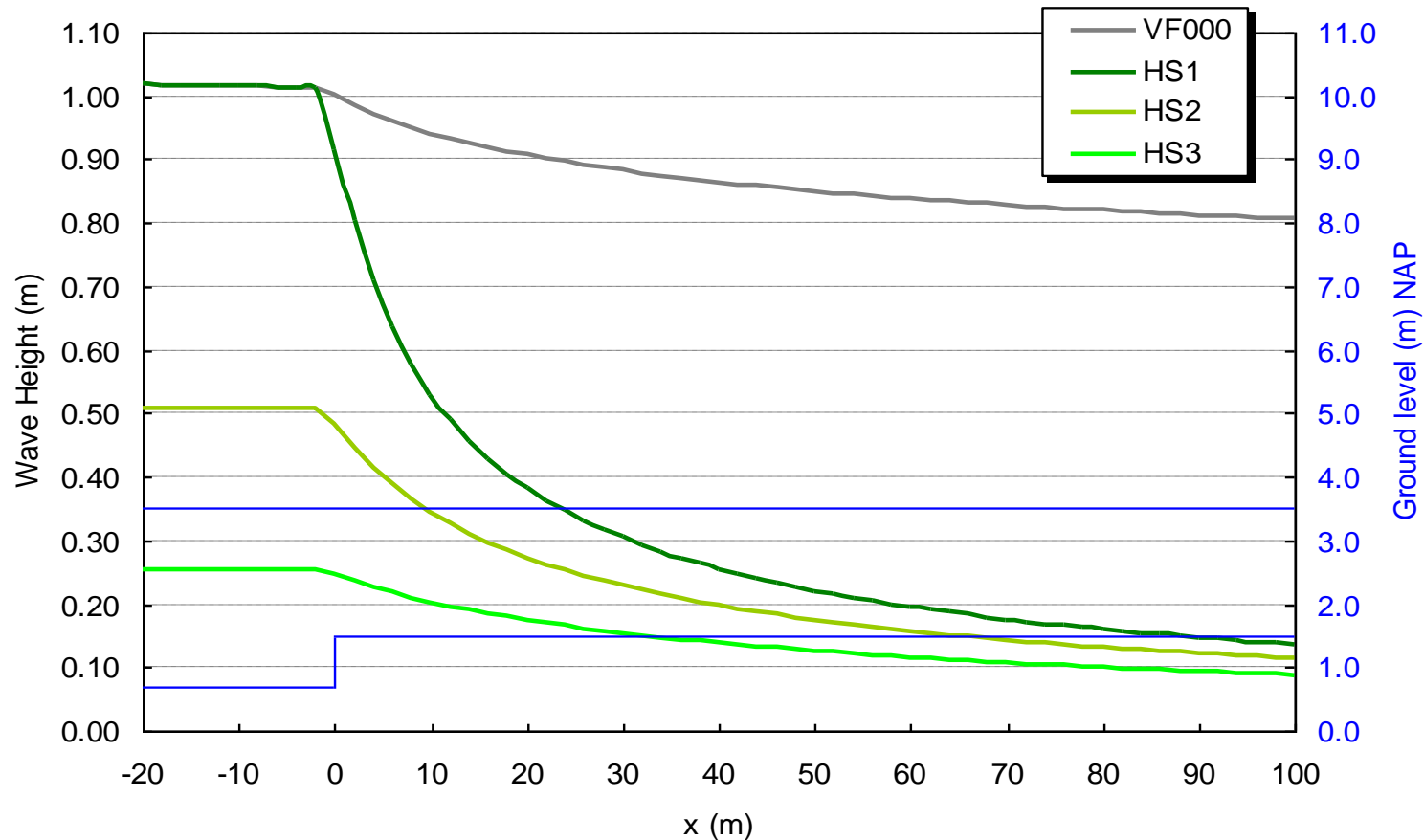


Blum 2011

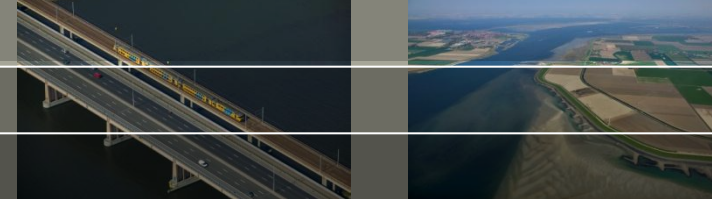
Adaptable



1. Self-sustaining and resilient
2. Accretes with rising water levels (peat or sediment)
3. **Dampens waves independent on wave height**



Additional benefits



- Nursery for fish and aquaculture species
- Food provisioning (fruits, waterfowl)
- Carbon fixation
- Firewood production
- Water purification
- Water retention
- Biodiversity
- Tourism & Recreation



System specific approach

Coastal systems

Temperate systems

Tropical systems

Beach and dunes

Sand

Beach and dunes

Shellfish reefs

Subtidal/intertidal

Coral reefs

Sea grass

Silt

Sea grass

Salt marsh

Intertidal

Mangroves

Intertidal flats

Intertidal flats

Coastal systems

Coastal systems

Temperate systems

Beach and dunes

Shellfish reefs

Sea grass

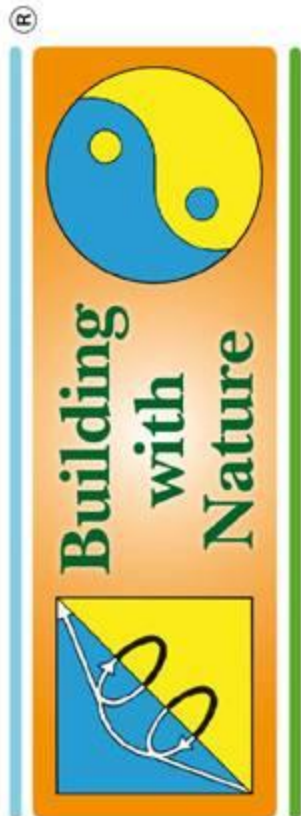
Salt marsh

Intertidal flats




Principles of Building with Nature (R. Waterman)

Emphasis on flexible soft structures in harmony with the sea, like dunes and beaches.




Ronald Waterman
Sustainable Development by Building with Nature®



Publications with Nature® published

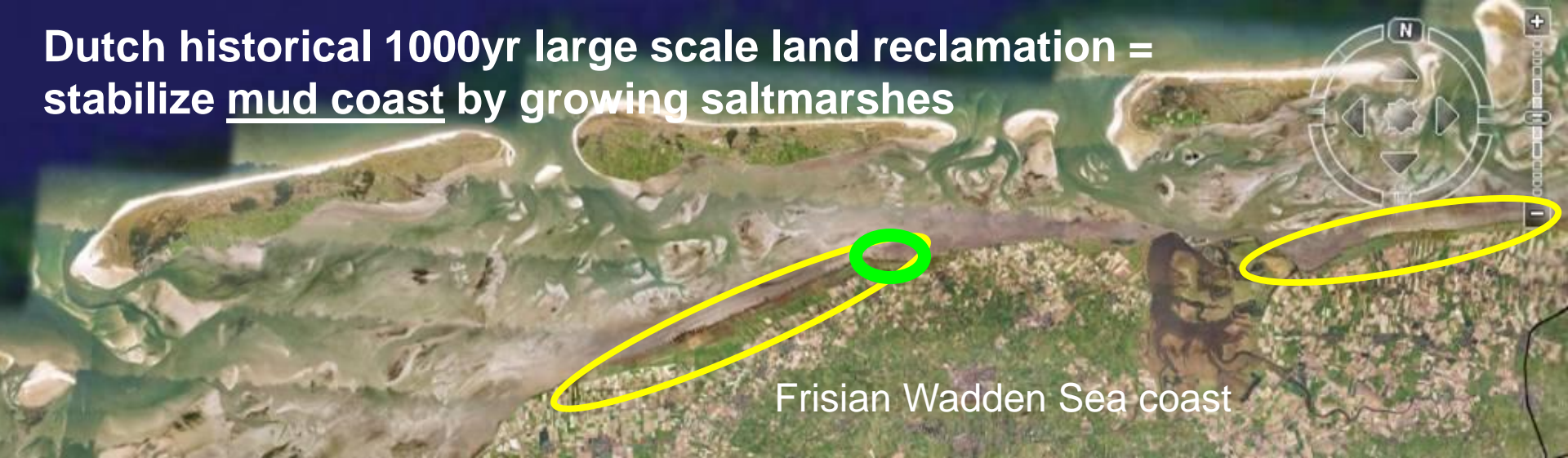
All views, ideas and plans of Ronald E. Waterman are assembled in a publication entitled 'Integrated Coastal Policy via Building with Nature®'. The book can be regarded as a master piece of documentation in the field of Coastal Zone Development & Maintenance. It represents both national and international a milestone in the history of the development of Delta Technology.



English version: Integrated Coastal Policy via Building with Nature®
ISBN/EAN 978-90-805222-3-7
Luxurious, binded document
450 pages with over 450 illustrations and DVD
Price € 127,20 incl. 6% VAT

- Profile
- Functions
- Awards
- Expertise
- Master piece
- Sustainability first
- Building with Nature
- Conclusions
- EU Waterways Forward
- Contact
- Dutch presentation

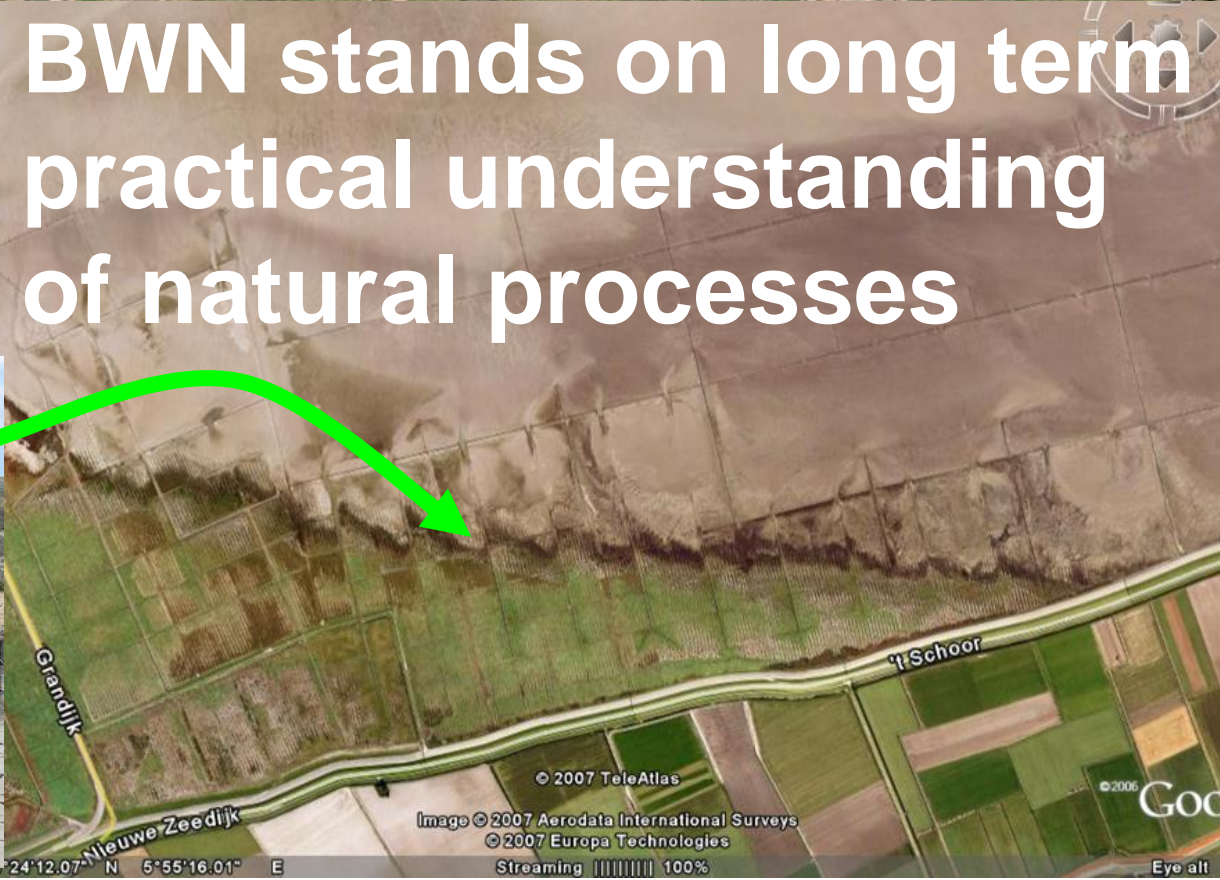
Dutch historical 1000yr large scale land reclamation = stabilize mud coast by growing saltmarshes



Frisian Wadden Sea coast

Effective low cost
low tech method
produces safety
& productive habitats
& more space

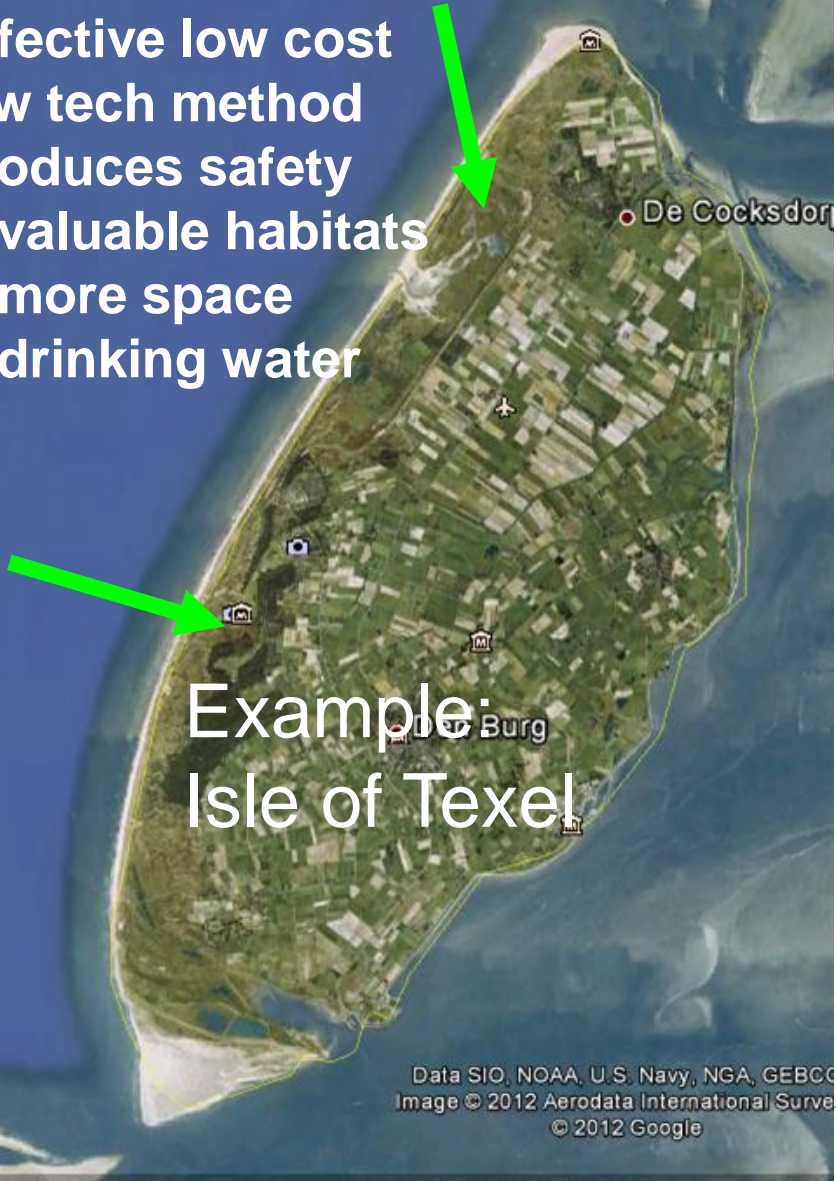
BWN stands on long term practical understanding of natural processes



100's km Dutch sandy coast stabilized by vegetation

protected long term with dunes

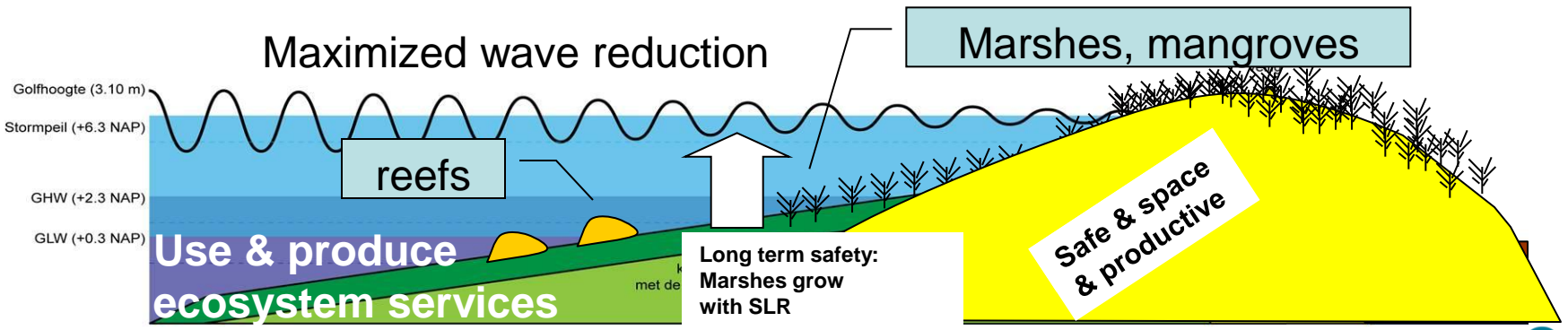
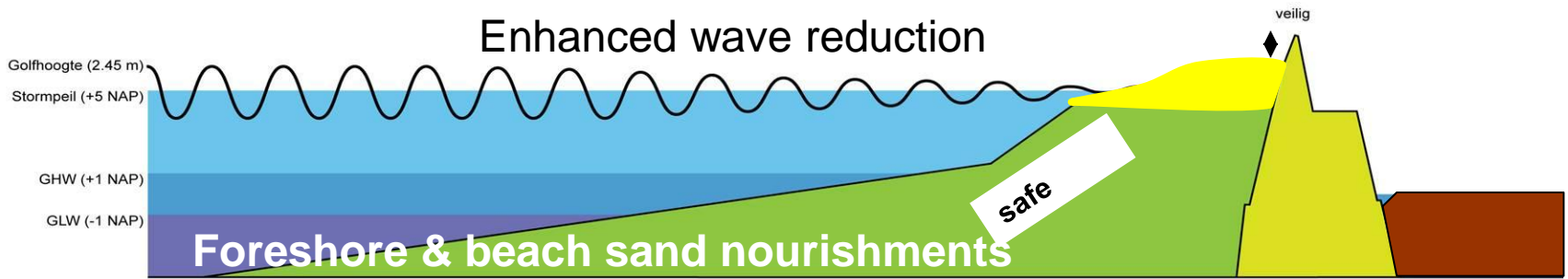
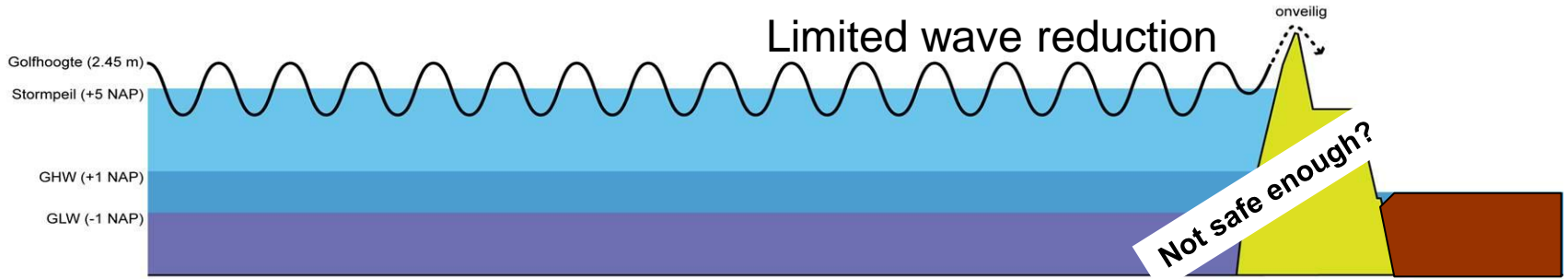
Effective low cost
low tech method
produces safety
& valuable habitats
& more space
& drinking water



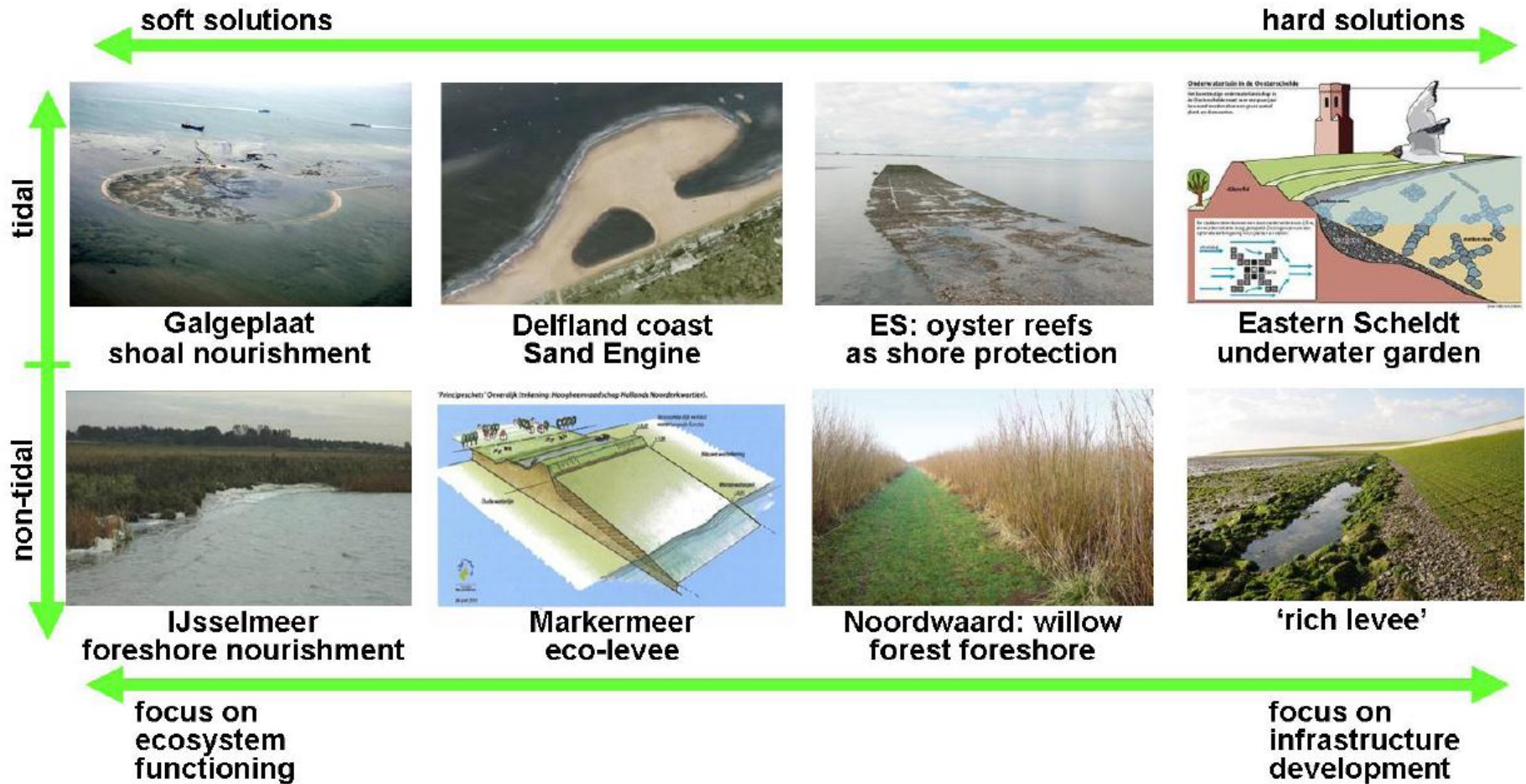
Example:
Isle of Texel



Traditional knowledge and BWN integrated to build safe soft eco levees by reef, marsh, dune, dike combinations



BWN delivers continuum of concepts and applications



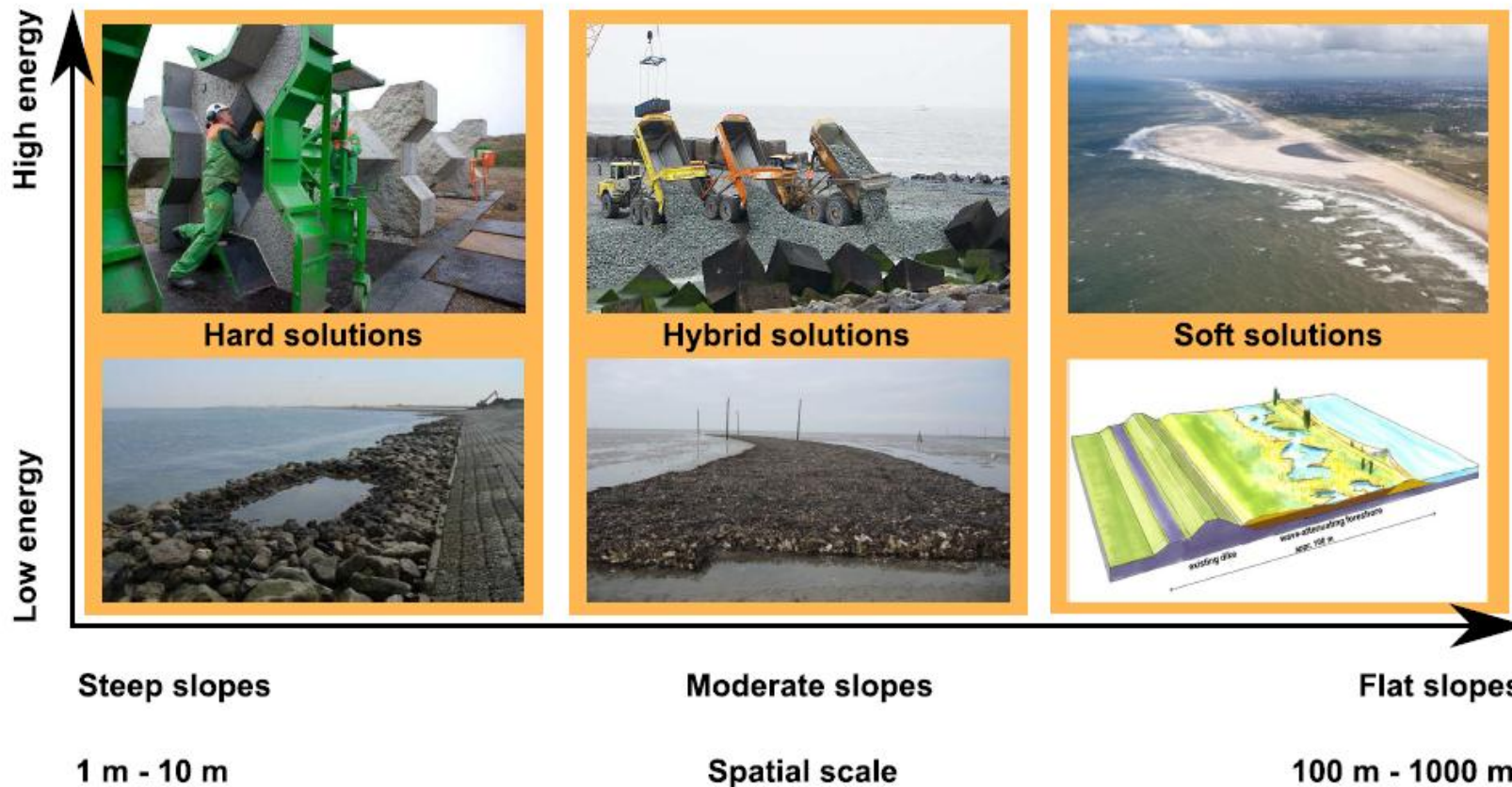
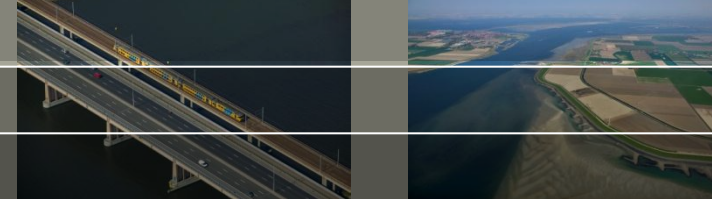


Figure 1: Range of potential BwN applications along the main axes of given bed slope and hydrodynamic energy. Of course factors like salinity and geo-climatic region also determine potential solutions.

Hybrid Example: 2010, Ecoshape consortium: foreshore protection with oyster reef experiment

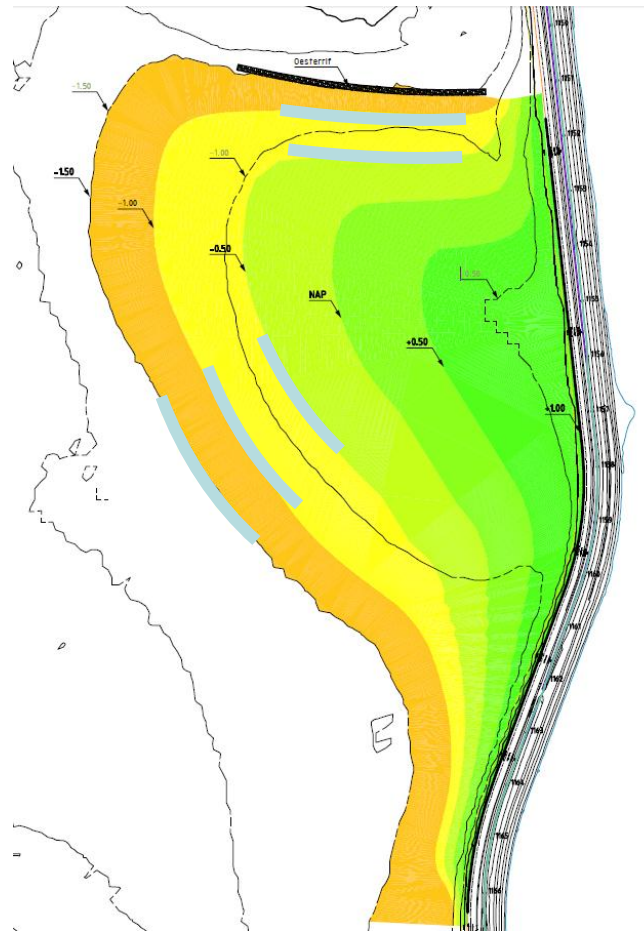


3x 200m x 20m
Reduce erosion of intertidal flats
in Eastern Scheldt, maintain
habitats and protect the dike



Safety buffer Oesterdam (implemented in 2013)

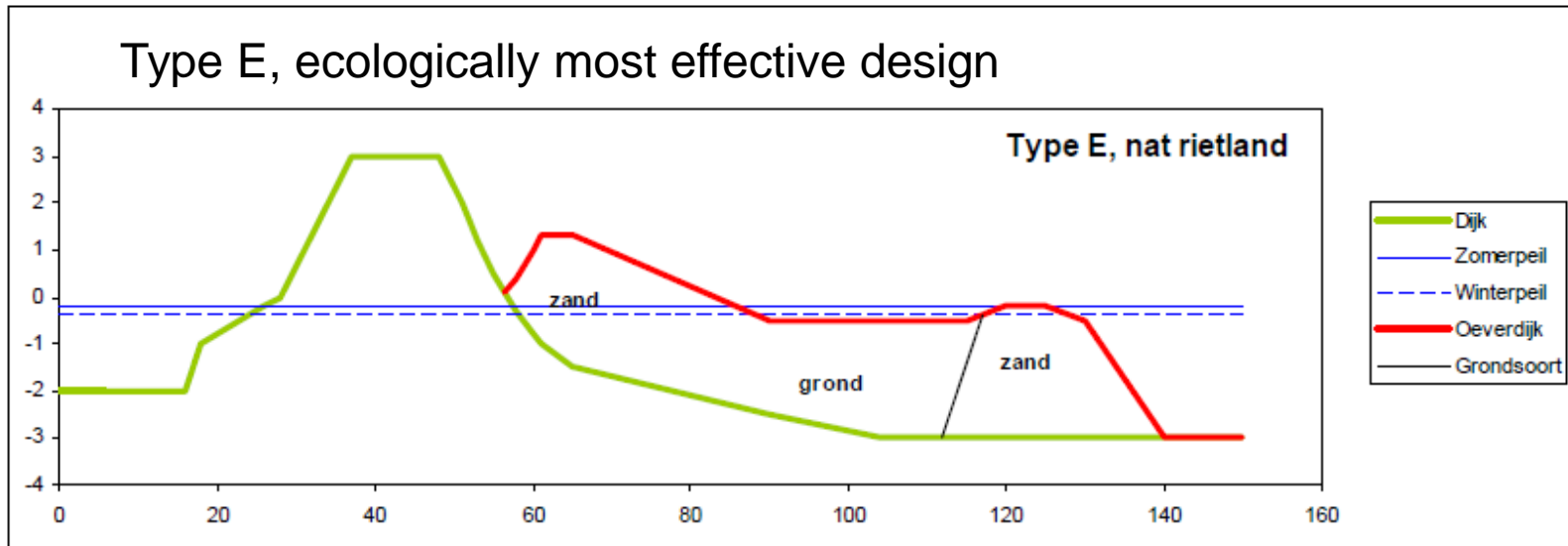
- Reduce erosion
- Promote aquaculture
- Promote nature



2011: Conceptual Design 'Oeverdijk'

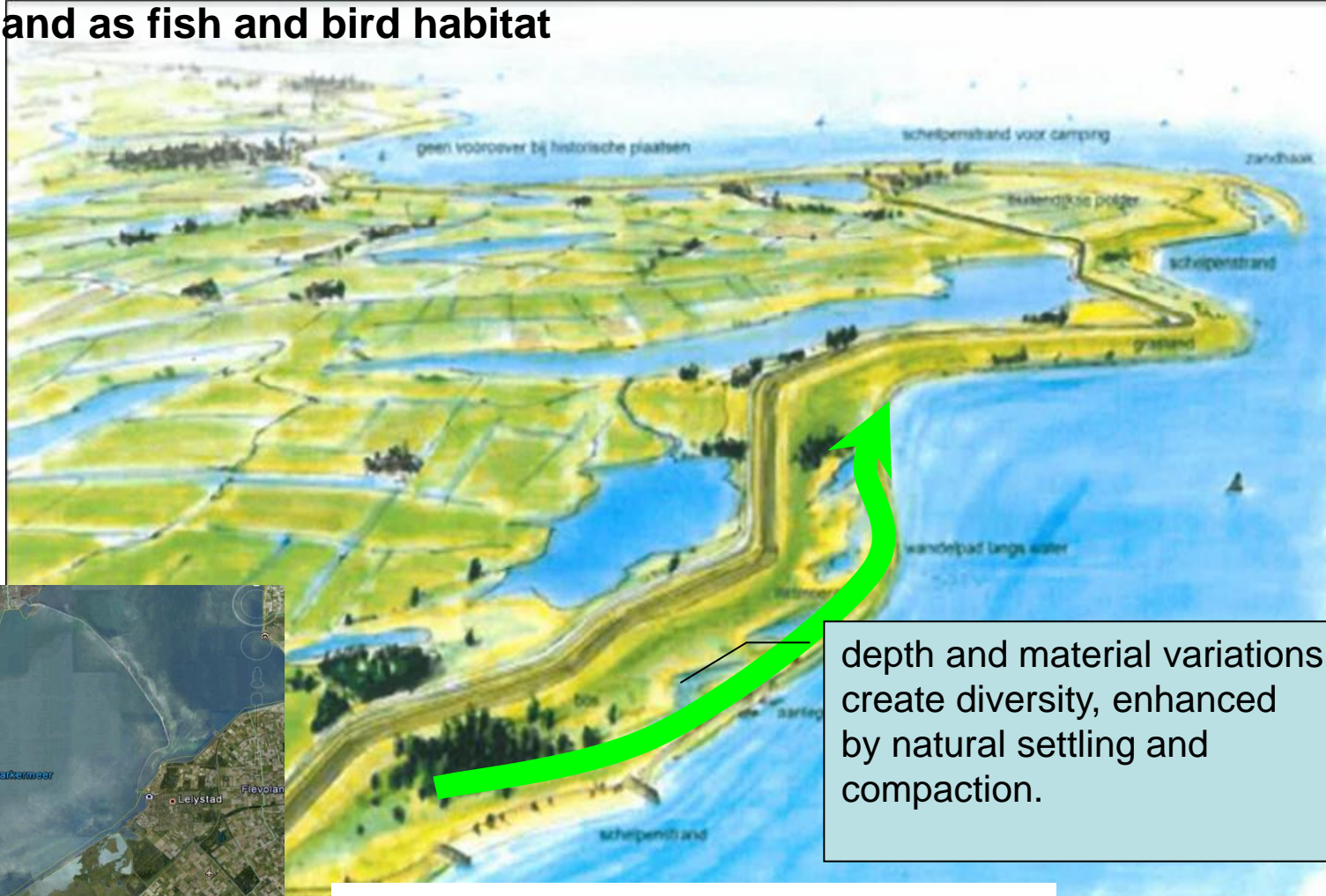
Door ARCADIS –DELTA RES

- Aim1: replace weak dike section with safe and cheap solution
- Aim2: produce a natural solution that delivers benefits to other functions.
- Construction: 2018



Soft Example: 2010, Waterboard, RWS, Deltares: completely soft green solution replaces existing dike

Nature development with longshore connectivity and regional relevance for recreation and as fish and bird habitat



depth and material variations create diversity, enhanced by natural settling and compaction.



80m wide, 15 km, along lake shore
Final technical design phase

overdijken: kans voor

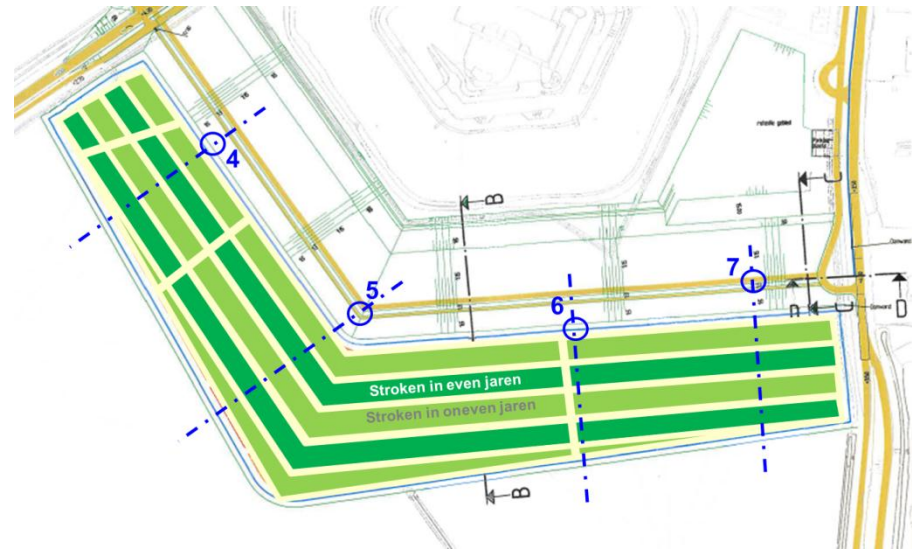
Forest-Dike combination near Werkendam



- Aim: reduce waterlevel at peak discharge at city of Gorinchem
- Need to build new dike as part of dike-ring. Klaar in 2015.
- Design of cheap hybrid solution with a low as possible crest heighth.
- Maintain legally required safety level

Build a wave reducing forest

- A willow tree forest is introduced





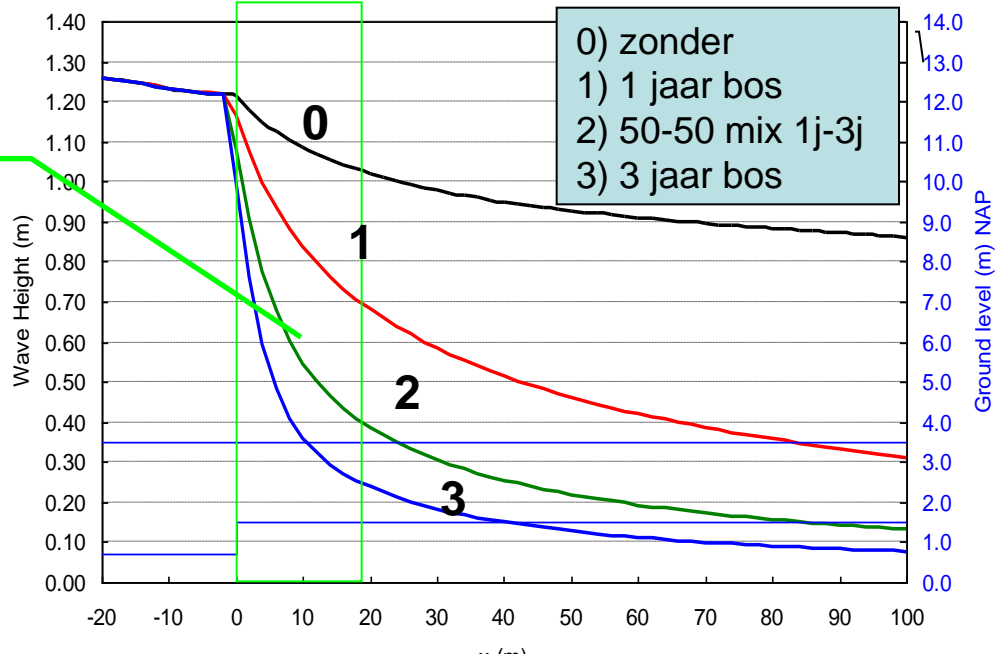
twee jarige wilgetenen



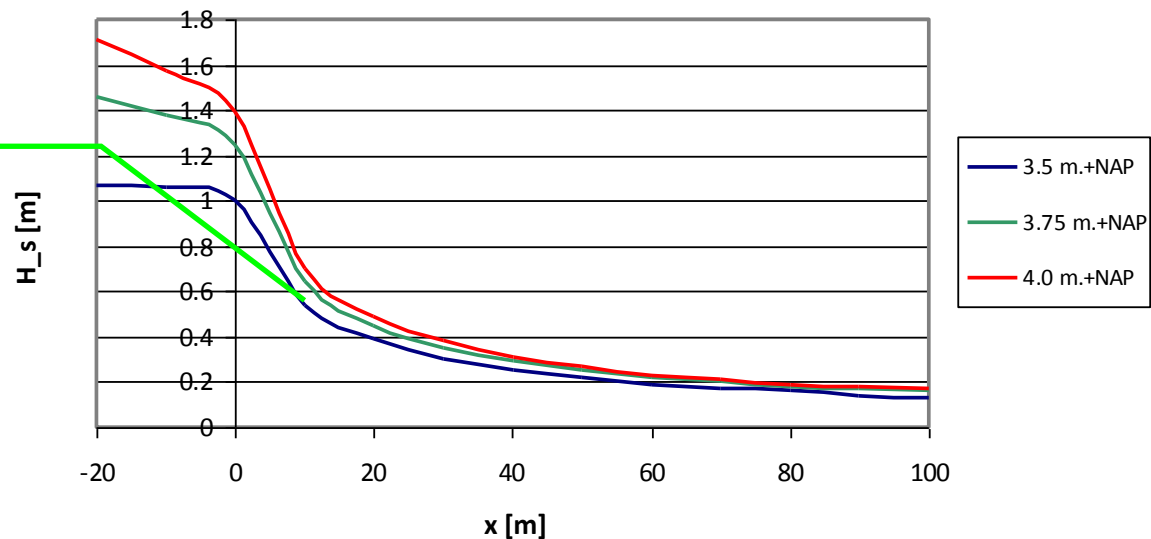
8 jaar oud griend, twee jaarlijks gemaaid

Willows reduce waves, predicted by SWAN-VEG WAVE model

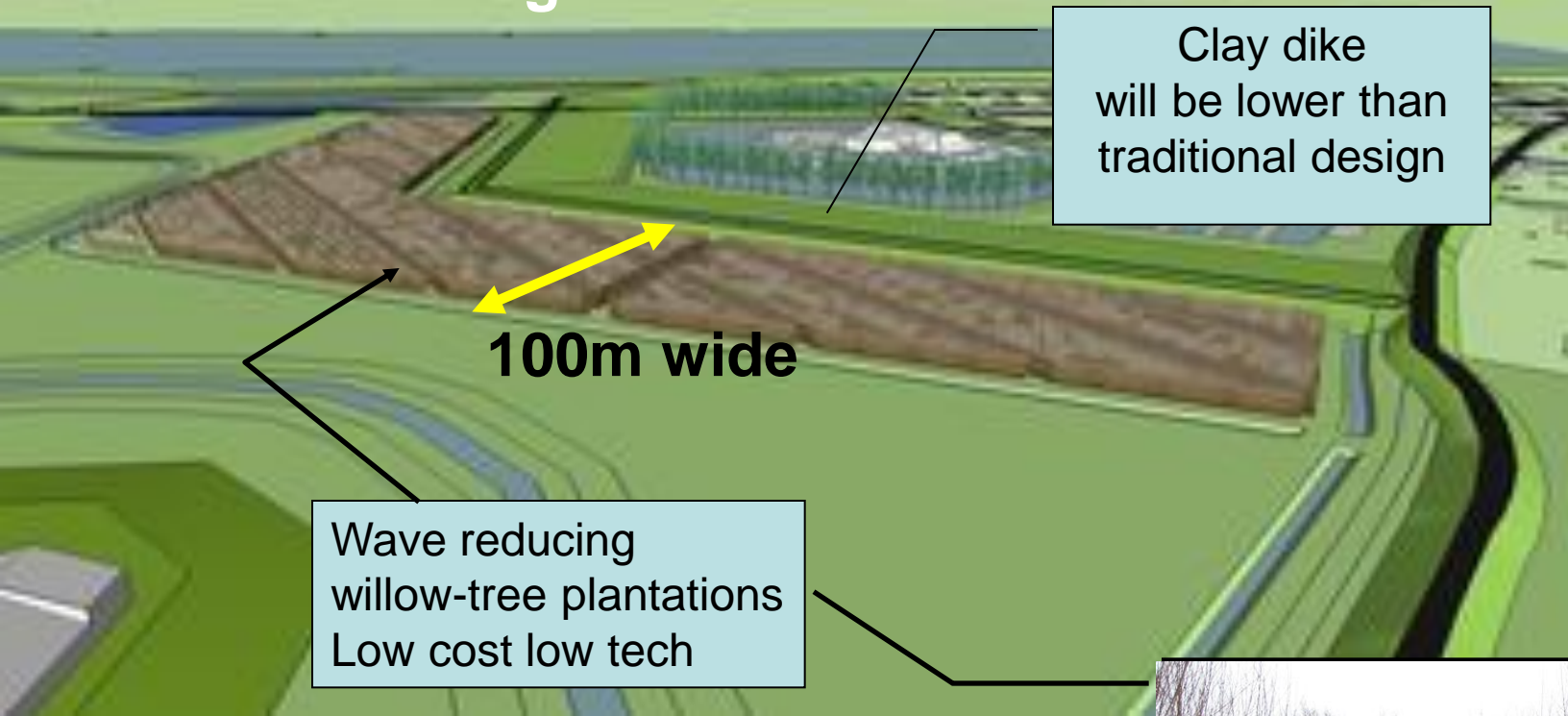
70%-80% reductie van golfhoogte in wilgenbos in eerste 20 m (2 en 3)



Golfreductie is ongevoelig voor stijgende waterhoogte



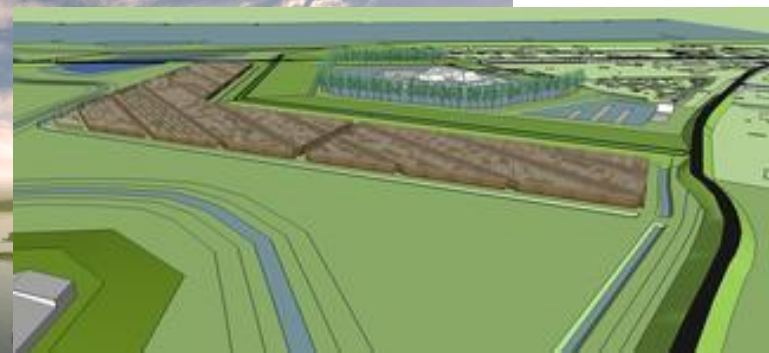
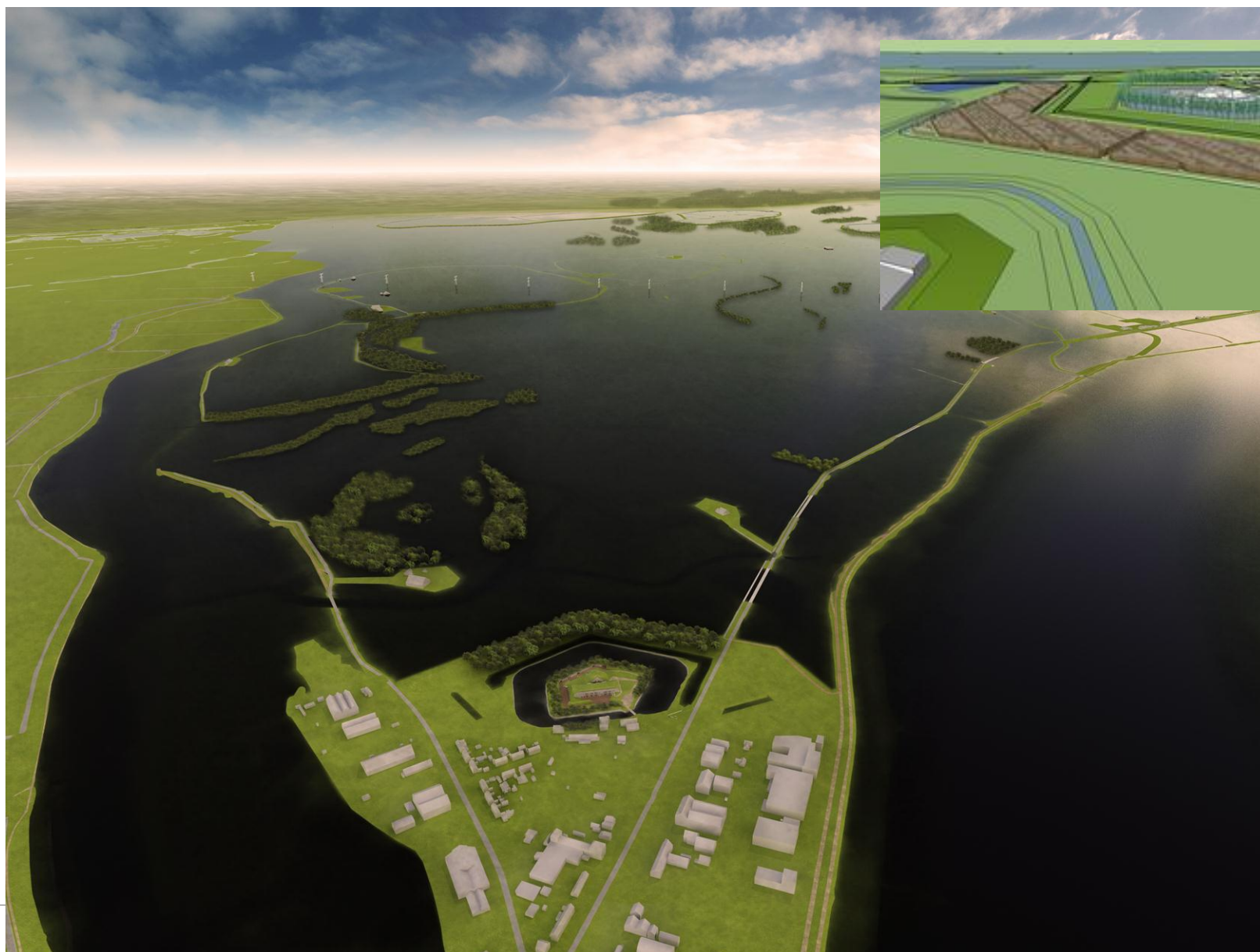
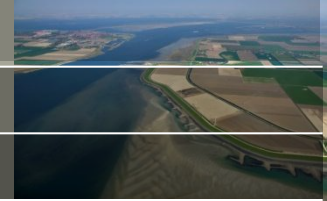
Hybrid Example: 2009 RfR programme Noordwaard Wavereducing forest- soft dike combi 'Werkendam'



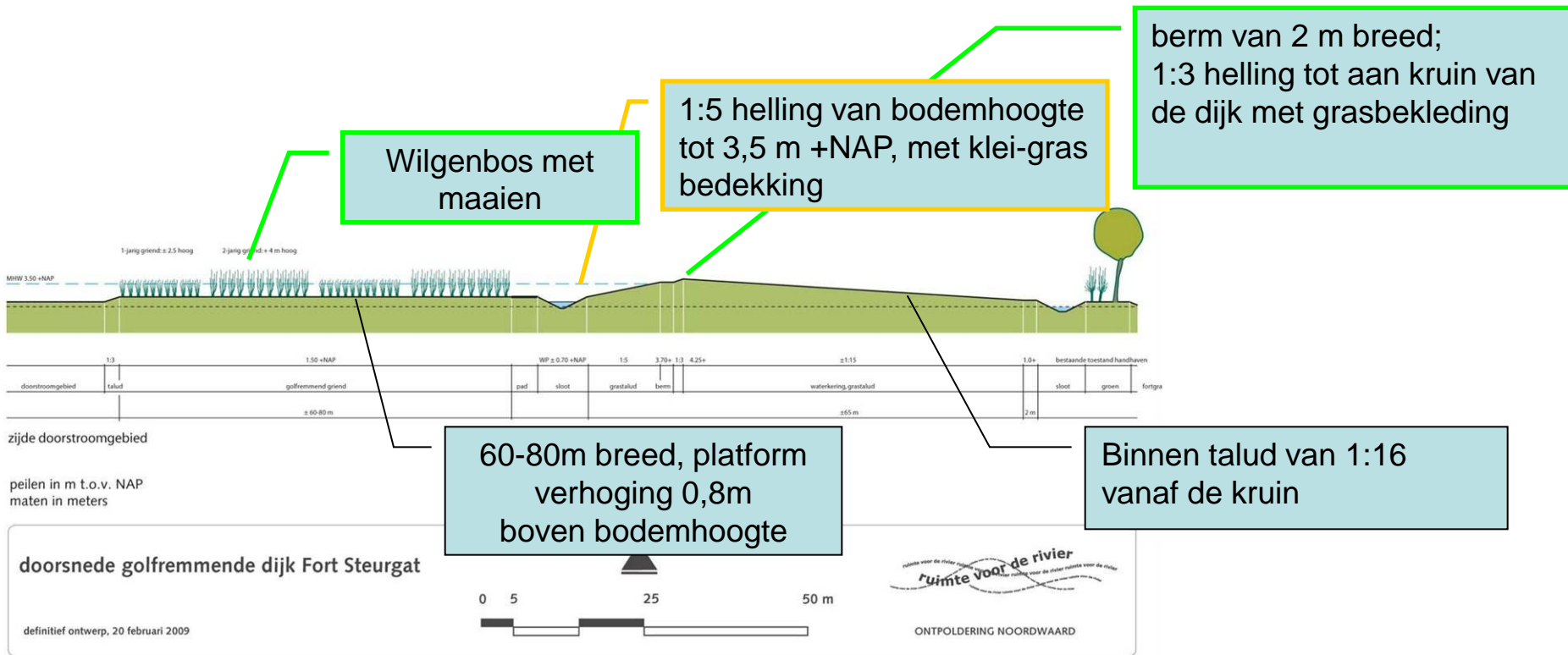
- >70% reduction of wave height in healthy willow forest
- Deltares/RWS design achieves required 1/2000 safety standards and is now under construction.



Artist impression: hybrid dike near Werkendam

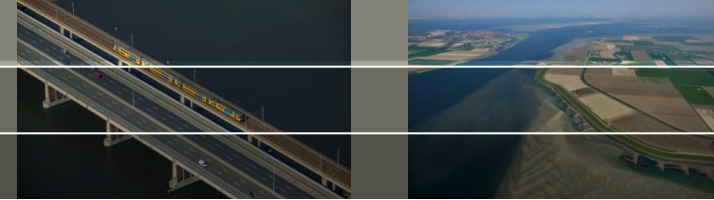


Technical design of forest-dike combi



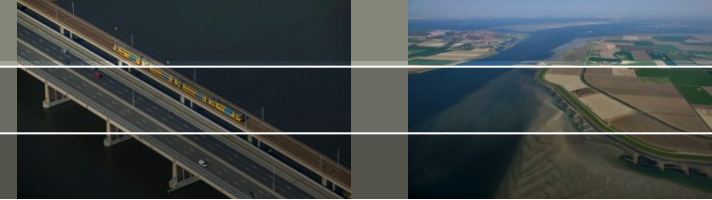
Hybrid dike replaces traditional design
Crest height reduced with 0.7m. Completely soft design of slope

Monitoring....



- Regular yearly monitoring
 - growth/health/density
 - Stability of the slopes
- Check status @ extreme conditions:
 - Storm events
 - Ice cover/flows
 - Fire
 - Diseases

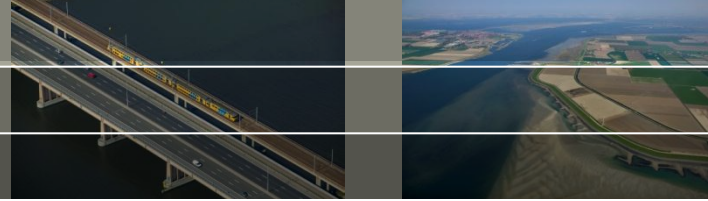
Maintenance is crucial



- Use adequate measures for heath issues
 - Chemicals, cutting
- Regular cutting is part of healthy forest management:
 1. *After storm season*
 2. *Half of forest each year (or two years)*
 3. *Use slow growing species*
 4. *Replace old trees (they will die after about 30-40years)*



Benefits en cost



- Lower dike
 - No hard cover needed
 - Added natural and landscape values
 - Robust design (climateproof, flexible w.r.t . boundary conditions)
-
- Saved 1500 Eur/m in construction cost)
 - Maintenance 2 Eur/m/y higher (forest, Eur1.500/ha)

Our minister of transport and environment is supportive



26-04-2013 **Werken met de natuur**

Minister Schultz wil 'werken met de natuur'. "Eeuwenlang hebben we de natuur met dammen en dijken proberen in te perken. Maar we kunnen de oplossing niet alleen blijven zoeken in het ophogen of verbreden van dijken. Ik wil bouwen mét de natuur.

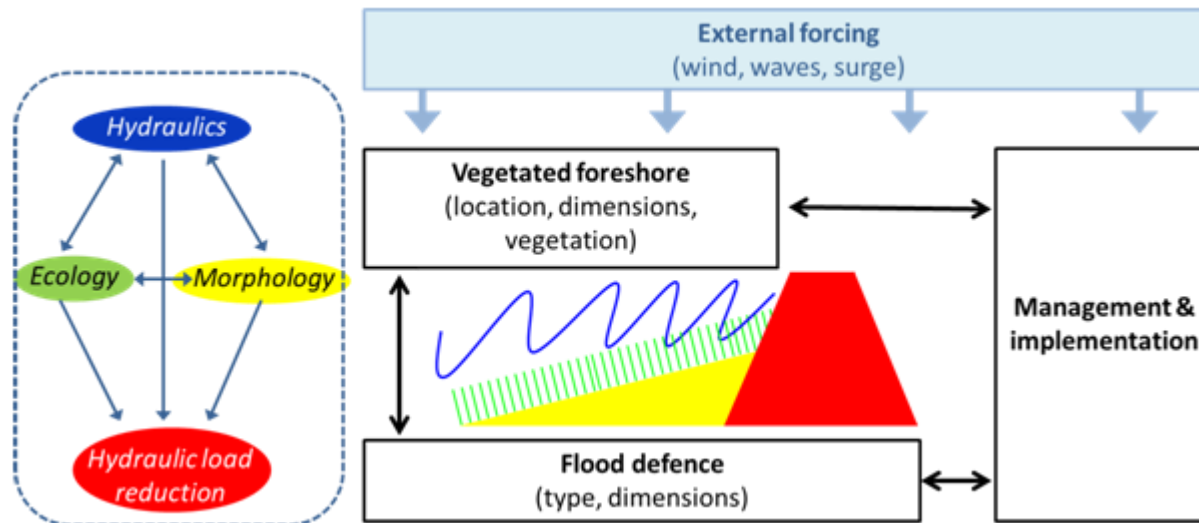
Melanie Schultz: 'Mijn beeld is dat bouwen mét de natuur je veel beter beschermt dan de technische oplossingen die tegen de natuur ingaan.' Volkskrant 26 januari 2013

Stability of saltmarshes: filling gaps in Hydralab 3 (2012-2013)



NWO project BE-SAFE (2014-2017)

- Focus on dynamic development of foreshore in time
- We aim to develop new methods to assess how, and how much vegetated foreshores can contribute to flood risk reduction. This requires integration of knowledge from ecology, biogeomorphology, hydraulic engineering, and governance



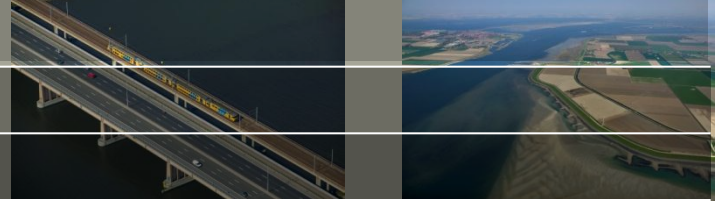
NIOZ, TUD, UT, HKV, Deltares
End users: RWS, NGO's, Waterboards



FAST
Foreshore Assessment using Space
Technology

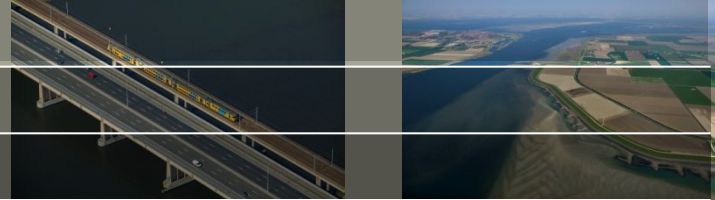
EU 7th Framework Programme SPACE

***‘Stimulating development of downstream
services and service evaluation’***

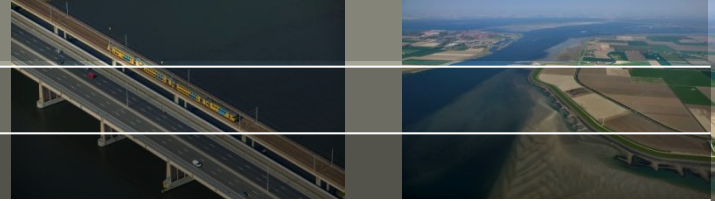


Challenge: foreshores are currently not included in water safety assessments and in levee design but can be effective building blocks for safety.

Aim: to develop a new GMES/Copernicus downstream service by developing products based on Sentinel data to gain spatial information on foreshore and floodplain characteristics, such as morphology, sediment characteristics and vegetation properties.



- EO data collection of foreshore characteristics
- On site ground truthing in 4 study areas
- Setup general relationships between foreshore and flood risk mitigation properties will be derived and implemented in a GIS based software package.
- Create software that calculates effects of foreshores and floodplains on hydraulic and bed conditions.
- Translate effects into to potential reduction in levee width and crest height.



- Develop software in close contact with end-user groups to ensure commercial uptake and long-term continuation of services.
- Provide tool for integrating levee-landscape interaction into cost efficient and safe flood risk management strategies.
- Provide business case and disseminate the results

Dissemination to a wide audience

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European Study on Dike Upgrades Kicks Off (The Netherla

Posted on Jan 30th, 2014 with tags [Dike](#), [dredging](#), [Europe](#), [European](#), [kicks](#), [netherlands](#), [News](#), [study](#), [The](#), [u](#)



http://www.infrasite.nl/news/news_articles.php?ID_nieuwsberichten=17673 - Windows Internet Explorer

http://www.infrasite.nl/news/news_articles.php?ID_nieuwsberichten=17673

NIEUWS

ACHTERGROND Europees onderzoeksproject waterbouw

Satelliet meet effect beplante vooroever

Het Europese project Fast (Foreshore Assessment using Space Technology) gaat vier jaar lopen. Door de Europese Commissie is er voor die periode een kleine 3 miljoen euro beschikbaar gesteld. Fast gaat vooral op basis van satellietdata voorspellingen proberen te doen van het golvingend effect van de vegetatie. Aan de hand van de hoeveelheid per ettelceerlicht van een bepaald golftekte kunnen satellieten de hoeveelheid chlorofyl in vooroevers bepalen. Dat is een maat voor de hoeveelheid biomassa die zich voor de dijk bevindt. "Maar wel een grove maat", waarschuwt Mindert de Vries van Delta res die het Europese onderzoeksprogramma coördineert. "De aard van de begroeiing is uit de satellietgegevens niet zomaar af te leiden, net zo min als de hoogte ervan. De satellietdata moeten dus gekoppeld worden aan waarnemingen in het veld en rekenmodellen om onderbouwde uitspraken te kunnen doen." Vier onderzoeksinstituten in Engeland, Spanje, Roemenië en Nederland aan

stuk voor stuk twee locaties selecteren waar ze dat onderzoek gaan uitvoeren. Deltares heeft samen met NIOZ al een schor in de Westerschelde geselecteerd waar ze de komende jaren de golfhoogtes, begroeiing, sedimentatie en andere parameters gaan monitoren. De Vries is nog op zoek naar een geschikte locatie in de Biesbosch. Liefst een stuk dijk van ongeveer een kilometer langte waarvan een deel van de vooroever is begroeid en een deel juist ook niet, om goed het verschil te kunnen waarnemen.

Griend
Langs de Nieuwe Merwede leidde De Vries drie jaar terug al een project dat de opmaat vormde tot het Fast-project. Daar werd toen het effect van griendbos onderzocht op de golfhoogte. Een griendbos van 100 meter breedte voor de dijk bleek een golf van een meter hoog te kunnen halveren. Die bevindingen worden nu meegenomen bij de herinrichting van de polder Noordwaard. Het is het



In de Biesbosch is eerder al onderzoek gedaan naar het effect van wieden op de golfkracht. Foto: Deltares/Dirk Hol

Deltares leads major European study on damping of waves by vegetation - Windows Internet Explorer

http://www.dutchwatersector.com/news-events/news/9248-deltares-leads-major-european-study-on-damping-of-waves-by-vegetation.html

http://www.infrasite.nl/news/news_articles.php?ID_nieuwsberichten=17673

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Home / News & Events / Deltares leads major European study on damping of waves by vegetation

News

Deltares leads major European study on damping of waves by vegetation

Posted on 4 February 2014

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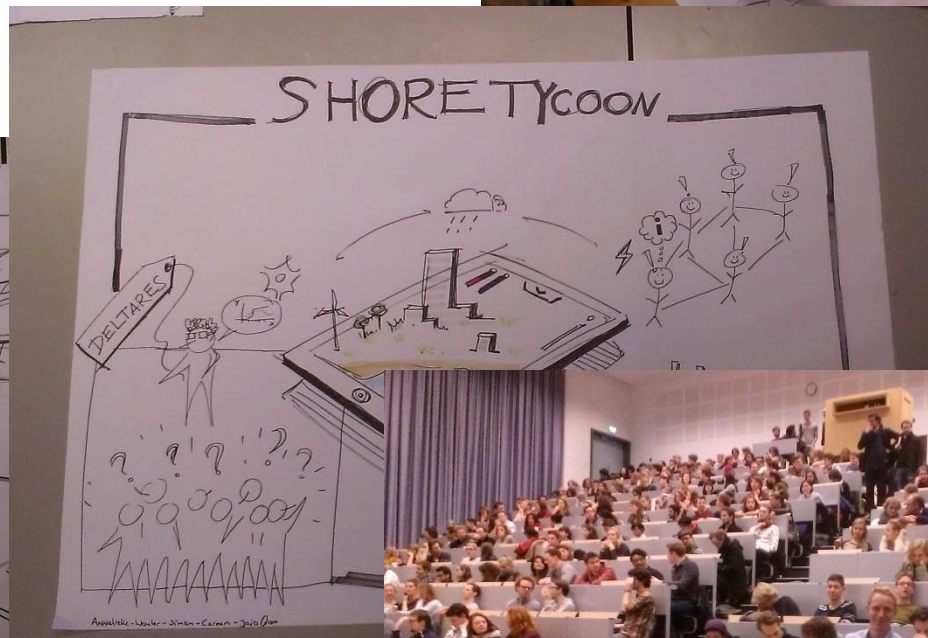
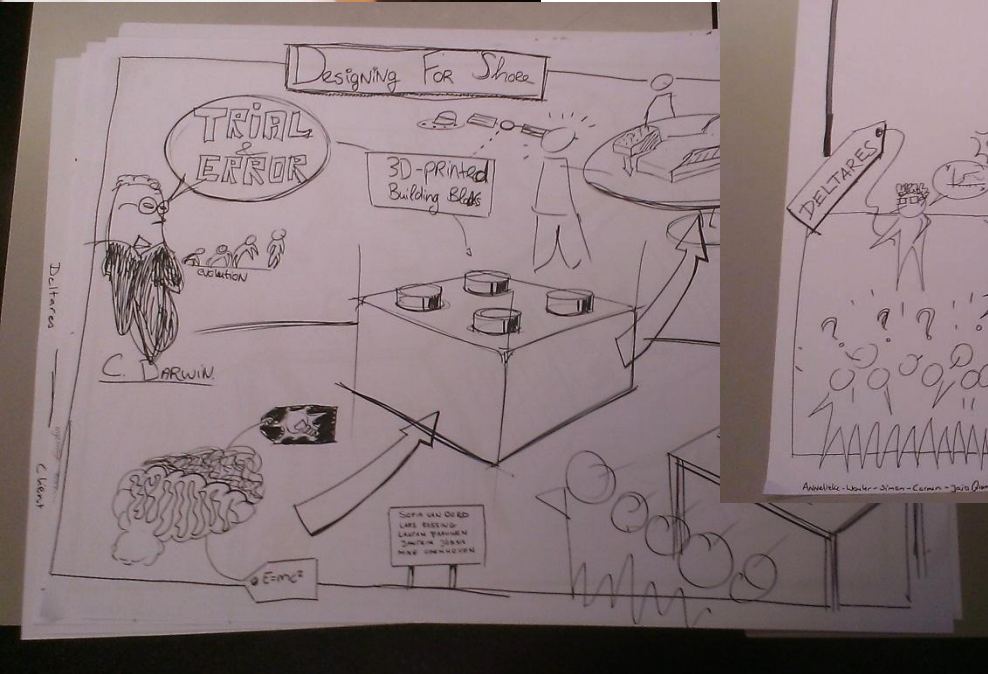
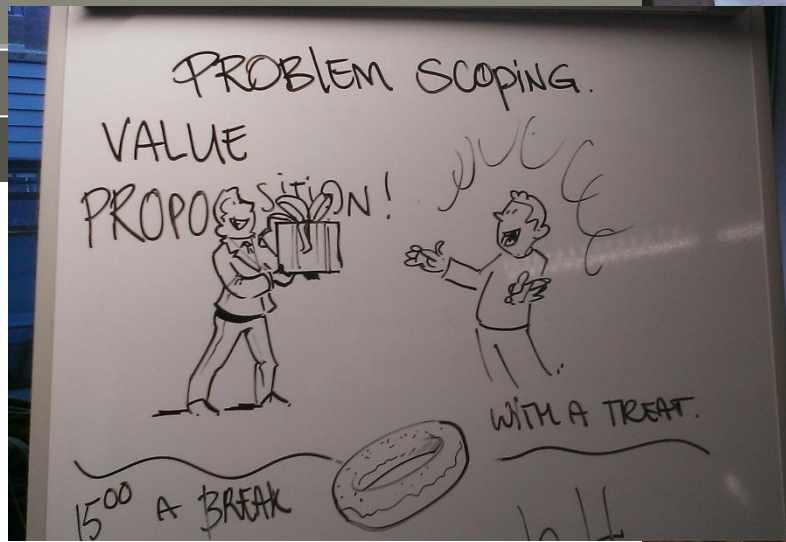
yesterday

Dutch consortium starts #dredging project for maintenance #urban drainage in #Dhaka

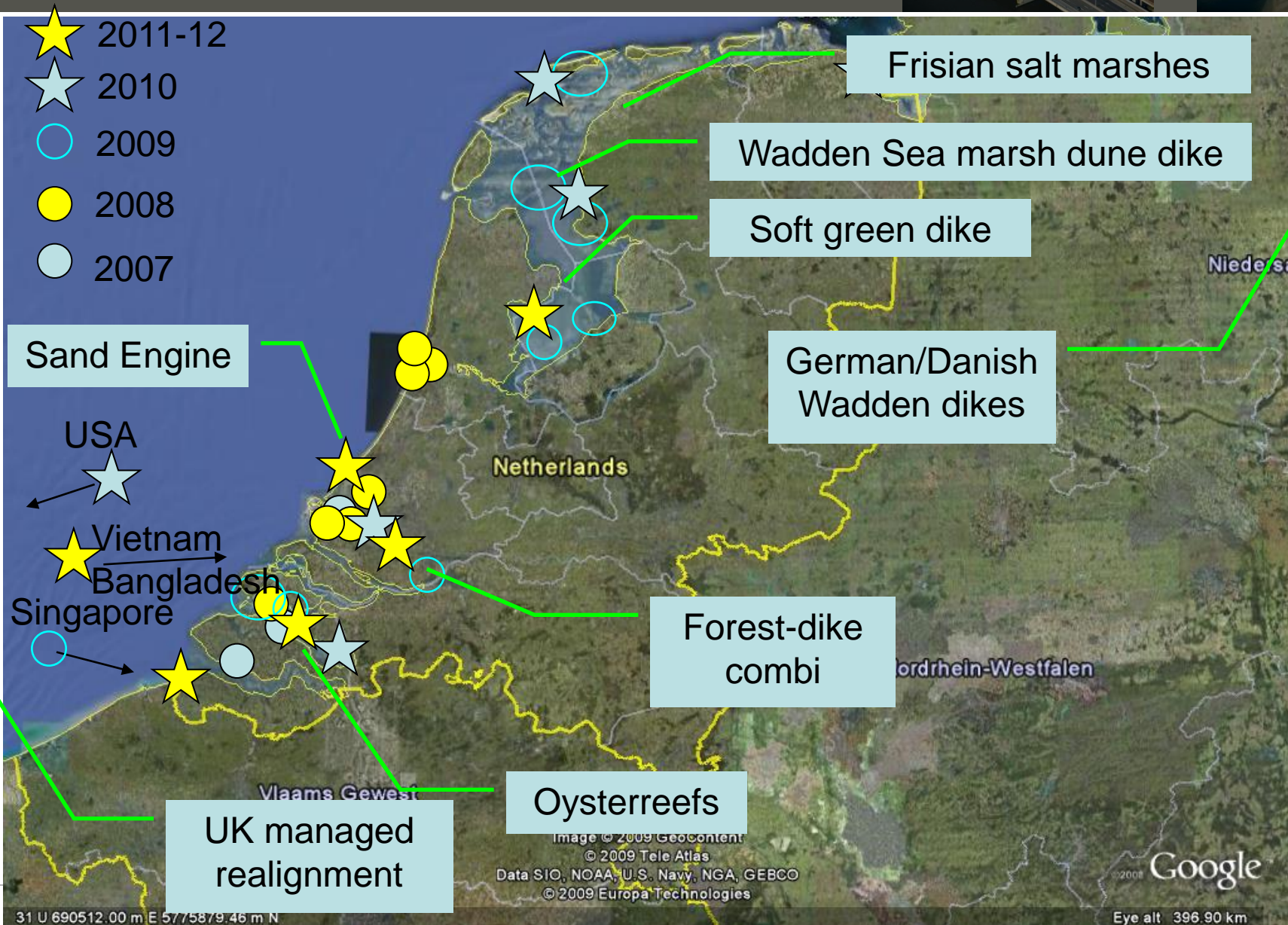
Bron: <https://beeldbank.rws.nl>, [Rijkswaterstaat](#)
Datum: 31-01-2014

GROOT EUROPEES ONDERZOEK doel: ontwikkel

Deze maand is er een nieuw, groot Europees onderzoek met behulp van satellietgegevens. Deltares doet dit effect in kaart brengen, zodat er bij toekomstige dijkversterkingen rekening mee kan worden gehouden. Kosten voor dijkversterkingen kunnen worden beperkt door de hoeveelheid biomassa die zich voor de dijk bevindt. Dit kan worden gedaan door de hoeveelheid biomassa die zich voor de dijk bevindt te meten. Dit kan worden gedaan door de hoeveelheid biomassa die zich voor de dijk bevindt te meten.



Building with Nature projects overview



BW(L)N related publications, until now...

- Borsje, B.W., B. K. van Wesenbeeck, F. Dekker, P. Paalvast, T. J. Bouma, M. M. van Katwijk, M. B. de Vries, **2011**. How ecological engineering can serve in coastal protection. *Ecological Engineering*, V37: 113–122.
- Bouma, T.J., M. B. De Vries, E. Low, G. Peralta, I. C. Tanczos, J. Van De Koppel and P. M. J. Herman, 2005. Trade-Offs Related To Ecosystem Engineering: A Case Study On Stiffness Of Emerging Macrophytes. *Ecology*, 86(8), 2005, pp. 2187–2199
- Leeuwen, B. van, D.C.M. Augustijn, B.K. van Wesenbeeck, S.J.M.H Hulscher, M.B. de Vries, 2009. Modeling the influence of a young mussel bed on fine sediment dynamics on an intertidal flat in the Wadden Sea. *Ecological Engineering*.
- Paalvast, B. K. van Wesenbeeck, G. van der Velde, M. B. de Vries, **2012**. Pole and pontoon hulass: An effective way of ecological engineering to increase productivity and biodiversity in the hard-substrate environment of the port of Rotterdam. *Ecological Engineering V44*: 199–209
- Slobbe, E. van, H.J. de Vriend, S. Aarninkhof, K. Lulofs, M. de Vries, P. Dircke, **2012**. Building with Nature: in search of resilient storm surge protection strategies. Accepted for publication as 'note to the editor' in *Natural Hazards special issue in on storm surges*.
- Temmerman, S., T. J. Bouma, G. Govers, Z. B. Wang, M. B. De Vries, and P. M. J. Herman (2005), Impact of vegetation on flow routing and sedimentation patterns: Three-dimensional modeling for a tidal marsh, *J. Geophys. Res.*, 110, F04019.
- Temmerman, S., T.J. Bouma, J. Van de Koppel, D. Van der Wal, M.B. De Vries and P.M.J. Herman, 2007. Vegetation causes channel erosion in a tidal landscape. *Geology*, V35 (7): 631–634, (2007).
- Temmerman, Stijn, Mindert B. De Vries, Tjeerd J. Bouma, **2012**. Coastal marsh die-off and reduced attenuation of coastal floods: A model analysis. *Global and Planetary Change* 92–93 (2012) 267–274P.

Cooperation is the key to progress and success



Universiteit Twente
de ondernemende universiteit



EcoShape

2009-2013
*EcoShape
scientists –
practitioners
consortium,
Building with Nature
(BwN)*

2013-2018
*progress from
'Show that it works' to
'Make it happen!'*

Cooperation is the key to progress and success

The screenshot shows the EcoShape website interface. At the top, the URL 'ecoshape.nl' is visible in the browser address bar. The navigation menu includes 'EcoShape', 'About', 'Building with Nature', 'Examples', 'Guideline', 'News', and 'Contact'. The 'About' and 'Building with Nature' items are circled in green. Below the navigation is a large banner with the text 'www.ecoshape.nl' and the EcoShape logo. The main content area features a 'Welcome to 'Building with Nature'' section, a 'Latest news: Building with Nature Book' section with a 'DOWNLOAD BwN BOOK (pdf)' button circled in green, and two sidebars: 'EcoShape tweets' and 'EcoShape shows it is'.

ecoshape.nl

EcoShape About Building with Nature Examples Guideline News Contact

www.ecoshape.nl

EcoShape

Welcome to 'Building with Nature'

Building with Nature aims to utilize natural processes and provide opportunities for nature while realising hydraulic infrastructure. [Design guidelines](#) on how to make this happen in practice are the main end product of the Building with Nature innovation programme. The work is carried out by the [EcoShape consortium](#), that consists of private parties, government organisations and research institutes.

Latest news: Building with Nature Book

[DOWNLOAD BwN BOOK \(pdf\)](#)

During the EcoShape Edustrum Conference, Huib de Vriend presented the Building with Nature Book.

Feel free to [download a digital copy \(pdf\) here](#).

EcoShape tweets

RT @friesheinis: Mooi artikel in @cobouwredactie over succes Building with Nature @EcoShapeBwN. Zie ook <http://t.co/AT18AzSK> #topsectorwater

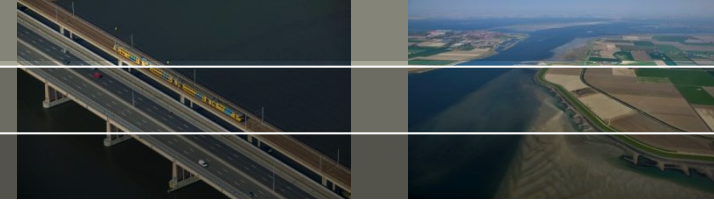
7 dagen geleden

EcoShape shows it is

Innovative hydraulic engineering through 'Building with Nature' works

[Read more >](#)

Homework for each week

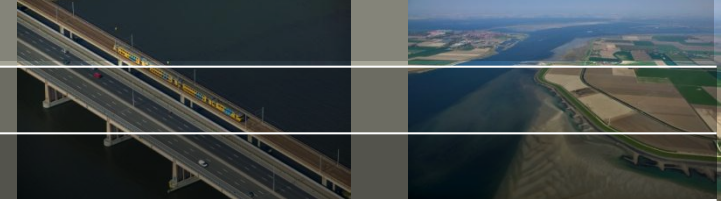


- We will setup a wiki page that contains the information presented in each lecture
- The wiki page will be setup in a fixed format
- It needs to contain the following chapters (if relevant) :
 - Summary
 - Description of the issue that is solved
 - Aim of the project at hand
 - Definition of ecosystem
 - History and location of the problem
 - Relation to legislation and government planning
 - Principles of the solutions
 - Design/description of solutions
 - Techniques of implementation/construction
 - Costing of works
 - Monitoring techniques
 - Maintenance
 - Relation to BWN principles
 - Benefits to nature and other functions
 - A list and definition of concepts (with photos)

Prepare a presentation on a BWN publication

- Summary
- Description of the issue that is solved
- Aim of the project/publication at hand
- Principles of the solutions proposed or implemented
- Design/description of solutions
- Benefits to nature and other functions

Questions?



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