

# The Living Lab for Mud Two Years Later

## Update on the Ongoing Pilots that Integrate Sediment Management and Building with Nature

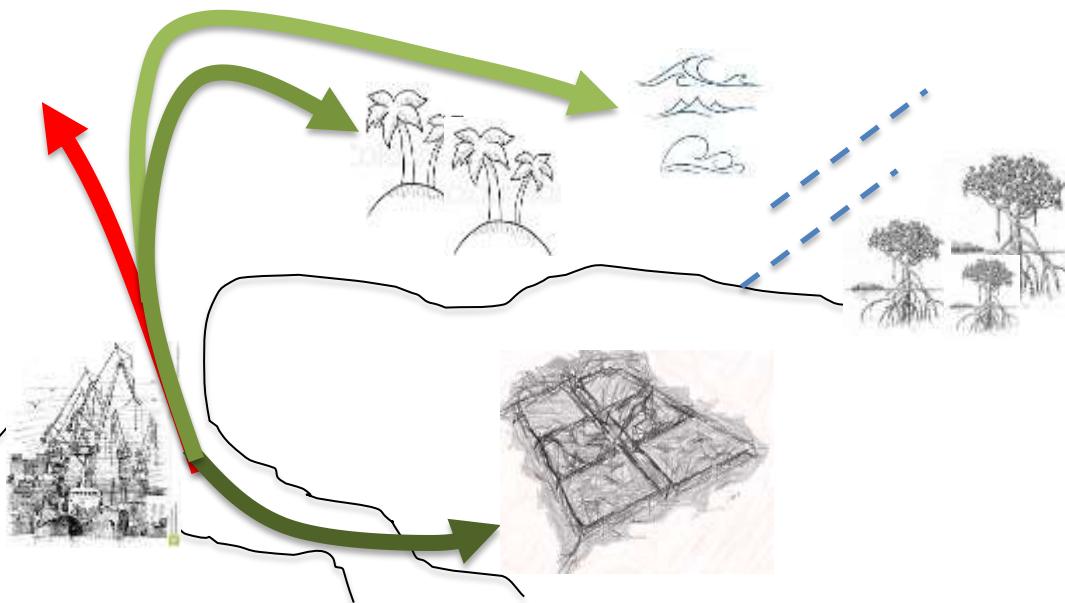
L. Sittoni, E.M.M van Eekelen, F. van der Goot and H.E. Nieboer



# ...where we left it two years ago...



## Integrated, with Nature Sediments Mgmt. for sustainable development



building with nature

# The Living Lab for MUD: pilots via BwN



Sedimentation – transport – consolidation – strength – ecology – socio-economics

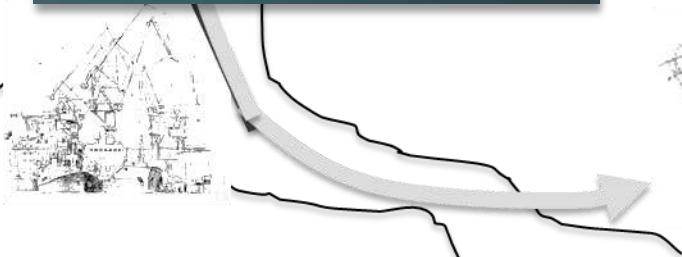
Marker Wadden, NL



Mud Motor, NL



Demak - Indonesia



Kleirijperij, NL

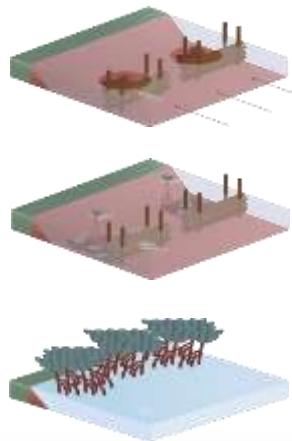
building with nature

# The Living Lab for Mud: five *live* applications

Flyer: [https://www.ecoshape.org/uploads/sites/2/2017/10/Ecoshape\\_mud\\_aanpassingen-6\\_ENG-web.pdf](https://www.ecoshape.org/uploads/sites/2/2017/10/Ecoshape_mud_aanpassingen-6_ENG-web.pdf)



## 1. Vegetation recovery



Vegetation Recovery  
Demak Indonesia



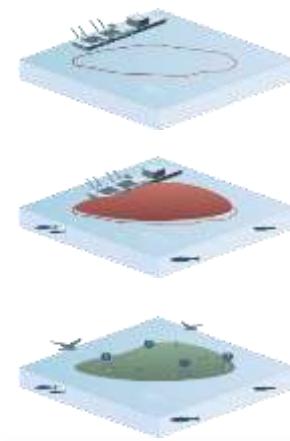
## 2. Mud Motor



Mudmotor  
Koehol



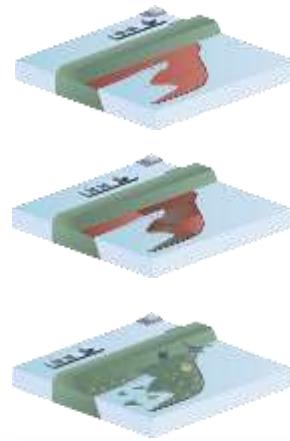
## 3. Construction natural islands



Natural Islands  
Marker Wadden



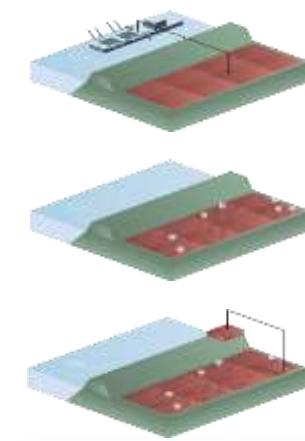
## 4. Salt marsh development



Salt Marsh Devpmt.  
Marconi Delfzijl



## 5. Clay ripener



Clay ripener  
Kleirijperij Delfzijl



# The Living Lab for Mud: five *live* applications

[https://www.ecoshape.org/uploads/sites/2/2017/10/Ecoshape\\_mud\\_aanpassingen-6\\_ENG-web.pdf](https://www.ecoshape.org/uploads/sites/2/2017/10/Ecoshape_mud_aanpassingen-6_ENG-web.pdf)



+ Interaction with Ecology and Governance (socio-economics)

Vegetation Recovery  
Demak Indonesia



Mudmotor  
Koehol



Natural Islands  
Marker Wadden



Salt Marsh Devpmt.  
Marconi Delfzijl



Clay ripener  
Kleirijperij Delfzijl



## 1. Vegetation Recovery: Demak Indonesia



*Coastal resilience, climate change, local economy*

## 2. Mudmotor: Koehol, NL



*Saltmarsh development, coastal resilience*

## 3. Natural Islands: Marker Wadden, NL



*Nature restoration, water quality*

## 4. Salt Marsh Development: Marconi Delfzijl, NL



*Saltmarsh and water front development and restoration*

## 1. Vegetation Recovery: Demak Indonesia



*Coastal resilience, climate change, local economy*

## 2. Mudmotor: Koehol, NL



**Publication Mud Motor, Ecological Engineering:**  
<https://www.sciencedirect.com/science/article/pii/S0925857418304361>

## 3. Natural Islands: Marker Wadden, NL



*Nature restoration, water quality*

## 4. Salt Marsh Development: Marconi Delfzijl, NL



*Saltmarsh and water front development and restoration*

## 5. Clay ripening: Kleirijperij, Delfzijl, NL

*Water quality, coastal resilience, raw material*



# Kleirijperij

2 mei 2013



## Project Partners

- Provincie Groningen ("State" Gvmt)
- Rijkswaterstaat (Ministry of Infrastructure and Water)
- Hunze en Aa's (Waterboard)
- Het Groninger Landschap (Nature Organization)
- Groningen Seaports
- EcoShape

Delfzijl

Kleirijperij, NL

Breebart

**From Pilot to Scale Up and Policy?**

Technical and economic feasibility

Google

## Kleirijperij Valgenweg

11.01.2019

Huidig aantal '10': ca. 100.000 m<sup>2</sup>  
Huidig jpl: '10' ca. 100.000 m<sup>2</sup>

### D6 – Standaard laagdikte

- Vloothoogte 2m
- Zandlaag niet drangafgesloten
- Frequentie onweken & voorin trekken

### D7 – Hoge laagdikte

- Vloothoogte 2,5m
- Zandlaag niet drangafgesloten
- Standard onweken & voorin trekken

### D7 – Lage laagdikte (in één keer gevuld)

- Vloothoogte 2,5m
- Zandlaag niet drangafgesloten
- Standard onweken & voorin trekken

### D8 – Standaard laagdikte

- Vloothoogte 2m
- Geen zandlaag niet drangafgesloten
- Standard onweken & voorin trekken

### D10 – Lage laagdikte (in één keer gevuld)

- Vloothoogte 1,95m
- Standard onweken & voorin trekken

### D12 – Zout water vak (in één keer gevuld)

- Vloothoogte 0,7m
- Geen zandlaag niet drangafgesloten
- Zandlaag niet gevuld met zout water
- Optische zout water meetstok in de achter
- Standard onweken & voorin trekken

### D14 – Standard laagdikte

- Vloothoogte 2m
- Zandlaag niet drangafgesloten
- Frequentie onweken & voorin trekken

### D1 – Biologisch blanco

- Vloothoogte 2m
- Zandlaag niet drangafgesloten
- Bevruchting continue biologische vaten

### D2 – Standaard laagdikte

- Vloothoogte 2m
- Geen zandlaag niet drangafgesloten
- Standard onweken & voorin trekken

### D3 – Biologisch vak

- Vloothoogte 2m
- Inclusief vegetatie
- Zandlaag niet drangafgesloten
- Standard onweken & voorin trekken
- Na installen: lagere circulatiequentie

### D4 – Standaard laagdikte (in één keer gevuld)

- Vloothoogte 2m
- Zandlaag niet drangafgesloten
- Standard onweken & voorin trekken

### D9 – Standaard laagdikte

- Vloothoogte 2m
- Geen zandlaag niet drangafgesloten
- Standard onweken & voorin trekken

### D11 – Standaard laagdikte

- Vloothoogte 2m
- Geen zandlaag niet drangafgesloten
- Standard onweken & voorin trekken

### D13 – Biologisch vak

- Vloothoogte 2m
- Inclusief vegetatie
- Zandlaag niet drangafgesloten
- Standard onweken & voorin trekken
- Na installen: lagere circulatiequentie

### D15 – Lage laagdikte (in één keer gevuld)

- Vloothoogte 1,5m
- Zandlaag niet drangafgesloten
- Standard onweken & voorin trekken



Google

Eerste

Fiemel

## Kleirijperij Kweiderlocatie

11.01.2019

Huidig aantal '10': max  
100.000 m<sup>2</sup> tot verstoppen

### K2 – Standaard laagdikte (in één keer gevuld)

- Vloothoogte 1,60 m
- Standard onweken & voorin trekken

### K3 – Biologisch blanco.

- Vloothoogte 1,60 m
- Standard onweken & voorin trekken
- Bevruchting continue biologische vaten

### K4 – Standard laagdikte

- Vloothoogte 1,60 m
- Standard onweken & voorin trekken

### K5 – Biologisch vak

- Vloothoogte 1,60 m
- Inclusief vegetatie
- Standard onweken & voorin trekken
- Na installen: lagere circulatiequentie

### K6 – Standard laagdikte

- Vloothoogte 1,60 m
- Standard onweken & voorin trekken

### K7 – Standard laagdikte

- Vloothoogte 1,60 m
- Frequentie onweken & voorin trekken

### K8 – Standard laagdikte

- Vloothoogte 1,25 m
- Standard onweken & voorin trekken

### K9 – Biologisch vak

- Vloothoogte 1,60 m
- Inclusief vegetatie
- Standard onweken & voorin trekken
- Na installen: lagere circulatiequentie

### K10 – Standard laagdikte (in één keer gevuld)

- Vloothoogte 1,60 m
- Standard onweken & voorin trekken

April 5th 2018



April 2018



# September 2018



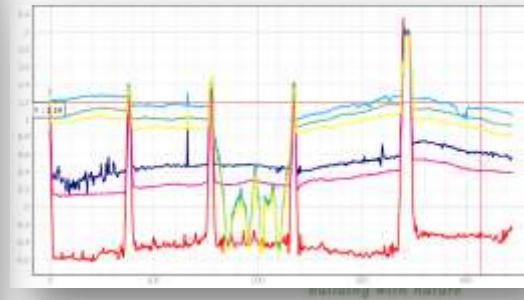
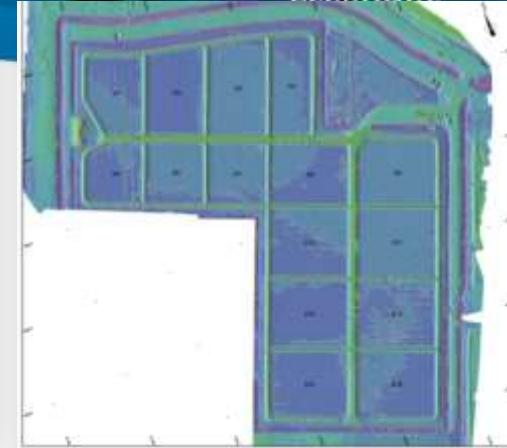
# September 2018



# Kleirijperij Breebart: (partial) filling completed on 31th March



# Delfzijl field investigation, October 2018



EcoShape

# Main Technical Results at early 2019



Parameter	Oct 2018 (m)	Oct 2018 (M)	Initial Ave	Goal
TDS [ton]	55,000	55,000	55,000	53,000
Density [kg/L]	1.21	1.34	1.19	>1.2
Organic content [%]	10.7	12.9	13.5	5.0
Salt Content [g/L]	14.3	21.4	18	<4.0
Ripening factor n [-]	nd	Nd	2.9	0,5-0,75
Class (env.)	nd	Nd	Klasse A/AW en Wonen	Klasse A + (Wonen)

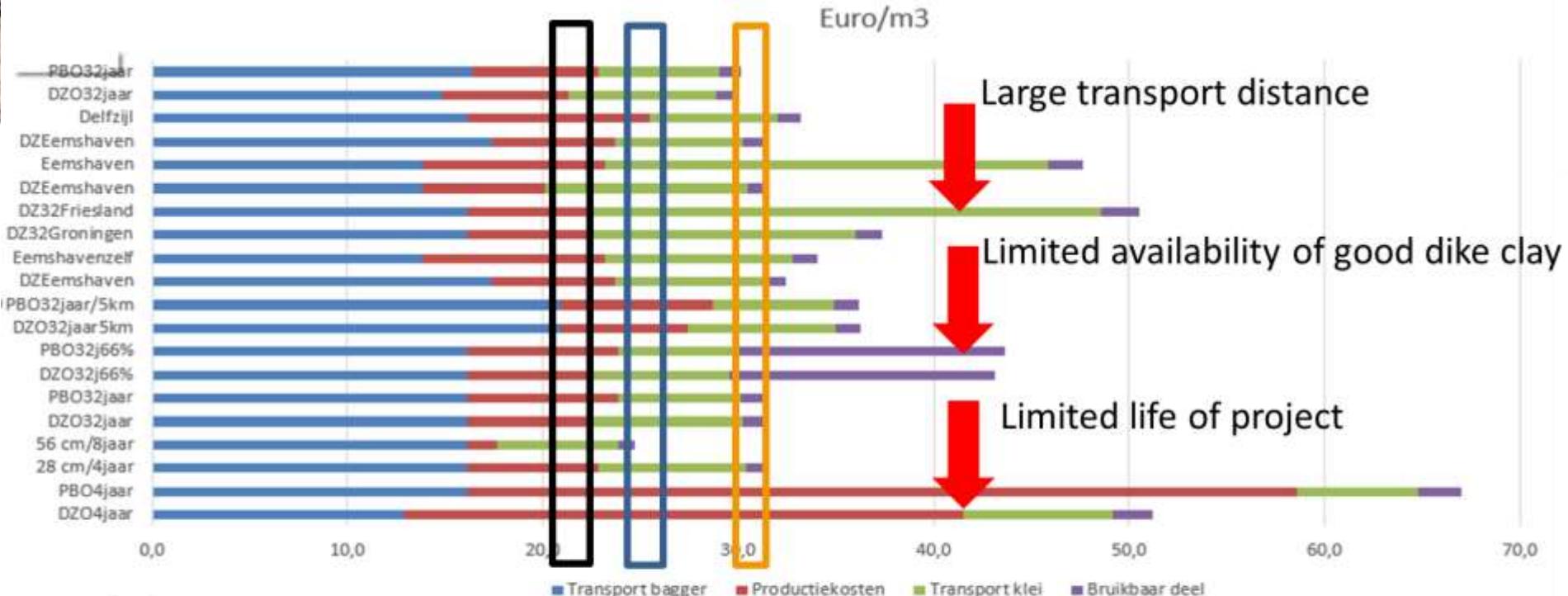
# Main Technical Results at early 2019



Parameter	Oct 2018 (m)	Oct 2018 (M)	Initial Ave	Goal
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TD	Conclusions:			
De	<ol style="list-style-type: none"><li>1. Watercontent decreased significantly, with ripening underway</li><li>2. Very limited decrease in organic content</li><li>3. No decrease in salt content</li></ol>			
O				
Sa				
Ri				
Cl	Results skewed by a very dry summer (for Dutch standards)			

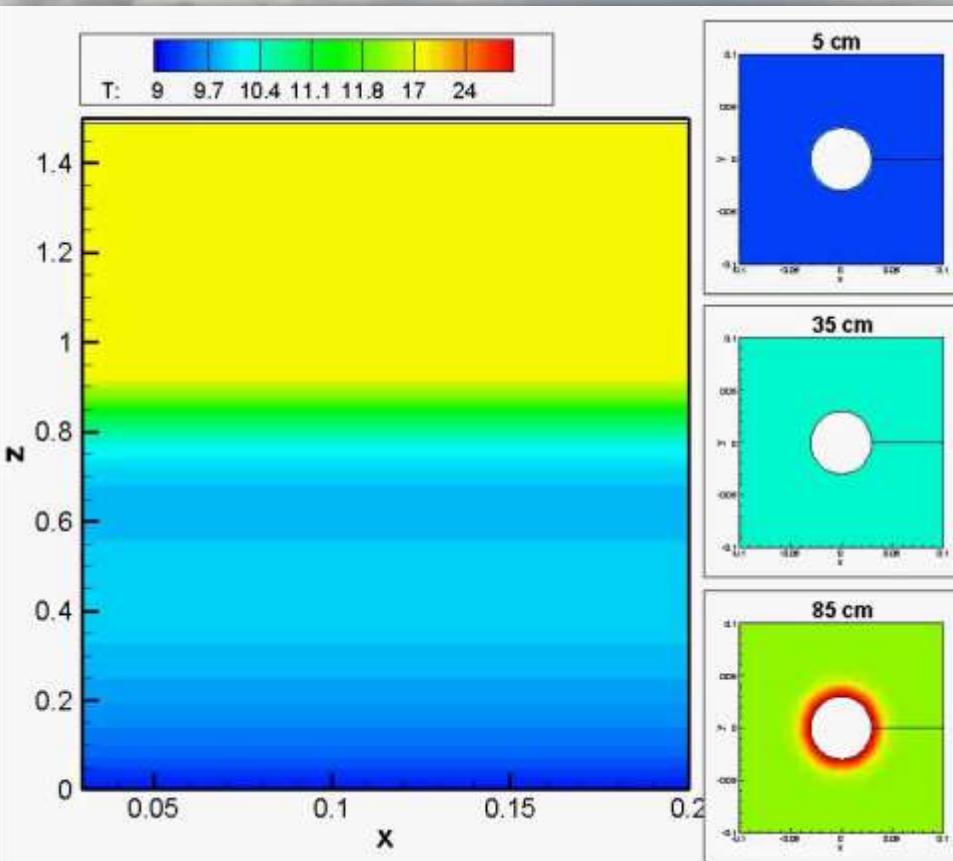
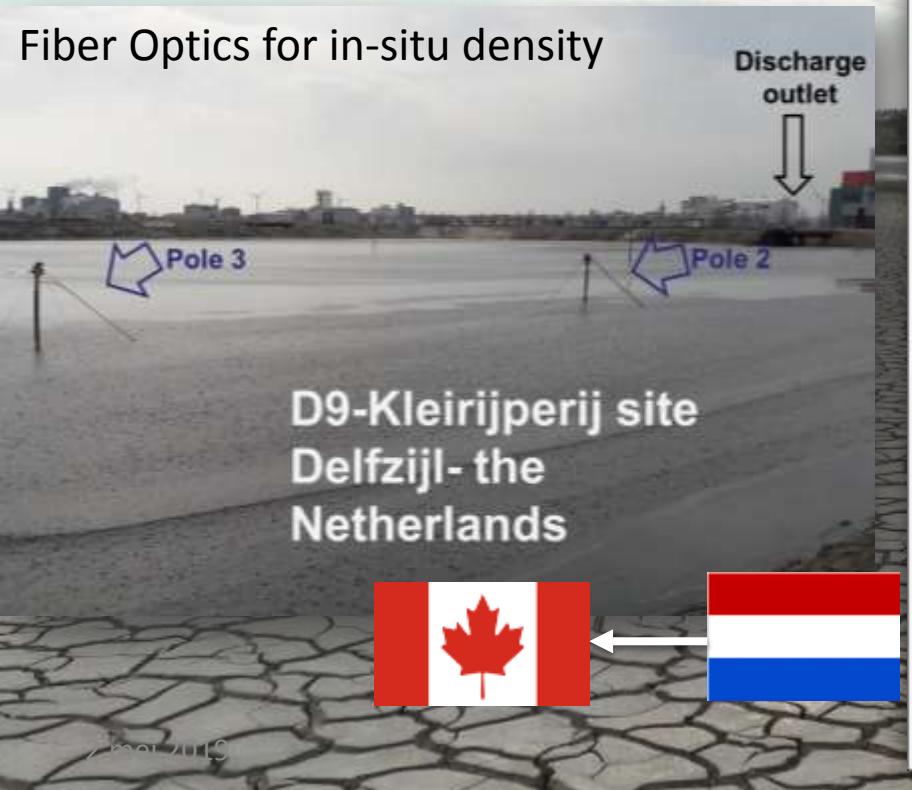
# Business Model – Kleirijperij



- Dubbele dijk: 13 tot 22 Euro/m³ (incl.BTW) voor cat 2 en cat 1 klei, of duurder?
- Aftrek huidige kosten voor baggerwerk (ca 1-1,2 Euro/m³ slib=2,5-3 Euro/m³ klei)
- Potentiele kosten voor afvoer naar NZ (ca 3 Euro/m³ slib=9 Euro/m³ klei)

# Kleirijperij as Living Lab

Fiber Optics for in-situ density



# Key enablers

- Alignment and commitment of (public and private) stakeholders to mutual added value
- Demonstrate economical value and opportunity to scale-up / transfer
- Show that it works technically
- High profile and integrated challenge(s)
  - Water quality / ecological
  - Flood risk and climate adaptation
  - Need for local resource and circular economy
- Opportunity for multifaced solution
  - Technical
  - Socio-economic
  - Multi-stakeholders
- (Political) will for iconic project, and potential for export

# International initiatives and publications



## CEDA Working Group Beneficial Sediment Use

- Collection of BU Case studies
- Focus on last 10 years, sustainability and NBS
- Clean and contaminated sediments
- In press

# International initiatives



The CEDA (Central Dredging Association) website features a "Case studies" section with four examples:

- Marker Wadden:** Describes the use of dredged material as a protective measure against rising sea levels.
- Sealing material on chemical sites in Hamburg:** Describes the use of dredged material as a protective layer on industrial sites.
- Dredged sediment as Dike Construction Material:** Describes the use of dredged sediment as a construction material for dikes.
- Lift top of Landmarks:** Describes the use of dredging and deposition of sediment to a artificial island in a Central Dredging Initiative (CDI).

The website also includes a "Latest Tweets" section showing recent posts from the CEDA Twitter account (@CEDA\_dredging), and a sidebar with links to various CEDA resources and social media profiles.

# International initiatives and publications



## SedNet WG Sediment and Circular Economy

- Circular pathways of sediments
- Includes financial and policy considerations



## PIANC WG 214: Beneficial Use of Sediments

- Building up on current material (CEDA, PIANC, ...):
- Transition from technical to governance
- Highlight success factor or triggers, and hold backs
- Started Q1 – 2019, expected publication after 18 months

## AquaConSoil, Antwerp May 20th – 24th

- Working Group
- Session on Beneficial Sediment Use and Circular Economy



# Take home messages



- 1. *Clean and contaminated* sediment is a critical resource for sustainable development and climate adaptation**
- 2. Beneficial Use ↔ Circular Economy**
- 3. Lot of energy and Intl. activities → Need to coordinate**

[luca.sittoni@ecoshape.nl](mailto:luca.sittoni@ecoshape.nl)