Project part-financed by the European Union (European Regional Development Fund)

WP5 Measures

Basic analysis reports

Measure nr° 14. Groynes at the marsh near Waarde

Annelies Boerema,
Antwerp Port Authority (APA)

Disclaimer

The authors are solely responsible for the content of this report. Material included herein does not represent the opinion of the European Community, and the European Community is not responsible for any use that might be made of it.

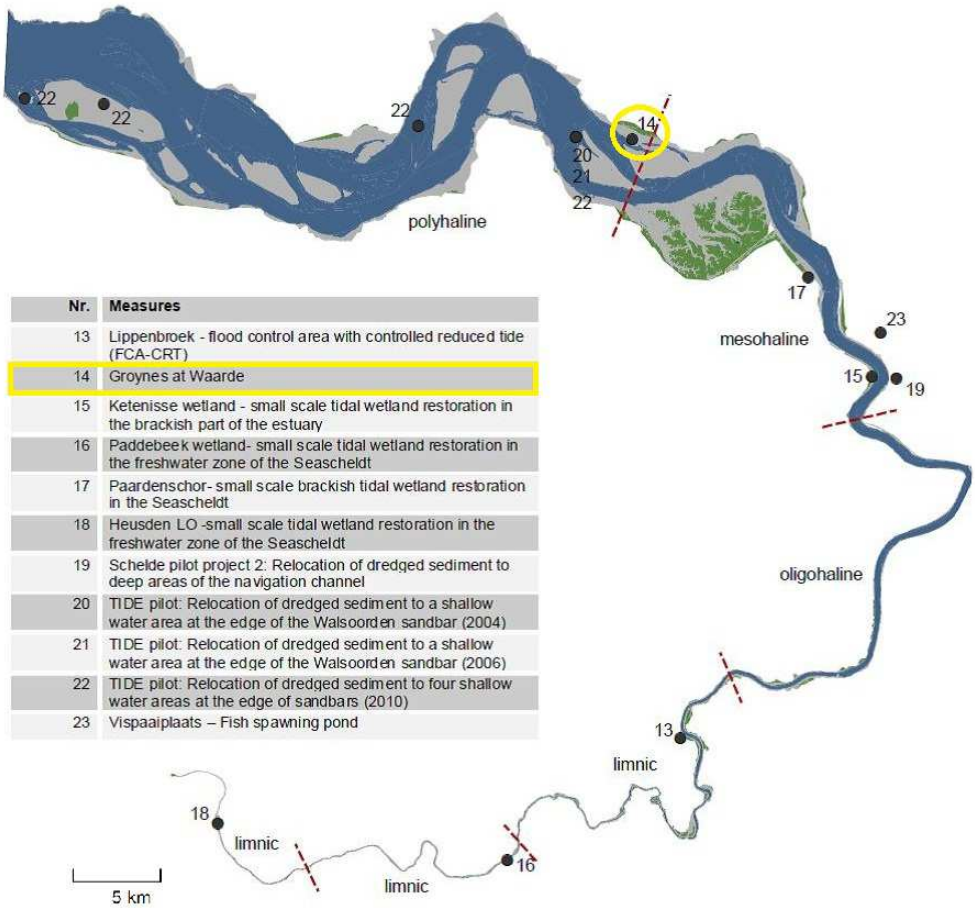
Annelies Boerema
Antwerp Port Authority

23.01.2013

TABLE OF CONTENTS

1 Description of measure

- Measure Category: Biology/Ecology
- Estuary: Scheldt
- Salinity zone: Polyhaline
- Pressure: Habitat loss and degradation
- Status: Implemented (in 2003)
- River km: TIDE-km 117
- Country: the Netherlands
- Specific location: Western Scheldt (Westerschelde), province Zeeland, near Waarde (Figure 1)
- Responsible authority: Ministry of Infrastructure and the Environment (the Netherlands)
- Costs: /
- Cost category: between 1.000.000 and 5.000.000 euro



Nr.	Measures
13	Lippenbroek - flood control area with controlled reduced tide (FCA-CRT)
14	Groynes at Waarde
15	Ketenisse wetland - small scale tidal wetland restoration in the brackish part of the estuary
16	Paddebeek wetland- small scale tidal wetland restoration in the freshwater zone of the Seascheldt
17	Paardenschor- small scale brackish tidal wetland restoration in the Seascheldt
18	Heusden LO -small scale tidal wetland restoration in the freshwater zone of the Seascheldt
19	Schelde pilot project 2: Relocation of dredged sediment to deep areas of the navigation channel
20	TIDE pilot: Relocation of dredged sediment to a shallow water area at the edge of the Walsoorden sandbar (2004)
21	TIDE pilot: Relocation of dredged sediment to a shallow water area at the edge of the Walsoorden sandbar (2006)
22	TIDE pilot: Relocation of dredged sediment to four shallow water areas at the edge of sandbars (2010)
23	Vispaaiplaats – Fish spawning pond

Figure 1. Location of the groynes near Waarde

Figure 2. LEFT: Situation 1998 and 2004 (1 year after completion). Situation 1998 (up) shows the remains of the flooded 17th century village. Situation 2004 (down) shows the groynes and the sedimentation that already took place after one year. RIGHT: Air view of the study area (after completion)

1.1 Measure description

In the Western Scheldt, two groynes were constructed on the intertidal flat in front of the salt water marsh near Waarde to counteract structural erosion. This measure had two goals. First, the aim was to compensate for the loss of estuarine habitat caused by the 2nd deepening of the navigation channel in the late 1990s. The second aim was to preserve a flooded 17th century village from being flushed away by the tides. By stopping the erosion, an intertidal flat of about 90 ha can be preserved.

This measure is part of the so called "nature compensation programme Western Scheldt", which has a number of compensation measures for the loss of ecological values caused by the 2nd deepening and widening of the Western Scheldt in the late 1990's. This compensation programme is an administrative agreement between several Dutch public authorities: Ministry of Infrastructure and the Environment, Ministry of Agriculture, Nature Management and Fisheries, Province of Zeeland, several Water Boards and neighbouring municipalities.

1.2 Monitoring

No extended specific monitoring programme was set up. However, this location was already part of an existing yearly monitoring programme in the whole of the Western Scheldt. This could be used to evaluate the effects of the groynes. Parameters that were monitored are: sedimentation/erosion, sediment characteristics, benthos, bird numbers, and vegetation.

1.3 Monitoring results

The erosion problem is illustrated in Figure 3. Since the construction of the groynes, the erosion at the intertidal flat habitat had stopped (Schelde nieuwsbrief 2002).

The **vegetation** on the edge of the marsh near Waarde consists of species of the high marsh such as Sea Couch (*Elytrigia atherica*) and Red Fescue (*Festuca rubra*). At some places also Sea Plantain (*Plantago maritima*), sea milkwort (*Glaux maritima*) en Greater Sea-spurrey

(*Spergularia media subsp. angustata*) and rarely Common Scurvy-grass (*Cochlearia officinalis subsp. officinalis*) (van der Pluijm and de Jong 2008). Erosion of the edge of the marsh has an effect on the vegetation: change from the specific basin vegetation into species specific for marsh cliffs. Since the creation of the groynes, erosion of mud flats and marsh cliff decreased, sedimentation was enhanced and more high marsh vegetation started to grow at the cliff edge (Figure 4). At two measure locations (pq 5 and pq 7) the vegetation of Seaside Arrowgrass (*Triglochin maritima*) has been replaced by Red Fescue (*Festuca rubra*), Sea Couch (*Elytrigia atherica*) and locally also Sea Plantain (*Plantago maritima*) (van der Pluijm and de Jong 2008).

A **bird** counting project is performed in this area (province Zeeland) in the period January 2010-January 2011. The intertidal flat near Waarde serves a diversity of migratory and wintering birds. This area is an attraction for duck species like Eurasian Wigeon (*Anas Penelope*), Common Teal (*Anas crecca*) and Northern Pintail (*Anas acuta*), and waders like Dunlin (*Calidris alpine*), Common Oystercatcher (*Haematopus ostralegus*), Grey Plover (*Pluvialis squatarola*) and European Curlew (*Numenius arquata*). The area is also suitable for breeding birds like Common Redshank (*Tringa tetanus*) and Common Tern (*Sterna hirundo*).

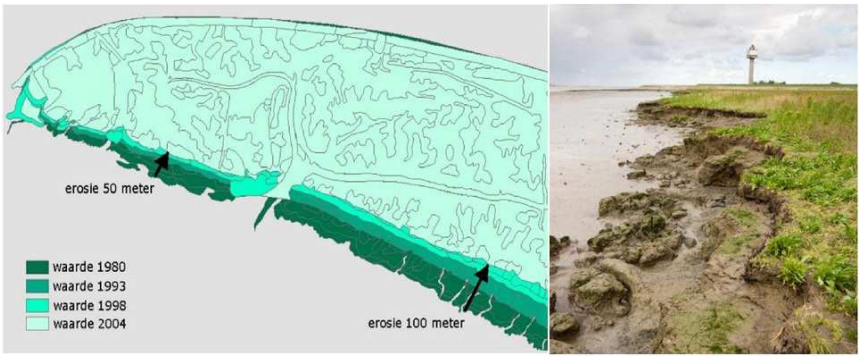


Figure 3. Illustration of the erosion on the mud flats and marsh near Waarde before the building of the groynes (van der Pluijm and de Jong 2008)

Figure 4. Evolution of the vegetation on the marsh near Waarde, 1980/1993/1998/2004 (van der Pluijm and de Jong 2008)

Some critical notes

The groynes were successful to stop the erosion of the mudflat and the shore of the marsh, but according to some experts some negative aspects have to be considered. In the first place was the height of the groynes too high due to which the sedimentation was too fast. This is a problem in the frame of the Nature development in the Netherlands because the mudflat will evolve much quicker to a marsh which was not the objective of the groynes. The marsh will additionally evolve to a high marsh which was also not the objective. The enhanced sedimentation, induced by the groynes, could not be stopped although the objective is already achieved. In the future, more adaptive management is needed with adaptable and removable constructions.

Secondly, during the building of the groynes no attention was addressed to the local morphology. The building of the groynes caused a partial closing of the Zimmerman channel, a local short-circuit channel through the Valkenisse sandbars (Figure 5). This resulted in less discharge in this short-circuit channel (the flood flow found another direction and the ebb flow is hindered by the ends of the groynes), by which this is threatened to disappear over time.

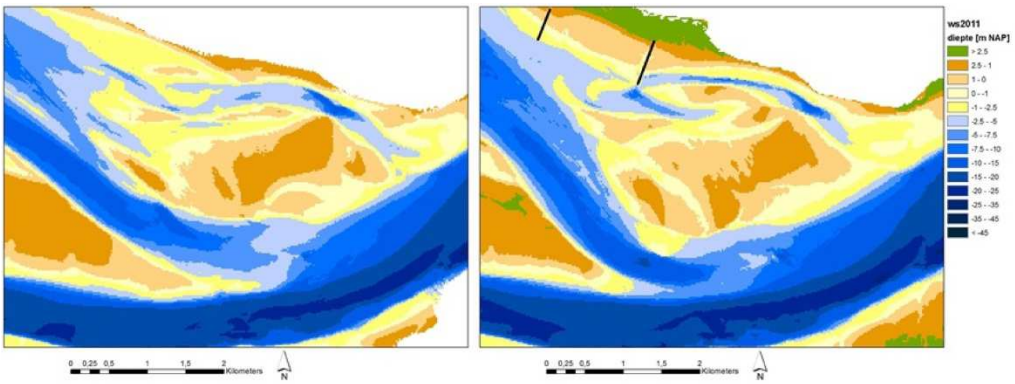


Figure 5. Bathymetry in the area of the measure site: before (left) and after (right) building the groynes.

2 Execution of main effectiveness criteria

2.1 Effectiveness according to development targets of measure

Step 1: Definition of development target
Two targets were put forward for the groynes (Schelde nieuwsbrief 2002).

- The first target is to stop the erosion of the tidal flat and salt marsh near Waarde (see Figure 3) and increase their ecological function (see Figure 4).
- The second target is to preserve the 17th century village.

Step 2: Degree of target achievement
The groynes were effective for both targets: the area of the intertidal flat has increased and new patches of salt marsh are being formed. Also, bird numbers and marsh vegetation have increased (van der Pluijm and de Jong 2008). Furthermore, the 17th century village is covered by sediment again and saved from flushing away. No maintenance is necessary.

2.2 Impact on ecosystem services

Step 1: Involved habitats
The measure Groynes at Waarde in the mesohaline zone of the Scheldt estuary was about the protection of intertidal flat habitat against erosion, improving the habitat quality.
Before the measure the intertidal flat habitat was in bad condition because of erosion. Additionally erosion had already led to the underlying peat layer. This layer was very poor in benthos species and the fear was that the erosion would continue over the entire flat habitat letting the peat layer outcrop and a general decrease in soil quality.
After the construction of the groynes the quality of the intertidal flat habitat increased because of reduced erosion and more important enhanced sedimentation with a positive effect on benthos species and the overall soil quality.

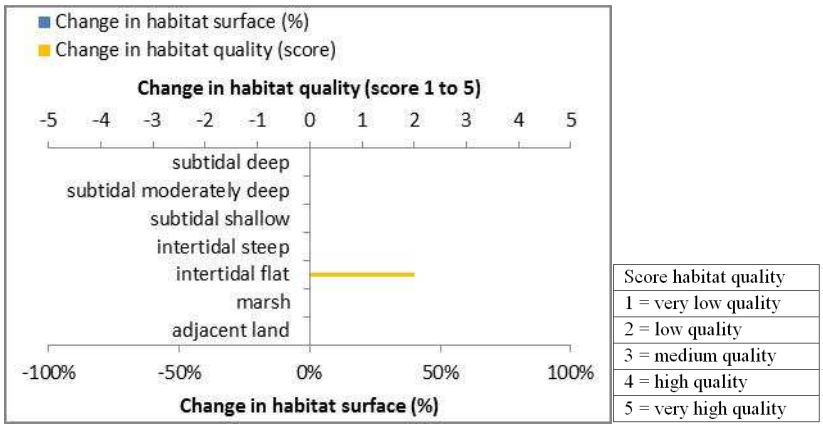


Figure 6. Ecosystem services analysis for Groynes at Waarde: Indication of habitat surface and quality change, i.e. situation before versus after measure implementation. The change in habitat quality, i.e. situation after the measure is implemented corrected for the situation before the measure, is '1' in case of a very low quality shift, and '5' in case of a very high quality shift.

<u>Step 2</u>: Expected impact on ecosystem services, compared with targeted ecosystem services, and expected impact on beneficiaries

More information about the methodology and the correct interpretation of the results could be found in the overall measures report (Saathoff et al. 2013).

(1) Overall expected impact on ES: From the ES assessment it is concluded that this measure generates overall a slightly positive expected impact for many ES, with a positive expected impact on "Biodiversity".

(2) Expected impact on targeted ES: The first target (erosion prevention) corresponds with the ES 'Erosion and sedimentation regulation by water bodies' and the second target (preserve an old village) corresponds with the ES 'Information for cognitive development'. The expected impact on both targets is slightly positive.

(3) Expected impact on beneficiaries: The expected impact for the different beneficiary groups is overall slightly positive.

Table 1. Ecosystem services analysis for Groynes at Waarde: (1) expected impact on ES supply in the measure site and (2) expected impact on different beneficiaries as a consequence of the measure

Groynes at Waarde

Cat.	Ecosystem Service	Score
S	"Biodiversity"	2
R1	Erosion and sedimentation regulation by water bodies	1
R2	Water quality regulation: reduction of excess loads coming from the catchment	1
R3	Water quality regulation: transport of polutants and excess nutriënts	0
R4	Water quantity regulation: drainage of river water	0
R5	Erosion and sedimentation regulation by biological mediation	1
R6	Water quantity regulation: transportation	0
R7	Water quantity regulation: landscape maintenance	1
R8	Climate regulation: Carbon sequestration and burial	1
R9	Water quantity regulation: dissipation of tidal and river energy	1
R10	Regulation extreme events or disturbance: Wave reduction	1
R11	Regulation extreme events or disturbance: Water current reduction	1
R12	Regulation extreme events or disturbance: Flood water storage	0
P1	Water for industrial use	0
P2	Water for navigation	0
P3	Food: Animals	0
C1	Aesthetic information	1
C2	Inspiration for culture, art and design	1
C3	Information for cognitive development	1
C4	Opportunities for recreation & tourism	1

Beneficiaries:	
Direct users	0
Indirect users	1
Future users	1
Local users	1
Regional users	1
Global users	1

X Targeted ES

Legend: expected impact*	
3	very positive
2	positive
1	slightly positive
0	neutral
-1	slightly negative
-2	negative
-3	very negative

*: Indicative screening based on ES-supply surveys and estimated impact of measures on habitat quality and quantity. Quantitative socio-economic conclusions require local supply and demand data to complement this assessment.

2.3 Degree of synergistic effects and conflicts according to uses

The public acceptance during implementation and after completion of the measure was high. No conflicts between stakeholders were observed. This measure has synergetic effects on the areas of nature conservation, conservation of archaeological heritage, flood protection and coastal defence.
A project group was found at the beginning of the project with the different stakeholders: Ministry of Infrastructure and the Environment (project leader), Scheldestromen Water Board, Management of the nature reserves in the Netherlands ('Staatsbosbeheer'), and a private owner. Within the project group communication was organized concerning planning, execution, controlling etc.

3 Additional evaluation criteria in view of EU environmental law

3.1 Degree of synergistic effects and conflicts according to WFD aims

The creation of the groynes at the intertidal marsh near Waarde (mesohaline zone) was a restoration measure that contributed to tackle the loss of riparian zones. By stopping the erosion the intertidal marsh was preserved. Hence, this measure was to a great extent suitable to reach this WFD aim to stop loss and degradation of intertidal habitat.

Indicator Group	Code	Main pressures **mesohaline** zone Scheldt	Effect?					Description
			- -	-	0	+	++	
S.I.	1.1	Habitat loss and degradation during the last about 100 years: Intertidal					X	By stopping the erosion the intertidal mudflat was preserved and the quality improved.
S.I.	1.5	Gross change of the hydrographic regime during the last about 100 years			X			
S.I.	3.1/3.2	Decrease of water and sediment chemical quality			X			
D.I.	1.3	Land claim during the last about 100 years			X			
D.I.	1.7	Relative Sea Level Rise			X			
D.I.	2.12	Port developments			X			

S.I. = state indicator; D.I. = driver indicator

3.2 Degree of synergistic effects and conflicts according to Natura 2000 aims

The intertidal flat near Waarde is part of the Natura 2000 estuary habitat (code 1130) and more specific of the area **Western Scheldt** (**Westerschelde) & Saeftinghe** (nr° 122, side code NL9803061 for the Habitat Directive and NL9802026 for the Bird Directive). This measure was able to stop erosion of the tidal flat and salt marsh near Waarde and increase their ecological function, i.e. more benthic species (Alterra , Alterra). Hence, this measure has the possibility to conserve and improve estuary habitat. In addition, more area of mud flat makes this area more valuable for birds (breeding, migratory and wintering birds).
This measure was to a great extent suitable to reach the Natura 2000 aim to preserve the surface and increase the quality of intertidal mudflats and marshes with a positive effect on biodiversity.

CO	**Specification**	**Effect?**					**Short explanation**
		- -	-	**0**	+	++	
Habitat directive: estuary habitat	Preserve and increase the quality of marshes, mud flats and salt grasslands. Preserve undisturbed resting places and optimal breeding habitat.					X	The main goal of this measure was to stop erosion of the tidal flat and salt marsh near Waarde and increase their ecological function. (Figure 3) Quality is also increased because this area is suitable for both 'salt' and 'fresh' plants (Figure 4). More specific bare peat land transformed into intertidal mudflat rich in benthos species.
Bird	Breeding birds				X		Observed birds: • Common Redshank (*Tringa tetanus*)

directive							• Common Tern (*Sterna hirundo*)
	Migratory and wintering birds				X		Observed birds: • Duck species like Eurasian Wigeon (*Anas Penelope*), Common Teal (*Anas crecca*) and Northern Pintail (*Anas acuta*) • Waders like Dunlin (*Calidris alpine*), Common Oystercatcher (*Haematopus ostralegus*), Grey Plover (*Pluvialis squatarola*) and European Curlew (*Numenius arquata*)

4 Crux of the matter

A positive lesson was that the planning of the project and the choice of the measure has been carried out in cooperation with all competent authorities therefore involving all available knowledge on a variety of aspects early on in the project. Hydromorphological models were used during the planning stage to analyse different configurations of groynes and the configuration with the least morphological impact was selected.
Lesson learned: adaptive management is needed with adaptive and removable constructions. For example, start with rather low groynes and heighten the groynes in case the sedimentation is not sufficient. Also, when building groynes the local morphology around the area has to be considered.

5 References

Alterra. Beschermde natuur in Nederland: soorten en gebieden in wetgeving en beleid: Westerschelde & Saeftinge. http://www.synbiosys.alterra.nl/natura2000. Ministerie van Economische Zaken, Landbouw en Innovatie.

Alterra. Essentietabel Natura 2000-gebied 122. Westerschelde & Saeftinghe. Ministerie van Economische Zaken, Landbouw en Innovatie.

Saathoff, S., J. Knüppel, S. Manson, and A. Boerema. 2013. Management measures analysis and comparison. Investigation of measures planned and implemented at the estuaries of Weser, Elbe, Humber and Scheldt. Study report in the framework of the Interreg IVB project TIDE, Oldenburg, Hamburg, Hull, Antwerp.

Schelde nieuwsbrief. 2002. Het behouden waard. September 2002, nummer 32. Het Schelde informatiecentrum.

van der Pluijm, A. M. and D. J. de Jong. 2008. Vegetatieontwikkeling westelijk deel Schor van Waarde (Westerschelde) 1981 – 2006. Werkdocument. Rijkswaterstaat, Dienst Zeeland Middelburg.