Report of Workshop 'Oesterdam suppletie' held on 10th january 2012

Workshop background

This report presents the results of the workshop titled; 'Oesterdam suppletie', held on the 10th of January at RWS Zeeland office in Middelburg. The workshop was organized as part of the Master thesis project from Lies de Graaf on the Oesterdam project. The main goal of the workshop was to gather different ideas and arguments behind design choices for the Oesterdam foreshore nourishment. The generated designs are used as input to the Master thesis study.

Program and goal

Main workshop goal; The participants are asked to produce ideas and designs for the Oesterdam foreshore nourishment. The challenge is to make three designs that optimize nature, safety or the project goal (combination of safety and nature), where arguments on specific choices in the design are most important.

Program

14.00 uur	Welkom
14.10-14.20	Presentation: Oesterdam project (Eric van Zanten)
14.20-14.45	Presentation: Workshop problem description (Lies de Graaf)
14. 45-15.30	1st design round; Sandy solutions
15.30-16.00	Presentations designs (chairman: John de Ronde)
16.00-16.30	2nd design round; sand + other solutions (e.g. Building with Nature)
16.30-17.00	Presentations designs 2nd round

Workshop participants

	Name	*Organisation*
1	John de Ronde	Deltares
2	Dick de Jong	RWS Zeeland
3	Eric van Zanten	RWS Zeeland
4	Dirk van Maldegem	RWS Zeeland
5	Edwin Paree	RWS Zeeland
6	Yvo Provoost	RWS Zeeweringen
7	Carla Pesch	Hogeschool Zeeland
8	Ruud de Boer	Hogeschool Zeeland
9	João Salvador	Hogeschool Zeeland
10	Mindert de Vries	Hogeschool Zeeland/ Deltares
11	Jaap van Thiel de Vries	Deltares/ TU Delft
12	Menno Eelkema	TU Delft
13	Lies de Graaf	TU Delft
	Absent	
	Kees van Westenbrugge	RWS Zeeland
	Jaap Brilman	Provincie Zeeland
	Nicolette Volp	TU Delft

1st part - Presentations introducing Oesterdam project

Presentation - Oesterdam project (Eric van Zanten)

Intertidal flats in the Eastern Scheldt are eroding due to the reduced tidal prism since the storm surge barrier. The lowering of shallow foreshore results in higher waves being able to reach the Oesterdam. Besides this expected increase in hydrodynamic loads, the current revetment on the entire Oesterdam stretch is classified unsafe.
The project originated with the idea of strengthening the Oesterdam solely with sand. This initiative has been proposed to the ministry of I&M, after which it has been scaled down to a solution where a new revetment would be combined with a foreshore nourishment of 600.000 m3. The aimed purpose of this nourishment is to restore the height of the foreshore to the situation before the storm surge barrier in 1986. Compensating in this way the loss of intertidal habitat.
The nourishment is also intended to delay the expected necessary maintenance/renewal of the revetment on the Oesterdam by 20/25 years. Increasing it lifetime from 30 years to 50 years.
The project is funded by three different parties namely; Natuurmonumenten (1 Miljoen euro), the Ministry of I&M (1.4 miljoen euro) and by the Provincie Zeeland (125.000 euro).

Remarks/Discussion:

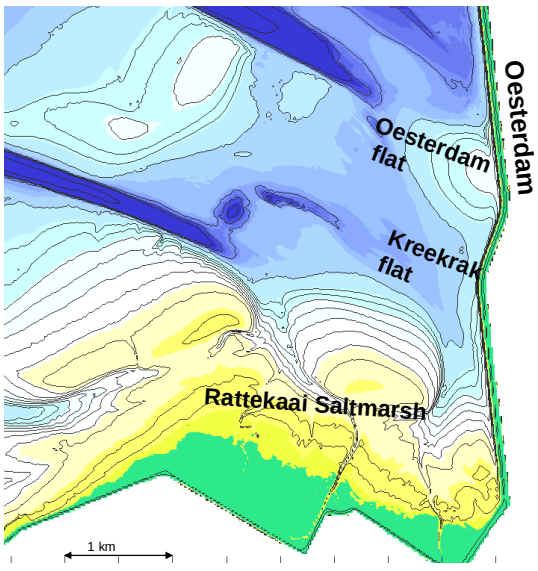
Question from Carla; What is the time planning of the project?
Eric: The planning of the project is ambitious. We aim to start with the construction of the nourishment at the end of 2012 or the beginning of 2013. This means that the design will have to be completed at the summer of 2012.

Presentation – Workshop problem description (Lies de Graaf)

During the Saint Felix flood in 1530 a large part of the Kom, currently known as the 'Verdronken land van ZB' was flooded. Channels in this area are cutting through peat layers, creating steep lopes.

The project area can be divided in three different sections (Information from Edwin Paree), see figure to the right.

1. Oesterdam flat: A broad sandy flat in the North. Not much variation in benthic life.
2. Kreekrak flat: A narrow flat with a more silty bottom, more variation in benthic life.
3. Rattekaai saltmarsh: This saltmarsh lies at the Southern end of the project area. Hardly any erosion is found here and it is a valuable habitat.



The most important users in the Kom are; oyster fisheries and 'pieren spitters'. The area is also a Nature2000 area, intertidal flats are especially important habitat for wader bird species.

The Deltaworks have reduced the tidal prism and hence the tidal currents in the channels of the Eastern Scheldt. Due to this the channels have smaller capacities to transport sediment onto the shoals. Erosion processes during storm continue unaffected and on average the intertidal areas are loosing sediment. This process is called 'sandhunger=zandhonger'.

This loss of intertidal flats is visible in the bathymetry data of the Kom. However, the 'vaklodingen' datasets show a unrealistically large loss of sediment volume. The erosion rate found (-2 cm/y) provides a possible high erosion scenario. The RTK transect data show much smaller erosion rate and a conservative scenario of -5mm/y is based on these measurements. With a lifetime of 50 years and including sealevel rise, these scenarios show an erosion of 125cm or 50cm.
The effect is that the exposure time of the intertidal flats shortens. Birds will have less time to feed.

An overview of the hydraulic boundary conditions of the project area as presented during the workshop is attached to this report (attachment A).

Discussion/Remarks

Dick; Be careful when concluding that high areas erode fast. Salt marshes are not eroding, there is cliff erosion but this is a completely different process. Only the higher area of the intertidal flats are eroding fast.

Eric suggests to make the goal of the workshop more concrete. It is decided to make at least 3 different designs with specific intentions.

- Safety solution. This design does not contain the new revetment on the dam. It should provide safety with only sand, including the remaining strength of the current dam. Not building the new revetment would save money, so more budget should then be available for the nourishment. That is why a larger sand volume can be used.
- A nature solution. This solution aims not only to have as little negative effects on nature as possible and keeping current nature values, but creating more/better nature. Increasing nature values. For this design, the project area considered may be larger then just the foreshore at the Oesterdam.
- Project solution. This design should be within project frame. Both benefit for safety and nature and within assigned volume (600.000 m3) and project area. And no possibility to create high dry solutions like a dune, as this is not the current nature situation.

1st design round - Sandy solutions

The participants form small groups of 3 persons each to work on possible designs, using maps and aerial photographs to sketch their ideas. After 45 min. each group assigned a team member to present their designs.

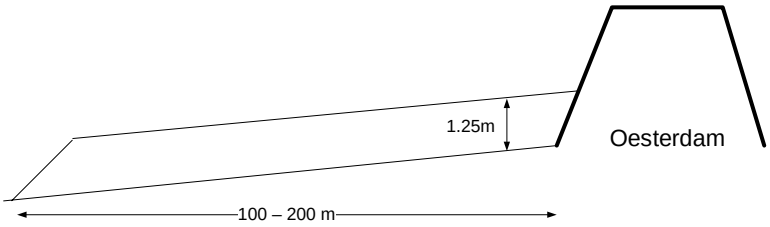
Groups

1) John de Ronde, Ruud de Boer, João Salvador
2) Dick de Jong, Menno Eelkema, Mindert de Vries
3) Jaap van Thiel, Edwin Paree, Yvo Provoost
4) Carla Pesch, Eric van Zanten, Dirk van Maldegem

Presentations

Group 1

Project variant



The design that fulfills the project goals generated by this group is very straight forward. The reasoning behind the decision to make a tidal flat between 100 to 200m wide and 1.25m high is clear. When the highest erosion scenario is chosen, this means that during the lifetime of 50 years, 1.25m of the tidal flat will be eroded. This amount of sediment is therefore added to the current situation over 100m or 200 m width. In this way ensuring that the hydraulic conditions remain equal to the current situation, even after 50 years of erosion. The foreshore will have an overall gentle slope, similar to the current bathymetry in order to create as natural intertidal flat as possible.

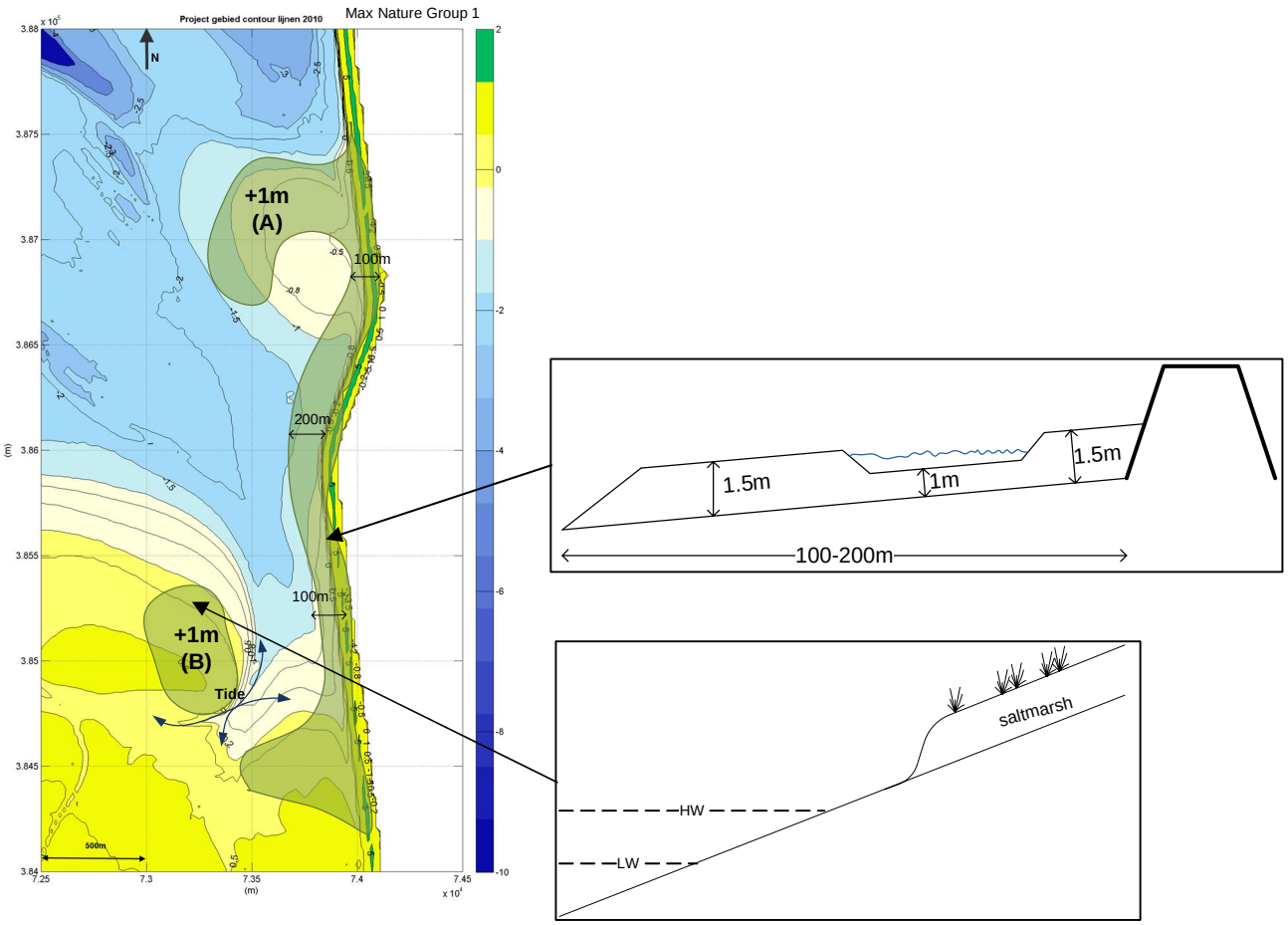
Nature variant

This solution is trying to create new saltmarsh area, as this is considered valuable habitat. Saltmarshes might be formed by placing sediment on high areas and creating sheltered locations behind these higher flats where silt could settle.

One of these high areas looks like an island and is placed on the Rattekaai saltmarsh (B). Another is shaped as a spit extending on the Oesterdam flat in the North (A). These higher islands will be about +1m above NAP and they create sheltered area's on the lee side. Because these islands break the waves, erosion along the dam at this sheltered 'shadow' is lower. This means that there the foreshore-nourishment can be narrower, 100m instead of 200m.

The area underneath the southern island remains open, not obstructing the flow. Ensuring that the tide will still be able to flow in and out as is does now.

Along the cross section variation in height can add extra benefit for nature. For example a higher flat with a deeper area behind with water. This will give extra nature value.

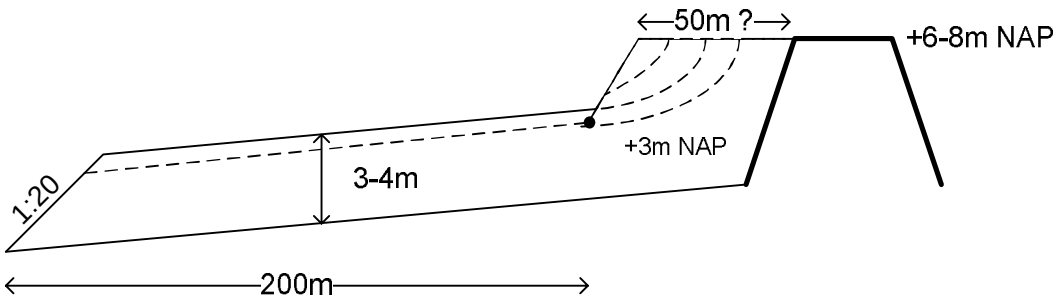


Discussion/Remarks

Question from Dick de Jong; What is the function of the island in the Southwest in the nature design? Is it expected that this island creates some sort of benefit for nature?
Answer; Yes, this island is meant as benefit for nature. The area is already relatively high. This means that not much sediment is needed to make a higher area of +1m NAP. The idea was to create different habitats and possibility for saltmarshes to be created in the sheltered lee side of the islands.
Dick; No! Saltmarshes will not form in the Eastern Scheldt as there is no silt available for sedimentation. Furthermore the idea of using an island to create a sheltered area will not have much effect. The location is already one of the most sheltered areas in the Eastern Scheldt.

Safety variant

To optimize safety the group has come with the solution of a high nourishment of 200m wide and a height of 3-4m. Against the Oesterdam a high dune is placed that will be eroded during storm conditions throughout the entire lifetime. The eroded sediment will spread across the foreshore. The minimal width to compensate the dune erosion has to be determined/calculated, 50m seems a good first estimate.
The dune foot should start at a height of +3m NAP, or at least above the HWS level. In this way, dune erosion only occurs during high storm levels. Greatly increasing the lifetime of the dune.
With a height of 3 to 4 meter the nourishment will be above high water. This means that the design will create the possibility of a recreational beach along the Oesterdam.



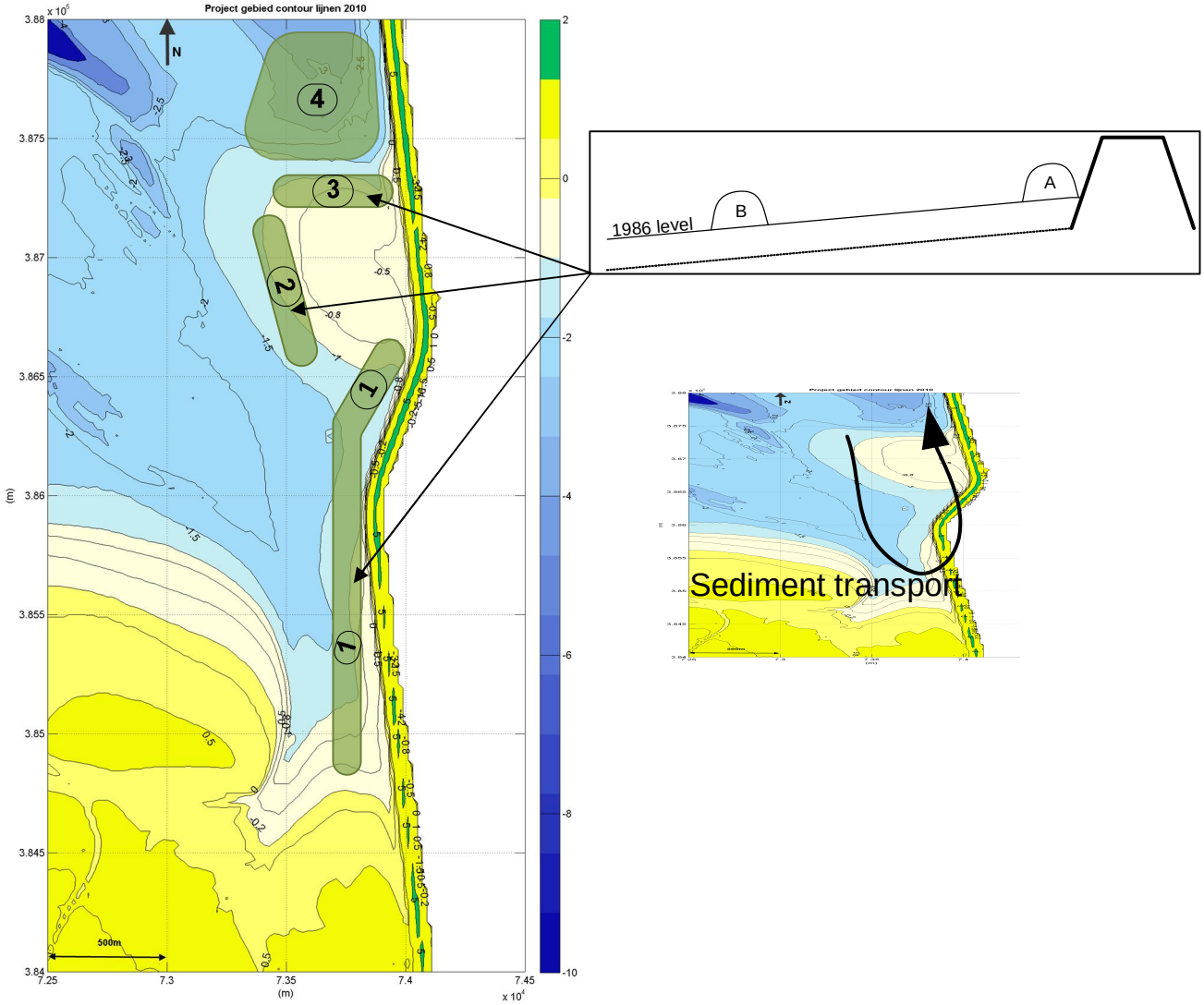
Group 2

Before they started, the group concluded that there is no (or hardly) erosion on the Rattekaai and most of the erosion occurs further North. The chosen project area was restricted to this northern location.

Safety variant

Protecting the dam from waves is the main goal of this design. Further the assumption is made that the current foreshore will be backfilled to the 1986 profile.
Now the consideration was to place a ridge somewhere on this profile. The question remains what is the best location for this ridge? There are two main cross-shore locations; against dam (A) or further offshore (B).

If the ridge is placed right next to the dam (A), waves across the flat will be higher than if ridge is placed further offshore (B). In that way the ridge breaks the waves there and shelters the flat behind. As waves are lower also erosion rates are expected to be less.
When the ridge is located further offshore it also traps the sediment on the flat. However, if the ridge is placed close to the dam foot, the sediment will spread across the foreshore.



There are three possible alongshore locations for the nourishment.

1. Close and parallel to dam. This is the most straight forward location and provides safety along the entire stretch of Oesterdam considered.
2. Parallel to dam on the Oesterdam flat. This creates a sheltered area behind the ridge where less erosion occurs.
3. Cross to dam on north side Oesterdam flat. Assuming that the sand loss from the flat is to the north (see sketch), this design could also act as a sand trap. Also a sheltered area is created south of this ridge.
4. A general consideration; what happens if you put the sand instead of in a ridge on flat, in the deep part of the Zilverput north of the flat (location 4). What is the effect? Is it similar as ridge? This will need more sand to fill this deeper area up to the same level.

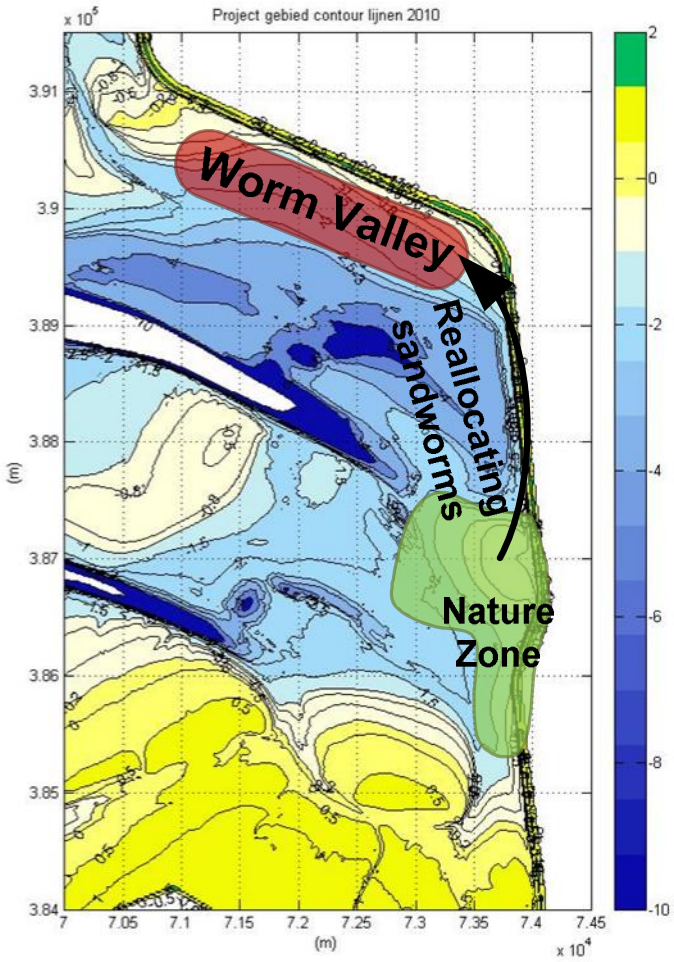
Nature variant

Ridges

Group 2 came to the conclusion that the ridges from the previous variant are no real bonus for nature. They create no habitat for ‘wadpieren’. The ridges might have a positive effect for birds regarding feeding time. Although, if there is not enough food (worms etc.) available at these ridges the effectiveness is depending on balance between these two.

Worm valley

Another idea from this group to create a nature design was reallocating the 'pierenspitters'. Currently there is a 'spit' location at the broad flat. If the sediment available for this project is used to make the area near the Bergsediepsluis shallower, the pierenspitters can move to that location. The current project location could then be assigned as a nature zone. This would mean an undisturbed area for nature is created, that is a great benefit for nature.

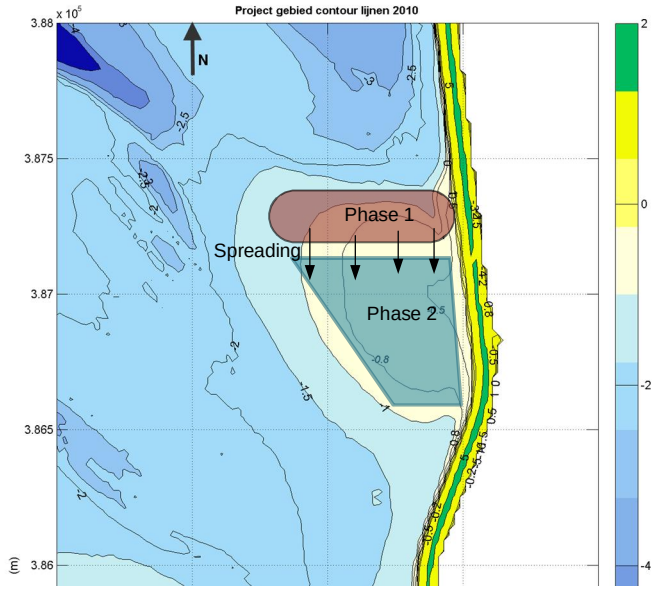


Consideration; Spreading the nourishment works in time and space

A consideration from this group is that zoning the nourishment works in both time and space could also be beneficial for nature, or at least ensures the least amount of impact.

Phasing the project in time can be done by working in different zones or applying the nourishment layer by layer over the entire area. This last method is technically not feasible, because the nourishment would have to be placed in too thin layers. Besides, this method would disturb the entire area during each phase, not allowing nature to restore itself.

The nourishment could also be phased in different zones in space. For example by first applying the nourishment on north side of flat (phase 1). Let this sediment spread over the flat during 10yrs. After that fill up the rest of the flat to required height (phase 2). This location might have been fed by the previous nourishment.

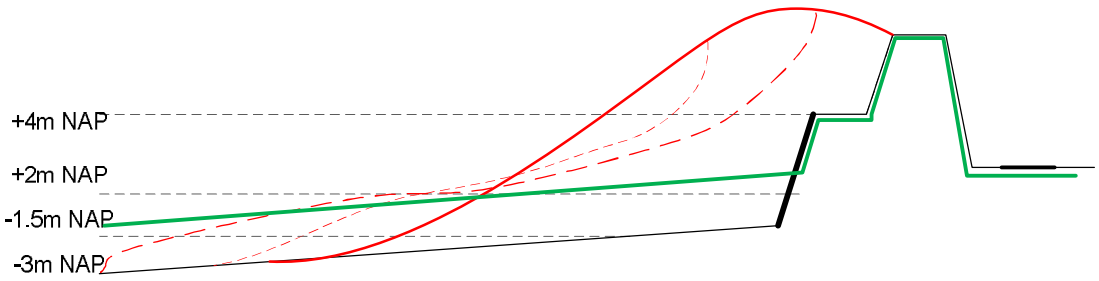


Group 3

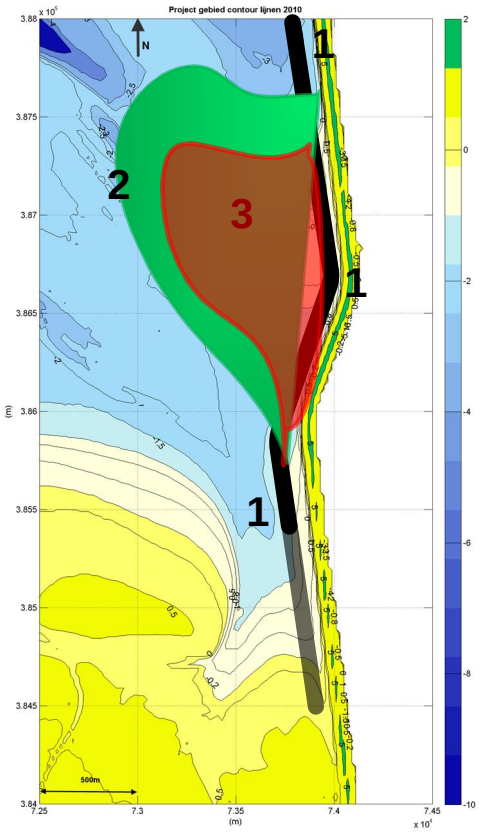
Safety variant

This design consist out of a dam within a high dune in front of it, this can be schematized as a dam within a dune. Before the dune has eroded, it will provide all the safety of the design. As the duneface erodes during storms within the lifetime, the sediment will spread across the foreshore. Creating a growing foreshore area for nature.

After 50 years the (green line) dune is expected to be completely eroded. The sediment has spread cross-shore, creating a high flat in front of the dam. This high flat reduces waves with 50%. The old revetment should still have sufficient strength left to withstand these smaller wave conditions during the design storm.



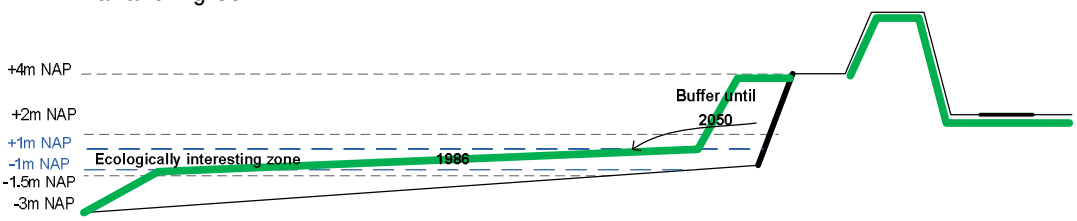
The most logical location (1) in the project area for this safety design is parallel and close to the dam, as sketched in black in the figure below. Because the entire Oesterdam is qualified as unsafe, this dune profile should be applied over the entire length of the dam.



Nature variant

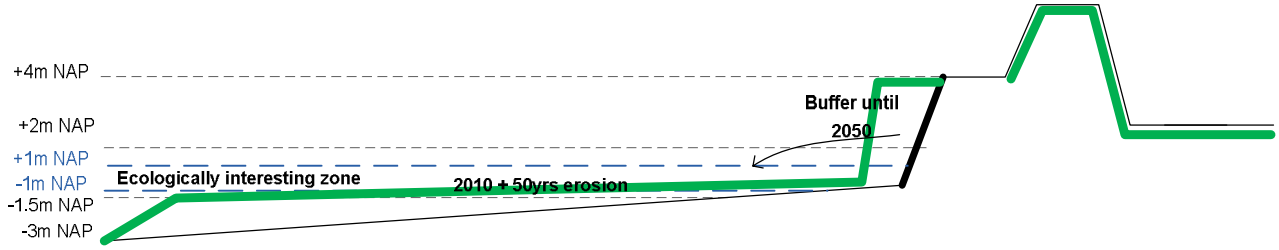
The design aims to create a large area within the tidal range, mostly between -1m NAP and +1m NAP because this zone provides most benefit to nature. This intertidal flat restores the 1986 situation of the foreshore. A volume of sediment placed against the dam toe provides a buffer for the erosion over the intertidal foreshore during its lifetime of 50 years.

The optimal 2D location with regards to nature by creating a large intertidal area. That is why the nourishment is placed on the shallow Oesterdamflat, even extending further North and West in order to create as much intertidal habitat as possible. The figure above shows location 2 of the nature variant in green.



Project variant

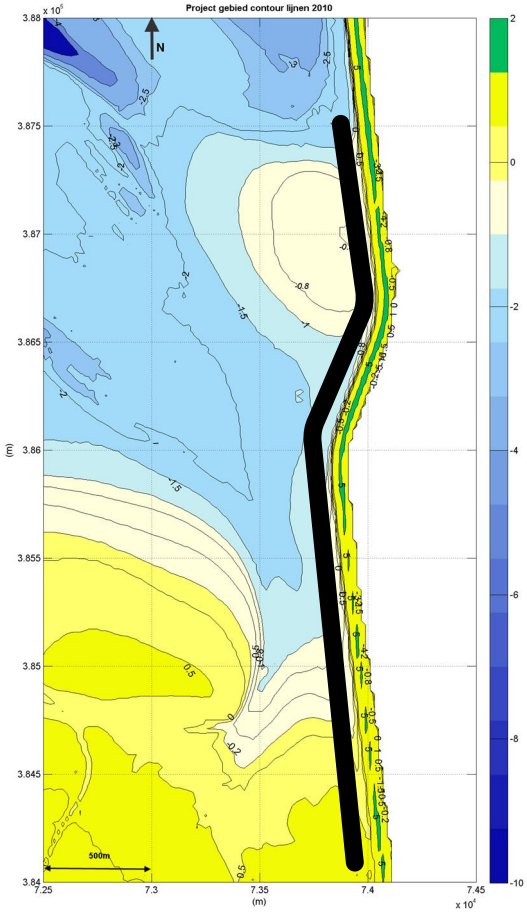
The group concluded that the project design is basically the nature variant with a euro factor. Because the project aim is to enhance safety and creating maximum benefit for nature, however with a budget restriction. The aim of this project design is therefore not to restore the foreshore back to the 1986 situation, but keep the current situation for the next 50 years. Another sacrifice made in order to keep costs down, is the total area that will be nourished. The nourishment will be smaller in the project design, location 3 (red), creating less intertidal area.

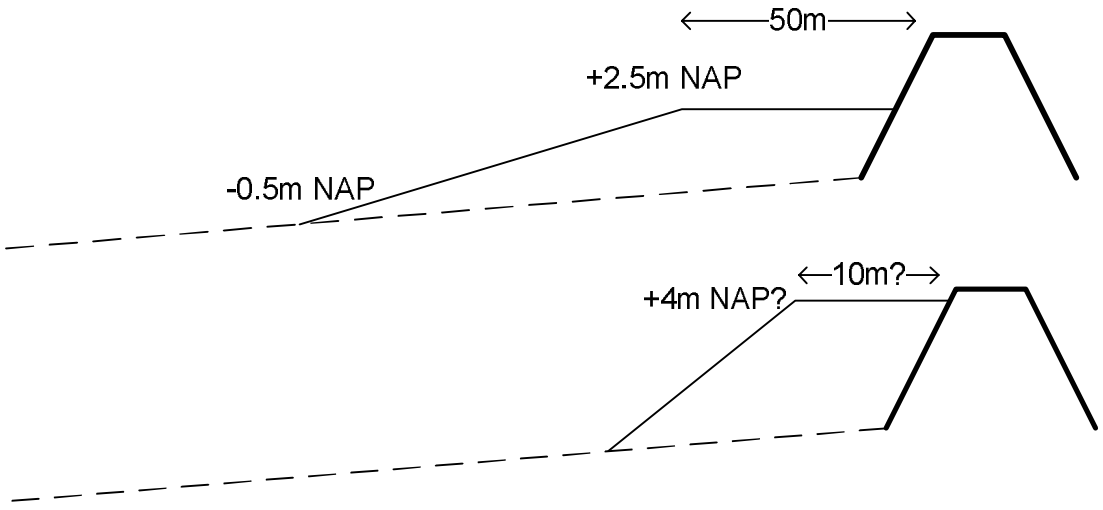


Group 4

Safety design

In this design the sand is placed close to the dam foot. The group concluded that the residual strength of the revetment is still considerable thus the dam in current condition will still withstand small waves. Therefore, the nourishment doesn't have to be above the design level of +4m NAP. Somewhat above HW, say +2.5m NAP, is probably sufficient to break the highest waves in order for the dam to withstand the reduced hydraulic conditions.



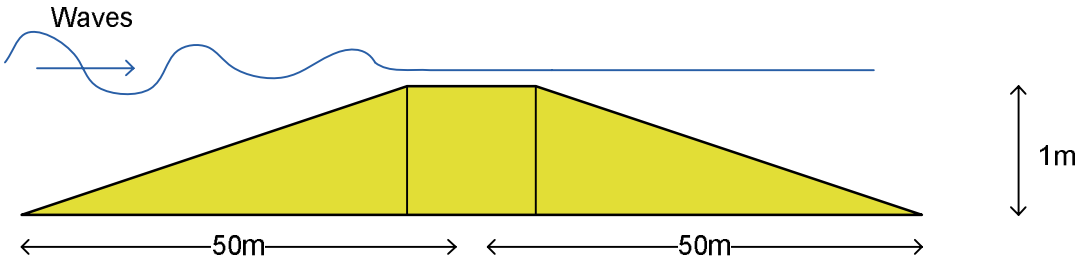


The necessary width of the buffer can be estimated using the lifetime of 50 years and the horizontal dune erosion rate. Suppose that with a steep slope of 1:3 the buffer will erode 0.5m/y in horizontal direction, the first estimated width of 50m is surely going to be sufficient.
If this design strategy is chosen, two basic designs are possible; either a wide low design or a smaller but high foreshore, see figures. These solutions are creating a high sandy beach so you are sacrificing intertidal area.
A problem for this design is that the design is above NAP, the nourishment is a beach, and it will not create intertidal flats. Intertidal area is sacrificed, the design is not beneficial for nature. In the reality this is not in line with the project goal and will therefore not be desirable nor feasible.

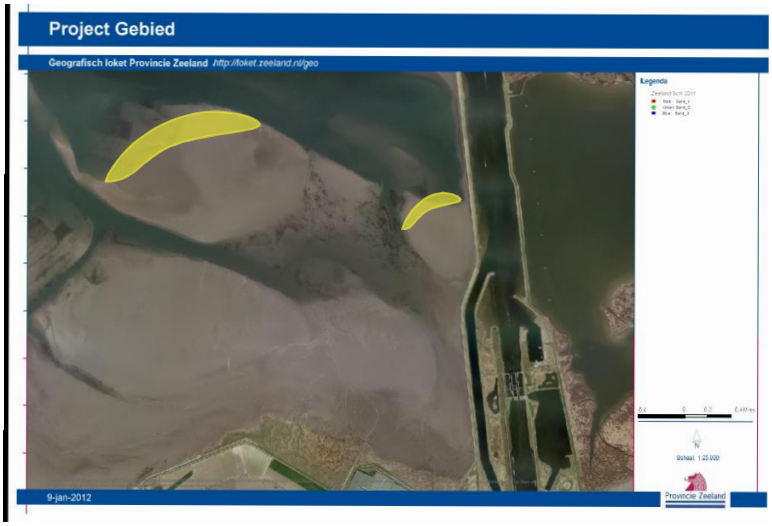
Discussion/ remarks

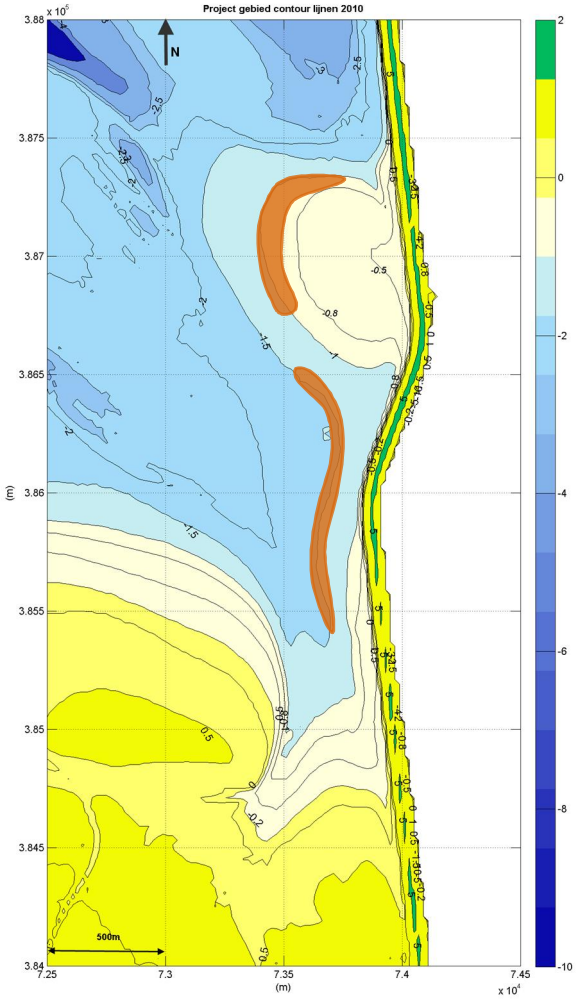
- John: The high small design would sacrifice the least amount of intertidal area, if creating beach is unwanted this is best for nature. Because the least amount of intertidal surface is covered.
- Dick: Why is your design extended so far south along the Oesterdam?
  The group did this because the entire dam is 'rated unsafe'. Dick remarks that in this Southern area there is large lost of nature, as there are still salt marshes present there. While the erosion is not that large.

Nature design 'sausage of sand' ('little tent')



This design consists out of a general building block that looks somewhat like a small tent. The height of this block is 1m high and it is two times 50m wide, with two gentle slopes on both sides. This block functions both as a breakwater, breaking highest waves, and as reservoir, the sand will slowly spread across the adjacent flats.
With a total available volume of 600.000m3 of sand and a volume of 100m3 per meter length, this gives 6km length of these building blocks. This turned out to be surprisingly long, you could go twice along the dam within the project area and still have volume left. This gave many possibilities for the location.
The challenge is to place this 'sausage' in such a way that it will create maximum benefit for nature. As the Kreekrak foreshore bottom contains large amount of silt and lots of benthic life and erosion is small. This is not the best location for these building blocks to create nature. The Hooge Kraaijer flats makes more sense, because the soils is more sandy and erosion is high.
Three possible locations where defined.
1; On Hooge Kraaijer. Here the erosion is high. The sand will spread across flat compensating this erosion. Besides there is no great loss of nature at construction at this location, because the bottom is sandy without many benthic species.
2; On Oesterdam flat. For the same reasons as above. And because the shallow building blocks will break the high waves attacking the Oesterdam.
3; In the deeper water in front of the Kreekrak slik. By locating the nourishment here, the silty flat remains undisturbed while the foreshore will be nourished by the sediment spreading naturally over the flat.


Project Gebied
Geografisch loket Provincie Zeeland http://loket.zeeland.nl/geo
Legenda
9-jan-2012
Provincie Zeeland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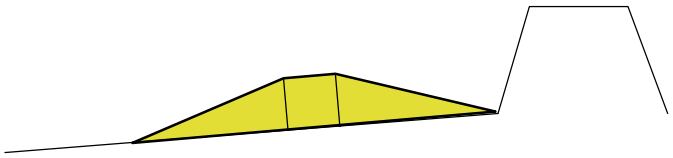
Project design

This design combines providing safety with creating intertidal habitat. The same ridges as previous design are used. To act more as wave breakers they are now placed closer to the dyke.



Discussion/Remarks

- The wave breaking by these building blocks is very limited. Because the height is only 1 m it will not create a sufficiently shallow area where the waves will break. Especially if it is placed in deeper parts, such in front of the Kreekrak flat and/or during high water levels during storm. The design condition for the waterlevel is +4m NAP, with such large water depth the 1m high blocks will not have much effect.
- Are these small block not going to be eroded away very quickly? Eric; nourishment on Galgeplaat seems stable. Edwin; remember that in first 3yrs Galgeplaat nourishment lost 0.5m of height and that was large nourishment. Not small little exposed ridge with less 'body'. This will probably erode even faster.
- Mindert; What is the expected benefit for nature? Eric; Preservation of the flat behind. Sediment will be spread across flat behind compensating for the erosion. Also the block acts as wave breaker, reducing the erosion rate on flat behind. Remark; such a small ridge is not sufficient volume to nourish flat behind. Erosion over 50yrs is large and for large area you would need large volume to compensate.

2nd design round - Building with Nature concepts

As there were only 30 minutes left for this second design round it is decided to change the approach. Everyone remains seated and the participants work in three larger groups to generate ideas for possible Building with Nature concepts.
Groups

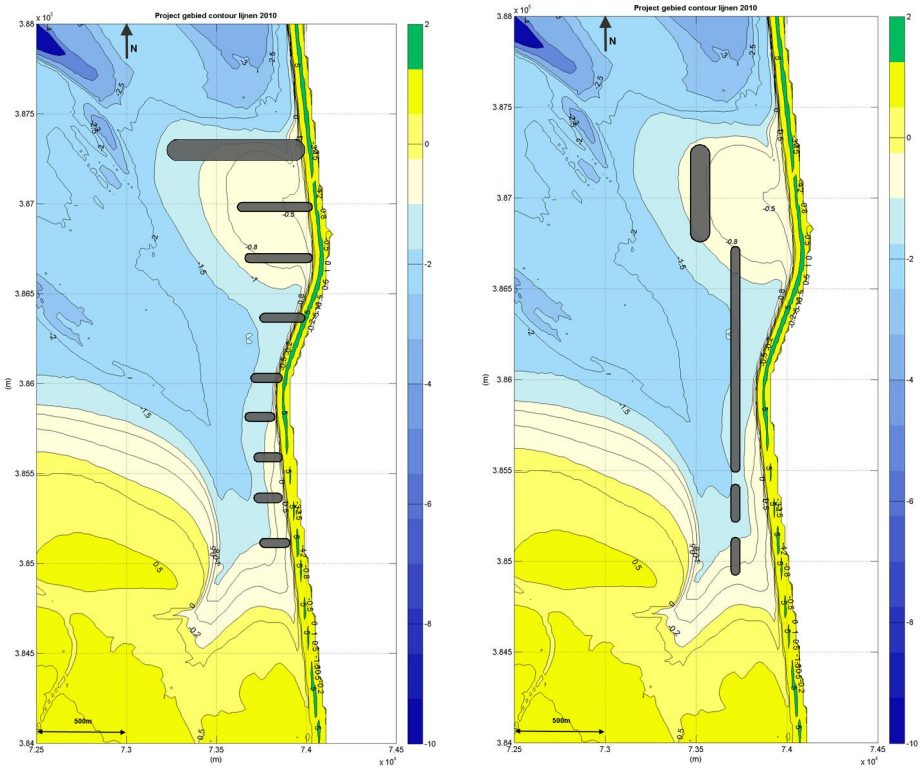
1. Menno, Mindert, Edwin, Dick, Lies
2. Eric, Carla, Yvo, Dirk
3. Jaap, John, João

1st group

Ridged hard structures, such as 'strekdammen' can act in two principal ways; blocking sediment transport or reducing the hydraulic conditions.

Blocking sediment transport

Blocking the sediment transport can happen in two directions. The first method is to restrict/reduce the alongshore sediment transport. This is done by placing one large cross shore 'dam' or other structure at the North of the Oesterdam flat. In this way blocking the assumed northern directed sediment transport. This in combination with small cross shore dams along the dyke. These dams will block the alongshore sediment transport without restricting any possible 'positive' transport cross shore towards the dam.
The second method is blocking the cross-shore transport. Placing a structure alongshore the Oesterdam, it will block the cross-shore transport completely. Including any possible 'building' transport towards the dyke.
These dams can be made out of BwN concepts, for example; oyster reefs, stones or wooden piles ('wilgenbos').



Breaking waves

Also floating structures, such as MosselZaadinvangInstallaties (MZIs), were considered as wave breakers. Question with these floating structures and other experimental concepts is whether they are effective in reducing the wave height.

Discussion/Remarks

Mindert; In the 'wilgenbos'- project, approximately 3 poles per m2, gave 80% reduction of 1m high waves over 30m width. These hanging structures will probably have the same effect. Currently the MZIs in the Eastern Scheldt are very open, and most likely too open to result in any reduction of the wave height.

Dick; Oyster reefs are not a good idea in the Eastern Scheldt and especially in the Kom. Because the Eastern Scheldt has a shortage of food, that is largest in the Kom. Currently the nutrients in the water (algae) are not sufficient and oyster would filter out this, leaving no/not sufficient food for cockles.

2nd group

'Boomse' clay

This group was still thinking about the idea of group 4 in previous round, using sand ridges as building blocks. These ridges have to 'walk' into the desired direction onto the shoals and not towards the deeper water or channels. This means that the channel side of the ridge needs to be stabilized and protected against erosion. Ideas that generated were; oyster (no good as explained), stone protection (also not very innovative or beneficial to nature). Finally the group decided on using 'boomse klei' chunks. The project at Sluiskiltunnel ('geboorde tunnel') will make such chunks of clay available for use. This type of clay is very hard and the blocks could be used as armouring of the channel side of the slope.

Oyster shells

A second idea was to strengthen the sand by using oyster shells. With these shell banks could be created, which naturally present else in the Eastern Scheldt. These shell banks prevent erosion.

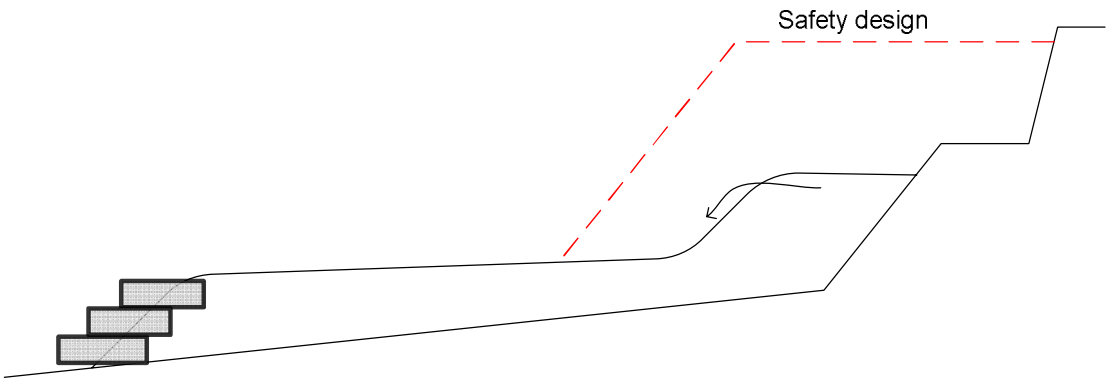
Discussion/Remarks

- John; in Hoorn there has been an experiment where shells have been mixed with sand, this experiment showed less erosion indeed.
- Oyster shells are cheap, they are waste from the oyster fishery industry. Currently they sell them to the 'grit' industry. Easily to get these shells, cheaper then sand.
- Dirk; Thinking that erosion around fixed ridges object is always large. Will this not give problems? The shells could be (partially) crushed to get a better grading. This would give a better results. With this mix of sand and crushed shells, the slopes could be steeper.
- Entire group is enthusiastic about this idea.

3rd group

'Oesterrif hanger'

This idea is similar to the 'hanging beach'- project, the stacked oyster baskets act as a small wall that retains the sediment. The overall slope can therefore be steeper.
This project requires maintenance, the iron baskets will rust. If these old baskets are no longer sufficient new baskets will need to be constructed. This could be done by placing a new basket on top of old broken down baskets.
These oyster reefs make that the slope can be steeper. They might also break the waves, reducing erosion. However, still erosion at the flat behind so buffer still necessary yet it could be smaller.


Safety design

Attachment A: Hydraulic boundary conditions project area

Normal tide

SWL = +3cm NAP	*High Water (cm +NAP)*	*Low Water (cm +NAP)*	*Tidal range*
Average tide	186	-160	346
Spring tide	214	-165	379
Neap tide	152	-139	291

1/3** year storm

Location	*Wind speed*	*Wind direction*	*Water level*	*Hs (m)*	*T_Hs (s)*
Oesterdam Flat	15 m/s *	~300 degrees *	+2.8m NAP *	1.0 *	4.2 *
Kreekrak Flat	15 m/s *	~300 degrees *	+2.8m NAP *	0.8 *	4.2 *

* Based on one year measurements at MRG station (2010)
** From frequency tables of potential wind speed at Vlissingen (1971-2000)

Design storm (1/4000 year)

Location	*Wind*	*Direction (nautical)*	*Waterlevel*	*Hs (m)*	*Tp(s)*
Oesterdam Flat	d=300 deg v=31 m/s	330	+4m NAP	2	5
Kreekrak Flat	d=300 deg v=31 m/s	315	+4m NAP	1.8	5