



Ministerie van Economische Zaken, Landbouw en  
Innovatie  
Attn. Mister mr. drs. J.W. van der Ham  
P.O. Box 20401  
2500 EK 'S-GRAVENHAGE

Date	Our reference	Number of pages
13 April 2012	1204087-000-ZKS-0157	13
From	Direct line	E-mail

**Subject**

Opportunities and risks combination alternative

Dear Mr Van der Ham,

The Deltares report 'Nature restoration in the Western Scheldt: A further exploration of Alternatives' (May 2011) defined the task of nature restoration within the framework of the study at hand as the realisation of 295 hectares of estuarine nature. Deltares identified three locations outside the dikes and three locations inside the dikes, where measures can be taken to contribute to nature restoration in Western Scheldt. As except for the flooding (depolderisation) of the Braakman-Noord polder, none of the single locations was sufficiently large to realise 295 ha, a number of combination alternatives were identified as well.

The Ministry of Economic Affairs, Agriculture and Innovation (EL&I) is considering a new combination alternative (295 ha) consisting of:

- Inside the dikes:
  - Golf and shooting area and adjacent area to the south, also known as Appelzak location inside the dikes (65 ha)
  - Welzinge polder and part of the southern Schorer polder (125 ha)
  - Northeastern part of the Hertogin Hedwige polder (100 ha)
- Outside the dikes:
  - Partial removal of the Gasdam (5 ha)

The locations Appelzak inside the dikes and the Welzinge en Schorer polders were identified in the Deltares report, but the considered implementations are variations to the measures as described in the report. EL&I has suggested the removal of 100 ha of the Hertogin Hedwige polder as an additional location. This corresponds to about one third of the surface area of the Hertogin Hedwige polder. Finally, the partial removal of the Gasdam was suggested to create connectivity between the Seaftinghe salt marsh and the Sieperda and small Hedwige and Prosper area.

EL&I has requested Deltares to evaluate the variation to previously identified measures, the additional 'small Hedwige' location, the partial removal of the Gasdam and the new



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combination alternative on morphological-ecological grounds, following the same methodology of the Deltares report. Also, a cost estimate following the report's methodology is requested.

This letter contains:

- A description of opportunities and risk for each of the locations (following paragraph 4.5 of the Deltares report)
- Net contribution of each of the four locations to the task of nature restoration (following paragraph 6.1 of the Deltares report)
- Cost estimate (following paragraph 6.2 of the Deltares report)
- Integrated assessment of the new combination alternative for the task of nature restoration (following paragraph 6.4 of the Deltares report)

The identified locations outside the dikes are not included in the combination alternative. However, realisation of low dynamic intertidal flats is still considered at the Platen van Ossensisse (net contribution<sup>1</sup> 12.5-28 ha) and Slikken van Hulst (net contribution<sup>1</sup> 5-14 ha). Deltares is currently carrying out a follow-up study to draft a pre-design including the quantitative analysis of possible risks. The locations are not described further in this letter. The Appelzak location outside the dikes is no longer considered.

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1. *The gross realisation of intertidal area is bigger than the net contribution to nature restoration, as the net contribution takes a weighting factor and a risk factor into account. The weighting factor acknowledges that measures outside the dikes improve quality by converting one habitat to another. The risk factor acknowledges an extra uncertainty for actual realisation.*



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## *Appelzak location inside the dikes*

### Description and opportunities



The flooding of the Appelzak location inside the dikes is described in paragraph 4.5.2 in the Deltares report. Its current elevation is approximately +6 m NAP and needs to be lowered before it can be flooded: The spring high water level reaches over +3 m NAP. As a cost reduction measure, a ground level varying from approximately +1 m NAP at the current Western Scheldt dike to +3 m NAP at the new dike is foreseen. A ground level of +1 m NAP is similar to the ground level of the nearby Hertogin Hedwige polder. A ground level of +3 m NAP is flooded at spring tide only. Further optimisation is recommended in the design phase.

As the current intertidal area outside the dikes is characterised as low dynamic, the flooded Appelzak location is expected to develop into a low-dynamic intertidal area as well. Pioneer vegetation would be expected to establish itself alongside the dike, followed by salt marsh vegetation. In time, this could lead to the development of a broad transition zone extending from the channel to the salt marsh.

### Risks

The flooding of the Appelzak location will slightly reduce the water level upstream (<1 cm). As long as dikes are built that comply with the relevant safety standards, there is no increased safety risk for the area behind the dikes. The increased cross section will slightly reduce current velocities, but no substantial effect is expected to be noticeable. Therefore, no impact on shipping is expected.



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As long as no pioneer and/or salt marsh vegetation has established itself, it is possible that erosion occurs and sediment is transported to the secondary channel. Current velocities are sufficiently high so that silting up of the secondary channel(s) is unlikely and the multi-channel system is not at risk.

It is not known whether the sediment in the Appelzak location inside the dikes is contaminated. Possibly the material is suitable for reuse elsewhere, e.g. sand mining.

### Cost estimate

Appelzak inside the dikes			65 ha	
			costs (M€)	
Dike removal (km)	1	M€/km	2 km	2
Dike construction (km)	3.75	M€/km	3.2 km	12
Earthworks (m3)	6	€/m3	2.600.000 m <sup>3</sup>	15.6
<b>Subtotal</b>				<b>29.6</b>
Inclusive increment	+101%			59.5
Inclusive VAT	+19%			70.8
Land acquisition	0.1	M€/ha	65 ha	6.5
<b>Totaal</b> (rounded to nearest multiple of 5)				<b>75</b>

### *Welzinge polder and part of the southern Schorer polder*

EL&I proposes to flood the Welzinge polder and to use only that part of the Schorer polders that is required for access to the Welzinge polder. An indicative area is shown in the map below. The surface area of the Welzinge polder and the southern part of the southern Schorer polder is 125 ha (instead of 151 ha in the Deltares report where the Schorer polder south and north were flooded).

Opportunities and risks are the same as in the Deltares report (refer to paragraph 4.5.3).



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## Cost estimate

Welzinge and southern Schorer polders			125 ha	
			costs (M€)	
Dike removal (km)	1	M€/km	0.6 km	0.6
Dike construction (km)	3.75	M€/km	4.8 km	18
Earthworks (m3)	6	€/m3	300.000 m <sup>3</sup>	1.8
<b>Subtotal</b>				<b>20.4</b>
Inclusive increment	+101%			41.0
Inclusive VAT	+19%			48.8
Land acquisition	0.1	M€/ha	125 ha	12.5
<b>Totaal (rounded to nearest multiple of 5)</b>				<b>60</b>

### Small Hertogin Hedwige polder

#### Previous studies

The evaluation in this letter focused on the *Rijksinpassingsplan* and the Environmental Impact Assessment (EIA – 'Milieueffectrapportage (MER)' in Dutch). These documents describe in most available detail the specific measures and anticipated (ecological) results for a removal of the complete and joint Hertogin Hedwige and Prosper polders. Hence, these documents provide the best available information to describe the measures and anticipated (ecological) results for the 'small Hedwige' alternative as well.

A greater number of studies is available that describe the overall nature restoration goals (e.g. *Langetermijnvisie*, *Ontwikkelingsschets 2010*) and the selection and contribution of the Hertogin Hedwige polder as a suitable location to achieve these goals. As far as relevant for the development of the Hertogin Hedwige polder, these studies are summarised in the



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Rijksinpassingplan and the EIA. Therefore, none of these studies is included separately in the evaluation in this letter.

## Description of opportunities and risks for the 'small Hedwige' location

The Hertogin Hedwige polder is located directly west of the Netherlands-Belgian border and is about 3 km south of the identified Appelzak location inside the dike. The current land use of the Hertogin Hedwige polder is agriculture. There are a number of (farm) houses and buildings.

A 100 ha part of the polder extends about 900 m inland from the Western Scheldt. The narrowest width is about 900 m along the Western Scheldt and the widest about 1,250 m on the inland boundary. The contour follows the current Delta dikes on the Western Scheldt to the north-east and Saeftinghe to the North-west and follows the inland secondary dike on the south-east that is on Belgian territory. A curved dike trajectory should be considered as part of the (landscape) design and the optimisation of morphological-ecological processes (in particular in combination with the partial removal of the Gasdam described later)

In line with the plan area for the combined Hedwige and Prosper polder development, a larger plan area for the combined small Hedwige and Prosper polder development has to be considered. In addition to the small Hedwige, the plan area includes the northern part of the Sieperda salt marsh, the salt marshes along to the Western Scheldt and the Prosper polder and its dikes. The salt marshes along the Western Scheldt will be affected, as the dikes will be removed, lowered or breached (depending on the implementation variant) and thus water flows will change. The salt marshes will be partly removed to allow the tide to inundate the area.



*Tentative plan area for small Hedwige (dark blue line) polder and Prosper polder – a curved trajectory for the SW dike (dotted line) should be considered during the design*



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## Opportunities

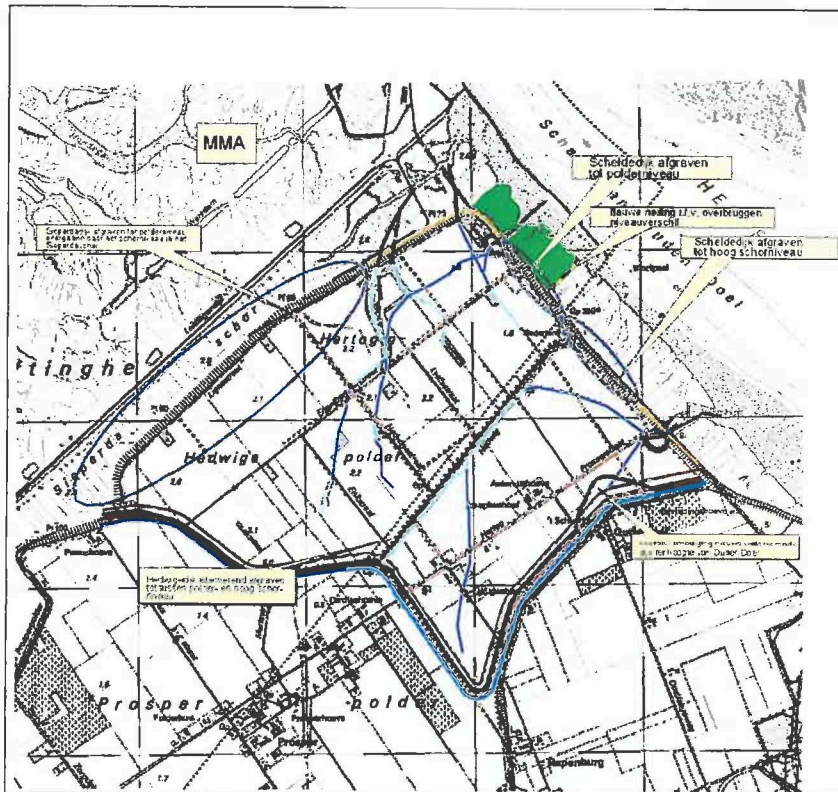
Based on all research carried out on the Hertogin Hedwige polder, it can be concluded without doubt that every hectare of the Hertogin Hedwige polder that is converted to estuarine nature, contributes 100% to the task of nature restoration in the Western Scheldt. A part of 100 ha that is connected to the Sieperda salt marsh in the north-west and to the Prosper polder in the south-east will thus be part of a greater added ecological value.

The physical-morphological conditions and the ecological developments in the 100 ha area will be similar to those foreseen in the removal of the complete Hertogin Hedwige polder. A mix of estuarine habitats from gullies to intertidal areas and salt marshes will develop. As compared to the complete polder, the small Hedwige will probably have relatively more gullies and shallow water and relatively less pioneer vegetation and salt marsh. Development over time will change the distribution. The area will form a continuum with the Saeftinghe and Sieperda salt marshes to the north-west and the Prosper polder to the south-east.

With reference to the alternatives considered in the EIA – from which the Most Environmentally Friendly Alternative (*Meest Milieuvriendelijke Alternatief* (MMA) in Dutch) is shown in the cartographic impression below – the following major activities can be distinguished:

- Lowering, removal or breaching of dikes
- Creation of a passage (gully) through the Scheldt salt marsh
- Creation of initial gully and creek system in the small Hedwige area
- Removal of all hard structures, roads and standing vegetation (e.g. trees)
- Damping of water ways

The activities need to be detailed in a revision of the EIA/*Rijksinpassingsplan*. For example, it must be decided to what extent and to what level the dikes need to be lowered or removed. As the tidal volume of the small Hedwige is smaller than the complete Hertogin Hedwigepolder, it is anticipated that a smaller area of the Scheldt salt marsh needs to be removed, so that the loss of salt marsh is slightly less.



MER voor de inrichting van het intergetijdengebied in de Hedwig- en Prosperpolder

Cartografische voorstelling Meest Milieuvriendelijk Alternatief

Verklaring

- Bouw nieuwe waterkerende dijk
- Graven langsgracht
- Maken van bressen: afgraving Scheldedijk tot op polderniveau te dempen delen huidige draaggestel
- Graven getuianzelen tot gemiddeld laagwaterniveau
- Kreekaanzetten behoud
- graven
- Bouw nieuw pompstation
- Afgraven schor tot polderniveau
- Fauwe helling 1:1 v overstuggen niveauverschil

Opmerking: binnen het projectgebied worden alle opgaande gebouwen, constructies en vegetatie verwijderd

Bronnen  
topografische kaarten 1/100.000 NGI  
datum 1:22000  
datum april 2007  
doosnr. 124215008 spr



Impression of the Most Environmentally Friendly Alternative (MMA) for the Hedwig and Prosper polder

The estuarine nature will consist of gullies and creeks, shallow water, intertidal areas, pioneer vegetation and salt marsh. The (relative) distribution of these habitats will depend on the initial elevation and will change over time due to the morphological and ecological development itself. Inundation will transport sediment into the area that will in time settle and raise the elevation. A natural pattern of habitats will develop over time. As indicated in the EIA, it is expected that the pattern will have been established within 10 years after first inundation. Subsequently, ongoing silt sedimentation will eventually lead to a high ground level salt marsh similar to the Sieperda and Saeftinghe salt marshes. This could take up to 50 years.

Consistent with the EIA and the *Rijksinpassingsplan*, but also for example with the Committee Nijpels report, the habitat that can be expected in the small Hedwig is qualitatively defined as intertidal areas, pioneer vegetation and salt marshes. No further quantitative distinction is made, as the distribution will be the result of natural processes. The EIA states for example that 'it is not possible to predict in detail the period within which the intertidal ecology and salt marsh vegetation will be developed'.

### Risks

The EIA concludes for the complete Hertogin Hedwig polder that 'as current velocity and current direction in the shipping channel do not change significantly', there is no impact on shipping. The same conclusion can thus be drawn for the small Hedwig polder that with a smaller area will have a smaller effect.





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Removal of the small Hedwige polder will lead to a small decrease in the water levels upstream (1-2 cm). As long as dikes are built that comply with the relevant safety standards, there is no increased safety risk for the area behind the dikes.

The new Delta dike that will have to be built across the polder, will not follow an existing dike body. Specific measures are possibly required to construct the new dike on the underground. A geotechnical survey will be required, if no data is available.

The EIA and the *Rijksinrichtingsplan* will have to be revised to take into account the smaller area of the Hertogin Hedwige polder that will be included in the development. It is anticipated that the majority of the work already carried out can be adapted with relatively minor effort.

### Cost estimate

Approximately 2 km dike needs to be removed and approximately 1.25 km dyke at Delta height needs to be constructed. Additionally about 0.8 km of dike at Delta height needs to be constructed between the Hertogin Hedwige polder and the Prosper polder. In addition, earthworks and land acquisition is required.

The removal of about 1 km of secondary dike between the Hertogin Hedwige polder and the Prosper polder is not included in the cost estimate, as it is assumed to be part of the Prosper polder works.

Small Hedwige polder			100 ha	
			costs (M€)	
Dike removal (km)	1	M€/km	2 km	2
Dike construction (km)	3.75	M€/km	2.1 km	7.9
Earthworks (m <sup>3</sup> )	6	€/m <sup>3</sup>	750.000 m <sup>3</sup>	4.5
<b>Subtotal</b>				<b>14.4</b>
Inclusive increment	+101%			28.9
Inclusive VAT	+19%			34.4
Land acquisition	.1	M€/ha	100 ha	10
<b>Totaal</b> (rounded to nearest multiple of 5)				<b>45</b>

### Partial Removal of the Gasdam

#### Description, opportunities and risks

The Gasdam separates the Saeftinghe and Sieperda marshes. The 3.4 km long and 70 m wide dam (24 ha) ends in a triangular area bordering the Western Scheldt. This roughly 0.5 km by 0.5 km area (25 ha) contains a chalet from the Zeeuws Landschap. The elevation of the Gasdam and the triangular area varies between +6 m NAP and +7 m NAP. The Gasdam protects a number of pipelines transporting gas, refinery products and water.

Removing the Gasdam completely or making the Gasdam permeable has been considered in earlier studies, among other the study by the Maljers Commission and the subsequent referral by the Nijpels Commission. The Maljers study estimate that the complete removal will realise 24 ha of estuarine nature and indicates that the triangular area remains intact (i.e. the passage under the Western Scheldt is kept intact).



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The Maljers report describes opportunities and risks for the removal or permeability of the Gasdam. The information is considered still valid and is not repeated in this letter (refer to pages 31-33 of the Maljers report, in Dutch).

A partial removal of the Gasdam has not been considered before. A partial removal implies that the pipelines need to be buried over a length of about 500 m. Where the complete removal considers the translocation of the trajectory through the Hertogin Hedwige polder and then reconnection at the Western Scheldt passage, translocation is not possible for partial removal. Thus, heavy construction activities need to be carried out in the Western Scheldt & Saeftinghe Natura2000 area and are likely imply a temporary but severe disturbance.



Partial removal of the Gasdam will contribute to nature restoration in two ways. At the location of the Gasdam, estuarine nature will develop. Also, the removal will create a direct connection between the Saeftinghe and Sieperda marshes and further to the small Hedwige and Prosper. A connection that is now absent. Water, sediment and flora (e.g. seeds) and fauna can be transported or migrate through the opening.

#### Costs

The Maljers report estimate costs at 60 million Euro for translocation of the trajectory to the Hertogin Hedwige polder in case the polder is flooded, and 45 million Euro in case the polder is not flooded. The Nijpels Commission adds +30% unforeseen costs and comes at 80 million Euro. The construction of culverts is estimated at 'several million Euro each'. Neither studies include VAT and inflation correction should be applied from 2006 (Maljers) or 2008 (Nijpels).

A cost estimate for the partial removal of the Gasdam cannot be given without further study and design.



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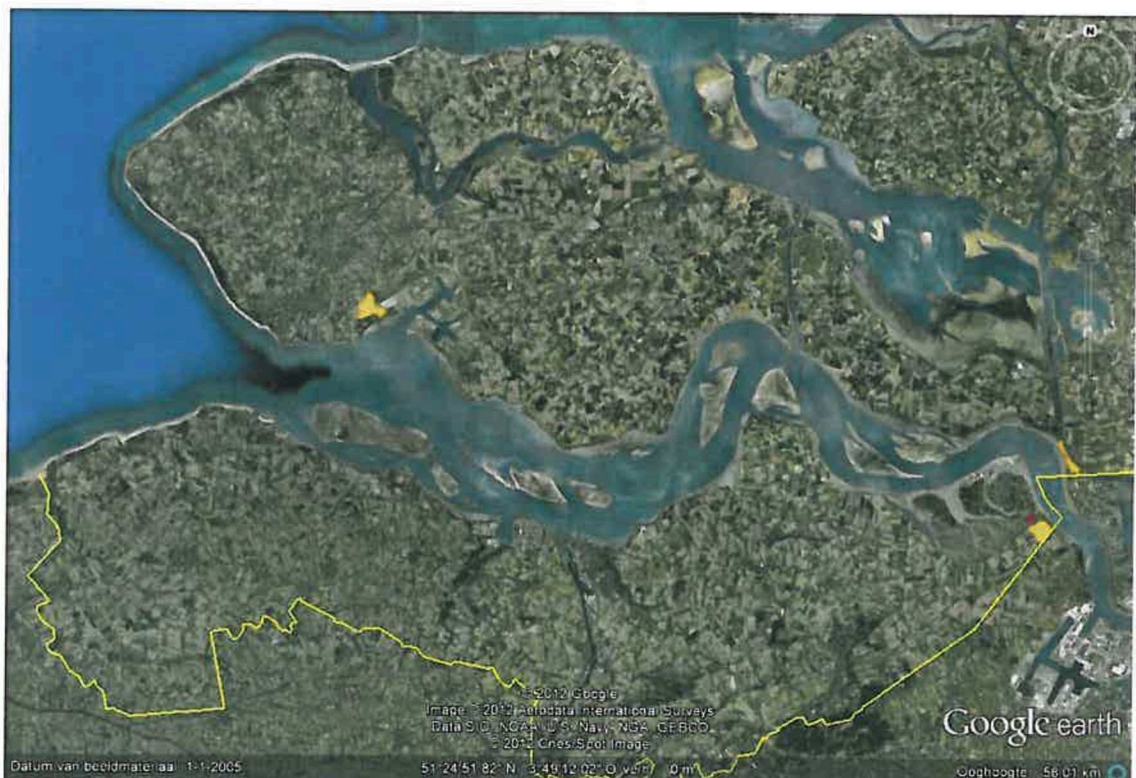
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## Net contribution to the task of nature restoration

All locations inside the dikes are a process focused measure. Process focused measures create space for hydro-morphological processes so that ecotopes can develop naturally and contribute to large-scale process restoration (depending upon extend and location of surface expansion). Locations inside the dike where the full tide has access (i.e. no limited or controlled tide), contribute 100% to the task of nature restoration. This statement has been underlying all previous research and studies and is subject to scientific unanimity.

Partial removal of the Gasdam occurs outside the dikes. The removal itself will convert a hard structure with no estuarine ecological value to estuarine nature, ranging from a connecting gully to salt marshes (and developing over time). Hence, the removed area contributes 100% to the nature restoration objective. The resulting connectivity cannot be expressed in hectares, but can be considered as a local processed focussed measure (i.e. creating space for processes). Note that the Gasdam may provide habitat for species that are not necessarily estuarine, but may fall under the Habitat or Bird Directive anyway.

## Integrated assessment of the combination alternative for the task of nature restoration





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EL&I has requested to Deltares to evaluate the following combination alternative of locations inside the dike and outside the dike:

Measures	Net contribution to nature restoration (ha)	Cost estimate (M€) Margin $\pm$ 20%
Appelzak location inside the dikes	65	75
Welzinge and southern Schorer polder	125	60
Small Hedwige polder	100	45
Partial removal of Gasdam	5	pm
<i>Combination alternative</i>	295	180 + pm

Following Table 6.4 in the Deltares report, the combination alternative can be summarised as below. The combination alternative is not compared to other (combination) alternatives.

Alternative	Morphological-ecological contribution <sup>a)</sup> to the task of nature restoration (ha)	Contribution complies with legal criteria <sup>b)</sup> (Natura 2000)	Cost estimate for implementation <sup>c)</sup> Total and per hectare margin $\pm$ 20%	Cost estimate for management activities (M€/year) margin $\pm$ 50%	Effect on safety <sup>d)</sup>	Effect on navigational access <sup>e)</sup>	Contribution to process restoration	In Western Scheldt?	Polder removal?	Effect on econom. functions? <sup>f)</sup>
<i>Combination of measures outside and inside the dikes in the Western Scheldt</i>										
Appelzak location inside the dikes (flooding) Welzinge and Schorer polders (flooding) + Small Hedwige polder (flooding) + Gasdam (partial removal)	295	+	180 M€ + pm (0.6 M€/ha + pm)	5	+	0	+	Y	Y	Y

- The net morphological-ecological contribution to the task of nature restoration is determined with the help of a weighting factor for locations outside the dikes. A risk factor is also applied to locations outside the dikes that are considered complex and surrounded by extra uncertainties. A green colour indicates that the requirement of 295 hectares is complied with.
- If the morphological-ecological contribution is insufficient (i.e. less than 295 hectares), then the Natura 2000 criteria (article 6 section 2) are not complied with. The assumption here is that a combination of measures inside and outside the dikes is possible that will satisfy the requirements of the nature restoration task.
- Cost estimates are based on assumptions regarding transport of soil/sediment, construction and/or removal of dikes, infrastructural works, land purchase and several other items. Costs are inclusive of VAT and an extra percentage for factors such as unforeseen costs.
- The effect on safety corresponds to a limited reduction in the high water level. No calculations were carried out in this regard; the score is also a relative measure in comparison to each other.
- The effect on navigational access is not useful for differentiating between alternatives, as a point of departure with regard to the working out and implementation of the alternatives is that there would be no negative effect on the shipping sector.
- Does extra attention have to be paid to the alternative in terms of implementation because certain economic functions are affected?

### Concluding remarks

Process focussed measures (inside the dikes) that give room for hydrodynamic and morphological processes, are preferred above habitat focused measures (outside the dikes), as the former will provide a more structural and sustainable contribution to nature restoration in the Western Scheldt. The proposed combination alternative contains 290 ha process focussed



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measures through flooding inside the dikes at three locations. The partial removal of the Gasdam is outside the dikes, but is considered as local process focussed measure as a manmade structure is partly removed.

Measures in the Western Scheldt always need to be placed into perspective of the dynamic and ever continuing (autonomous) development of the estuary. We wish therefore to repeat one recommendation from our 2011 report. Deltares recommends the preparation of a Development Sketch for 2020. With the implementation of the measures (for 600 hectares) for nature restoration, the Development Sketch 2010 will be completed as far as the natural environment is concerned. However, the Long-Term Vision document sets out a target for 2030. The issues related to climate change, as addressed by the Delta Programme, are of a more recent date and were therefore not included in this document. In addition, within the framework of Natura 2000, a first re-evaluation is expected to take place in 2012 of the degree to which the Western Scheldt & Saefinghe area has been successfully maintained. The Development Sketch 2020 provides an opportunity to integrate the new questions that have arisen in relation to climate change and possibly also new questions in relation to the natural environment that resulted from the Natura 2000 re-evaluation within an overall perspective including safety and navigational access.

#### Quality assurance

Versie	Datum	Auteur	Initialen	Review	Initialen	Goedkeuring	Initialen
def.	13-4-2012	drs. A.J. Nolte	AN	prof. dr. ir. H.Y. Vriend		ir. T. Schilperoord	

Yours sincerely,

drs. A.J. Nolte  
Project manager Alternatives Nature Restoration Western Scheldt

#### References

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