3. CONCEPTUAL CHOICES

Flood areas are sophisticated, strategically chosen places. After all, not every point along a river is suitable to be organised as a flood area. The location of the flood area must ensure that the area makes an efficient contribution towards safety. The impact on agriculture, local residents and the economy must also be kept to a minimum. The Flemish Government established the contours of the Sigma areas in 2005 and 2006 in the Most Desirable Alternative.

This chapter outlines the contours of the Most Desirable Alternative for the Kalkense Meersen Cluster and the various sub-projects. It then explains how this Sigma project contributes towards the safety and nature objectives. Finally, it looks in greater detail at how the project satisfies the concerns of users of the areas in question and interprets the land use plan and the GRUP for this Sigma project.

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3.1 Most Desirable Alternative for the Kalkense Meersen Cluster

3.1.1 Situation of the Kalkense Meersen Cluster and the various sub-projects

Chapter 1 describes how the Most Desirable Alternative came into being. The Kalkense Meersen Cluster is part of that, and belongs to the group of projects for which implementation must have begun by 2010 at the latest. The Kalkense Meersen Cluster and the sub-projects in this cluster contribute significantly towards the safety and nature objectives of the Most Desirable Alternative.

The purpose of the safety functions is to keep the risk of flooding in the Scheldt basin to a minimum. Dyke heights are being increased along the entire length of the Scheldt. In addition, there are various types of construction – some of them temporary – to help buffer high water levels. The area around Wijmeers, Bergenmeersen and Paardeweide is one of the most strategic points for absorbing extreme high waters in a controlled fashion within the Sea Scheldt basin. Populated areas behind the dykes are thus better protected against flooding.

Wijmeers 1, Bergenmeersen and Paardeweide will function as flood control areas (FCAs), absorbing water from the Scheldt via overflow dykes in the event of a storm tide. Ring dykes at Sigma height protect the hinterland behind the incoming water. When the tide ebbs, the water will flow back into the Scheldt. Table 3.1 provides an overview of the different subsectors of the Kalkense Meersen Cluster.

The other subsectors, Kalkense Meersen and Paardebroek, will function as wetland. Wetlands are wet areas of significant natural value. They can be wet grasslands, marshy areas or wet forests. Safety is not the primary function of wetlands. They do not accommodate water from the Scheldt. The drainage of upstream areas is, however, an important safety aspect. A higher groundwater level is needed for the development of wet nature.

Wijmeers 2 is being de-poldered, as a result of which the area will again come under the influence of the Scheldt's tides. This means the area will be watered on a daily basis.

The operating principles of the various subsectors are illustrated in Figure 3.1.

Kalkense Meersen: wetland

The aim in the Kalkense Meersen subsector is to raise the groundwater level by raising groundwater tables in reservoir basins. Because the subsector is already a natural basin and the adjoining zones are higher, damming up in the area has no effect outside the subsector. The level of the Kalkense Vaart, which is responsible for draining a

Table 3.1. Overview of the different subsectors of the Kalkense Meersen Cluster

Subsector	Area	Use
Bergenmeersen	41.37 ha	FCA-CRT
Kalkense Meersen	606.16 ha	Wetland
Paardebroek	27.77 ha	Wetland
Paardeweide	84.73 ha	FCA-wetland
Wijmeers part 1	158.75 ha	FCA-wetland
Wijmeers part 2	27.85 ha	Removal of polders
Total	946.63 ha	

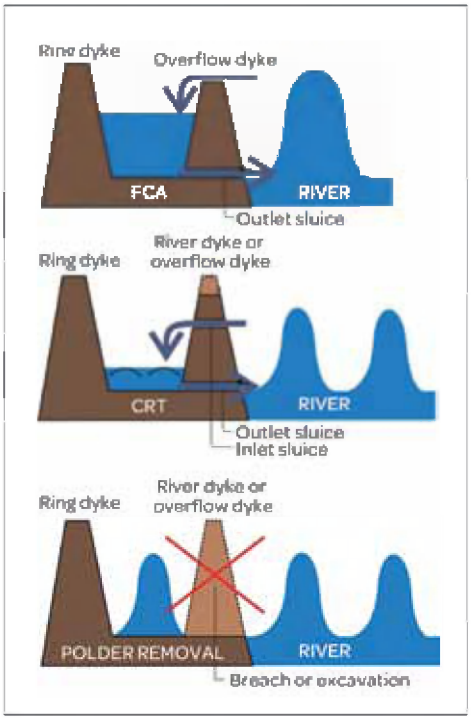

Figure 3.1. The operating principles of an FCA, FCA-CRT and the removal of polders

significant area of hinterland, is being cut off from the reservoir basins. Adjustable weirs are being installed in the side basins and channels that open into the Kalkense Vaart. The drainage of the Kalkense Vaart itself is controlled by the pumping station.
The purpose of this project is to raise and strengthen the dykes to +8 m TAW (Tweede Algemene Waterpassing - Second General Levelling) instead of the current +7 to 7.5 m TAW. The raised Sigma dyke will form part of the reference situation.

Wijmeers 1: FCA-type wetland
For Wijmeers 1, the ring dyke already constructed around the de-poldered Wijmeers 2 area will partly be converted into an overflow dyke. To do this, the dyke will be lowered from +8 m to +6.8 m TAW and reprofiled (overflow dykes have a shallower profile). Outflow constructions will be built in the existing Scheldt dyke to the Scheldt, but there will be no direct outflow constructions to the de-poldered area. A new ring dyke will be constructed around Wijmeers 1 at Sigma height (+8 m TAW). The ring channel is being built to ensure the drainage of Wijmeers 1 for development as an FCA. This ring channel will be shoaled or partially filled to create the rewetting that is required for the desired nature development in Wijmeers 1. A compartmentalising dyke will be constructed in the Wijmeers 1 area at +5.5 m TAW between the eastern and western sections.

Bergenmeersen: FCA-CRT
The existing Bergenmeersen FCA is being converted into an FCA-CRT. The area will flood daily in a controlled manner at high tide. A limited amount of water will be let into the area at each high tide via a new inlet construction in the dyke. At low tide, the water flows back into the Scheldt via the low outlet pipes. This creates a CRT in the polder. When water levels in the Scheldt are normal, the inflow of water is extremely limited. This is the only way the desired mix of mud flat and marsh can be created.
The existing ring dyke (+7.6 to 7.8 m TAW) is being raised to Sigma height (+8 m TAW). The height of the existing overflow dyke (+6.4 to 6.5 m TAW) will be retained. The area will continue to serve as an FCA in extreme storm tides.

Paardeweide: FCA-type wetland
The existing function of Paardeweide as an FCA will be retained, but will be adapted to the stricter safety standards. To this end, the existing ring dyke will be raised to +8 m TAW. No changes will be made to the existing overflow dyke along the Scheldt. The FCA becomes operational if the level of the Scheldt exceeds +6.3 to 6.5 m TAW. Calculations by Flanders Hydraulics Research show that statistically, this flood area will be operational once a year.

Paardebroek: wetland
The objective in the subsector of Paardebroek is rewetting. This is possible due to the existing relief and without waterlogging the areas upstream, just as in the Kalkense Meersen.

Wijmeers 2: polder removal
This polder removal is being implemented as the first sub-project, as a result of which there are two different implementation situations: the situation as a de-poldering area

without an adjacent FCA, and the situation with an adjacent FCA.

In a first phase, the existing Scheldt dyke will be locally breached, allowing the Scheldt water to flow freely into the area at high tide. A new ring dyke at Sigma height (+8 m TAW) will prevent the water from continuing into the area behind. Drainage of the dyked areas is being ensured by the construction of a ring channel. This will partly follow the current course of the Sompelbeek and the Oeverbeek, with a new section of ring dyke being constructed in between. This brook will drain into the Scheldt at the Bellebeek outlet sluice. The adjacent ring channel will be modified so that the nature objectives can be achieved.

3.1.2 Contribution of the Kalkense Meersen Cluster to the safety objectives

The following paragraphs outline the frequency of flooding for each subsector. The effect on the rise in the water level if the flood areas are not created is described for several recurrence intervals (T10, T100, T1000, T2500 and T4000 (situation in 2000)), without taking into account the possible formation of breaches. In each case, the planned interventions within a clus-

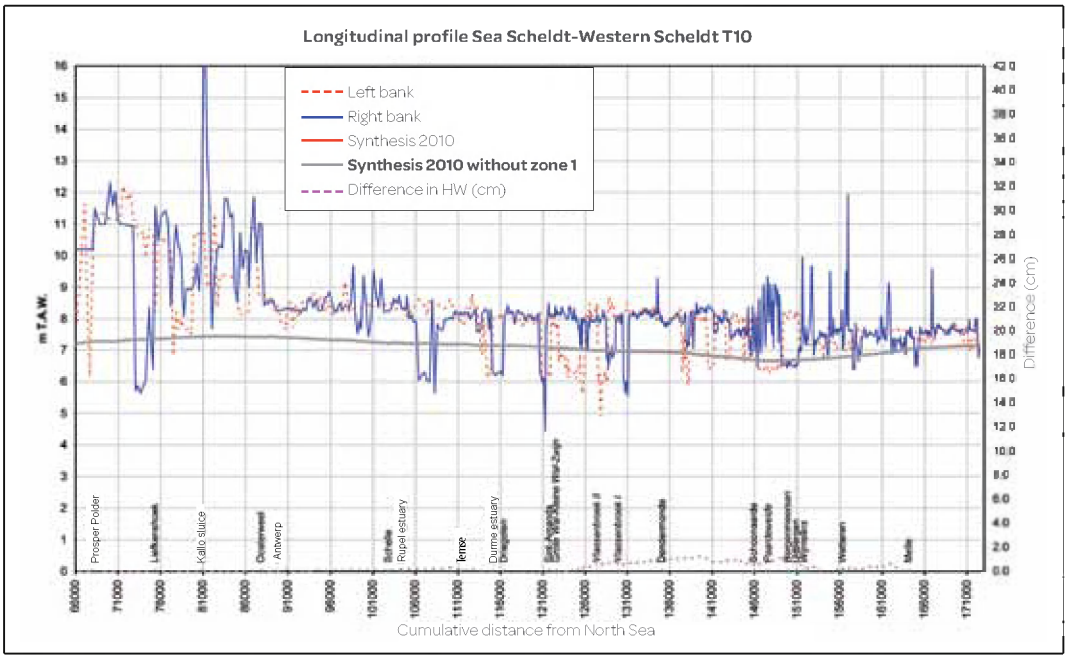

Figure 3.2. Longitudinal profile of the Sea Scheldt, maximum water levels during a storm with a recurrence interval of 10 years

ter were rectified in the synthesis model. All calculations were performed without taking into account the function as an FCA-CRT.

Frequency of flooding

The flood control areas of Bergenmeersen and Paardeweide will come into operation during a storm with a recurrence interval of one and two years respectively. Only the eastern section of Wijmeers 1 will be filled via the overflow dyke for storms with recurrence intervals longer than 25 years. The western section of the Heisbroek FCA, Wijmeers 1, will be fully protected from flooding up to a recurrence interval of 100 years (T100). At T100, only the compartmentalising dyke between the eastern and western sections will overflow. At T500, both the compartmentalising dyke and the actual overflow dyke of that section of Wijmeers 1 will overflow.

Increase in the water level if the Wijmeers FCA is not put in place

Figures 3.2 to 3.7 show the longitudinal profile of the Sea Scheldt with the maximum water levels for different recurrence intervals.

- Because the Wijmeers 1 FCA and the Heisbroek FCA only flood in storms with a recurrence interval longer than 25 years, the disconnection of the Wijmeers flood zone

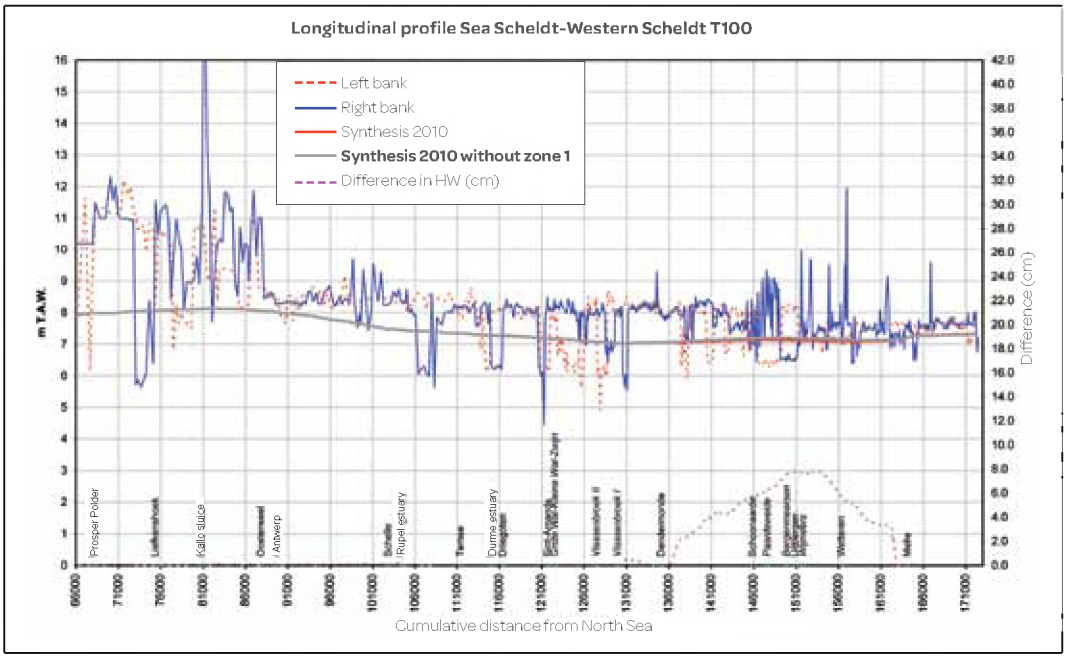

Figure 3.3. Longitudinal profile of the Sea Scheldt, maximum water levels during a storm with a recurrence interval of 100 years

(through the de-poldering of Wijmeers 2) only has a limited impact on the water level in the Sea Scheldt at **T10**.

- However, if the Kalkense Meersen Cluster is disconnected, the water level in the Scheldt will rise at **T100**. The maximum water level in the Scheldt will rise by approximately 8 cm at Wijmeers and Bergenmeersen, and by approximately 6 cm at Paardeweide. The rise in the maximum water level in the Scheldt will only continue to a limited degree, upstream to Melle, downstream to just before Vlassenbroek I. At Vlassenbroek, the (expected) increase will be completely absorbed by the extra filling of the FCAs. The Vlassenbroek I FCA in particular will then receive more water (lowest overflow height).
- In storms with longer recurrence intervals, this rise will increase further, as will its range. Upstream, the rise will always continue as far as the edge of the model area. Downstream, it will continue to just past Vlassenbroek at **T500**, where it will always continue further for longer recurrence intervals, as far as the mouth of the Rupel at **T4000**. At Vlassenbroek, the increase is partially absorbed by the extra filling of the FCAs.
- At **T500**, the maximum water level in the Scheldt will rise by approximately

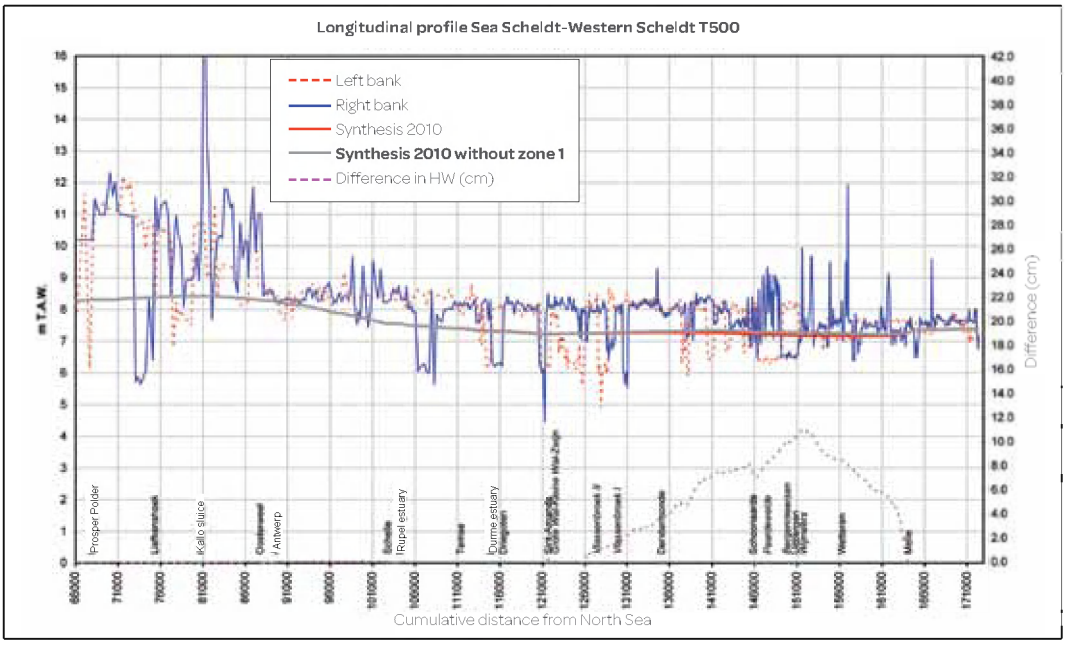

Figure 3.4. Longitudinal profile of the Sea Scheldt, maximum water levels during a storm with a recurrence interval of 500 years

10 cm at Heisbroek, Wijmeers and Bergenmeersen, and by approximately 8 cm at Paardeweide.

- At **T1000**, the maximum water level in the Scheldt will rise by approximately 11 cm at Wijmeers and Heisbroek, and by approximately 9 cm at Bergenmeersen and Paardeweide.
- At **T2500**, the disconnection of the Kalkense Meersen Cluster will cause a rise in the maximum water level in the Scheldt of approximately 32 cm at Heisbroek, Wijmeers and Bergenmeersen, and of approximately 27 cm at Paardeweide. In a storm with a recurrence interval of 2500 years, the water level will remain below +7.5 m TAW if the Wijmeers flood zone is put in place. But if the Wijmeers flood zone is not established, the maximum water level at T2500 will be higher than +7.5 m TAW, where +7.5 m TAW is the design water level to be held back in the area around Wijmeers.
- At **T4000**, the maximum water level in the Scheldt will rise by approximately 27 cm at Heisbroek and Wijmeers, by approximately 33 cm at Bergenmeersen and by approximately 35 cm at Paardeweide.

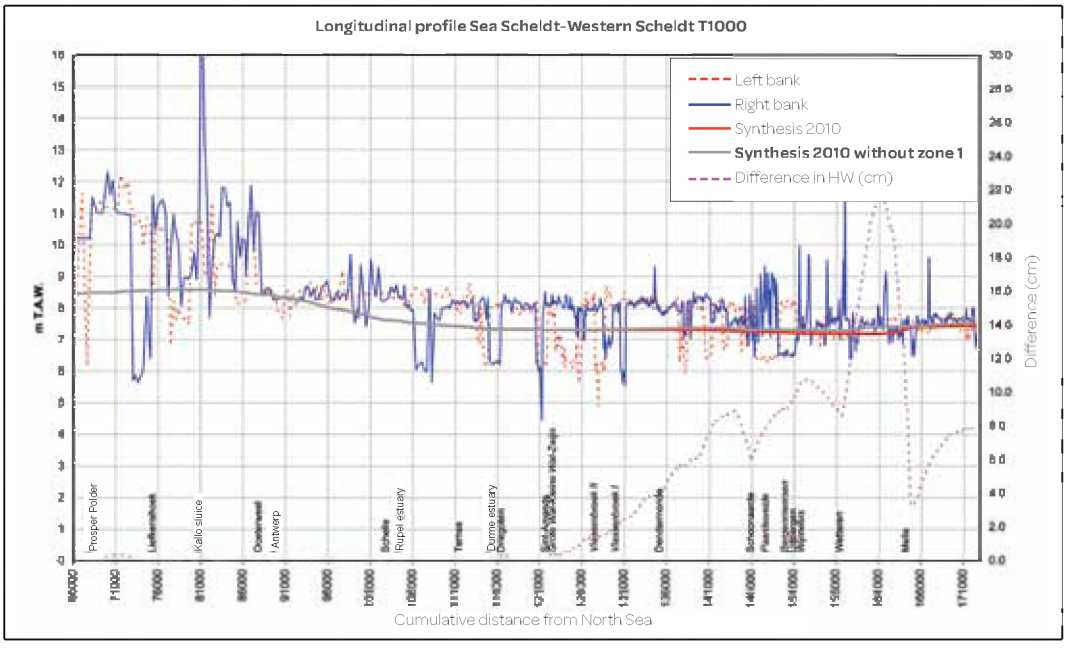

Figure 3.5. Longitudinal profile of the Sea Scheldt, maximum water levels during a storm with a recurrence interval of 1000 years

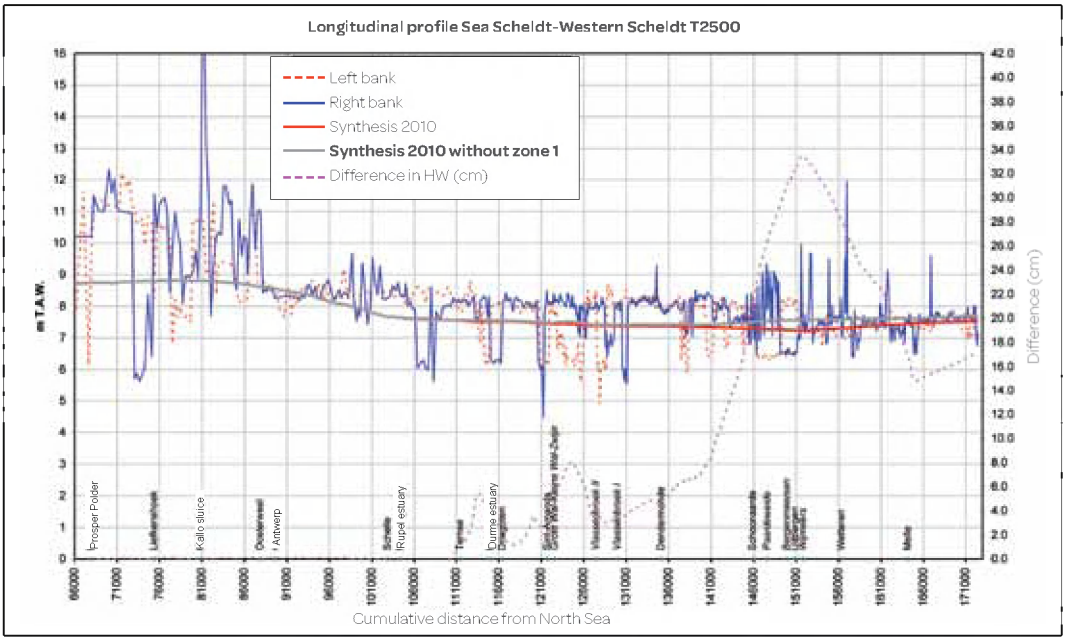

Figure 3.6. Longitudinal profile of the Sea Scheldt, maximum water levels during a storm with a recurrence interval of 2500 years

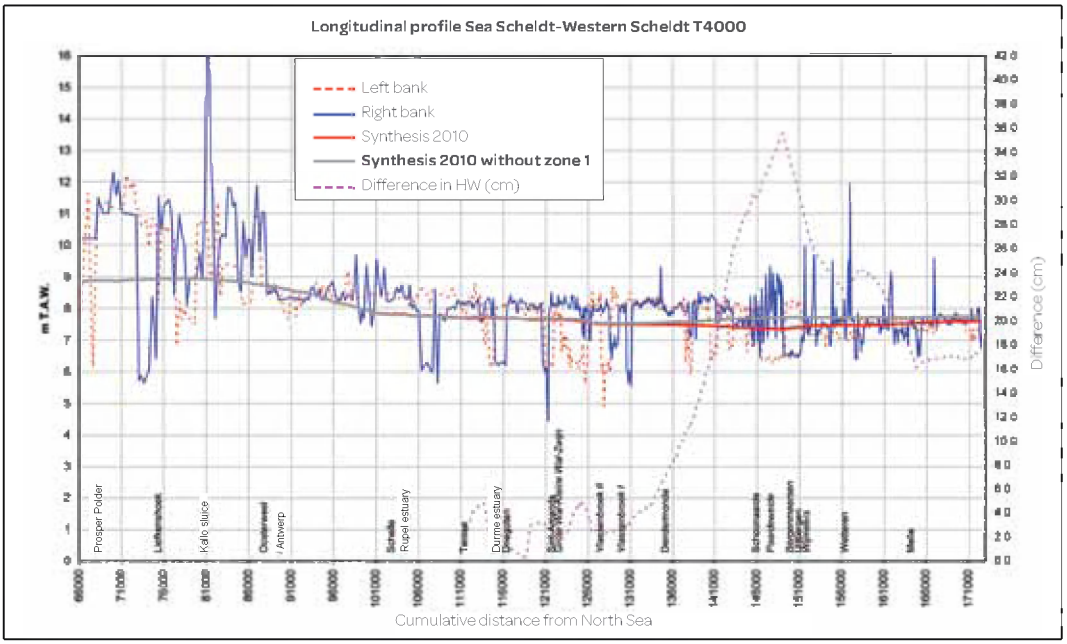

Figure 3.7. Longitudinal profile of the Sea Scheldt, maximum water levels during a storm with a recurrence interval of 4000 years

3.1.3 Contribution of the Kalkense Meersen Cluster to the nature objectives

The Sigma Plan approaches the Scheldt Valley in all its aspects. The aim is to restore as much of the river as possible in the most sustainable way possible. This will be achieved by restoring the contact between the river and the valley, creating wetlands and, where possible, once again increasing the intertidal zone and the opportunities for estuarine nature.

For the "natural quality" aspect, integrated European nature objectives (conservation objectives) were established for ecosystem functions, habitats and species. Thus, all legal requirements (the Habitats and Birds Directive and the Water Framework Directive) are satisfied without conflicting with each other. In general terms, these objectives encompass developing wetland types and estuarine nature within the Kalkense Meersen Cluster.

Estuarine nature: Bergenmeersen and Wijmeers 2

The Flemish Government has selected a number of areas that are favourably situated to once again be brought under the influence of the tidal pattern of the river. This is achieved by reducing the action of tides or by removing polders. By establishing the right preconditions in these areas for optimal ecological development, as dynamic a system as possible is sought, with nature itself as the main controlling factor. After all, tidal action is the driving force behind the development of an ecosystem with mud flats and marshes. A pattern of creeks will develop along which the water will flow in and out. In the lowest-lying zones, which flood daily, mud flats will be created. In the higher zones, which flood less often, marshes will develop in which unique vegetation will quickly spring up. This new landscape is known as "estuarine nature" (see also Chapter 4).

Bergenmeersen

The Bergenmeersen subsector has been organised as an FCA. Thanks to a sophisticated inlet and outlet system, the area is brought under the influence of a controlled reduced tide (CRT). The influence of the tidal dynamic creates mud flats and marshes. In particular, it is the imitation of the spring neap tide variation that makes a difference in mud flat and marsh habitats and leads to a diverse, functional ecosystem (see Chapter 4). The estuarine nature that will develop here will contribute towards the conservation objectives for the Scheldt estuary defined within the context of the European Habitats and Birds Directive.

At the new low-lying inlet and outlet structures, a main creek onset has been dug at mean low water level (MLW level). The connecting drainage channels ensure that the area can drain sufficiently, for example in the event of the design storms.

Based on further studies, certain zones were excavated to provide a sufficient open water area.

Wijmeers 2

Wijmeers 2 is being de-poldered, which will bring it under the influence of the Scheldt's tidal pattern. Here, too, estuarine nature will develop that will contribute towards the

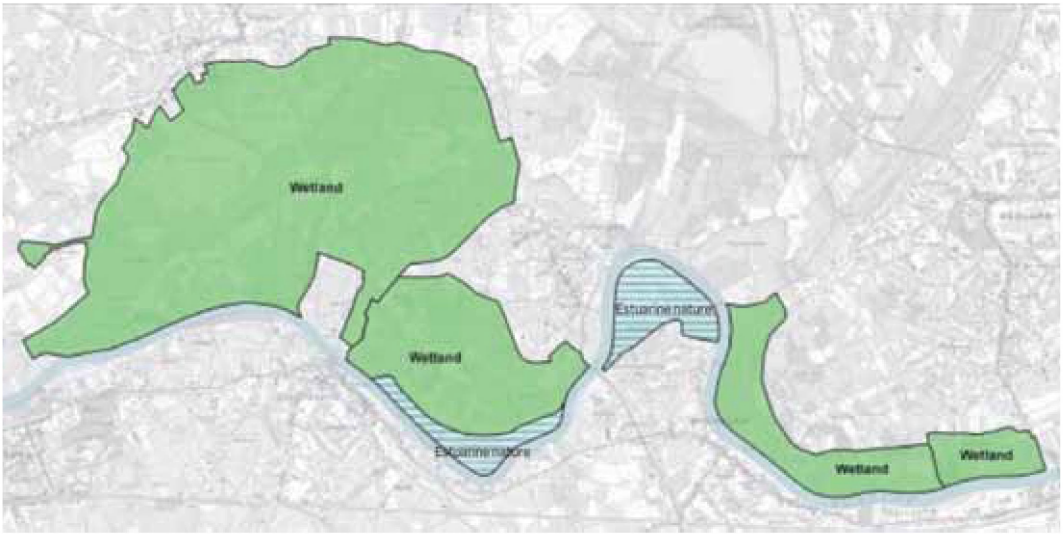

Figure 3.8. Nature objectives according to the Most Desirable Alternative for the Kalkense Meersen Cluster

European nature objectives for the Scheldt estuary.

Wetland: Kalkense Meersen, Wijmeers 1, Paardebroek and Paardeweide

The updated Sigma Plan aims to restore more space to the typical and water-rich river landscapes. The plan capitalises fully on ecological potentials by applying the most appropriate forms of management for the different types of wetland.

In the context of the Sigma Plan, "wetland" is a collective name for water-rich natural areas not influenced by the tide. Here, water levels follow a natural path, with higher levels in the winter than in the summer. Wetlands can form widely varying landscapes. For the Kalkense Meersen Cluster, this involves different types of grassland, open water, reed vegetation and wet woodland. The final type depends on the form of management applied.

By definition, wetlands are situated on lower-lying land in the valley. Some areas are naturally so low-lying that they are permanently wet (without artificial watering) and provide adequate opportunities for nature to develop. Surface water from the surrounding area is then drained to these zones via brooks and channels. Other zones were too heavily drained in the past to still be able to develop into ecologically valuable wetland. In these areas, weirs can be used to raise the groundwater level in relation to the surrounding area, where drainage remains guaranteed at all times.

Figure 3.9. Walkway in Bergenmeersen

Finally, the deep ponds of little natural value – mostly created by peat or soil excavations – can be filled in again, creating opportunities for marshes and hydrosere vegetation. By managing the areas in a natural way (grazing, mowing, zero management, etc.), rare plant and animal species will be attracted once again.

The rewetting is achieved by increasing the base level throughout the entire area as well as building weirs or digging channels and making the brooks shallower locally.

3.2 Reconciling divergent interests

Various points for attention were discussed during consultations with the project-based work group and the different thematic work groups. The following paragraphs describe how these points for attention were addressed when drawing up the land use plan for Bergenmeersen.

When drawing up the land use plan for Bergenmeersen, consideration was given to various concerns of the municipality of Wichelen (see also Chapter 2). Besides reorganising the existing FCA as an FCA-CRT by building a new inlet/outlet construction, the existing ring dyke was also brought up to Sigma height (+8 m TAW).

Figure 3.10. Land use plan for the Kalkense Meersen Cluster Sigma project

Figure 3.11. Detail of the land use plan for Bergenmeersen

Figure 3.12. Extract from the regional plan (a) and the "Kalkense Meersen Cluster" GRUP (b)

When designing the raised and broadened ring dyke, the current landwards-facing toe of the dyke was retained. The necessary raising and broadening were carried out along the river side of the FCA. In this way, the impact of this work on nearby homes in the district of Nederkouter could be limited: the distance between the ring dyke and the nearby homes has not changed.

The area was designed so that the higher parts of the flood area are on the edge of the built-up area of Nederkouter. In this way – as requested – sufficient distance was retained between the built-up area and those parts that regularly flood as a result of the reduced tidal action (see Section 2.6.1 and 2.6.2).

The ring dyke was made inaccessible to recreational users further to the request from the municipality of Wichelen. This prevented people from looking into and disturbing the homes in Nederkouter. However, walkers and cyclists can obviously use the existing overflow dyke to move along the Scheldt. A walkway was also constructed along which walkers can explore the area. The same walkway also allows visitors to admire the inlet sluices and the Scheldt water flowing in at high tide from close up.

3.3 Land use plan and spatial implementation plan

The land use plan for the Kalkense Meersen Cluster is the result of a great deal of research and consultation (see Figure 3.10).

Figure 3.13. "Kalkense Meersen Cluster" GRUP, finalised by the Flemish Government on 26 March 2010, shows the regional plan around the cluster.

The Bergenmeersen FCA-CRT is part of that land use plan. Figure 3.11 shows a detail of the flood area. The various dykes, the inlet/outlet construction and the source for the formation of streams are also shown.

As mentioned above, a regional spatial implementation plan (GRUP) was produced for the entire Kalkense Meersen Cluster. This GRUP changed the designated use of most of the plots to nature areas. For Bergenmeersen, this meant that its designation as a rural area of ecological interest, rural area, nature area and residential area was changed to nature area.

To mitigate the effects for the agricultural sector, the GRUP provides for a phased conversion to nature area (see also Section 2.4.3). For Bergenmeersen, the conversion to nature area began on 1 January 2012. Figure 3.12 shows an extract from the graphic plan of the original regional plan and the new designations according to the GRUP.

3.4 References

- ***Ecosysteemvisie Cluster Kalkense Meersen (zone 1). Studie t.b.v. aanleg overstromings-gebieden en natuurgebieden i.h.k.v. het Sigmaplan.*** *(Ecosystem vision for the Kalkense Meersen Cluster (zone 1). Study for the development of flood areas and nature areas as part of the Sigma Plan.) G. Van Ryckegem et al. (2008), INBO.R.2010.3 / www.inbo.be/files/bibliotheek/83/246583.pd*

Figure 3.14. People walking on the walkway