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National Programme Room for the River

Integrated Flood Alleviation Measures in The Netherlands



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National Programme

Room for the River

~ Integrated Flood Alleviation Measures in The Netherlands

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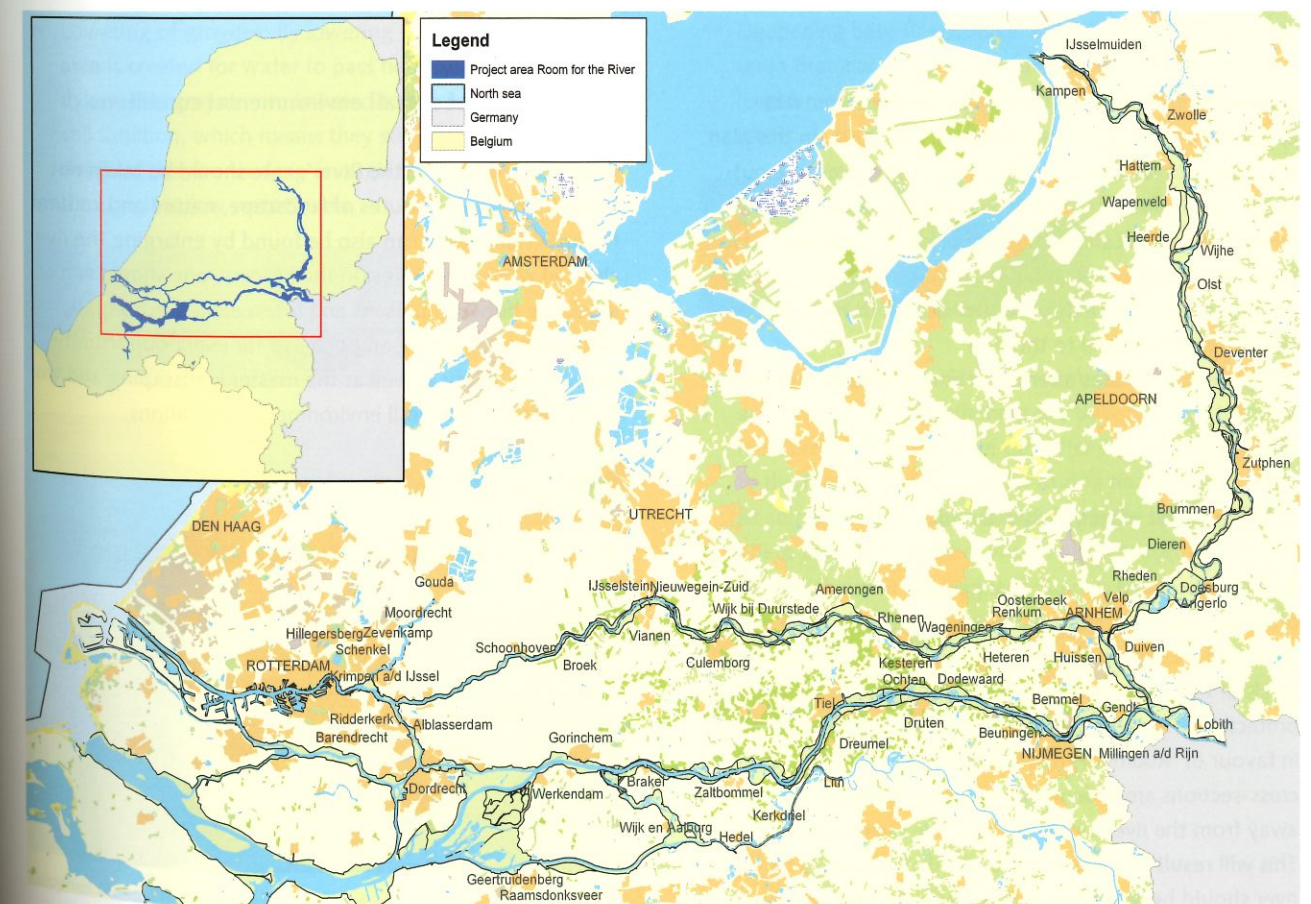
Introduction

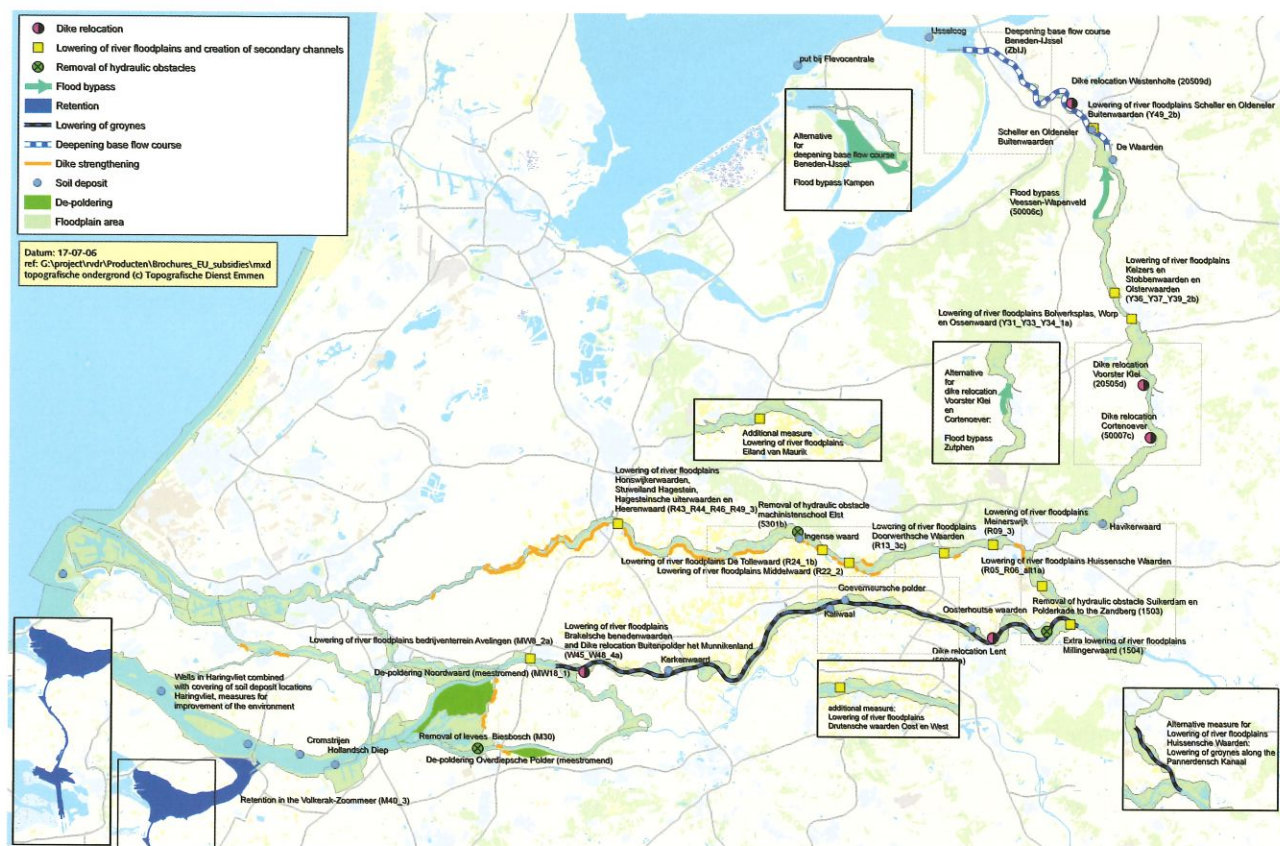
To maintain the level of flood protection of the most densely populated areas in the Netherlands, the Rhine delta river branches have to accommodate ever-higher extreme discharges, due to anticipated climatic changes. Until recently, it was standard policy to raise the crest levels of the dykes. This centuries-old policy was abandoned in 2000 in favour of *Room for the River*. In the new policy, river cross-sections will be widened by situating the dykes further away from the river, or by lowering the river forelands. This will result in lower flood levels. The Dutch cabinet ordered the preparation of a Spatial Planning Key

Decision, in which the spatial planning for the entire area related to the Dutch part of the Rhine delta is laid out.

The Spatial Planning Key Decision *Room for the River* document presents an integrated development plan with the main objectives of flood protection, master landscaping and the improvement of overall environmental conditions. This plan has now been finalized. Completion of the construction of the planned projects is foreseen by 2015, with a budget of € 2.2 billion. The plan also offers suggestions for the long-term accommodation of extreme river discharges.

Project area of the National Programme Room for the River





National programme Room for the River and alternative or additional measures

Spatial Planning Key Decision *Room for the River* was approved by the Dutch Parliament in July 2006. In this plan, the measures for flood control of the major rivers are outlined; they include the creation of additional space for the rivers. For each location, the local plans are described: e.g. the construction of secondary channels in the river foreland, the displacement of a dyke further inland, or returning previously reclaimed land to the river. The plan also includes alternative and additional measures.

Objectives

Safety against extreme river floods

Due to anticipated climatic changes, the Rhine delta river branches have to accommodate ever-higher extreme discharges. Until recently it was standard policy to raise the crest levels of the dykes to maintain the required level of flood protection. This centuries-old policy was abandoned in 2000 in favour of 'Room for the River'. In the new policy, river cross-sections are widened by situating the dykes further away from the river, or by lowering the river forelands. This will result in lower flood levels. By the year 2015 the river should be able to safely discharge 16,000 m³/s.

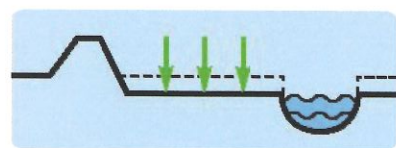
Improvement of overall environmental conditions

In creating 'Room for the River', care should be taken not to affect valuable features of landscape, nature and cultural history. More space can also be found by enlarging the river channel within the dykes. In the process, one should aim at a balance between present and foreseeable future spatial requirements, keeping an open eye for every opportunity to enhance safety as well as the master landscaping and the improvement of overall environmental conditions.

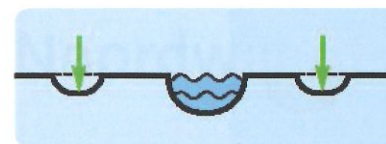
Measures

Measures between the winter dykes

~ Lowering of river floodplains, either entirely or only part of the floodplain, so that more water can pass through the area between the winter dykes.

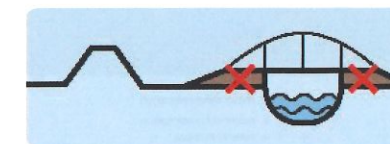


~ The creation of secondary channels by digging them in the floodplain area allows for more water to pass through the area between the winter dykes, without lowering the whole floodplain.



Secondary channel which was dug in the floodplain area along the IJssel River called the Vreugderijkerwaard

~ Removal of hydraulic obstacles: By removing or streamlining buildings in the riverbed and floodplain area more water can pass through the river at flood levels.



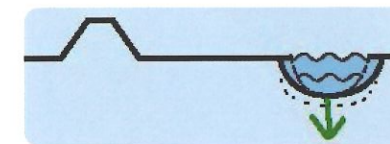
Removal of an hydraulic obstacle, part of the railway bridge at Oosterbeek

~ Lowering of groynes: By lowering the groynes a greater area is created for water to pass between the winter dykes. The groynes are lowered to the point that they still function, which means they still ensure that the depth of the river is deep enough for large boats to pass through it at low water levels.

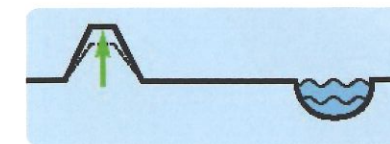


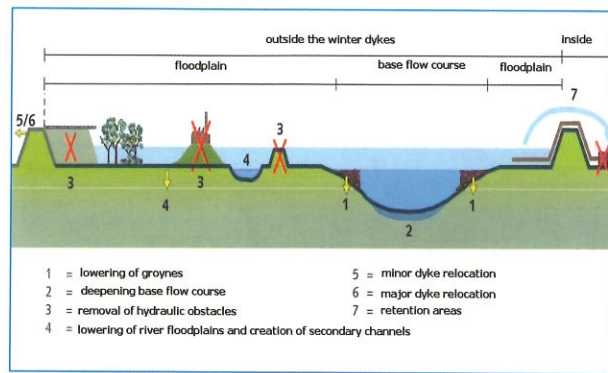
Groynes along the river Waal

~ Deepening base flow course: By deepening the riverbed (area that always contains water, even at low water levels) more water can pass through the river at flood levels.



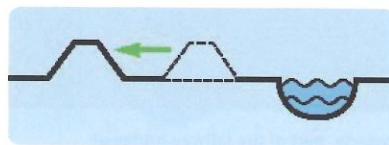
~ Dyke strengthening: This means making the dyke higher and broader or strengthening the dyke through technical measures so that the dyke can offer a greater resistance to the force of the river water during flood levels. At some places this standard policy is the only option. There are no possibilities voor making space for the river.





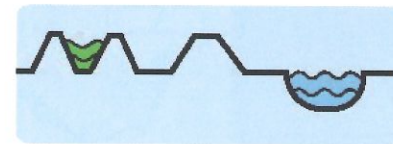
Measures outside the winter dykes

~ Dyke relocation: This means building a new dyke at a certain distance away from the river and removing the old dyke closer to the river to create a greater space between the winter dykes. This allows more water to pass through the riverbed at flood levels.

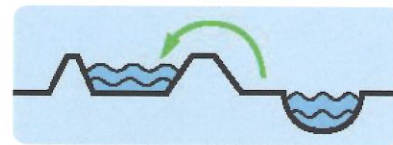


3D Visualisation: The dyke relocation of Bakenhof near Arnhem at the bifurcation point of the Pannerdensch Kanaal into the IJssel and Neder-Rijn rivers.

~ Flood bypass: A new river course outside of the already existing riverbed that, at flood levels, is part of the water containing part of the river. The outer borders of the flood bypass are marked by two dykes or elevated areas.



~ Creation of retention areas: A retention area or basin is an area located a certain distance away from the river which can be used at flood levels to temporarily store water.



~ Depoldering: This means lowering or removing (parts of) a dyke at an inlet and outlet point of a polder. The area through which water can flow is flooded at least several times a year, especially in the wintertime.

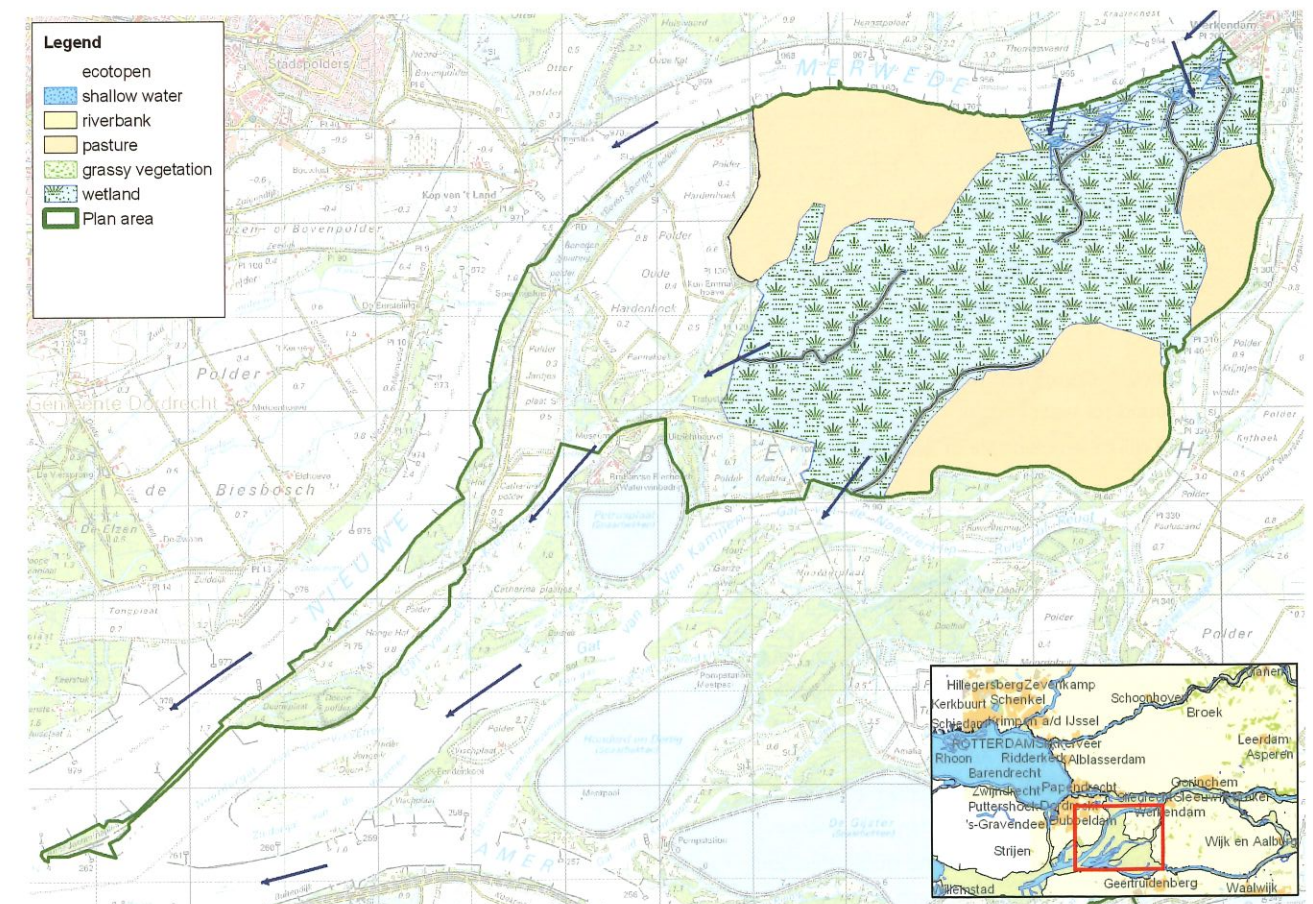
Noordwaard Depoldering Project

Project description

The project involves the depoldering of the area called Noordwaard, which is now protected against flooding by dykes. This agricultural area with large-scale horticulture will be transformed into a multifunctional area with differential flooding frequencies to ensure the safety elsewhere in the watershed area. By making the area floodable at high water levels it is possible to let water coming from the Nieuwe Merwede flow through the area in the direction of the Hollands Diep; this will create a connection between these

two rivers. Building new bridges and dams will keep the new floodplain area accessible. The relationship between naturally open channels with tidal influence and summer polders will be stimulated. The result will ensure safety for the inhabitants, and farmers will have the possibility of staying in the area. Safety behind the dykes in the Noordwaard will be transformed into another safety concept. The safety concept includes that the housing and infrastructure in the area will be adjusted to flooding during high water, without endangering the people, goods and livestock. Another result of this project will be the creation of nature and recreation areas.

Project area



This project is already further into the planning phase than the other projects in the National Programme Room for the River.

The project area is situated along the southern bank of the Nieuwe Merwede (Rhine) and north of the Brabantse Biesbosch (Meuse). It covers an area of 2050 ha. There are 49 houses and 26 farms; several are registered as historic buildings. The project area comprises agricultural and residential areas, a monumental fort and an industrial estate in the northeast corner.

Activities

- ~ Lowering part of the dyke along the Nieuwe Merwede
- ~ Lowering the entire dyke along the Gat van de Noorderklip (Brabantse Biesbosch)
- ~ Making inlets and building bridges in the Bandijk
- ~ Building low levees or raising existing ones to protect the summer polders and building roads on top of them so the area remains accessible
- ~ Building a dyke along Fort Werkendam and the industrial estate
- ~ Extending the Bevert and Boomgat creeks
- ~ Removing or moving homes (rebuilding at a different location)
- ~ Protecting electricity poles and station
- ~ Removing a levee to optimise flow of flood level water
- ~ Building a road on top of an old dyke on the eastern side of the Noordwaard (evacuation route)
- ~ Building bridges and a viaduct

Innovative transnational approach

- ~ Adjusting housing and infrastructure to flooding during high waters without endangering peoples, goods and livestock
- ~ Opportunities to strengthen Natura 2000 by creating feeding ground for water birds
- ~ The project will be an example of integrated project development
- ~ Implementation of international river management in local planning
- ~ Development of integrated flood defence systems and multifunctional land use
- ~ Maintaining adapted functionality (agriculture, housing and recreation) depending on the variety of flooding frequencies needed to preserve the required safety elsewhere in the region
- ~ Finding a safety concept that is acceptable for all those affected including private persons/families, entrepreneurs/farmers, administrators and public decision makers, and keeping in mind that part of the area will

flood several times a year but that other areas might still need to accept a flooding frequency of once every 100 years or up to 1000 years

- ~ Aiming for compatibility in maintaining agriculture and nature conservation (in addition to the Biesbosch National Park and the nature objectives in the Noordwaard development plan), recreational infrastructure and flooding

Organisations involved

Directorate General for Public Works and Water Management (*Rijkswaterstaat*)

Project implementation schedule

Currently: planning and design phase

Project decision: 2009

Implementation: 2011-2014

Lowering of river floodplain at Brakelse Benedenwaarden and dyke relocation at Buitenpolder het Munnikenland

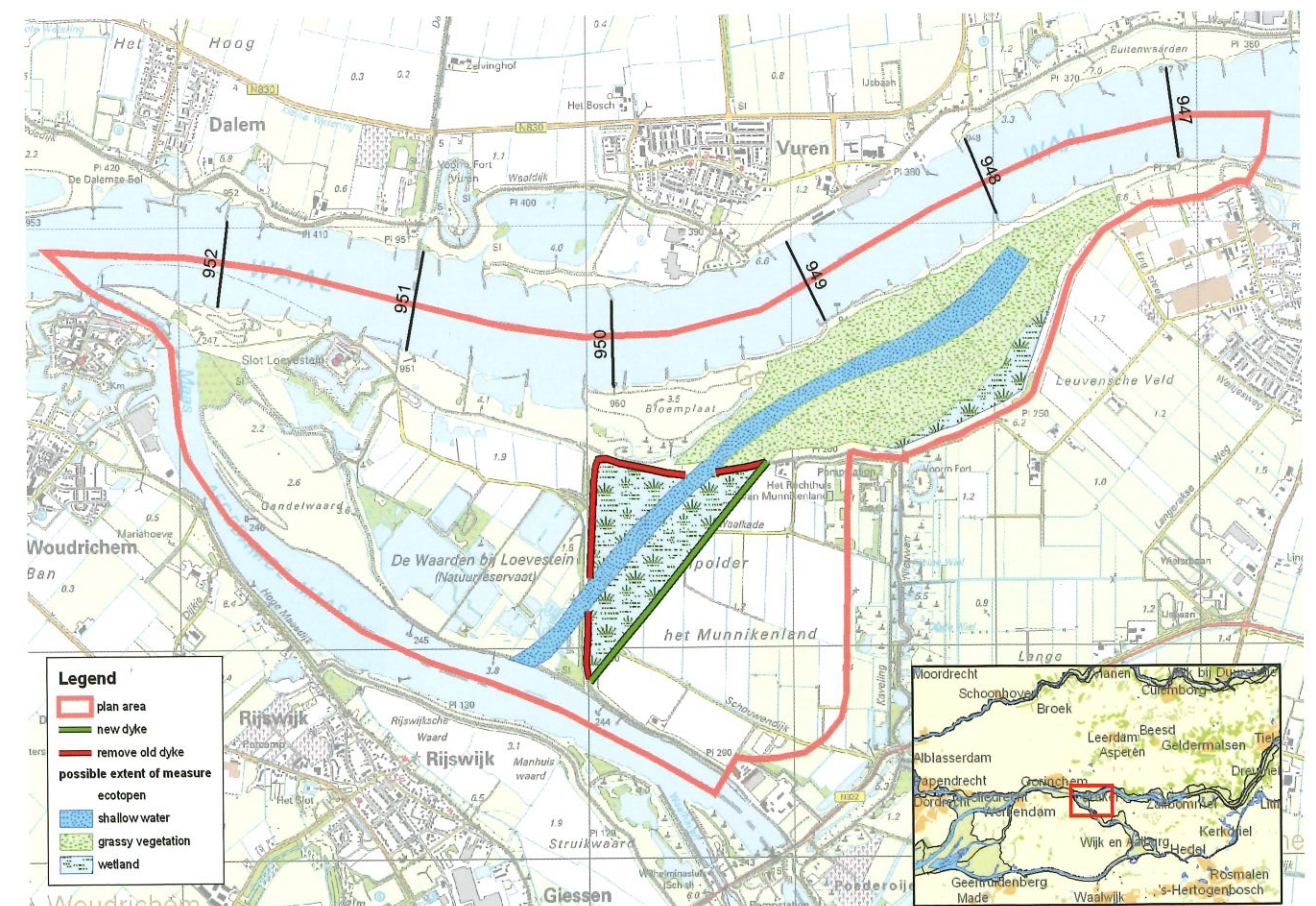
Project description

The Brakelse Benedenwaarden is located along the Waal River. This area and the dyke referred to in this project are situated between the town of Brakel and Fort Loevestein. The western part of the dyke where it is perpendicular to the Dammed Up Meuse River (Afgedamde Maas) will be re-

located away from the river at a 45-degree angle to the Waal River and the Dammed Up Meuse. Furthermore, a secondary channel will be dug parallel to the new dyke, connecting the Waal River to the Dammed Up Meuse.

The geomorphological and botanical values present in the Benedenwaarden and the Bloemplaat will be spared as much as possible. The new floodplain area will change from agri-

Project area



culture to nature and the existing floodplain will be preserved as a nature conservation area. The current agricultural area of the Brakelse Benedenwaarden will be turned into a wildlife area. Fort Loevestein will remain accessible at flood levels by means of an obstacle-free bridge. This project will also restore an old defence line, the *Nieuwe Hollandse Waterlinie*.

Present situation

The area around Munnikenland and Loevestein is very valuable for nature, the landscape, cultural heritage and recreation. The area had a tidal influence of approximately half a meter. Until a dyke was built around it in 1975, Buitenpolder Munnikenland was a floodplain of the Waal River. The former floodplain is open cultivated land with relatively little botanical value. The value of the landscape is contributed to by elements such as Fort Loevestein and vestiges of the ongoing battle with water and its effect on the landscape give value to the landscape, evident in the sleeper dyke at Brakel (Nieuwendijk) and the geomorphological values of the Benedenwaarden in the former riverbeds and channels.

Ford Loevestein

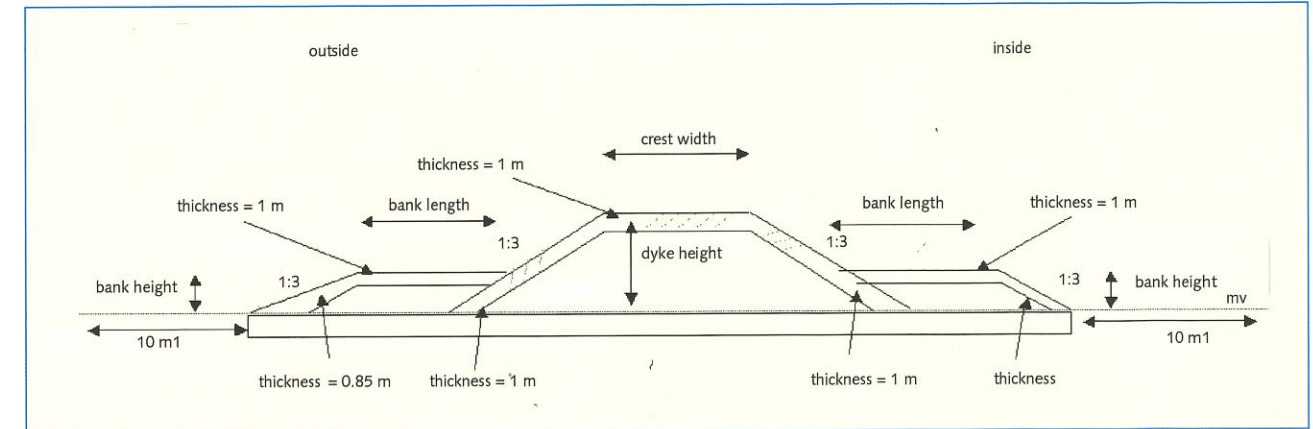


Nieuwendijk and Bloemplaat have been designated as habitat areas because of the valuable grasslands.

A chief criterion in planning this project was to protect the botanical and geomorphological values of the Bloemplaat and Benedenwaarden as well as the pumping station and *Rechtshuis* (old court house) of Munnikenland.

Activities

- ~ Land acquisition: from private parties, the national government and other government bodies
- ~ The area will be converted from agriculture (pasture) to a more natural ecological environment
- ~ Removal of the old dyke
- ~ Construction of a new dyke: 1.35 km long, 8 meters wide and 7.7 meters high
- ~ Removal of (summer) levees in the floodplain
- ~ Digging of the secondary channel
- ~ The secondary channel will have an outlet along the Dammed Up Meuse River. The inlet will have no direct connection with the Waal River



Construction of a new dike

- ~ The outlet of the secondary channel will have soil and riverbank protection and a small bridge will be built so the area remains accessible
- ~ A protective layer to prevent seepage will cover 25% of the bottom of the secondary channel
- ~ A new road and bridge will be built to ensure that Fort Loevestein remains accessible during flooding
- ~ Relocation of utility lines (including gas pipes)
- ~ Highly polluted soil will be deposited at the special soil depot at Cromstrijen/Hollandsch Diep
- ~ Some clay will be reused for the new dike and some will be sold
- ~ Dug up sand will be reused for the new dike
- ~ Clean or slightly polluted soil will be deposited at Haringvliet to create ecologically more attractive areas

Innovative transnational approach

- ~ Combining nature, agriculture and flood safety with cultural heritage and recreation
- ~ The project will be an example of integrated project development
- ~ Implementation of international river management in local planning
- ~ Development of integrated flood defence and nature
- ~ Cohesion of nature, agriculture and historical areas

Organisations involved

- ~ Ministry of Transport, Public Works and Water Management
- ~ Rivierenland Water Board
- ~ Province of Gelderland
- ~ Municipality of Zaltbommel
- ~ Local farmers
- ~ Ceramic Industry
- ~ Organisations for nature and environmental protection

Project implementation schedule

Planning phase: 2006-2009
Implementation: 2009-2013



Depoldering of Overdiep Polder

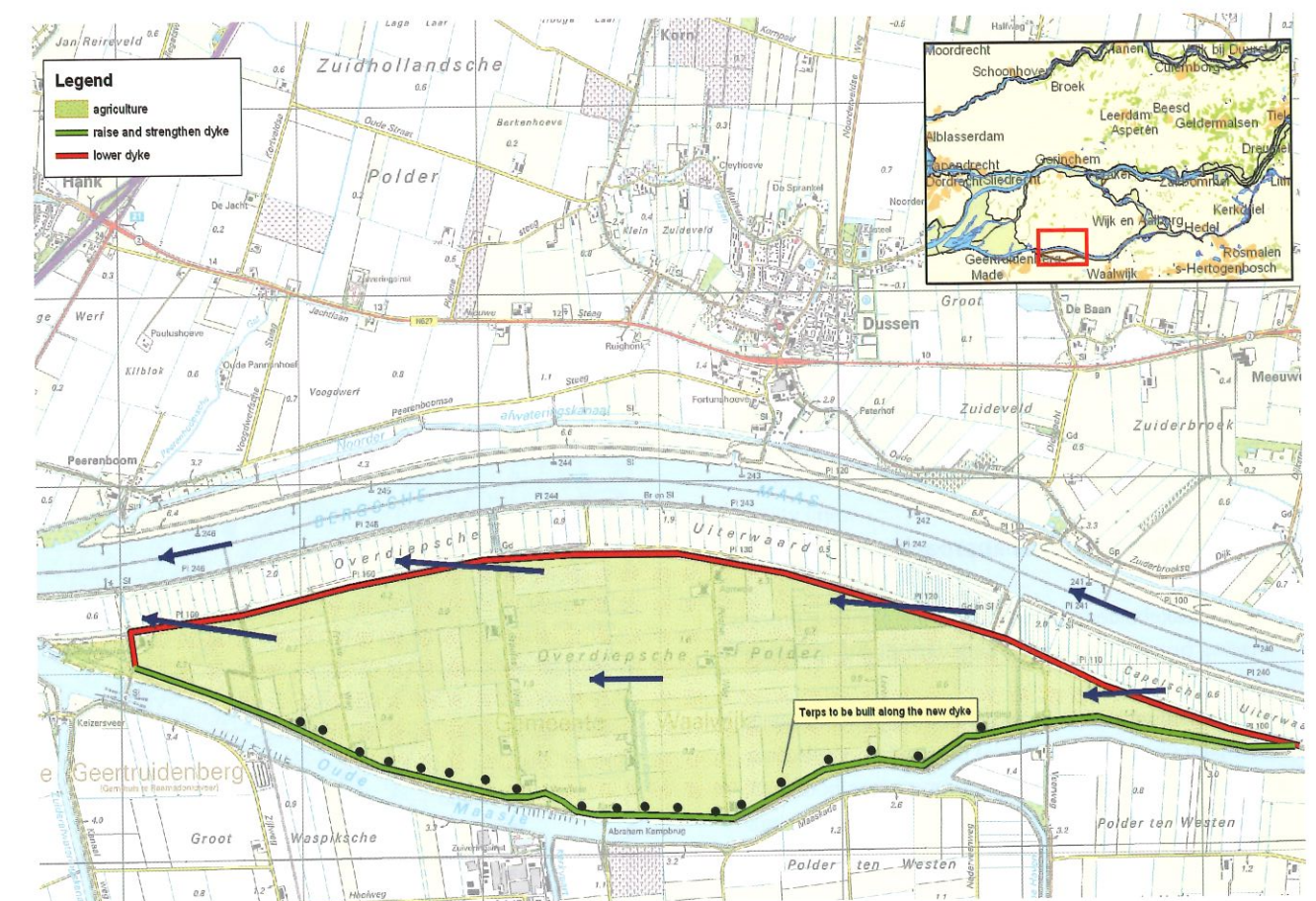
Project description

The project involves the lowering of the northern dyke closest to the Bergse Meuse such that the area south of this dyke will be flooded once every 25 years. The polder will be turned into floodplain area. The southern dyke along the Oude Maasje will be raised and strengthened and the buildings and houses will be rebuilt on top of *terps* (mounds) along the dyke. The criterion is that agricultural land-use will still be possible after the project is completed.

The depoldering of the Overdiep Polder will reduce the flood level up to 30 cm (locally). Because this will have a significant effect further upstream as well, this project will accomplish a large part of the flood level lowering that is required along the Bergse Meuse.

This project is further into the planning phase than the other projects in the National Programme Room for the River. The province of North Brabant is responsible for this process.

Project area



The project area is situated along the southern bank of the Bergse Meuse between the towns of Geertruidenberg and Waalwijk. The Bergse Meuse sets the northern boundary and the *Oude Maasje*, the southern.

The Overdiep Polder is partially polder and partially river floodplain. The area consists of a 550-hectare polder situated inside the dykes and a 180-hectare floodplain. The floodplain and the riverbed are separated by a levee or summer dyke/dam. The Overdiep Polder is now used for agriculture and accommodates 16 dairy/crop farms, a large pig farm, a marina with 340 boats and a military exercise ground. An old soil depot (soil from the Bergse Meuse was stored here) that is about 5 meters higher than the surrounding area is located in the western part of the polder. In the east there is a small patch of woods with mainly willow and alder trees which were planted as part of previous land consolidation projects.

Activities

- ~ Lowering the current dyke along its entire length to a level such that flooding occurs an average of once every 25 years (elevation about NAP + 2.50 m)
- ~ Optional: only lowering the old dyke at the inlet and outlet sites
- ~ Elevating and strengthening the Overdiep dyke (the southern dyke) to flood protection level
- ~ Moving houses onto mounds on the (elevated) Overdiep dyke
- ~ Removing and rebuilding of houses and buildings
- ~ Removing the excess soil in the soil depot on the western side of the polder to ground level
- ~ Removing or lowering elevated infrastructure (roads on levees) in the area
- ~ Part of the lightly contaminated excess soil will be reused in this project and the rest will be deposited at the soil depot at Haringvliet to make this area less deep and ecologically more attractive.
- ~ Sand and clay will be bought on the market to elevate the dyke and create the elevated mounds on which the houses will be built

Innovative transnational approach

- ~ Active stakeholder participation in the planning process
- ~ Placing houses on mounds, built with slightly polluted soil
- ~ Multifunctional land-use so agricultural functions will be maintained

Organisations involved

- ~ Province of North Brabant
- ~ Brabantse Delta Water Board
- ~ Municipality of Waalwijk

Project implementation schedule

- Planning process: now underway
- Project decision: 2008
- Implementation: 2011-2015

Flood Bypass (Green River) at Veessen Wapenveld

Project description

The project involves the construction of a flood bypass outside the winter dykes in the area of *Veesser broek*, *Vorchter broek* and *Wapenveldsche broek*. The main objective is to lower the water level at high floods. This will increase the safety of the inhabitants against flooding. The inlet structure of the flood bypass will be located west of the village of Veessen.

The outlet structure will be constructed east of the pumping station of the Veluwe water board.

The flood bypass is connected to the floodplains of the *Welsumerwaarden* (upstream) and the *Hoerwaard* (downstream).

The project area is situated along the left bank of the IJssel River outside the winter dyke. Some villages are located in the immediate surroundings: Wapenveld to the north and Veessen and Heerde to the south.

The project area covers 1410 hectares which is used for agriculture, mainly pastureland. The ecological value of the area is low and there are no remarkable landscape elements. Buildings, mainly historical farmhouses with large yards, are concentrated on the levee at the eastern side.

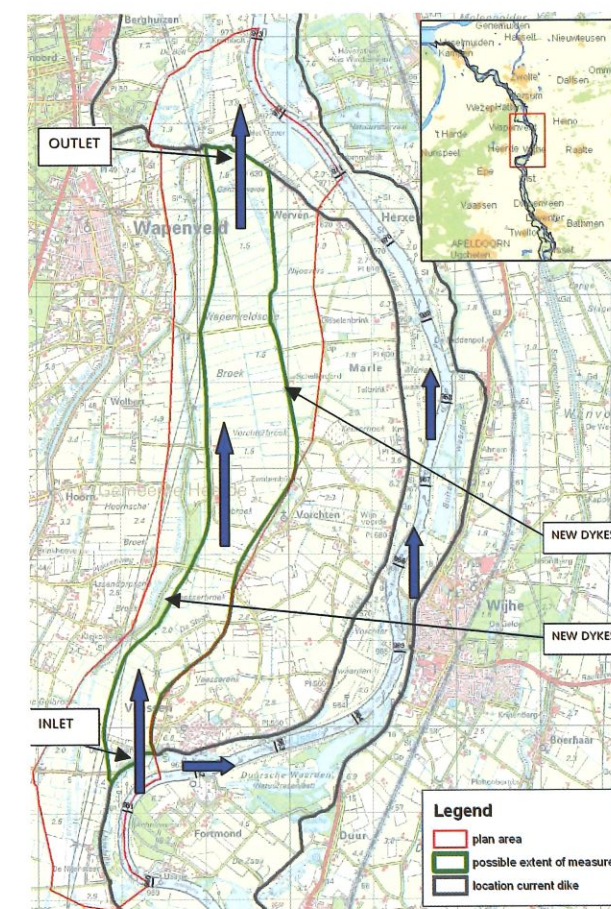
Activities

- ~ Construction of adjustable weirs at inlet and outlet structures. The width of the weirs will be 260 metres, consisting of beams
- ~ Construction of dykes to protect the area outside the flood bypass, total length approximately 15 km
- ~ Removal of old dyke at the inlet and outlet sites
- ~ Bridge construction to reach the island at high flood
- ~ Acquisition of buildings
- ~ Land acquisition (area of the new dyke alignment)
- ~ Protection of power supply lines, relocation of utility lines
- ~ Construction of pumping station for discharge of seepage water

Innovative transnational approach

- ~ Creation of a green river with cohesion between agriculture, nature and recreation
- ~ The flooding frequency has to be kept low to ensure the agricultural use of the land. Innovative arrangements have to be made for compensation

Project area





Flood By-pass Kampen

Project description

This is a large spatial measure which is located outside of the current riverbed of the IJssel but inside the IJsseldelta. It is mentioned as part of the national programme "Room for the River" as alternative spatial measure for the technical measure of lowering of the riverbed of the IJssel in this area. To reach the required lowering of the flood level for the short term either the bypass or the riverbed lowering

measure is necessary. However, the by-pass creates a greater opportunity for improving the landscape and spatial quality of the area. If the by-pass is proven to be financially feasible and the implementation is shown to be possible before 2015 this measure can replace the lowering of the riverbed of the IJssel.

The Dutch Minister of Housing, Spatial Planning and the Environment has chosen the project IJsseldelta as a pilot

- ~ New dyke ring area to be developed with safety level of 1/1250 year to protect the inhabitants of the island at high floods
- ~ Design of the weirs (duck bill)
- ~ Innovative dyke design, to fit in the landscape
- ~ The flood bypass will form a transition zone between ecological corridors, improving the spatial quality in the area
- ~ Flood bypass is a robust long-term measure that protects valuable floodplain areas. The effect of the water level lowering is far-reaching upstream, up to the city of Deventer. Some small local measures in valuable floodplain areas, such as lowering of floodplains and dyke relocation, will no longer be necessary
- ~ Opportunities to strengthen Natura 2000:
 - ~ nature development in seepage areas
 - ~ feeding ground for water birds

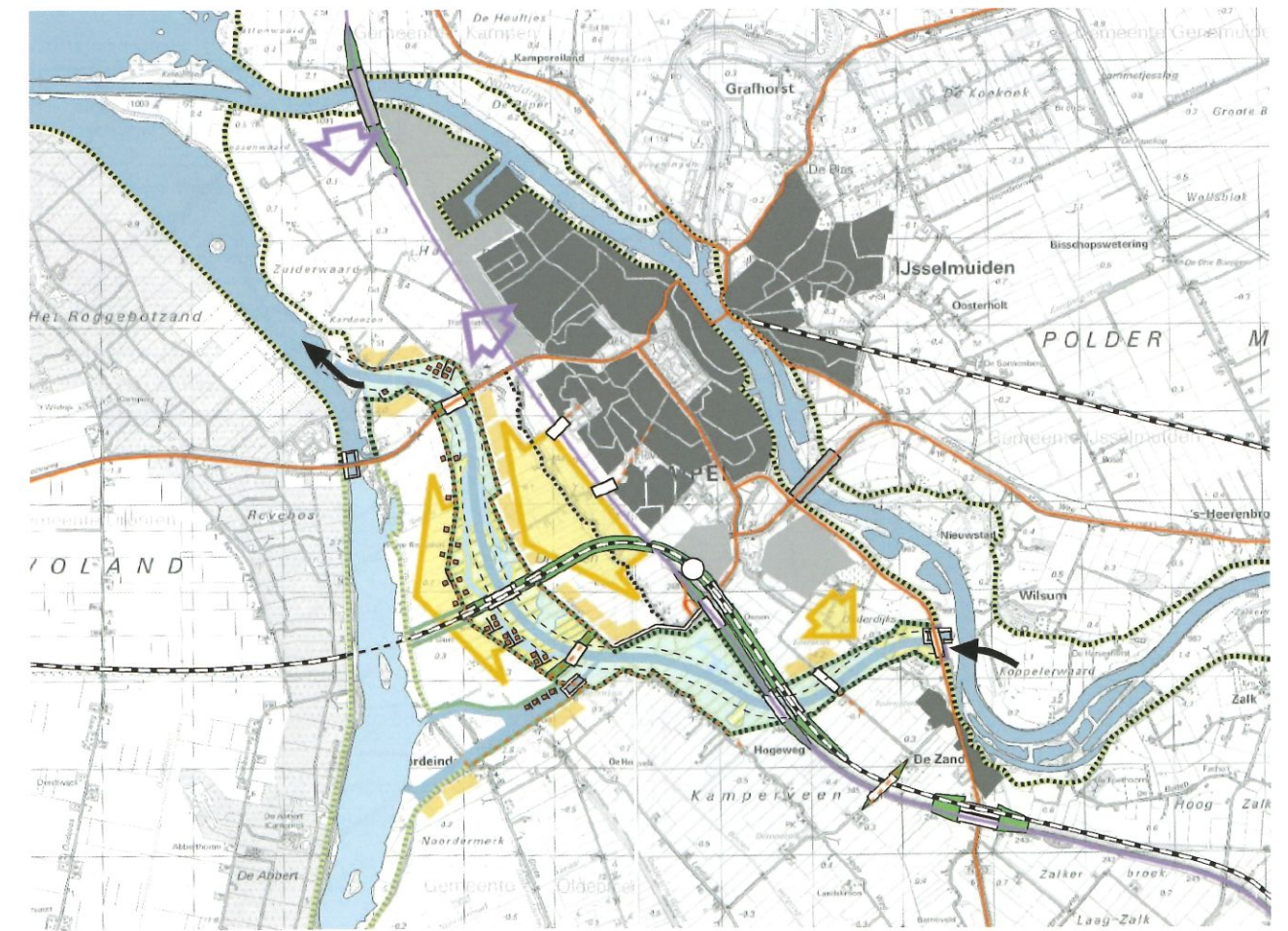
Organisations involved

- ~ Directorate General Public Works and Water Management (Rijkswaterstaat)
- ~ Province of Gelderland
- ~ Municipality of Heerde
- ~ Veluwe Water Board

Project implementation schedule

Planning: 2007-2009
Implementation: 2011-2015

Project area



project within the framework of the National Spatial Strategy and spatial development. The aim of the project is to combine the spatial claims for housing, infrastructure (development of the new railway line Hanzelijn and of the provincial road N50) and space for the river/flood control into one integrated spatial vision. This idea is being further developed by the province of Overijssel. The municipality of Kampen and the province of Overijssel are opting for a blue flood by-pass, which means: a secondary channel (flood by-pass) that permanently holds water with possibilities for recreation. If the criteria of the national programme "Room for the River" are met the project will be included in the spatial planning key decision and implemented.

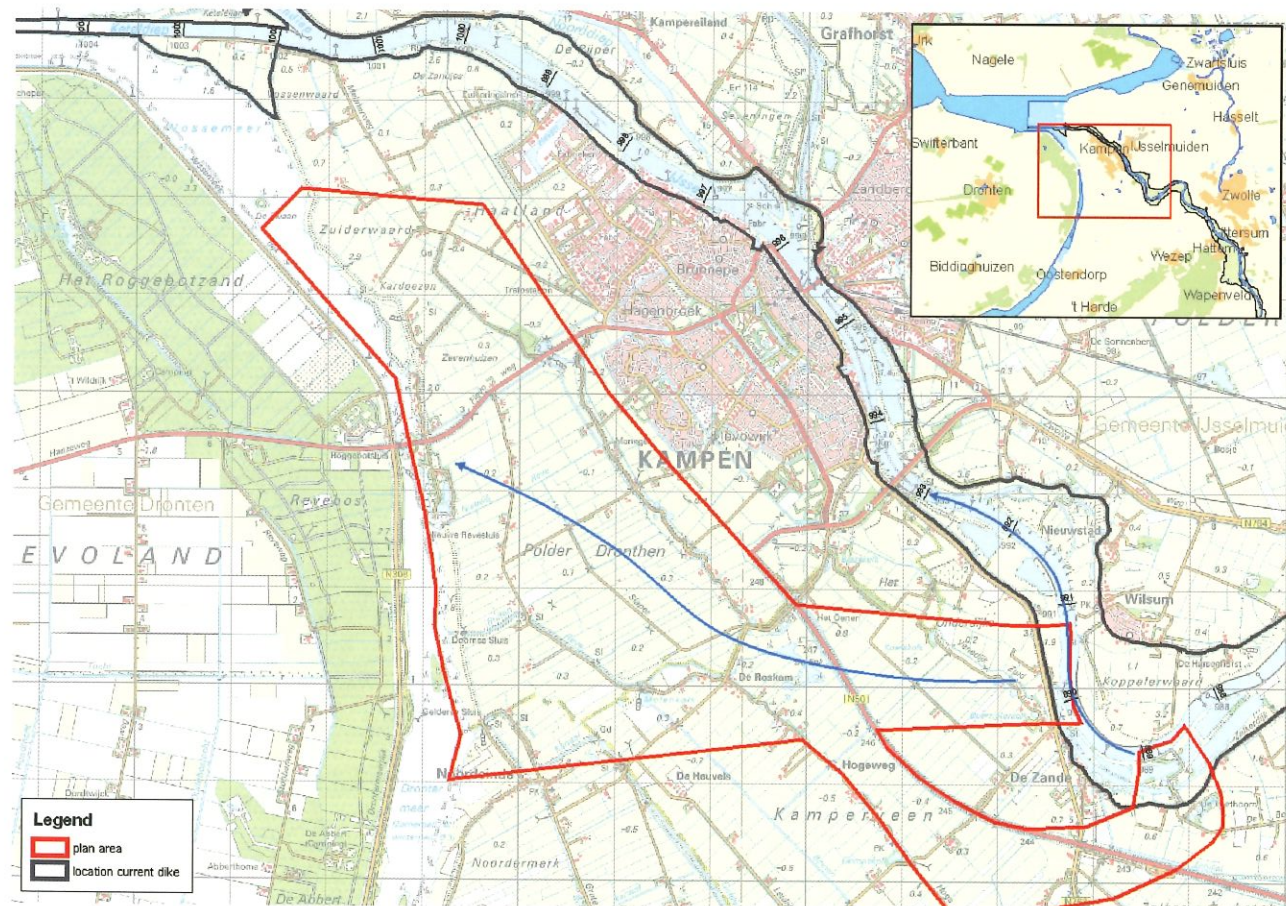
In order to reach the necessary lowering of flood water levels a "green river" would suffice. This means that the by-pass would not necessarily have to be filled with water the whole year round. This means that two, newly built, dykes would lead the flood level water freely from south to north. These new dykes will function as primary protection against flooding of the areas behind the dykes. The flood by-pass at

Kampen is seen as an opportunity to spatial quality. A by-pass reinforces the image of a delta with multiple channels and can be combined with development of housing and recreation. The preference of the region itself is to create a blue channel because this will combine flood safety with the opportunities mentioned and because it fits into the delta-character of the region.

The history of the landscape of the area south of Kampen and the plan area of the by-pass is marked by the struggle against flooding. This can be seen by the many old dykes in the area and the elevated mounds on which houses were built (terps) which are still present. The most striking examples of this heritage is the Hogeweg and the Zwartendijk. The western side of the plan area borders on the Veluwerand lakes: the Vosse- en Dronterlake. To the east is the town of Kampen, the provincial road N50 and the river IJssel.

The main current function of the area is agriculture. The area is extended with a lot of open space.

Project area



Artists impression

Activities

- ~ Construction of adjustable weirs at inlet and outlet structures
- ~ Construction of dykes to protect the area outside the flood bypass
- ~ Removal of old dike at the inlet and outlet sites
- ~ Bridge construction to reach the island at high flood
- ~ Acquisition of buildings
- ~ Land acquisition (area of the new dike alignment)
- ~ Protection of power supply lines, relocation of utility lines
- ~ Construction of pumping station for discharge of seepage water

Innovative transnational approach

- ~ Combination of flood safety with opportunities for housing and recreation
- ~ New dike ring area to be developed with safety level of 1/1250 year to protect the inhabitants of the island at high floods
- ~ Design of the weirs (duck bill)

- ~ Innovative dike design, to fit in the landscape of the IJsseldelta
- ~ The flood bypass will form a transition zone between ecological corridors, improving the spatial quality in the area
- ~ Flood bypass is a long term robust measure
- ~ Opportunities to strengthen Natura 2000:
 - ~ nature development in seepage areas
 - ~ feeding ground for water birds, creation of marsh area

Organisations involved

- ~ Water Board Groot Salland
- ~ Municipality Kampen
- ~ Province of Overijssel

Project implementation schedule

Project decision: 2009
Implementation: 2011-2015

Flood By-pass Zutphen

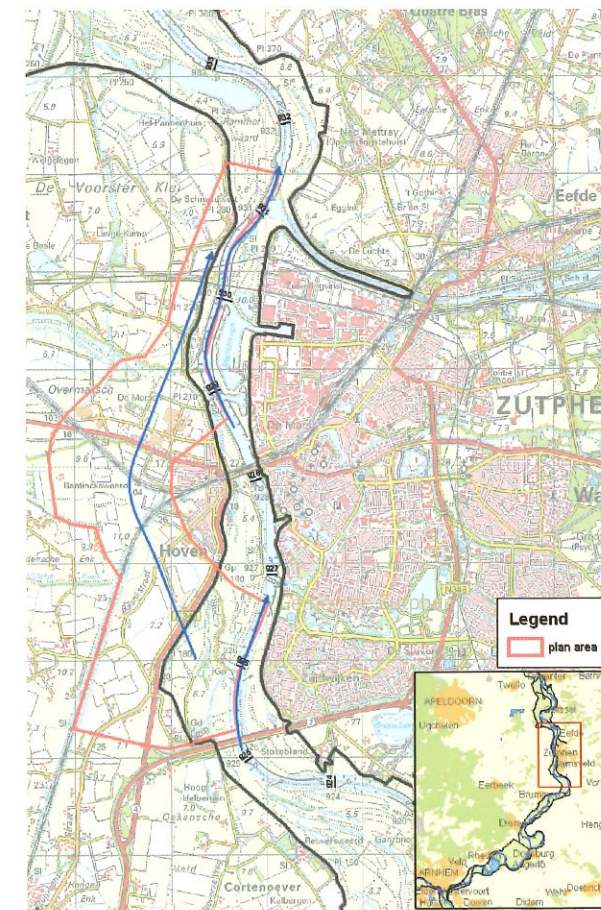
Project description

This inner-dyke measure has been added to the Spatial Planning Key Decision (PKB) 'Room for the River' as an alternative for dyke relocations at Cortenoever and Voorsterklei, offering many opportunities. In the long run three inner-dyke measures are needed along this stretch of the river. For a short-term solutions either the dyke relocations or the flood by-pass are needed. However, the flood by-pass creates most opportunities for the improvement of spatial quality. Should it turn out to be financially feasible and

realisable before 2015, then the Flood by-pass Zutphen can still be added to the main package of measures. These possibilities are being explored on initiative of the municipality of Zutphen.

The area where the Flood by-pass would be located has also been allocated for housing and adjustment of the present infrastructure. This implies a need for integrated Spatial Planning for this area. Several private parties have shown interest in participating in this. Whether this could lead to additional financing or possibilities for economizing has not yet been determined.

Project area



In order to meet the goals and demands of the task at hand, a green river would be sufficient. This means that the two new dykes would lead the water from south to north in a free stream, and that the current social functions mostly remain the same. The dykes are also the new primary embankment. In either case, the suburban area 'De Hoven' will be located on a kind of island. The width of the Flood by-pass is approximately 400 meters. The inlet of the Flood by-pass will be realised in between 'De Hoven' and the 'fork' from the N348 (road) to the IJssel. The out-let will probably be located around 'de Wellenberg' in the Voorsterklei. The length of the Flood by-pass will a maximum of four kilometres.

In the urban surroundings of Zutphen, including the area 'De Hoven' situated across the IJssel from Zutphen, the IJssel turns very narrow, creating a hydraulic bottleneck. For the element of landscape, the sub-areas 'the Overmarsch' and 'the Hoendernesterbeek' are characteristic for the whole area, with horticulture as the most important social function present.

Important characteristics for the area of the Flood by-pass are the transformation from a large-scale inner-dyke area to the urban area of Zutphen, the small-scale river flood plain, the old inner-dyke river landscape in the Voorsterklei and the old 'Kampenlandschap of Voorst/Empe'.

Most problems around Zutphen are related to the pressures of traffic and housing. The latter is partly relieved by plans for a housing project near Brummen and Zutphen.

Activities

- ~ Construction of adjustable weirs at inlet and outlet structures
- ~ Construction of dykes to protect the area outside the flood bypass
- ~ Removal of old dyke at the inlet and outlet sites
- ~ Bridge construction to reach the island at high flood
- ~ Acquisition of buildings
- ~ Land acquisition (area of the new dyke alignment)
- ~ Protection of power supply lines, relocation of utility lines
- ~ Construction of pumping station for discharge of seepage water
- ~ Construction of houses

Innovative transnational approach

- ~ Combination of economic growth of Zutphen with flood safety
- ~ New dyke ring area to be developed with safety level of 1/1250 year to protect the inhabitants of the island at high floods
- ~ Design of the weirs (duck bill)
- ~ Innovative dyke design, to fit in the landscape
- ~ The flood bypass will form a transition zone between ecological corridors, improving the spatial quality in the area
- ~ Flood bypass is a long term robust measure that protects valuable floodplain areas. The effect of the water level lowering is far reaching upstream. A number of measures, like lowering of the floodplains and dyke relocation, will not be necessary anymore
- ~ Opportunities to strengthen Natura 2000:
 - ~ nature development in seepage areas
 - ~ feeding ground for water birds



Project area of the flood bypass Zutphen

Organisations involved

Procedure for project decision: *Wet op de waterkeringen*, *Wet ruimtelijke ordening*

Authorities: Water board Veluwe, Municipality of Zutphen

Project implementation schedule

Decision to insert into PKB before: 2009

Project Decision before: 2010

Realisation: 2011-2015

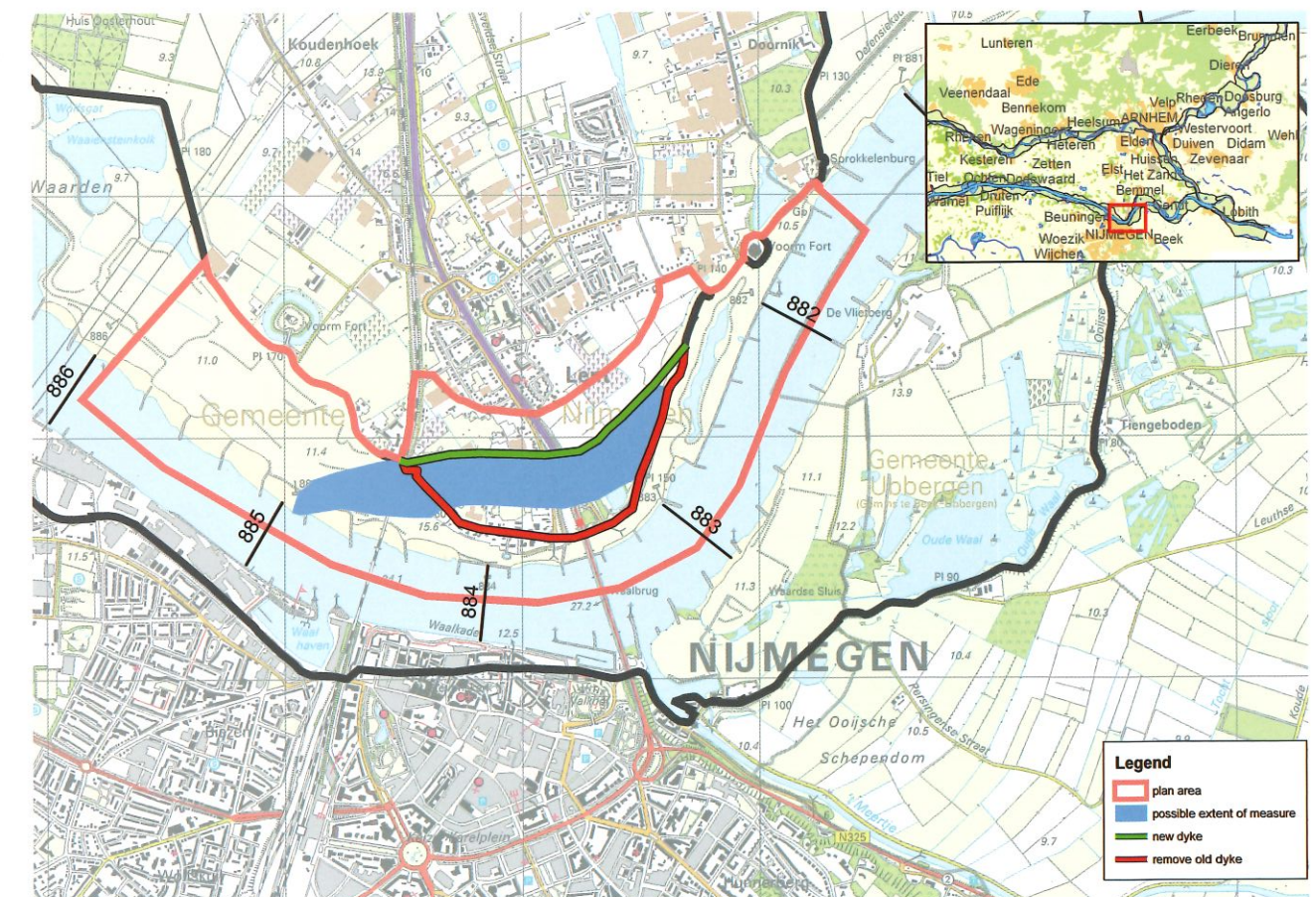
Lent Dyke Relocation

Project description

The project involves the relocation of the dyke near the village of Lent, across the Waal River from the city of Nijmegen. In combination with the development of a new housing area, this will create more space for the river and will solve the problem of the river bottleneck at this location. The Waal River now flows through a very narrow space between the winter dykes. This presents a large flood risk for the city of Nijmegen and the village of Lent, which are located very close to the

river. Furthermore, this measure will so effectively enlarge the space between the winter dykes that it will guarantee that no other measures (except those included in the national programme Room for the River) will be needed to decrease the water level in the Middle-Waal. The main objective is to lower the water level at high floods. This will further protect the inhabitants from flooding. This project provides for both urban growth and safety and the creation of a recreational area. Fifty houses will disappear but a new housing area (VINEX-location) will be built behind the new dyke.

Project area



A new dyke will be built 350 meters further inland from the river than the old dyke. The new dyke will be built in the form of a levee on which houses and other buildings can be constructed. Most houses on the Waal side of the Oosterhoute dyke will remain on the island of Veur-Lent, which is scheduled for development. In addition, a secondary channel will be dug under the traffic and railway bridges. These two bridges will have to be extended to reach the new dyke. The old dyke will be removed.

Activities

- ~ Acquisition of 50 houses
- ~ Removing houses and parts of the old dyke
- ~ Construction of a new dyke further away from the river and around the island of Veur-Lent, which is scheduled for development
- ~ Digging a secondary channel in the floodplain
- ~ Extension of two bridges to reach the new dyke to pass over the secondary channel
- ~ Remodelling and landscaping of the floodplain area and the island/riverfront

Innovative transnational approach

- ~ Relationship between space for water and city development
- ~ Solution for river bottlenecks



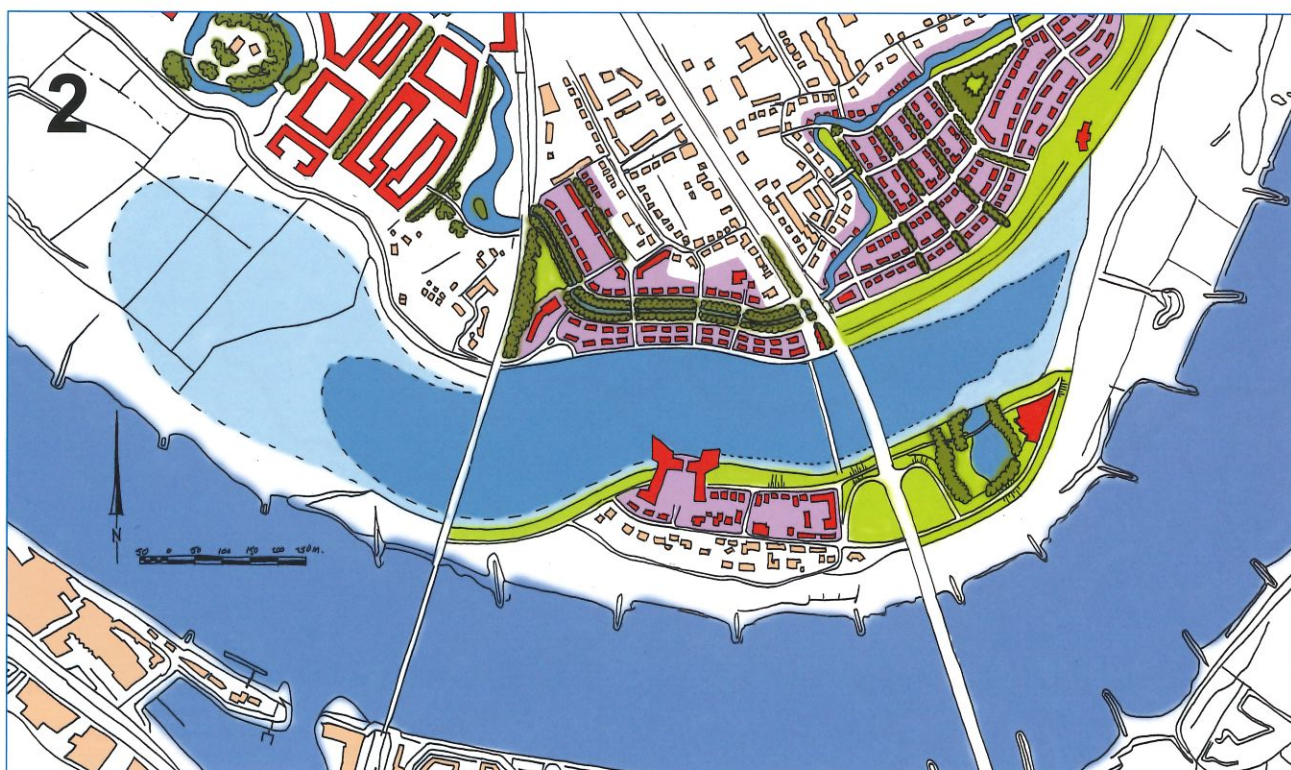
The village of Veur-Lent as it now appears at the site of the dyke relocation.

Organisations involved

- ~ Rivierenland Water Board
- ~ Ministry of Transport, Public Works and Water Management
- ~ Municipality of Nijmegen

Project implementation schedule

Project decision: 2007
Implementation: 2011-2015



Dyke relocation at Cortenoever and Voorster Klei

Project description: dyke relocation at Cortenoever

The project involves the relocation of the current dyke to some 1200 meters from the river's edge. The newly created floodplain area outside the winter dykes will continue to be used for agriculture, but the conditions will change. Because the area that the dyke used to protect from flooding will lose this protection, flooding will occur here more frequently (with an expected frequency of at least once a

year). Possibilities for agriculture will probably decrease as a result of frequent flooding. Given the possible environmental risks of flooding and the current economic value of the water purification plant in the southern part of the project area, a dyke will be built around it. The houses and buildings located along the current primary dyke will be situated outside of the dyke in a newly created floodplain area. A bridge will be built to keep the water purification plant accessible at high flood levels. The current primary dyke will be removed at the

Project area Cortenoever



water inlet and outlet locations. By lowering the dyke, two water inlet points will be created on either side of the water purification plant. Because of the required hydraulic effect, the western inlet point will be combined with the creation of a small lake.

Project description: dyke relocation at Voorster Klei

The current primary dyke along the Rammelwaard was only built in the 1960s. Before that, the area around Voorster Klei was mainly a river floodplain.

According to the design, the dyke along the Rammelwaard will be removed and rebuilt 700 to 1000 meters from the river's edge. The new dyke will run parallel to the road along the Voorster Klei. This means that the houses and buildings along this road, such as around Sinderen and Dovenkamp, and the pumping station at Voorsterbeek, will remain protected by the new dyke. The houses and buildings around Schnaauwert, Heetkool, de Wolfswaard and Wellenberg will in future be located in the newly created river floodplain. This new floodplain area will also be used for agriculture. As a result of the dyke relocation the flooding frequency of the

Project area Voorster Klei



area will increase and these wetter conditions will probably be sub-optimal for agricultural and farming purposes.

The dyke relocation offers opportunities for ecological, landscaping and recreational development. Moreover, as a result the dyke relocation, other measures in the Rammelwaard can be avoided. The Rammelwaard is a protected area because of its environmental, cultural and archeological heritage.

Activities at Cortenoever

- ~ Land acquisition (area of the new dyke alignment and new lake)
- ~ Compensation for decreased income from agriculture
- ~ Acquisition of buildings
- ~ Digging a small lake near the southern inlet
- ~ Removal of the old dyke at the inlet and outlet sites
- ~ Construction of a new dyke (3.27 km long); relocation of utility lines (including gas pipes)
- ~ The water purification plant will be protected by a newly built dyke and it will be made accessible by a new bridge

- ~ The area will be converted from an agricultural environment (pastureland) to a more natural ecological environment
- ~ The clay from the removed dykes will be reused in the dyke relocation project at Voorster Klei
- ~ Dug up sand will be reused in this project or at Voorster Klei or sold on the market.
- ~ Clean or slightly polluted soil will be deposited in the Havikerwaard floodplain
- ~ Highly polluted soil will be deposited at the special soil depot at IJsselooog
- ~ Clay still needed for the new dyke will be bought on the market

Activities at Voorster Klei

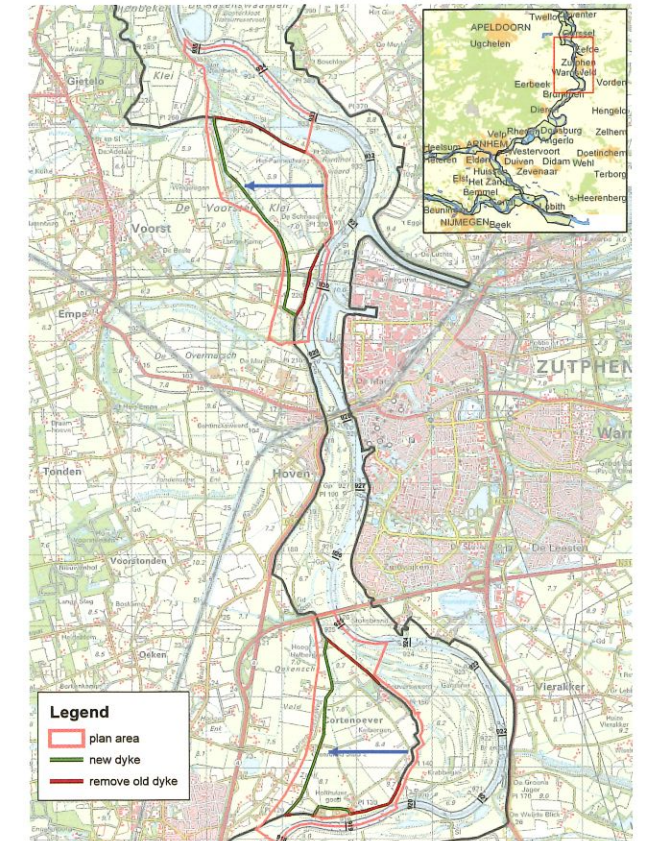
- ~ Land acquisition (area of the new dyke alignment and new lake)
- ~ Compensation for decreased income from agriculture
- ~ The area will remain agricultural
- ~ Acquisition of buildings
- ~ Removal of the old dyke at the inlet and outlet sites
- ~ Construction of a new dyke (3.17 km long)
- ~ Relocation of utility lines (including gas pipes)
- ~ Highly polluted soil will be deposited at the special soil depot at IJsselooog
- ~ Protection of power supply line by a dyke
- ~ The clay from the removed dykes will be reused in the flood bypass project at Veessen-Wapenveld
- ~ Clean or slightly polluted soil will be deposited in the Havikerwaard floodplain
- ~ The clay and sand to be used for the new dyke will come from the project at Cortenoever
- ~ Clay still needed for the new dyke will be bought on the market

Innovative transnational approach*

Added value: safety of farms and homes increases through the building of quays and terps.

Innovative: elevating existing farms; geographical value of the landscape remains intact.

- ~ Experience with the relocating of dykes to increase the extent of the river floodplain (depoldering) and maintaining the existing qualities of the landscape and possible land use (residential and agricultural) and at the same time developing new environmental qualities (such as ecological)
- ~ Developing new ways of landscaping and building dykes (building terps with dredged material, reusing sediment)



Project area

- and creating new forms of housing (integrating a new manor or stately home in the design)
- ~ Experience in looking into options for using market forces for innovative contracting
- ~ Experience in taking advantage and account of regional wishes and initiatives
- ~ Collaborating to make innovative dyke design possible
- ~ Improving the quality of the landscape by translating this into concrete measures
- ~ Creating an opportunity for local parties to take the initiative to implement the plans instead of Rijkswaterstaat
- ~ Collaborating to create win-win situations

* In the Spatial Planning Key Decision Room for the River, the flood bypass at Zutphen is an alternative measure for the dyke relocations at Cortenoever and Voorster Klei (together). Regional parties prefer to relocate the dykes and consider this a better alternative because it creates definite improvements in the region (measures against river flooding which creates opportunities for housing, farming, infrastructure, the environment and recreation). An integral plan for the whole area is being made that will combine all the developments, including a feasibility study of the flood bypass. The aim is to keep the Zutphen flood bypass in the short-term package of measures (2015) and to consider the dyke relocations as



Lowering of river floodplain at Avelingen industrial estate

Project description

The project involves the digging of a bypass through the floodplain south of the Avelingen industrial estate, which is linked to the Avelingerdiep. The main objective is to solve and prevent problems from occurring during high water levels at the Gorinchem bottleneck.

The Avelingen industrial estate is located between km 955.8 and km 957.7 on the north side of the *Boven Merwede*. The

area now covers about 15 hectares and is surrounded on both sides by floodplains (grasslands) with transverse dams. The transverse dams lead the inward bound navigation to the inland ports, which are shielded from the river by the floodplains. The part of the bypass that will be dug on the east side of the bridge, which spans the A27 motorway over the Waal River, will not be suitable for navigation purposes. However, it will remain possible to reach the inland ports through the existing navigation entrances.

measures for the long-term (2050), resulting in spatial reservations. The flood bypass probably has a greater chance of receiving EU funding.

Opportunities to strengthen Natura 2000 at Cortenoever:

- ~ Creating natural grassy areas under the condition that the grass is cut and removed (there are some prime examples in Cortenoever)
- ~ Creating woods on the eastern side of the project area
- ~ Creating a habitat for geese and swans, provided agricultural methods are adapted to the birds (good compensation area)
- ~ Nature development in seepage areas

Opportunities to strengthen Natura 2000 at Voorster Klei:

- ~ Creating a connection between the habitat of the salamander and other amphibians in IJssel floodplains, via Hoendernesterbeek and the old IJssel to Voorstonden and Empensche and Tondensche Heide; this will create a relationship between the areas in and outside the dyke and a connection to the seepage area of the Veluwe; the reli f in the area and the winter dyke (areas that do not flood) support these possibilities. Possibly dig isolated pools of water

- ~ Developing the stream in the north so that it creates possibilities for specific types of fish
- ~ Increasing the number of willow trees near Slot Nijenbeek
- ~ Creating small woods against the dyke
- ~ Cutting and removing vegetation to create natural grasslands
- ~ Deepening the lower-lying areas in the newly created floodplain (creating wetlands and isolated pools in the wintertime) to create opportunities for geese, ducks and other birds

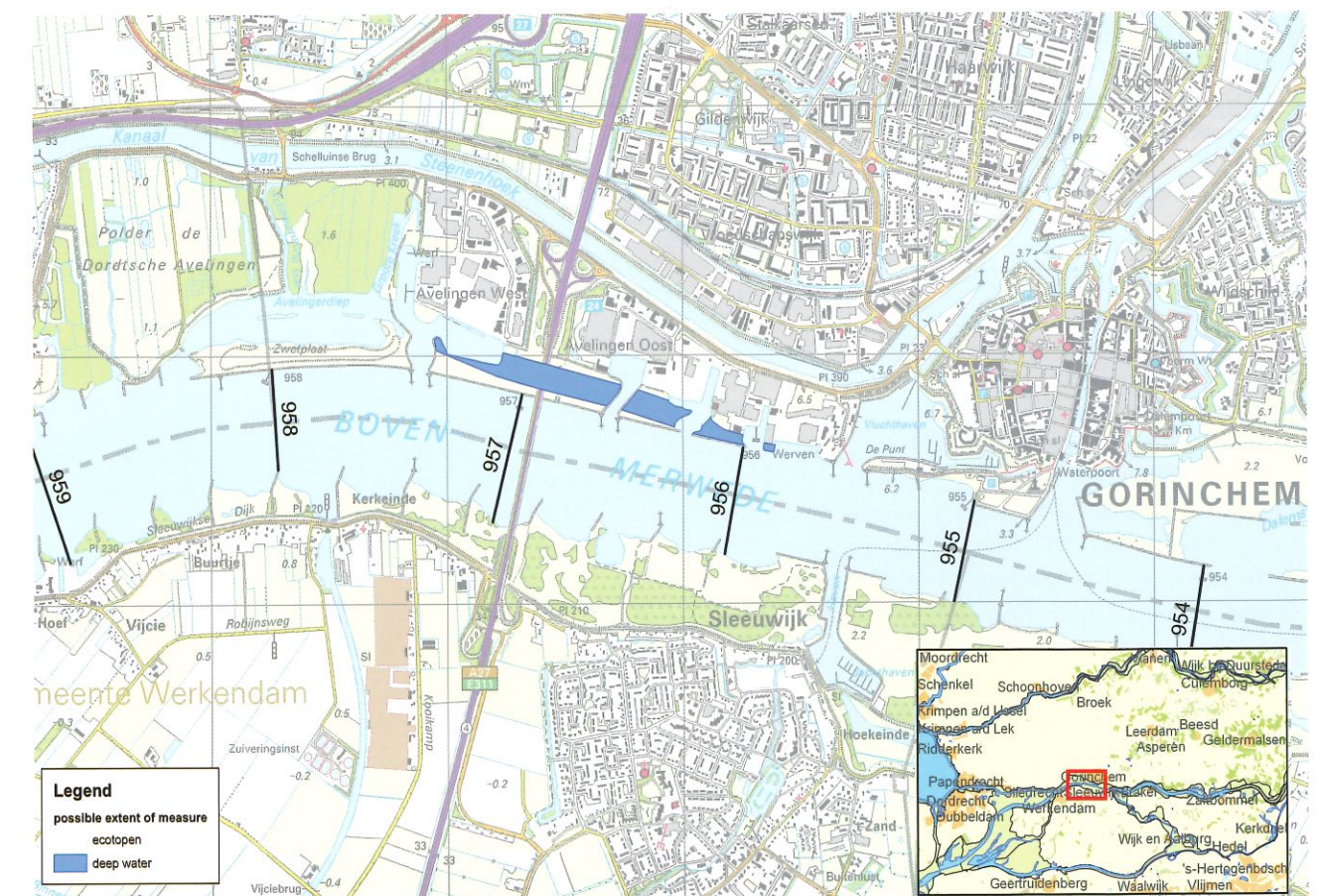
Organisations involved

- ~ Province of Gelderland
- ~ Veluwe Water Board
- ~ Municipality of Brummen

Project implementation schedule

- ~ Planning process: 2006
- ~ Project decision before 1 July 2009
- ~ Implementation of spatial plan 2010 - 2015

Project area





The whole area including its surrounding forelands is situated outside of the dyke-protected area. A dam on the west side (km 957.7) shields the industrial estate, but the forelands are flooded at high water levels.

Activities

- ~ Excavating and cleaning out the bypass through the forelands; 100 meters wide, bottom 5 meters-NAP, talus 1:4
- ~ Cleaning and excavating part of the floodplain: up to 5 meters -NAP
- ~ Removing certain wharfs at location km 956; up to 5 meters -NAP
- ~ Covering the river shores on the north side of the wharfs: about 300 meters
- ~ Excavating the river floodplain under the A27 motorway while preserving the existing pillars of the bridge: up to 5 meters -NAP
- ~ Lowering the current shore protection of the three inland ports to the depth of the bypass: up to 5 meter -NAP
- ~ Removing the pillars of the emergency bridge located in the area (km 956.5): 7 pillars
- ~ Constructing the depth of the bypass
- ~ Constructing a threshold at km 957.1 with a width of 100 meters: on 1.25 meters +NAP

Innovative transnational approach

The municipality of Gorinchem plans to develop the industrial estate in combination with the safety measures:

- ~ Economic development in relation to flood management
- ~ Shipping safety
- ~ Cleaning-up the present channel – removing old bridge pillars
- ~ Improved economic position of an inland port/industrial estate
- ~ Integrating flood defence and nature

Organisations involved

- ~ Municipality of Gorinchem
- ~ Ministry of Transport, Public Works and Water Management

Project implementation schedule

- ~ Planning, design, decision: 2011
- ~ Implementation: 2013 -2015

Lowering Dykes in the Biesbosch

Project description

The project involves the lowering of the dyke around the Allardspolder. This will create more room locally for river water.

This measure will be implemented in combination with the Noordwaard depoldering project, which compensates for local rising of the water level near Geertruidenberg. When the details of the Noordwaard plan have been worked out, this measure will require some reconsideration. The Allardspolder is located at the southern edge of the Bies-

bosch. The Grootte Polder and the Allardspolder were converted into a nature reserve in 1995, called the Aakvlaai, which means the area no longer has an agricultural character.

The dykes in the Biesbosch mentioned here are located between kilometres 251 and 253.5 and are situated north of the Amer and Bergse Meuse rivers.

The Allardspolder is part of the Grootte Polder and is located southwest of the Aakvlaai. A dyke surrounds the area, but the dykes are still low enough to be part of the river floodplain area. Because drainage activities in the polder

Project area



have ceased, it is mainly swamp and filled with reeds (marsh vegetation).

Flood frequency and duration: Dykes now protect the Allardspolder from flooding. After this project has been realised, it will be affected by flooding of river water on a daily basis.

Activities

- ~ Removing the grassmat in such a way that the ground level can be lowered and the grass replaced
- ~ Removing the dyke around the Allardspolder
- ~ Lowering the dam between the Allardspolder and Aakvlaai
- ~ Partially rebuilding a smaller dam between the Allardspolder and Aakvlaai

The last three points are important to ensure that water can flow through the whole Aakvlaai at flood levels and to prevent water from flowing back from the Allardspolder to the Aakvlaai at daily flood levels. The dykes will be lowered to ground level.

Innovative transnational approach

This project is surprisingly new in that formerly reclaimed land will be given back to the river to reduce flood levels during periods of high river discharges. The challenge is to extend the multifunctional purposes of this remarkable piece of land, while restricting the current agricultural usage.

Organisations involved

- ~ National Forest Service (*Staatsbosbeheer*)
- ~ Ministry of Transport, Public Works and Water Management

Project implementation schedule

Project decision: 2013

Implementation period: 2014-2015

Lowering of Groynes along the Waal River

Project description

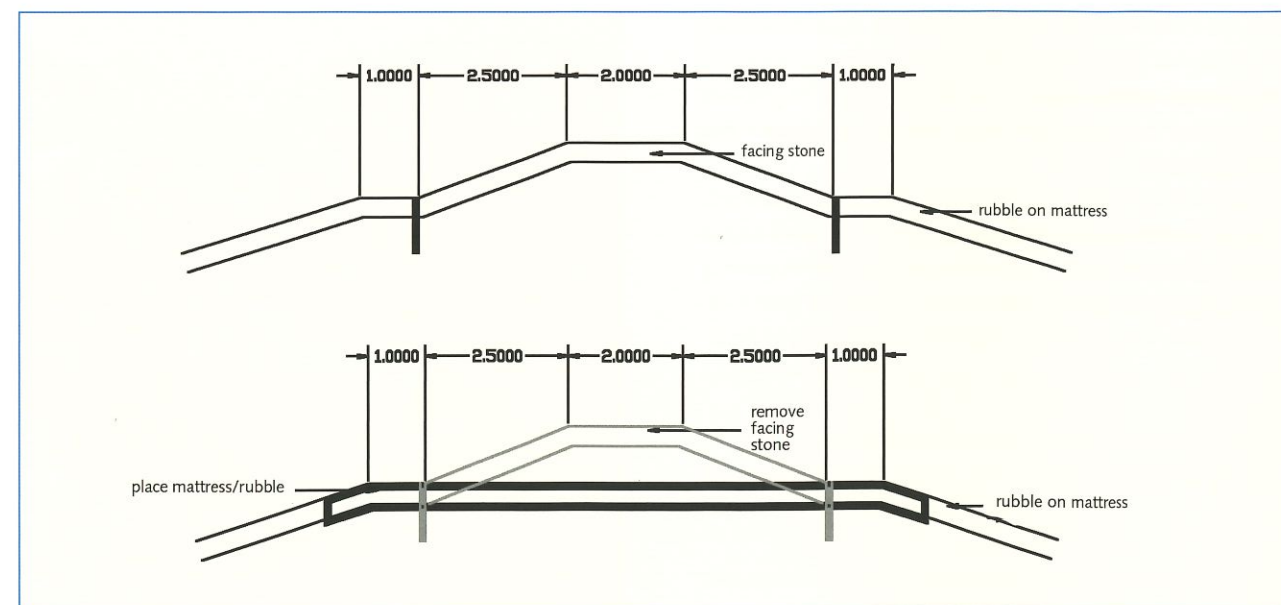
Lowering groynes along a river creates a greater cross-section for the water to flow through, which results in lower water during flood levels. This measure can be applied to all the rivers in the project area. Ongoing geological ground subsidence in the upper area of the Rhine river branches has resulted in the average height of the river groynes being higher than required to keep the river deep enough for boats to pass without touching the river bottom. This development makes it possible to lower the groynes without any adverse effect on river traffic. The groynes were lowered by about 1 meter.

Lowering the groyne results in a traditional groyne, which is covered on top by stones. See diagrams below:

Activities

- ~ Lowering groynes between the cities Nijmegen and Gorinchem
- ~ The existing stones will be removed and transported to a soil depot. Some of the stones can be temporarily stored and reused
- ~ The top 1-meter layer of soil will be removed and transported to a soil depot
- ~ The poles on top of the groynes will be removed

Before and after





Innovative transnational approach

Groynes with a new innovative design will be tested from 2004 to 2007. These groynes are lower on top and the side slopes are less steep, and a row of poles is at the end. The hydraulic effect of the new groynes should be greater (lower flood levels in the river at certain discharges), producing a 15-cm reduction in flood water level.

Organisations involved

Ministry of Transportation, Public Works and Water Management

Project implementation schedule

Project decision: 2011
Implementation: 2012 - 2015

Water storage in the Volkerak-Zoommeer (lake)

Project description

The Volkerak-Zoommeer will be used for flood water storage in case of extremely high water levels in the Hollands Diep and closure of the storm surge barriers in the *Nieuwe Waterweg* and *Hartelkanaal*. The water will then flow through the Volkerak locks from the Haringvliet into the Volkerak-Zoommeer (lake). This will lower the flood levels in the Haringvliet, the Hollands Diep, Spui, Amer, Oude Maas, Dordtsche Kil and the Noord. The required

safety level along the Haringvliet, Hollands Diep and Spui will then be maintained.

Water storage in the Volkerak-Zoommeer can be realised by making a few minor adjustments to the Volkerak and Krammer locks and to the dykes surrounding the Volkerak-Zoommeer.

The Volkerak-Zoommeer (VZM) from north to south consists of different bodies of water: the Volkerak, the Krammer, the Eendracht, the Zoommeer and the Bathse Spuikanaal. To the east of the Volkerak-Zoommeer lies the province of North Brabant and to the west are the islands of Goeree-Overflakkee, Tholen and St. Philipsland. The borders of the Volkerak-Zoommeer are formed by dykes 25 (Goeree-Overflakkee), 27 (Tholen and St. Philipsland), 34 (West-Brabant) and 31 (Zuid Beveland Oost) and the connecting dams Hellegatsdam, Grevelingendam, Philipsdam and the Oesterdam.

Dams separate the Volkerak-Zoommeer from the Hollands Diep, the Grevelingen and the Oosterschelde. Shipping is possible through the locks between the Hollands Diep and Volkerak-Zoommeer, between the Volkerak-Zoommeer and the Oosterschelde, and between the Volkerak-Zoommeer and Antwerp.

The Volkerak and the Zoommeer are part of a tide-free or tide-independent shipping route from the Rhine to the Schelde River. The Netherlands and Belgium have an agreement that the water level may not be higher than NAP +0.50 m because of the height needed to pass under three bridges along the Eendracht canal.

There is also a water agreement for the water level of the Volkerak-Zoommeer itself, which states that the level may vary from NAP -0.10 m to NAP +0.15 m.

The chance that water will be stored in the Volkerak-Zoommeer is once in 1430 years. This takes account of the average deviation between the predicted and actual water

Project area



level at Hook of Holland (9 cm). The level of the Volkerak-Zoommeer in that case will increase about NAP + 2.1 and NAP 2.5 m. This depends on the amount of river discharge and the storm water level at sea. This increase will last about 2 days, after which the water level of the Volkerak-Zoommeer will return to normal.

Activities

1. Dyke improvements and adjustments to structures that are part of the dykes;

An initial rough estimate shows that the safety of the dykes along the Volkerak-Zoommeer at flood water levels is sufficient. The dykes are high enough along every stretch. However, the dyke cover must be improved at certain locations and the dykes must be made more stable.

2. Adjustments to water release/flushing constructions (Volkerak locks and Krammer locks);

~ Adjustments to the Volkerak release sluices

To be able to use the Volkerak release sluices to allow high river discharge levels into the Volkerak-Zoommeer, two release sluices that are currently out of use must be put back into operation. Once these have been restored to their original function, four electronic installations will also have to be installed.

To prepare the release sluices for returning the retention water from the Volkerak-Zoommeer to the Hollands Diep after flood waters have subsided, the river or lake bed near the return sluices must be protected by a layer of rocks. These rocks must be placed along the whole width of the dams, at least 60 meters.

~ Adjustments to the Krammer locks

Lakebed protection on the Volkerak-Zoommeer side: the gravel bed will cover about 4.4 hectares and be at least 0.30 m deep.

Lakebed protection on the Oosterschelde side: the gravel bed will be as wide as the channel to the Oosterschelde and the whole channel will be covered.

3. Financial compensation for damage to buildings on river floodplain near Tholen;

The project to store water in the Volkerak-Zoommeer will result in higher water levels in the lake once every 1430 years. This means that given the current situation, some houses along the waterfront in Tholen will experience flood damage. Because the chance of this happening is so small, a budget for compensation has been reserved. After the

started, the need for further compensation and mitigation will be examined.

4. Possible damage to West-Brabant and necessary measures;

Research has shown that if the Volkerak-Zoommeer is used for flood water retention, possible peak discharges of rivers in West-Brabant will already have passed. The chance that both peaks (of the major rivers and of the smaller regional rivers) occur at the same time is very slim (<1/1430 years). However, during the two days that the retention measure is applied, meaning there is a higher water level in the Volkerak-Zoommeer, there is a 50-60% chance that the rivers in West-Brabant will have a higher-than-average winter discharge. This means that regional flooding and damage could occur near de Mark and de Vliet rivers. Furthermore, drainage of adjacent polders may be difficult under these circumstances, which means that if no measures are taken this can lead to further flooding and damage in these areas. The extent of the damage or measures to be taken is not known at this stage. This will be examined further in the planning phase of the project.

Innovative transnational approach

Using a water body for water storage purposes during periods of high river discharges has not yet been implemented in the Netherlands or the EU. Particularly this body of water, the Volkerak-Zoommeer, has a large influence on several functions, such as housing along the shores of the lake. In addition, the lake is part of an international shipping route between the harbours of Rotterdam and Antwerp.

The North Sea also has a major impact on this area. Studies on water storage near sea-dominated estuaries are quite new and innovative.

Organisations involved

Directorate-General for Public Works and Water Management (*Rijkswaterstaat*)

Project implementation schedule

Project decision: 1 July 2009

Implementation period: 2012-2014

This brochure is a publication of the projectorganisation Room for the River. The project Room for the River is an initiative of the Ministry of Transport, Public Works and Watermanagement, The Ministry of Housing, Spatial Planning and the Environment, and the Ministry of Agriculture, Nature and Food Quality.

For more information, please visit the website:
www.ruimtevoorderivier.nl

DESIGN AND PRODUCTION
Kris Kras Design BV, Utrecht

The main objective of the Spatial Planning Key Decision 'Room for the River' is to protect river areas from flooding by creating more space for water. This is necessary because the climate is changing and we have to anticipate wetter winters in the future. As a consequence, the rivers will take on more water, which means that the risk of flooding will increase. Raising the dykes alone is not a sufficiently long-term solution. New approaches are needed, involving the creation of more space for rivers by resituating the dykes and lowering the level of the floodplains. Alongside this, spatial-planning measures offer opportunities for improving the quality of the economy, ecology and landscape in river areas.

