

Flood protection and risk management

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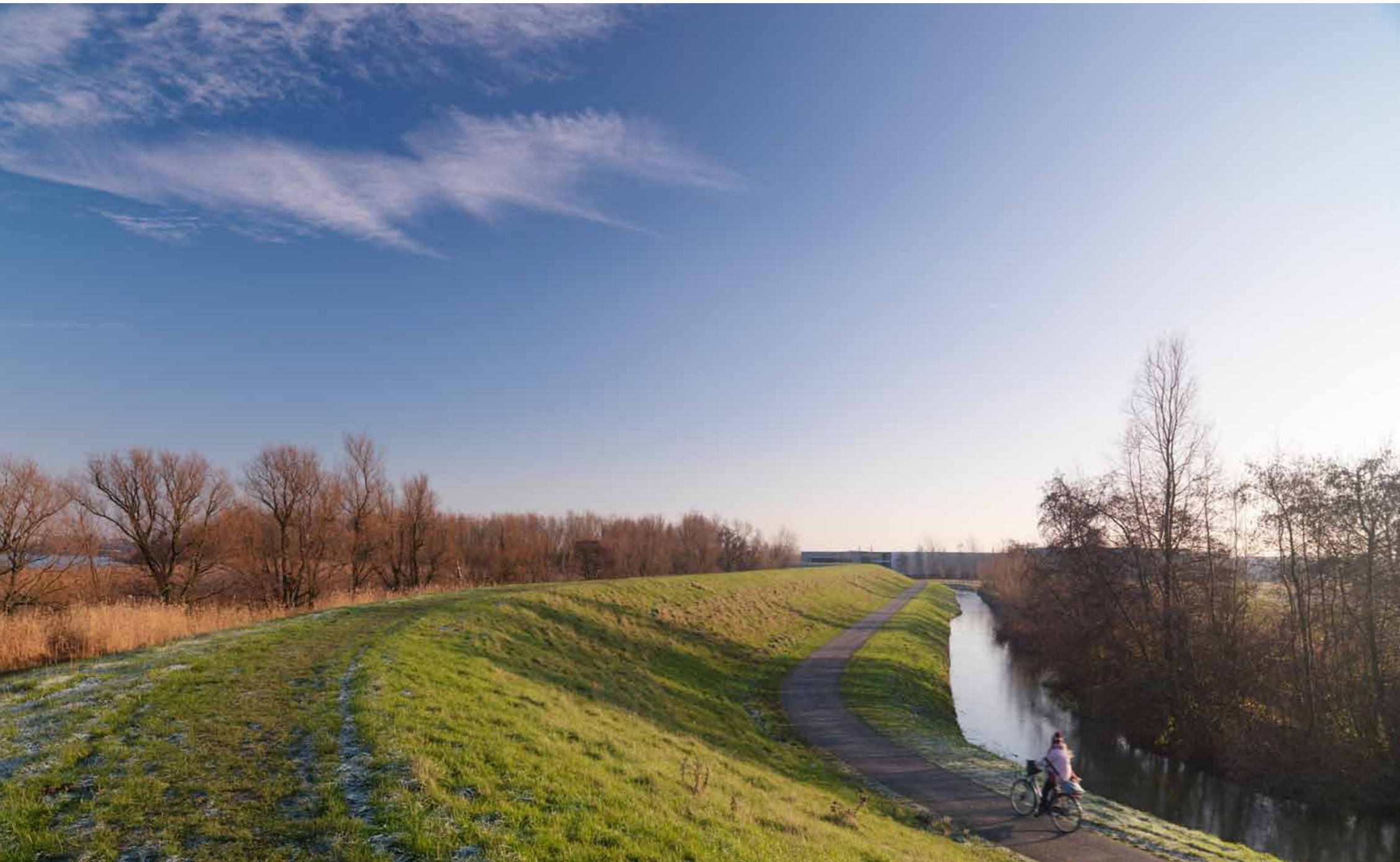
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Flood protection and risk management



Safeguarding low-lying countries such as the Netherlands from flooding is an ongoing process. Flood defences have to be continually monitored, strengthened and upgraded. For more than a century, ARCADIS specialists in flood defences have proudly contributed to the safety, growth and prosperity of the Netherlands.

ARCADIS has a full range of engineering and technical expertise to plan, design, assess and maintain flood defence infrastructure including dikes, dunes and dams along the coast, rivers and lakes.

Our goal is to create innovative and sustainable engineering solutions that blend seamlessly with the working and living environment. Our approach incorporates careful assessment of the potential impact on the physical and social environment, and of the opportunities to enhance nature and recreation. Delivering sustainable solutions requires involvement of stakeholders and open communication with all parties.

Specialist geotechnical consultancy





ESTABLISHING CURRENT STRENGTH OF DIKES WILNIS AND SURROUNDINGS (2008 - 2009)

In summer 2003, risk management by ARCADIS prevented further flood damage resulting from a breach in the Wilnis dike in North Holland. The long summer drought caused the largely peat dike to dry out and to weaken. This was a new phenomenon that prolonged drought and low water levels could reduce the strength of dikes.

In 2008, ARCADIS was commissioned to establish the strength and stability of the improved Wilnis dike and other dikes. Although safety standards limit dike deformation to 2%, dikes are generally stronger. To establish the actual strength of dikes, ARCADIS investigated the underlying ground conditions. Cone pressure tests were carried out, and boreholes drilled from which ground samples were taken. These samples were subject to detailed laboratory analysis including ten-step staged consolidation tests and Direct Simple Shear tests and the results were used in stability analysis (Mprostab and Plaxis models). These investigations have led to the establishment of new criteria for verifying dike strength.



Flood risk assessment



SAFETY ASSESSMENT OF FLOOD DEFENCES FOR THE DUTCH FLOOD PROTECTION PROGRAM (2006)

At five-year intervals, the condition of the primary flood defences is reported to the Dutch Minister for Transport and Public Works. ARCADIS carried out a safety analysis for 3500 km of flood defences including dunes, dikes, dams, and locks. The results provided input for the 2006 Dutch Flood Protection Program to maintain a safe flood protection system. The flood defences requiring improvement were identified and budget estimates prepared.



SAFETY ASSESSMENT OF FLOOD DEFENCES ALONG THE IJSSEL RIVER BETWEEN ZUTPHEN AND DEVENTER (2008-2009)

ARCADIS carried out a safety assessment of the flood defences along the IJssel River which protect the city of Arnhem and surroundings. This assessment is a requirement under the Dutch Flood Protection Program and was commissioned by the Rhine and IJssel Water Board.

ARCADIS established hydraulic design criteria to assess the condition of dikes and hydraulic structures against the Dutch National Flood Safety Standards. In addition, the impact was assessed of trees on the dikes, house cellars, and pipes and cables close to the dikes on the strength and stability of the dikes.

SAFETY ASSESSMENT OF FLOOD DEFENCES ALONG THE MEUSE RIVER BETWEEN BOXMEER AND HEUSDEN (2008-2009)

ARCADIS carried out a safety assessment of the flood defences along the Meuse River between the towns of Boxmeer and Heusden. This assessment is a requirement under the Dutch Flood Protection Program and was commissioned by the Aa and Meuse Water Board.

Ground investigations were carried out in order to assess the condition of dikes and hydraulic structures against the Dutch National Flood Safety Standards. ARCADIS assessed the structural strength and stability of five hydraulic structures, including stability with regard to the mechanism of piping and heave.



Flood defence schemes

Protection against flooding from rivers and lakes



RIVER DEFENCE SCHEME FOR SPUI WEST (2009)

ARCADIS prepared a river defence scheme and carried out an environmental impact assessment for Spui West which has been identified for improvement under the Dutch Flood Protection Program. The work was commissioned by the Hollandse Delta Water Board.

Several solutions were identified and developed to safeguard the coast against flooding for the next 50 years taking into account increasing river discharge and climate change. To facilitate the decision-making process, ARCADIS developed a methodology to compare environmental impact. The design for the preferred solution was also prepared.



RIVER DEFENCE SCHEME FOR HELLEVOETSLUIS (2009)

The Hollandse Delta Water Board commissioned ARCADIS to prepare a river defence scheme and carry out an environmental impact assessment for Hellevoetsluis.

This project is of particular interest as the dikes are part of the ancient city wall and also border on ecologically sensitive areas designated by Natura 2000.

ARCADIS prepared the design for the preferred solution and carried out geotechnical analysis.



RIVER DEFENCE SCHEME FOR HOEKSCHE WAARD NOORD (2008-2010)

Four sections of primary river defences of approximately 2 km in length have been identified for improvement. ARCADIS was commissioned by the Hollandse Delta Water Board to prepare a flood defence scheme and to carry out an environmental impact assessment. Several solutions were developed and a preferred solution designed. Special consideration was given to the many interests in the area such as agriculture, environment, recreation, and commercial activities. In addition ARCADIS prepared the submissions for the planning application and the nature mitigation plan.



RIVER DEFENCE SCHEME AND ARCHEOLOGICAL INVESTIGATION FOR MARKERMEER DEFENCES BETWEEN ENKHUIZEN AND HOORN (2008)

The Hollands Noorderkwartier Water Board commissioned ARCADIS to prepare a flood defence scheme for the dikes along the IJsselmeer between the towns of Enkhuzen and Hoorn. During an archaeological investigation, ARCADIS discovered remnants of the ancient dike. Archaeologists from ARCADIS managed the excavation work in cooperation with the client, contractor, and the Municipality of Hoorn.



RIVER DEFENCE SCHEME FOR IJSSELMEER DEFENCES BETWEEN HOORN AND EDAM (2008-2010)

This 18 km section of primary flood defences along the IJsselmeer has been identified for improvement. ARCADIS was commissioned by the Hollandse Delta Water Board to prepare a flood defence scheme, and an environmental impact assessment. Several solutions were developed and a preferred solution designed. In addition, the safety assessment of hydraulic structures was conducted and improvements designed.

ARCADIS provided consultancy services for archaeology, nature, environment, land purchase, planning application, and the tender process. ARCADIS was also the client representative during construction of the improvements.



Flood defence schemes

Protection against sea flooding and coastal erosion



COASTAL DEFENCE SCHEME FOR KATWIJK AAN ZEE (2008-2010)

Katwijk aan Zee is one area along the Dutch coast identified for improvement of the flood defences. ARCADIS prepared a flood defence scheme to incorporate improved coastal infrastructure as well as attractive public spaces and recreational areas. Several solutions were designed taking into account sea level rise and climate change. After stakeholder and public consultations, the preferred solution is an attractive esplanade protected by a low sand dune incorporating a hidden hard revetment. ARCADIS also carried out an environmental impact assessment, prepared the design for the preferred solution, and organised permit applications from government authorities.

COASTAL DEFENCE SCHEME FOR HONDSBOSSCHE AND PETTEMER SEA DEFENCES (2008-2010)

This 6 km section of primary coastal sea defences - Hondsbossche and Pettemer - along the Dutch coast has been identified for improvement. ARCADIS prepared a coastal defence scheme and carried out an environmental impact assessment. Several solutions have been developed taking into account sea level rise and climate change in order to safeguard the coast against flooding for the next 50 years.

ARCADIS managed an extensive ground investigation in order to establish the strength of the ground.

Consideration was given to the impact on ecologically sensitive areas, including those designated by Natura 2000, and the interests of residents and the general public. In cooperation with the client, solutions were selected to augment safety and to improve the public space including a large-scale beach nourishment program.

