# Spatial adaptation in coastal environments

## New possible synergies between flood protection infrastructure and urban landscape design

Iuorio, Luca

**Publication date**
2022

**Document Version**
Final published version

**Published in**
Towards Improved Flood Defences

**Citation (APA)**
Iuorio, L. (2022). Spatial adaptation in coastal environments: New possible synergies between flood protection infrastructure and urban landscape design. In M. Kok, J. Cortes Arevalo, & M. Vos (Eds.), *Towards Improved Flood Defences: Five Years of All-Risk Research into the New Safety Standards* (pp. 47-50). TU Delft OPEN Publishing.

*Edited by*
Matthijs Kok
Juliette Cortes Arevalo
Martijn Vos

# Towards Improved Flood Defences

## *Five Years of All-Risk Research into the New Safety Standards*

Risk

# Towards Improved Flood Defences

*Five Years of All-Risk Research into the New Safety Standards*


Editors

Matthijs Kok | Juliette Cortes Arevalo | Martijn Vos



TU Delft OPEN

# Table of Contents

**Article**
Background knowledge about flood risk

**Project Summary**
Overview of All-Risk research

**Storyline**
Highlighting All-Risk case studies

**Reflection**
Discussing the practical value of All-Risk research

Chapter 2
Risk Framework

Chapter 6
Law, Governance and Implementation

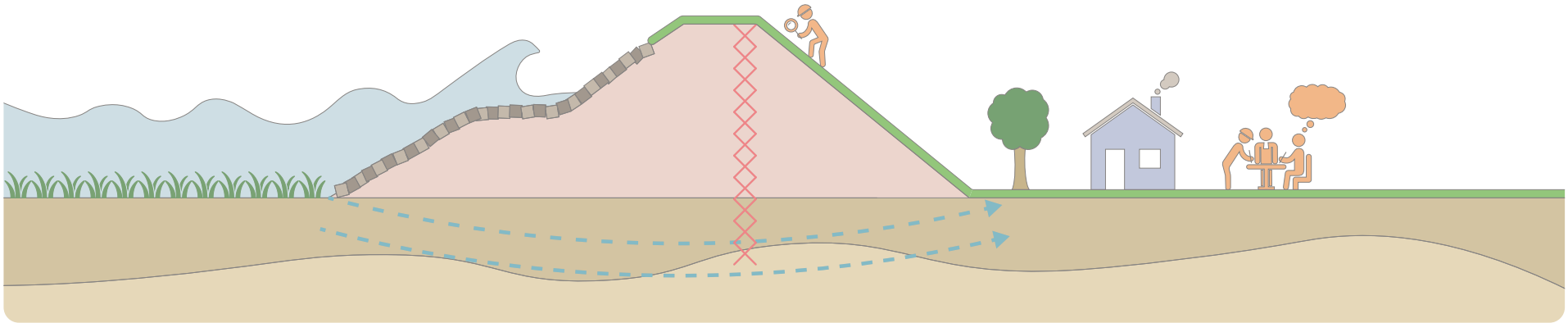
Chapter 3
Dynamics in Hydraulic Loads

Chapter 4
Subsurface Heterogeneity

Chapter 5
Reliability and Strength of Flood Defences

*Chapters 2 and 6 address cross-cutting themes that are relevant for the overall risk framework and the implementation cases.*

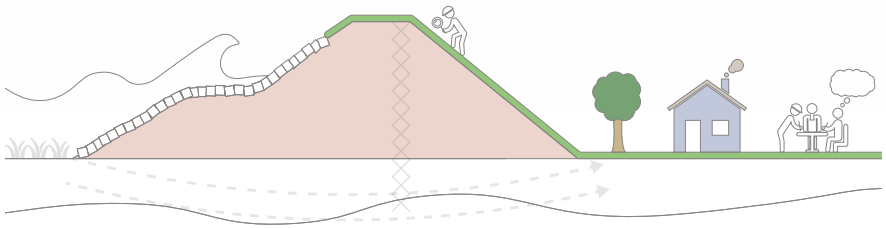




# Project Summary

## A4 - Spatial adaptation in coastal environments

*New possible synergies between flood protection infrastructure and urban landscape design*



**By Luca Iuorio**
*Delft University of Technology*

Project start: 09/2020
Project end: 09/2022

**Contributors**

Dr. ir. F.L. Hooimeijer
*Delft University of Technology*

Prof. dr. ir. M. Kok
*Delft University of Technology*

### Outcome

The current flood risk-related challenges induced by climate change place pressure on designing urban areas where natural and man-made conditions can be imbalanced. Today, flood risk is mostly managed to reduce the probability of flood events. However, the engineered probability approach to flood risk management might not always result in a well-designed landscape; especially in floodplain and coastal areas, water defence infrastructures significantly impact the urban structure. This project output highlights new possible synergies between flood protection infrastructure and urban landscape through integrated design. Designing, indeed, is the fundamental act to explore the spatial challenge of climate change in its complexity.

Figure 1: Ems bay seen from Delfzijl beach, Dutch Wadden Sea. Photo by Luca Iuorio.

## Motivation and practical challenge

Especially in the Dutch context, awareness increases that design and engineering are two sides of the same coin. In the last decades, this awareness gave birth to several experimental programmes in which flood risk management measures increasingly demand to overcome the division and practical silos between urban planning and flood management. Making space for water has become one of the hallmarks of a new generation of flood management plans and strategies that address a renovated attitude in living closer with water. However, living with water includes the discipline of spatial design more than the dominant engineering-based risk paradigm. Spatial development is a part of the risk approach, and engineering is a part of the spatial design. Therefore, by better considering the history, dynamics, and transitional aspects of urbanised areas, it is possible to envision alternative ways to adapt to climate change and the environmental crisis through the means of the design, in its infrastructural and spatial features.

Figure 2: Family swimming in the Wadden Sea, Eemshaven, August 2021. Photo by Luca Iuorio.

## Research challenge

The main question of the research is how to translate the risk approach (a product of the probability of flooding and its societal and economic consequences) into its spatial aspects. By better considering citizens' attitudes of perceiving and experiencing cities, landscapes and places, new possible perspectives in the flood defence system emerge to integrate spatial dimensions of protected areas to reduce the overall risk.

## Innovative components

The research explores the possibility to further demonstrate that flood defence infrastructures can be developed within a spatial approach. We recognised that flood defences are physical manufactures integrated into the urban landscape that impact urban development and the way people interact with water (and water-related risks) through the flood defences. This research explores alternative models of coastal management by integrating spatial planning and design. The spatial integration into the landscape of the traditional dikes and innovative nature-based measures, accepting water overtopping, implementing temporary dikes, and land-use change are developed as the main actions to reduce the overall flood risk of the Dutch coastal urban environments. Through this exploration, we produce future visions to show how including whole urban areas in the design of water protection systems can establish more complex and resilient flood management through spatial measures.

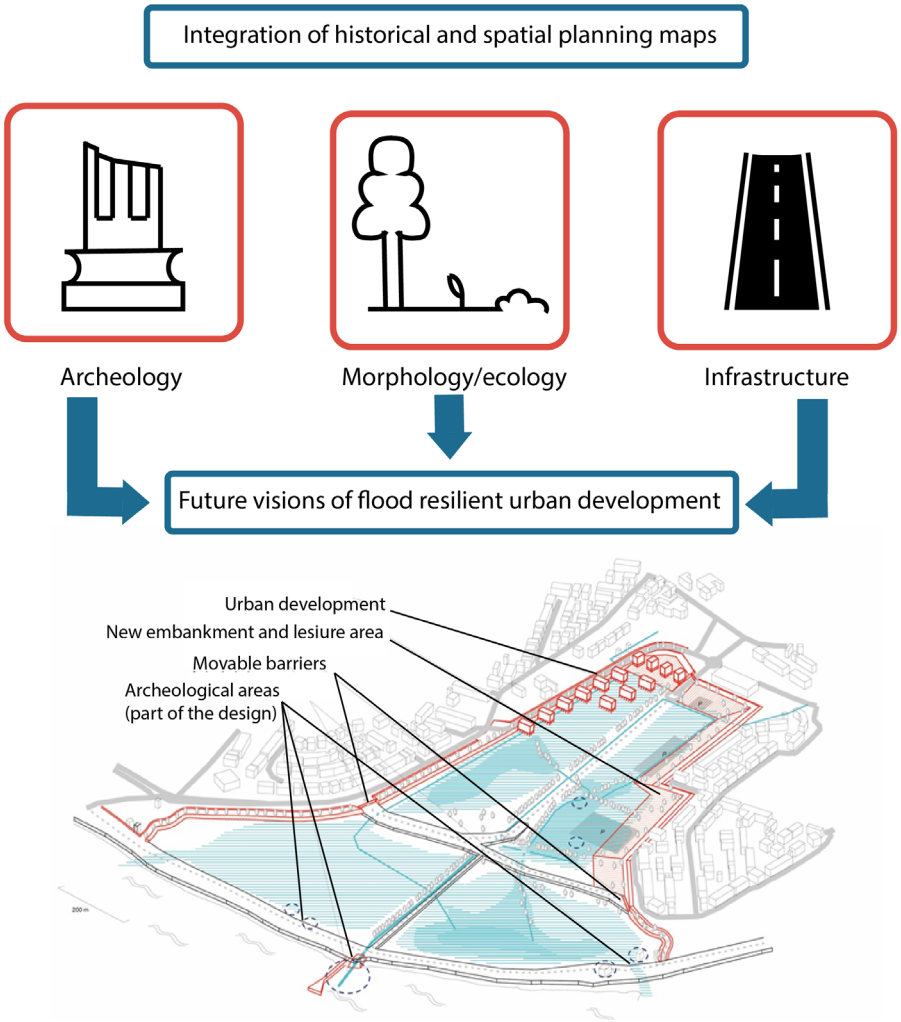



Figure 3: Schematic representation of the innovative components. Future vision examples for Southend-on-Sea drawn by Andrea Bortolotti and Luca Iuorio.

## Relevant for whom and where?

This project is relevant for both flood risk and spatial planners. The research deals with the big physical inheritance of the coastal built environment where changes in building and planning infrastructures by specialists may also impact the attitude of perceiving and experiencing cities, landscape and places by citizens.

## Findings and practical application

Referring to the Vlissingen (NL) and Southend-on-Sea (UK) Interreg SARCC project locations (see https://www.interreg2seas.eu/en/SARCC), we proposed accepting wave overtopping and building a secondary defence line instead of heightening the existing primary defence line. In such a way, we adapted specific zones to function as a retention basin for excess water in the case of extreme events while using the existing and enhanced drainage network that drains the area at the end of the storm. The visions for these urban areas into floodable parks better integrate the flood defences with new developments, enhance public spaces, and consider recreational functions. Moreover, we designed the new urban development inside the area to be flood-proofed (e.g., raised on piles or alternative ground floor functions, such as car parks). The resulting spatial interventions help stand a flood event in the future by reducing its impacts. The dike continues shaping the city as a fundamental part of it but represents only an element of the complex and broader territorial design. In contrast, the storage areas – where water once overtopped the dike and that can now store water – are an active part of the urban environment; the seasonal controlled floods change the configuration of the open spaces, adapting urban fabric to the storm events. For a detailed description of the findings, **check the project outputs on the next page**.

## Recommendations for practice

- Design flood defences by also coming to terms with the spatial form of the cultural landscapes and the technical construction of urbanised areas.
- Try to develop flood defence innovations by reducing the probabilities and the consequences of flood risk.


The research includes pilot locations in the Netherlands but also in the UK and Italy. Note: The designs for Vlissingen and Southend-on-Sea have been developed within the context of the Interreg SARCC Project.

Double Dike. Photo by Waterschap Noorderzijlvest.

## Key project outputs

Iuorio, L. & Bortolotti, A. (2021). Integrated coastal flood design: changing paradigm in flood risk management
Doi: 10.24404/616051311d74bb0008d549ca