

Tides of change

Maritime heritage and climate-adaptive design in evolving landscapes

Roos Boerma
Research plan

4856538

01 / 11 / 2024



Denkend aan Holland
zie ik **breede rivieren**
traag door oneindig
laagland gaan,
rijen ondenkbaar
ijle populieren
als hoge pluimen
aan den einder staan;
en in de **geweldige**
ruimte verzonken
de boerderijen
verspreid door het land,
boomgroepen, dorpen,
geknotte torens,
kerken en olmen
in **een grootsch verband**.
de lucht hangt er laag
en de zon wordt er langzaam
in grijze veelkleurige
dampen gesmoord,
en in alle gewesten
wordt **de stem van het water**
met zijn eeuwige rampen
gevreesd en **gehoord**.

H. Marsman - 1936

Contents

Introduction	p. 4
Problem statement.....	p. 6
Research questions	p. 8
Methodology.....	p. 11
Planning	p. 14
Bibliography.....	p. 16

Introduction

The Netherlands connection to water is intrinsic to its history and cultural heritage, defining the county's landscape and identity. This legacy is especially visible in the Waterdriehoek; a region where the cities of Dordrecht, the Biesbosch and the Kinderdijk windmills form a unique landscape tied by water as one of the seven "heritage lines" in South Holland (Rijksdienst voor het Cultureel Erfgoed, 2024). A heritage line is a geographic line connecting various locations that share a common historical narrative. By designating them as heritage lines, the cultural landscape becomes more visible (Hein, 2020). Situated at the edge of the Dutch delta, the Waterdriehoek represents centuries of Dutch expertise in water management. Water protection measures have been implemented in this low-lying area for centuries, with most flood prevention applications dating back to the 18th and 19th centuries (Toebast, 2012). With the St. Elizabeth Flood in 1421, the area got reshaped, which marks the beginning of the present-day Biesbosch, a freshwater tidal landscape defined by reed beds and creeks. Over centuries, this area witnessed further storm surges and floods, which led to extensive land reclamation. In the 17th century, this served as a catalyst for the development of new water-related industries (Hein, 2020). This historical intertwining with water in the Waterdriehoek is evident not only in the history of shipyards but also in dikes, mills, pumping stations, griend (willow) cultivation, and fishing (Rijksdienst voor het Cultureel Erfgoed, 2024).

Industrial growth accelerated in the 19th and 20th centuries with the construction of the Nieuwe Waterweg, transforming the region from Hoek van Holland to Gorinchem into an industrial hub

for shipbuilding, dredging and metal working (Arcadis, 2024). The riverbanks of the Noord and Merwede attracted industries for shipping and steel production due to convenient river access and low land costs (Hein, 2020). By the early 20th century, approximately 90 shipyards operated in the Merwede area, establishing it as an internationally recognised shipbuilding centre (Arcadis, 2024). However, economic shifts in the 1970s, coupled with the creation of the Maasvlakte industrial zone, led to a westward shift in activity, leaving behind many historic shipyards and maritime heritage sites that are now largely vacant, as can be seen in figure 2 and figure 3. This maritime heritage, stripped of their original infrastructure and equipment, have garnered interest for redevelopment, blending architectural preservation with new uses (Arcadis, 2024).

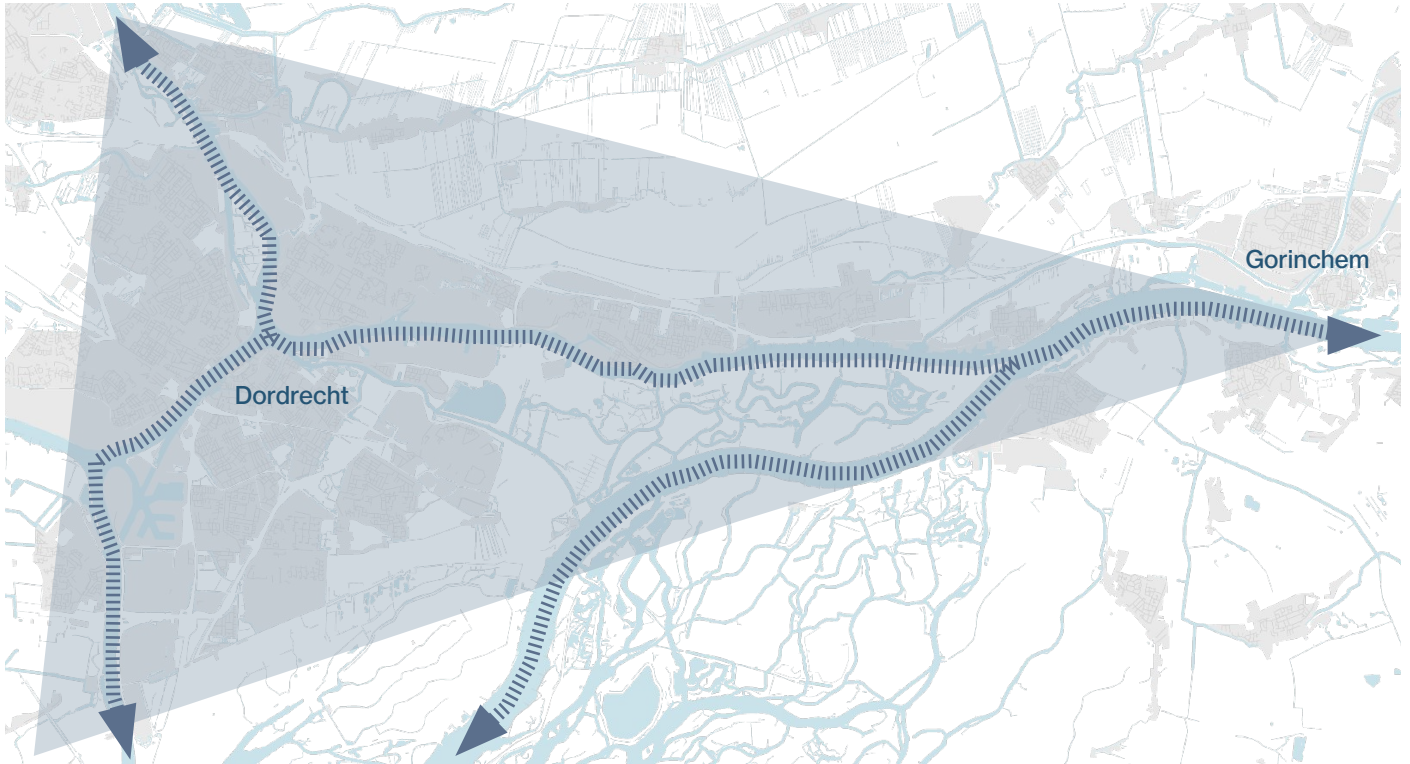


Figure 1: Waterdriehoek region (own image)



Figure 2: Delta Shipyard Wharf 1960-1970
(FotoArchief Gemeente Sliedrecht, n.d.)



Figure 3: Delta Shipyard Wharf 2020,
(Sliedrecht 24, 2020)

Problem Statement

Today, climate change poses significant threats to the Waterdriehoek's maritime heritage. This vulnerable delta, balanced by sedimentation and water inflow, has been disrupted by industrialisation over the past two centuries, accelerating sea-level rise and peak river discharges that strain the landscape (Gramsbergen, 2021). The Netherlands, with one-quarter of its land below sea level and many rivers converging within its borders, is highly vulnerable to climate impacts, facing increased flood risks and water management challenges (Daamen & Taylor, 2022).

Erratic climate conditions brings rising water levels, unpredictable river peaks and wetter winters, all heightening flood risks. Under extreme scenarios, river basins may produce flow volumes 20 to 30 percent greater than current design capacities, overwhelming existing flood protections (Klijn, 2019). Despite resilience projects like 'Ruimte voor de Rivier', further action is required to protect both natural and cultural heritage (Ministerie van Infrastructuur en Waterstaat, 2024).

The Waterdriehoek is particularly endangered, as it holds both ecological and historical value within a rapidly changing delta. Designated as a heritage line due to its cultural significance, this area contains centuries-old maritime infrastructure that tells the story of Dutch resilience against water. However, climate change threatens this historical narrative, and new adaptive strategies are urgently needed to preserve this heritage. The challenge now lies in developing research and design approaches to adapt maritime heritage to future climate scenarios. Meeting this challenge calls for collaborative efforts between developers to rethink, redesign and reinforce these sites

against the impacts of climate change (Daamen & Taylor, 2022). Addressing this issue at all scales, including architectural adaptation, offers hope for preserving the Waterdriehoek's invaluable maritime history for future generations.

This research paper examines the landscape developments and history of the Waterdriehoek to identify steps for preserving its maritime heritage and guiding the design of climate-resilient buildings. Learning from the past in the field over landscape and architecture, can form a strong foundation for how we should tackle future problems. The cultural maritime heritage and accumulated knowledge of water management over time can serve as valuable resources for a deeper analysis of the area. Within the Waterdriehoek, this research emphasises the area along the Beneden Merwede between Dordrecht and Gorinchem.



Figure 4: Painting of the St. Elizabeth Flood in 1421. The 44 villages in this painting are said to have all been swallowed by the water. On the foreground is Dordrecht, with the land of Heusden and Altena in the upper left. (Weingärtner, 1857)



Figure 5: Hoogwater in Gorinchem (Alblas, 2023)

Research Questions

In response to the problem statement, an effort is made to answer the following research question:

How have historical landscapes influenced the maritime architectural development in the Waterdriehoek, and what can we learn for designing climate-resilient buildings?

The main research question is broken down into several sub-questions that discuss and answer various aspects of this topic:

Historical research

1. How has the climate shaped the river landscapes of the Waterdriehoek over time?
2. How have historical landscapes in the Waterdriehoek influenced the development of maritime architectural forms over time, and vice versa?
3. What architectural measures did historical communities in the Waterdriehoek implement to protect against climate threats?

Design supporting research

1. What are the requirements and needs for creating a climate-resilient built environment? How can this be architecturally translated into heritage buildings?
2. What lessons from historical architecture in the Waterdriehoek can inform the new design of climate-resilient buildings?

The sub-questions are divided into two categories. The first category focuses on historical research in the Waterdriehoek concerning landscape and architecture and their developments. The second focuses on design-supporting research, with the aim of formulating design guidelines for integrating climate-resilience into maritime heritage in the Waterdriehoek and establishing a link with the area's history.

Link to project and broader relevance

This study connects with the Graduation Studio through its focus on maritime heritage in the Waterdriehoek and its connection between water and land. Research into the area's history and the interaction between landscape and built environment creates a stronger understanding of the area's past and present, laying the groundwork for the design project. Through the design, insights gained during the research process are applied to the future of this area.

The study is relevant not only to this project but also to the entire Waterdriehoek. As noted in the introduction, climate change presents various challenges, especially in this vulnerable area. Changing landscapes, climate threats, material shortages, and increased pollution are factors that must not be ignored in current design projects.

Additionally, also the transformation of heritage is increasingly important for minimising our environmental footprint, while also creating new opportunities for future heritage. The reuse, adaptation, and redesign of heritage can enhance the quality of the urban environment and with making it more climate-resilient it becomes more future proof. Understanding and analysing the relationship between water and heritage can also aid in a better understanding of both tangible and intangible heritage (Hein, 2020).

State of the Art

Considerable research has been conducted on maritime heritage, past developments, current issues, and future strategies. Particularly in the Netherlands, extensive information is available on this topic, as it is a common occurrence.

Out of the 13 Dutch sites on the UNESCO World Heritage list, seven have a relationship with water (Rijksdienst voor Cultureel Erfgoed, 2024). Moreover, research on climate change and its impact on the Dutch delta landscape has already been conducted. However, the link between these two subjects has not yet been established specifically for the Waterdriehoek. Additionally, previous research has not emphasised the architecture of maritime heritage itself, with climate adaptation mainly focused on the landscape scale. This study bridges these topics within the context of the Waterdriehoek.

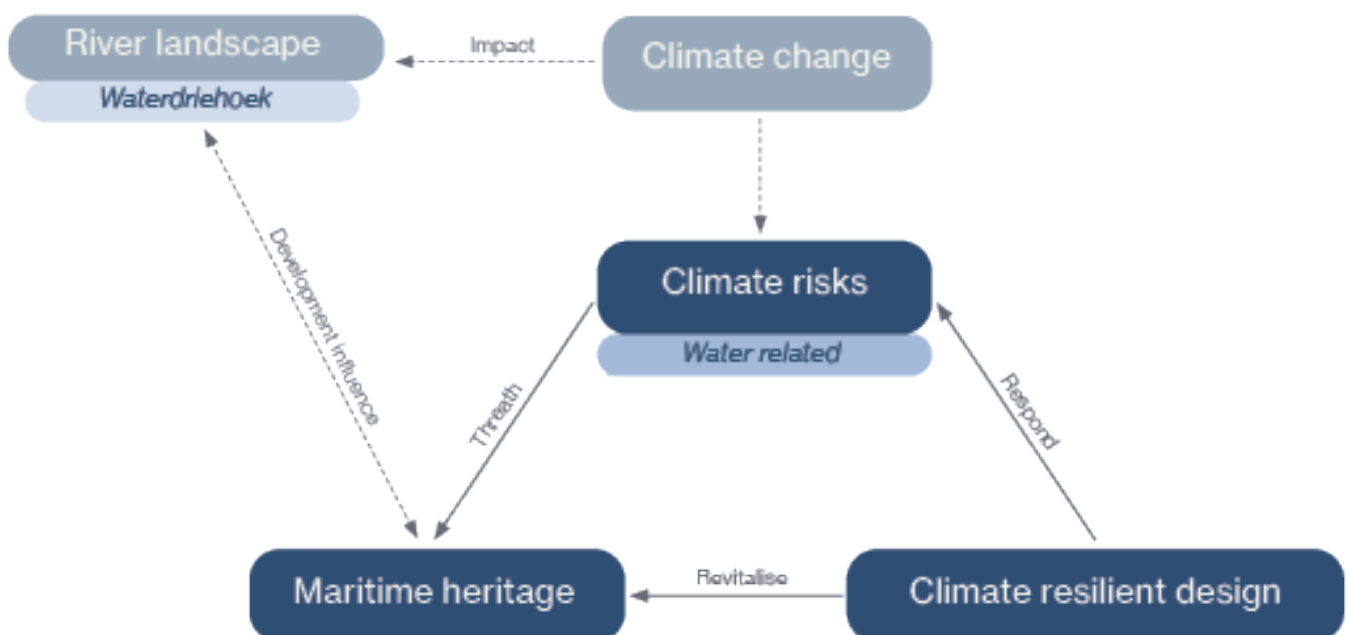


Figure 6: Relationship between the research topics (own image)

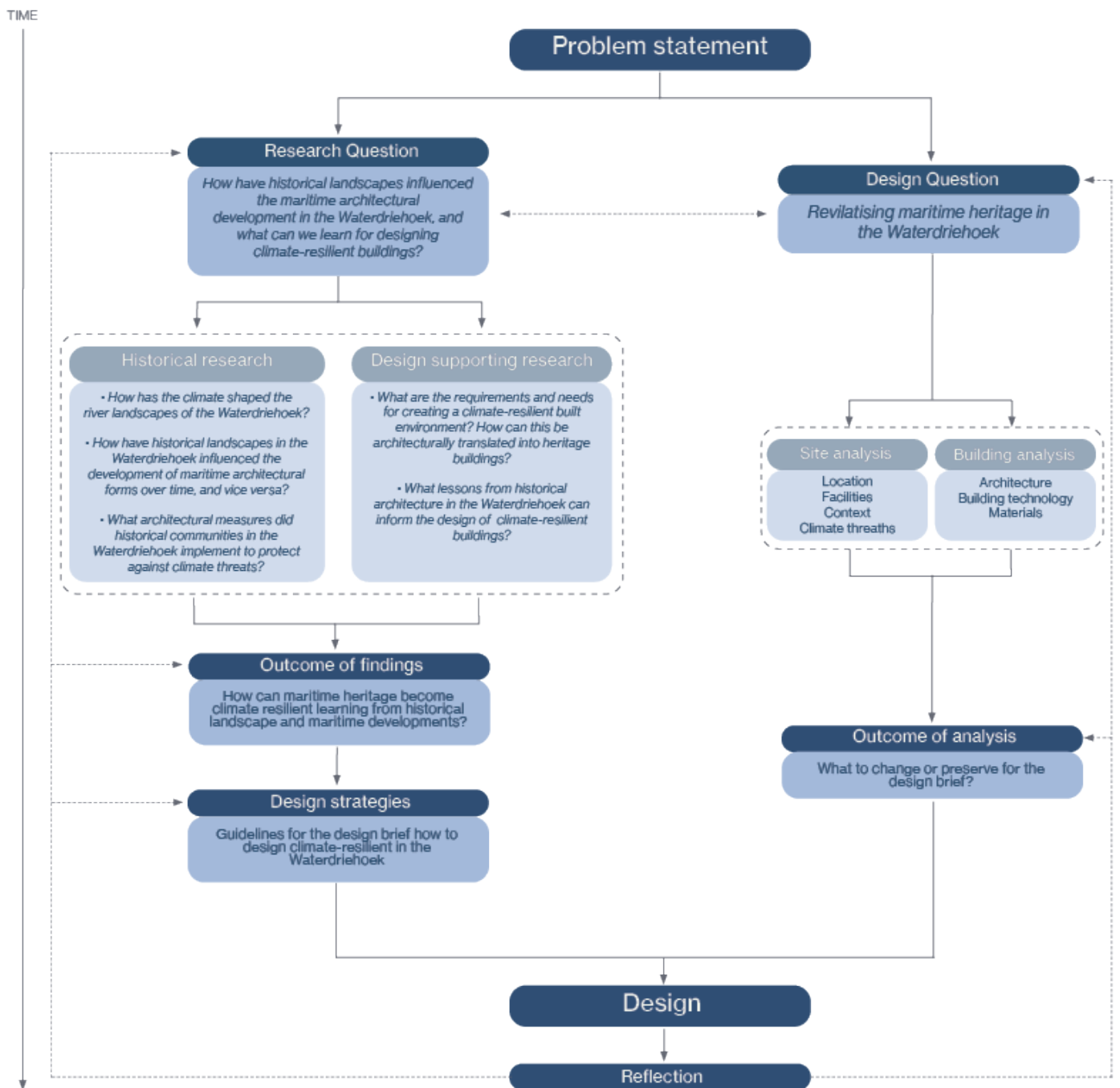


Figure 7: Relationship between research and design question (own image)

Methodology

Methods

The research for the main question is divided into two parts, focusing first on the historical aspect of the area, then on developing design guidelines. Each sub-question is addressed with different methods, though there will be some overlap. The methods used are outlined below.

Literature research

Literature research will be a major component of the study, providing insights into the historical developments of the Waterdriehoek in the field of maritime architecture and the relationship with the waterscape. The history of the maritime heritage in the Waterdriehoek can tell us more about the architecture and its position in society. This research will also offer substantial background on general phenomena, such as climate change and heritage-based design strategies and designing climate-resilient. Information will be gathered from books, municipal documents, and other public records, which are available through the faculty library, the library of *Rijksdienst voor het Cultureel Erfgoed* and online databases as *Scopus* or *Google Scholar*. This literature provides a foundation for a deeper understanding of the topics and forms the basis for the research.

Spatial analysis

Spatial analysis is another essential method. By comparing historical and current maps, a visual overview of changes in the area is created, encompassing both landscape transformations and changes in the built environment of the Waterdriehoek. With the St. Elizabeth's Flood as one of the most impactful changes in the landscape, this event is used as the starting point for the research. The website *Topotijdreis* provides access to maps over the years; however, as this resource only goes back to the 19th century, other

sources will be needed for earlier periods for the historical cartographic analysis. At the faculty of Bouwkunde, the 'Kaartenkamer' provides different atlases with historical maps of the Netherlands. On the website of *De Vereniging voor Waterstaatgeschiedenis*, the 1st and 5th editions of the 'Waterstaatkaart' can be found, which illustrate the water management situation in the Netherlands over the years. Additionally, *De Atlas Leefomgeving*, a governmental website with various climate-related maps, will support the climate-adaptive design component of the research.

Archival research

Archival research involves examining historical documents, drawings, news articles, and photographs from the Waterdriehoek, offering insights into the maritime structures and their relation with the waterscape, and the architectural styles of the structures. This method substantiates the historical research, providing a basis for design research for the maritime heritage structures in the area. Municipal archives within the Waterdriehoek as Sliedrecht, Dordrecht, Alblasserdam and Gorinchem will be consulted for this purpose.

Theoretical framework

The research question is addressed using the methods described above. However, some topics require additional theoretical background to ensure a comprehensive approach. This theoretical framework is divided into three categories, each supported by relevant literature.

Historical Landscape and Maritime Structures

Adaptive Strategies for Water Heritage: Past, Present and Future by Hein (2020)

This book, initiated by experts from CHGD and ICOMOS, presents a multidisciplinary study that connects water with heritage. It argues for

the need for integrated policies focusing on the preservation, transformation and adaptive reuse of maritime heritage. The book illustrates how these interventions can help us develop sustainable futures for cities, landscapes and maritime structures. Arie den Boer's chapter focuses on the Alblasserwaard region, located within the study area the Waterdriehoek, making it highly relevant to the application of this research.

Water Management and Cultural Heritage (OverHolland) by Gramsbergen et al. (2021)

This book describes how water management has shaped Dutch cities and landscapes over the centuries, particularly through map series that illustrate changes in the water system. The comparison between Venice and Rotterdam by Han Meyer also provides valuable insights into how cities struggle with their location in deltas and lagoons. Additionally, the discussion of the Dutch waterscape as a historical system and the redesign of traditional water landscapes offer useful perspectives for analysing the impact of water management on maritime heritage.

Designing Climate-Resilient

Climate-Responsive Design: A Framework for an Energy Concept Design-Decision Support Tool for Architects Using Principles of Climate-Responsive Design by Looman (2017)

This book on climate-responsive design provides architects with a framework to manage environmental challenges. It gives guidance for integrating climate considerations early in the design process. It focuses on the relationship between a building's energy needs and its local environment, suggesting solutions like adaptive building elements. The framework helps architects assess site-specific factors such as wind, water

and solar exposure but also adaptable insulation and water management. In this way, the design enhances both energy efficiency and protection against climate induced threats, such as flooding. This approach aids in balancing environmental, functional and aesthetic objectives, which is crucial for protecting riverside heritage buildings.

Adaptive planning for resilient coastal waterfronts: Linking flood risk reduction with urban development in Rotterdam and New York City by van Veelen (2016)

This thesis explores adaptive planning strategies for resilient urban waterfronts, focusing on flood-prone areas including Rotterdam. Using the Adaptation Pathway Method (APM), it connects flood risk reduction with urban development to create climate-resilient strategies. Although it emphasises area-wide approaches, it also addresses building-level measures such as wet-proofing and dry-proofing, which reinforce individual structures against floods. These building adaptations are discussed as essential components within a broader strategy to enhance resilience across entire urban waterfront areas.

Designing with Heritage Buildings

Heritage-Based Design by Meurs (2016)

The book *Heritage-Based Design* addresses how to design within a historical context and establish a strong connection to the site. The emphasis lies on the approach to the project and an understanding of the elements present at the site - beyond just the building itself. According to Meurs, the design task can be symbolised as a triangle, with cultural value and technology as the foundation of the design. This is crucial for creating an integrated plan to develop climate-resilient maritime heritage in the Waterdriehoek.



Figure 8: River Beneden Merwede (FotoArchief Gemeente Sliedrecht, n.d.)



Figure 9: Probability of flooding from sea, rivers and lakes at the Waterdriehoek (Atlas Leefomgeving, 2022)

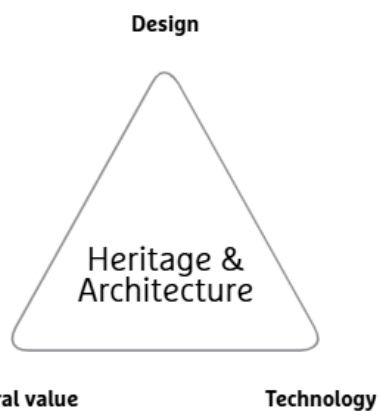


Figure 10: The triangle of Heritage & Architecture (Meurs, 2016)

Planning

To provide a clearer overview of the process and developments in the research, a general schedule has been created for the research and design phases. With an initial focus on research at the beginning of the process, it gradually shifts more toward design between P1 and P2. In the first phase of the research, the process begins primarily

with literature research, which is eventually combined with spatial analysis. The findings from this are translated into design guidelines that support the initial steps of the design phase. When the research reaches its final stage by the end of P2, the focus shifts entirely to the design.

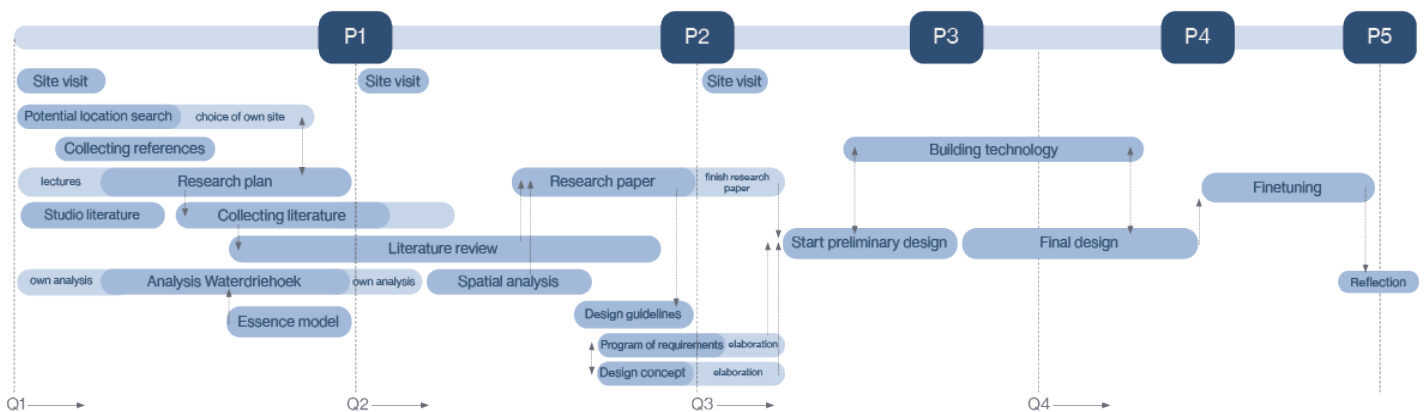


Figure 11: Global planning research and design (own image)

Bibliography

Sources in text - alphabetic

Arcadis, (2024).

[file:///C:/Users/RAMBo/Downloads/verkenning-herijking-erfgoedlijn-waterdriehoek%20\(1\).pdf](file:///C:/Users/RAMBo/Downloads/verkenning-herijking-erfgoedlijn-waterdriehoek%20(1).pdf)

Atlas Leefomgeving | Atlas Leefomgeving. (n.d.).

<https://www.atlasleefomgeving.nl/>

Daamen, T. A., & Taylor, Z. (2022). “Gebiedsontwikkelaars moeten keihard met klimaatadaptatie aan de slag”, Gebiedsontwikkeling.nu.

<https://www.gebiedsontwikkeling.nu/artikelen/gebiedsontwikkelaars-moeten-keihard-met-klimaatadaptatieaan-de-slag/>

Gramsbergen, E. H., Rutte, R. J., Engel, H. J., Diesfeldt, O. R., Pane, I., & Fraune, J. (Eds.) (2021). *OverHolland 21: Water management and cultural heritage*. (21 ed.) (OverHolland; Vol. 13, No. 21). Koninklijke Nederlandse Oudheidkundige Bond (KNOB).

<https://doi.org/10.7480/overholland.2021.21>

Hein, C. (Ed.) (2020). *Adaptive Strategies for Water Heritage: Past, Present and Future*. Springer.

<https://doi.org/10.1007/978-3-030-00268-8>

Klijn, F., Asselman, N., Mosselman, E., & Sperna Weiland, F. (2019). *Klimaatadaptatie in het rivierengebied: Een geo-ecologisch perspectief*. Landschap: tijdschrift voor landschapsecologie en milieukunde, 36(2), 105-113.

Looman, R. (2017). *Climate-responsive design: A framework for an energy concept design-decision support tool for architects using principles of climate-responsive design*. A+BE | Architecture and the Built Environment, 7(1), 1-282.

<https://doi.org/10.7480/abe.2017.1.1643>

Meurs, P. (2016). *Heritage-based design*. TU Delft.

<https://books.bk.tudelft.nl/press/catalog/view/484/493/107>

Planbureau voor de Leefomgeving (2024). *Kleine kansen, grote gevolgen*.

<https://themasites.pbl.nl/o/risico-overstromingen/>

Rijksdienst voor het cultureel erfgoed.

<https://www.cultureelerfgoed.nl/onderwerpen/praktijkvoorbeelden/overzicht-praktijkvoorbeelden/waterdriehoek-vergroot-bekendheid-en-bevordert-beleefbaarheid#:~:text=De%20Waterdriehoek%20is%20het%20gebied,haar%20erfgoedlijnen%20aan%20heeft%20verbonden.>

Toebast, J. (2012). Voor als de dijken doorgingen. Maatregelen tegen rivieroverstromingen bij boerderijen, zeventiende-negentiende eeuw. *Tijdschrift Voor Waterstaatgeschiedenis*, 21(1-2), 11-22. https://www.waterstaatsgeschiedenis.nl/tijdschrift/2012-1-2/TWG2012-1-2_11-22.pdf

Van Veelen, P.C. (2016). *Adaptive planning for resilient coastal waterfronts: Linking flood risk reduction with urban development in Rotterdam and New York City*. A+BE | Architecture and the Built environment, 6 (19), <https://doi.org/10.7480/isbn.9789492516213>

Images and figures - in order of appearance

De Overlaat van Cruquius, 1729-1730. (z.d.). planviewer.nl. https://www.planviewer.nl/imro/files/NL.IMRO.0505.BP180Nslb-3001/t_NL.IMRO.0505.BP180Nslb-3001_0002Planbeschrijving.html

Historische Vereniging Sliedrecht. (z.d.). *Scheepswerf Delta Shipyard bij De Zaaï*. Foto Archief Sliedrecht. <https://historie-fotoarchiefsliedrecht.nl/>

Donk, P. (2020). *Watertorenterrein 2020*. Sliedrecht 24. <https://sliedrecht24.nl/watertoren-b-v-zit-niet-stil-en-werkt-aan-schetsen-voor-watertorenterrein/>

Weingärtner, H. (1857). *Sint Elisabethsvloed* [Oilpainting]. Biesbosch museumEiland, Werkendam, Nederland.

Alblas, H. (2023, december). *Hoogwater in Gorinchem en Woudrichem*. De Stad Gorinchem. <https://www.destadgorinchem.nl/lokaal/natuur-en-milieu/993673/hoogwater-in-gorinchem-en-woudrichem>

Kaart Sliedrecht. (z.d.). [Map]. Foto Archief Sliedrecht, Sliedrecht, Nederland. https://historie-fotoarchiefsliedrecht.nl/Bestanden/Kaart_Sliedrecht_oud_1.jpg

Kans op een overstroming vanuit zee, meer of rivier (By Rijkswaterstaat). (2021). [Dataset; Atlas Leefomgeving]. <https://www.atlasleefomgeving.nl/kaarten>

Meurs, P. (2016). *The Traingle of Heritage & Architecture*. <https://books.bk.tudelft.nl/press/catalog/view/484/493/107>