TRANSPARENT WATER:

water quality education through design in the Waterdriehoek

AR3A010 Research Plan | Maritime Heritage

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Cover image by author

Contents

1. Introduction

In a country which prides itself on a rich history with its waterscape, the management of water and its quality is an inevitable aspect of society in the Netherlands. Yet with rapid industrialisation, scientific advancements, and other societal developments that helped the country soar economically in the past two centuries, there has been an apparent neglect of the environmental consequences. With the introduction of the Water Framework Directive to all EU member states in 2000 (European Commission, 2024), however, Dutch authorities are racing to reverse the damages and comply with the regulations by 2027.

Simultaneously, various parties in the regions around the Biesbosch, Drechtsteden and Kinderdijk in the Zuid-Holland province of the Netherlands have been working together to promote the cultural-historical values of the area since 2013. Named the 'Waterdriehoek', the scheme aims to strengthen the touristic value of the area by making it more accessible and attractive by incorporating historical narratives, all while ensuring better climate awareness (Rijksdienst voor het Cultureel Erfgoed, n.d.). With this programme, they hope to increase public attention on dealing with water in the future, thereby setting examples of how cultural heritage can be integrated into water-related projects.

This regional revitalisation project seeking to connect people to the environment through tangible interventions provides an ideal backdrop for a soft design approach in educating the public about the country's water quality and its past significance. Utilising historical maritime structures that have shaped the identity of the Waterdriehoek area, the historical values of the buildings can be preserved while a new society-orientated function is positioned between the original footprints.

It can therefore be seen that this research is placed within the three fundamental concepts that underpin the Maritime Heritage studio: water, land and building (Figure 1) – it examines how historical activities have impacted the waterways, with its consequent ecological and societal implications. The research further projects the findings onto an architectural realm by exploring how the stories of water contamination and their treatment processes can be told spatially in the form of a research laboratory or education centre. Embodying the Waterdriehoek's overarching aim of reaching a wider public audience, the project sets out collective goals for the future waterscape in the area.

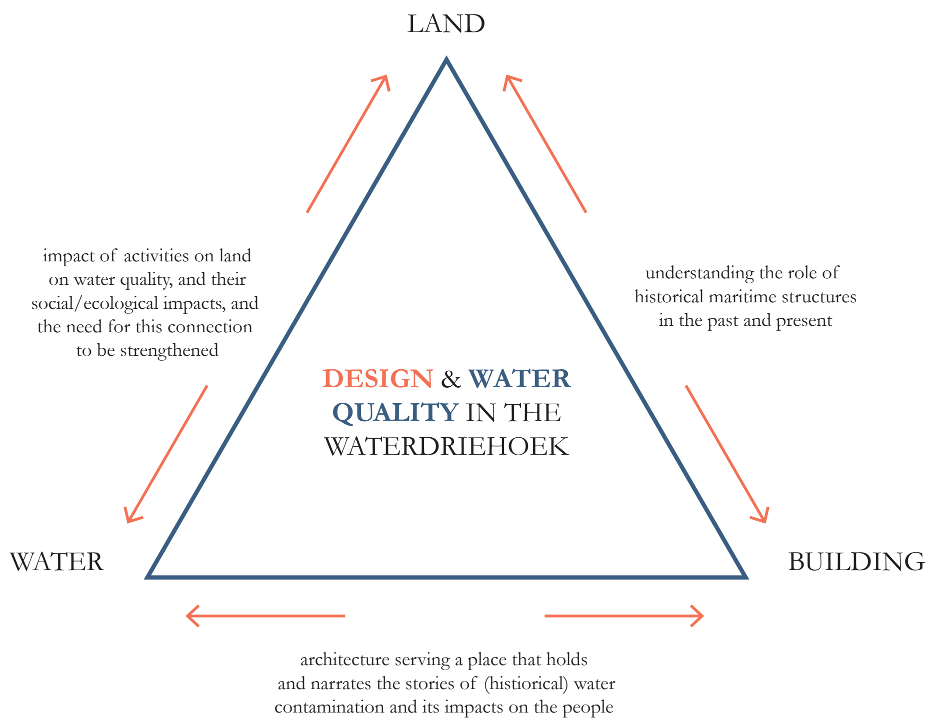

Figure 1: The research and its relevance to the triangle of the main concepts of the studio (image by author)

2. Problem statement

In 2022, research by Wageningen University revealed that the Netherlands has the worst water quality in the EU, with only 1% of the waters being satisfactory (Didde, 2022). Reports by the Kaderrichtlijn Water (KRW) show a similar result (Figure 2), with most of the country's water bodies containing at least two pollutants that do not comply with the health and safety standards (Figure 3).

Figure 2: Compliance of pollutants in water bodies in the Netherlands (adapted from: Waterkwaliteitsportaal, 2022)

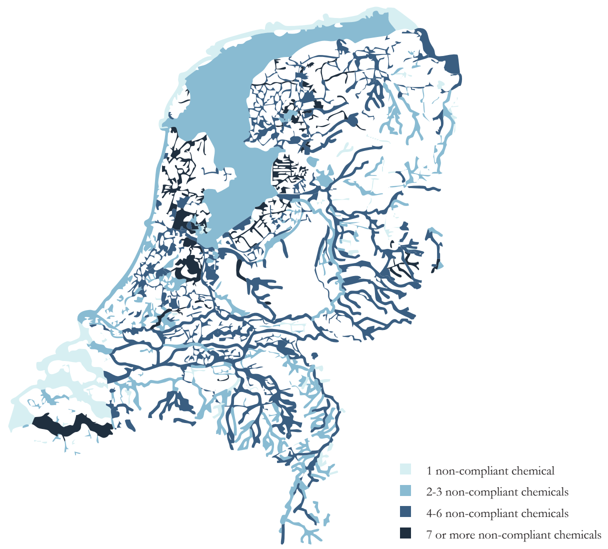

Figure 3: Number of non-compliant pollutants in Dutch water bodies (adapted from: Waterkwaliteitsportaal, 2022)

This trend is no exception in the Waterdriehoek, where a 2022 study showed that the area contained at least 4 non-compliant pollutants and more than 7 chemicals that were deemed unsatisfactory. In addition to NHx (ammonia) pollution and crop protection products caused mainly by the agricultural industry, the area shows traces of metals in the water (Figure 4). The occurrence of this along the northern edge of the Beneden-Merwede, in particular between Sliedrecht and Gorinchem where many of the former shipyards lie, suggests some correlations between the industry and metal contamination.

The issues of water pollution are not unfamiliar to the area, where in 2022, the province of South Holland issued an environmental permit to Chemours, allowing the chemical company to discharge PFAS-containing wastewater into the river Beneden Merwede (Evides, 2024). Located just across the river from Papendrecht and Sliedrecht, the plant emits harmful man-made substances in their production of Teflon, which do not break down naturally. Studies have shown the accumulation of these substances to be detrimental to human health and the environment, causing reproduction and developmental issues, some types of cancers, and irreversible effects on the food chain (Rijksinstituut voor Volksgezondheiden Milieu, n.d.). At a measurement point near Dordrecht, the PFOA (perfluorooctanoic acid, a type of PFAS) value was found to be 6.0µg/kg, six times higher than the maximum allowable value of 1.0 outlined by the EU regulations (Dreas, 2024).

It is thus not surprising that some have protested against Chemours, such as the drinking water companies Oasen and Evides. 'Stop PFAS', an organisation was founded to act against the negligence of the plant on the locals (Stop PFAS, 2024), as well as a neighbourhood council 'Burenraad' in hopes of strengthening the relationship between the businesses and people living in the area (Burenraad, n.d.). However, the power of the business dominates, and the outcomes of the people still remain to be seen.

The quality of water in the Waterdriehoek, given its negative societal and environmental consequences, is hence a problem that has been gaining significant attention in the past years. However, reaching the public still remains an issue – despite the site's strong historical connection with the maritime industry, the gap between people and the water has been widening both physically and psychologically with the decline of the waterfront industries. The challenge therefore lies in recognising the water-centred history of the site through its maritime buildings and thereby understanding how we can make water quality a more fundamental consideration for all.

Figure 4: Toxic pressure of metals in the surface water (adapted from Stowa, 2018)

3. Research aims

The research aims to analyse the historical causes of and effects on surface water quality degredation in the Waterdriehoek and use this to understand the potential role of architecture in making the issue more transparent to the public. Laying within the existing Waterdriehoek heritage line framework, it connects the issues of the environment, heritage values and social integration into a single theme of research.

Bridging the gap between scientific research and societal implications, the paper will answer the overarching research question:

How can architecture and landscape design be used to raise public awareness about water contamination in the Waterdriehoek?

The research will be divided into three parts, each with its own research aim and sub-question. The outcomes of the sections feed into the next, so as to build upon the cumulative findings of the previous analyses (Figure 5).

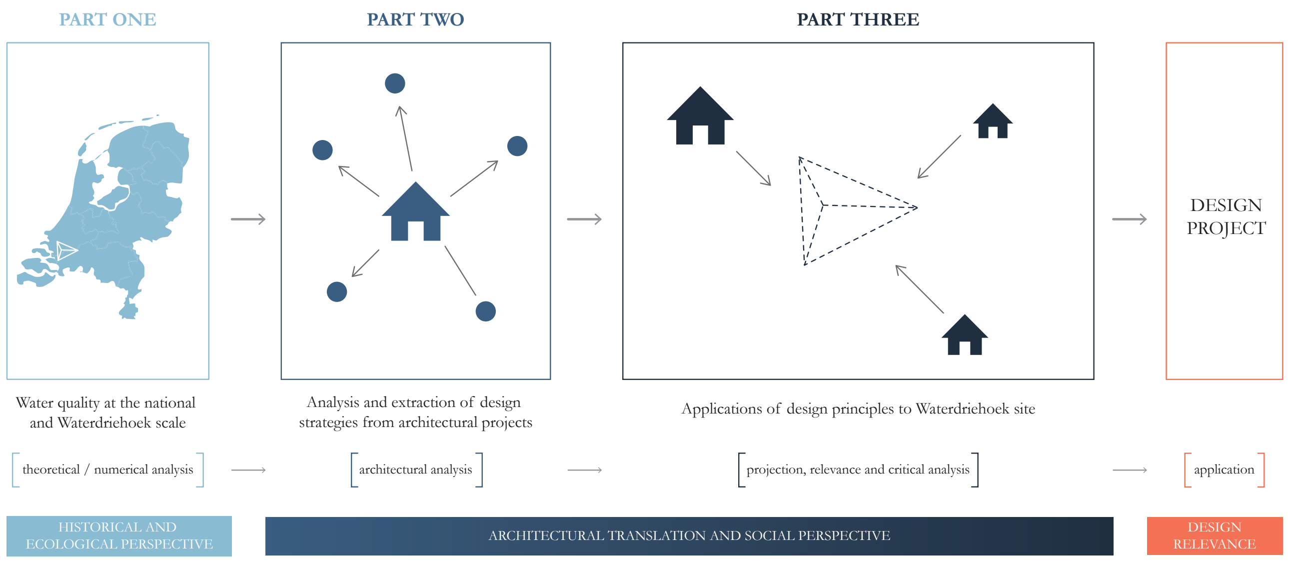

Figure 5: Research scheme – chronology of the research and its relevance to the design project (image by author)

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PART ONE:
Water contamination and its impacts in the Waterdriehoek

Sub-question: What are the ecological and societal impacts of water contamination in the Netherlands from a historical perspective?

To investigate the causes of water contamination and its impacts in the Waterdriehoek, the research will briefly zoom out to a national scale, looking at historical sources of water contamination in the Netherlands. The findings will be projected onto the site and analysed alongside the water quality measurements to study their correlations. The projection of the qualitative data against numerical evidence allows for a balanced and informed argument.

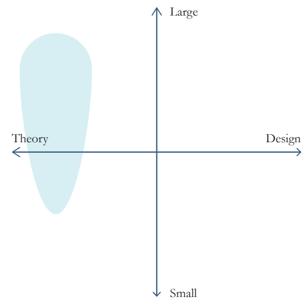

Figure 6.1

PART TWO:
Design in connecting people to the issues of water contamination

Sub-question: How can architecture be used to increase awareness of the issues of water quality and set environmental goals for the future waterscape?

This section transitions from theoretical research to its architectural relevance, where examples of architectural projects relating to the topic of water contamination will be analysed. The analyses will focus on the use of design in conveying intangible environmental and social values, to outline spatial goals and guidelines for the final design project.

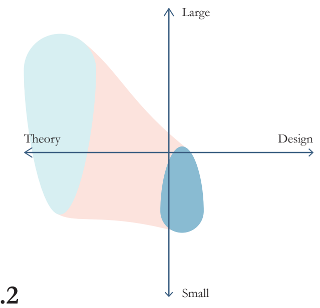

Figure 6.2

PART THREE:
Projection of design principles on the Waterdriehoek

Sub-question: how can the adaptive reuse of maritime industrial architecture in the Waterdriehoek (re) connect people to the water?

Reflecting the outcomes of Part One and Part Two onto the Waterdriehoek, this section explores the role of design in raising awareness of water issues in consideration of the heritage line. The design strategies extracted in the previous section will be tested for relevancy on site, especially in relation to the reuse of maritime industrial architecture that characterises the location.

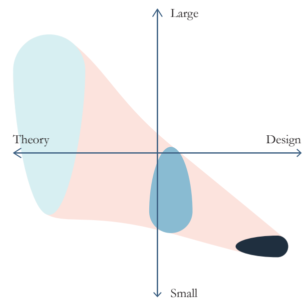

Figure 6.3

4. Methodology

The research aims to take the theoretical knowledge gained in Part One and apply an architectural lens in Part Two, aiding in the formulation of a site-specific, design-relevant conclusion in Part Three (Figure 7).

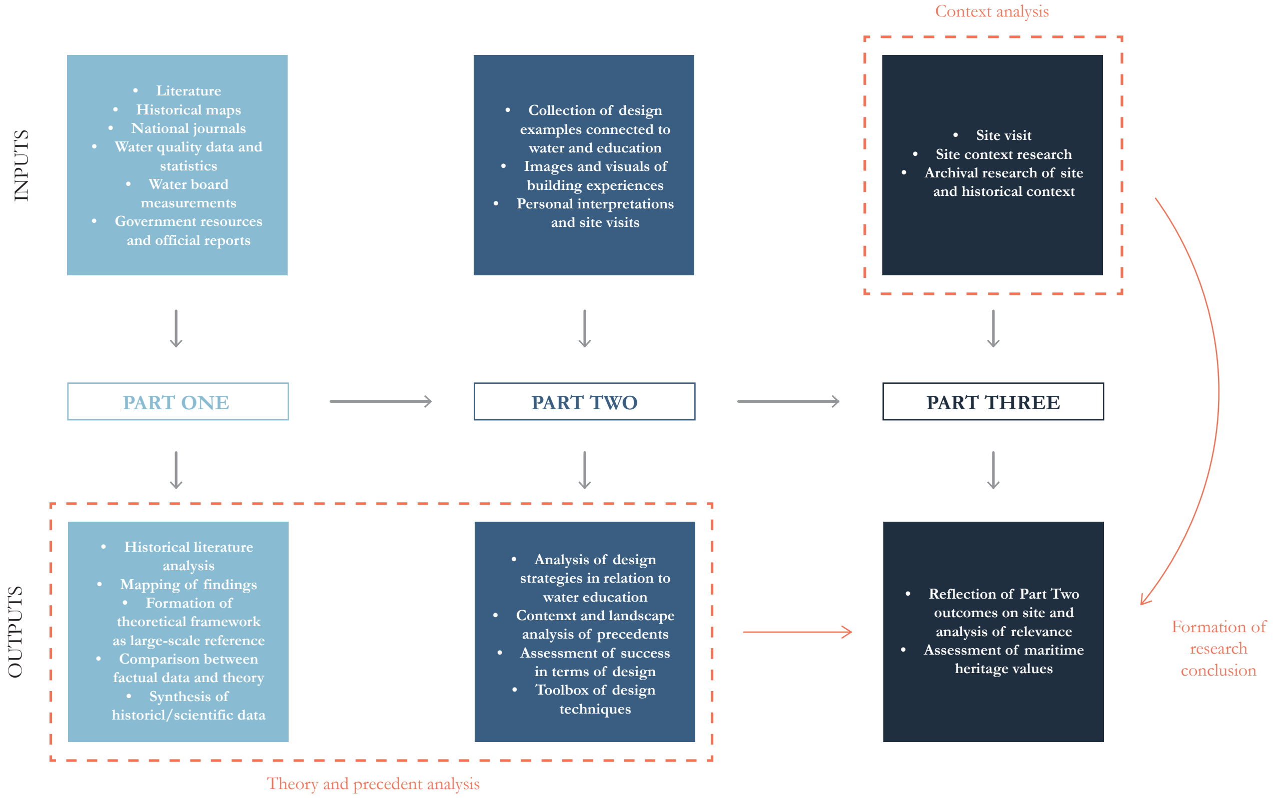

Figure 7: Different sources, methodologies and their relevance to the research (image by author)

The primary research step will form a framework of historical and theoretical knowledge, which will be analysed and tested for relevance in answering the main research question. Existing literature will be referenced, specifically about the history of water and the maritime industry in the Netherlands. A key source is the article 'Water System and Urban Form in Holland' by Abrahamse et.al. in Over Holland 21, which looks at the development of water systems in the Netherlands by comparing four different eras in detail (Abrahamse et.al., 2021). This not only sets the research within a historical and thematic frame but also displays an exemplary use of mapping as a research method. Suzanne Leon's 'Thirsty Cities: Learning from Dutch Water Supply Heritage' in Adaptive Strategies for Water Heritage is another example of text dedicated to water heritage, showing how the shipbuilding industry shaped the country's history (Leon, 2020). Publications focusing on the changes in water quality on a nationwide scale will also be consulted, such as the chapter 'History of the Dutch Drinking Water Sector' in J.E.M. Klostermann's The Social Construction of Sustainability in Dutch Water Companies, which bridges the gap between qualitative historical knowledge and quantitative values (Klostermann, 2003).

In addition to literature, numerical data will also be collected. This will be done through government-published documents by the Rijkswaterstraat and water quality reports by the relevant water bodies of Waterschap Hollandse Delta and Rivierenland. The use of interactive maps by the Waterkwaliteiesportaal and Atlas Leefomgeving also allows for the extraction of measurements at a specific location in comparison to other sites. Historical data on water quality can also be requested through the Rijkswaterstaat's Waterdata webpage, aiding the analysis of water quality changes over time. These organisations publish regulations on water quality and their propositions for the future, which will be used in the final section of the research to mirror their ambitions onto the design location.

In Part Two, architectural examples that display the issues of water quality and bring about a social dimension to the topic will be explored, to create a toolbox of concepts or design strategies to test in the final section. Existing projects have achieved this in differing ways – the Solrødgård Water Treatment Plant in Denmark (Figure 8) is a prominent example of raising climate awareness through interdisciplinary design, where a treatment plant is combined with a bird-watching tower, walking trails and roosting hotel for bats (Henning Larsen, 2019). The integration of these various functions into a single landscape allows first-hand public exposure to water and the natural cycles in a subtle, yet powerful way. In contrast, the Muttenz Water Purification Plant in Switzerland (Figure 9) creates a new landmark for the town, bridging the cognitive gap between the natural ecosystem and the scientific purification process. The architecture intentionally guides visitors through the process of water purification, thereby encouraging visitors to celebrate the value of water through their senses (Oppenheim Architecture, 2017).

Part Three will be a combination of the design toolbox extracted in Part Two with a study of maritime industrial sites in the area. These strategies will be considered in line with the social and environmental landscape and analysed for their potential in fulfilling the goals of the Waterdriehoek heritage line.

Figure 8: Solrødgård Water Treatment Plant in Hillerød, Denmark by Henning Larsen, 2017 (Due, 2017)

Figure 9: Muttenz Water Purification Plant in Muttenz, Switzerland by Oppenheim Architecture + Design, 2017 (Müller, 2017)

5. Historical and theoretical framework

Historical framework:
Water quality in the Netherlands

Before industrialisation, drinking water simply came from surface water in rivers and canals. However, urbanisation in the 13th century led to a decline in water quality due to pollution from industries such as textile, leather and paper processing (Wijmer, 1992, p.45). As cholera spread in the 1800s, the health consequences of contaminated water became publicly acknowledged, with health committees routinely examining the quality of water from public pumps (Leeflang, 1974, p.32).

Theoretical framework:
Maritime pollution and guidelines

As the link between clean water and cholera became apparent, the Metropolis Water Act was introduced in the UK in 1852. These regulations were soon adopted in other countries such as the US, France, Belgium, and the Netherlands ('t Hart, 1990, p.34).

Despite this, contamination from industries ceased to stop, and with the rise of the shipping industry towards the end of the century, oils and metals started to be dumped into the water. In the Waterdriehoek, the first shipyards were built in the early 1800s along the Merwede River (Erfgoedhuis Zuid-Holland, n.d.). Until the 1870s, ships were built in wood, meaning the industry also contained sawmills, warehouses, rope makers and sailcloth weavers. The neighbouring water quality was thus influenced by these agricultural processes.

The first environmental conflicts in Dutch water systems were recorded to have been in 1875 when the chemical company BASF dumped arsenic into the Rhine (Wijmer, 1992, p.89). The growth of other chemical industries after the war also caused degradation in surface water quality.

The first outline of a law on water quality was created between 1909 and 1912, focused on drinking water (Leeflang, 1974, p.203). After the end of WWII, the Dutch and German governments started to work together to address the pollution of the Rhine (Leeflang, 1974, p.192).

During industrialisation, wooden ships were replaced by steel and iron, changing the landscape into an ironwork and machine-building industry – this led to changes in the types of pollution.

As a result, new laws were created, such as the ban on oil and chemical dumping into the Rhine (Leeflang, 1974, p.195). Oil-receiving facilities were built along the banks to collect the industrial oils instead, but the regulations were largely ignored (Klostermann, 2003).

As shipyards suffered due to competition from newly industrialising Asian countries in the 1980s, many went out of business, abandoning their sites but leaving traces of their historical contamination.

Due to the increased environmental awareness in the 1970s, legislations for water were developed anew (Wijmer, 1992, p.122). Wastewater treatment facilities equipped themselves with cutting-edge chemical detection technologies.

Today, the water quality in different areas of the Netherlands is managed by their respective water boards, with a common effort to reduce pollution by chemicals, heavy metals and microplastics. Authorities, businesses and civil society organisations are actively addressed to set targets and management practices for the future (Rijkswaterstaat, n.d.).

6. Design relevance

Research into water pollution and its relationship to the maritime past in the Waterdriehoek will showcase why water quality is such a significant issue for the heritage line, and why a re-design project concerning water contamination is needed. The understanding of the current and historical water quality in the area gained through the research paper helps in forming a personal view of how design can connect people to their environment while preserving their connection with their historical maritime past.

The analysis of existing water contamination-related designs will explore the role of immersive design in water education and how these narratives can be organised spatially to reach a public audience. This will initiate a toolbox of design strategies, such as the buildings' routing, organisation of programmes, use of materials and relationships with the exterior, to name a few possible examples. In the design phase, the outcomes of the research will be translated spatially (Figure 10), such as in the design of water-related research laboratories or facilities that make the treatment of river water and waste more transparent to the public. The design is therefore a synthesis of theoretical and design-oriented research, with the aim of being able to visualise the issues of water quality through the site's innate connection to historical maritime architecture.

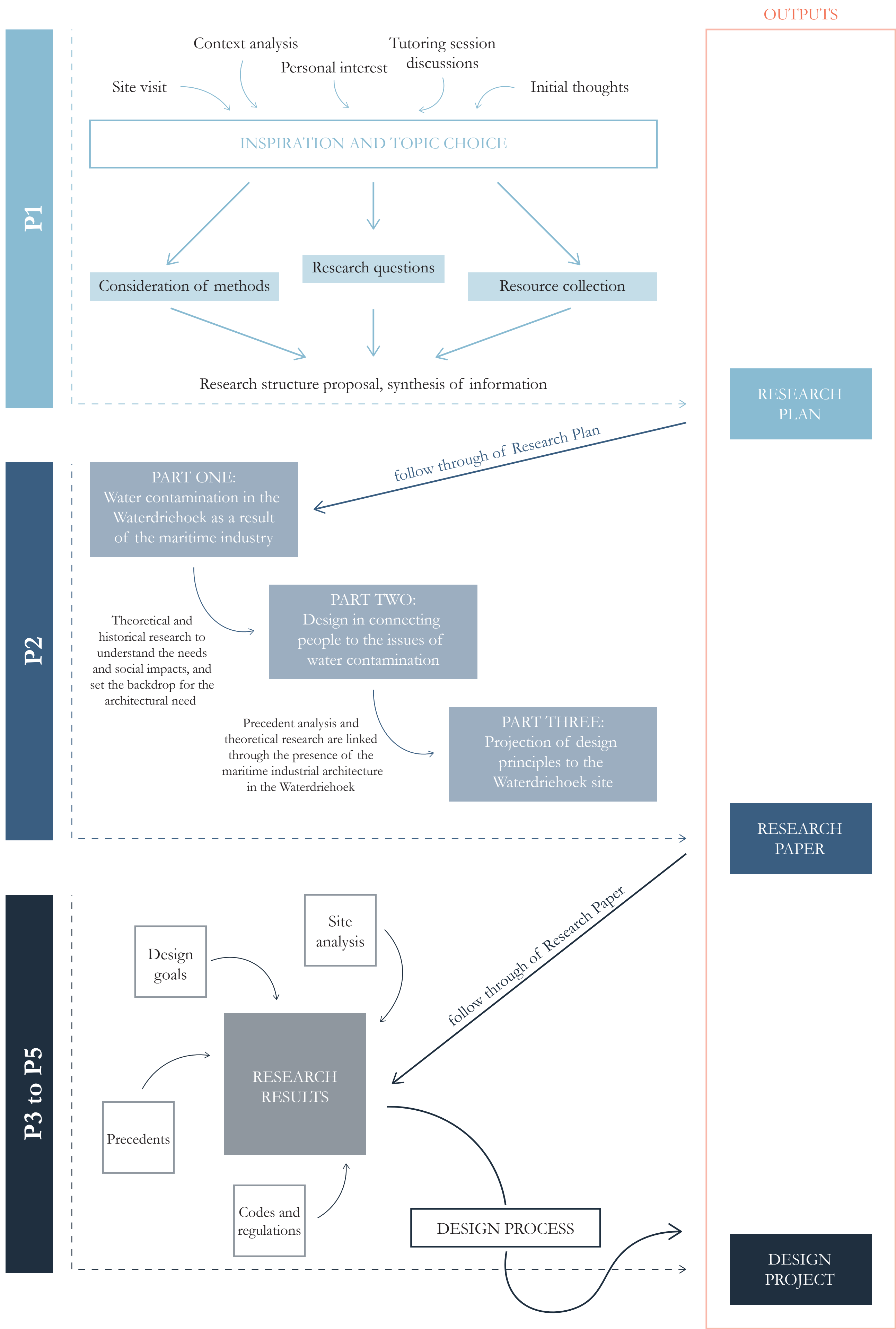

Figure 10: Research timeline in relevance to the design project (image by author)

7. References

Images

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