

On sinking ground

**A Design- Based Case Study Research of the Systemic Barriers to
Climate Adaption in Dutch Vulnerable Neighborhoods**

Management in the Built Environment

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Preface

This thesis marks the completion of my Master's degree in Management in the Built Environment at TU Delft. Over the past months, I have explored the complex but highly interesting question of how vulnerable neighborhoods can become climate-resilient and who is willing to contribute to that goal. The neighborhood of Bloemhof in Rotterdam turned out to be a highly relevant case, where different systems come together– or sometimes clash. This research has taught me a lot about area development and climate adaptation, but perhaps even more about the messy reality behind it.

I would like to sincerely thank my graduation supervisor Tom Daamen for his guidance, for introducing me to many relevant actors in the field, and for taking me along to conferences and professional meetings. His critical feedback and encouragement pushed me to sharpen my thinking and take my work one step further. A warm thank you goes out to Fransje Hooimeijer for her clear guidance and for sharing her urban design expertise. I really appreciated our conversations about variants, alternatives, perspectives... the way those terms kept evolving. Next to that our informal coffee moments were just as valuable.

Finally, I want to thank all the professionals who participated in the interviews, the workshop, and the expert panels. Their openness and involvement greatly enriched this research. And to my friends and family: thank you for your support and encouragement throughout this journey.

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Abstract

Vulnerable neighborhoods in the Netherlands face mounting challenges from climate change and land subsidence, threatening both infrastructure stability and residents' quality of life. Despite the urgent need for adaptation, financial stakeholders encounter persistent barriers: residents often lack the means to act, local governments face budgetary constraints, and private investors hesitate due to high perceived risks or insufficient return potential.

This research seeks to address the main question: *"What are the systemic barriers faced by financial stakeholders in implementing climate adaptation measures in vulnerable neighborhoods in Dutch Cities, and how can these barriers be addressed?"* To answer the research question, this thesis focuses on financial stakeholders, such as housing associations, government agencies, banks, insurers, and developers and their role in enabling or blocking climate adaptation.

Using the Bloemhof neighborhood in Rotterdam as a case study, the research combines qualitative methods with a design-based approach. Bloemhof is a historically layered, socio-economically vulnerable area with severe environment-related challenges. Three alternative spatial development approaches are explored to envision climate adaptation in practice: (1) selected demolition and reconstruction, (2) modest renewal, and (3) integrated redevelopment. To test these alternatives and uncover systemic barriers, a series of interviews, a design-based session, and expert panels were conducted with financial and other related stakeholders.

The findings reveal three interrelated barriers to collective adaptation: (1) at system level, national coordination is lacking, and no problem owner has been appointed to lead long-term adaptation efforts. (2) at the neighborhood level, fragmented ownership and the absence of integrated financing arrangements prevent collective action. Public and private stakeholders lack mechanisms to share the costs and benefits of adaptation. (3) at the stakeholder level, narrow mandates and institutional logics tend to reproduce the status quo, where no actor feels responsible for taking the first move.

The findings of this study contribute to the debate on climate-resilient (re)development and offers recommendations for governance arrangements that support adaptation in vulnerable neighborhoods.

Key words – climate adaptation governance, vulnerable neighborhoods, systemic barriers, Bloemhof

Executive Summary

Introduction

Dutch cities are increasingly confronted with environment-related challenges, such as land subsidence, heat stress, and flooding. These risks are especially apparent in vulnerable neighborhoods built on weak soils, where outdated infrastructure, fragmented property ownership, and limited financial capacity compound the problem. Despite growing awareness, climate adaptation in such neighborhoods often fails to happen in practice. While integrated, area-based climate adaptation is broadly acknowledged as necessary, implementation is hindered by systemic barriers. These barriers are particularly evident in existing neighborhoods where adaptation must be fitted into an already densely built urban fabric. Therefore, the aim of this thesis is to explore the barriers that financial stakeholders face in implementing climate adaptation measures in vulnerable neighborhoods, and to identify the conditions under which collective, area-based adaptation could become feasible. The neighborhood of Bloemhof in Rotterdam Zuid serves as a representative case study. This research is guided by the main question:

“What are the systemic barriers faced by financial stakeholders in implementing climate adaptation measures in vulnerable neighborhoods in Dutch Cities, and how can these barriers be addressed?”

Theoretical Background

Urban vulnerability is conceptualized using the exposure–sensitivity–adaptive capacity framework (Smit & Wandel, 2006; Funfgeld & McEvoy, 2011), which highlights that climate risks do not affect all areas equally. Vulnerable neighborhoods are often more exposed to physical risks, more sensitive due to poor housing and socio-economic conditions, and less able to adapt because of limited institutional and financial capacity. To contextualize this within the Netherlands, the research introduces the ABN AMRO (2023) five-layer vulnerability model, which maps climate and financial risks across neighborhoods. This model identifies over 900 vulnerable neighborhoods and highlights the effects of flood risk, foundation degradation, financial weakness, and transition risks. However, the thesis also critiques this model for its narrow view of vulnerability. To better understand why implementation fails, the thesis builds on climate governance literature to identify three categories of systemic barriers:

- **Resource barriers:** These refer to a lack of resources, such as funding, personnel, time, knowledge, and data, which limit the capacity of actors to implement adaptation measures (Biesbroek et al., 2013; Ekstrom & Moser, 2014). Particularly in low-capacity municipalities and complex urban contexts, adaptation competes with other priorities.
- **Institutional barriers:** deeper, systemic barriers that stem from existing rules, routines, and organizational logics. They include normative thinking, conflicting institutional logics and path dependency (Patterson et al., 2019; Chu et al., 2022). These barriers persist even when resources and knowledge are available, because institutional arrangements resist change.
- **Governance barriers:** relate to the way responsibilities and coordination are structured across actors and sectors. Governance barriers include fragmented responsibilities, unclear legal frameworks and policy misalignment (Runhaar et al., 2012; Lee et al., 2022).

In this context, scholars propose the concept of transformative governance: a mode of governance that enables institutional learning, experimentation, and alignment of roles and responsibilities to support long-term adaptation (Patterson et al., 2019; Chu et al., 2022).

Research Method

This research is part of the *Red & Blue* and *Redesigning Deltas* research programs and uses a qualitative, design-based case study approach. It combines 15 semi-structured interviews with financial stakeholders, a spatial design exploration of three alternative spatial development approaches (Block-by-Block, the Natte T, and Waterhof), and two group sessions: a workshop and an expert panel. These were used to assess the feasibility of adaptation alternatives and to understand the barriers that emerge. The findings were further validated during a presentation at the Resilient Delta Congress.

Results

The interviews reveal that financial stakeholders are exposed to climate risks in distinct ways:

- Housing associations face foundation damage and rising maintenance costs but are constrained by book-value rules and parallel policy obligations.
- Private homeowners are formally responsible for their property's foundation, but often lack the financial means or technical knowledge to act.
- Municipalities are responsible for public space and drainage infrastructure but have no authority over private plots, making integrated action difficult. Street elevation works (although necessary) can worsen ground-level differences between public and private domains, leading to technical and financial complications for adjacent property owners.
- Banks and mortgage lenders bear indirect risk as foundation issues are not reflected in valuation models, affecting loan-to-value ratios and raises the risk of mortgage defaults.
- Insurers typically do not cover gradual damage such as land subsidence, pushing responsibility onto households and the public sector.
- Water authorities are willing to contribute but can only act if there is a clear connection to their legal water-related mandate.
- Institutional investors experience little immediate impact, unless they hold large portfolios in vulnerable areas, limiting their incentive to engage.

This fragmentation of exposure to risks and capacities to act leads to inaction. Actors recognize the urgency of the issue, but feel constrained by their respective mandates and legal responsibilities.

To explore how climate adaptation could be spatially embedded, three urban design alternatives were developed. Each alternative represents a different level of ambition and complexity, and was used as a lens to reveal system, neighborhood-level, and stakeholder-specific barriers:

- (1) Block-by-Block focuses on the replacement of outdated housing stock of the housing association and it aligns closely with current institutional practices and property structures;
- (2) The 'Natte T' introduces water infrastructure, combined with selective redevelopment and densification;

(3) Waterhof is a full-scale integrated redevelopment of the neighborhood into a resilient urban fabric, combining a water park and new building typologies.

The combined findings from the interviews, the workshop, and the expert panels reveal that barriers to climate adaptation in Bloemhof occur at three interconnected levels:

- At the system level, there is no national coordination and no designated problem owner for climate adaptation in vulnerable neighborhoods. National policies, regulations, and valuation systems (such as housing depreciation rules, market-based appraisal models, and mortgage criteria) fail to incorporate long-term physical risks like foundation decay or land subsidence. This creates a disconnect between urgent physical threats and institutional responses. Current financial arrangements prioritize short-term cost control over long-term value creation. Rather than asking “*what does this yield?*”, stakeholders are locked in a logic of “*who pays?*”, which reinforces institutional inertia and risk avoidance. Design alternative 3 (Waterhof), which proposes a fully restructured and water-led urban fabric, was technically promising but highlighted that such transformative adaptation is infeasible without experimental legal frameworks, long-term investment instruments, and national leadership.
- At the neighborhood level, there is a lack of integrated financing models that allow for collective investment for climate adaptation. Existing subsidies are fragmented and insufficient, often only covering isolated interventions. At the same time, the costs and benefits of adaptation are unevenly distributed: some are expected to invest, while others may benefit without contributing. There are no mechanisms to fairly redistribute value increases. This became evident in alternative 2 (The ‘Natte T’), which envisions water-based restructuring and public space renewal. Despite stakeholder enthusiasm, it exposed the need for phased investment arrangements that account for uncertainties, financing in which public and private actors jointly invest based on shared interests and long-term goals, and equalization mechanisms to support implementation at scale.
- At the stakeholder level, actors operate within narrow mandates and institutional logics that hinder collaboration and adaptation. Each stakeholder acts according to their formal responsibilities, but no one takes ownership of the collective challenge. This fragmentation leads to risk avoidance and blame shifting. Crucially, there is also a mismatch in who is, and who should be present at the decision-making table. Alternative 1 (Block-by-block) was considered the most feasible within existing roles and responsibilities, but it reproduced the current logic and offered limited climate resilience, showing how institutional routines and current decision-making lock in ‘the status quo’.

Across all three alternatives, design served as a tool to expose the limits of the current system. While each alternative demonstrated spatial opportunities, it also revealed how systemic barriers must be addressed before implementation becomes viable. It shifted conversations from “what can we do now?” to “what should become possible?”.

Conclusion

The research shows that adaptation in Bloemhof is not blocked by a lack of awareness or technical solutions, but by a persistent combination of institutional, resource, and governance barriers. While

stakeholders recognize the urgency, they operate within narrow mandates, risk-averse logics, and fragmented policy frameworks. This results in inertia: no actor feels formally responsible and has the mandate to initiate integrated action. Current policy frameworks are not equipped to deal with the scale and complexity of land subsidence, foundation decay, and long-term physical degradation. This makes “scenario 0” (doing nothing) not only likely, but also socially and economically costly. The case of Bloemhof shows that adaptation is a systemic challenge, where ownership structures, laws and regulations and financial responsibilities are misaligned. With institutional reform, shared ownership, and new financial frameworks, integrated area (re)development could potentially become feasible. Design plays a role in this process, not as a blueprint for implementation, but as a tool to expose systemic barriers, initiate dialogue, and reveal possible futures. By making visible what is currently restricted, design enables reflection on what should be made possible.

Recommendations

To overcome the barriers identified in this thesis, five recommendations are proposed. Each recommendation targets a barrier at one of the three interrelated levels (system, neighborhood -and stakeholder scale), and together they outline a path toward enabling collective, long-term climate adaptation:

- Expose the costs of inaction (“scenario 0”): Conduct cost-benefit analyses of doing nothing to reveal the long-term physical, social, and financial consequences of inaction. This builds urgency and supports strategic decision-making.
- Appoint a national problem owner: Assign a public authority to coordinate adaptation in vulnerable neighborhoods, with mandate over funding, valuation, and governance reform.
- Enable experimental zones: Current regulations and valuation rules block integrated redevelopment. To overcome this, designate neighborhoods where legal and financial rules (e.g. on book value) can be temporarily adjusted to test new approaches.
- Align timelines and decision moments: Clarify the roles, interests, and incentives of each stakeholder involved in the neighborhood. This includes identifying who has a direct or indirect stake in the issue, and under which conditions they are willing to participate.
- Develop area-based financing models: Develop shared financial arrangements that enable phased investment across public and private actors.

Table of Contents

1	Introduction: The Challenge of Adaptation in Sinking Neighborhoods	11
1.1	Problem statement.....	12
1.2	Research aim	13
1.3	Relevance to Area Development.....	13
1.4	Research Questions	14
1.5	Conceptual model	15
1.6	Research guide/ structure	15
2	Understanding Environment-Related Challenges in Dutch Cities	16
2.1	Environmental Stressors and Climate Impact in Urban Areas	16
2.2	Understanding Vulnerability	17
2.3	Mapping Urban Vulnerability in Dutch Context.....	19
2.4	Past Urban Development Decisions	20
2.5	Conclusion	20
3	Understanding Systemic Barriers to Climate Change.....	23
3.1	Exposure of Financial Stakeholders to Environment-Related Challenges.....	23
3.2	Systemic Barriers for Implementation	25
3.3	Transformative Governance and Institutional Change	28
3.4	Conclusion on Theoretical Background.....	28
4	Methodology	29
4.1	Research Design	29
4.2	Participation in Research Program.....	29
4.3	Case Selection.....	30
4.4	Data Collection	30
4.5	Data Plan	32
4.6	Ethical Considerations	32
4.7	Limitations.....	33
5	The Case of Bloemhof.....	34
5.1	Environmental Challenges in Bloemhof	34
5.2	Research by Design: Urban Design Perspectives.....	36
1:	Phased Renewal Through Demolition and New Construction (Blok voor Blok).....	38
2:	Modest Renewal (De Natte T).....	39
3:	Integrated Redevelopment (Waterhof)	40
6	Barriers Faced by Financial Stakeholders in Bloemhof	41
6.1	Missing Resources in Adaptation Efforts.....	41

6.1.1. Lack of Financial Resources	41
6.1.2 Lack of Human Capacity	42
6.1.3 Knowledge	42
6.1.4 Land Fragmentation	43
6.2 Institutional Barriers: Roles, and Routines that Block Collective Adaptation	44
6.2.1 Role Perception and Responsibility	44
6.2.2 Legal and Regulatory Constraints.....	47
6.2.3 Absence of National Coordination	48
6.2.4 Distribution Dilemma: who pays, who benefits?	49
6.2.5 Risk Avoidance.....	49
6.3 Transformative Governance.....	51
6.3.1 Area Coordination and a Strong Business Case.....	51
6.3.2 Legal and Regulatory Flexibility for Area-specific Solutions.....	51
6.3.3 Shared Investment Arrangements	51
6.3.4 Clear Roles and Responsibilities	52
7 Experts on the Urban Design Perspectives	53
Alternative 1: Blok voor Blok.....	53
Alternative 2: De Natte T.....	54
Alternative 3: Waterhof	54
Overarching Insights From the Workshop	54
8 Expert Panel Public Parties	56
8.1. Private Homeowners.....	56
8.2 Housing Association	57
8.3 The Municipality.....	57
8.4 The National Government.....	58
8.5 The bank	58
8.6 Insurer	58
8.7 Conclusion on Vicious Circle.....	59
9 Outcomes of the Resilient Delta Congress.....	60
9.1. Scenario 0	60
9.2. Property Valuation	60
10 Discussion and Limitations	63
10.1 Design Research	63
10.2 Interpretation of Findings	64
10.2.1 Coordination Barrier: The absence of national leadership	64
10.2.2 Lack of Structural Funding.....	65

10.2.3 Legal and Regulatory Barriers: Rules blocking transformative adaptation.....	66
10.4 Limits and Future Research	67
11 Conclusion and Recommendations.....	69
11.1 Conclusion on sub- research questions.....	69
SQ1: What environment-related challenges affect vulnerable neighborhoods in Dutch cities?..	69
SQ3: What urban development approaches can be conceived for the case of Bloemhof?	71
SQ4: What barriers do financial stakeholders perceive in these spatial development approaches, and how can these be addressed?	71
11.2 Conclusion on Main Research Question.....	71
11.3 Recommendations.....	73
11.3.1 Rationalize: Analyze the societal costs of doing nothing ('scenario 0')	73
11.3.2 Delegate: Appoint a national problem owner.....	73
11.3.3 Experiment: Create legal and financial flexibility	73
11.3.4 Synchronize: Create shared timelines and decisions	74
11.3.5 Arrange: Develop new finance arrangements	74
12. Reflection.....	75
13. References.....	76
14. Appendices	80
Appendix I. Codebook Development.....	81
New information and key takeaway	81
Codebook (inductive and deductive codes)	83
Appendix II. Excel for stakeholder position and logics.....	87
Appendix III. Miro board for 3 Urban Designs Perspectives	92
Appendix IV: Consent form Interview Dutch.....	93
Appendix V: Interview Protocol.....	95
Appendix VI. Workshop Protocol	98
Appendix VII. Workshop Evaluation of the Urban Design Alternatives	100
Appendix VIII. Expert Panel Protocol.....	101
Appendix IX. Data Management Plan.....	102

1 Introduction: The Challenge of Adaptation in Sinking Neighborhoods

Land subsidence, climate change and ecological degradation are becoming increasingly problematic for urban areas, especially in low-lying and densely populated regions like the Netherlands (Boehnke et al., 2023). Land subsidence is a process in which the ground sinks due to the compaction of peat soils, groundwater extraction, and the weight of infrastructure. This poses serious risks to the stability of buildings and infrastructure, particularly in vulnerable areas such as the Randstad (TNO, 2024). Climate change, which increases the frequency of extreme weather events like heavy rainfall and prolonged droughts, increases these hazards (Trenberth, 2005).

The economic and environmental consequences of land subsidence are substantial. Damage estimates for the Netherlands suggest potential costs of up to €20 billion by 2050, with €17 billion attributed to the structural repair of buildings (KNMI, 2023). In addition to financial damage, subsidence disrupts drainage systems, lowers ground levels, and increases flood risk in vulnerable neighborhoods. These challenges disproportionately affect low-income communities in older, vulnerable neighborhoods where adaptive capacity is limited, and therefore reducing long-term resilience.

To adapt to these challenges, a combination of technical solutions is needed. These include climate adaptation measures based on soil -and water conditions, better use of green spaces, soil improvement, and in extreme cases a complete renewal of the neighborhood. In new developments or spacious areas, it is often easier to apply these measures. For example, in Gnephoek, a planned new neighborhood near Alphen aan den Rijn, climate adaptation is built into the urban design from the very beginning. The area is being developed with higher ground levels, flexible building methods, and an integrated water systems to handle both flooding and subsidence risks. In contrast, existing urban neighborhoods face more complex problems. These areas have spatial constraints, fragmented ownership, and outdated infrastructure, which limits the feasibility of such interventions. On top of that, political debates about funding responsibilities make it difficult to take decisive action. Neighborhoods with social housing, low land value, and weak soil conditions are most affected by environment-related issues, but they also have the lowest financial resources to adapt.

Bloemhof, a pre-war neighborhood in Rotterdam Zuid, serves as a representative case of such vulnerability. Most of the housing stock, built in the 1930s on soft, waterlogged soil, is constructed either on steel (without piles) or on wooden pile foundations, especially near street edges and redeveloped plots.

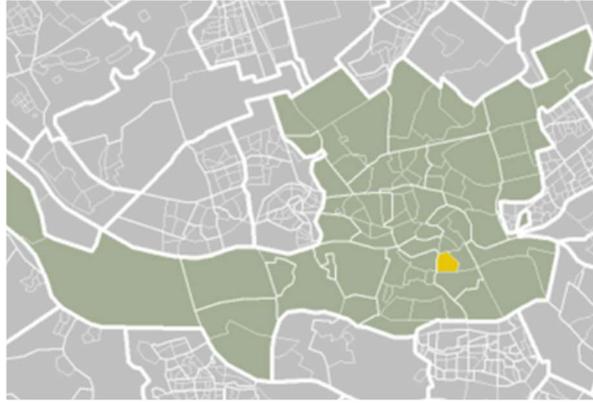


Figure 1. Bloemhof in Rotterdam Zuid (Source: Wikipedia)

Bloemhof is characterized by narrow streets, limited green space, and shallow plot sizes, which do not meet modern urban and climate-resilient demands. Additionally, the technical condition of the housing stock is not future-proof. With limited investment capacity among homeowners, housing associations, the municipality and a lack of interest from private investors due to high financial risks Bloemhof exemplifies the adaptation challenge in vulnerable neighborhoods.

To address the technical challenges in Bloemhof, this research explores three spatial development approaches in Bloemhof: (1) selected demolition and new construction, (2) modest renewal, and (3) integrated redevelopment. These approaches are designed to explore thought experiments: they explore how Bloemhof could be redesigned in a soil- and water-system-oriented way, while also accommodating densification and future-proof housing.

1.1 Problem statement

The complexity of land subsidence, climate change and ecological degradation is leading to an environmental crisis in vulnerable neighborhoods. This emphasizes the urgency of implementing integrated adaptation measures. However, in practice, adaptation remains difficult to plan and finance. Municipalities, water boards, provinces, and the national government all operate under different regulations and this leads to misalignment and inefficient decision-making. On top of that, these areas are known for having a fragmented mix of private property owners, housing associations, and other actors which results in conflict over cost distribution, particularly in neighborhoods with little opportunity for private investment. Current approaches to environment-related challenges often prioritize repair over prevention. Both public and private actors tend to act only when damage becomes visible, leading to higher long-term costs, than would be the case if preventive measures were implemented earlier on in the process. This is partly due to the high upfront costs without immediate financial returns of long-term solutions.

This thesis argues that while integrated climate adaptation (re)development is widely promoted in theory, it often fails to happen in practice. Especially in existing vulnerable neighborhoods the institutional and financial conditions for implementation collective, area-based measures are often missing. As one respondent explained:

“Everyone is needed, but no one can do it alone and the current system does not encourage acting together.”

This quote captures the essence of what many stakeholders express across the interviews. While there is a shared awareness of the urgency and complexity of this issues, individual actors, whether housing associations, financial institutions, or public actors face limits in terms of mandate, funding, and coordination.

1.2 Research aim

The goal of this research is to explore the systemic barriers that financial stakeholders face in implementing integrated adaptation measures in vulnerable neighborhoods, with a focus on the case of Bloemhof in Rotterdam. This neighborhood, like many other pre-war urban areas in the Netherlands, is increasingly affected by land subsidence, water-related risks and heat stress, all of which are intensified by climate change. These challenges demand urgent and coordinated adaptation efforts. However, despite growing awareness and policy ambitions, the actual implementation often proves difficult. In theory, an integrated area based approach, where multiple actors collaborate to address the issues collectively, is seen as desirable. However, in practice this often remains difficult, with each actor addressing only their own responsibilities. This research seeks to understand the systemic barriers that hinder collective area based action and explores how these can be addressed through novel governance arrangements.

The primary research objective is to identify and analyze the barriers that financial stakeholders, such as housing associations, banks, insurers, public institutions, and developers, encounter when engaging with vulnerable neighborhoods. In order to work towards effective solutions, it is essential to understand how the problem is perceived and structured within current institutions. By uncovering these issues, the research aims to build a better understanding of how financial stakeholders perceive their role, responsibilities, and possibilities within this complex issue.

A second objective is to examine how alternative spatial development approaches affect the position of financial stakeholders. The study investigates how neighborhoods such as Bloemhof could become future-proof by experimenting with different designs. Through this, the research contributes to an understanding of how urban design choices and investment strategies can be better aligned to support adaptive, long-term area development.

Another objective is to explore pathways to overcome these barriers by synthesizing insights from the interviews, the design-based exploration, and expert panels. By combining empirical findings with design, the research aims to identify governance arrangements that enable more integrated and adaptive climate action in vulnerable neighborhoods.

1.3 Relevance to Area Development

Environment-related challenges affect vulnerable areas, where the adaptive capacity is limited and residents face increased risks to their quality of life. By focusing on Bloemhof, this research aims to generate academic insights for neighborhoods like Bloemhof and practical lessons specifically to Bloemhof.

Societal relevance

Climate change poses urgent challenges in Dutch Cities. This research contributes to the public debate on how to make existing urban neighborhoods more resilient to climate change. By analyzing the

systemic barriers the study reveals why climate adaptation efforts stall in practice. It also explores potential approaches to adjust current systems and uncover new governance arrangements.

Scientific relevance

While the importance of climate adaptation is well recognized in academic literature, the practical implementation of such measures in existing vulnerable neighborhoods remains underexplored, and particularly the role of financial stakeholders has received little attention in literature. Most researches focus on institutional frameworks or policies, but lack examining how different financial stakeholders deal with environment-related risks. By linking these insights to three spatial development approaches the study offers new contributions to the debate on climate adaptation in existing areas.

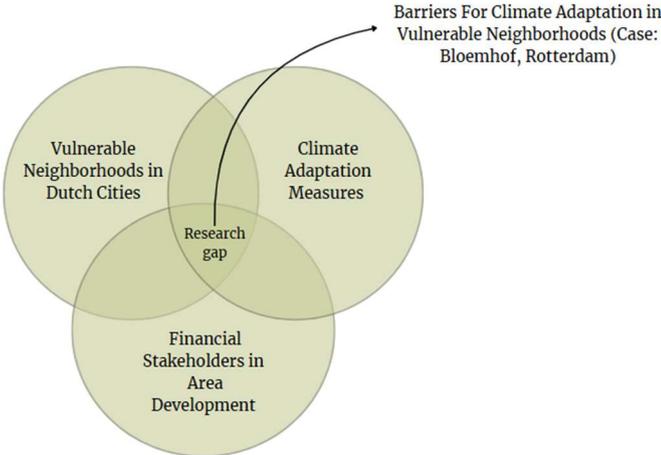


Figure 2. Research gap

1.4 Research Questions

Based on the problem statement, this study will address the following research questions:

"What are the systemic barriers faced by financial stakeholders in implementing climate adaptation measures in vulnerable neighborhoods in Dutch cities, and how can these barriers be addressed?"

The address the main research question, the study is structured around four sub-questions:

- 1. *What are environment-related challenges in vulnerable neighborhoods in Dutch cities?*

This question aims to identify the key environment related problems that affect vulnerable neighborhoods in the Netherlands. This research question will be answered by reviewing literature and relevant policy reports.

- 2. *How are the financial stakeholders in vulnerable neighborhoods affected by environment-related challenges?*

This question identifies the key financial stakeholders involved in vulnerable neighborhoods and investigates the effects they face. This research question will be answered by reviewing academic literature, policy reports and exploratory interviews.

- 3. *What spatial development approaches can be conceived for the case of Bloemhof in Rotterdam, and;*

This question explores three alternative spatial development approaches for climate adaptation and real estate improvements in the Bloemhof neighborhood. These serve as design-based explorations to uncover systemic barriers and opportunities. The underlying hypothesis is that an integrated adaptation approach is desirable, but difficult to implement in practice.

4. *What barriers do financial stakeholders perceive in these spatial development approaches, and how can these be addressed?*

This final question connects the previous insights by examining how financial stakeholders perceive the feasibility of the proposed spatial development approaches, and under what conditions they would be willing to participate.

1.5 Conceptual model

The conceptual model provides a framework to understand the relationships among the key concept of this research study and is designed to explain the dynamics that play in vulnerable neighborhoods and their context (figure 3).

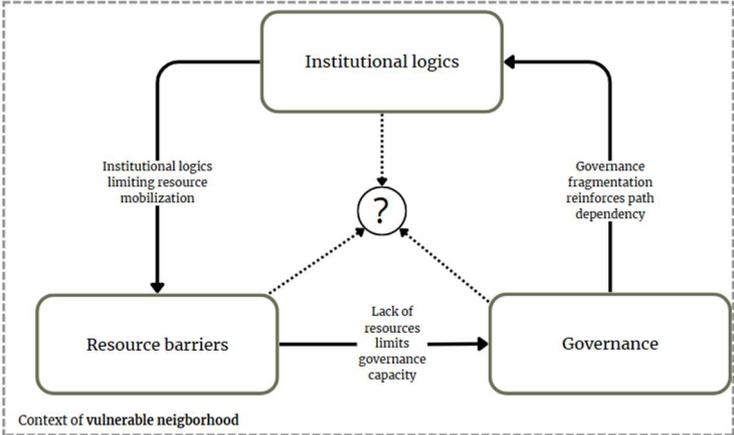


Figure 3. Conceptual model (Made by Charlotte Boreel)

1.6 Research guide/ structure

This thesis is structured to guide the reader through an understanding of climate adaptation challenges in vulnerable neighborhoods. Readers interested in the physical and institutional context of climate risks can start with Chapters 2 and 3, which provide the theoretical background on environment-related challenges in vulnerable neighborhoods and the barriers to adaptation. Readers interested in the research approach and the three spatial design alternatives developed for the case of Bloemhof can look at Chapter 4 (Methodology) and Chapter 5 (Research by Design). Chapters 6 to 9 present the empirical findings. Chapter 6 contains the interview results, structured around key barrier types. Chapter 7 reports on the outcomes of the design workshop, and Chapter 8 presents the insights from the public expert panel. Chapter 9 reflects on insights from the Resilient Delta Congress. Finally, Chapter 10 offers a discussion of the findings, and Chapter 11 concludes the thesis with answers to the research questions and five recommendations for future action.

2 Understanding Environment-Related Challenges in Dutch Cities

This chapter aims to identify environment-related challenges that affect vulnerable neighborhoods. These challenges include risks such as heat and extreme precipitation, land subsidence due to soil -and ecological degradation and outdated urban infrastructure. Together, they contribute to a broader environmental crisis that requires integrated adaptation. This chapter addresses the first sub-question of this research: *What are environment-related challenges in vulnerable neighborhoods in Dutch cities?*

Section 2.1 introduces how climate change impacts urban areas and introduces the concept of climate adaptation. Section 2.2 explains the concept of vulnerability in broader context. Section 2.3 applies this to the Dutch context and section 2.4 explains how historical decisions in urban development have contributed to current vulnerability.

2.1. Environmental Stressors and Climate Impact in Urban Areas

Climate change refers to long-term changes in temperature, precipitation, and other components of the earth's climate system (Hansen et al., 2006). Climate change exacerbates extreme weather events, increasing the number of warm and hot days and maximum temperatures (Mees et al., 2013). These changes are primarily caused by human emissions of greenhouse gases (Zahnow et al., 2025). The consequences are rising sea levels, more frequent heatwaves, drought and more intense rainfall. These pose significant risks to both human, societies and natural ecosystems (Rovers et al., 2015). These impacts are more severe in cities due to the Urban Heat Island effect, which results from the increased heat capacity of urban materials, the presence of additional heat sources, and the lack of cooling from vegetation (Lauwaet et al., 2018; Ahmed et al., 2023). In Delta regions such as the Netherlands, these climate related problems are worsened by other environmental stressors, including ecological degradation, declining groundwater levels, and land subsidence.

There are two terms used to respond to the impacts of climate change: climate mitigation and climate adaptation. Climate mitigation aims to address the root causes of climate change, such as by reducing greenhouse gas emissions through energy transition, circular construction, and passive building design. Climate adaptation focuses on adjusting urban systems to withstand a new environmental regime (IPCC, 2022).

Adaptation is defined as “*adjustments in ecological-social-economic systems in response to actual or expected climatic stimuli, their effects or impacts*” (Smit & Wandel, 2006, p. 283). In recent years, increasing attention has been paid to climate change adaptation in both science and policy (Adger et al., 2007; Moser, 2009; Preston et al., 2009). Many scholars aim to explain why there is often an ‘adaptation gap’ (Burton, 2009), meaning a gap between what society should do to be prepared for climate impacts and what is actually being done. This problem is not just limited to low-income countries. High-income countries like the Netherlands are also insufficiently prepared for environment-related challenges (National Research Council, 2010).

Research from the Climate Proof Cities Program shows that Dutch cities are facing more intense rainfall, heatwaves, and droughts, increasing the risks of waterlogging, heat stress, and damage to infrastructure (Rovers et al., 2014). These risks are increased by urban planning factors such as extensive paving and high building density. In the Netherlands, heatwaves are becoming more frequent and intense. According to the KNMI, the highest annual maximum temperature has increased by 2.4°C since 1960 (Ahmed et al., 2023). During recent heatwaves, temperatures in the Netherlands exceeded 40°C, with surface temperatures rising above 50°C, which has direct implications for public health, including dehydration, heat stroke, and increased mortality among vulnerable populations (Ahmed et al., 2023).

Besides heatwaves, water-related challenges form another risk. Due to the high degree of paved surface in cities rainwater has limited opportunity to infiltrate in the ground, leading to an increased risk of flooding (Claessens et al., 2014). The Netherlands ranks fourth in Europe for surface sealing, with a 15% increase between 2000 and 2018 (PBL, 2019). During extreme precipitation events, sewer systems are often unable to cope, resulting in overloaded infrastructure and flooded streets (Rovers et al., 2014).

Land subsidence is a problem in low-lying urban areas in the Netherlands, especially those built on former peatlands. Although subsidence itself isn't directly caused by climate change, it is an effect of controlling the water system and therefore accelerated by climate-related effects, such as extreme rainfall and prolonged droughts (Deltares, 2021). Heavy rainfall increases pressure on already subsiding areas, increasing the risk of flooding, while drought lower groundwater levels, causing soils to lose their stability and sink faster (Dodman et al., 2022).

From a climate governance perspective, climate adaptation is often seen as technical or spatial measures to reduce environment-related challenges, such as making cities greener, building water storage, or adjusting infrastructure. In reality adaptation is more multi-dimensional process. In vulnerable neighborhoods, these complexities are especially visible. Adaptation cannot be achieved through technical solutions alone. Therefore, in this thesis, adaptation is seen as a systemic challenge rather than an implementation issue. This shows that the challenge is not only one of adapting to climate change, but responding to broader environmental challenges.

2.2 Understanding Vulnerability

Climate change disproportionately affects disadvantaged or vulnerable neighborhoods (Dodman et al., 2022). A commonly used model for analyzing neighborhood vulnerability is the exposure-sensitivity-adaptive capacity framework (Brooks, 2003; Smit & Wandel, 2006). This model is often cited in climate adaptation literature and explains that vulnerability emerges from the interaction between external risks, internal sensitivities, and the capacity to adapt. Although vulnerability is often framed as a function of exposure, sensitivity, and adaptive capacity (Brooks, 2003; Smit & Wandel, 2006), it is valuable to place these concepts within a broader system dynamic. The framework by Fünfgeld & McEvoy (2011) offers a clear visualization of this dynamic (as shown in Figure 4).

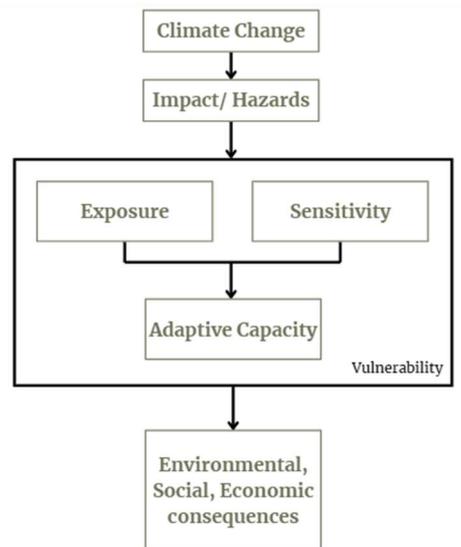


Figure 4. Vulnerability model (Source: Funfgeld & McEvoy, 2011)

In this model, the chain begins with climate change, which leads to an increase in the frequency and intensity of impacts or hazards. The resulting vulnerability of a neighborhood is determined by the interaction between exposure, sensitivity and the adaptive capacity of the system. Vulnerability is a central concept in this model: it determines the extent to which climate impacts actually lead to environmental, social, and economic consequences (Fünfgeld & McEvoy, 2011).

Exposure refers to the nature and intensity of the risks that a neighborhood faces (Brooks, 2003). These may include climate-related hazards such as flooding, heatwaves, or drought, as well as broader social or economic stressors such as unemployment or population decline. The IPCC (2001, p. 987) defines exposure as: “*The nature and degree to which a system is exposed to significant climate variations.*” For vulnerable neighborhoods, exposure implies that they are physically located in high-risk areas (for example, low-lying zones prone to flooding), but also that they may be subject to compound risks. In cities in the Netherlands, some neighborhoods are more frequently affected by water-related issues or heat stress due to their location, density, and layout (Rovers et al., 2015).

Sensitivity indicates the extent to which a neighborhood is actually affected by a given impact or hazard. It reflects the degree to which existing characteristics (social, physical, or economic) contribute to being vulnerable to harm (Brooks, 2003). The IPCC (2007, p. 881) defines sensitivity as: “*The degree to which a system is affected, either adversely or beneficially, by climate variability or change. The effect might be direct or indirect.*” For vulnerable neighborhoods, this means that areas with high proportions of elderly residents, low incomes, and poor housing quality are more sensitive to the impacts of climate change than less vulnerable neighborhoods. Two neighborhoods may experience the same amount of rainfall or heat, but the impact can vary depending on the population, housing quality, and the presence of support services. Vulnerable groups, characterized by factors such as the elderly, chronically ill, or low-income residents are generally more sensitive to the effects of climate change (Adger, 2006; Cutter et al., 2003).

The adaptive capacity of a neighborhood refers to its ability to respond to risks and changes. According to the IPCC (2007, p. 869), adaptive capacity is defined as: “*The ability of a system to*

adjust to climate change to moderate potential damages, to take advantage of opportunities, or to cope with the consequences". Adaptive capacity is shaped by factors such as health, education, and social networks, as well as structural factors like collaboration between public and private parties, regulatory frameworks, and the broader economic context (Brooks, 2003). This means that strong community networks, active resident organizations, access to information, and responsive local governments contribute to greater resilience (Adger, 2003; Smit & Wandel, 2006).

From a climate governance perspective, while the classical model is analytically helpful, it lacks to explain why adaptation fails to occur. The concept of adaptive capacity is defined as a systematic feature. The framework by Fünfgeld & McEvoy (2011) addresses this limitation by placing vulnerability within a broader dynamic. In vulnerable neighborhoods, where multiple actors have fragmented responsibilities and mandates, adaptation is not just about the presence or absence of capacity, but also about the alignment of roles, incentives and decisions. To contextualize vulnerability in the Dutch context, the ABN AMRO (2023) model is introduced.

2.3 Mapping Urban Vulnerability in Dutch Context

According to research by ABN AMRO, as many as 900 neighborhoods in the Netherlands are vulnerable to climate change (ABN AMRO, 2023). These neighborhoods face high risks from one or more environment-related challenges, such as flooding or foundation problems, while often lacking sufficient financial capacity to effectively respond.

Within this broader group, a subset of 90 neighborhoods is classified as extremely vulnerable due to multiple overlapping risk factors. Physical climate risks occur with socioeconomic challenges like low average incomes, low property (WOZ) values, and outdated housing stock. These extremely vulnerable neighborhoods are mostly located in areas with weak soils (such as parts of the Randstad), neighborhoods with older, inadequate foundations, or cities with higher flood risks (e.g., Limburg). Vulnerable areas in provinces such as Zeeland, Friesland, and Groningen combine drought-sensitive soils, energy-inefficient housing, and limited financial resources among homeowners (ABN AMRO, 2023).

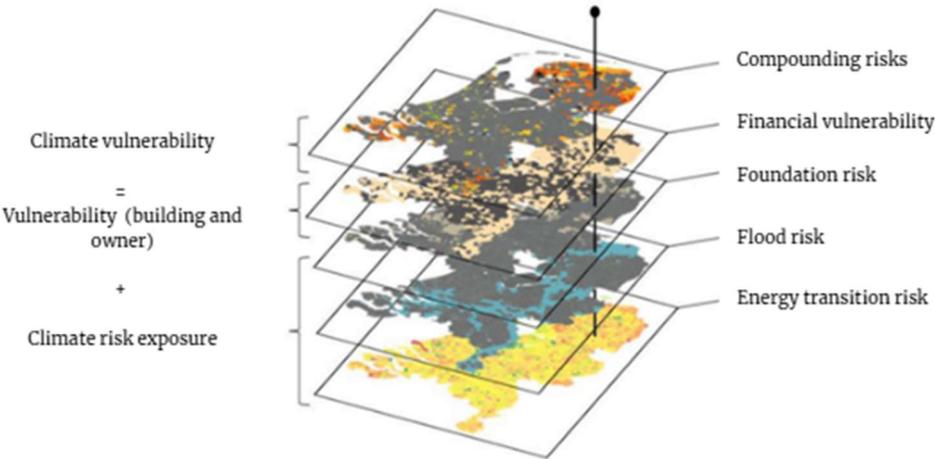


Figure 5. Climate vulnerability at different layers (Source: ABN AMRO, 2023)

These physical and socioeconomic vulnerabilities are illustrated in figure 5, which shows five layers of risk: energy transition risks, flood risks, foundation risks, financial vulnerability, and a combined layer representing where these risks intersect. This model demonstrates that vulnerability occurs in areas where multiple risks overlap.

However, from a climate governance perspective, this model also has its limitations. It shows clearly where risks are concentrated, but it does not fully take into account all ranges of environment-related risks. While it does include important components, it does not consider for example heat stress as a separate risk factor.

2.4 Past Urban Development Decisions

An important factor in understanding environment-related challenges is the legacy of past urban development and construction choices. Many urban neighborhoods in the Netherlands were developed during periods in which the climate produced different rain patterns or wasn't expecting the extreme extent of other climate related problems, such as droughts and land subsidence. Therefore, tacking precautions measures for these type of issues was not yet part of the planning agenda.

One of the clearest examples is the type of foundations used in pre-war housing stock. In many Dutch cities, pre-war housing was built either on shallow foundations on clay soils (op stal) or on wooden piles in peat-rich areas. These techniques were suitable under stable groundwater conditions, but are now under increasing pressure due to land subsidence and changing hydrological regimes (KCAF, 2022). Land subsidence can expose wooden piles to air, causing them to rot, while buildings on shallow foundations become uneven, as the soil beneath them compacts and shifts (TNO, 2023). This leads to damage such as cracks, tilting, and costly foundation repair needs.

Next to that, the historical planning decisions also led to densely paved neighborhoods with limited green space or room for water retention. These spatial decisions now amplify heat stress and surface flooding (Runhaar, 2012). These issues are deeply embedded in existing ownership structures, housing policies, and infrastructure systems. Changing this is far from straightforward. Many of these areas are now inhabited by residents with limited financial means, making collective repair and adaptation efforts even more complex.

From a climate governance perspective, while the physical consequences of these decisions are clearly visible, their continued persistence reflects deeper institutional problems. Knowledge about foundation risks remains fragmented, not transparently shared, or poorly integrated in housing markets mechanisms. Responsibilities are fragmented across public and private actors, and existing policies do not encourage proactive investment. In this sense, vulnerability is not only the result of climate pressure, but produced by a system that struggles to respond to its own historical decisions.

2.5 Conclusion

This chapter set out to answer the first sub-question of this research: *What are environment-related challenges in vulnerable neighborhoods in Dutch Cities?* Through a review of scientific and policy

literature, this study has mapped out the various challenges that manifest in urban areas, with particular attention to their impact on vulnerable neighborhoods. Four environment-related challenges can be identified:

First, heat stress is increasingly affecting urban neighborhoods due to both rising temperatures and the Urban Heat Island effect. High building density, paved surfaces, and limited greenery contribute to elevated surface temperatures, particularly in low-income areas where residents may lack cooling options or green spaces (Ahmed et al., 2023; Rovers et al., 2015). During recent heatwaves, Dutch cities experienced surface temperatures above 50°C, with public health impacts like heat strokes and increased mortality rate.

Second, increasing precipitation and flooding increases threats to current infrastructure. Due to high degrees of surface sealing and aging sewer systems, rainwater cannot infiltrate properly, leading to overflows and waterlogging (Claessens et al., 2014; PBL, 2019). The frequency and intensity of rainfall events have increased over the years, and vulnerable neighborhoods (often) located in low-lying areas with insufficient drainage capacity, feel the effects to a greater extent.

Third, land subsidence poses a long-term risk, particularly in neighborhoods built on peat or clay soils. Although not caused directly by climate change, subsidence is exacerbated by droughts and fluctuating groundwater levels, which lead to soil shrinkage and instability (Deltares, 2021; Klimaatadaptatie Nederland, 2024). These processes risk buildings, roads, and underground infrastructure, and are expected to cause billions in damages by 2050 (TNO, 2023; KNMI, 2023).

Fourth, the legacy of historical urban development also creates vulnerability. Many pre-war homes were built on shallow foundations or wooden piles, which are now failing under today's changing soil and water conditions (KCAF, 2022). These weaknesses are most severe in vulnerable neighborhoods with outdated housing stock. As foundation conditions deteriorate due to subsidence and groundwater levels, repair is often unaffordable, particularly for private homeowners.

The IPCC framework for vulnerability—exposure, sensitivity, and adaptive—helps conceptualize how these risks interact. Vulnerable neighborhoods are typically more exposed to climate change, more sensitive due to socio-economic and physical characteristics, and have less capacity to adapt due to limited resources and lack of institutional support (Brooks, 2003; Adger, 2006; Fünfgeld & McEvoy, 2011). To bring this into the Dutch context, the ABN AMRO model (2023) identifies 900 vulnerable and 90 extremely vulnerable neighborhoods where physical climate risks intersect with financial vulnerability and outdated infrastructure.

In conclusion, environment-related challenges in vulnerable neighborhoods are not only caused by climate change itself, but also by historical construction choices, weak soil conditions, outdated infrastructure, and a lack of adaptive capacity. Vulnerability is therefore not only physical or environmental, but also shaped by deeper institutional and governance systems that, among others, affects the ability of financial stakeholders to act on climate adaptation in practice. The next chapter shifts focus to these stakeholders.

3 Understanding Systemic Barriers to Climate Change

While the physical consequences of climate risks are explained thoroughly in current literature, their impact on the broader network of financial actors related to the built environment remains less explored. Dealing with outdated housing, soil subsidence and increasing flood risks requires significant capital from various sources. Thus, financial stakeholders play an important role in determining what forms of adaptation are feasible. The chapter first sets out who these stakeholders are, what roles they play in the area development financial system, and how their logics, mandates and risk perceptions shape their capacity and willingness to engage in climate adaptation. Section 3.3 identifies the barriers that limit ability or willingness to act on environment-related challenges. Section 3.4 introduced the concept of adaptive governance.

3.1 Exposure of Financial Stakeholders to Environment-Related Challenges

In this thesis, financial stakeholders are defined as both public and private actors that allocate, manage, or influence financial flows in the built environment (Lützkendorf et al., 2011). This includes housing associations, which manage large portions of the affordable housing stock in vulnerable neighborhoods; banks, who provide capital and carry credit risks tied to property values; insurance companies, responsible for covering damage related to climate risks; institutional investors, such as pension funds, who channel long-term capital into area development; and public actors including municipalities and water boards who govern and finance infrastructure and spatial quality (Lützkendorf et al., 2011; OECD, 2022; Franzen, 2017). Understanding the role of financial stakeholders requires more than identifying who they are, it also involves analyzing how and when they become involved in the urban development process. The financial value chain of area development shows these dynamics (figure 6). Each phase involves different stakeholders, financial logics, and responsibilities, which influence how value is created and distributed. In the context of climate adaptation, this framework helps to identify when and how financial stakeholders engage, and where barriers might emerge.

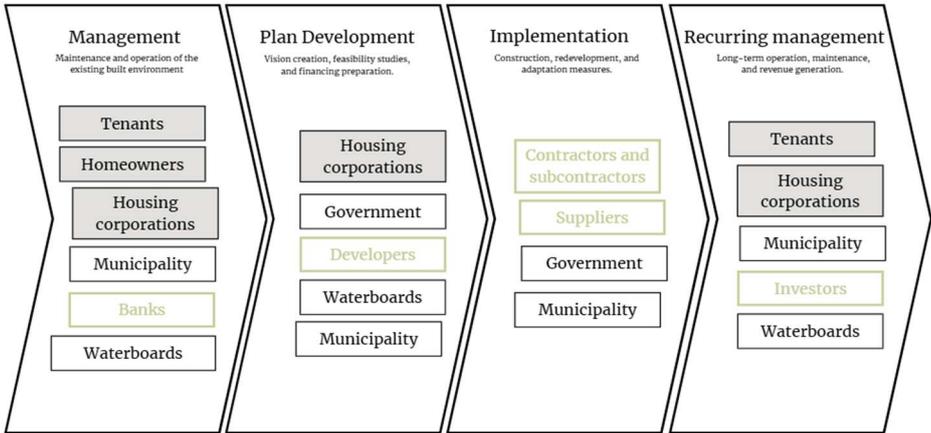


Figure 6. Area (re)Development Value Chain (Source: own diagram based on Franzen, 2017)

Municipalities are responsible for public infrastructure, spatial planning, and local policy implementation. They are directly exposed to rising maintenance costs due to water overload, subsidence, and deteriorating sewer systems. However, they often lack resources or capacity to proactively address these risks, especially in low-income areas. Without integrated investment strategies or legal mandates, municipalities may be forced into reactive action, further increasing costs, uncertainty for private partners, policy failure and loss of public trust (OECD, 2022).

Housing associations, which typically manage large amounts of social housing in vulnerable neighborhoods, are particularly vulnerable to physical risks, given their aging housing stock and concentration in unstable or flood-prone areas. They are exposed to rising maintenance costs, structural damage, and declining asset values (Aedes, 2023). Their long-term business models rely on stable rent revenues and asset valuation, both of which may come under pressure in climate-stressed areas. For example, subsidence in combination with outdated foundation types creates costly technical challenges that are difficult to cover within current financial frameworks (Aedes, 2023). Next to that, housing associations are subject to increasing regulatory demands, such as renovation obligations and sustainability targets.

Banks and mortgage lenders face heightened credit risks as mortgage portfolios become exposed to deteriorating housing. If the physical condition or perceived long-term viability of housing declines due to flooding or structural damage, this affects loan-to-value ratios and default risk (Battiston et al., 2017; DNB, 2021). This could lead to forced sales or early write-downs of assets, especially if ownership is fragmented or if public funding for renovation is absent (DNB, 2021).

Insurers are more directly exposed to physical risks due to extreme weather events, while insuring against flood or foundation damage is often not possible. In the Netherlands, a large proportion of real estate is uninsured against climate risks (DNB, 2017). As a result, insurers play an important role as risk signalers, but they also face reputational risks and struggle with the limited predictability of environment-related challenges. Some companies are investing in preventive measures through premium differentiation or risk-based underwriting (Platform for Sustainable Finance, 2023).

Institutional investors, such as pension funds and asset managers, hold real estate and equity portfolios. According to Battiston et al. (2016), 36–48% of the investment portfolios of European pension funds and insurers are exposed to sectors that are sensitive to climate policy. ESG frameworks have increased pressure to account for environment-related challenges in investment portfolios, but the assessment of localized risks remains underdeveloped (Battiston et al., 2016).

The risks for financial stakeholders is divided into three categories: physical risks, transition risks, and reputational risks (DNB, 2021; Sanderson et al., 2019; Runhaar et al., 2012). Physical risks refer to direct damage or degradation. These risks can decrease asset value, disrupt the housing market, and increase maintenance costs. Transition risks come from shifts in climate policy, regulation, or societal expectations, such as higher energy performance standards or limitations on high-risk real estate investments. These risks might result in stranded assets and increased financial costs (Battiston et al., 2021). Reputational risks arise when financial actors are held accountable for not addressing known climate risks, potentially resulting in legal claims or reputational damage (Runhaar et al., 2012).

In addition to exposure, stakeholders respond to risks in fragmented ways. Banks and investors may assess risk in terms of market liquidity and default probabilities, while public actors focus on safety and social equity. This exacerbates vulnerabilities in areas and reinforces the position of already disadvantaged neighborhoods (Mees et al., 2013).

Institutional logics and accountability frames influence whether and how risks are acknowledged. Financial actors tend to prioritize short- to medium-term risks that directly affect their operations, while broader risks, such as long-term subsidence remain under the radar (Patterson et al., 2019).

3.2 Systemic Barriers for Implementation

Adapting to climate change is hindered by various challenges that can delay, obstruct, or alter the course of adaptation efforts. The IPCC (2014) characterizes these challenges as conditions that limit the ability to plan or carry out adaptation actions, or that reduce the range of available options.

In the literature on climate adaptation, different terms are used to describe the factors that make implementation difficult. Two of the most common terms are *constraints* and *barriers*. Eisenack et al. (2014) define barriers as “*challenges, obstacles, constraints or hurdles that impede adaptation,*” suggesting that these terms are often closely related. Biesbroek et al. (2013) describe barriers as factors that prevent policymakers from effectively developing or implementing adaptation strategies. Although the difference between the two terms is subtle, some researchers use constraints to describe more flexible or context-specific limitations, and barriers refer to deeper, structural obstacles that are harder to overcome.

In this thesis, the term barriers is used: climate adaptation in vulnerable urban areas is not only delayed by uncertainty or complexity, but often hindered by institutional structures, rules, and decision-making processes. These barriers are seen as part of the system itself and understanding them is important to identifying why adaptation does not happen, even when the need is clear.

Research has identified a range of commonly observed barriers in urban settings. There has been made an attempted to categorize these barriers. Ekstrom and Moser (2014) classify barriers into four overarching types: institutional barriers, attitudinal barriers, financial barriers, political barriers. Biesbroek et al. (2013) propose a more detailed framework with seven barrier types, such as conflicting timescales, institutional crowdedness and voids, lack of awareness and communication and lack of resources. Based on the literature review the following factors seem to be often identified as the most significant barriers: a lack of resources (knowledge, personnel, financial means), and institutional limitations and governance barriers. (Biesbroek, et al., 2013; Ekstrom & Moser, 2014; Patterson et al., 2019; Adelle et al., 2021; Lee et al., 2022; Runhaar, et al., 2012).

3.2.1 Lack of Resources as Symptoms

Resource barriers are a recurring theme in climate adaptation literature, as they directly affect the capacity of institutions and stakeholders to implement adaptation strategies. Resource barriers are understood as the absence or insufficiency of tangible inputs (Biesbroek et al., 2013). This could be a lack of funding, personnel, time, knowledge, and tools, that are necessary to design and execute effective adaptation measures (Ekstrom & Moser, 2014; Biesbroek et al., 2013).

Several studies have identified financial constraints as the most prominent barrier. Adaptation initiatives lack dedicated funding streams, and the long-term uncertainty to benefits of adaptation tend to make it unattractive within short political or investment cycles (Dodman et al., 2022; Adelle et al., 2021). In lower-capacity municipalities or vulnerable neighborhoods, adaptation competes with more immediate concerns such as housing shortage, safety, or economic development. This mismatch could result in delayed action (Runhaar et al., 2012).

In addition to budget limitations, human capacity barriers also play a role in the inaction of adaptation. Local governments and planning departments may lack sufficient staff, time, or expertise to translate climate data into workable strategies (Lee, Paavola, & Dessai, 2022). Capacity constraints are especially visible in the implementation phase, where technical knowledge, project management, and coordination are required (Uittenbroek et al., 2013).

In addition to these barriers, there are also informational and technical resource barriers. These refer to the lack of relevant climate data or tools to assess risks and impacts (Chu, 2022; Eisenack et al., 2014). While global climate models provide long-term projections, they often lack the detail needed for planning at the neighborhood scale. This makes it harder to make well-informed decisions, and can lead to inaction due to uncertainty or a perceived lack of urgency (Runhaar et al., 2012; Adelle et al., 2021).

This thesis therefore interprets resource barriers not as isolated obstacles, but as symptoms of deeper systemic failures. These challenges do not emerge independently, but are shaped by institutional norms and governance structures that constrain the allocation of resources, even when the necessity for adaptation is acknowledged.

3.2.2 Institutional Logics as Root Causes

Institutional logics form the foundation that explains why other barriers persist. Institutional logics are often considered among the most persistent and complex obstacle. Unlike resource barriers, institutional logics are deeply embedded and can be referred to as the “rules of the game” (Patterson et al., 2019). These logics may not be immediately visible, but they influence what types of actions are seen as possible or thinkable within a context. This could mean that existing policy frameworks, legal systems, and professional routines are often not suited for long-term and uncertain challenges (Patterson et al., 2019).

One important institutional barrier is institutional inaction. This refers to the tendency of existing systems to resist change. This can manifest as political routines, outdated planning procedures, or mechanisms that hinder experimentation and innovation (Eisenack et al., 2014). Chu et al., (2022) observes that even in cities that have embraced “transformative adaptation,” implementation is often blocked by long-standing procedures and risk-averse cultures. These forms of “path dependency” make it difficult to integrate new knowledge, collaborate across sectors, or shift towards more proactive approaches

Another issue is conflicting institutional logics, where different sectors or policy domains operate under conflicting norms or priorities. An example mentioned by Uttenbroek et al (2013) is that development departments driven by money may prioritize growth and densification, while urban

planners seek to preserve open space for water and greenery. These logics are not easily adapted. This normative thinking leads to institutional inaction: even when knowledge and resources are available, actors lack the mandate, incentive, or authority to act (Adelle et al., 2021; Amundsen et al., 2010). As Chu et al. (2022) argue, many cities remain trapped in incremental strategies that leave institutions unchanged, despite the ambitions in policy.

Therefore, in this research institutional barriers are not defined as "soft" challenges, but as structural barriers that determine the success or failure of adaptation. Institutional barriers are deeply embedded rules, routines, and logics within organizations and systems that shape what is considered possible and therefore constraining climate adaptation. Addressing them requires more than just policy changes, but also institutional reflection.

3.2.3 Governance Maintaining Barriers

Resource and institutional barriers do not operate in isolation. Governance determines how these barriers are maintained, reinforced, or potentially overcome. Governance determine who is responsible, under what conditions, and through what coordination structures adaptation can occur. When these systems are fragmented or misaligned, they can reinforce institutional inertia and create environments in which adaptation is formally everyone's concern, but substantively no one's responsibility (Patterson et al., 2019; Chu et al., 2022).

Recurring from the literature is the fragmentation of responsibilities, where climate adaptation responsibilities are spread across multiple departments, agencies, or levels of government without clear coordination. This leads to inefficiencies, double work, or policy gaps (Lee, Paavola & Dessai, 2022). For example, water management, spatial planning, and public health may all play a role in climate adaptation, yet operate under separate mandates and timelines.

Unclear or overlapping mandates leads to actors being unsure who holds responsibility for initiating or funding adaptation measures, particularly in contexts where public and private roles overlap. This accountability problem is common in housing and infrastructure projects, where climate adaptation is not always legally enforced (Boezeman & De Vries, 2019). Unclear legal frameworks reinforce this problem. Runhaar (2012) show that in the Netherlands, there is unclarity about who is responsible for adaptation in the built environment.

Policy misalignment further exacerbates governance gaps (Biesbroek et al., 2011; Uittenbroek et al., 2013; Runhaar et al., 2012). This refers to inconsistencies between climate goals and other policy domains where climate adaptation remains a secondary concern. For example, housing shortage may conflict with the need for green or blue spaces to mitigate heat or flooding risks. These competing goals make it difficult to prioritize adaptation into existing planning routines (Runhaar et al., 2012).

In this thesis governance is defined as the channel through which barriers are shaped, maintained, or potentially overcome. However, when governance is redesigned through adaptive, collaborative, or multi-level governance arrangements it can enable institutional change and integrated climate adaptation (Patterson et al., 2019; Ekstrom & Moser, 2014).

3.3 Transformative Governance and Institutional Change

Although systemic barriers hinder climate adaptation, scholars emphasize that these barriers are not unchangeable. They can be challenged and transformed over time when actors reflect on existing structures and are willing to experiment with new ways of working (Patterson et al., 2019). However, to adjust these structures, small improvements are not enough. They call for institutional change: a shift in the rules, routines, norms, and beliefs that shape how decisions are made and who is responsible. Patterson et al. (2019) shows that institutional change does not happen automatically. It takes time and often involves disagreements.

This is where the concept of transformative governance is introduced (Egerer et al., 2021; Chu et al., 2022). Transformative governance seeks to overcome path dependency by institutional innovation and aligning regulatory, financial, and organizational arrangements with long-term adaptation goals. Chu et al. (2022) explains that aligning adaptation with other priorities requires changes in institutional culture and routines. Governance systems must change to allow new ways of thinking and acting (Lee et al., 2022; Adelle et al., 2021). However, such transformations are unlikely to emerge from top-down control alone. Multilevel governance approaches, which combine regulatory frameworks with room for experimentation and bottom-up initiatives are needed (Molenveld et al., 2020; Amundsen et al., 2010).

3.4 Conclusion on Theoretical Background

Based on academic and policy literature, it is clear that financial stakeholders are confronted with the impacts of environment-related challenges and the exposure to these risks affects stakeholders in different ways. The chapter started by identifying the financial stakeholders involved in the area development value chain. The impacts of climate change not only threaten the value of assets but also create physical, transition and reputational risks.

Housing associations face rising maintenance costs and degradation of their housing stock, while their long term business models rely on stable rental income and asset values. Municipalities and water boards face growing financial liabilities tied to public infrastructure, but often lack sufficient resources to act. Banks and mortgage lenders are confronted with uncertainties about the long-term value of mortgaged properties, which could trigger risk-averse behavior, including stricter lending conditions. Insurers experience more frequent claims and may respond by raising premiums. Investors are under growing pressure to align their portfolios with ESG standards and may reconsider the viability of long-term investments in vulnerable areas, while developers could be confronted with delays, higher costs, and higher complexity in project planning and permitting.

Despite growing awareness and exposure of environment-related challenges, the ability to respond is constrained by systemic barriers. The literature has shown that the barriers are not only caused by financial limitations, but due to institutional logic that guide how organizations think and act. Existing governance is often fragmented, with unclear responsibilities and conflicting policies. This chapter also introduced transformative governance: a mode of governance that enables institutional learning, cross-sectoral collaboration, and change. Rather than small adjustments, transformative governance seeks to overcome path dependency by questioning current decision-making.

4 Methodology

4.1 Research Design

This research is a qualitative, design-oriented case study research, focusing on the neighborhood of Bloemhof in Rotterdam. The case study approach made it possible to take a close look at how different financial stakeholders work in this context, what challenges they face, and how current institutional logics affect their actions. Given the limited theoretical and empirical work in such contexts, the study aligns with what Edmondson and McManus (2007) define as a *nascent phase of theory development*. In this phase, open-ended research questions, inductive reasoning, and qualitative methods are most appropriate to uncover new insights. The research design therefore uses semi-structured interviews, design workshops, and expert panel discussions to generate new insights.

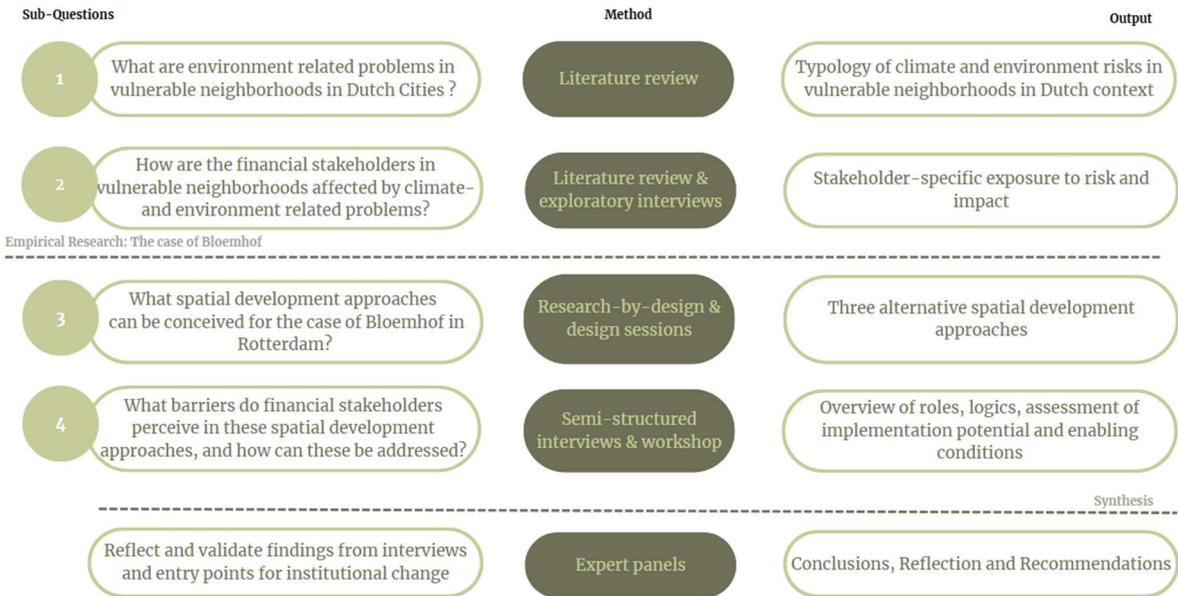


Figure 7. Research design (Made by Charlotte Boreel)

4.2 Participation in Research Program

This graduation research adopts a multidisciplinary approach and is aligned with two research programs: the *Red& Blue program* and the *Redesigning Deltas* program led by Fransje Hooimeijer.

The Red& Blue program investigates the financial impact of climate risks on the built environment and how these risks influence decision-making in urban development. It focuses on the question of who bears the costs of climate adaptation and how public and private actors respond. My research aligns with this focus by examining the systemic barriers to addressing environment-related challenges in vulnerable neighborhoods, using Bloemhof as a case study.

In addition, I participate in the Redesigning Deltas program, funded by Resilient Delta, which approaches urban transformations from a design perspective. In collaboration with a consortium of the TU Delft, Erasmus, Flux and ZUS, led by Fransje Hooimeijer, this research will explore three alternative spatial development approaches for the Bloemhof neighborhood.

This research combines these two approaches: the governance -and institutional perspective of the Red & Blue program and the spatial design perspective of Redesigning Delta's, to gain a better understanding of why adaptation measures in vulnerable neighborhoods are being obstructed.

4.3 Case Selection

This research focuses on Bloemhof in Rotterdam South as the main case study. The selection of Bloemhof was informed by the Red& Blue research program, which uses the area as a testing ground for integrated climate and spatial strategies and financial governance.

The neighborhood faces land subsidence, foundation problems, and growing pressure on its drainage systems and these characteristics make Bloemhof a typical example of a “sinking neighborhood”. Bloemhof is also a relevant example for exploring spatial (re)development approaches due to the growing demand for housing in Rotterdam. This creates pressure for densification, which makes it an opportunity to link climate adaptation with urban redevelopment.

Bloemhof has a mixed ownership structure, with housing associations, private owners, and municipal control over public space. Current municipal plans for street-level elevation and sewer renewal show the urgency of adaptation but also reveal fragmented governance and limited coordination between stakeholders. Bloemhof therefore provides a relevant testing ground for exploring how spatial redevelopment with measures for soil and water system adaptation, housing provision, and governance arrangements can be aligned.

4.4 Data Collection

Research by Design

This research applies a *Research by Design* approach. Research by Design is understood as a methodology in which spatial and urban design are not only outcomes, but active instruments of inquiry (Van Dooren et al., 2014). Three alternative spatial development approaches were developed: (1) selected demolition and reconstruction, (2) modest renewal, and (3) integrated redevelopment. Each approach integrates soil- and water-led adaptation measures. These designs are not intended as fixed plans, but helped to generate new knowledge. It not only produced design ideas, but also gave a better understanding of how spatial risks are connected to slow or fragmented decision-making.

Semi Structured Interviews

The interviews form a core component of this study and aim to provide insight into the systemic barriers financial stakeholders face in the development approaches and to uncover their institutional logics. The use of semi-structured interviews offers both structure and flexibility, allowing respondents to emphasize their own perspectives and introduce new insights. The participants for the interviews are chosen based on the following criteria:

- The participants have positions within the financial value chain of area development
- The participants are familiar with the problems experienced in vulnerable neighborhoods
- The participants have institutional differences to capture multiple perspectives

A total of 15 interviews were conducted between March and April 2025 (Table 2). Interviews lasted between 45 and 90 minutes and were held either in person or via Teams. Prior to the interview,

participants were asked to sign a consent form (see Appendix IV: Consent Form). The names of the respondents are kept anonymous so they could speak freely.

The interviews were built around two main themes. The first part was about understanding the role and responsibilities of the stakeholders. They were asked how they see environment-related challenges and adaptation in vulnerable neighborhoods, what challenges or barriers they face and their ideas for changing the system or improving governance.

In the second part of the interview, three spatial development approaches for the Bloemhof neighborhood were presented. Respondents were shown visualizations and descriptions of the three approaches and asked to reflect on them. The discussion focused on the opportunities and challenges they perceived within each approach, the conditions under which involvement would be considered, and their assessment of the feasibility and realism from their perspective. The full interview protocol is included in Appendix V: Interview protocol.

All interviews were recorded, transcribed, and analyzed using software Atlas.ti. Coding was carried out using a combination of deductive codes derived from literature and inductive codes that emerged from the empirical data. This approach allows for both the validation of theory and the identification of patterns (Appendix I: Codebook). Next to that, a separate analysis was conducted to interpret stakeholder positions and institutional logics; their role, investment logics, accountability frame and a key quote of the interview. Since these elements reflect broader patterns of reasoning across entire interviews, they were analyzed outside of Atlas.ti and organized in an Excel table (Appendix II).

The interviews not only served as a means of analysis but also as a feedback loop to the design process. Feedback on the spatial development approaches was structured using a Miro board, as it allowed for a more visual organization of stakeholder responses directly on the design material (Appendix III). The input stakeholders provided was relayed back to the design approaches. This created an iterative process in which insights contribute to improving and refining the approaches.

Workshop and Expert Panels

To complement the interviews, a workshop and an expert panel was organized. Each session served a different purpose within the research and involved distinct groups of participants.

The first session served as a design review workshop aimed at refining the three spatial development approaches. This workshop was held in collaboration with professionals from academic institutions, landscape architects and representatives from public organizations. The discussion focused on the spatial and technical feasibility of the strategies, their adaptability to urban conditions, and their relevance for addressing environment-related challenges. Feedback from this session was used to update and finalize the designs prior to stakeholder testing.

The second session was an expert panel that brought together public-sector stakeholders involved in the financing and regulation of climate adaptation. The goal of this session was to validate the findings from the interviews, get their feedback on the design perspectives and explored the implications and possible governance arrangements.

In the third session, the preliminary findings and design alternatives were presented at the Resilient Delta Congress. This congress brought together academics, policymakers, and practitioners involved in climate adaptation and urban resilience in the Netherlands. The presentation served both as a validation moment and as an opportunity to collect feedback from a wider community of experts.

Across all sessions, data was collected through audio recordings and field notes. The outcomes of the data is included in the empirical chapter. This combination of interviews, design sessions, and expert panels made it possible to compare viewpoints from different types of stakeholders and to check whether insights from the interviews matched what came up in the panel and workshop (triangulation). By putting different perspectives next to each other and connecting them to design ideas, it became easier to see common patterns. Although this method helped to reduce bias and gave a deeper understanding of the barriers, the findings are still specific to the case of Bloemhof.

4.5 Data Plan

The aim of this research is to share knowledge and provide insights, not only including sharing the outcomes of the research, but also ensuring the accessibility and usability of the data collected during the study. To achieve this, the FAIR Guiding Principles (Wilkinson et al., 2016) have been adopted, ensuring the data adheres to the standards of Findability, Accessibility, Interoperability, and Reusability. A detailed Data Management Plan has been developed to support this goal (Appendix XI: Data Management Plan).

4.6 Ethical Considerations

This research involves discussing possible future strategies and design approaches for an existing neighborhood. While the research is theoretical and does not necessarily mean that any form of implementation or intervention will happen, the topic is sensitive. Climate adaptation in vulnerable areas touches on issues of displacement, affordability, ownership, and trust between institutions and residents. Therefore, the research was approached with care and responsibility. The spatial development approaches that are presented are not binding or formal plans, but exploratory ideas meant to better understand the boundaries of institutional action and cooperation. All respondents were informed about the academic nature of the study.

Extra caution was taken in anonymizing interview responses, keeping sensitive information confidential and storing it securely on encrypted platforms, accessible to the research team. The research does not evaluate or judge the actions of specific organizations, but rather seeks to learn from their insights to identify potential pathways for system change. The four ethical considerations described by Diener and Crandall (1978) are:

- Informed consent
- Voluntary participation
- Anonymity
- Avoiding exaggeration of objectives

4.7 Limitations

This research has several limitations. First, the study focuses on a single case: Bloemhof in Rotterdam. Although this case is relevant due to its vulnerability and adaptation potential, its specific institutional and spatial conditions limit the generalizability of the findings to other contexts. Second, the empirical data was gathered from financial stakeholders, however excludes the perspective from residents, which may have yielded additional insights into social feasibility or local priorities. Third, the spatial designs developed serve as exploratory frameworks, rather than implementation-ready plans and they were used to test responses and stimulate dialogue. They have not been technically, legally or administratively calculated for feasibility. Finally, the context in which this research took place is subject to change. Interviews reflect a specific moment in time (early 2025), and policy developments may have evolved since. These limitations are further discussed in Chapter 11.

5 The Case of Bloemhof

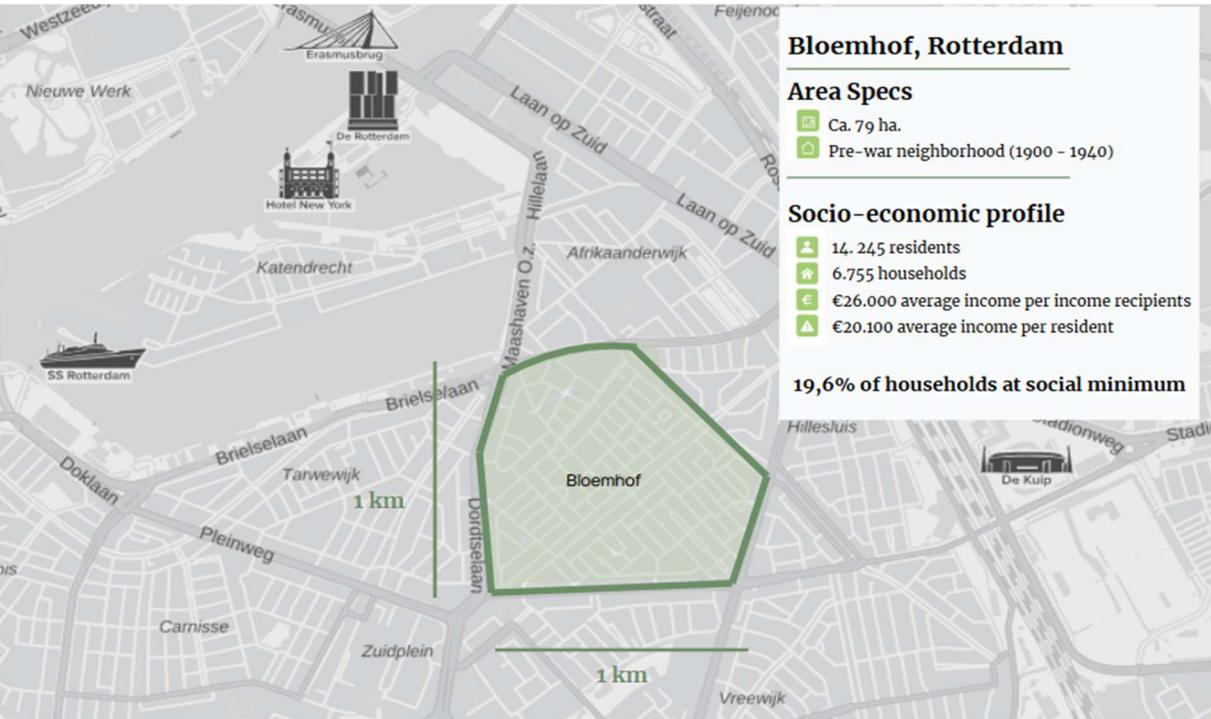
This chapter presents the case of Bloemhof, a pre-war neighborhood in Rotterdam that is increasingly affected by subsidence, foundation damage and environment-related challenges. This chapter start by introducing Bloemhof and the challenges this neighborhood faces. Section 5.2 explores three spatial design perspectives, each corresponding to a different level of intervention specific to the case of Bloemhof.

5.1 Environmental Challenges in Bloemhof

Bloemhof is a good example to explore systemic barriers associated with adaptation in existing urban context. The neighborhood is characterized by a combination of outdated housing, land subsidence and other environment-related challenges. Next to that the neighborhood also has a fragmented ownership structure. Bloemhof is a pre-war neighborhood originally developed in the early 20th century as a working-class area to accommodate laborers during the expansion of the port. The houses were built at a rapid pace in the period 1905–1940 to meet the housing shortage among working-class families. Unlike much of central Rotterdam, Bloemhof was largely spared from wartime bombing, leaving its original urban fabric intact.



Today, this legacy results in a relatively low-density, porch-style housing and closed building block structures with narrow streets, limited public space and a predominantly paved ground level. The district is under increasing pressure from environment-related challenges. Extreme precipitation regularly leads to water on the streets, partly because the sewer system has insufficient capacity. Heat stress occurs frequently during warm summers, especially in the densely built-up streets without shade or ventilation (Municipality of Rotterdam, 2020).



De subsoil of Bloemhof mainly consists of peat and clay, which have limited bearing capacity. Most of the housing are built ‘on steel’ or on wooden foundations, which have an increased risk of pile rot and foundation failure. Due to a combination of soil compaction, settlement and ground water extraction, subsidence resulted in tilted buildings, surface depressions and damages to both housing and infrastructure. Figure 8 shows how severe the consequences are. The two doors were once at the same height and cracks can be seen in the facades. These consequences not only lead to high costs for the housing association and residents, but also leads to a decrease in the value of the real estate.



Figure 8. Examples of visible foundation damage in Bloemhof (Source: Own images)

The current physical structure offers little space to adequately address these environment-related challenges. There is limited space for the construction of wadis, extra greenery or water storage. The quality of the subsoil and the low location of the district make it technically complex and expensive to take structural measures without spatial interventions. Socially, Bloemhof is one of the most vulnerable neighborhoods in Rotterdam, with a diverse population, high mobility, and low average income levels. These socioeconomic conditions reduce the area’s attractiveness to banks and investors, who perceive high financial risk. Together, these physical, institutional, and social characteristics in Bloemhof form a complex environment in which climate adaptation must take place.

Bloemhof is marked by a fragmented ownership structure (see Table 1 and Figure 8). This mix makes a collective approach to foundation repair, ground level raising or adaptive measures complex. The presence of many private owners in particular forms a barrier. Many of these owners have limited financial resources, are not always aware of foundation risks, or postpone necessary investments.

Owner	Percentage of the neighborhood
Woonstad	34.6%
Private property owners	48.7%
Hef Wonen	7%
Government	6.0%
Unknown	3.7%

Table 1. Fragmented Ownership



Figure 9. Fragmented ownership (Source: Municipality of Rotterdam, edited by Charlotte Boreel)

The strategic advisor urban development of the Municipality of Rotterdam expressed this complexity at the SKG congress. She talked about how urgent the task has become, but how difficult it is to develop an effective implementation strategy in an area with a high share of private homeownership and multiple ambitions converging sustainability, public health, and foundation repair. For the city as a whole they will need €18 billion in investment funds by 2050. She also said: *“We are working on this together with residents, but we haven’t yet found the definitive answer.”* This shows the need to explore what is spatially possible in Bloemhof to make the area climate-proof in the long term. In the next section three design perspectives are illustrated that explore different urban solutions for the neighborhood.

5.2 Research by Design: Urban Design Perspectives

Based on the challenges in Bloemhof, three alternative design perspectives were developed that explore different spatial solutions for climate adaptation. These perspectives are not blueprints for implementation, but serve as design hypotheses: they show which physical interventions would be necessary to make the area future-proof. The designs differ in the degree of intervention, urban structure, integration of soil and water system, density, and required cooperation. Each perspective reflects a different way of dealing with the foundation problems, subsidence, water management and ownership structure. By exploring these perspectives, it investigates which spatial choices are desirable and feasible, given the institutional and financial reality of a district like Bloemhof.

In an initial exploratory workshop, four guiding principles were established that the three design alternatives had to adhere to: (1) Building for the neighborhood, (2) Densification with respect for the existing character of the area, (3) A soil- and water-led development approach, and (4) housing corporations (with buildings on shallow foundations) as the strategic starting point.

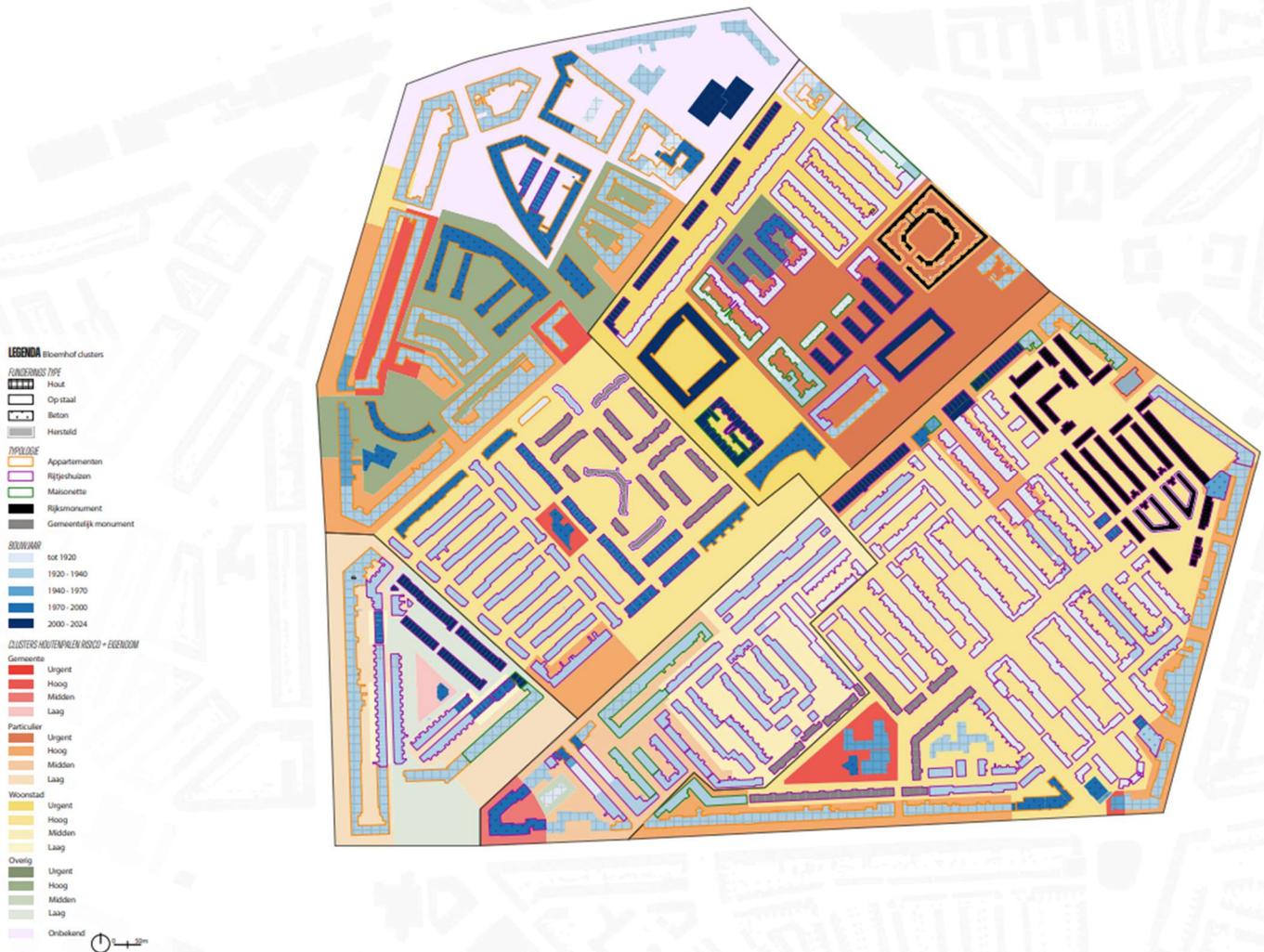
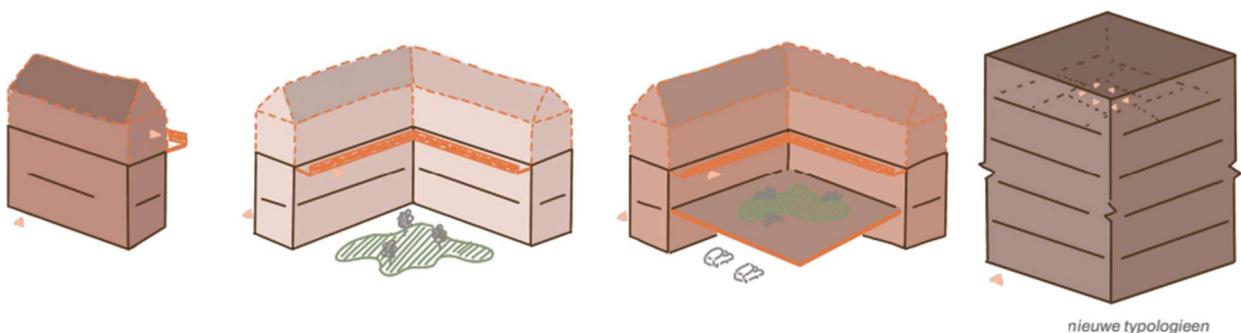
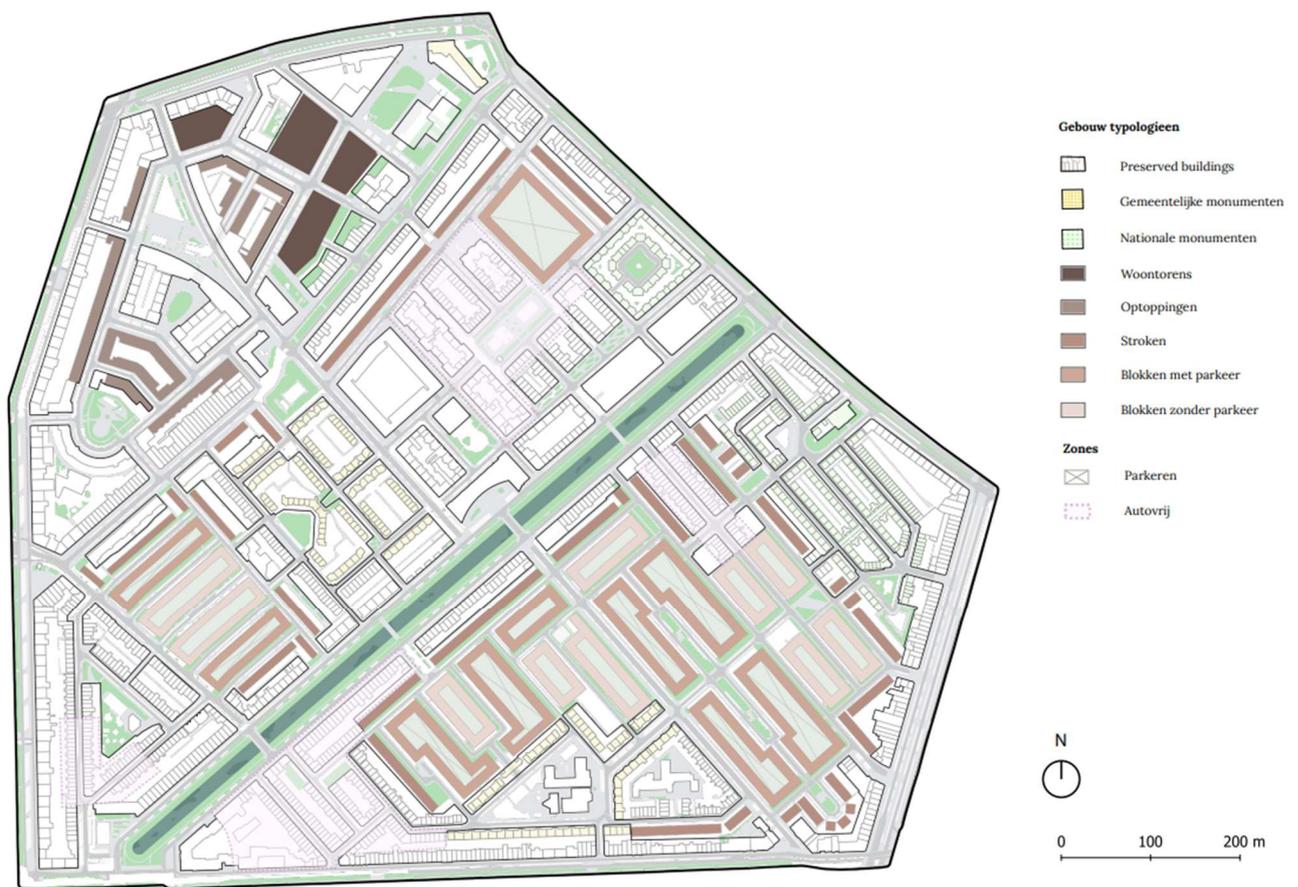


Figure 9. Map of Bloemhof and Phasing (Made by the Redesigning Delta's Team)

Figure 9 shows a map that was developed for Bloemhof. It visualizes the distribution of ownership, highlighting in blocks which areas are owned by the housing association and indicating the approximate ownership shares of other stakeholders. The map also categorizes the urgency of subsidence problems per property owner using different colors, and shows the phased agenda proposed by the housing corporation.

1: Phased Renewal Through Demolition and New Construction (Blok voor Blok)

This perspective builds on the existing urban structure and proposes a phased demolition and replacement of outdated housing. The focus is on properties owned by the housing association, which allows for coordinated interventions at the building scale. Interventions in the ground, such as raising the ground level or installing drainage systems are combined with a phased redesign of streets and buildings. A feature of this perspective is the ambition to remove cars from the streetscape. Cars are relocated to collective parking zones or at the edge of the neighborhood. Also housing will be shifted 1.5 meters backwards, making space in the streets for more greenery. The overall density increases by 29%, but the quality of the built environment improves significantly in terms of safety, energy performance and spatial comfort (32% more greenery). This perspective requires close collaboration between housing associations, private homeowners and the municipality. The impact on the soil and water system is limited

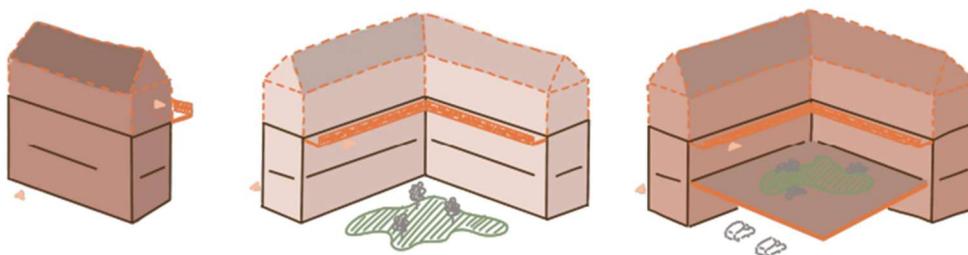
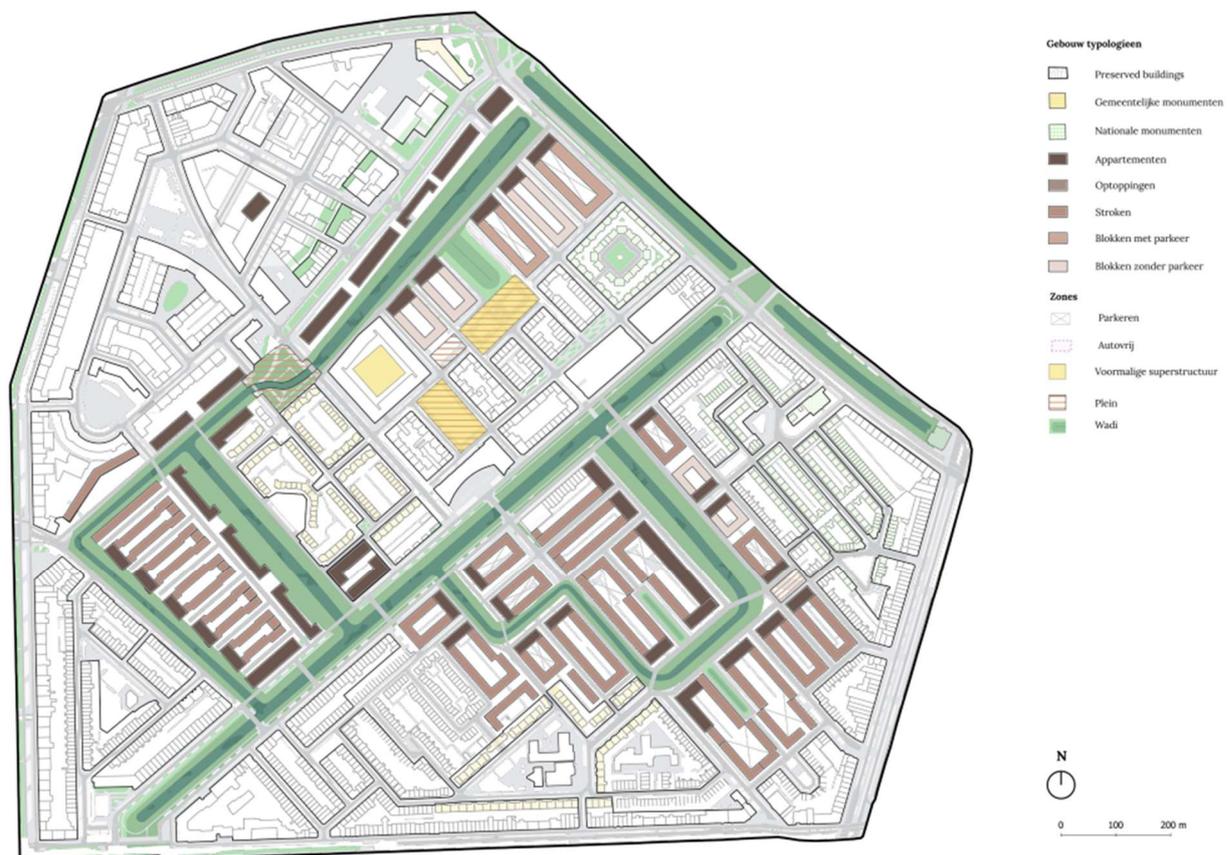


2: Modest Renewal (De Natte T)

This alternative introduces a new canal system as a central element in the urban design. It aims to address land subsidence, water challenges, and improve spatial quality in an integrated way. By adding canals at strategic locations, more space is created for water storage, green areas, and housing development. The new structure strengthens the neighborhood's ability to deal with climate impacts and improves the overall living environment.

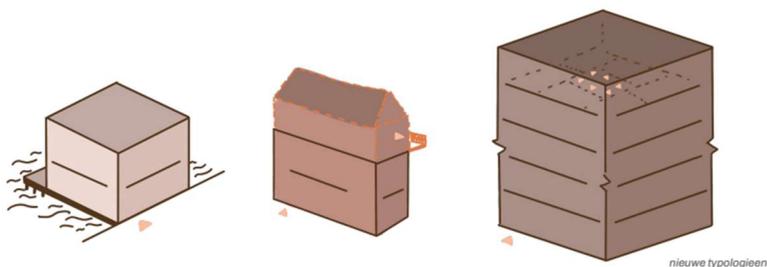
The canals are carefully placed to fit well with the current layout of Bloemhof and to connect with the wider structure of the city. This supports a clear and logical transformation of the area. The replacement of buildings is done step by step and is based on the urgency of foundation problems and the type of property ownership. This phased approach allows for flexibility and reduces disruption. This alternative results in around 74% more surface water, a 22% increase in housing, and a strong improvement in the public space, with 44% more green.

A key feature of this alternative is the idea of a *superstructure*: a central housing facility where residents can stay temporarily while their homes are being renewed. This supports relocation, helps people stay in the neighborhood, and keeps the community together during the changes.



3: Integrated Redevelopment (Waterhof)

The third perspective is the most radical of the three. The soil and water system serves as the organizing principle for the redevelopment of the neighborhood. Rather than adapting the existing urban layout, Bloemhof is fully restructured into a climate-adaptive district, in which water, greenery, foundations and infrastructure are designed as a coherent system. In this perspective, most of the existing buildings are replaced. The new urban structure follows natural elevation differences, soil conditions, and water flows. A network of courtyard structures, open water bodies and green zones is created to provide cooling, water retention and ecological value. New housing blocks with higher density and a diverse housing mix are introduced. This alternative leads to 800% more water surface, approximately 40% extra living space and 120% more greenery. The redevelopment is disconnected from the existing ownership structures and is primarily based on soil and water conditions. The institutional and financial complexity of this perspective is high. It requires large-scale property redistribution, long-term investment, and strong public leadership.



6 Barriers Faced by Financial Stakeholders in Bloemhof

This chapter presents the results of 15 semi-structured interviews with financial stakeholders (table 2). The interviews were conducted to explore how different stakeholders perceive the challenges of environment-related challenges and the implementation of adaptation measures in vulnerable neighborhoods, using Bloemhof as the primary case study.

This chapter is structured as followed: section 6.1 explains the resource barriers: what ‘hard’ barriers are missing to make action possible? Resource barriers do not stand alone, but are symptoms of deeper institutional barriers; section 6.2 explains how these institutional barriers result in the case of Bloemhof. An overview is provided of the public and private stakeholders, including their institutional logics, rules and routines that block collective adaptation. Section 6.3 explores governance arrangements which would in potential make adaptation feasible. This section explains what is needed according to the stakeholders to contribute to the restructuring of Bloemhof.

#	Stakeholder	Duration
Respondent 1	Housing corporation	-
Respondent 2	Housing corporation	01:12:00
Respondent 3	Commercial Bank	01:06:00
Respondent 4	Public Bank	01:05:00
Respondent 5	Landscape architect	31:00
Respondent 6	Developer	1:03:00
Respondent 7	Developer	46:00
Respondent 8	Insurer	47:00
Respondent 9	Insurer	34:00
Respondent 10	Housing corporation representative	01:02:00
Respondent 11	Water Authority	52:00
	Institutional investor	cancelled
Respondent 12	Expert	55:00
Respondent 13	Expert	57:00
Respondent 14	Public party	01:01:00
Respondent 15	Institutional investor	45:00

Table 2. Overview of respondents

6.1. Missing Resources in Adaptation Efforts

This section analyses how resource barriers manifest in the case of Bloemhof. Resource barriers are a recognized constraint. Throughout the interviews multiple financial stakeholders emphasized resource-related challenges, such as money, data, capacity and knowledge.

6.1.1. Lack of Financial Resources

The most prominent barrier to the implementation of adaptation is the shortage of financial resources. In the context of Bloemhof, all interviewees identified a lack of sufficient funding as a critical obstacle to addressing both the impacts of subsidence and the broader need for climate adaptation.

"The biggest barrier is simply money. As a corporation, we have so many tasks hanging on our necks... this just doesn't fit." – Respondent 2

This shows that corporations are confronted with an accumulation of social tasks, such as sustainability, new construction, foundation repair and livability, which means that climate adaptation no longer fits within their existing investment programs in financial terms. Despite available subsidies,

housing corporations still have to bear the majority of the investment costs themselves. As a respondent explained, the subsidy for climate adaptation measures only covers about 20% of the actual costs per home, about 80% of the financial burden still lies with the corporation itself. A similar problem was also outlined by the development sector:

"We don't need additional loans; the problem is that there is simply no investment money available for adaptation measures in these existing neighborhoods." – Respondent 8

This makes it clear that the challenge lies not only in financing forms such as loans, but especially in the lack of investment capital for projects with low profitability. The findings from the interviews make it clear that the lack of available investment resources is a direct barrier to the implementation of necessary adaptation measures. Without public or private co-financing, plans for Bloemhof will remain stuck in the design phase.

6.1.2 Lack of Human Capacity

The interviews also revealed that a lack in the capacity of staff is a barrier to adaptation in Bloemhof. Implementing collective area-based adaptation measures requires intensive preparation, long-term involvement and coordination between different parties. In practice, it appears that many organizations, both within the public and financial sectors, do not have sufficient staff and internal expertise available to effectively support these complex projects:

"And on the other hand, it is also just a bank of our size. We do not have that many employees. So we do not have the human capacity to get explicitly involved in this." – Respondent 4

This is also a recognizable problem within municipal, waterboards and housing corporations:

"Municipalities and corporations struggle with capacity: they simply do not have enough people to properly prepare and implement large scale restructuring projects." – Respondent 7

"We also see that there is too little internal capacity within water boards to actively support complex neighborhood renewal and climate adaptation projects." – Respondent 8

The lack of human capacity not only translates into shortages within individual organizations, but also into a lack of effective collaboration.

"There is insufficient coordination between parties, partly because everyone is busy within their own organization and there is no time for a joint long-term vision." – Respondent 10

These findings show that a structural shortage of human resources and available time not only hinders the progress of individual projects, but also undermines broader collaboration. In neighborhoods like Bloemhof, the lack of human resources therefore forms an important resource barrier for the realization of integrated adaptation measures.

6.1.3 Knowledge

In addition to the often mentioned lack of financial resources, the interviews also reveal another fundamental resource barrier: the lack of applicable knowledge. Stakeholders indicate that there is little experience and examples of how climate adaptation can be effectively shaped in existing vulnerable neighborhoods with complex ownership structures. This means that the term knowledge

and data not means a shortage of raw data or technical information (such as climate scenarios or soil maps), but mainly of a lack of practical knowledge about how to act, what it costs and what it yields.

"I do not know of any other neighborhoods where this has been tackled successfully, or even at all" – Respondent 4

This statement shows that there also is an absence of proven approaches. As a result, stakeholders have no frame of reference, no blueprint, and no learning experiences on which to base their own strategies. This therefore creates uncertainty, and without clear precedents, stakeholders are hesitant to invest or initiate action. Next to that, there is a lack of tools to make the potential benefits of adaptation visible and tangible.

"We lack methods to make the economic benefits of green and climate adaptation concretely visible" – Respondent 8

This statement shows that decision-making depends heavily on measurable outcomes and financial justification. The insurance sector also pointed to the absence of calculation models that can translate long-term risks into home value and mortgage conditions:

"There is still little insight into how you can really calculate long-term risks on home value in mortgages." – Respondent 9

As a result, climate adaptation is not yet embedded in financial procedures, because of its current inability to assess and operationalize its long-term risks and benefits. Not because it is seen as unimportant, but because the lack of knowledge on how to.

This shows that the knowledge gap goes beyond technical data. It concerns a lack of experiential knowledge. The task is new, complex, and still largely untested in practice. Stakeholders do not yet know how to act or what a successful adaptation process would even look like. Until this changes, collaborative action and financial commitment, are unlikely to emerge. This shows the need to create space for experimentation.

6.1.4 Land Fragmentation

Another barrier which is seen in the case of Bloemhof, is the lack of available and governable land. In Bloemhof, this manifests in several ways. Physically, the current urban structure leaves little room for densification or adaptation measures. The existing building typology, narrow street profiles, and land use make it extremely difficult to introduce green-blue infrastructure, broaden streets, or add other necessary adaptation measures. As one respondent stated:

"Now we can't do anything there. Everything is paved. Only when you do a full reconstruction, we [the water board] can step in." – Respondent 12

The fragmented ownership in Bloemhof reinforces this barrier. Housing is divided among housing associations, private owners, and investors, resulting in *'versnipperd bezit'*. This scattered property pattern hinders coordinated action and makes it impossible to develop large-scale or integrated area interventions:

“Everything used to belong to the housing association. But they sold off houses with poor foundations, and now we’re stuck with highly fragmented ownership that makes coordinated redevelopment almost impossible.” – Respondent 12

The municipality lacks an active land strategy or public landholdings in Bloemhof, limiting its ability to facilitate temporary relocations. While the housing associations do own a significant share of the housing stock, it is often not sufficiently concentrated to enable efficient redevelopment without complex buy-out procedures. Therefore, land itself must be understood as a resource barrier. Without control over the land parcels, the ability to integrate adaptation measures in Bloemhof is very complex.

In conclusion, the barriers described above can be seen as the hard, direct obstacles to adaptation: there is no money, little capacity and not enough knowledge to take action. It is important to state that these are seen as ‘hard’ barriers, because they form the first obstacle in the implementation of measures. However, these resources are not lacking ‘automatically’: the fact that there is no budget, or that no one frees up capacity, is the result of underlying systemic choices, responsibility structures and behavior. The following paragraph therefore zooms in on ‘institutional barriers’: the underlying rules and logics that determine why resources are lacking.

6.2 Institutional Barriers: Roles, and Routines that Block Collective Adaptation

This section shows, despite the shared urgency and potential for resource deployment, actual collaboration and investment is hindered. Based on the interviews, this section first analyses how responsibilities are set out and why actors do not take initiatives (yet).

6.2.1 Role Perception and Responsibility

6.2.1.1 Public and Semi-Public Parties

Municipality

The municipality plays an important role in vulnerable neighborhoods like Bloemhof. Although the municipality isn’t interviewed in this research, their role was consistently mentioned in the other interviews. As the public authority responsible for streets, sewer systems, public space and spatial planning, the municipality has the potential to guide and connect different projects. Many interviewees note that the municipality follows a technical logic rather than a strategic one. A clear example is the current plan of the municipality to replace the old sewer system and raise the street levels in Bloemhof. While technically necessary, without linking this replacement to long-term adaptation or the foundation problems of the existing housing stock, there is a risk that municipal actions unintentionally undermine the opportunity for an integrated solution. As one respondent stated:

"The municipality has a policy of returning to the original ground level. That means raising the public space by about half a meter. That really doesn’t work in these areas. You’re basically writing off all the surrounding homes if you do that.” – Respondent 14

This is also visible when it comes to the potential to combine technical works with broader improvements to the neighborhood. As one respondent said:

“If you’re going to fix the sewer system anyway, then do everything at once. Otherwise, the sewer is replaced, everything gets closed up again, and the neighborhood remains just as paved and overheated.” – Respondent 8

National Government

The national government plays a decisive but indirect role in the framework in which actors operate. Although the central government itself was not interviewed in this study, it was regularly mentioned as a system manager and actor that creates the preconditions for adaptation. Stakeholders refer to the government as responsible for the legal and financial structures in which decisions are made, including legislation, subsidy systems, fiscal frameworks and national agreements on public housing and sustainability. Despite this, many interviewees experience the role of the national government as distant, reactive, or even absent when it comes to the problems in Bloemhof. Several respondents expressed that the national government has not yet developed a clear long-term vision for dealing with complex urban climate risks:

“We need a nationwide approach to this problem. It is too big and too complex for local actors to solve on their own. Right now, every municipality or project has to reinvent the wheel.” - Respondent 15

Water Authority

Water authorities approach climate change from a functional logic focused on water safety, retention, and system management. Their financing and mandate are linked to the management of surface water, groundwater levels, and flood defenses. Investments in spatial adaptation measures are only possible when there is a direct water task. This means that the water board is a partner in adaptation issues, but can only take action if the measure fits within their mandate. In existing neighborhoods like Bloemhof their contribution remains limited without a clear link to their core objectives. They position themselves as cooperative parties, who would prefer to be involved early in the spatial planning process. They feel responsible for the functioning of the regional water system and the protection of the urban landscape against climate change, however they are highly dependent on the initiative and direction of other parties to be able to actually contribute:

“We would really like to be involved early in the planning process, to think carefully about how to best design this area given the changing climate.” – Respondent 12

This reflects their willingness to contribute, but also highlights the limitations of their mandate. Without integrated planning, many opportunities for joint adaptation remain unrealized.

Housing Association

Housing associations follow a public and social logic, with their main goal of providing affordable housing for vulnerable groups. They want to contribute to a better and more climate-resilient neighborhoods, but their ability to invest is limited by national rules, financial frameworks, and legal constraints. Their formal role focuses on managing, maintaining, and improving their own social housing stock. They can only invest in climate adaptation if it clearly improves the condition or value of their properties. They see themselves as organizations that follow the policy direction of

municipalities and the national government. They feel responsible for their tenants, but they do not take leadership over broader area-based adaptation. When larger area-based action is needed, they point to local and national governments to take the lead. As one respondent explained:

"You want us, as large property owners, to take the lead in climate adaptation... And we want to be that actor, but we simply can't afford it. Period." – Respondent 11

6.2.1.2 Private parties

Developers

Developers and builders approach climate adaptation from a practical perspective. Their involvement is mostly driven by feasibility: can a project generate enough value to justify investment? Developers recognize the importance of climate-adaptive measures, and are becoming sensitive to broader social goals, such as health and quality of life, but say that such measures must be integrated into a viable business case. Developers operate on behalf of others in the restructuring of existing neighborhoods. They position themselves as implementing parties that can provide advice on adaptive measures, but without a mandate to independently initiate large-scale developments or restructuring processes:

"The difficult thing with these kinds of neighborhoods is that when we carry out a renovation project, we have a client. All we can do is point things out [...] We may want all kinds of things, but if [the client] says everything must be painted blue, then everything will be painted blue, even if we would prefer green." – Respondent 8

Banks

Banks play a central but reserved role. Their possibilities and responsibilities vary. Commercial banks, such as mortgage providers, work with a risk-driven logic: they provide loans based on the market value of the collateral asset and the repayment capacity of the customer. In vulnerable neighborhoods this poses a problem. If homes lose their value due to subsidence or other issues, it becomes risky for banks to continue providing mortgages, as lenders are risking not to pay them back. At the same time, commercial banks also feel social pressure. They want to contribute to solutions, but indicate that they can only take action if a clear plan is presented. A big commercial bank will not be 'the first mover', but does warn that in the absence of a perspective they will be forced to offer less finance:

"We act purely as a financier. The property serves as collateral for a loan" – Respondent 3

A public bank works differently. This bank lends money to public institutions such as housing associations, at a low interest rate. They assess customers on their financial health, but do not explicitly interfere with what happens to the money. According to them, the responsibility lies with their clients:

"We trust that our clients, such as Woonstad, can make these considerations themselves." – Respondent 4

Both types of banks are cautious as long as there is no plan or certainty. Commercial banks are directly affected by loss of value and residual debt risks. Public banks mainly see indirect risks, but point out the importance of long-term solutions.

Insurers

Within the financial sector, insurers take a signaling and reflective position. Their institutional logic is risk-driven: controlling damage and preventing loss of value of collateral assets. Although they are increasingly concerned with the consequences of climate change, their formal responsibility lies within the domain of insurable damage. Problems such as foundation damage or subsidence often fall outside this domain, as these are seen as a long-term developing process that does not meet the criterion of 'sudden damage'. Although they actively think about solutions from sector-wide initiatives, such as working groups and platforms focused on climate adaptation, their mandate does not lie with direct interventions. The role is more strategic and advisory than executive:

“I don't really see it as the role of the financial sector to do a lot about this. We like to think along, but the choices that are made, we really see that as a public task.” – Respondent 9

This shows that insurers are willing to commit when public guarantees, shared risks and structural solutions are present. The willingness to contribute is there, but within a limit.

“No one says: I am responsible. Everyone points at each other, and that's why the problem remains stuck.” – Respondent 13

This combination of different role understandings across sectors leads to a situation where no one takes full responsibility. Although all actors recognize the urgency in Bloemhof and are willing to contribute, none of them feel it is their main task to take the lead in a collective area-wide solution, which therefore leads to a lack of coordination and leadership.

6.2.2 Legal and Regulatory Constraints

Efforts to address the problems in Bloemhof are hindered by existing legal and institutional frameworks. Legally, responsibility lies with individual homeowners, who are legally accountable for their building's foundation, however as seen in Bloemhof they often lack the resources or knowledge to act.

Housing associations are constrained by accounting regulations that prevent depreciation of aging properties, making demolition and redevelopment financially unattractive:

“If you were allowed to use the book value instead of market value, the business case would be much more feasible.” – Respondent 4

In addition, heritage regulations also require preservation and therefore limiting densification options:

“You're formally required to reproduce the same façades. That means low-rise again, so you can't build upwards.” – Respondent 14

The municipality is responsible for public infrastructure but cannot implement necessary interventions without negatively impacting homes in the neighborhood. At the same time, it lacks the legal authority to temporarily acquire or intervene in fragmented ownership structures. The water authority faces similar limitations:

“We can’t do anything there now; everything is paved, the sewer and utilities are in the way, and there is no space for water.” – Respondent 11

At the national level, there is no overarching policy or fund for subsidence-related damage. The Funderingsherstelfonds (FHF) offers a solution in specific cases, however it also faces limitations: only a limited number of municipalities participate, which restricts access for many homeowners; the application process is complex and the financing focuses solely on foundation repair. The FHF operates on a house-by-house basis, whereas a neighborhood like Bloemhof requires an integrated, area-based approach to effectively address collective risks.

Next to that, foundation risk is not integrated in loan-to-value ratios, market valuations, or insurance coverage. As a result, properties with foundation problems continue to circulate in the housing market.

“You know the system is blocking action, and you also know it will take years to change it.”- Respondent 10

6.2.3 Absence of National Coordination

In almost all interviews with the financial stakeholders the same reflex emerged: the desire for national direction and structural funding. Fragmentation arises from the involvement of multiple actors in the (re)development, without a single party taking end responsibility for the area as a whole. Stakeholders experience that responsibility is largely placed with local parties, while the problems are so complex and expensive that a city-wide or nationally coordinated approach is necessary.

"You cannot expect a corporation or a municipality to solve these types of large-scale tasks from their own resources. Without direction and contributions from the national government, we will continue to do nothing." – Respondent 10

"This is a larger social problem and you cannot just put it on the plate of corporations or private individuals. That requires a national approach under the direction of the government." – Respondent 11

These statements show that higher authorities are expected to take clear responsibility. The central government in particular is seen as a responsible stakeholder and respondents state that they must create conditions in which collective area-based adaptation becomes feasible and scalable.

At the same time, spatial policy is decentralized. In Bloemhof, this means that the municipality is responsible for addressing environment-related challenges, however the issue is so complex and costly that the neighborhood is left with fragmented interventions that lack coordination or long-term impact. The lack of a national framework not only leads to fragmentation, but also to the lack of a concrete action perspective (Dutch: handelingsperspectief). Actors want to, but do not know how and with whom they can act.

“Everyone is waiting for a plan. But as long as it’s not concrete, no one does anything.” – Respondent 13

This shows that while many actors are willing to contribute, there is a lack of national direction and financial commitment. This leads to uncertainty and standstill. The interviews suggest that large-scale

adaptation in Bloemhof cannot depend on local initiatives alone, but requires a multi-level governance approach.

6.2.4 Distribution Dilemma: who pays, who benefits?

In addition to the lack of national direction, it is also a distribution issue. Many adaptation measures require high investments now, while the benefits only become visible later. This creates a clear imbalance: the party that pays is usually not the one who gains.

A clear example is foundation repair in areas with land subsidence. Fixing damaged foundations can cost up to 150.000 euros per home. These costs are usually paid by individual homeowners or the housing association, but the benefits are long-term and not easy to calculate. Repaired foundations do not generate additional rental income or (significantly) increase property value, especially in areas with already a low socioeconomic status. This makes it hard to justify the investment:

“You create value, but there’s no way to cash in on that value.” – Respondent 9

If we look at a collective area-based approach, several respondents emphasized, that there is uncertainty about the distribution of burdens between owners, corporations, governments and the benefit holders. The term ‘benefit holder’ refers to actors who do profit from the effects of climate adaptation, but who do not typically contribute directly to its financing. This could include health organizations (due to reduced heat stress and air pollution), pension funds (through inflation-proof real estate), private homeowners (due to rising property values), and even the national government (through avoided long-term societal costs).

“There are benefit holders, for example people living in the area, but also municipalities, health organizations, pension funds, insurers. All of them parties that never sit at the table.” – Respondent 8

The interviews make it clear that the lack of a mechanism to allocate benefits to specific actors leads to the problem: each party waits for the other to take initiative, hoping to join later without bearing the greatest financial risks. As a result, necessary investments are postponed and collective action is not coming into action.

“We invest in measures, including climate-adaptive ones. We can calculate the costs precisely. But the benefits never land with us, these play out in the longer term.” – Respondent 8

The current situation calls for new forms of cost sharing and financing that also include indirect beneficiaries.

6.2.5 Risk Avoidance

An underlying cause of the lack of joint action is the way in which risks are interpreted and managed. This risk shifting isn’t necessarily driven by unwillingness or malicious intent, but rather operates as a defense mechanism. Instead of jointly addressing this nationwide problem, actors tend to minimize their own formal responsibilities and avoid liability.

In Bloemhof this risk shifting behavior is clearly shown in the debate over who is responsible for the foundation damage. The municipality argues that foundations are located on private or corporate owned plots, and are therefore not responsible. Housing associations and homeowners point to the

lowering of groundwater levels, soil subsidence and failing sewer infrastructure as contributing causes. These are factors that fall outside their direct control. Rather than working collaboratively towards an integrated understanding and shared solution, each party shifts responsibility and, by extension, also the financial burden. The political time horizon plays a role in this. Measures with a payback period of decades fall outside the policy comfort of many organizations:

“It is easy to push it forward. Of course, it’s the kind of slow moving politics, so you can say quite easily: I will not do anything about this for the next four years, that is for my successor.” – Respondent 13

Next to that, financial institutions, such as banks and insurers, use assessment frameworks that are tailored to direct damage, individual value and credit risk.

“Our assessment is mainly based on what a property is worth today, not on what it will mean in twenty years under a changing climate” – Respondent 3

The banking sector does recognize that climate change will have an increasing impact on the housing market, and therefore advocates instruments such as a uniform climate label to make this more transparent.

“Foundation damage is a slow process. That does not fit into our definition of damage. It is not economically insurable” – Respondent 10

This statement shows that climate risks that develop slowly fall outside the current risk frameworks. This means that private home owners and housing associations are left with the burden, while they are neither insured nor can claim additional financing. This leads to passive behavior: residents often only take action when there is really no other option, or pass on the problem by selling their houses:

“It is very difficult with private owners. Many people literally do not see the problem, or pass it on: ‘I will continue to live here until I die.’” – Respondent 13

Behind this lies a deeper problem: institutional inertia and path dependency. Stakeholders operate within systems formed by years of routines and role divisions, which do not fit with the issues Bloemhof faces today. This makes it difficult to let go of existing working methods and make room for different forms of collaboration. In several interviews it was emphasized that the current problems arise from historical choices in urban planning, ownership relations and housing policy. At the same time, the current frameworks for spatial planning, housing policy and financing have hardly been adapted to this new reality.

“We once built that district for dock workers, cheap and temporary. It was never the intention that [these houses] are still there. But in the meantime you are stuck in a structure of small plots, low densities and complex forms of ownership.” – Respondent 6

This results in stakeholders delaying action, shift blame and eventually allow the problem to get worse. Unless recognizing risk shifting as a constraint Bloemhof will keep getting worse.

6.3 Transformative Governance

The interviews primarily provided insight into the systemic barriers that hinder collective action in Bloemhof, however, various signals emerged about possible conditions and solutions in which integrated adaptation could potentially become possible. Respondents sometimes spoke explicitly, sometimes implicitly about what should change in the current governance and although the interests differ per stakeholder, a returning pattern emerged about what would make integrated, area-based adaptation strategies more viable.

6.3.1 Area Coordination and a Strong Business Case

One of the most frequently mentioned needs was the appointment of a coordinating actor or gebiedsregisseur, capable of overseeing the bigger picture and connecting fragmented mandates. Respondents emphasized that in the current governance context, each actor remains locked within their own institutional logic, which obstructs integrated action. As one respondent noted: *“You really need a coordinator who brings all these parties together and facilitates agreements for a collective solution.”* And another representative from the financial sector added: *“It would be better if there were a solid master plan for the neighborhood, and that everyone acted according to that plan. Instead of everyone inventing separate solutions for their own block of housing.”*

Several respondents also stressed that such coordination should be supported by a financially viable and appealing business case. Investors need to see both societal value and financial return. As one developer stated: *“Just make the case attractive enough for investors, and you’ll find them.”* In this light, the national government was repeatedly called upon to assume a stronger coordinating role.

6.3.2 Legal and Regulatory Flexibility for Area-specific Solutions

A second recurring theme was the need for greater legal and regulatory flexibility to enable area-specific solutions. Several respondents pointed out that current frameworks, such as housing regulations, accounting rules, and investment criteria are often too rigid to accommodate the tailored interventions needed. There was a clear call for more juridische ruimte (legal leeway), with an emphasis on acting with the neighborhood rather than only planning for it. As a respondent phrased it: *“Don’t talk about the neighborhood: start with the neighborhood.”* This statement shows the desire to move beyond procedural limitations and allow for context- experimentation.

6.3.3 Shared Investment Arrangements

Next to that respondents emphasized the need to move away from fragmented, project-based financing models toward joint investment arrangements. Given the complexity and scale of the interventions required, no single actor is able, or willing to carry the financial burden alone. Instead, shared financial commitments across public and private actors were seen as essential. This approach would help reduce first-mover risks and better align incentives. As one interviewee noted: *“You need to reach collective agreements for a shared solution.”* Another explained: *“Everyone should pay a share of the total. That makes it manageable.”* These suggestions point toward models such as revolving funds or shared-risk mechanisms to encourage long-term engagement. As one insurer explained: *“You overpay when buying up that property, but you earn it back through densification.”* A similar idea was expressed by another respondent: *“What this really calls for is a kind of equalization fund. Because the one who invests is not the one who benefits.”* This highlights the misalignment between investment and benefit

streams and underscores the need for collective arrangements that redistribute costs and returns more fairly across stakeholders.

6.3.4 Clear Roles and Responsibilities

Finally, respondents highlighted the need for a clear division of roles and responsibilities among key actors. Without such clarity, collaborative efforts risk stagnation. One respondent noted: *“What you’re looking for is a kind of public-private partnership, involving the municipality, housing corporations, and developers.”* The need for a tangible starting point was also mentioned, for instance through a so-called vliegwielpject (catalyst project): *“Where can you start with one block [...] as a flywheel for the rest?”*

These types of first-mover initiatives, aligned with new mandates or investment plans, could help build trust and momentum. As the water authority explained: *“If we can link it to our own assignment, we do have resources. Right now, we can’t contribute. Only when a reconstruction is planned, then we become involved.”*

7 Experts on the Urban Design Perspectives

In order to explore the spatial, technical and institutional implications of possible adaptation measures in Bloemhof, a workshop was organized. During this session, a multidisciplinary group of experts was invited to assess three urban design perspectives. The participants consisted of representatives of the municipality, urban planning agencies, researchers and experts (Table 3). The workshop served as a testing moment in which the urban design perspectives were evaluated. During the workshop, the design logic behind the three alternatives was plenary explained. Then, in small groups the participants reflected on the pros and cons of each alternative, from their professional perspective. The session was concluded with a joint evaluation, in which the three alternatives were assessed on how well each alternative responds to environment-related challenges and its feasibility from the perspective of government, housing corporations, and residents. To structure the discussion and enable comparison, a multi-criteria evaluation framework was used during the plenary assessment. The full assessment table is included in Appendix VII. The session not only offered feedback on the designs, but also made collective dilemmas and systemic barriers visible. The workshop protocol can be found in Appendix VI.

#	Organization
Respondent 1	TU Delft
Respondent 2	Erasmus University
Respondent 3	Landscape architect
Respondent 4	Landscape architect
Respondent 5	TU Delft
Respondent 6	TU Delft
Respondent 7	TU Delft
Respondent 8	PZH
Respondent 9	Municipality
Respondent 10	KBF

Table 3. Stakeholder participants in Workshop

Alternative 1: Blok voor Blok

During the workshop, this alternative was recognized as a relatively conservative approach. The architectural appearance and urban structure of the district remain largely intact, which contributes to the current identity of the neighborhood and may provoke less resistance from residents. However, it was emphasized that this alternative only offers limited contributions to the broader climate objectives and system change. It is seen as an illustration of current practices: pragmatic, feasible for the housing association, but without fundamental change to the soil and water system. Participants indicated that this approach is particularly attractive to institutional actors who want to operate within existing frameworks. The limited spatial impact makes this alternative politically and socially acceptable, yet risks for privately owned properties and the wider neighborhood context remain unaddressed. This alternative was therefore also referred to as 'keeping it mush and wet' (pap en nat houden): technically solvable within its own domain, but without a long-term vision. The evaluation table (Appendix VII) shows that this strategy was generally seen as feasible but insufficient in contributing to structural climate adaptation, leading to a 'lock-in' of current problems. Therefore this alternative primarily functions as a reference point for discussion to reflect how current practices are not adaptive enough.

Alternative 2: De Natte T

In the workshop, this alternative was considered the most realistic and feasible. The addition of the water structure as an organizing principle in the district was appreciated as a smart intervention that combines climate adaptation, water storage and urban densification. This alternative provides a clear spatial quality boost: 40% more green space, 23% extra living space and an increase in water surface. An important part of this alternative is the proposal of the 'superstructure'. Participants saw this as a powerful instrument to actively involve residents in the process and to reduce social resistance. The phasing makes implementation possible step by step, which is beneficial for financial feasibility. At the same time, concerns arose about governance issues: who coordinates the whole, how are residents involved, and how do you ensure sufficient support in a socio-culturally diverse district with 150 nationalities?

It was also mentioned that implementation of the single structure involves large soil displacements, for which circular solutions are required. Although this alternative received high appreciation for its adaptive potential, uncertainties surrounding the social side of the transition were pointed out. The superstructure in particular raises questions about acceptance, use and social interaction between various population groups. The legal and financial feasibility of temporary relocation was also mentioned as a point of attention. As indicated in the evaluation table, Alternative 2 was appreciated for its adaptive potential and spatial quality, but uncertainties were noted regarding phasing, coordination, and the superstructure's social acceptability.

Alternative 3: Waterhof

This alternative is the most radical, but also the most forward-looking proposal. In the workshop, this alternative was highly valued by designers and technical experts. They emphasized the potential to structurally solve climate risks, not only for the built environment, but also for public space, infrastructure and the water system. The introduction of 'water living', the replacement of outdated buildings and the creation of large buffers and public space were received positive. The experts on soil and water systems, were very enthusiastic, as the plan also preserves and protects the houses on wooden piles located at the edges of the neighborhood, and it offers a long-term solution for the years to come.

However, it was also seen as political and socially risky. As reflected in the evaluation table, this radical alternative scored highly on system-level adaptation potential but raised major concerns about social justice, feasibility and legitimacy. The change in the urban character has high probability to lead to resistance from residents, policymakers and financial institutions. Also the term 'wetrification' was mentioned: a new district for other target groups, comparable to the redevelopment in Crooswijk. The uncertainty about support, ownership position, compensation and social legitimacy was also mentioned.

Overarching Insights From the Workshop

Firstly, each alternative presents a different type of strategy. Where alternative 1 will probably create less resistance, it does not address the fundamental climate challenges, alternative 3 shows how far you can go in system change, but it raises many questions about social justice, relocation and support. Alternative 2 offers an intermediate form, with serious climate gains and spatial added value, but also

institutional complexity. The alternatives should therefore not be seen as ready-made solutions, but as conversation starters: they make visible what often remains implicit and exposes different system barriers.

Although the workshop started with physical and urban designs, the discussion ultimately revolved mainly around the question: "Who is going to do this, and how do we get the right parties on board?" Many questions were asked about phasing, ownership, collaboration and resident participation. It is clear that design quality and climate adaptation do not guarantee implementation and institutional collaboration, direction and organizing social support are important for feasibility.

The social context of Bloemhof is complex: many residents struggle with financial problems, have had to deal with the benefits affair, or experience language and participation barriers. Concerns arose with each alternative about who can or cannot return? how are residents involved? and whether new forms of housing (such as water homes or superstructures) fit in with the community. An important lesson is that social justice and cultural sensitivity are factors that contribute to the success of each redevelopment scenario.

It was mentioned that the urgency of subsidence in Bloemhof clearly creates momentum for action, however it does not automatically lead to the formation of coalitions. The seriousness of the issue is broadly recognized, but the discussion in the workshop revealed the absence of a coalition to collectively address the challenge. The financial sector, residents, the municipality, and housing associations each approach the neighborhood from different interests. The workshop illustrated that design research can serve as an "thinking instrument" to reveal these differences and create a shared space for dialogue to reveal system questions, limitations and preferences, however, the alternatives should not be presented as ready-made solutions, but rather as thinking tools that expose the real underlying questions: What is fair? What is feasible? What is future-proof? And: how do we make a business case of that together?

8 Expert Panel Public Parties

On May 15, 2025, an expert panel took place with representatives of the government, the municipality and housing corporation (table 4). The panel was organized to gain a better understanding of the systemic barriers to adaptation in Bloemhof.

#	Organization
1	The Water Authority
2	Housing Corporation
3	Municipality of Rotterdam
4	Province of South Holland
5	Ministry of Foreign Affairs
6	Housing Corporation

Table 4. Stakeholder participants in Expert Panel

This panel tests the hypothesis that a collective integrated development strategy, in which actors take shared responsibility for both the physical and financial aspects of the challenge is preferable to the fragmented, individual approach that is currently seen in practice. During the panel, the focus was not on the assessment of the urban designs perspectives in themselves, but on the question of which stakeholders are hindered in their actions and why. This involved both 'hard' barriers (such as financing and land positions) and institutional barriers (such as regulations, risk perception, logics and role perceptions).

8.1. Private Homeowners

The private owner is the legal owner of the building and is therefore legally responsible for maintenance, repair and maintaining a safe home. It is clear that private homeowners are in a complex and vulnerable position, in which both financial and institutional barriers come together.

As discussed in the panel, many owners see their house as an asset and not as something that may depreciated over time. Where in the past a home was depreciated after 50 years and people started saving for renovation, this logic is now lacking (#5). The panel speaks of a 'valuation paradox': although the foundation is technically defective and repair costs can mount up to 100,000 euros, the market value of these homes remains the same. Due to the housing shortages, unhealthy homes remain in demand. There is no mechanism that discounts foundation risks in the sales price. There is no obligation for banks or lenders to take into account hidden damage or future investment needs, which leads to over-crediting and risks for homeowners. Sellers are also not obliged to mention this when selling their home and this leads to a situation in which unsuspecting buyers are actually buying hidden risks (#3).

In addition, there is also the lack of financial resources for the owners in Bloemhof. Many private owners do not have sufficient savings or do not have access to additional mortgages. For owners who want to invest, the instruments are lacking. It has also been made clear that an investment in the foundation does not increase the market value, as it is an 'invisible' investment compared to an investment in a nice kitchen or other cosmetic measures (#3).

The panel also acknowledged the 'first mover' problem. Owners wait for action from the municipality or other parties before they invest themselves. In the past, the municipality has tried to create

transparency about the subsidence and raising plans of the sewer system. It was expected that house prices would fall, but that did not happen. Those house prices, equal to the index with the rest of Rotterdam South, but the number of houses for sale after the call had tripled (#3).

"Actually, that is people's first move: we escape the situation by selling it." (#5) This shows that the private owner is formally responsible for her own home, but in fact, when we look at the scale and complexity of the task, this is unrealistic. Without a reform of the system, mortgage rules, information obligations and a joint approach, private owners will continue to buy unhealthy homes.

8.2 Housing Association

The housing association is a major owner of the property in Bloemhof. The corporation is legally expected to provide quality and healthy housing for its tenants. During the panel, it became clear that the corporation is aware of this responsibility, but at the same time is confronted with several barriers.

A major barrier is the obligation to maintain the book value of its homes. This means that homes that have been technically depreciated still represent value administratively, making demolition financially unattractive or even impossible. Due to changed rules, the corporation is no longer allowed to depreciate homes to zero, even if they are in poor condition. In fact, the current system therefore revolves around the end of life and depreciation period of the building stock (#3).

In addition to this financial barrier, the corporation also experiences legal planning restrictions. For example, parts of Bloemhof are seen as a protected cityscape, which limits the possibilities for restructuring and densification. The corporation indicated that this leads to tensions between desired renewal and maintaining cultural-historical values, such as the existing street pattern and the characteristic courtyards (#2).

Finally, communication with residents also appears to be a barrier. The corporation is not yet able to discuss concrete scenarios with tenants, partly because the future of the district is still uncertain. A neighborhood vision is being worked on, but the implementation will take decades (#6). In the meantime, it remains unclear what exactly tenants can expect and to what extent they will be involved in future decisions.

8.3 The Municipality

One of the biggest obstacles that the municipality experiences is the technical and financial inability to restore the sewer to the original issue level without negative consequences for private homes. If the ground level is raised to improve water management, the homes will be lower, which causes damage and health problems. The execution of the municipality's formal task therefore causes problems for private owners, while doing nothing leads to system failure (#3).

The municipality does have insight into the scale of the problem: thousands of buildings in Rotterdam don't have a foundation, but they see no direct solution that is financially feasible. Without ownership over the space, municipalities can't intervene, however it was noted that a block-by-block approach has insufficient effects for the scale of the problem. It is therefore stated that without substantial external contributions, renewal is impossible. At the same time, it is also said that the municipality itself is reluctant to publicly take a leading role, because the financial and social consequences are huge. It is acknowledged that the municipality lacks the capacity to solve the problem alone. In some

cases, there is a tendency to circumvent the complexity of the issue by initiating new studies and research trajectories, rather than making concrete and difficult policy decisions (#3).

8.4 The National Government

Formally, the government has no direct responsibility in Bloemhof. The panel indicated that there is a clear division of responsibilities in the Netherlands: private owners are responsible for their own homes, and municipalities for public space. Only when these responsibilities clash in practice does a dependency arise that requires coordination. But that does not automatically mean that the government must intervene, because government intervention in private properties is sensitive and socially controversial (#5).

8.5 The bank

The discussion shows that banks are an indirect but crucial actor, with a great influence on the financing possibilities of both private owners and parties.

A first barrier that emerged concerns the valuation of the collateral. In the current mortgage system, personal debt is assumed and the collateral being secondary, and therefore the technical condition of a home has little influence on the loan provided. This leads to a situation in which homes with defects are financed, without this being visible in the mortgage conditions or home values. The lack of transparency in the housing market shifts financial risks to unsuspecting new owners. This lack of information contradicts the role of the bank as a risk assessor.

A second barrier is the lack of differentiation in loan conditions. It is indicated that banks could theoretically lend less on properties with foundation problems, for example by providing a lower loan-to-value (70% instead of 100%). This does not happen in practice, because banks then have to review their entire portfolio, including existing customers (#3). This is not an easy task, because once the loan has been granted, the bank is in a contract. If you would want to change this system, all comparable cases should receive the same treatment. This principle of equality hinders customization and banks do not adjust their policy, not even in risk areas such as Bloemhof.

Although banks initially seem to be covered against financial damage, because the liability lies with the debtors, we can say that when foundation problems and loss of value spread across a large number neighborhoods, the systemic risk for banks can also increase. In Bloemhof, this may be a decimal point for the bank, but if you look at 90 of these types of neighborhoods, it can lead up to very high amounts.

Finally, it was mentioned that banks are also cautious when it comes to financing transformation projects such as demolition and new construction, where the collateral temporarily disappears. As long as there is no guarantee (as in Groningen). In Bloemhof, that guarantee does not exist, which means that banks leave the risk with the owner and limit their role to the existing system.

8.6 Insurer

The panel noted that insurers do not compensate for foundation damage, which means they are withdrawing from this risk. This leads to a shift in responsibility towards private owners and public parties. The withdrawal of insurers leads to the risk of “uninsurable” homes. This not only has direct consequences for owners, but also for banks (which often require insurance as a condition for granting

mortgages) and for the functioning of the housing market. The behavior of insurers therefore poses a risk: if more and more homes become uninsurable due to foundation problems or subsidence, the liquidity of the housing market decreases and social costs arise. Insurers do not currently play an active role in the solution, but they do increase the urgency of the problem because the financial risks are piling up at individual households and public institutions.

8.7 Conclusion on Vicious Circle

The expert panel shows that the issues in Bloemhof is characterized by a ‘vicious circle’ of responsibility and institutional inability. Owner, corporation, municipality, bank, insurer act according to their formal task, but this is precisely what causes stagnation. The private owner is responsible for his foundation, but lacks financing space and prefers to sell the problem on. The municipality manages the public space, but cannot raise the ground level without damaging private buildings. Banks and insurers withdraw from risk areas and offer no solutions, while housing associations are bound by book values, regulations and limited resources. This creates a system in which no one has a perspective for action, because everyone fulfils their own role, as stated in the panel:

“That is why we need each other to help both of us to get rid of the misery. If everyone were to carry out their formal task, it would seem as if nothing was wrong. Then we have individually taken on our responsibility, but we have not solved the problem” (#5)

In conclusion, the panel discussion mainly revealed the complexity of the task, as well as the underlying systemic barriers. In order to achieve possible breakthroughs for Bloemhof, it is important to sharpen the problem definition; you cannot find solution if it is not first clear which problem one aims to solve (#5). Piling up tasks without clear prioritization is pointless and a phased approach is therefore needed, in which it is determined per phase which issue is to be tackled. The panel pointed out that many barriers arise from existing legislation and institutional rules, including the housing valuation system and mortgage financing. In addition, there is the problem of depreciation on real estate. The idea of ‘eternal housing value’ does not help and in practice this means that corporations and private owners cannot financially anticipate demolition or foundation repair. Reference is made to the situation in Groningen, where the government guarantees investments in connection with gas extraction. Although Bloemhof has a different origin, we can learn from Groningen for area-based guarantees.

9 Outcomes of the Resilient Delta Congress

On May 22, 2025, a presentation was given at the Resilient Delta Congress to present the findings of this study to representatives from different sectors. The Resilient Delta Congress is a national event focused on the challenges of climate adaptation in vulnerable urban areas.

The session began with a reflection on the ABN AMRO model. Although the model has been influential in identifying neighborhoods at risk, it became clear during the discussion that it has its limitations. The model primarily focuses on energy transition and fails to fully capture issues like subsidence, foundation damage, or long-term structural decline. Notably, Bloemhof does not appear among the 90 ‘extra vulnerable’ neighborhoods identified in the model despite clear signs of degradation and environment-related risks. This raised serious questions about the scope and methodology of the model, and highlighted the need for revision to include a broader definition of vulnerability relevant to climate adaptation.

Following this, Bloemhof was introduced to test the hypothesis for the need of integrated climate-adaptive redevelopment. The findings from this research were presented, which combined the interview results, the stakeholder workshop, and the expert panel. The alternatives served as a lens to discuss shared barriers and institutional challenges across different governance levels. The session not only allowed for dissemination of the previous research results, but also provided a moment of validation and reflection. In the next section, the main insights and reactions from the congress discussion are analyzed.

9.1. Scenario 0

One of the key insights is that the ‘status quo’ is not a cost-free starting point. This so-called ‘scenario 0’ should no longer remain implicit but must be made explicit through financial and societal impact assessments. It is important to show that without making the real and moral costs of inaction visible, potentially no sense of urgency will arise among policymakers, financiers, and investors. Scenario 0 not only reveals the physical damages (such as foundation decay, subsidence, and declining livability), but could also clarify which actors bear the losses: current homeowners, mortgage lenders, municipalities, and taxpayers. A standardized calculation of scenario 0 per stakeholder is needed to show clearly: where the pain lies, for whom, when, and to what extent. This will provide a foundation to make interests explicit and generate political urgency. This therefore becomes a tool to break deadlocks and to facilitate discussions on decision making.

9.2. Property Valuation

The conference also validated the flaw in the current valuation system for real estate: the underestimation of neglect, foundation risks, land subsidence, and repair costs. Property valuations, mortgage lending, and appraisals are based on market value, with technical deficiencies ignored. This creates a situation where homes are overvalued, buyers are insufficiently protected, and financiers rely on flawed assumptions. There is a clear need for buyers to understand what they are purchasing, and for financiers to base their decisions on actual value, including potential restoration costs. In scenarios where municipalities restore the ground level to its original height, properties may effectively lose all value: the land value minus demolition costs can result in a negative residual value. This stands in

contrast to the notion that houses are ‘built for eternity’ and the market’s trust in their apparent residual worth.

It was argued that issuing mortgages for properties with foundation damage, without this being reflected in the valuation model is morally irresponsible. This observation reinforces and deepens the analysis from the interviews, which indicated that the financial sector (including banks, appraisers, and insurers) underestimates physical risks, and that current valuation systems are not adapted to the long-term consequences of climate change. As a result, the gap between technical urgency and financial instruments becomes even more apparent than already emerged from the interviews: the current system has a blind spot. The clear call is to develop adjusted valuation frameworks for vulnerable areas: frameworks that incorporate not only market value, but also technical condition and societal costs.

9.3. Problem Ownership

What already emerged during the interviews and at the conference is the absence of a clearly defined problem owner. Due to the fragmentation of responsibilities, there is no actor with sufficient mandate, legitimacy, and resources to take the lead in a area-based approach. As a result, stakeholders remain siloed and look at each other for action. However, the conference showed that a shared interest does exist: all involved parties are likely to incur damages in the long run if no measures are taken and that they could benefit from a collective approach. This insight deepens the earlier interview finding of a "blame culture," where actors point fingers instead of assuming joint responsibility. But whereas that observation primarily described a symptom, the conference provided a direction for a solution: it explicitly called for the clear designation of who can or should act as problem owner, what their stake is, and under what conditions they would be supported by other parties. It was stressed that appointing a problem owner should not only be a top-down decision but must be in the trust of residents and local partners. This calls for a new governance approach in which coordination, mandate, and involvement are aligned. It requires a deliberative processes, in which public and private stakeholders, together with residents, determine who will be entrusted with the mandate to act as coordinator. The problem owner must be capable of mobilizing resources, coordinating collaboration, and steering across domains.

The conference also called for upscaling: major cities with comparable challenges (Rotterdam, Groningen, Dordrecht, and Amsterdam) should align their efforts, rather than each city developing isolated, neighborhood-specific policies, there is a need for a strategy that creates knowledge sharing, the development of shared financial and legal arrangements, and a joint lobby towards national government. Municipalities that proactively bring concrete proposals to higher authorities prove more effective than those passively awaiting top-down intervention. This strengthens my earlier recommendation for national leadership, now extended with an important scale dimension: alongside local experimentation, intercity coordination is essential for achieving structural solutions. Without a clear assignment of ownership, and without the combination of top-down strategy and bottom-up initiatives, the status quo will persist and vulnerable neighborhoods will remain stuck in inaction.

9.4 Experimental Zones

The conference also confirmed the earlier findings for the necessity of establishing experimental zones (“regulation-light areas”) as a step forward. In the experimental zones it should be possible to temporarily deviate from existing rules and regulations. This flexibility would allow for the testing of innovative financing arrangements and valuation methods, providing room to operate beyond frameworks without immediately disrupting the entire system. This experimental space must be supported by a shared calculation model. Such a model would clarify, for each scenario, the expected costs, benefits, risks, and distributional effects. It would not only highlight the direct financial impacts, but also indirect consequences, such as loss of livability or potential value creation (e.g., increased property tax revenue following restructuring). The model should be easily updateable with new data, forming a foundation for fair negotiations between parties about who invests how much, when, and under which conditions. Whereas the interviews primarily emphasized the need for alternative financing structures, the conference provided a method for developing them: by experimenting, supported by data and driven by collaboration. This aligns with a broader analysis presented during the conference: the current financial system act as a brake on integrated area development in vulnerable neighborhoods. There was a plea for creating temporary experimental space in which these financial logics can be suspended. Only then can alternative solutions be tested and institutional learning take place.

This sharpens my earlier recommendation to pursue institutional breakthroughs at the neighborhood level. The conference demonstrates that innovation requires designated spaces where exceptions are possible.

10 Discussion and Limitations

This discussion reflects on the findings of the research, using three alternative spatial development approaches, a combination of interviews, a workshop, and expert panels. These insights were then presented at the Resilient Delta Congress, where they were further enriched through reflections from government officials, financial sector representatives and scholars. The discussion explores how design can act as a lever for transformation and identify systemic barriers at different levels. Finally, the section outlines the study's limitations and offers suggestions for future research.

10.1 Design Research

The three alternative spatial development approaches were a central part of this research. They were not only explored as possible solutions, but used to reveal underlying barriers. The designs helped stakeholders think about what is needed to achieve climate adaptation at the neighborhood level of Bloemhof, and which rules or ways of thinking currently stand in the way. The alternatives showed not only what is currently impossible, but especially what could be imagined under different institutional conditions. This is an important step toward breaking through 'path dependency' (Patterson et al., 2019).

During the interviews, many stakeholders saw alternative 1 as the most realistic. It fits best within existing responsibilities and regulations. At the same time, this alternative mostly reproduces the 'status quo' and it is a way to fix problems within the existing system. Many comments were about what is "not allowed" or "not part of our mandate." This shows how existing roles and rules shape what is seen as feasible. This preference for the least transformative option illustrates how institutional structures tend to reproduce themselves, thereby reinforcing existing path dependencies (Patterson et al., 2019).

At the workshop, however, there was strong support for alternative 3, especially from experts in soil and water. They noted that this alternative could preserve more housing than expected and solve multiple problems simultaneously, because it takes the ground conditions and future risks more seriously. Participants also valued that this option sparked conversation about property ownership, public control, and new housing typologies. Next to that, during the expert panel, even the housing corporation expressed a preference for alternative 3. They stated that this design clearly demonstrated what is needed to make the neighborhood truly future-proof and could offer current residents a perspective on what their neighborhood could look like in a possible future. This highlighted that design can support the exploration of new roles or responsibilities. At the same time, the more radical proposal (alternative 3) also encountered resistance, especially from financial stakeholders, illustrating that it also challenges assumptions about value, risk, and feasibility. Some respondents were clearly uncomfortable with proposals that challenged current financial arrangements and ownership patterns.

This role of design was also acknowledged at the Resilient Delta Congress. The alternatives were seen as helpful examples of how complex system challenges can be visualized in spatial terms, making it easier for different sectors and governance levels to start conversation. Not as ready-made solutions, but as starting points for dialogue about what could be possible, if we think beyond current rules. The

design alternatives showed where the limits of the current system lie, and rather than starting from what is allowed, they invited reflection on what should be made possible.

10.2 Interpretation of Findings

In the theoretical framework of this thesis, systemic barriers were categorized into three main types: resource barriers (linked to funding, capacity, and data), institutional barriers (such as fixed rules, routines, and accountability structures) and governance (related to coordination, roles, and responsibilities). These 3 types helped categorize the systemic barriers that arose in the interviews about Bloemhof. In this discussion, these barrier are also analyzed across three levels: the system level, the neighborhood level, and the stakeholder level. These levels refer to where the barriers appear in practice: in national frameworks, in local contexts like Bloemhof, or in the behavior of individual organizations.

10.2.1 Coordination Barrier: The absence of national leadership

One of the most persistent barriers identified in this research is the lack of national coordination. While this issue is most visible at the system level, through missing leadership, fragmented policies, and a lack of direction from the national government, its effects are felt at the neighborhood level. It also limits the actions that individual stakeholders can take.

Both public and private actors acknowledged this issue during the research. In many interviews, stakeholders called for a stronger role for the national government. According to them, there is a structural absence of problem ownership at the national level. Adaptation in Bloemhof and other comparable neighborhoods requires conditions that, in their view, can only be provided by the central government. While municipalities and housing associations are active at the local level, they often lack the tools or mandate to drive system-level change. This also aligns with what Moser and Ekstrom (2010) identified with the lack of a clear problem owner as a barrier, leading to stagnation in decision-making.

This call for national leadership was nuanced during the expert panel. Participants emphasized that responsibility first lies with local governments and the homeowners. The message was that the national government can get involved once a strong, locally supported initiative is in place, led by the municipality, housing associations, and other relevant actors. This reflects a broader governance dilemma: while national leadership is considered desirable, it is seen as complementary to local efforts, not a replacement for them. In the absence of central ownership, actors retreat into their own responsibilities.

During the workshop, this lack of coordination also became clear. While participants appreciated the ambition of the more transformative proposal, they pointed out that there is no institutional framework to implement such area-based transformations. At the system level, there is no national policy or funding to support large-scale change and at the neighborhood and stakeholder level, fragmented ownership and responsibilities make coordinated action difficult.

Another important insight from the interviews and expert meetings is that often the “wrong people” are at the table. For example, banks were represented by mortgage departments, whose main concern is financial risk exposure for individual homeowners, while area-based adaptation requires long-term,

portfolio-level investment perspectives. This misalignment between who participates in decision-making and what kind of decisions are needed leads to solutions that also reinforce the status quo. This helps explain why many stakeholders favored alternative 1: it fits current roles and logics, and does not require structural change. This result is a first mover problem: no actor is willing or able to take the lead, because the risks of moving alone are high.

The Resilient Delta Congress reinforced the urgency for national involvement. There was broad support for appointing a “Delta Commissioner for Vulnerable Neighborhoods”. During the expert panel, reference was made to the approach taken in Groningen. Unlike Bloemhof, the Groningen case involved a clearly identified cause (natural gas extraction) which provided a legal and political basis for national responsibility and long-term funding. While the contexts differ, this example illustrates what becomes possible when the state takes ownership of a urgent issue.

A first step toward overcoming these system barriers is the appointment of a clear problem owner. This does not necessarily have to be a single ministry: it could take the form of an interdepartmental task force responsible for coordination, budgeting, and legal experimentation. At the same time, it is crucial that municipalities and other local actors jointly develop a clear strategy through which they can actively engage national stakeholders. Afterwards a relationship can emerge, where responsibility and local ownership reinforce one another. This must also include the development of alternative valuation frameworks that reflect long-term societal and environmental benefits, beyond current market-based logics. Bloemhof could serve as a testing ground for such an approach. Next to that, institutional change must be supported by new frameworks: rethinking of existing task and mandate divisions. This aligns with the concept of transformative governance (Patterson et al., 2019; Chu et al., 2022), in which existing institutions are adapted to make room for innovative solutions.

10.2.2 Lack of Structural Funding

One of the most persistent barriers identified in this research is the lack of structural, long-term funding for integrated climate adaptation. Although this problem is most visible at the neighborhood level (where renewal efforts often stagnate) it originates in systemic issues at the national level and is maintained by barriers at the stakeholder level. This is not just a lack of resources, but a sign of a broader institutional failure to organize joint investments and share financial risks.

Across interviews, stakeholders consistently identified funding as a barrier. At the system level, respondents pointed to the absence of a national investment strategy or funding framework for vulnerable neighborhoods. The scale and complexity of the issues in areas like Bloemhof far exceed local capacity, yet there is no structural support from the national government. At the neighborhood level, this funding gap translates into a lack of investment in fundamental transformation. While municipalities and housing associations still have access to maintenance budgets, there are no instruments or resources available to collectively initiate large-scale, integrated projects. Stakeholders operate within siloed legal and financial frameworks.

During the Resilient Delta Congress, this funding problem was clearly seen as a structural issue. Existing financial systems (such as property valuation, tax rules, and mortgage conditions) are based on the idea that buildings remain usable forever. There is no room in this system to allow for planned demolition, value loss, or neighborhood-scale transformation. The results in neighborhoods like

Bloemhof, there is no viable business case. Even if the area is densified three or four times, the financial gap remains. And next to that there is no mechanism to fairly share the public and private costs and benefits of such a transformation.

The interviews and expert panels also showed that stakeholders have different views on what sustainable area development means. These differences make it hard to agree on a shared investment logic. This reflects what Patterson et al. (2019) describe as competing institutional logics, which undermine collaborative decision-making and action.

This highlights that resource barriers are closely intertwined with institutional and governance barriers. It is not simply about having more money, but about how financial responsibilities are structured, how risks and benefits are distributed, and whether actors are enabled to act collectively. The climate adaptation literature confirms this. Mees et al. (2013) argue that one time funding is insufficient for systemic change, while Moser and Ekstrom (2010) describe the absence of structural funding as a fundamental resource barrier.

Overcoming this barrier requires innovative financing arrangements. One promising approach is the development of phased, area-based investment models, where each phase clearly outlines who contributes what, when, and under what risk conditions. A ‘no-regret’ contribution from public funds could serve as a catalyst for private co-investments. Another direction involves value capture mechanisms, such as leasehold systems, levies, or development rights to reinvest future added value back into the neighborhood. In the design research, the idea of a land acquisition fund was also proposed, enabling temporary consolidation of fragmented ownership to support coordinated redevelopment.

10.2.3 Legal and Regulatory Barriers: Rules blocking transformative adaptation

A third major systemic barrier identified in this research concerns the restrictive nature of existing legal and regulatory frameworks. This barrier is deeply rooted at the system level: current laws and regulations are not designed to enable bold, future-oriented transformation. Yet the consequences of this are clearly visible at the neighborhood level, and are further reinforced by how individual stakeholders interpret and apply their legal responsibilities.

At the stakeholder level, climate adaptation is hindered by institutional logics and fragmented mandates that limit collaboration and shared responsibility. Throughout the interviews it became clear that each of these stakeholders operates within its own framework defined by formal roles, routines and accountability structures. While many actors acknowledge the importance and their willingness to contribute to adaptation, they are constrained by institutional settings that discourage cross-sectoral action. These limitations do not stem from a lack of willingness, but from deeply embedded institutional structures that discourage adaptive behavior. The interviews revealed that these institutional mandates lead to fragmented action and a lack of shared responsibility. Stakeholders feel accountable only for the part of the neighborhood or issue that falls within their formal tasks. This results in a culture of “finger-pointing,” where each organization justifies inaction by pointing to the responsibilities of others. This finding aligns with what Patterson et al. (2019) describe as institutional barriers: the formal and informal rules, norms, and expectations that shape how organizations function.

These findings were strongly confirmed during the expert panel, where participants discussed how valuation rules, such as book value and mortgage regulations, limit the ability of actors to initiate renewal. At the system level, regulations on heritage protection and taxation are often based on the idea of preservation, but they offer little room for dynamic, future-focused neighborhood transformation. At the neighborhood level, these legal structures lead to institutional lock in. Current regulations tend to place responsibility primarily on private homeowners and the housing association, which reinforces a dynamic of finger pointing and hampers collective action.

The Resilient Delta Congress confirmed that legal and regulatory barriers are among the biggest systemic barriers. Participants argued for the creation of “experimentation zones”, where temporary exemptions from existing rules should be tested. The aim is to create space for learning: without legal room to explore new models, there can be no meaningful innovation. At the same time, participants emphasized that experimentation is only valuable if it informs broader policy reform. This reflects the idea of transformative governance, where institutions are adjusted to allow for new and adaptive solutions (Patterson et al., 2019).

10.3 Limits and Future Research

This research should be seen as an exploratory step in a growing field. This topic is still in its early stages and therefore, this study provides initial insights, but further research is needed to build a deeper understanding. Several limitations should be considered.

First, the project is still in an early and exploratory phase. Elements such as the design proposals are not yet fully developed. The design alternatives are not supported by financial calculations, and the planned elevation of the street level (naar maaiveld) was not included. As a result, the effectiveness and feasibility of the proposed strategies remain hypothetical. Future research could develop more detailed designs to better understand the impact of these interventions.

Second, this study focuses on only one case. Although Bloemhof reflects typical characteristics of vulnerable neighborhoods in the Netherlands (foundation risks, mixed ownership and socio-economic problems), the institutional and policy context is specific. A broader, comparative study in different cities or regions would help identify common patterns and context-specific differences. Future research could explore successful (inter)national cases, focusing for example on the role of institutional investors and their risk perceptions: under what conditions are they willing to invest, and what structures make these cases viable?

Another limitation is the absence of direct resident participation. Although a site visit to the neighborhood and consulted the housing association about resident needs, the residents themselves were not interviewed, although this is relevant for interventions like demolition, which require strong social support. Future research should include the voices of residents. In addition, the role of the provincial government was not included. Due to time and access limitations, no interview could be conducted with provincial representatives. Future studies should examine how this government level can help enable adaptation efforts.

From a theoretical perspective, there are also limitations. The scientific literature on this topic is fragmented and spread across different disciplines. The theoretical framework in this study had to be

constructed from multiple, partly overlapping sources. While this provides a layered and rich understanding, it also increases the risk of fragmentation in interpretation. Furthermore, the ABN AMRO vulnerability model used in this research proved less applicable to the case of Bloemhof. The model focuses mostly on neighborhoods with high homeownership rates, while Bloemhof consists largely of social housing. This mismatch highlights the need to review or expand existing vulnerability models. In line with Edmondson and McManus (2007), this research can be classified as a ‘nascent’ study: it addresses a new and complex problem, uses qualitative data, and aims to identify constructs and relationships rather than test already existing hypotheses. The findings are based on interviews, exploratory design alternatives, and stakeholder dialogue, which are typical for early-phase theory development. To move this research forward, future research should evolve toward the ‘intermediate’ phase. This would involve using more structured data, comparative case studies, and partly developed theoretical frameworks to test propositions across settings. Such a step would enable a better understanding of the systemic structures that influence climate adaptation in vulnerable neighborhoods.

Lastly, future research could contribute by identifying which specific legal frameworks could be temporarily suspended or adjusted within ‘experimental zones’. It is essential to define learning objectives and success criteria in advance, to ensure that insights gained can be effectively translated into broader policy.

11 Conclusion and Recommendations

This thesis aimed to answer the question: *"What are the systemic barriers faced by financial stakeholders in implementing climate adaptation measures in vulnerable neighborhoods in Dutch Cities, and how can these barriers be addressed?"* The neighborhood of Bloemhof in Rotterdam was used as a case study to explore this issue in depth. Bloemhof is a clear example of an area where physical climate risks, institutional complexity, and social vulnerability come together. These conditions made it a suitable setting to examine how different financial actors experience and respond to the challenge of climate adaptation. To answer the main question, the research combined a literature review, 15 interviews with financial stakeholders, spatial design exploration, and discussions through a workshop and multiple expert panels. The analysis was structured around four sub-questions that guided the research process, but the main goal was to build an understanding of how systemic barriers prevent action, even when the need for adaptation is recognized.

11.1 Conclusion on sub- research questions

SQ1: What environment-related challenges affect vulnerable neighborhoods in Dutch cities?

The literature shows that vulnerable neighborhoods face a set of environment-related challenges: land subsidence, foundation problems, flooding, and heat stress. These problems are exacerbated by outdated infrastructure, high levels of paving and limited green space. Land subsidence not only causes physical damage, but also increases pressure on the urban water system. In addition, extreme rainfall and heatwaves lead to health issues and strain on the sewer infrastructure. In the case of Bloemhof, these issues are further intensified by soil conditions (peat and clay) which compromise the stability of homes. This vulnerability is compounded by the social and institutional context: low-income households, historical urban design choices (such as building on steel or wooden piles) and limited adaptive capacity.

SQ2: How are financial stakeholders affected by environment- related challenges in vulnerable neighborhoods?

The impacts of these risks vary across financial stakeholder groups in vulnerable neighborhoods, as shown in literature, interviews, and the expert panel. In this study, financial stakeholders refer to the institutions and actors that play a direct or indirect role in the funding, valuation or financing of urban (re)development projects. This includes actors such as housing associations, banks, insurers, investors, the municipality, the national government and the water authority. These stakeholders are not only involved in the allocation of capital, but often determine which strategies are seen as “affordable” or “realistic”, and their (in)action can reinforce or help to overcome existing vulnerabilities.

Stakeholder	How they are affected
Housing Association	Face direct damage to their buildings, because of foundation problems caused by land subsidence and outdated building methods. Current regulations prevent technical depreciation, making demolition financially unattractive. Their investment capacity is further constrained by parallel obligations such as sustainability upgrades, new construction, and social housing responsibilities.
Private Homeowners	They bear individual responsibility for foundation maintenance but

	often lack the financial means, knowledge, or options to act. Foundation risks are rarely reflected in market prices, leading to a valuation paradox where properties remain high value despite technical deficiencies, leading to hidden risks in the housing market. Private homeowners choose to delay action or transfer risk to future buyers, by selling off their property. Coordination with other owners in mixed ownership blocks further complicates collective action.
Municipality	They are accountable for public space, sewer infrastructure, and street-level management. Due to subsidence and deferred maintenance, fulfilling these tasks without damaging adjacent properties is increasingly difficult. Next to that, they face financial limitations and lack legal authority over privately owned properties, hampering their ability to coordinate large-scale interventions.
The National Government	Bears indirect financial risk through rising social costs, declining property values, and potential pressure for national interventions. However, current policies delegate responsibility to local actors, which hinders large-scale coordination.
Banks and mortgage providers	Foundation-related issues are not integrated into financial risk models. Lending decisions are based on current market value, even for properties with hidden structural issues. As seen in Bloemhof, this results in hidden vulnerabilities within mortgage portfolios. This affects loan-to-value ratios and raises the risk of mortgage defaults. Banks are also reluctant to finance demolition and reconstruction due to temporary loss of collateral.
Insurance Companies	Damage from gradual processes like land subsidence or pile rot is generally excluded from coverage. Many homes are therefore uninsurable against these risks. This shifts liability to residents, housing associations, and the public sector.
Water Authorities	Although motivated to contribute to climate adaptation, their investment scope is restricted to water-related objectives. In dense urban areas they depend on integrated redevelopment efforts to act. Without sufficient physical space or coordinated planning, their role remains advisory rather than executive.
Developers	Developers face higher construction costs due to unstable soil conditions and the need for climate-resilient design. At the same time, the benefits of such investments often land somewhere else, such as homeowners or the municipality. This misalignment between who pays and who benefits makes it difficult to develop viable business cases.
Investors	Typically seek long-term, stable returns and low risk exposure. In vulnerable neighborhoods, unclear investment horizons, and poor collaboration with municipality make such areas unattractive for investment, making it difficult to assess potential losses or gains. Their absence limits the potential for integrated area (re)development.

Table 5. Impacts of Environmental Risks on Stakeholders

Table 5 illustrates that each financial stakeholder is affected in different ways by environment-related challenges and as a result, responsibilities remain misaligned and no actor feels equipped to address the issue at system scale.

This fragmentation creates a vicious cycle where homes could become uninsurable. Without insurance, banks are unwilling to issue mortgages. Without a mortgage, homes cannot be sold. Homeowners become stuck with degrading properties, unable to invest or relocate. This leads to market stagnation and physical decline, which in turn increases the pressure on municipalities. Over

time, these localized failures accumulate, evolving into a national policy challenge. What begins as a technical risk at the building level escalates into a broader financial and governance crisis. This cycle illustrates how environment-related challenges not just affect buildings, but compromise the functioning of the entire governance system.

SQ3: What urban development approaches can be conceived for the case of Bloemhof?

For this study three spatial design alternatives were developed for the case of Bloemhof, each aimed at soil and water system adaptation. The first alternative focuses on demolition and new construction of social housing stock, combined with urban greening. The second combines redevelopment, a water structure, and increased density. The third proposes a radical redesign of the neighborhood, including the creation of a water park and the introduction of innovative housing typologies such as floating homes. These designs served as conversation starters with stakeholders. They provided a foundation to discuss the spatial challenges and potential interventions. Although not intended as fixed blueprints, they provided valuable insights for identifying systemic barriers and breakthroughs, as each alternative revealed different limits: alternative 1 showed the limits of current practices, alternative 2 the need for alignment, and alternative 3 the requirements for system change and innovation.

SQ4: What barriers do financial stakeholders perceive in these spatial development approaches, and how can these be addressed?

Each urban development alternative revealed specific systemic barriers. In alternative 1, the proposed strategy largely builds on existing logics and was therefore seen as insufficiently adaptive. Constraints included the absence of ground level elevation, limited densification, high per-unit costs, and a lack of financial capacity within the housing association. Since there is no convincing business case, implementation remains dependent on additional public funding. In alternative 2, stakeholders expressed enthusiasm for the integrated systems approach, yet found it to be complex and administratively ambiguous. Barriers related to unclear role divisions, legal feasibility, financial feasibility and ownership issues. Unless significant densification is added (a fourfold increase in housing units). This makes the alternative vulnerable to political caution and market volatility. Alternative 3 was seen by soil and water experts as a robust solution, but politically unfeasible without a widely supported narrative. This approach requires fundamental systemic change, legal exemptions, active redistribution of property rights, and substantial upfront investments. Stakeholders noted that such a radical vision is only viable if experimental zones are created and ownership is collectively organized.

11.2 Conclusion on Main Research Question

This research aimed to answer the question: *“What are the systemic barriers faced by financial stakeholders in implementing climate adaptation measures in vulnerable neighborhoods, and how can these barriers be addressed?”*

The findings from the case of Bloemhof reveal that financial stakeholders are constrained by three interrelated systemic barriers across three levels: (1) the system level (national structures and rules), the neighborhood level (spatial and ownership characteristics), and the stakeholder level (actor-specific mandates, logics, and capacities).

First, at the system level, there is the lack of national coordination and long-term financial commitment for climate adaptation in vulnerable neighborhoods. Multiple stakeholders pointed to the absence of a “problem owner” and fragmented policies where responsibilities are distributed across multiple actors without clear alignment. This lack of national direction is compounded by restrictive financial and legal frameworks. Existing rules on property valuation and cost allocation mechanisms (book value rules) are not designed to facilitate long-term adaptation efforts in financially weak areas.

Overcoming these systemic barriers requires the appointment of a national problem owner, capable of coordinating action. Additionally, experimentation zones are needed to allow for deviations from standard valuation rules enabling new financial models to be tested in specific neighborhoods like Bloemhof. This also means rethinking what we consider to be ‘value’: not just focusing on market value, but also including aspects like reduced climate risk and long-term social benefits.

Second, at the neighborhood level, systemic barriers arise due to fragmented ownership, unequal risk distribution, and a lack of coordinating capacity. Ownership is highly fragmented: a mix of social housing, private homeowners, and investor ownership leads, which leads to mismatched investment horizons, limited ability to act collectively and there is no structure to align public and private resources. Spatial measures such as street elevation can unintentionally worsen the position of vulnerable homeowners whose properties then sit below street level. Without a shared financial model, actors stay with inaction. In practice, some private owners respond by selling off their properties, thereby shifting risk to future buyers who are often unaware of the underlying structural issues. This means that even when the urgency is recognized, implementation remains stuck due to financial uncertainty and fragmentation.

Third, at the stakeholder level, restrictive regulations and fragmented mandates prevent coordinated action. Each actor operates within an institutional framework, with limited room to deviate from established roles or legal responsibilities. As a result, financial stakeholders avoid taking ownership of shared adaptation challenges. This leads to a culture of inaction, in which actors point to each other, rather than working together. Even when actors are willing to contribute, the absence of shared accountability and risk-sharing mechanisms leads to passivity and delay.

These three systemic barriers are deeply interrelated: unclear responsibilities at the system level reinforce institutional logics at the stakeholder level, which then undermines coordination and investment capacity at the neighborhood level. Overcoming them requires institutional change across all levels. As demonstrated in the case of Bloemhof, spatial design can help reveal these systemic barriers and explore new possibilities. Yet without corresponding reforms in regulation, finance, and governance, such spatial approaches remain hypothetical.

Targeted interventions are required at multiple levels. At the national level, improved coordination is essential, including the appointment of a clear problem owner to align public and private actors. Regulatory barriers (restrictive heritage and book value rules) must be adjusted to enable large-scale redevelopment. Innovative funding mechanisms, such as phased area-based models or buy-out funds, should ensure sufficient resources for adaptation. To support stakeholder action, valuation models and knowledge exchange can help align institutional logics and time horizons. A redistribution mechanism, such as a recurring fund, should be established to fairly allocate the costs and benefits

across stakeholders. This would increase investment incentives and reduce risk shifting. Importantly, decision-making must involve the right stakeholders.

11.3 Recommendations

Based on the findings from the case study in Bloemhof and the systemic barriers identified at different levels, this research presents five recommendations to support climate adaptation in vulnerable neighborhoods. These recommendations follow a stepwise logic: first, establish a sense of urgency (rationalize), then assign leadership (delegate), appoint space for learning and change (experiment), align agendas (synchronize) and finally structure investment (arrange).

11.3.1 Rationalize: Analyze the societal costs of doing nothing ('scenario 0')

One reason for inaction is the lack of a sense of urgency. In Bloemhof, the societal costs of doing nothing are rising (property devaluation, health problems, increasing maintenance expenses) but these costs are rarely made explicit. That is why it is essential to conduct an analysis of the 'doing nothing' scenario. This analysis should not only outline the overall costs of inaction, but also specify who will bear which costs, when, and how much. By making this distribution explicit, this can help trigger financial stakeholders into action. This should include calculations of damage to homes, increasing maintenance costs, decline in property values, loss of homeowner equity and also broader social costs from deterioration and public health impacts.

11.3.2 Delegate: Appoint a national problem owner

Many stakeholders act without coordination or shared direction. To address this, a national problem owner should be appointed; not only a symbolic figure, but someone with real authority and a clear mandate. This actor should lead area-based adaptation in appointed experimental areas. This could take the form of an interdepartmental taskforce, a national program office, or a specifically appointed commissioner. Their role would include:

- Creating a national investment and implementation framework for climate adaptation;
- Supporting cities that need to act (Rotterdam, Dordrecht, and The Hague) with knowledge, mandate, and funding;
- Establishing pilot areas such as Bloemhof to test new forms of collaboration, finance, and regulation.

11.3.3 Experiment: Create legal and financial flexibility

Many stakeholders in Bloemhof are constrained by existing regulations, valuation frameworks, and institutional routines. Such structures are generally not designed to accommodate integrated urban redevelopment in combination with climate adaptation objectives. To overcome these barriers, it is necessary to establish experimental spaces where stakeholders are temporarily allowed to deviate from current rules and frameworks. A possible approach is to designate pilot areas where specific regulatory exemptions apply within a clearly defined scope. These zones allow experimentation without triggering broader systemic effects. However, such experimentation must be accompanied by clear monitoring and learning frameworks to ensure that lessons learned can be evaluated and potentially translated into long-term policy reforms. The experimental process should also be actor-specific and the potential impact of regulatory flexibility should be assessed: what if housing associations or

financial institutions are allowed to operate under alternative financial rules? By systematically unpacking the effects per actor, it becomes possible to identify what each party can contribute. To support this process, it is essential to define clear objectives and establish shared learning moments. These reflections form the basis for institutional learning and, ultimately, the embedding of successful innovations in policy, law and financing systems.

11.3.4 Synchronize: Create shared timelines and decisions

Even when stakeholders are willing to act, different time horizons and decision-making cycles do not align. As a result, projects stall due to misunderstandings, missed timing, and hesitation to commit. To address this, it is essential to establish shared adaptation timelines, which requires a coordinated process that aligns the timelines and decisions of all parties involved. This requires:

- Setting up joint development timelines, broken down into manageable phases (e.g., per housing block or neighborhood cluster);
- Agreeing on fixed decision points, so that all stakeholders know when key choices will be made and what their roles are;
- Using shared information and data as a common basis for decisions.

This makes the process more predictable and it creates clarity and accountability, making it easier for stakeholders to act at the same time, with shared expectations. Instead of waiting for each other or postponing decisions, this approach enables step-by-step progress.

11.3.5 Arrange: Develop new finance arrangements

Adaptation in vulnerable neighborhoods requires long-term investments that cannot be financed all at once. Especially in a neighborhood like Bloemhof, where foundation repair is no longer possible and large-scale demolition and reconstruction is needed, there is no solid business case. Therefore, financing must be structured, while explicitly accounting for uncertainties and long-term value creation. This means that investment must be arranged in such a way that it becomes feasible for a broad coalition of public and private actors to contribute at different stages and in different forms. This includes:

- Establishing a public-private acquisition fund to buy up fragmented private properties for restructuring purposes;
- Provide a base fund for each development phase. For example, for ground level elevation, demolition of technically irreparable buildings, or the construction of new water infrastructure;
- Applying value-capture instruments such as leasehold or area-specific contributions, so that future value increases can (partially) be reinvested in the area.

By linking these tools to physical phasing, a financial framework is created that clearly shows who contributes, when, and with what purpose. At the core of this approach lies the question: what perspective can be offered to each individual homeowner with €200,000 debt? Perhaps they cannot afford a full contribution, but could co-invest €50,000 if the remaining risks and costs are shared. How can housing associations, municipalities, and banks be incentivized to invest, not only based on returns, but also on reduced long-term risks and improved spatial quality?

12. Reflection

At the start of my graduation project, I mostly knew that I wanted to do something related to urban development, but I wasn't sure yet in which direction. I was drawn to the topic of area development because it brings together many different interests and scales. That complexity fascinated me, although I couldn't have imagined just how complex it would actually turn out to be. Through the Red & Blue research program, I was introduced to the topic of climate adaptation in vulnerable neighborhoods, and to the case study of Bloemhof. From there, I started a collaboration with Redesigning Deltas, which had chosen the same neighborhood as a design case. That's how my research developed at the intersection of design, governance, and finance. This helped me connect different perspectives and work across disciplines. I chose a methodological approach that combined interviews, spatial design, a workshop, and expert panels. Looking back, this combination turned out to be very valuable. The interviews gave me insight into the institutional logics and responsibilities of the financial actors involved. The designs made it easier to discuss spatial consequences, but even more importantly, they helped surface current tensions and systemic barriers. During the workshop and expert panels, I was able to test how different stakeholders responded to the proposed designs and how ideas for system change could be grounded in spatial concepts.

The first part of the process (up until the P2 moment) was mostly about exploring. It wasn't until I got further into the literature and orientation phase that I began to understand how multi-layered this issue of adaptation in vulnerable areas really is. The literature was broad, fragmented, and sometimes hard to apply, and it took me time to clearly define my main research question and to find a theoretical framework that fit the institutional side of the problem. As became clear in my conversations, there are multiple, conflicting definitions of what "sustainability" even means. For some, it's about financial feasibility; for others, it's about climate resilience or even circular construction. Throughout the process, I also learned that "who is at the table" is just as important as "what is being discussed". That misalignment in representation is itself a process-related barrier. As I reflect on this, I begin to understand the nature of transition management: navigating uncertainty on moving targets. The work of adaptation is not only about changing spatial structures or financial models, but also about shifting institutional behavior and governance mindsets.

What made the experience even more valuable for me was doing the project within two research programs that linked policy and design practice. Thanks to the guidance of my mentors, I was able to move between design and institutional analysis, and I gained access to a network of experts and I took part in different events. In the end, this project taught me what it means to work as a young researcher on a real-world complex problem where many interests, ideas of value, and rules come together. I learned that doing research is not a straight path, but is shaped by the context, timing, and the people involved. Because of that, my recommendations are not fixed solutions, but building blocks that can help support a larger change process. I hope this thesis contributes to that ongoing transition.

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14. Appendices

Appendix I. Codebook Development

Appendix II. Excel for Stakeholder Position and Logics

Appendix III. Miro Board for 3 Urban Design Perspectives

Appendix IV. Consent form Interview Dutch

Appendix V. Interview Protocol

Appendix VI. Workshop Protocol

Appendix VII. Workshop Evaluation

Appendix VIII. Expert Panel Protocol

Appendix XI. Data Management Plan

Appendix I. Codebook Development

The interview codebook was developed in two stages. First, deductive codes were derived from the theoretical orientation, ensuring alignment with existing literature on barriers. Next, inductive codes were added based on new insights from the interviews.

New information and key takeaway

Interview	New information	Key takeaway	Inductive codes
Interview 1. Bank	The interview revealed that the bank currently holds X mortgages in Bloemhof, with X of them recently issued at maximum financing, despite growing concerns about foundation risks. Since late 2023, the municipality has warned homeowners via its website, but without providing actionable options leading to fears of uninformed sales. ING is internally discussing stricter lending policies.	Bank is willing to contribute to area-wide climate adaptation but stresses the need for a clear and actionable municipal plan before any financial commitment can be made. The bank sees starting with housing corporations as most feasible, while private homeowners will be harder to mobilize due to fragmented ownership and limited financial resilience. Ultimately, ING acknowledges its societal role but maintains that it cannot carry disproportionate financial risk without coordinated public effort.	Risk transfer to owner
Interview 3. Public-supporting knowledge partner	He highlighted an experimental case in Friesland where a mix of private and corporate owners jointly transitioned to new homes offering a rare but replicable model.	The key barrier in Bloemhof is not technical, but systemic: too many fragmented property owners and institutions make decision-making nearly impossible. A coordinated buyback strategy by housing corporations, supported by banks and municipalities, is needed to reduce complexity and enable long-term climate-proof redevelopment.	Afwezigheid van directe risico-incentive
Interview 4. Bank public parties	New information that the Waterschapsbank interview provided is that the bank is fully capable of financing climate adaptation projects, but only when such proposals are initiated by municipalities or housing corporations. The bank itself does not actively steer or prioritize adaptation. It simply responds to financing requests.	The key takeaway was that he acknowledges it lacks the internal capacity to engage meaningfully in climate adaptation planning. Despite its public role and long-term financing mandate, the bank remains a passive actor due to limited staffing and resources.	Passive financing role of public banks
Interview 5. Developer/builder	The most interesting insight was that they linked climate adaptation to public health by involving stakeholders like the Ministry of Health. They believe that the benefits of a green, healthy environment should be quantified and connected to broader societal outcomes like reduced healthcare costs.	The key takeaway was omdat zij zich ook moeten houden aan allemaal duurzaamheid eisen van het gebouw zelf, is het budget op terwijl zij zelf ook erkennen dat je dat geld beter in het gebied had kunnen stoppen.	Absence of beneficiaries
Interview 6. Housing corporation representative	New information of this interview was that housing associations are structurally willing to make loss-generating investments, as long as the financial system allows it This shows that the real limit is not just a lack of funding, but how the financing system is structured. It	A key takeaway was the sense of resignation around legal barriers. Although stakeholders acknowledge that current regulations hinder climate adaptation: such as restrictions on investing in private property they also accept that change will take	institutional resignation

	raises the question whether the current setup of public housing finance is actually capable of supporting large-scale climate adaptation.	years. This reflects a form of <i>institutional resignation</i> , where actors feel trapped in a systems without clear prospects for reform, even when urgent action is needed.	
Interview 7. Landscape architect	One of the most interesting insights from interview is that the return of the middle class was used as an explicit urban design objective. The spatial strategy was not just about housing or infrastructure, but about creating an environment that would appeal to middle-income families by integrating features like private gardens, parking spaces, and proximity to schools and supermarkets.	A key takeaway is how public facilities were strategically used as a financial lever to attract private investment. The construction of a new Dalton school and the availability of demolition subsidies helped create value in an area that initially lacked market appeal, showing how public investment can play a role in area-based redevelopment.	Public investment
Interview 8. Public lender	New information that I gained was their creation of a tailored loan product for homeowners who are not eligible for traditional financing allowing them to address severe foundation issues. This is a concrete example of financial innovation, however they stated that in practice it still doesn't work	Foundation repair is a societal problem, but the costs and responsibilities are unevenly distributed, often falling on those least able to pay. Without structural changes in how risk, responsibility, and investment are shared initiatives like the FHF remain limited in impact. A coordinated, collective approach is essential.	Need of financial instruments
Interview 9. Insurer	A surprising initiative is the development of a shared-loss financing model via the <i>Fonds Duurzaam Funderingsherstel</i> , where mortgage providers and public funds may jointly absorb future financial losses.	The only realistic way forward is coordinated redevelopment through sloop/nieuwbouw combined with substantial densification, enabling shared financial responsibility and investor interest. Without a clear redevelopment plan, no stakeholder is willing to take the first step.	No viable businesscase
Interview 10. Water authority	The most interesting point was that they see <i>The Hague</i> (national politics) as a bottleneck due to slow decisions, shifting priorities, and risk aversion, even though water boards themselves are known for stability.		Political delay and shifting priorities
Interview 11. Developer/ Builder	Pleidooi voor "partner tendering" in plaats van "project tendering" om integrale samenwerking mogelijk te maken.	Herstructurering van kwetsbare wijken vereist een transparant, integraal plan en een flexibele governance-aanpak. Juridische en boekhoudkundige regels belemmeren de haalbaarheid, terwijl strategische samenwerking en verdichting essentieel zijn om een realistische businesscase te maken.	Juridical restrictions
Interview 12. Housing association	An insight is that the corporation faces its biggest financial barrier not in investment, but in maintenance funding. This makes even effective solutions unsustainable on the long-term.	The biggest challenge for housing association is the structural underfunding of climate adaptation in existing housing, combined with legal and technical constraints. While they have strong analysis	

	They also highlight a regulatory paradox: protected cityscapes block climate, showing how heritage protection and climate resilience collide.	tools and partnerships in place, long-term action is hindered by budget rules, conflicting municipal agendas, and the lack of national coordination or shared financial responsibility.	
Interview 13. Insurer	Surprisingly active in the Bloemhof case, not in its traditional role as an insurer, but as a mortgage provider. They are exploring innovative financing structures, such as leasehold-based models with long-term institutional investment.	The main barrier to climate adaptation in vulnerable neighborhoods like Bloemhof is the combination of extremely high costs and fragmented stakeholder involvement. They see no leading role for the financial sector but is willing to contribute if provided a solid, coordinated plan is in place.	Long term financial models

Codebook (inductive and deductive codes)

Code	Description	Example quote	Link to literature
1 – Resource barrières	Resource barriers are about the lack of money, staff, time, or knowledge needed to plan and implement climate adaptation effectively. In vulnerable neighborhoods, these resources are often limited, which makes it harder to prioritize adaptation.		Biesbroek et al. (2013) highlight these as tangible limitations, such as a lack of funding, personnel, and technical tools. These shortages reduce the ability of governments and other actors to carry out adaptation, especially during the implementation phase.
1 – resource barriers: lack of financial resources	Limited or missing financial means to implement adaptation measures.	<i>“Alles is verliesgevend, dus je moet gaan kiezen waar je je geld aan uitgeeft”</i> – Housing association	Biesbroek et al. (2013) highlight resource-related constraints such as lack of funding and capacity as central barriers to adaptation.
1 – resource barriers: lack of human capacity and time	Lack of adequate staff to time within organizations.	<i>“We hebben gewoon niet de menselijke capaciteit om ons hier nadrukkelijk mee te bemoeien.”</i> – Public bank	Ekstrom & Moser (2014) highlights capacity barriers including insufficient staff and expertise within organizations. Lee et al. (2022) highlight time constraints as an overlooked but crucial barrier at the policy level.
1 – resource barriers: lack of data/ technical capacity	Lack of technological knowledge, tools, or innovation capacity for adaptation.	<i>“Er zijn wel kaarten, maar dat is geen actieplan. Er is geen inzicht wat je nu echt waar moet doen, en al helemaal niet per woning.”</i> – Interviewee, Housing Association	Runhaar (2012) identifies lack of localized data and projections as key inaction factors among Dutch planners.
1 – resource barriers: geen sluitende businesscase	Investeringen leveren te weinig financieel rendement op, of alleen bij een te lange looptijd.	<i>“Wat je ziet is: je levert allerlei ecosysteemdiensten op – schonere lucht, meer wateropvang – maar daar hangt niemand een prijskaartje aan. Dus je stopt er geld in, maar krijgt</i>	<i>Inductive code</i>

		er niks voor terug. En daar gaat het mis in de businesscase.” – Interviewee, developer	
1 – resource barriers: beperkte subsidiemogelijkheden en geen passende instrumenten	Geen of ongeschikte subsidieregelingen zijn voor hun type maatregelen	“We hebben wel eens gekeken naar regelingen, maar dat past vaak niet bij onze opgave. En als het wel past, is het vaak tijdelijk.” – Interviewee, housing association	<i>Inductive code</i>
1 – resource barriers: Onrendabele top	De kosten van maatregelen zijn hoger dan wat kan worden terugverdiend via huur, verkoop of waardeontwikkeling	“Het herstellen van de fundering in principe nog wel kan, maar dat de opstanden het eigenlijk niet waard zijn.” – Interviewee, Insurer	<i>Inductive code</i>
2 – Institutional barriers	institutional barriers are deeper, more structural obstacles: like rules, routines, or norms, that shape how people and organizations behave.		Patterson et al. (2019) describe institutions as
3 – Institutional barriers: Kortetermijnlogica / ROI-denken	Investerings worden beoordeeld op korte termijn rendement; adaptatie vraagt langetermijnperspectief.	“Op korte termijn, dat is zo jammer, het is natuurlijk zo dat je op dit moment een project hebt, dat wil je eigenlijk misschien wel klimaat adaptief inrichten. Alleen de middelen zijn er niet voor. Als je kijkt op lange termijn, dan zou dat uiteraard gewoon betekenen dat je alles dik dubbel en dwars zou terugverdienen. Alleen je moet nu ook door met investeren, dat is een beetje het probleem.”	
3 – Institutional barriers: conflicting institutional logics	conflicting values, goals or routines between public, private, and civil society institutions, which hinder collective action or shared investment in climate adaptation	“De gemeente moet met een compleet plan; ze moeten zich over de emotie heen zetten dat je niet economisch rendabel kan terugbouwen.”	Patterson et al. (2019) highlight that conflicting logics between sectors can create significant barriers to integrated climate adaptation efforts.
3 – Institutional barriers: institutional inertia	Slowness or resistance to change within institutions.	“Het laat zich makkelijk voor zich uitschuiven. Het is natuurlijk langzaam voortschrijdende politiek. Dus je kan het vrij makkelijk zeggen: dit doe ik even vier jaar niks aan, dat is voor mijn opvolger.” – Interviewee, Funderingsherstel Fonds	Patterson et al. (2019) describe institutional inertia as the persistence of existing routines that resist adaptation despite changing environmental needs.
3 – Institutional barriers: Path dependency	Adaptation does not align well with existing governance frameworks or planning cycles. Decisions are locked into earlier planning choices or structural paths (‘path dependency’).	“10 jaar geleden zijn we hier al mee begonnen. Deze panden hier in Bloemhof, die passen niet meer. Daar moet wat mee. Maar het staat er nog steeds. Dus dat geeft ook al	Adelle et al. (2021) discuss how past planning paths limit current adaptation choices. Chu (2022) highlights that formal structures

		aan hoe lastig het is om die cycli te doorbreken.” – Interviewee,	often don’t match the nature of climate risks.
3 – Institutional barriers: Beperkte rolopvatting	Stakeholders beschouwen adaptatie niet as hun taak of verantwoordelijkheid (“dat is aan de overheid / markt”)	“Wij zijn puur financier. Het is een onderpand voor een financiering.” – Interviewee, bank	Lee et al. (2022) identify overlapping institutional mandates as a core challenge in national policies.
3 – Institutional barriers: risk avoidance through system design	Financial actors have little incentive to act on climate risks because systemic rules shield them from early losses, transferring risk to residents or the state.	“Als er echt niets meer te krijgen is, komt het pand naar ons toe en dan is het gewoon waard wat de markt ervoor wil bieden.” – Bank	<i>Inductive code</i>
3 – Institutional barrier: finger pointing culture	Stakeholders, including government, corporates and investors, shift responsibility rather than taking the lead. This results in a governance vacuum where no one initiates action.	“Er is niemand die zegt: ik ben eindverantwoordelijk. Iedereen wijst naar elkaar en daardoor staat het probleem op slot.” – Interviewee,	<i>Inductive code</i>
2 – Institutional barriers: beleidsregels	Other policy goals (e.g. housing, safety) are prioritized over adaptation.	“Daar zit jij in jouw projectgebied hier ook mee. Want formeel is Bloemhof een beschermd stadgezicht. Dus als je daar gaat nieuw bouwen, moet je formeel dezelfde gevels terug laten komen. Dat betekent weer laagbouw, dan kan je niet de hoogte in. En dat zijn ook uitdagingen die je dan krijgt met het realiseren op een vlakte.” – Interviewee,	<i>Inductieve code</i>
2 – Institutional barrier: Absence of beneficiaries	Parties that benefit from adaptation measures are not present around the table and taking financial responsibility	“Er zijn batenhouders; dat zijn de mensen die in dat gebied wonen, maar ook gemeentes, gezondheidsorganisaties, pensioenfondsen, verzekeraars. Allemaal partijen die nooit aan tafel zitten.”- developer	<i>Inductive code</i>
2 – Governance arrangements			Uittenbroek et al. (2013) explain that fragmented governance structures and lack of coordination lead to inefficiencies, duplication of efforts, or policy gaps.
2 – Governance arrangements: Fragmented coordination structures	Governance fragmentatie verklaart waarom verantwoordelijkheden onduidelijk zijn, wat resource- en institutionele barrières versterkt.	Appeared in almost every interview, which leads to delay, unclear responsibility, and the inability to engage in collective action.	Lee, Paavola & Dessai (2022) show that fragmented coordination across sectors undermines effective climate adaptation
2 – Governance arrangements: Need for policy integration	Beter afgestemde beleidsdomeinen kunnen resource- en institutionele barrières verminderen.	“Onze begroting moet twee jaar van tevoren rond zijn voor zo'n project. Dus op het moment dat de gemeente ons dan belt van	Dodman et al. (2022, IPCC) underscore poor vertical and horizontal coordination in urban governance.

		we gaan over een half jaar in Vreewijk het riool vervangen, doen jullie mee? Ja, dan moet ik zeggen, nee, dat kan niet, het geld is niet begroot” – Interviewee, housing association	Biesbroek et al. (2011) emphasize that integrated policy approaches are essential for mainstreaming adaptation.
2 – Governance arrangements: accountability clarification (oplossingsrichting)	Heldere verantwoordelijkheidsstructuren kunnen resource-allocatie en actie stimuleren.		Boezeman & De Vries (2019) argue that clearer accountability frameworks are critical for enabling climate resilience efforts.
2 – Governance arrangements: Need for centrale strategy (oplossing)		“De gemeente moet met een compleet plan; ze moeten zich over de emotie heen zetten dat je niet economisch rendabel kan terugbouwen [...] Er is een maatschappelijk belang dat er een plan komt.” – Interviewee, bank	<i>Inductive code</i>
3 – Governance arrangements: Breaking the status quo (strategie)	Verandering van governance-arrangementen kan helpen om institutionele inertie te doorbreken.		Patterson et al. (2019) show that adaptive governance mechanisms can disrupt existing vulnerabilities.
4 – Governance arrangements: legal and regulatory flexibility	Wet en regelgeving moet ruimte bieden voor adaptatie oplossingen	Er zijn wel regeltjes die dat belemmeren voor woningcorporaties. En hetzelfde speelt eigenlijk bij individuele kopers. Woningcorporaties zijn door boekhoudregels gehouden de huidige marktwaarde toe te passen – developer	Inductief
4 – Governance arrangements: resident involvement in planning	Zonder bevoegdheid om versnipperd bezit te bundelen (via opkoop of recht van overname), is samenwerking beperkt.	<i>Dit kwam erg vaak terug, maar omdat ik niet op het sociale aspect focus zal ik deze niet meenemen</i>	
4 – Governance arrangements: Guarantees on social return/ relocation options	Corporaties willen garanties dat sociale doelstellingen geborgd blijven bij herstructurering (terugkeer, betaalbaarheid)	Je moet zeker zijn dat de mensen die er wonen terug kunnen naar een plek die ook betaalbaar is voor hun. [...] Die moeten in een nieuwe situatie ook die situatie kunnen hebben dat ze gewoon een hypotheek hebben met een dergelijke lage maandlast. – Verbond van verzekeraars	

Appendix II. Excel for stakeholder position and logics

This Excel provides an overview of stakeholder positions and institutional logics, including their role, investment logics, time horizons, accountability frame and a key quote of the interview. These patterns were interpreted across full interviews and are therefore not suitable for fragment-based coding in Atlas.ti. Instead, this analysis was conducted separately in Excel.

Stakeholder	Institutional logics	Role/ mandaat	Position and accountability frame	Impact on climate related problems	Citaat
Verzekeraar/ institutionele belegger	Risicogedreven financiële logica; waarde moet stabiel zijn, risico's moeten beheersbaar blijven; kosten van funderingsherstel of klimaatadaptatie zijn alleen te rechtvaardigen als ze de waarde van onderpand waarde veiligstellen	Neemt een observerende rol; brengen risico's in kaart en denken mee over systeemoplossingen, maar voeren geen maatregelen uit. Ze hebben geen juridisch/ beleidsmatig mandaat om in fysieke interventies te investeren. Ze kunnen geen directe actie ondernemen.	Positioneert zich als meedenkende maar terughoudende actor: ze willen bijdragen als er een plan ligt, maar nemen geen regierol. Hun verantwoordelijkheid ligt bij hun klanten (particuliere huiseigenaren) en investeerders en ze willen vermijden dat die waarde verliezen, maar hebben geen mandaat om eigenaars te "redden".	Word geraakt door klimaatproblemen in de vorm van waardedaling van onderpanden. Als veel woningen in Bloemhof onverkoopbaar worden of onder water komen te staan, lopen zij risico op restschulden en kapitaalverlies. Toch kunnen ze pas handelen als publieke partijen eerst een plan maken.	"Wat is jullie rol als een verzekeraar hierbij? [...] Nou ja, we zitten hier meer in als hypotheekverstrekker." → Dit laat zien dat Achmea zichzelf in deze context niet ziet als verzekeraar met een actieve rol, maar als hypotheekverstrekker die vooral financieel belang heeft bij het behoud van de woningwaarde.
Bank/ hypotheekverstrekker	bank baseert financieringsbeslissingen op waarde van het onderpand, risico-inschatting en terugbetaalcapaciteit. Investerings zonder directe waardetoename vallen buiten hun kernlogica.	bank verstrekt hypotheek binnen de regels van toezichthouders (DNB). Ze kunnen geen fysieke interventies initiëren. Slechts meewerken aan collectieve oplossingen indien vooraf duidelijke plannen bestaan.	Heeft een afwachtende houding en legt verantwoordelijkheid bij gemeenten en eigenaren: verantwoordelijk voor het beheren van financiële risico's, maar niet voor de staat van de wijk. Ze verwachten eerst een plan van overheden of corporaties voordat zij eventueel instappen.	Klimaatproblemen tasten direct de waarde van hypothecaire onderpanden aan. Dit beperkt het vermogen van eigenaren om nieuwe leningen aan te trekken of hun woning te verkopen, en vergroot het risico op restschuld. Bank wordt geraakt via verhoogde financiële onzekerheid, maar kan zich terugtrekken door de woning te laten veilen.	"De gemeente moet met een compleet plan; ze moeten zich over de emotie heen zetten dat je niet economisch rendabel kan terugbouwen." → Dit laat zien dat de bank pas wil meebewegen als er een sluitende gebiedsvisie ligt en benadrukt dat emotionele of sociale argumenten onvoldoende zijn zonder economische onderbouwing. "Als er echt niets meer te krijgen is, komt het pand naar ons toe en dan is het gewoon waard wat de markt ervoor wil bieden." → Dit citaat laat zien dat het risico bij de woningeigenaar is. Als het onderpand zijn waarde verliest, kan de bank het terug nemen.
Woningcorporatie	Handelt vanuit een maatschappelijke logica waarin betaalbaar wonen voor kwetsbare groepen centraal staat. Ze willen bijdragen aan een leefbare stad, maar worden sterk begrensd door financiële regels en institutionele structuren. Hun denkkader is gericht op het langetermijnbeheer van bezit, met een focus op betaalbaarheid en	Heeft de taak om sociale huurwoningen te beheren, onderhouden en waar nodig te vernieuwen. In theorie kunnen ze investeren in klimaatadaptatie binnen hun bezit, maar hun wettelijke mandaat beperkt zich tot sociaal vastgoed en laat geen investeringen toe in gemengd of particulier bezit.	Ze positioneren zich als uitvoerende partij binnen de grenzen van landelijk en gemeentelijk beleid. Ze voelen zich verantwoordelijk voor hun huurders en de staat van hun vastgoed, maar niet voor de	Havensteder ervaart klimaatproblemen als urgente risico's die hun woningvoorraad fysiek en economisch aantasten. Ze willen ingrijpen, maar kampen met onderfinanciering, juridische beperkingen (zoals beschermd	"Jullie willen wel dat wij als groot vastgoedbezitter de aanjager zijn van klimaatadaptatie en mitigatie... En dat willen we ook wel zijn, maar we kunnen het gewoon niet betalen. Punt." → laat zien dat Havensteder zich verantwoordelijk voelt voor de wijk, maar vanwege financiële beperkingen geen leidende rol kan nemen in klimaatadaptatie.

	onderhoud.		brede wijkopgave. Ze verwijzen naar gemeente en Rijk voor financiering, regie en beleid.	stadsgezicht) en een gebrek aan gecoördineerde strategie met andere partijen.	
Ontwikkelaar/ Bouwer	hanteert een projectgedreven en waarde-gedreven logica. Klimaatadaptatie maakt kans als het de ontwikkelkwaliteit of het projectrendement vergroot → marktgedreven, maar met een groeiend bewustzijn van maatschappelijke co- benefits.	Ontwikkelaar is uitvoerder in opdracht van anderen. Zonder mandaat of opdrachtgever hebben zij geen zeggenschap over het gebied of ingrepen in bestaande wijken.	Ze positioneren zich als oplossingsgericht e partner die wil meedenken over brede maatschappelijke opgaven, maar benadrukt dat de verantwoordelijkheid voor integrale klimaataanpak ligt bij publieke partijen. Hun verantwoordelijkheid ontstaat pas bij betrokkenheid in een ontwikkelcoalitie.	Zij ervaren klimaatgerelateerde problemen indirect: hogere eisen aan energieprestatie, hittestress en waterbeheer in ontwerpen. Klimaatadaptatie verhoogt de technische en financiële complexiteit van projecten, maar zij zien kansen als dit leidt tot betere leefomgevingen en gezondheidswinst, mits dit meetbaar en financierbaar is.	“Als wij een renovatieopgave doen, dan hebben we een opdrachtgever. Dan kunnen we zelf helemaal niet aan dat gebied komen. Het enige wat we kunnen doen is erop wijzen.”
Funderingsherstelfonds	het fonds probeert de negatieve effecten van funderingsproblemen voor individuele woningeigenaren te mitigeren via financiële instrumenten. Ze zien funderingsherstel als een collectieve opgave, maar hij zegt wel dat het huidige systeem verantwoordelijkheid en kosten eenzijdig bij bewoners legt, wat de ongelijkheid in stand houdt.	Het FHF is een publieke geldverstrekker die innovatieve financieringsconstructies ontwikkelt voor funderingsherstel, met name voor huishoudens die buiten reguliere bancaire financiering vallen. Hun mandaat is beperkt tot de ontwikkeling van leenproducten en het uitvoeren van beleid in opdracht van overheden.	FHF positioneert zich als laatste redmiddel voor niet-kunners. Ze voelen zich verantwoordelijk richting bewoners die nergens anders terecht kunnen, maar benadrukken tegelijktijd dat zij slechts kunnen functioneren binnen een breder bestuurlijk en financieel stelsel dat nog ontbreekt.	Zij worden indirect geraakt door klimaatverandering via de toenemende funderingsschade en zij ervaren druk om op te schalen, maar lopen tegen een gebrek aan systeemverandering aan en gedeeltelijke verantwoordelijkheid. Impact is beperkt omdat maar weinig gemeenten deelnemen, wat hun effectiviteit ernstig remt.	“Het doet echt iets als je niet meer veilig voelt in je eigen huis.” → Dit citaat laat de emotionele lading van funderingsschade zien, maar ook het sociale onrecht dat de FHF probeert te adresseren. Het onderstreept waarom het fonds zich inzet voor een systeem waarin eigenaarschap, risico en verantwoordelijkheid eerlijker verdeeld worden; iets wat nu ontbreekt.
Waterschap	Het waterschap redeneert vanuit watersysteembelangen: veiligheid, waterberging, infiltratie. Ze financieren alleen maatregelen die aan hun kerndoelen bijdragen.	Waterschap is verantwoordelijk voor het regionale watersysteem (oppervlaktewater, grondwaterbeheer, waterveiligheid) en deels ook voor wegen. Ze mogen enkel investeren wanneer er een eigen opgave ligt (zoals berging of afvoer) en zijn gebonden aan normen die door de provincie worden opgelegd.	Willen vroegtijdig betrokken worden, maar zijn sterk afhankelijk van ruimtelijke partners. Verantwoording ligt bij de samenleving en het landschap, maar hun handelingsruimte is beperkt door sectorale financiering en regelgeving	Ze worden direct geraakt door extreme neerslag, droogte, bodemdaling en verouderde stedelijke infrastructuur zoals in Bloemhof. Echter, zolang klimaatadaptatie niet gepaard gaat met een aantoonbare wateropgave, kunnen ze	“Wij willen ook graag aan de voorkant van het planproces betrokken zijn om goed na te denken over hoe kunnen we dit het beste kunnen inrichten als je kijkt naar het veranderende klimaat.” → willen een actieve houding aannemen

				nauwelijks bijdragen ondanks erkenning van de urgentie.	
prprojecto ntwikkela ar	redeneert vanuit ontwikkelpotentie en haalbaarheid. Ze willen bijdragen aan gebiedsontwikkeling, maar alleen als er maatschappelijk en financieel draagvlak is: een sluitende businesscase. Ze willen bijdragen aan maatschappelijke doelen, maar alleen als de governance en juridische kaders dat ook mogelijk maken.	is ontwikkelend partner bij transformatie en sloop/nieuwbouw. Ze nemen initiatief in gebieden waar opschaling mogelijk is.	Positioneert zich als marktpartij die wil bijdragen, mits bewoners en gemeente ook instemmen. Verantwoordelijkheid ligt bij coalities. Ze wijzen op het belang van “partner tendering” en gedeelde verantwoordelijkheid. Ze voelen zich verantwoordelijk voor het maken van haalbare plannen, maar niet voor het oplossen van systeemfouten in wetgeving of publieke sturing.	Wordt niet direct geraakt door klimaatverandering in termen van eigenaarschap, maar ervaren wel indirecte effecten. Klimaatadaptieve maatregelen verhogen de complexiteit van projecten, maken de businesscase moeilijker, en botsen met bestaande regels. Zonder flexibiliteit in regelgeving kunnen zij hun rol als integrale ontwikkelaar onvoldoende vervullen.	“Je hebt van die schuifpuzzels, dan moet je maximale flexibiliteit houden om te kunnen schuiven. Want als je één vakje gaat vastlijmen, dan wordt het heel moeilijk.” → Dit citaat laat zien dat succesvolle herstructurering van kwetsbare wijken vraagt om flexibiliteit. “Vastlijmen” verwijst hier dus denk ik naar rigide beleidskaders of institutionele verhoudingen die innovatie en maatwerk blokkeren Als één onderdeel (regelgeving of rolverdeling) vastligt, belemmert dat het aanpassen van andere elementen. Hij pleit dus voor bestuurlijke ruimte om te kunnen schuiven met oplossingen.
Overkoepel voor woningco rporaties	werkt vanuit een publieke en maatschappelijke logica. Ze vertegenwoordigen woningcorporaties die bewust verliesgevende investeringen doen voor de doelgroep die niet zelfstandig op de woningmarkt terecht kan. Winst is geen doel, maar een middel om maatschappelijke opgaven zoals duurzaamheid en klimaatadaptatie mogelijk te maken.	heeft een coördinerende en vertegenwoordigende rol richting de overheid, en onderhandelt over nationale prestatieafspraken met het Rijk. Ze zijn geen uitvoerende actor, maar bepalen in belangrijke mate het beleidskader waarbinnen woningcorporaties opereren.	positioneert zich als belangenbehartiger voor de corporatiesector als geheel. Ze voelen zich verantwoordelijk voor het structureel in beeld brengen van wat financieel wel en niet mogelijk is binnen de sector, en houden de rijksoverheid verantwoordelijk voor het scheppen van de juiste voorwaarden.	Klimaatproblemen brengen hoge kosten met zich mee die nauwelijks terugverdiend kunnen worden. zegt dat dit op termijn de investeringscapaciteit van corporaties aantast, zeker in wijken met grote sociale en fysieke opgaven zoals Bloemhof.	“Nieuwbouw heeft een negatief rendement, verduurzaming heeft een verliesrendement. En ja, dat is nou ook helemaal de core business van corporaties. Ze doen juist bewust verliesgevende investeringen, omdat we dat doen voor de doelgroep die zelf het niet redt op de woningmarkt→ Dit citaat legt perfect bloot wat Aedes bedoelt met maatschappelijk ondernemerschap. Woningcorporaties nemen bewust financiële verliezen op zich om kwetsbare groepen te bedienen. Dat maakt duidelijk waarom klimaatadaptatie voor hen een institutioneel vraagstuk is: niet omdat ze niet willen investeren, maar omdat het huidige stelsel hun grenzen bereikt.
Publieke bank	werkt vanuit een publieke financieringslogica; zij verstrekken goedkoop kapitaal aan publieke instellingen zoals woningcorporaties, waterschappen en gemeenten. Hun	De bank financiert publieke instellingen met lage rente door geld op te halen op de internationale kapitaalmarkt. Hun mandaat is om publieke investeringen te	positioneert zich als ondersteunende partner: ze beoordelen de kredietwaardigheid van klanten zoals Woonstad,	Hoewel de bank zelf weinig direct risico loopt (door garanties van het WSW), zien ze wel dat funderings- en adaptatieproblemen steeds zwaarder	“Wij vertrouwen er gewoon op dat onze klanten zoals Woonstad die afwegingen zelf goed kunnen maken.” → Dit laat zien dat de Waterschapsbank een vertrouwenslogica hanteert. zij treden niet inhoudelijk op,

	<p>kernlogica is risicoarm, niet-sturend en gebaseerd op vertrouwen in de publieke sector.</p>	<p>ondersteunen, maar niet om inhoudelijk te sturen op klimaatadaptatie of gebiedsontwikkeling. Ze bieden balansfinanciering, zonder project- of wijkniveau sturing.</p>	<p>maar nemen geen inhoudelijk standpunt in over wat er gebouwd of herontwikkeld moet worden. Hun verantwoordelijkheid ligt bij financieel beheer en naleving van de regels van het Waarborgfonds Sociale Woningbouw (WSW).</p>	<p>drukken op de corporaties die ze financieren. Als zulke opgaven leiden tot financiële knelpunten bij klanten, kan dat op termijn ook de leningsruimte van corporaties beperken</p>	<p>maar gaan ervan uit dat publieke instellingen hun maatschappelijke verantwoordelijkheid nemen. Daardoor blijft hun rol passief, ook wanneer structurele klimaatproblemen om proactieve samenwerking vragen.</p>
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Appendix IV: Consent form Interview Dutch

Titel van het onderzoek: Drempels bij klimaatadaptatie in kwetsbare wijken.

Betreft:

Geachte heer/mevrouw,

U wordt uitgenodigd om deel te nemen aan het onderzoek: drempels bij klimaatadaptatie in kwetsbare wijken.

Dit onderzoek wordt uitgevoerd door C.F.C. (Charlotte) Boreel, als afstudeeronderzoek voor de Master Management in the Built Environment aan de Technische Universiteit Delft (Faculteit Bouwkunde). Zij wordt daarin begeleidt door mentoren Dr.ir. T.A. (Tom) Daamen en Ir. F.L. (Fransje) Hooimeijer vanuit de TU Delft.

Doel van het onderzoek

Het doel van dit onderzoek is om inzicht te krijgen in de belemmeringen die stakeholders ervaren bij de implementatie van klimaatadaptatiemaatregelen in kwetsbare stedelijke wijken. Door financiële stakeholders, zoals banken, verzekeraars, investeerders en gemeentelijke instanties, te identificeren en hun beperkingen te analyseren, wordt onderzocht hoe deze barrières zich voortdoen in Bloemhof.

Het interview

Het interview duurt circa 60 minuten en wordt bij voorkeur opgenomen. De audio opname zal worden gebruikt voor het uitwerken van het interview. Uw deelname is vrijwillig en u kunt uw deelname op elk gewenst moment stoppen. U hoeft geen vragen te beantwoorden die u niet wenst te beantwoorden. Het bredere doel van dit onderzoek is kennisdeling met praktische inzichten voor toekomstige gebiedsontwikkelingen. Uw privacy is en blijft maximaal beschermd. Er wordt op geen enkele wijze vertrouwelijke informatie of persoonsgegevens van of over u naar buiten gebracht, waardoor iemand u zal kunnen herkennen. Voordat de onderzoeksgegevens naar buiten gebracht worden, worden uw gegevens anoniem gemaakt. De geanonimiseerde data zal worden gebruikt in de publicatie van dit onderzoek in de TU Delft Repository. De primaire data, zoals audio-opnamen, formulieren en andere documenten die in het kader van deze studie worden gemaakt of verzameld, worden opgeslagen op een beveiligde (versleutelde) locatie. Na afronding van het onderzoek worden deze documenten verwijderd.

Om deel te kunnen nemen aan het onderzoek, vraag ik u de bijgaande verklaring in te vullen en te ondertekenen. Bij vragen en/of opmerkingen kunt u contact met mij opnemen.

Met vriendelijke groet,

Charlotte Boreel

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Toestemmingsverklaring

- Ik heb de informatie over het onderzoek gedateerd ___/___/_____ gelezen en begrepen, of deze is aan mij voorgelezen. Ik heb de mogelijkheid gehad om vragen te stellen over het onderzoek en mijn vragen zijn naar tevredenheid beantwoord.
- Ik doe vrijwillig mee aan dit onderzoek, en ik begrijp dat ik kan weigeren vragen te beantwoorden en mij op elk moment kan terugtrekken uit de studie, zonder een reden op te hoeven geven.
- Ik begrijp dat het geluids- en/of beeldmateriaal (of de bewerking daarvan) en de overige verzamelde gegevens uitsluitend voor analyse en wetenschappelijke presentatie en publicaties zal worden gebruikt.
- Ik geef toestemming om mijn antwoorden, ideeën of andere bijdrages anoniem te quoten in resulterende producten.
- Ik geef toestemming om de geanonimiseerde data die over mij verzameld worden gearchiveerd worden in de TU Delft repository opdat deze gebruikt kunnen worden voor toekomstig onderzoek en onderwijs.

Handtekening

Naam Deelnemer	Handtekening	Datum
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Ik, **de onderzoeker**, verklaar dat ik de informatie en het instemmingsformulier correct aan de potentiële deelnemer heb voorgelezen en, naar het beste van mijn vermogen, heb verzekerd dat de deelnemer begrijpt waar hij/zij vrijwillig mee instemt.

Naam onderzoeker	Handtekening	Datum
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Contactgegevens van de onderzoeker voor verdere informatie: Charlotte Boreel, +31 6 30 29 98 58, c.f.c.boreel@student.tudelft.nl

Appendix V: Interview Protocol

Onderzoek:

Het doel van dit onderzoek is om inzicht te krijgen in de belemmeringen die stakeholders ervaren bij de implementatie van klimaatadaptatiemaatregelen in kwetsbare stedelijke gebieden, met een specifieke focus op de wijk Bloemhof in Rotterdam. Klimaatverandering en bodemdaling vormen steeds grotere uitdagingen voor stedelijke gebieden, en effectieve adaptatiemaatregelen zijn noodzakelijk om de leefbaarheid en veiligheid van deze wijken te waarborgen. Echter, de financiering van dergelijke maatregelen blijkt vaak een struikelblok, vooral in economisch kwetsbare buurten waar investeringen minder vanzelfsprekend zijn.

Dit onderzoek richt zich op het identificeren van financiële stakeholders, zoals banken, verzekeraars, investeerders en gemeentelijke instanties, en het analyseren van de beperkingen die zij ervaren bij het financieren en implementeren van klimaatadaptatiemaatregelen. Daarnaast wordt onderzocht hoe deze barrières kunnen worden aangepakt door middel van stedelijke ontwerpstrategieën en innovatieve financieringsmodellen.

De onderzoeksvraag luidt: *"What are the barriers faced by financial stakeholders in implementing climate adaptation measures in vulnerable neighborhoods in Dutch cities, and how can these be addressed?"*

Om deze vraag te beantwoorden, worden verschillende subvragen onderzocht, waaronder de rol en beperkingen van financiële stakeholders, de specifieke klimaatproblemen in kwetsbare stedelijke wijken, en de manier waarop stedenbouwkundige perspectieven kunnen bijdragen aan haalbare en effectieve klimaatadaptatiestrategieën. Dit onderzoek draagt bij aan de ontwikkeling van beleidsmatige oplossingen die de financiering van klimaatadaptatie in bestaande wijken op gang kunnen brengen.

Interview:

Het interview duurt circa 60 minuten en wordt bij voorkeur opgenomen. De audio opname zal worden gebruikt voor het uitwerken van het interview. Uw deelname is vrijwillig en u kunt uw deelname op elk gewenst moment stoppen. U hoeft geen vragen te beantwoorden die u niet wenst te beantwoorden. Door deel te nemen aan dit onderzoek zult u meer inzicht krijgen in het proces van de gebiedsontwikkeling. Het bredere doel van dit onderzoek is waardevolle kennisdeling met praktische inzichten voor toekomstige gebiedsontwikkelingen.

Datum:

Geïnterviewde: _____

Functie: _____

Organisatie: _____

Datum: _____

Checklist | Start

Voor interview

- Uitnodiging interview verzonden
- Formulier geïnformeerde toestemming getekend
- Uitnodiging verzonden (tijd, locatie, indien van toepassing digitale link Teams)
- Teams en opname apparatuur klaarzetten

Start interview

- Introductie (Kennismaking)
- Dank participatie
- Wijzen op opnemen interview en opnieuw toestemming vragen ter controle
- Aanzetten opnameapparaat + back-up device

Tijdsindeling:

Deel van het interview	Onderwerp	Vraag of toelichting
Introductie (5 min)	<ul style="list-style-type: none"> • Introductie onderzoek en structuur interview (2 delen) • Uitleg vertrouwelijkheid en anonimiteit • Toestemming audio opname • Vragen voorafgaand aan interview 	
Achtergrond interviewee (5 min)	<p>Identificatie van de geïnterviewde: naam, organisatie, functie en betrokkenheid bij stedelijke ontwikkeling en klimaatadaptatie.</p> <p>Inzicht krijgen in de rol en verantwoordelijkheden van de stakeholder in dit vraagstuk.</p>	<ul style="list-style-type: none"> • Kunt u kort iets vertellen over uzelf en uw rol binnen de organisatie? • Hoe komt uw in aanraking met vraagstukken rond klimaatadaptatie in bestaande wijken? • Bent u bekend met de wijk Bloemhof?
Onderzoek (25 min) Deel 1	Perspectief op het vraagstuk en ervaren barrières	<ul style="list-style-type: none"> • Wat zijn volgens u de grootste barrières bij het aanpakken van klimaatadaptatiemaatregelen in wijken zoals Bloemhof? • Zijn er specifieke obstakels die uw organisatie ervaart bij het investeren in klimaatadaptatie? • Wat zijn voor u randvoorwaarden om dit soort maatregelen mogelijk te maken? • Wie ziet u als de verantwoordelijke(n) voor het realiseren van klimaatadaptatie in wijken zoals Bloemhof? • Hoe verloopt de samenwerking met andere partijen op dit vlak? • Wat zou uw organisatie kunnen motiveren om wél een actieve rol te spelen in Bloemhof?
Onderzoek (15 min) Deel 2	Reflectie op stedenbouwkundige oplossingsrichtingen	<ul style="list-style-type: none"> • Wat is uw eerste indruk van dit scenario's? • Welke kansen ziet u hierin vanuit het perspectief van uw organisatie? • Welke belemmeringen of risico's ziet u? • Ziet u een rol voor uw organisatie in de realisatie van een dergelijk plan? • Welke voorwaarden zouden nodig zijn om dit scenario voor u aantrekkelijk of haalbaar te maken? • Als u de drie scenario's vergelijkt: welke richting acht u

		<p>het meest kansrijk of realistisch, en waarom?</p> <ul style="list-style-type: none"> • Heeft u suggesties voor hoe deze scenario's beter kunnen aansluiten op de praktijk?
Afsluiting (5 min)	Ruimte voor aanvullende opmerkingen van de geïnterviewde, dankwoord en uitleg over verwerking en mogelijke terugkoppeling van de onderzoeksresultaten.	<ul style="list-style-type: none"> • Zijn er thema's die wij niet besproken hebben, maar die u relevant vindt voor dit onderzoek?
Uitloop (5 min)		

Checklist | Einde

Afsluiting

- Procedure verwerken data toelichten
- Vraag of geïnterviewde de publicatie van rapport graag ontvangt
- Bedank mail opsturen

Appendix VI. Workshop Protocol

Doel: De workshop heeft als doel om drie ontwerpvarianten voor Bloemhof te toetsen op hun effectiviteit in de omgang met bodemdaling, gekoppeld aan bredere ruimtelijke en bodemgerelateerde opgaven. Samen met experts uit praktijk, beleid en onderzoek wordt gereflecteerd op haalbaarheid en aantrekkelijkheid van de scenario's, om handelingsperspectief en coalitievorming te stimuleren.

Opzet workshop: De workshop start met een korte introductie, gevolgd door een presentatie van de drie ontwerpvarianten. De deelnemers reflecteren in subgroepen op de scenario's, waarna inzichten plenair worden teruggekoppeld. Er wordt gezamenlijk besproken welke vervolgstappen nodig zijn voor uitvoering of verdere uitwerking.

Benodigdheden:

- Beamer en laptop voor presentatie
- Posters of print-outs van de drie ontwerpvarianten
- Flip-over of whiteboard + stiften
- Post-its en pennen voor deelnemers
- Koffie/thee

Opzet:

Tijd	Activiteit
9:00 – 09:10	Opening en toelichting programma
09:10 – 09:30	Introductieronde deelnemers en hun perspectief op de vraag: “hoe kijk jij naar de omgang van bodemdaling in stedelijke omgeving?”. Dit vormt een gedeelde referentiekader voor het gesprek.
09:30 – 09:45	Presentatie van de drie ontwerpvarianten door het ontwerpteam (Flux, ZUS en TU Delft). Per variant wordt toegelicht: de stedenbouwkundige aanpak, omgang met funderingen, water en groen, en implicaties voor woonkwaliteit. Varianten zijn: (1) Blok voor blok, (2) Nieuw Singelplan, (3) Waterhof. De presentatie wordt ondersteund met plattegronden, doorsneden, typologieën en kengetallen.
09:45 – 10:30	Werkvorm: carrousel of subgroepen. Elke groep bespreekt één variant aan de hand van drie vragen: <ul style="list-style-type: none">- Hoe koppelt dit scenario bodemdaling aan ruimtelijke/bodemopgaven?- Hoe haalbaar is het (politiek, financieel, maatschappelijk)?- Hoe aantrekkelijk is het resultaat (stedelijk beeld/ leefkwaliteit)? Na 15 min doorschuiven naar volgende variant, bij elke ronde bouwen groepen voort op wat anderen gezegd hebben. Geen kritiek, alleen aanvulling.
10:30 – 10:45	Pauze
10:45 – 11:15	Plenaire terugkoppeling & scenariovergelijking: gezamenlijke bespreking. Voor elk scenario word inzichten gedeeld en eventueel gescoord op: <ul style="list-style-type: none">- Ruimtelijke/ bodemopgave- Haalbaarheid- Aantrekkelijkheid
11:15 – 11:45	Gesprek over vervolgstappen? Open gesprek; <ul style="list-style-type: none">- welke scenario's zijn kansrijk voor realisatie?;- welke kennis, partners en middelen zijn er nodig?;

	<ul style="list-style-type: none"> - wat vraagt dit van de gemeente, woningcorporaties, private partijen? Korte reacties van sleutelpersonen
11:45 – 12:00	Afsluiting en follow-up? <ul style="list-style-type: none"> - Wat zijn de belangrijkste inzichten - Hoe worden deze vastgelegd en gedeeld? - Vervolgafspraken?

Appendix VII. Workshop Evaluation of the Urban Design Alternatives

“Waardering” ontwerpalternatieven voor de omgang met bodemdaling en klimaatbestendige ruimtelijke ontwikkeling van Bloemhof

Alternatieven	Ruimtelijke, stedenbouwkundige en/of infrastructurele opgaven in Bloemhof (TU)								Governance
	Civiele constructies	Beheer Bodem - grondwater, kwantiteit en kwaliteit	Klimaat-Adaptatie	Woning-bouwoopgave, diversiteit in typologieën (wat komt er terug?)	Fundering en Woningrenovatie	Energie-Transitie Energie armoede aanpakken?	Kwaliteit Leef-omgeving	Bouwrijp en woon peil	Fasering
<p>1. Blok voor blok Gebied wordt door tijd heen vernieuwd door sloop/nieuwbouw met behoud van het ruimtelijke karakter; Renovatie van monumentale gebouwen en identiteitsdragers</p> <p>Business as usual Niet klimaatproof Lock in</p>	<p>Nieuw gescheiden rioolstelsel</p> <p>Niet efficiënt</p> <p>Snel beginnen</p> <p>+</p>	<p>0% extra oppervlakte water, mee ropen bodem door terugleggen rooilijk met 1,5 meter</p> <p>Weinig speelruimte, oplossingen bovengronds op gebouw niveau (groene daken)</p> <p>Lock in</p> <p>+/-</p>	<p>0% extra wateroppervlak</p> <p>Minimale collectieve bijdrage, individuele oplossingen door particulieren op gebouwniveau Burgerparticipatie</p> <p>+</p>	<p>29% meer woningen</p> <p>Gestippeld bezit –</p> <p>Minimaal incidenteel nieuw blok wel meer draagkracht op korte termijn, op lange termijn onrechtvaardig</p> <p>-</p>	<p>Woonstad nieuwe woningen op paalfunderingen ipv van staal fundering, privaat moet het zelf oplossen (of in combinatie met woonstad? Voorbeeld Beukelsdijk) Gestippeld bezit, moeilijk tav renovatie</p> <p>Maximaal efficiënt voor materiaalgebruik</p>	<p>Grotere vraag voor het individu</p> <p>+</p>	<p>-same same met kleinere verbeteringen, wel meer groen</p>	<p>Bouwrijp en woon peil</p>	<p>Veel fasering</p> <p>Maatwerk</p>
<p>2. Natte T – singelplan Gebied ondergaat minimale vorm herstructurering door een infrastructurele ingreep die toekomstwaarde borgt ten aanzien van het bodem watersysteem/klimaat adaptatie; Gebied wordt door tijd heen vernieuwd door sloop/nieuwbouw met grotendeels behoud van het ruimtelijke karakter en aanvulling op de woningtypologie op momenten langs de nieuwe infrastructuur; Renovatie van monumentale gebouwen en identiteitsdragers</p>	<p>Nieuw gescheiden rioolstelsel +</p> <p>Mantelbuis</p> <p>+</p>	<p>Gesloten grondbalans/vrijkomende grond?</p> <p>Betere grondwaterstanden +</p> <p>Meer groen rond de singels</p> <p>+</p>	<p>Meer verkoeling mee waterberging +</p>	<p>Superstructuur, permanente tijdelijkheid</p> <p>Gestippeld bezit –</p>	<p>Gestippeld bezit -</p> <p>Superstructuur helpt +/-</p> <p>Funderingsprobleem opgelost privaat moet zelf oplossen +/-</p>	<p>KW uitwisseling</p> <p>Nieuwbouw = duurzaam bouwen, energie neutraal +</p>	<p>Overall verbetering, meer groen +</p>	<p>Bouwrijp en woon peil</p>	<p></p>
<p>3. Waterleliehof Gebied ondergaat maximale vorm herstructurering uitgaande van het bodem water systeem; Renovatie van monumentale gebouwen</p>	<p>Openbare ruimte +</p> <p>Door grootschalige vernieuwing kun je alles opnieuw in de grond leggen +</p> <p>K&L kan in goten cq innovatieve oplossingen +</p>	<p>Buffer ++ Waterkwaliteit?</p> <p>Is leidend in dit alternatief dus kosten besparend op termijn ++</p> <p>Gesloten grondbalans?</p>	<p>Duurzame bodemstructuur –</p> <p>Het uitgangspunt ++</p>	<p>++ toekomst bestendigheid behoud van bewoners/ Doorstroming</p> <p>Radicale verandering van typologie en dus doelgroepen (vraagt veel tijd en is onzeker)</p> <p>-</p>	<p>Duurzame fundering kosten –</p> <p>Panden op houtenpalen randen +</p> <p>Circulair gebruik grootschalig +</p> <p>Vervangen + duurzaam behouden van de woningen op houten palen ++</p> <p>Gaat uit van sloop/nieuwbouw ook van particulier bezit (vraagt veel tijd en is onzeker) -</p>	<p>+ duurzame huizen</p> <p>Veel mogelijkheden voor nieuwe technieken +</p>	<p>Gezondheid + MKBA/TEEB + Sociale veiligheid +</p> <p>Niet eenduidig waardoor verschil per bewoner erg groot kan worden +/-</p>	<p>Bouwrijp en woon peil</p>	<p>vraagt veel</p>

Appendix VIII. Expert Panel Protocol

Doel: Het doel van panelgesprek is het bespreken van inzichten uit eerdere interviews met publieke en private partijen over barrières en (potentiële) doorbraken voor de financiering van een integrale adaptatiestrategie in de herontwikkeling van kwetsbare binnenstedelijke wijken. We zullen aan de hand van een stedenbouwkundige visie voor de wijk Bloemhof in Rotterdam gezamenlijk bespreken welke formele middelen en institutionele kaders een integrale adaptatiestrategie bevorderen of bemoeilijken. Daarnaast zullen we sturingsmogelijkheden bespreken die adaptatie in potentie mogelijk maken.

Opzet:

Tijd	Activiteit
14:30 – 15:00	Inloop op Bouwkunde, TU Delft
15:00 – 15:10	Opening en introductie Korte toelichting op het onderzoek (binnen Red&Blue/RDI) en introductie van de casus Bloemhof. Schets van de wijk: ligging, problematiek en urgentie. Doel van de paneldiscussie bespreken en uitleggen hoe de resultaten (geluidsopname) verwerkt worden.
15:10 – 15:20	Presentatie ontwerpvarianten Drie ontwerpvarianten voor Bloemhof: sloop/nieuwbouw, minimale herstructurering en integrale herstructurering; toelichting op ontwerpdoelen en relatie met adaptatiestrategie. Voorkeursvariant 2 uitleggen (voor het gesprek). Vragen beantwoorden.
15:20 – 16:20	Paneldiscussie Gesprek over gepresenteerde voorkeursvariant in drie stappen (2x30min): 1. Middelen: welke middelen (geld, grond, capaciteit, kennis) ontbreken?; Hoe verschillen de drie varianten in haalbaarheid op basis van beschikbare middelen? Is de voorkeursvariant ook het meest haalbaar? 2. Institutionele kaders: Welke (beleids)regels, verantwoordelijkheden, rolopvattingen of routines staan de aanwending van middelen in de weg?; Wat mag of kan in de huidige praktijk (niet) en waarom?
16:20 – 16:30	Uitloop/ pauze
16:30 – 17:00	Wrap-up: gezamenlijke reflectie op potentiële doorbraken Welke sturingsmogelijkheden (governance) maken adaptatie in potentie mogelijk?; Wat neem je mee uit dit gesprek naar jouw organisatie? Wat zijn suggesties voor verdere samenwerking of uitwerking?

Appendix IX. Data Management Plan

Plan Overview

A Data Management Plan created using DMPonline

Title: MSc Project - Cities on sinking ground

Creator: Charlotte Boreel

Affiliation: Delft University of Technology

Funder: Delft University of Technology

Template: TU Delft Data Management Plan template (2025)

Project abstract:

Vulnerable neighborhoods in the Netherlands face challenges from climate change and land subsidence. This threatens infrastructure stability and residents' quality of life. Despite the urgent need for adaptation, barriers faced by various financial stakeholders hinder progress, as residents have limited resources, local governments face budget restrictions, and private investors are often reluctant to invest due to high perceived risks.

This research seeks to address the main question: *"What are the barriers faced by financial stakeholders in implementing climate adaptation measures in vulnerable neighborhoods in Dutch cities, and how can these constraints be addressed?"* To answer this, the study focuses on financial stakeholders, such as housing associations, banks, investors, insurers, water authorities, and developers and their role in enabling or blocking climate adaptation.

This research focuses on the Bloemhof neighborhood in Rotterdam, a historical and diverse area characterized by aging housing stock, climate -and foundation problems, and socio-economic vulnerability. Using the neighborhood of Bloemhof as a case study, the research combines stakeholder interviews with a design-based approach. Three urban design perspectives are developed to explore how adaptation could take shape in practice: (1) dwelling-by-dwelling (2) block-by-block and (3) area-based

To explore potential solutions, expert panels with financial stakeholders are organized. Design based sessions serve to test the proposed redevelopment perspectives, assess their feasibility, and identify new governance solutions. This study contributes to the debate on climate-resilient urban redevelopment and offers recommendations for governance arrangements to support adaptation in vulnerable neighborhoods.

ID: 171072

Start date: 18-02-2025

End date: 21-07-2025

Last modified: 03-05-2025

MSc Project - Cities on sinking ground

0. Administrative questions

1. Provide the name of the data management support staff consulted during the preparation of this plan and the date of consultation. Please also mention if you consulted any other support staff.

Janine Strandberg, Data Steward at the Faculty of Architecture & the Built Environment, reviewed this DMP on 1 May 2025.

I have also discussed the research design and data management aspects of this project with my supervisor, Tom Daamen.

2. Is TU Delft the lead institution for this project?

- Yes, the only institution involved

1. Data/code description and collection or re-use

3. Provide a general description of the types of data/code you will be working with, including any re-used data/code.

Type of data/code	File format(s)	How will data/code be collected/generated? <i>For re-used data/code: what are the sources and terms of use?</i>	Purpose of processing	Storage location	Who will have access to the data/code?
Informed consent forms	.pdf	Informed consent forms signed digitally	To gain approval for study participation and data processing	TU Delft OneDrive	The project team (The PI and the two postdocs: Tom Daamen en Fransje Hooimeijer)

Anonymous transcriptions of interviews	.txt	Transcripts will be manually created by the researcher based on the audio recordings, and anonymised by removing names and identifiable references	To analyse stakeholder perspectives on financial barriers and use them in qualitative research findings. Transcripts will be anonymised by removing names, roles, and identifiable reference	TU Delft OneDrive	The project team (The PI and the two postdocs: Tom Daamen en Fransje Hooimeijer
Report/thesis	.pdf	Seves as record of the process as well as documentation	Long term	Project Storage drive	The project team (The PI and the two postdocs: Tom Daamen en Fransje Hooimeijer
Qualitative interview data	.mp3	Audio recordings will be made during semi-structured interviews conducted via Microsoft Teams or in person. Participants will give explicit consent beforehand. Recordings will be securely stored on TU Delft OneDrive. Participants are recruited via purposive sampling based on relevance to the financial adaptation topic. In-person interviews will be recorded using a secure voice recorder or Microsoft Teams if remote.	To explore institutional logics and stakeholder positions related to climate adaptation in vulnerable neighbourhoods. Recordings may include personally identifiable research data (e.g., voice, role, professional opinion). These data will be pseudonymised during transcription, and all identifiable information will be removed before publication.	Tu Delft OneDrive	The project team (The PI and the two postdocs: Tom Daamen en Fransje Hooimeijer

Notes and recordings from expert panels	.mp3, .txt	Audio recordings and notes taken during expert panel sessions with financial stakeholders. Participants give informed consent in advance. Participants are recruited via purposive sampling based on relevance to the financial adaptation topic.	To analyse collective stakeholder insights and validate spatial-financial strategies. These may contain personally identifiable research data such as stakeholder roles, professional opinions and voices	The TU Delft OneDrive	The project team (PI and the two postdocs: Tom Daamen and Fransje Hooimeijer)

II. Storage and backup during the research process

4. How much data/code storage will you require during the project lifetime?

- 250 GB - 5 TB

5. Where will the data/code be stored and backed-up during the project lifetime? (Select all that apply.)

- Another storage system - please explain below, including provided security measures
- Project Data Storage (U:) drive at TU Delft
- TU Delft OneDrive

Interview recordings and transcripts containing personally identifiable research data will be stored in the TU Delft Project Data Storage (U:) drive, which is accessible only to the project team (PI and the two postdocs: Tom Daamen and Fransje Hooimeijer).

Temporary back-ups may be saved briefly on TU Delft OneDrive, but these will be transferred to the secure Project Storage as soon as possible and deleted from OneDrive.

Signed informed consent forms and any contact details will be stored separately from research data, in a secure and encrypted folder within the same Project Data Storage environment, to avoid re-identification risks.

III. Data/code documentation

6. What documentation will accompany data/code? (Select all that apply.)

- Data - Methodology of data collection

Although the dataset will not be shared in a public data repository due to privacy concerns, the methodology of data collection and processing will be described in detail in the MSc thesis, which will be made publicly available in the TU Delft Repository.

This documentation will include:

- the interview and expert panel procedures
- criteria for participant selection
- type of data collected
- approach to anonymisation and data handling

No formal metadata or codebook will be provided separately, as the data are not intended for reuse beyond this project.

IV. Legal and ethical requirements, code of conducts

7. Does your research involve human subjects or third-party datasets collected from human participants?

If you are working with a human subject(s), you will need to obtain the HREC approval for your research project.

- Yes - please provide details in the additional information box below

I intend to apply for ethical approval from the Human Research Ethics Committee (HREC) before conducting any interviews or expert panel sessions. My supervisor, Tom Daamen, will act as the Corresponding Researcher for this application. Once approval has been obtained, the DMP will be updated with the application number and approval date.

8. Will you work with personal data? (This is information about an identified or identifiable natural person, either for research or project administration purposes.)

- Yes

The personal data that will be collected includes: name, email address, phone number, voice recordings, professional role, current occupation, and work experience.

These data serve two purposes:

- (1) Administrative purposes, such as scheduling interviews and communication. These details will be stored separately and deleted after the project.
- (2) Research purposes, as professional roles and opinions may be relevant to understanding institutional dynamics in climate adaptation.

Voice recordings and other identifiable data will be pseudonymised during transcription and any publication will use anonymised data only.

9. Will you work with any other types of confidential or classified data or code as listed below? (Select all that apply and provide additional details below.)

If you are not sure which option to select, ask your Faculty Data Steward for advice.

- Yes, politically-sensitive data (such as research commissioned by public authorities, research in social issues)

The research involves politically-sensitive data due to the involvement of public authorities and financial stakeholders in discussions about institutional barriers to climate adaptation in vulnerable neighbourhoods.

These data may include critical opinions on governmental strategies, responsibilities, and funding mechanisms, which could be reputationally or politically sensitive.

All participants will provide informed consent, and the data will be pseudonymised during transcription. Results will be presented in an anonymised and aggregated manner to minimise sensitivity and ensure confidentiality.

10. How will ownership of the data and intellectual property rights to the data be managed?

For projects involving commercially-sensitive research or research involving third parties, seek advice of your [Faculty Contract Manager](#) when answering this question.

This is an internal TU Delft MSc thesis project. As such, the intellectual property rights remain with me, the student. There are no external parties involved, and no commercially-sensitive or third-party proprietary data is being used.

The project involves politically-sensitive data (see Q9), such as critical stakeholder views on public climate policy. Although no formal restrictions apply to data reuse under TU Delft research policies, all data will be anonymised and reused only in line with the informed consent provided by participants and with appropriate sensitivity.

The data will be stored and managed according to TU Delft data policies. No specific legal restrictions on data access or reuse apply.

11. Which personal data or data from human participants do you work with? (Select all that apply.)

- Other types of personal data or other data from human participants – please provide details below
- Proof of consent (such as signed consent materials which contain name and signature)
- Audio recordings
- Telephone number, email addresses and/or other addresses as contact details for administrative purposes
- Names as contact details for administrative purposes

Participants' names, email addresses, and phone numbers will be collected solely for administrative purposes such as communication and scheduling. These data will be stored separately and deleted after the project.

Audio recordings of interviews and expert panel sessions will be made with participants' consent, and may include identifiable information such as voice and professional opinions. These recordings will be pseudonymised during transcription.

Signed informed consent forms (with name and signature) will be stored securely and separately from the research data.

No special categories of personal data (such as race, religion or health data) will be collected.

12. Please list the categories of data subjects and their geographical location.

The data subjects are professionals involved in identifying financial barriers to climate adaptation, including employees of:

- banks
- institutional investors
- insurance companies
- housing associations
- water authorities
- urban design and development advisors

All participants are based in the Netherlands, with a focus on urban areas such as Rotterdam (including the neighbourhood Bloemhof).

The research includes both semi-structured interviews and expert panel sessions. In some cases, the same individuals participate in both; in other cases, different participants are involved.

13. Will you be receiving personal data from or transferring personal data to third parties (groups of individuals or organisations)?

- No

16. What are the legal grounds for personal data processing?

- Informed consent

17. Please describe the informed consent procedure you will follow below.

All research participants will receive an information sheet explaining the purpose of the research, the types of data collected (including personal data), how the data will be processed, and their rights as participants (e.g., to withdraw at any time).

Participants will be asked to sign a written informed consent form (digital or physical) **before** the start of the interview or expert panel. This consent covers both participation in the research activities and the processing of their personal data.

The consent form includes options to separately agree to:

- Participation in semi-structured interviews
- Participation in expert panel sessions
- Audio recording of their contribution

The forms also emphasize that all data will be treated confidentially, that quotes will be anonymised, and that recordings will be pseudonymised before transcription.

All consent forms will be securely stored and separated from research data to avoid re-identification.

18. Where will you store the physical/digital signed consent forms or other types of proof of consent (such as recording of verbal consent)?

All signed informed consent forms (digital copies) will be stored on the TU Delft Project Data Storage (U:) drive, in a separate folder from the research data, to reduce the risk of re-identification.

Only the researcher and the supervisor (Tom Daamen) will have access to this folder. No consent forms will be stored on personal devices or cloud storage services outside the TU Delft infrastructure.

19. Does the processing of the personal data result in a high risk to the data subjects? (Select all that apply.)

If the processing of the personal data results in a high risk to the data subjects, it is required to perform a Data Protection Impact Assessment (DPIA). In order to determine if there is a high risk for the data subjects, please check if any of the options below that are applicable to the processing of the personal data in your research project.

If any category applies, please provide additional information in the box below. Likewise, if you collect other type of potentially sensitive data, or if you have any additional comments, include these in the box below.

If one or more options listed below apply, your project might need a DPIA. Please get in touch with the Privacy team (privacy-tud@tudelft.nl) to get advice as to whether DPIA is necessary.

- None of the above apply

This project involves qualitative interviews with professionals (e.g. financial stakeholders) in their professional capacity. The interviews do not include special categories of personal data (e.g. health, ethnicity, political beliefs), nor are the participants scored, evaluated or monitored. Participants provide informed consent and have the right to withdraw at any time. No high-risk processing is expected, and no DPIA is necessary.

23. What will happen with the personal data used in the research after the end of the research project?

- Anonymised or aggregated data will be shared with others

Only fully anonymised data will be shared after the research project ends. This includes aggregated insights and anonymised quotes from interviews and expert panels, as included in the MSc thesis.

No names, roles, or other directly or indirectly identifying details will be included. Any quotes will be edited to remove identifiable references.

The anonymised results will only be shared via the final thesis, which will be publicly accessible through the TU Delft Repository. No raw or pseudonymised data will be shared.

24. For how long will personal research data (including pseudonymised data) be stored?

- Personal data will be deleted at the end of the research project

Personal data will be retained for the duration of the thesis project plus 1 month, to allow for final checks and possible follow-up questions.

After that, any remaining personal data will be permanently deleted. Anonymised versions of the transcripts may be stored longer as part of the thesis documentation, but these will not contain any information traceable to individual participants.

25. How will your study participants be asked for their consent for data sharing?

- In the informed consent form: participants are asked to give their explicit consent for sharing their (pseudonymised) personal data with restricted access with specific recipients for specific purpose(s)

V. Data sharing and long term preservation

27. Apart from personal data mentioned in question 23, will any other data be publicly shared?

Please provide a list of data/code you are going to share under 'Additional Information'.

- All other non-personal data/code underlying published articles/reports/theses

The MSc thesis will be published via the TU Delft Repository.

It will include aggregated and anonymised insights from interviews and expert panel discussions, as well as descriptions of the methods used. No raw personal data or identifiable information will be shared.

29. How will you share research data/code, including those mentioned in question 23?

- I am a Bachelor's/Master's student at TU Delft and I will share the data/code in the body and/or appendices of my thesis/report in the Education Repository

31. When will the data/code be shared?

- As soon as corresponding results (papers, theses, reports) are published

VI. Data management responsibilities and resources

33. If you leave TU Delft (or are unavailable), who is going to be responsible for the data/code resulting from this project?

My supervisor, Dr. T.A. (Tom) Daamen, Associate Professor at the Department of Management in the Built Environment, Urban Development, will be responsible for the data and code resulting from this project if I leave TU Delft or become unavailable.

Email: t.a.daamen@tudelft.nl

34. What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

No additional financial resources are required for data management in this MSc thesis project. Data will be managed and stored securely using TU Delft's Project Data Storage, and the anonymised findings will be made publicly available through the TU Delft Repository as part of the final thesis. The time spent on data management (e.g. anonymisation, storage, documentation) is included in the regular project workload.

35. Which faculty do you belong to?

- Faculty of Architecture and the Built Environment (ABE)