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# **SPONGE CITY OLDENBURG**

**HOW TO ENABLE THE  
TRANSITION TOWARDS THE  
SPONGE CITY CONCEPT VIA  
GOVERNANCE ARRANGEMENTS**

Title: Sponge City Oldenburg: How to enable the transition towards the Sponge City Concept via Governance Arrangements

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## Abstract

Urban water management in mid-sized cities faces growing challenges due to climate change, urbanization, and inadequate planning. The Sponge City Concept (SCC) provides an innovative approach to mitigate issues such as flooding, droughts, and water pollution through the integration of blue, green, and grey infrastructure. This thesis investigates the institutional conditions enabling SCC development and implementation, focusing on the case of Oldenburg, Germany. Utilizing the Policy Arrangement Approach (PAA), the study examines governance arrangements across four dimensions: discourse, actors and coalitions, rules of the game, and power and resources. Key barriers identified include fragmented governance, unclear actor responsibilities, and excessive bureaucracy. Opportunities, such as a paradigm shift in water management, showcase projects, and diverse policy instruments, provide avenues for progress. The findings underline the importance of adaptive governance frameworks that promote actor collaboration, streamline policies, and encourage innovative solutions. Lessons from Oldenburg suggest that addressing local governance structures is crucial while offering broader insights for cities with similar environmental and institutional contexts.

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## List of Abbreviations

BGI - Blue-Green Infrastructure

DIN - German Institute for Standardization (Deutsches Institut für Normung)

LID - Low Impact Development

PAA - Policy Arrangement Approach

PPP - Public-Private Partnership

SCC - Sponge City concept

SUDS - Sustainable Urban Drainage Systems

UBA - German Federal Environment Agency (Umweltbundesamt)

WUSD - Sensitive Urban Design

# 1. Introduction

## 1.1 Background

As of 2017, 55 % of the world's population lives in urban areas (Richter & Roser, 2018). This worldwide development has increased the demand for built-up areas to accommodate the growing urban population (Jia et al., 2017), causing cities to grow unevenly and at varying speeds (Duranton & Puga, 2014). This rapid urban growth, paired with inadequate planning, severely impacts urban water management. At the same time, climate change is also increasingly affecting urban water management. More frequent and severe extreme weather events such as high intensity precipitation, storms and drought periods are confronting current water management concepts with challenges ranging from increased urban floods and water pollution to water shortages and the urban heat island effect. As a result, existing urban water management concepts are increasingly inadequate for addressing the demands of modern cities, as they often rely on traditional grey infrastructure that lacks the capacity to absorb, infiltrate, and store rainwater (Nguyen et al., 2019). This development puts pressure on cities and their institutional frameworks to adapt to the emerging challenges (Low et al., 2005).

A promising concept to manage these issues is the Sponge City concept (SCC). Developed in 2014 by the Chinese government, the SCC was specifically designed to address water management in densely populated areas, with large impermeable surfaces due to roads, rooftops and flood pressures. It aims for a holistic and integrated approach that addresses the urban water cycle as a whole and makes use of its natural processes instead of trying to dominate them (Nguyen et al., 2019). Due to the long-lasting effects of rapid urbanization, inadequate planning and climate change on cities, the implementation of the SCC, challenging traditional water management by making space for water, faces substantial barriers. Nguyen et al. (2019) identified four key barriers related to the adoption of the SCC. Technical and physical challenges, including limited regional data, and a lack of simulation models; financial challenges, such as high costs of implementation and insufficient funding sources; administrative fragmentation, which involves inadequate coordination between governmental levels and sectors; and public awareness and acceptance challenges, highlighting the need for improved communication and community engagement to foster support and understanding of the SCC (Chan et al., 2018; Nguyen et al., 2019).

The city of Oldenburg in Lower Saxony, Germany, was recently threatened both by flooding during the Christmas floods of 2023/24 and by long periods of heat and drought, particularly since 2018 (Tagesschau, 2024; City of Oldenburg, 2024). Confronted with large amounts of water, inadequate protective measures, as well as the upcoming threat of water shortages, Oldenburg must now face up to these emerging issues. In order to tackle these threats, the current water management concept needs to be rethought and alternative approaches considered. The SCC, integrating green and blue infrastructure for rainwater retention, infiltration, and reuse offers a flexible approach for Oldenburg to enhance its water management by utilizing multifunctional infrastructure (Nguyen et al., 2019). This flexibility makes the SCC especially suitable for Oldenburg, as it addresses multiple challenges through its diverse range of measures, which can be seamlessly incorporated into the city's existing infrastructure.



Oldenburg has already shown ambition to increase its sponge capacity by exploring measures such as green roofs, natural rainwater retention basins, and open drainage systems. These initiatives have been implemented, for example, in the new district developed on the site of the former 'Fliegerhorst' airbase, where sponge city principles like sustainable water management and natural cooling effects are being tested. However, these efforts remain largely limited to small-scale pilot projects, highlighting the need to scale up and integrate such measures into the city's governance arrangement (City of Oldenburg, 2020).

To study institutional barriers and opportunities related to the current development and implementation of the SCC in Oldenburg, the governance arrangement approach offers a valuable framework (Hegger et al., 2014). This approach is particularly beneficial in the Oldenburg context, as the dynamic interplay of environmental pressures demands coordinated, flexible, and cross-sectoral responses. The analysis focuses on the four dimensions essential to a governance arrangement: discourse, which reflects the prevalent policy ideas and narratives; actors and coalitions, identifying the dominant coalition of actors; rules of the game, encompassing formal and informal regulatory norms; and power and resources, indicating the distribution and control of tools and capacities (Wiering & Immink, 2006; Arnouts et al., 2012). These four dimensions reveal not only the structural elements but also the interactions and dependencies that drive policy adaptation, providing a comprehensive basis for examining how Oldenburg can integrate the SCC through its existing governance arrangement.

This thesis is essential for understanding institutional barriers and opportunities related to the practical development and implementation of innovative concepts such as the SCC. Using Oldenburg as a case study provides a valuable perspective, as the city has already implemented showcase projects aligned with the SCC. Given Oldenburg's need to implement solutions within its established infrastructure, insights from this research can highlight pathways for other mid-sized cities facing similar challenges. By analysing how Oldenburg's governance arrangement can support the integration of the SCC, this thesis aims to uncover practical approaches for adapting urban water management to evolving demands.

## 1.2 Problem statement and research question

This study aims to explore the practical development and implementation of the SCC. This is achieved via a case study on Oldenburg's governance arrangement. The city encountered several extreme weather events since 2018 and just recently in December and January 2023/24 experienced prolonged heavy rainfalls and closely avoided a dam break. This event is now recognized as the Christmas flood (City of Oldenburg, 2024). By recognizing these emerging issues, the city has already taken first steps towards implementing climate adaptive measures and is slowly stepping away from the traditional, exclusive use of grey infrastructure (City of Oldenburg, 2024). In the process, Oldenburg has carried out showcase projects venturing on new approaches and also the SCC. In doing so, the city has encountered the implementation barriers of the concept first hand. This study aims to explore how to enable the implementation of the SCC via a governance arrangement's approach. This is achieved by analysing the four dimensions of Oldenburg's governance arrangement – discourse, actors and coalitions, rules of the game, power and resources – to identify institutional barriers and opportunities that facilitate or hinder SCC implementation. To achieve this, the main research question is:

*Which institutional conditions promote the development and implementation of the SCC in mid-sized cities, and which lessons can be drawn from the case of Oldenburg in this respect?*

To answer the main research question three sub-questions have been formulated. The first sub-question aims to explore how the SCC can be conceptualized to address institutional barriers and leverage opportunities within governance arrangements, providing a theoretical framework for understanding the interplay between the SCC and institutional conditions.

The second focuses on analysing the existing water governance arrangement and policies in Oldenburg to understand the current development and implementation of the SCC and thus analyses the empirical findings obtained. The third sub-question brings the theoretical and empirical perspectives together by asking about the key learnings from the institutional conditions of Oldenburg. This highlights the institutional barriers and opportunities, providing insights into how the implementation of the SCC can be enabled.

1. How can the SCC be conceptualized and what does a governance arrangement approach entail?
2. How does Oldenburg's existing water governance arrangement and policies structure the development and implementation of the SCC?
3. What lessons can be learned about the institutional conditions that would enable the implementation and upscaling of the SCC in Oldenburg?

### 1.3 Theoretical approach

The theoretical framework of this thesis centres around governance arrangements in order to understand barriers and opportunities to enable the implementation of the SCC. The SCC, as outlined by Nguyen et al. (2019), is an innovative urban water management strategy designed to mitigate issues such as urban flooding, water pollution, and water shortages, all of which are exacerbated by rapid urbanization and climate change. The SCC integrates green and blue infrastructure using techniques such as permeable pavements, green roofs, and bio-retention systems to promote sustainable urban water cycles and enhance resilience in cities (Nguyen et al., 2019). To facilitate the implementation of the such measures, understanding the prevailing water governance arrangement in a city is essential. The governance arrangement approach, which is based on the Policy Arrangement Approach (PAA), examines the interplay between discourse, actors and coalitions, rules of the game, and power and resources (Wiering & Immink, 2006), and offers a framework to assess the institutional conditions and requirements for translating the SCC in Oldenburg. This approach integrates insights from the four dimensions: discourse, actors and coalitions, rules of the game, and power and resources. It is particularly useful for analyzing adaptive governance, allowing for interactions between these dimensions and the integration of diverse strategies to address water management challenges, which aligns closely with the governance needs for implementing the SCC (Hegger et al., 2014). By utilizing the governance arrangement approach, this thesis identifies institutional barriers and opportunities within Oldenburg's governance context, focusing on how the established water governance arrangement can support or hinder new concepts in urban water management.

## 1.4 Research Strategy

This thesis is a qualitative case study on the city of Oldenburg (Figure 1). Oldenburg's water management involves a large number of actors with different resources and objectives. Despite this, the city has managed to implement several showcase projects in line with the SCC within the existing governance arrangement. Additionally, Oldenburg's historical infrastructure, such as the mixed water system in its historic city centre, poses further challenges for adapting to modern urban water management demands, making it a compelling subject for analysis. The success of implementing SCC projects despite a large number of actors participating and the historical background makes Oldenburg an interesting case to investigate, as its lessons can be transferable to other mid-sized cities facing similar challenges of integrating innovative water management concepts within established governance arrangements. Therefore, investigate the practical opportunities and institutional barriers to implementing the SCC in the Oldenburg case, aiming to identify insights for enhancing governance arrangements in comparable urban contexts. To analyse the existing governance arrangement, empirical data is obtained through a policy document analysis, a media analysis and semi-structured interviews. The conceptual framework combines the four barriers of SCC implementation with the four dimensions of the Policy Arrangement Approach to analyse Oldenburg's existing governance arrangement and systematically identify the institutional barriers and opportunities for enabling the SCC.

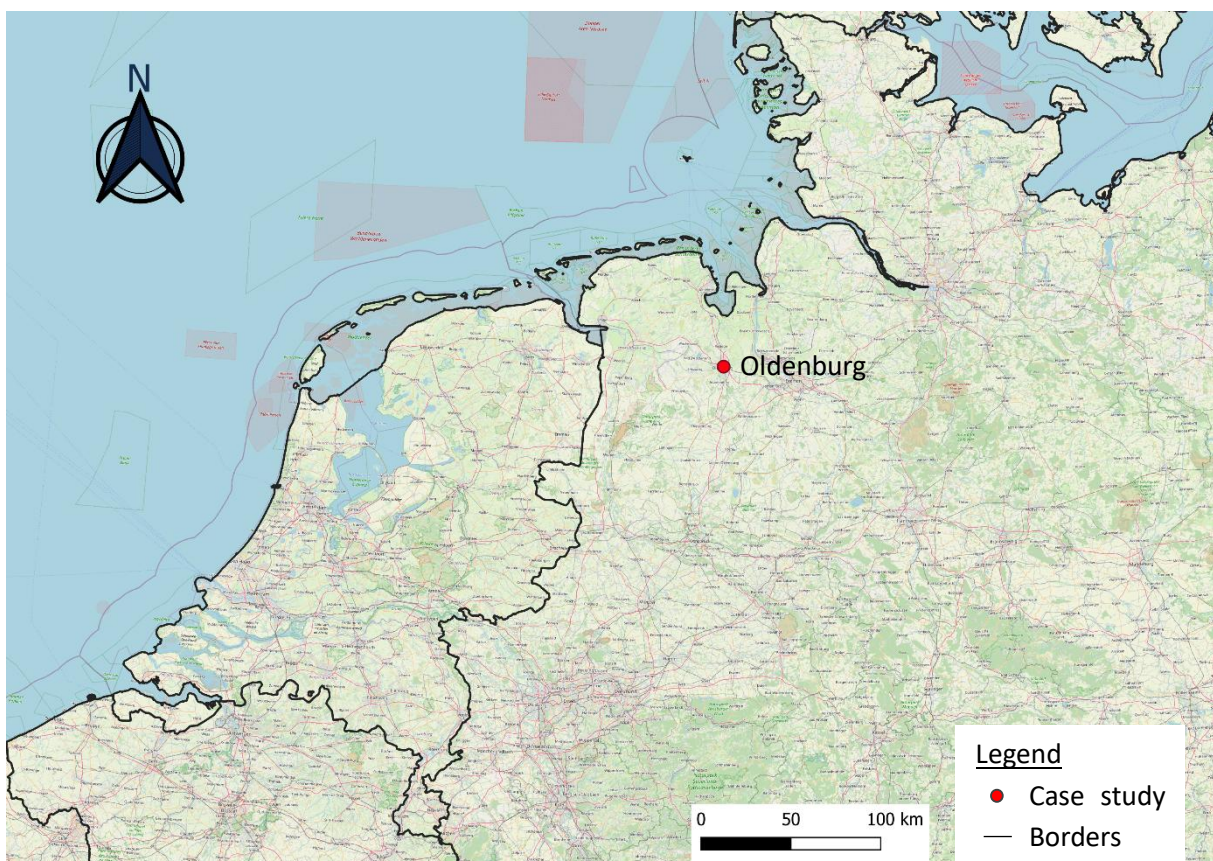


Figure 1. Map showing location of Oldenburg, its surrounding area and country borders, (Source: Author).

## 1.5 Research Relevance

### **Social relevance**

Water related challenges that urban environments are faced with due to climate change, rapid urbanization, and inadequate planning are key factors for the need to create resilient urban water management (Marlow et al., 2013). The SCC provides a way to address multiple issues simultaneously by making use of co-benefits (He et al., 2019). Co-benefits are positive secondary effects that result from measures that address a specific problem and at the same time have a positive impact on other issues. In the SCC context, this means that by dealing with water management issues, co-benefits arise that mitigate other issues and support positive trends. The co-benefits approach is therefore a multi-functional win-win strategy that creates many opportunities for the SCC to contribute to the society (He et al., 2019). He et al. (2019) name five general dimensions in which co-benefits arise. The social dimension holds stress reduction and health improvement. The climate-related dimension comprises greenhouse gas reduction and enhanced resilience to climate change. Environmental co-benefits include biodiversity protection, ecosystem service support, and air pollution reduction. The economic dimension the financial performance can be improved by attracting private investors or by pushing technological innovation. This particularly contributes to supporting public private partnerships which are crucial for the SCC. Institutional co-benefits can contribute to political stability and interregional collaboration as well as institutional collaboration (He et al., 2019). Additionally, as Wang (2021) highlights, SCC measures can increase social equity by ensuring that benefits such as improved water management and resilience are distributed inclusively across socio-economic groups. By implementing the SCC therefore, multiple social benefits can be triggered.

### **Scientific Relevance**

The SCC emphasizes the integration of natural hydrological processes into urban water management to address pressing challenges like flooding, water scarcity, and environmental degradation in urban areas (Chan et al., 2018). However, its effective implementation requires a shift in governance arrangements, as the discourse in water management has historically been dominated by a technical, engineering perspective that prioritized grey infrastructure solutions (Wiering & Immink, 2006).

Incorporating the SCC into urban contexts is, therefore, of scientific relevance as it challenges traditional paradigms of urban water management by promoting climate adaptive solutions such as nature-based solutions (Hegger et al., 2014). Through the integration of green and blue infrastructure, the SCC is simultaneously addressing flooding, heat island effects, and public space improvement, contributing to overall liveability (Chan et al., 2018). By linking water management with broader urban planning objectives, the SCC promotes multifunctional solutions that not only enhance climate resilience but also support sustainable urban development (Hegger et al., 2014). This integration fosters interdisciplinary collaboration between different policy areas, including spatial planning, water management and climate adaptation, and helps to break down the fragmentation that has hampered comprehensive climate change adaptation strategies in cities in the past (Hegger et al., 2014). By addressing institutional barriers and leveraging opportunities within governance arrangements, the SCC enables planners to design cities that are not only more resilient but also more sustainable and inclusive, creating a transformative impact on planning practices.

## 1.6 Outline of Thesis

In this first chapter, background information has been provided that explains the need for new urban water management concepts. The two concepts of SCC and governance arrangements have been introduced and the research question was formulated. In Chapter 2, the theoretical framework is described, going further into detail on the SCC and governance arrangement concepts. The conceptual framework for the analysis of this thesis is introduced from the synthesis of these two concepts. In Chapter 3, the methodology is presented, detailing the qualitative case study approach, the rationale for selecting Oldenburg as the focus of analysis, and the techniques used for data collection and analysis. Chapter 4 continues the description of the city of Oldenburg, followed by a presentation and analysis of the findings from the data collection. The findings are structured according to the four dimensions of the water governance arrangement: discourse, actors and coalitions, rules of the game, and power and resources. Chapter 5 answers the research questions, draws a conclusion and presents policy recommendations from the lessons learned about the institutional barriers and opportunities. Finally, it reflects on the theory and methodology and provides recommendations for future research.

## 2. Combining concepts: Sponge City and governance arrangements

### 2.1 An introduction to the Sponge City concept

Urban water management concepts have gradually evolved over centuries through trial and error. Initially, the focus was solely on flood mitigation and rainwater collection for private uses, but over time, objectives evolved to incorporate biodiversity, recreation, and social aspects (Nguyen et al., 2019). Because climate change, rapid urbanization, and inadequate planning make urban water management worldwide increasingly complex, many different concepts have been developed trying to address these issues (Chan et al., 2018), such as Low Impact Development (LID; United States and Canada) (Li et al., 2017; Pyke et al., 2011), Sustainable Urban Drainage Systems (SUDS; United Kingdom) (Griffiths, 2017), Blue-Green Infrastructure (BGI; United Kingdom) (Lamond & Everett, 2019), and Water Sensitive Urban Design (WSUD; Australia) (Wang T. , 2006). These concepts pursue similar objectives, such as sustainable stormwater management, while also generating co-benefits, including urban cooling, enhanced biodiversity, and improved recreational spaces, through the use of comparable measures like green roofs, permeable pavements, and swales (Qin et al., 2013; Lamond & Everett, 2019). Despite these shared characteristics, the contexts and specific focus differs. LIDs focus on localized retention and infiltration of rainwater to mitigate flooding and water quality degradation (Pyke et al., 2011). SUDS replicates natural drainage processes to manage surface runoff and reduce maintenance costs (Griffiths, 2017). BGI focus on integrating water and green networks to create more resilient urban environments (Chan et al., 2018). WSUDs take a more comprehensive perspective by addressing excess water, droughts, while also including a socio-political component, embodied through local governments (Morison & Brown, 2011).

Despite their potential, these concepts also face major challenges. LID's narrow focus on excess water management often neglects drought and extreme heat, while its high implementation costs and land demands hinder adoption (Wang T. , 2006). SUDS struggle to accurately replicate natural water responses due to inadequate maintenance and limited cross-sectoral coordination (Zhou, 2014). BGI require large-scale implementation and public acceptance, which can be difficult to achieve within respective socio-political contexts (Lamond & Everett, 2019). Even WSUDs, take initial steps towards broader integration by incorporating socio-political aspects, remain too narrowly focused to fully address the multifaceted challenges of urban water management while facing limited political will and insufficient governmental capacity. A robust regulatory framework and public engagement are needed to achieve impact (Morison & Brown, 2011). Although valuable, these concepts lack a truly comprehensive perspective that links water management with sectors beyond water itself. A holistic integration of technical, social, environmental, economic, legal and institutional areas, which is essential to address the complex challenges of climate change, urbanisation and inadequate planning.

#### **Problems addressed by the SCC**

Compared to these preceding concepts, the SCC's advantage lies in its ability to provide such a holistic perspective that addresses the interconnected challenges of urban water management. In order to do so, it focuses on three critical challenges traditional cities today are faced with: urban flooding, droughts and urban heat islands (UHI), and water pollution (Li et al., 2017).

Urban flooding has become a pressing challenge in cities worldwide, driven by the combined effects of climate change and unsustainable urban development practices. The rapid growth of urban

populations has resulted in increased land consumption, leading to the excessive reliance on grey infrastructure. This created large areas of impervious surfaces and eliminated natural rainwater retention components such as green spaces, and ponds, crucial for the storage and recycling of rainwater (Nguyen et al., 2019). As a result, during more frequent heavy rainfall events caused by climate change, water cannot be drained sufficiently via the existing urban drainage systems. It accumulates on the impermeable roads obstructing traffic, industries, daily life (Yan et al., 2023), and causes property and infrastructure damages that can run into the billions (Li et al., 2016).

Droughts pose a critical challenge as they threaten the urban water supply and ecosystems. This scarcity increases dependence on overexploited resources such as groundwater and reservoirs, leading to long-term environmental degradation and economic crisis (Nguyen et al., 2019). With temperature difference off up to 10°C between urban and rural areas, UHIs are additional pressing issues for urban water management (Imhoff et al., 2010), leading to a dramatic increase in morbidity and mortality, and energy consumption (He et al., 2019).

Water pollution poses another critical challenge, endangering ecosystems, biodiversity, and human health. Flood events exacerbate this issue by releasing and mobilizing large quantities of pollutants into the environment (ten Veldhuis et al., 2010). This impacts not only biodiversity and the entire ecosystems, but also human health (Nguyen et al., 2019). Heavy metals and nutrients, pathogens entering through floods pose a direct threat to aquatic life and can lead to waterborne diseases in human populations (ten Veldhuis et al., 2010).



## Traditional cities

Why heavily sealed cities should become Sponge Cities:



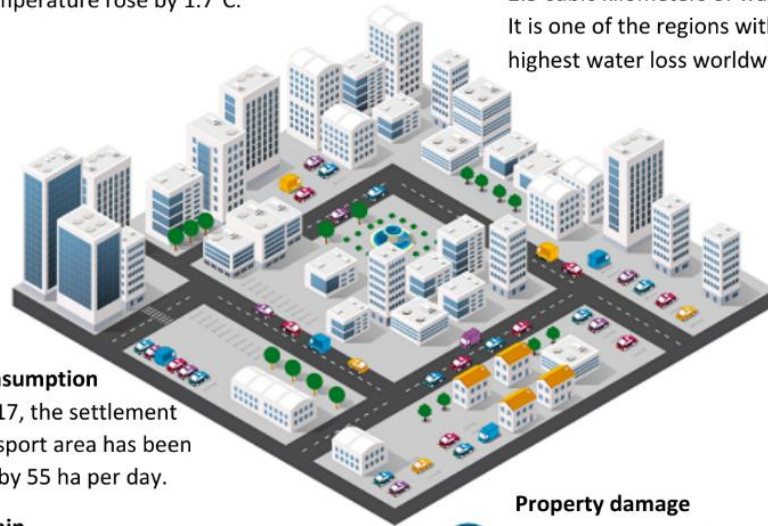
### Rising temperatures

Between 1881 and 2022, the annual mean temperature rose by 1.7°C.



### Water loss

Since 2002, Germany has been losing 2.5 cubic kilometers of water per year. It is one of the regions with the highest water loss worldwide.



### Land consumption

Since 2017, the settlement and transport area has been growing by 55 ha per day.



### Heavy rain

Heat promotes heavy rain: In 2021 heavy rain-warnings affected 30% of the settlements.



### Property damage

In 2021, heavy rainfall events led to insurance claims totalling 8.1 billion euros.



### Drought

Increasing and longer periods of drought jeopardise the vitality of urban greenery and cause groundwater levels to fall.



### Heat stress

In the record year of 2018, an average of around 20 hot days were recorded in Germany, and as many as 42 in Frankfurt am Main.

Source: 2023 Monitoring Report on the German Strategy for Adaptation to Climate Change.

Figure 2. Traditional heavily sealed cities in Germany (modified from UBA, 2024)

## The SCC

The SCC was first introduced in China in 2014 and designed as an innovative approach to urban water management (Li et al., 2017). The aim is to create cities that can absorb, store, filter and clean rainwater by integrating BGI (Figure 2). To achieve this, the concept combines ecological principles, urban planning strategies, and advanced engineering practices to harmonize urban water cycles, mitigate flooding risks, enhance water quality, and provide sustainable water resources. This requires the interplay of structure and agency, where institutional frameworks and policies (structure) guide and support individual and collective actions (agency), ensuring that actors can implement and adapt the SCC into the local contexts. (Nguyen et al., 2019).



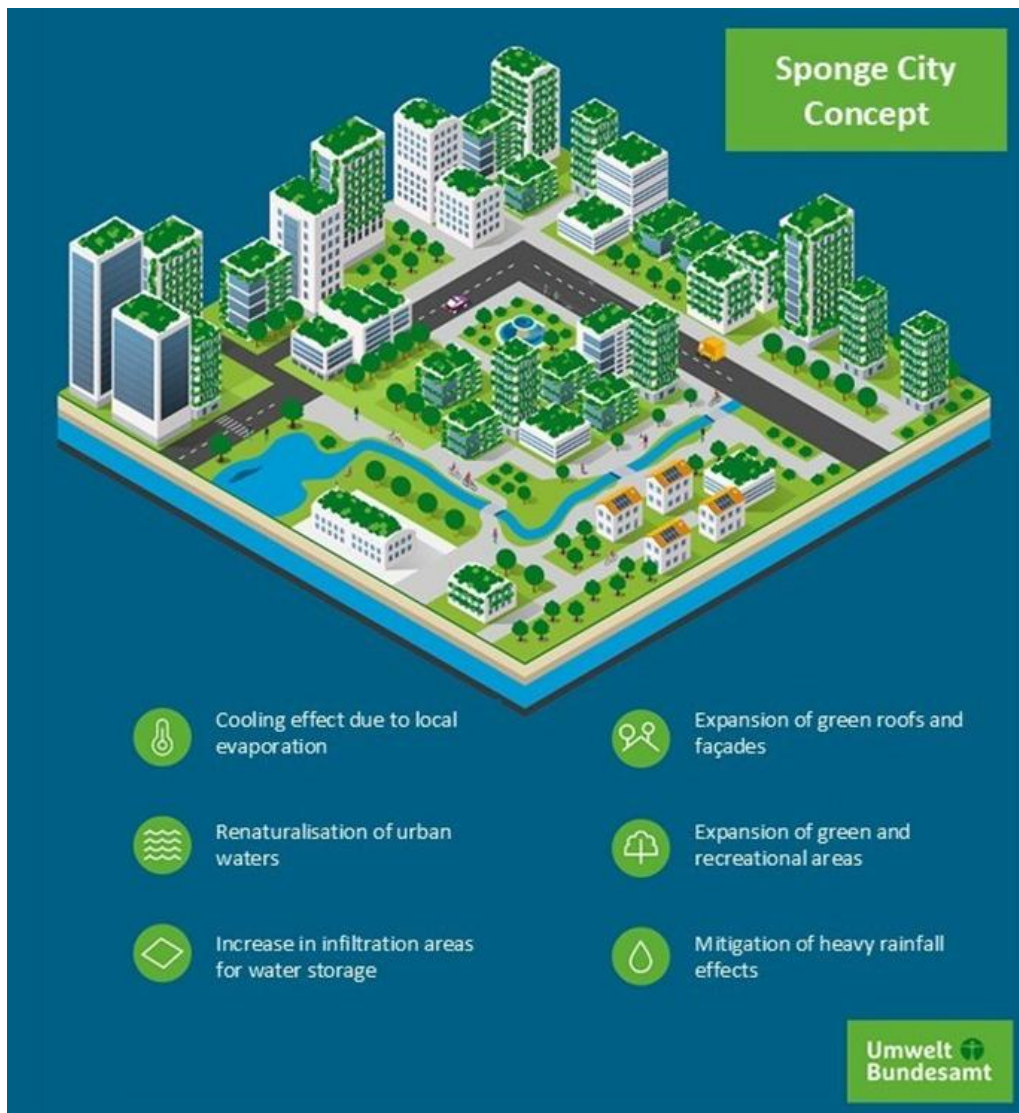


Figure 3. The SCC (modified from UBA, 2024)

In this way, the SCC tackles the challenges of urban water management by regulating peak water discharge, improving water quality and promoting multifunctional infrastructure (Figure 3). For this the SCC utilizes several approaches simultaneously (Chan et al., 2018). To manage stormwater and reduce runoff volumes, LID elements and underground storage systems are integrated (Jia et al., 2017). This provides an alternative to conventional drainage systems that focus on rapid drainage only (ibid). Additionally, urban flooding is mitigated through retention basins and artificial wetlands (Nguyen et al., 2019). Water quality is improved through natural and artificial water bodies which act as purification systems by filtering pollutants while also counteracting urban flood risks (ibid). Natural hydrology and infiltration to replenish groundwater is supported by renaturalising urban water bodies and integrating pervious surfaces such as bio-swales (ibid). In addition, urban green spaces and artificial water features such as rain gardens are utilised not only for ecological restoration but also to create attractive recreational spaces and improve biodiversity, in line with the SCC's multifunctional objectives (Chan et al., 2018). Another key component is the promotion of cooling effects through the greening of roofs and façades, which reduces UHIs. Together, these measures not only support urban water management, but contribute to improving quality of life and ecological diversity (Chan et al., 2018; Nguyen et al., 2019). In this way, the concept combines natural (blue and green) and technical (grey)

approaches. It strengthens urban resilience to water crises and promotes sustainable urban landscapes (Nguyen et al., 2019).

Resilience is therefore a main component of the SCC and will be briefly outlined here. In the context of water management, resilience provides a framework for preparing urban systems to face an uncertain future. By incorporating the key capabilities of persistence, adaptability, and transformability, it enables the design of cities that can withstand, adjust to, and evolve in response to water-related challenges (Restemeyer et al., 2015). In an urban context, O’Donnell et al. (2020) state that flood water resilience is multi-disciplinary. It focusses on flood risk, wastewater and stormwater management via securing service delivery under flood, normal and drought conditions and the enhancement and extend of useful life of aging grey construction elements while implement multi-functional BGIs (O’Donnell, 2020). Resilience in the context of the SCC represents the capacity to create urban environments that can endure, recover from, and adapt to water-related challenges, ensuring long-term sustainability and liveability in the face of future uncertainties (Chan et al., 2018; Jia et al., 2017).

2.2 Implementation barriers

Despite its potential, the SCC faces barriers to its implementation: technical and physical, financial, public acceptance and legal barriers (Figure 4) (Li et al., 2017; Nguyen et al., 2019).

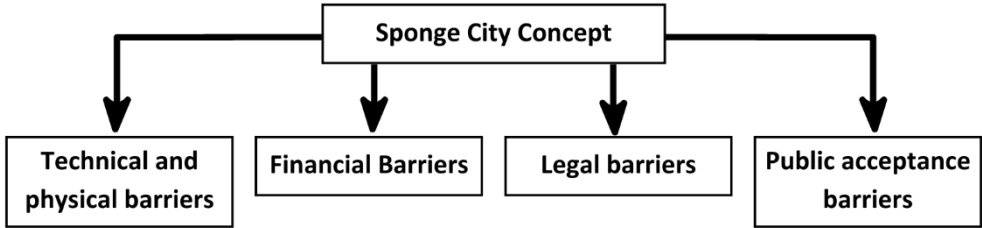


Figure 4. Barriers to the implementation of the SCC based on Li et al. (2017) and Nguyen et al. (2019).

**Technical and physical barriers**

A key technical barrier is the scarcity of appropriate simulation models. So far, plans for the implementation of SCCs were often rigidly transferred to other cities, with the risk of not being suitable to the new context (Nguyen et al., 2019). As the SCC is highly sensitive to local conditions, measures taken must be selected on the basis of careful consideration of the local context, while monitoring must continue throughout operation and maintenance (Li et al., 2017). Even though there are simulation models such as the sustainable water management model, there is a shortage of skilled personnel that is able to operate them. Another issue with simulation models is the lack of sufficient data (Nguyen et al., 2019). Physical barriers comprise local climates, soil and geographical conditions. For example, variations in rainfall patterns, soil permeability, or topography influence the choice of SCC measures. In addition, the SCC uses sustainable materials, e.g. for pervious pavements. Their unavailability and cost represent a further physical barrier. To overcome these barriers, experts such as architects, urban planners, environmental engineers, and hydrogeologists, etc. need to be included into the creation of an SCC from the start (Nguyen et al., 2019).

## **Financial barriers**

While small-scale projects bear low costs using for instance a single LID measure, an implementation at catchment scale requires a robust and dynamic financial basis (Nguyen et al., 2019). In order to achieve this, it is important to involve multiple actors from the governmental sector, public-private partnerships (PPP), and non-governmental organisations (NGO) as well as economic instruments such as subsidies, taxes, insurance fee differentiations (Nguyen et al., 2019; Mees et al., 2014). For example, the pilot city of Wuhan in China was financed 50% by private investors, 40% by the local government and 10% by the central government (Liang, 2018). However, governmental subsidies alone are insufficient to meet the extensive and long-term funding needs of SCCs. Another challenge lies in visualizing and accurately estimating life-cycle costs. While design and construction expenses are clear, costs for operation and maintenance remain difficult to predict (Nguyen et al., 2019).

A promising financial option for SCCs are PPPs, which involve joint funding, construction, and management of projects by governments and private entities, with shared risks and benefits. However, private investors are hesitant to invest due to the high financial risks from unpredictable life-cycle costs and low experience (Liang, 2018). To overcome financial barriers, a robust regulatory framework, independent agency, comprehensive project database, feasibility studies, and stronger institutional capacity are required (Li et al., 2017).

## **Public acceptance barriers**

In contrast to traditional urban water management systems, the SCC is tangible within the urban environment, integrating elements such as green roofs and facade greening. Therefore, public awareness and education on the SCC is crucial for its acceptance (Li et al., 2017). To increase awareness, it is vital to promote issues in water management as well as the SCC in different sectors including, politics, planning, construction, landscapers, and the public. Spreading knowledge in a wide range can initiate the shift in public acceptance and perception that is needed for the SCC (Li et al., 2017).

To encourage such a paradigm-shift towards the SCC, education is essential. The general lack of training, education, and experience in various fields of SCC such as planning, design, maintenance, and benefits is a major barrier (Li et al., 2017). Local staff, management, development, consulting industries and the public do neither have sufficient knowledge nor experience to venture on the SCC (Li et al., 2017; Nguyen et al., 2019). This results in a cautious attitude or avoidance of such concepts as carrying out the implementation without sufficient knowledge or experience can exacerbate rather than improve the situation (Li et al., 2017).

## **Legal barriers**

A key barrier in this context is the preference for grey over green infrastructure in local ordinances. This bias not only hinders the implementation of green infrastructure but also complicates its maintenance, particularly when it is situated on private property (Li et al., 2017). Here public agencies face difficulties gaining access for proper maintenance, and securing long-term compliance with sustainability objectives. The lack of clear regulations regarding ownership and maintenance responsibilities further exacerbates the issue, as property owners are often unaware of their obligations or lack the capacity to fulfil them. Therefore, the need for legal frameworks that balance public benefits with private rights is a critical barrier in fostering green infrastructure adoption (Tempels, 2022), which is essential to the SCC. To ensure that new regulations are tailored to local conditions such as culture, environment, economy and societal norms, administrative powers need to be decentralized to local governments (Jia

et al., 2017). Furthermore, legislation needs to allow and foster collaboration and coordination among actors. This need for enhanced cooperation is a lesson learned from existing urban resilience strategies, which have historically suffered from inadequate collaboration between functions and agencies (Chapter 2.1). Past experiences highlight the importance of inter-connectedness among different levels of administration, agencies, and society for the successful realization of SCC (Nguyen et al., 2019). To overcome these legal barriers, establishing an agency dedicated to foster collaboration and benefit-sharing across sectors can enhance cooperation and inter-agency involvement (Nguyen et al., 2019).

Although the SCC concept itself is well-defined, these barriers hinder its development and implementation. Overcoming these barriers requires close cooperation between related functions and agencies, presenting a clear governance challenge that demands coordinated efforts across multiple sectors.

### 2.3 The governance arrangement approach

In order to tackle these implementation barriers and address the governance challenges they create, it is crucial to better understand how the existing governance arrangement in Oldenburg influences the development and implementation of the SCC. For this, a structured framework is essential. A governance arrangement approach provides a lens for examining how governance arrangements can be adapted to support the development and implementation of the SCC. This approach is particularly relevant, as it emphasizes the interconnected dimensions of discourse, actors and coalitions, rules of the game, and power and resources, which are essential for addressing the complexity of urban water management in a changing climate (Hegger et al., 2014; Wiering & Immink, 2006).

The governance arrangement concept has its origin in the Policy Arrangements Approach (Figure 5) which are according to Van Tatenhove et al. (2000) defined as “the temporary stabilisation of the organisation and content of a policy domain, at a specific level of policy making” (Van Tatenhove et al., 2000, p.54). Policy arrangements are sector-based and firmly rooted in daily practices (Wiering & Immink, 2006). Focusing on discrete policy sectors such as environment, water management, and nature conservation (Hegger et al., 2014). This sectoral structure often resulted in fragmented approaches, lacking coordination across different sectors. These limitations of sectoral policy arrangements became evident as global challenges such as climate change and sustainable development emerged, necessitating coordinated responses across multiple sectors. This realization prompted a shift towards focusing on governance arrangements that emphasize integration, collaboration, and coherence across policy domains, aligning with Hegger et al. (2012) findings in the context of flood risk governance arrangements (Hegger et al., 2012). Governance arrangements involve a broader spectrum of actors, including governmental and non-governmental entities, and focus on the processes and mechanisms that drive policy integration (Jordan & Lenschow, 2010). According to Mees et al. (2014), there are three types of governance arrangements. Hierarchical (public) arrangements, where governments are the main governing actors. Interactive arrangements, where governments and private actors govern jointly, and market arrangements, where the initiative to implement adaptation measures is left to private actors and civil society (Mees et al., 2014). This differentiation is especially relevant to the policy instrument mix used to enable a shift towards the SCC.

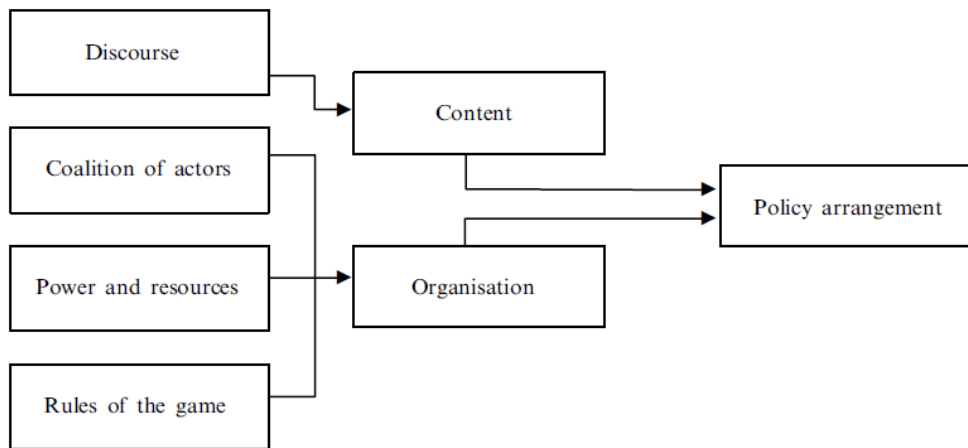


Figure 5. The dimensions of a policy arrangement (after Van Tatenhove et al., 2000).

### Discourse

The ‘discourse’ dimension refers to the content of the policy domain and the way in which actors give meaning to the content and derive meaning from it (Wiering & Immink, 2006).

As the discourse is often a central driver of governance change, a paradigm shift within this dimension can trigger a chain reaction affecting the remaining dimensions of power and resources and actor and coalitions (Hegger et al., 2012). Therefore, it is crucial to highlight the discourse currently at the heart of the policy debate, in order to determine institutional barriers and opportunities within existing governance arrangements.

The centre of the debate is the paradigm-shift in urban water management towards sustainable and resilient approaches. Climate change, combined with rapid urbanization and inadequate urban planning, has initiated this shift in the water management discourse. So far, the focus was on ‘battling against water’, which is characterized by engineering solutions that separate water from land-use through reliance on grey structures. This view gradually evolves to a discourse on ‘accommodating water’, creating space for water within urban and natural landscapes. This transition reflects the growing need to adapt water management practices to contemporary challenges in collaboration with spatial planners (Wiering & Immink, 2006).

A barrier to this paradigm-shift is the invisibility of well-functioning infrastructure systems to the everyday eye. The better the system works, the less attention it attracts and seamlessly integrates into everyday life. A phenomenon called the ‘black-boxing’ effect (Graham & Thrift, 2007). As a result, the value of water management systems often goes unrecognized as long as they function without disruption. ‘Black-boxing’ reflects how continuous, normalized use of infrastructure systems lead to deeply rooted ‘taken-for-grantedness’ and invisibility within society. Only sudden interruptions to such systems brings them into public awareness, exposing vulnerabilities ‘unblack-boxing’. In water management, this problem is magnified by the limited buffer capacity of the system. A complete system failure would not only draw immediate awareness but also trigger a supply catastrophe, highlighting the critical role of water infrastructure in modern society (Graham & Thrift, 2007).

## **Actors and coalitions**

The 'Actors and coalitions' dimension describes those actors involved in shaping a governance arrangement and the coalitions they form. Actors can be both state and non-state, such as governmental institutions, private sector representatives, NGOs, and individuals, who interact to achieve specific policy objectives (Arnouts et al., 2012). Coalitions of actors can form based on both shared belief systems or discourses. The formation can also be influenced by strategic alliances, power dynamics, and the pursuit of mutual benefits (Wiering & Immink, 2006).

A dynamic coalition of actors is essential for addressing complex issues such as water management, where interdisciplinary collaboration is crucial. Successful governance arrangements require integrating diverse perspectives and aligning interests through mechanisms such as joint knowledge production (Hegger et al., 2012). This fosters mutual understanding and leverages complementary resources across sectors. However, achieving coherence in such arrangements often encounters challenges such as power imbalances, institutional barriers, and conflicting objectives (Jordan & Lenschow, 2010).

While dynamic coalitions offer opportunities for collaboration, they are often undermined by structural challenges within governance arrangements. Fragmentation, often rooted in decentralized governance structures, poses significant barriers to coordination and integration. It hinders coordination, leading to inefficiencies and gaps in decision-making processes (Jordan & Lenschow, 2010). Another key issue in this dimension is that successful collaboration depends on participants' willingness and social compatibility, which fosters cohesive coalitions. Without mutual trust, fragmentation persists, limiting dynamic coalitions' potential (Brown et al., 2019). Furthermore, unclear responsibilities exacerbate the problem. Overlapping responsibilities or unclear roles can lead to conflicts and delays in policy implementation. For instance, disputes over funding, jurisdictional authority, or maintenance responsibilities can impede progress and reduce the effectiveness of governance arrangements (Li et al., 2017).

## **Rules of the game**

The 'rules of the game' dimension lays down institutional patterns and visions in formal and informal rules (Wiering & Immink, 2006). While formal rules include procedures, substantive norms, division of power, and official procedures (Wiering & Immink, 2006), informal rules encompass routines of interaction (Lifferink, 2006). The composition and mixtures of the rules form the arrangement for a policy domain (Wiering & Immink, 2006). The 'rules of the game' are fundamental in shaping how urban water management is planned, executed, and maintained. Formal regulations may dictate specific standards and practices, while informal norms could influence or hinder actor engagement and community participation. According to Wiering & Immink (2006), at first 'old', stable, and 'new', dynamic patterns in policy concepts and institutional 'rules of the game' will coexist. It is therefore crucial to first assess the existing regulations to pinpoint the barriers and opportunities.

Bureaucracy often poses a significant barrier within the 'rules of the game' dimension, as rigid administrative structures and complex regulatory frameworks can hinder the adaptability required for effective urban water management (Jordan & Lenschow, 2010). Frequently bureaucratic processes slow down decision-making and implementation, particularly when overlapping regulations from different sectors or levels of government create uncertainties (ibid). Additionally, the interplay between existing policies and new urban water management concepts demands policy adaptation to align traditional

regulatory frameworks with innovative concepts (Wiering & Immink, 2006). This adaptation is essential to address conflicting objectives. By simplifying bureaucratic procedures and updating policies to reflect contemporary needs, governance arrangements can enable the development and implementation of integrated water management strategies (Nguyen et al., 2019).

### **Power and resources**

'Resources and power' refer to tools with which an actor or coalition can exercise influence. Those range from financial resources to production and strategic use of knowledge to the mobilisation potential of social movements (Wiering & Immink, 2006). In order to distinguish this broad field of tools the typology of policy instruments from Mees et al. (2014) is operationalised. Here policy instruments are categorised based on their underlying rationales into legal, economic, and communicative instruments and the kind of governance into hierarchical (public), interactive (collaborative), and market-based (private) arrangements. In hierarchical public arrangements governments represent the main governing actor, in interactive arrangements governments and private actors jointly govern, and in market governance the initiative to implement measures is left to private actors. Even though most instruments could be employed in any type of governance arrangement, legal instruments tend to dominate in hierarchical arrangements whereas economical instruments in market arrangements (Mees et al., 2014). Legal instruments steer actors by restricting or permitting behavioural options through clearly defined rules, such as zoning regulations or building codes. Economic instruments influence decision-making by altering cost-benefit ratios, such as (smart) subsidies or taxes, thereby incentivising or disincentivising certain behaviours. Communicative instruments guide choices by disseminating relevant information, such as public awareness campaigns or education programs, which can enhance understanding and acceptance of policy measures. This typology highlights how each instrument aligns with specific governance objectives, making them crucial components in policy instrument mixes for climate adaptation (Mees et al., 2014).

The type of governance arrangement: We distinguish between hierarchical public arrangements with governments as the main governing actors; interactive arrangements in which governments and private actors jointly govern; and market governance in which the initiative to implement adaptation measures is left to private actors (e.g., companies or homeowners) and civil society.

## **2.4 Towards Sponge City Governance Arrangements**

To address the barriers associated with the SCC, it is essential to establish governance arrangements that facilitate its development and implementation. This requires identifying both the institutional barriers and opportunities within the existing governance arrangement.

### **Discourse**

In order to enable the implementation of the SCC a paradigm shift is needed: Water infrastructure must be recognized as a vital and limited resource, an essential element not only for basic needs but for sustaining the quality of life. Currently, the Global North, water is often taken for granted; there is an expectation that it will always be readily available, not just as a drinking supply but for watering gardens or filling pools. This perception must evolve, as society faces new challenges. However, water management often suffers from a weak profile, as its inherent invisibility makes the value of investments in innovative urban water management concepts not immediately apparent. Investments

are often perceived as expenditures without clear returns, as they mainly focus on preserving our current quality of life rather than responding to an immediate crisis. While the impact of climate change, rapid urbanisation and inadequate urban planning on the resources water is acknowledged, (financial) responsibility is often shifted onto others (Lamers et al., 2010). For water to gain the status required to enable the development and implementation of the SCC, society must recognize its value in order to allocate the necessary priority, shifting from passive use to active stewardship.

The SCC supports this paradigm shift in shifting urban water management from grey infrastructure to integrated, resilient approaches (Chan et al., 2018). It considers water as a vital resource in urban landscapes and bridges ecological principles with urban policies creating a holistic approach that aligns environmental goals and governance structures (ibid). In addition, SCC showcase projects, such as rainwater harvesting systems, green roofs and permeable pavements demonstrate the feasibility and effectiveness of SCC measures and support the paradigm shift on a small scale. By providing tangible evidence of the benefits these projects build public trust and social acceptance (Li et al., 2017). Pilot cities in China have shown that such localised efforts can promote wider acceptance by addressing technical, financial and societal challenges in a controlled environment (Chan et al., 2018). Furthermore, the prominence of these projects helps to change the perception of water management from an abstract political concept to a practical, community-relevant solution. As acceptance increases, these small-scale efforts lay the groundwork for city-wide implementation on a larger scale.

### **Actors and coalitions**

This dimension centres around the diversity of actors and their coalitions and how their co-operation affects the implementation of SCC. Actors that play a key role include public, private and civil actors. Public actors contain local and state government agencies. Although the federal government plays a role as a legislative actor, it is subordinate in the local context (UBA, 2022). Additionally, associations governed by public law are responsible for wastewater treatment, water maintenance, and drainage. While public water supply remains a municipal responsibility as it is a service of general interest (Lower Saxony Ministry for Environment, Energy, Building and Climate Protection, 2022), it can be managed through hybrid structures where private companies undertake operational tasks. In such cases, responsibility for the drinking water supply lies with the public body that holds the licence, the operational management, however, including technical and logistical tasks, is transferred to private companies (Lower Saxony Ministry for Environment, Energy, Building and Climate Protection, 2022). Such structures combine public actors, which aim to comply with legal requirements and protect the common good, with the innovative strength of private actors. This constellation can present an opportunity, as private sector expertise supports the implementation of technical solutions. At the same time, conflicts of interest between public control and private actor objectives can delay or impede implementation (Li et al., 2017; Jia et al., 2017). Private actors comprise companies and organisations such as engineering firms responsible for implementing technical solutions in urban water management in the form of PPPs. Civil actors include community groups, civic associations and environmental organisations that advocate new concepts, raise public awareness or actively participate in shaping water management policy (Federal Ministry for Environment, Nature Conservation, Nuclear Safety and Consumer Protection, 2023). Understanding the interplay between different actors and coalitions is key to understanding policy dynamics. In this context, cooperation between municipalities, state actors and knowledge institutions can form 'Learning Action Alliances' that can create resources, including knowledge, through joint networks and improved capacities (Hegger et al., 2012).



A barrier in this dimension represents the excessive fragmentation within the water sector. In Germany, this fragmentation is deeply rooted in federalism, which divides responsibilities between the federal and state levels. While the federal government sets overarching water regulations through the Water Resource Act, states retain the authority to deviate in certain areas, leading to a complex and decentralized system (UBA, 2022). While broad actor networks can promote the creation of 'socially robust' knowledge, there is a risk that too many actors involved will make steering and coordination more difficult (Hegger et al., 2012). At the same time, excluded actors may resist to the change, whether out of self-interest or frustration at their exclusion, hindering progress (Lamers et al., 2010). This results in the related barrier of low inter-connectedness between actors. The SSC is dependent on the close integration of urban planning, water management, land use and ecological systems in order to achieve positive social results (Nguyen et al., 2019). Cooperation at administrative levels and support from actors involved are essential for the implementation (ibid). Without strong coordination and cooperation between different actors, such as public and private actors or different administrative units, key objectives of the SCC will be difficult to achieve (ibid).

At the same time, a diversified actor network offers a great opportunity, as it can contribute to a broader transfer of knowledge, promote innovative approaches and increase acceptance of the SCC within society. This diversity of perspectives can help to develop integrative and viable solutions that take into account different interests and are sustainable in the long term. However, the precondition for this is that actors are willing to actively participate. For that, highlighting a clear added value or so-called 'win-win' situations in the collaboration is essential. Otherwise, there is a chance that actors do not recognize themselves as a 'problem-owner' and are unwilling to participate (Lamers et al., 2010). Ultimately, the number of actors in any collaborative process must be limited in order to keep the process manageable (Driessen & Leroy, 2010).

To overcome the barriers of fragmentation and utilise the opportunities of diversity, clear governance mechanisms are required. These include transparent processes for the allocation of roles, the creation of common objectives, communication and coordination structures (Nguyen et al., 2019). According to Wiering & Immink (2006), it is likely that area-specific cooperation, concerning for instance water management and nature conservation, is especially necessary. The integration of different actors in a specific area result in broader access to types of knowledge, powers, and tools. In this way, the actors and coalitions dimension can become a supporting pillar of SCC implementation.

### **Rules of the game**

The 'rules of the game' determine the development and implementation of SCC, hence identifying barriers and opportunities in this policy dimension is crucial (Wiering & Immink, 2006). In the water sector, utilisation, economic and ecological interests often compete with each other. Water law attempts to mediate between these different demands (UBA, 2022). To highlight the barriers and opportunities for the implementation of the SCC within existing governance arrangements, the legal frameworks of water and construction law are particularly relevant and therefore addressed in this thesis (Nguyen et al., 2019).

An understanding of these two laws is therefore essential in order to highlight barriers and opportunities for the SCC. To ensure legal compliance and unlock potential funding opportunities, the SCC must navigate within these frameworks (Li et al., 2017). However, complex bureaucratic processes make it difficult for actors to navigate the system, leaving them uncertain about compliance and procedural requirements. As a result, there is a tendency to rely on traditional concepts and practices,

as these are perceived as safer and more straightforward due to their well-established legal frameworks (Jordan & Lenschow, 2010; Li et al., 2017). Additionally, do municipal codes often favour grey over green infrastructure (Li et al., 2017). While building law aims to promote urban development, its requirements can sometimes come into conflict with the objectives of the SCC (ibid). This regulatory conflict not only complicates the implementation of the SCC, but also increases the administrative burden for actors and therefore draws on their resources (ibid).

### **Power and resources**

Using the typology of Mees et al. (2017) allows for a categorization of the policy instruments at hand in the existing governance arrangement, which is essential to identify opportunities and overcome institutional barriers.

The main legal instrument for guiding and organising the urban development, through the lens of the SCC, is the urban land-use plan. It is divided into preparatory urban land-use planning (land-use plan for the entire urban area) and binding urban land-use planning (development plans for specific parts of the urban area). While the land use plan is only binding on the authorities, the development plan, as a municipal statute, has legal effect on everyone (City of Oldenburg, n.d.). This is where measures such as green roofs and the drainage concept can be defined. These two instruments are therefore central to the development and implementation of the SCC.

Economic instruments for the SCC are above all subsidies and incentives. By providing financial support for blue and green infrastructure, such as rain gardens, green roofs, and permeable pavements the SCC becomes financially attractive (Nguyen et al., 2019; Li et al., 2017). For more specific cases, smart subsidies can be utilised to support the development in a limited area (Mees et al., 2014). Additionally, tax deductions or favourable loans could enhance the willingness of private investors. The encouragement of PPPs is an important financial pillar for the SCC (Nguyen et al., 2019), as they diversify the SCC's financial base and thus make it more robust.

The major communicative instrument in this category is a public information campaign (Mees et al., 2014). Particularly for the SCC, this is an important instrument, as it has an educational effect and alerts citizens to the threats lurking beneath the surface. It also makes the benefits of the SCC more visible and emphasizes the need for the new concept which could increase the willingness to implement it. Furthermore, by providing education and training enhances public awareness and acceptance of the SCC (Nguyen et al., 2019).

## 2.5 Conceptual framework

The conceptual framework for this thesis is based on the PAA as introduced in the literature review (Chapter 2.3). It allows for an analysis of governance arrangements through the four interdependent dimensions of discourse, actors and coalitions, rules of the game, and power and resources (Wiering & Immink, 2006). These dimensions provide a structured lens to explore how institutional conditions influence the development and implementation of the SCC (Chapter 2.1). Discourse reflects how narratives shape perceptions of water as a resource or hazard, influencing policy priorities. Actors and coalitions examine the involvement of diverse actors and their collaborations, while rules of the game refer to the regulatory frameworks and informal norms that structure decision-making. Lastly, power and resources focus on the distribution of authority, funding, and technical capacity. This integrated

approach captures the complexity of governance. Based on this framework, Table 1 outlines the key aspects of each dimension as they relate to the development and implementation of the SCC.

Table 1. Conceptual framework: governance arrangement dimensions for the development and implementation of the Sponge City Concept (Source: Author).

	<b>Key aspects</b>	<b>References</b>
<b>Discourse</b>	<ul style="list-style-type: none"> <li>Paradigm shift: water as a valuable resource and ecological asset</li> </ul>	(Wiering & Immink, 2006); (Li et al., 2017)
	<ul style="list-style-type: none"> <li>Integrated approach combining blue, green and grey infrastructure</li> </ul>	(Li et al., 2017); (Nguyen et al., 2019); (Chan et al., 2018)
	<ul style="list-style-type: none"> <li>Weak visibility of water management systems (black-boxing effect)</li> </ul>	(Griffiths, 2017)
<b>Actors and coalitions</b>	Broad multi-actor coalition: <ul style="list-style-type: none"> <li>public: municipalities, state government agencies, public corporations</li> <li>private: engineering firms</li> <li>civil: citizen groups</li> </ul>	(Hegger et al., 2012); (Li et al., 2017); (UBA, 2022)
	<ul style="list-style-type: none"> <li>PPPs</li> </ul>	(Liang, 2018); (Mees et al., 2014)
	<ul style="list-style-type: none"> <li>Learning Action Alliances for knowledge sharing and capacity building</li> </ul>	(Hegger et al., 2012)
<b>Rules of the game</b>	<ul style="list-style-type: none"> <li>Adaptive regulatory frameworks to incentivize blue-green infrastructure (BGI)</li> </ul>	(Nguyen et al., 2019); (Tempels, 2022)
	<ul style="list-style-type: none"> <li>Simplified bureaucratic processes</li> </ul>	(Jordan & Lenschow, 2010); (Li et al., 2017)
<b>Power and resources</b>	<ul style="list-style-type: none"> <li>Technical expertise</li> </ul>	(Mees et al., 2014); (Nguyen et al., 2019)
	<ul style="list-style-type: none"> <li>Financial resources</li> </ul>	(Liang, 2018); (Nguyen et al., 2019)
	<ul style="list-style-type: none"> <li>Smart subsidies and funding models</li> </ul>	(Mees et al., 2014); (Nguyen et al., 2019)
	<ul style="list-style-type: none"> <li>Communicative instruments (e.g., public awareness campaigns, education)</li> </ul>	(Mees et al., 2014); (Nguyen et al., 2019)

### 3. Methodology

#### 3.1 Introduction

This thesis is a qualitative single case study designed to understand which institutional conditions promote the development and implementation of the SCC in mid-cities. By investigating the “how” of the implementation process and the specific challenges that arise when applying the SCC in a real-world context, a qualitative case study approach was deemed most appropriate (Yin R. K., 2018). This approach enables an in-depth exploration of governance arrangements, which are complex and highly dependent on their specific institutional and societal context.

The research design is rooted in the governance arrangement concept, which examines discourse, actors and coalitions, rules of the game, and power and resources. This framework provides a structured lens to identify institutional barriers and opportunities for SCC implementation. Figure 6 illustrates how the case study database was developed: first, the theoretical framework provided the foundation for analysing governance arrangements and the SCC concept; second, empirical data was gathered through policy document analysis, media analysis, and semi-structured interviews. This use of multiple data sources represents triangulation ensuring validity and reliability of the findings (Yin R. , 2003). By integrating theoretical insights with empirical research, this methodology supports a comprehensive analysis of governance arrangements and offers practical lessons for mid-sized cities seeking to address complex urban water management challenges.

The following sections present the case study selection and introduction (Section 3.2), describe the data collection methods (Section 3.3), explain the data analysis process (Section 3.4), and address ethical considerations related to the research (Section 3.5). Throughout, particular emphasis is placed on ensuring the reliability and validity of findings through triangulation and the use of a systematic analytical framework.

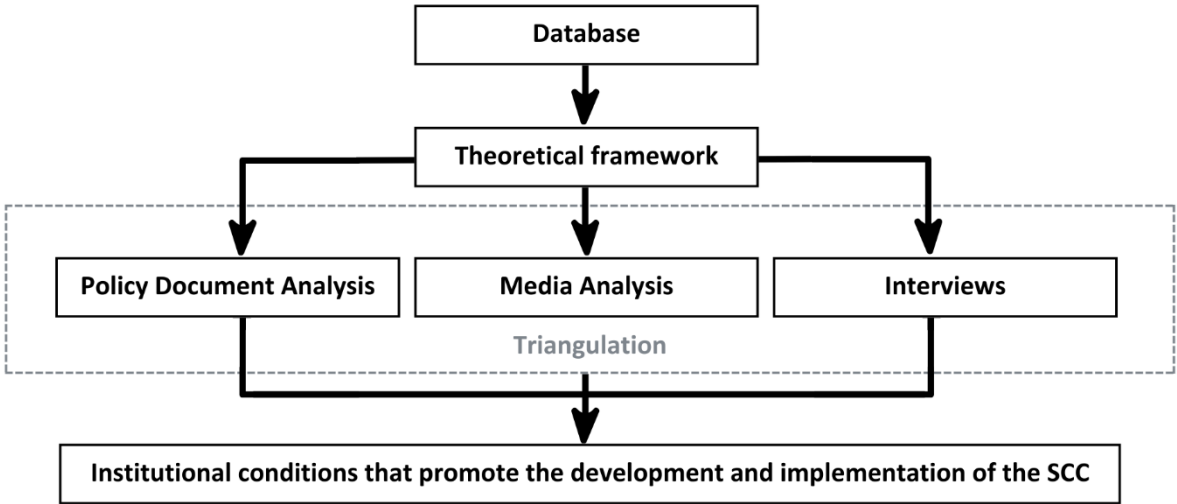


Figure 6. Development of the database for the qualitative case study research (Source: Author).

### 3.2 Case study selection and introduction

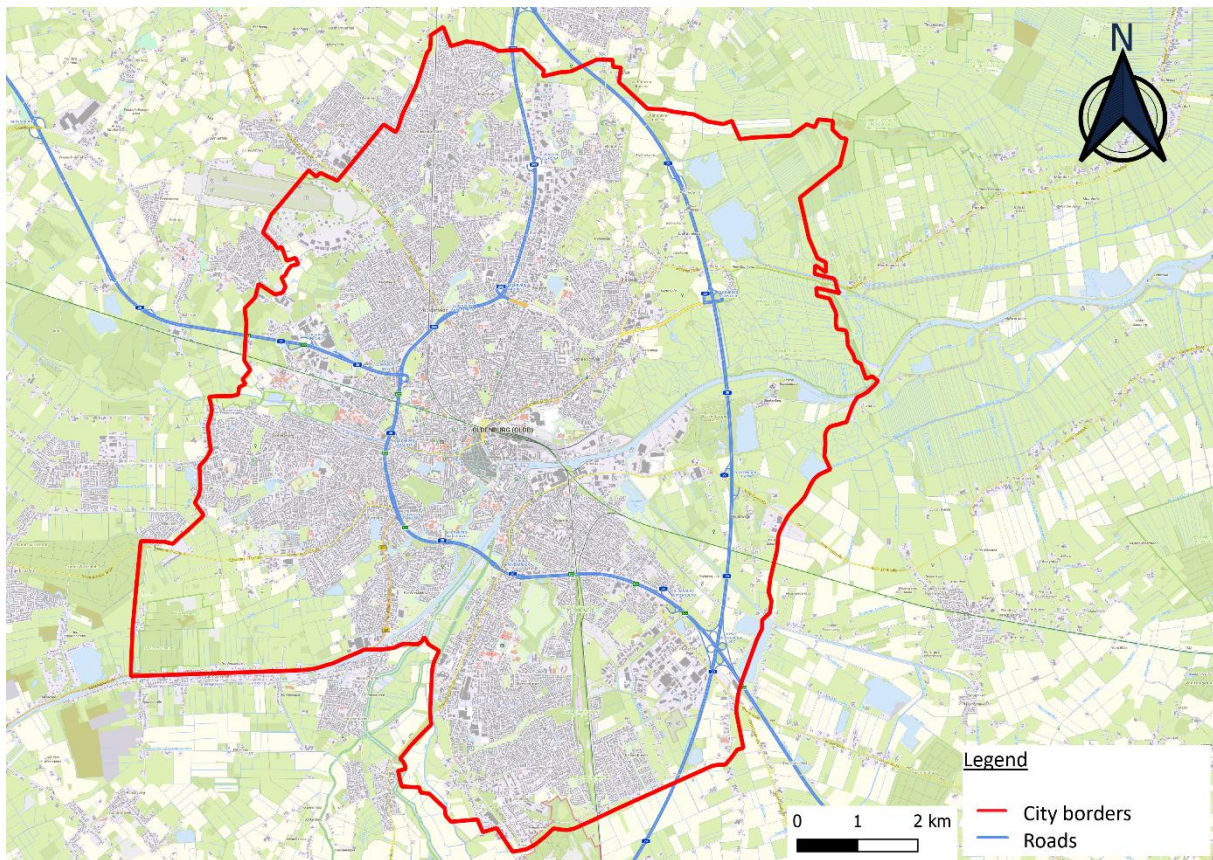


Figure 7. Map of the county free City of Oldenburg 2024 (Source: Author).

The unit of analysis comprises the county-free City of Oldenburg, located in the northern part of Lower Saxony, Germany (Figure 7). It is important to distinguish between the City of Oldenburg and the district (Landkreis) of Oldenburg. While the City of Oldenburg is an independent urban municipality (kreisfreie Stadt) with its own local government, the district of Oldenburg is a separate administrative region that surrounds the city but does not include it. From here on, Oldenburg always refers to the city of Oldenburg, a mid-sized city with a population of approximately 175,000 residents (City of Oldenburg, 2024).

The selection of Oldenburg as the case study was guided by specific criteria: First, the city's recent efforts to implement climate-adaptive measures, including the SCC, made it particularly relevant for studying governance arrangements (City of Oldenburg, 2024). Second, Oldenburg's exposure to extreme weather events since 2018, including droughts and the near-dam failure during the Christmas flood of 2023/24, underscores its urgent need for innovative water management approaches (City of Oldenburg, 2024).

Other mid-sized cities in northern Germany such as Osnabrück or Göttingen, were considered. However, Oldenburg was chosen due to its experience with SCC related projects unique governance challenges: The city is shaped by the interaction of three distinct water systems, the Hunte River, the Haaren River, and the coastal canal (Küstenkanal), as well as the tidal influence of the North Sea (City of Oldenburg, 2024). These multiple, interdependent factors make water management in Oldenburg complex and provide a rich basis for examining institutional barriers and opportunities. Additionally, the diverse water systems offer insights for other mid-sized cities, drawing lessons from those aspects

of Oldenburg's governance arrangements that align with their specific local contexts. The city's role as a pioneer in SCC related projects, combined with its multifaceted water challenges, makes it an exemplary case for studying governance in urban climate adaptation.

### 3.3 Data collection

To examine the existing governance arrangement and SCC implementation in Oldenburg, this study incorporates multiple sources of data (semi-structured interviews, policy document analysis, media analysis) and perspectives from diverse stakeholders, including academia, governmental officials, and private sector. This is crucial because governance arrangements are shaped by the interaction of multiple actors, each with unique perspectives, roles, and influences. Including these perspectives allows for a comprehensive insight into the current governance arrangement within the given context of Oldenburg (Wiering & Immink, 2006).

Data was collected through three separate methods: policy document analysis, media analysis, and semi-structured interviews. This use of multiple data sources, or data triangulation, enhances the construct validity of the case study and "provides multiple measures for the same phenomenon." (Yin, 2018, p. 128). The semi-structured interviews provided valuable qualitative data which, together with the findings from the policy document and media analysis, enabled an understanding of the implementation barriers in Oldenburg and how to address them via adjusting the existing governance arrangements. This triangulation of data ensured that a wide range of actors and perspectives was considered, providing holistic insights into governance in the context of urban water management in light of the Sponge City Concept.

#### **Policy Document Analysis**

Within the policy document analysis key policy documents essential to the Oldenburg context were reviewed. This includes acts, laws and ordinances that apply to the entire nation or federal state, as well as documents that apply to the local context. This includes the statutes of the Oldenburg-East Frisian Water Association (OOWV) and the respective water and soil boards. The considered documents, their date of issue and objectives are presented in Appendix X.

Data collection involved systematically gathering and reviewing policy documents relevant to urban water management and climate adaptation in both Oldenburg, the state and nation. Data collection involved systematically gathering and reviewing policy documents relevant to urban water management and climate adaptation in both Oldenburg, the state, and the nation. Particular emphasis was placed on documents compiled under the umbrella of Water Law (Wasserrecht) by the German Federal Environment Agency (UBA), which includes guidelines and directives addressing water resource protection, flood risk management, and urban adaptation strategies (UBA, 2022). These documents provided a critical legal framework to assess the governance arrangements influencing Sponge City implementation. Additionally, documents from the realm of building law were also reviewed, with particular focus on the Federal Land Utilization Ordinance (Baunutzungsverordnung, BauNVO) as a complement to the Federal Building Code (Baugesetzbuch, BauGB). These documents were reviewed as they are critical to the development and implementation of the SCC. Additionally, documents recommended by interviewees were also incorporated. Additionally, documents recommended by interviewees were also incorporated, including central guiding frameworks in the water sector provided by the German Technical and Scientific Association for Gas and Water and the German



Association for Water, Wastewater and Waste. The collected documents were analyzed with the software Atlas.ti Web to identify recurring patterns in relation to the barriers and opportunities of the SCC within the existing governance arrangement (ATLAS.ti Web, 2024). For this purpose, a codebook was used to categorize the codes into the dimensions of the PAA. It includes deductive codes that were created prior to data collection based on the theoretical framework and inductive codes that evolved from the interview transcripts. The underlying codebook can be found in Appendix X.

### **Media Analysis**

Media analysis is a central instrument in communication and media studies that makes it possible to systematically analyse the content, structures and effects of media communication (Kessler & Wicke, 2023). It offers an objective and comprehensible approach to describing both the content and formal characteristics of messages (ibid). The reporting can also be used to determine how the respective topics are framed in the media landscape (ibid). To gather relevant media articles, online searches were conducted using the database Nexis Uni. The search terms "Sponge City" OR "Schwammstadt" AND Oldenburg in the time period between 2019 and 2024 were applied. Additionally, a manual search for relevant articles was conducted. This process yielded a collection of 30 articles from local newspapers and online news portals (Appendix D).

### **Semi-Structured Interviews**

Semi-structured interviews are a valuable qualitative method, allowing for in-depth insights into subjective perspectives, motivations, and attitudes of participants. They are particularly effective for exploring complex issues and capturing interactions, as they adapt to individual experiences and contexts (Metag & Scheu, 2023). The semi-structured approach provided a general framework for the interview but allowed flexibility depending on the interviewee's responses. This method ensured that key questions were addressed by all interviewees, while respective topics could be further explored based on the interviewee's expertise and knowledge. In order to gain a broad perspective and insights, actors from utility providers, government agencies, water and soil associations and academia (represented by researchers from both Carl von Ossietzky University and Jade University) were interviewed. In addition, representatives of two citizens' associations of particular interest in this case, from the districts of Ofenerdiek and KB, were interviewed to provide a local perspective. Ofenerdiek is particularly hard hit by heavy rainfall and KB is host to Sponge City showcase projects further discussed in chapter 4.3. By including this broad spectrum of actors, the interviews enabled a holistic understanding of the governance arrangements surrounding the City of Oldenburg.

The interviews were organized into five main sections to facilitate a structured yet adaptable dialogue. First, through general questions a baseline of understanding the interviewee's role and perspectives on urban water management and climate adaptation was established. Second, the discourse section focused on the narratives and communication strategies surrounding water management and whenever used the SCC. It focussed on the content of the debate and the way in which actors give meaning to and derive meaning from it (Wiering & Immink, 2006). The third section explored actors and coalitions. This part explored the actors involved in Oldenburg's water management, including their roles, interests, and how/if they collaborate. The division of responsibilities is also discussed at this point. The rules of the game delved into the regulatory frameworks guiding urban water management and whether they enable the SCC. Last, in power and resources, the distribution of resources, decision-making power, and how these elements influence project outcomes were discussed. To ensure transparency and

provide a clear guide for replication of this research method, the interview guide used for the sessions is presented in Appendix X.

Interviews were conducted with 12 actors involved in Oldenburg's water management (Table 2). As it was possible to interview another actor, actors P5 and P6 were interviewed together. The interviews were recorded and transcribed via the TRINT software. To ensure ethical standards, interviewees signed a consent form in German, to be found in the Appendix, agreeing to the recording of the interview, being quoted, and specifying whether they wanted to remain anonymous. In order to provide complete transparency, the translated English version of the consent form can also be found in the Appendix. If anonymity was requested, only the organization would be mentioned. During the course of the thesis, it became clear that presenting results was more effective if all interviewees were referenced solely by their organization. Consequently, all participants were assigned pseudonyms, with their respective organizations mentioned instead (Appendix F). The records were transcribed and imported into Atlas.ti and coded according to the dimensions of the PAA (discourse, actors and collations, rules of the game, and power and resources).

*Table 2. List of interview partners and their organisations.*

<b>Pseudonym</b>	<b>Organisation</b>	<b>Date Group</b>
P1	OOWV	30.05.2024
P2	Jade University of Applied Sciences	10.06.2024
P3	Former OOWV; Sponge City Expert	18.06.2024
P4	City of Oldenburg: Environmental Protection and Building Regulations Office (EBO)	24.06.2024
P5	OOWV	26.06.2024
P6	City Planning Office of Oldenburg	26.06.2024
P7	Carl von Ossietzky University Oldenburg	27.06.2024
P8	Carl von Ossietzky University Oldenburg	04.07.2024
P9	Lower Saxony Water Management, Coastal and Nature Protection Agency (NLWKN)	08.07.2024
P10	Haaren Water Board	17.07.2024
P11	Citizens Association Kreyenbrück/Bümmerstede (KB)	19.07.2024
P12	Citizens Association Ofenerdiek	21.08.2024

### 3.4 Data analysis

The use of different data sources for this thesis of policy document analysis, media analysis, and qualitative interviews, offered different approaches to collect the ultimately always individual experiences through triangulation and thus derive generalisable findings for further development and communication (Gabriel et al., 2023). The triangulation provides a comprehensive understanding of Oldenburg's governance arrangements, identifying institutional conditions in the form of barriers and opportunities critical for SCC implementation and development.

A codebook was developed as the central analysis tool. It combined deductive codes derived from the conceptual framework with inductive codes generated from the data itself. Deductive codes reflected the predefined dimensions of governance arrangements (discourse, actors and coalitions, rules of the game, power and resources). Inductive codes, related to the barriers and opportunities, captured



emergent themes such as the beginning of a paradigm shift and the bureaucratic challenge that emerged during the analysis of the interviews and documents. The coding process itself involved two steps: First, the familiarization with the documents, articles, and interview transcripts were read in detail to gain a holistic understanding of the content. Second, the coding itself. Text segments were assigned codes based on the to policy dimensions. Topics that stood out from the text or were repeatedly addressed in the documents were coded in vivo and later categorised into inductive codes.

Based on the codebook, the policy documents were systematically reviewed to highlight the barriers and opportunities the development and implementation of the SCC, with attention to formal rules, subsidies, and technical guidelines. Media articles were analysed to examine public discourse and framing of climate adaptation and the SCC. This helped uncover societal perceptions, acceptance, and resistance to adaptation measures. The semi-structured interviews provided primary insights into local practices, challenges, and opportunities. Transcripts were analysed using the same codebook, enabling cross-comparison with secondary data sources. Particular attention was given to capturing direct experiences and strategies proposed by practitioners.

Finally and importantly, triangulation was employed to validate findings and enhance robustness. Data from the different sources were compared to identify consistent patterns and contradictions. For example, insights from interviews about challenges in actor coordination were cross-checked with policy documents for evidence of institutional barriers and media articles for public perceptions.

### 3.5 Ethical considerations

According to Yin (2018, p. 88), “nearly all case studies are about human affairs”, which is why there is a high need for protecting human subjects within case studies. In line with this principle, all participants were informed about the research aims, confidentiality, and the participants rights through an information sheet. They provided their consent by signing the form of consent. Both the information sheet and form of consent can be found in the Appendix. The interviews were conducted in German and subsequently transcribed using the software trint (Trint, 2022). Used quotations were translated into English using the software DeepL (DeepL, 2024). Following the interviews, the responses were transcribed and translated into English for analysis. Care was taken to ensure the translations were accurate and preserved the original meanings and tones of the participants' responses. However, it has to be noted that modifications can occur during this process. To address this, the original German quotes, as well as the translated English version are provided in the Appendix.

## 4. Implementation of the SCC in Oldenburg: Institutional barriers and opportunities

In this chapter, the Oldenburg case is first presented in more detail in order to provide a comprehensive understanding of the context. This is essential for analysing the existing governance arrangement in relation to the four policy dimensions. In this way, barriers and opportunities that may enable or hinder Oldenburg's transition to an SCC can be identified. Finally, a reflection on the results and the answers to the research questions can be found in Chapter 5.

### 4.1 Introduction

In order to understand the Oldenburg case, it is first important to explain the following key contextual factors related to the development and implementation of the Sponge City concept in Oldenburg: the roadside ditch system, the existing land-use conflicts and the initial effects of climate change.

Traditional roadside ditches play a central role for Oldenburg's drainage system (City of Oldenburg, 2020). The ditches can hold more water than underground pipes, contribute to rainwater retention and thus reduce the risk of flooding. However, this historically evolved system has been increasingly degraded over the years due to increasing population density, building development and the sealing of surfaces. As P3, formerly OOWV, explains:

“The ditches were created decades ago and this is a drainage culture that suits the region. [...] But over the decades, this system has been destroyed to some extent by the residents, by the high density and by car traffic and parking, which also plays a major role, so that it no longer works.” (P3, 2024).

The ditches also have an image problem and are often perceived as messy and valuable lost land. In many cases they have been piped and sealed, reducing their effectiveness. P4 from the EBO emphasizes that efforts are being made to stop this development: “Open systems that we have, roadside ditches in particular, remain open. [...] The absolute priority is the preservation of open waters.” (P4, 2024). Despite these challenges, it is crucial for the city to maintain these open systems.

Land-use conflicts have multiple facets, with densification playing a major role in Oldenburg. Former large plots of land with single-family homes are increasingly being divided into several residential units in order to meet the growing demand for construction land, resulting in the sealing of surfaces. Historically, these plots provided infiltration, natural cooling, and supported biodiversity. However, the increasing caused the loss of these benefits. Decreasing infiltration also increases the pressure on the drainage system, which leads to water backing up during heavy rainfall. The historic city centre, with its mixed water system, is particularly at risk. P4 from the EBO explains, that there is a depression in the area of a main road which already overflows during 30-year events. To mitigate this, a traffic guidance system as part of the EU Interreg CATCH project was implemented (City of Oldenburg, 2023). P4 from the EBO adds: “We installed [...] warning signs that automatically come on and divert traffic so that cars, cyclists, and pedestrians don't have to drive through mixed water.” (P4, 2024). While this helps manage the issue, it does not solve the underlying problem. Particularly pronounced is the densification in the Ofenerdiek district, leading to more regular floods (City of Oldenburg, n.d). P12 from the Ofenerdiek citizens' association explains that adjustments at a later date are hardly possible: “Retrofitting [...] can sometimes be very difficult, especially in areas with background development where large excavators can no longer access the site.” (P12, 2024). Figure 8 illustrates the densification of the district Ofenerdiek in the past decades. Moreover, costs of implementing new concepts such as

the SCC play a key role, with P11 from the KB citizens association stating, “It is already almost impossible for families to build a house” (P11, 2024).



Figure 8. Left: Aerial view of Ofenerdiek from 1952 with sparse settlement in the area of Ofenerdieker Str./ Neu-südender Weg. Right: Current image of the district, from Langenweg with the “Swarte-Moor-See”, date unknown (Ofenerdiek Citizens' Association, n.d.).

Additionally, climate change has now noticeably arrived in Oldenburg. P9 from the NLWKN described this as follows:

“We have been dealing with the effects of climate change. This was particularly pronounced in 2018 and 2019, when many people first realized that something was happening. Although scientists have been warning us for 20 or 30 years, it is only now that the water management problems of climate change have become tangible. [...] The municipal levels are particularly affected, as they are having to contend with considerably heavy, locally very limited precipitation events, as well as increasingly dry months.” (P9, 2024).

Therefore, Oldenburg's water sector is facing new challenges to which the SCC presents a promising solution, as Oldenburg already green infrastructures being a garden city (City of Oldenburg, 2024). However, for Oldenburg to transition to the SCC the barriers and opportunities of the existing governance arrangement must be identified. Therefore, in the remainder of this chapter, the four dimensions of discourse, coalition of actors, rules of the game, and power and resources are analysed. Starting with the actors and coalitions dimension in order to lay out the dominant actors who are relevant for the rest of the thesis.

## 4.2 Actors and Coalitions: Dynamics in Oldenburg's water management

In Table 3 actors involved in Oldenburg's water management coalition are presented. In what follows, an overview of the roles and responsibilities of each actor involved in Oldenburg's water management is presented. Subsequently, the barriers of fragmentation and collaboration, as well as unclear distribution of responsibilities are outlined.

### **Oldenburg's water management coalition**

Oldenburg's dominant water management coalition comprises a large number of public and private actors. This results in a fragmented structure that is difficult to coordinate as well as to unclear distribution of responsibilities for the public.

Table 3. Dominant coalition of actors in Oldenburg's water sector.

Actors	Responsibilities
City of Oldenburg	Regulatory authority
NLWKN	Expert and advisory function for water management, coastal defence and nature conservation
OOWV	Since 2001, responsible for waste water disposal in Oldenburg
VWG Ltd.	Holds drinking water concession; responsible for drinking water supply
Ewe Netz Ltd.	Operational drinking water management on behalf of the VWG
Water and soil associations:	Responsible for maintenance of watercourses in Oldenburg (Haaren, Hunte, Wüstring, Moorriem-Ohmsteder Siel)
Citizens associations	16 citizens associations in Oldenburg; represent the interests of citizens
Monument preservation	Preserv listed landmarks

The city administration of the City of Oldenburg is divided into four departments, with their own offices and specialist services (City of Oldenburg, 2024). The lower water authority is part of the Department for Building, Environment and Transport and the EBO. It is responsible for licensing matters relating to water protection and water usage. Its main task is to monitor surface waters and groundwater and to ensure compliance with legal regulations (City of Oldenburg, 2024). Here, the NLWKN state authority for safe dykes, clean water and the preservation of biodiversity, is acting in an advisory function.

Water and soil associations are responsible for the maintenance of water bodies, the construction and maintenance of facilities in and around water bodies, as well as the protection of properties from flooding (Federal Office of Justice, 1991). Water associations are entities under public law and are therefore not profit-orientated. In Oldenburg, four different associations (Haaren, Hunte, Wüstring, and Moorriem-Ohmsteder Siel water and soil association) are responsible for water maintenance, each having different budgets based on the size of the association area and the type of usage of the area. Meaning that, although these associations have the same objectives, they have different resources at their disposal. Since 2001, the OOWV has been responsible for managing Oldenburg's surface drainage system, including sewage and rainwater. As a public entity, the OOWV also operates on a non-profit basis. The OOWV's objectives, relevant to Oldenburg, include legally mandated wastewater disposal, provided this responsibility is assigned by its members. Additionally, the OOWV is tasked with constructing, expanding, and maintaining water bodies and related facilities. Protecting groundwater is another key focus, alongside managing areas, facilities, and water bodies to safeguard the natural ecosystem (OOWV, 2023). The drinking water supply concession is held by the Transport and Water Ltd (VWG). The VWG has commissioned operational management to the EWE NETZ Ltd. For this purpose, Oldenburg has three waterworks extracting drinking water entirely from groundwater (EWE Netz, n.d.). Also, part of the coalition are Oldenburg's 16 civic associations. These represent the general interests of the citizens (ASTOB, n.d.). This study focuses on the KB and Ofenerdiek citizens association, as the KB citizens association is home to several showcase projects for the SCC (Gloger, 2019), and the Ofenerdiek citizens association is experiencing increased flooding (City of Oldenburg, n.d.). Finally, monument protection also plays a major role as parts of the main watercourses of the Hunte and Haaren are under monument protection and must therefore be preserved in their existing form (City of Oldenburg, n.d.).

## **Fragmentation and collaboration**

As established, Oldenburg's water sector comprises numerous actors that, each with individual objectives. P2 from the Jade University sector describes this as follows:

“There are many different actors who have different objectives and try to achieve these objectives predominantly on a sectoral basis. [...] They know each other and are in dialogue, but there is no one organization that is responsible for water management as a whole.” (P2, 2024).

This fragmentation also limits communication between actors, leaving them unaware of each other's activities and passing up on opportunities. Although this fragmentation was introduced in order to do justice to the complexity of the water sector, it results in actors, each pursuing their own objectives, being insufficiently coordinated. P2 goes on to describe this as a barrier to the SCC:

“The objectives are to achieve these individual sectoral objectives. If possible, without harming others in any way or disadvantaging the other objectives. But there is no integrative approach to these individual objectives. In this respect, there are many, many sub-goals that we are trying to achieve. But there is no overall optimization, so to speak.” (P2, 2024).

P2, from the Jade University emphasizes the critical need to address this fragmentation: “I think that really is the main challenge. The knowledge is there, but it's fragmented in different places. We have to bring it together and we have to set off together.” (P2, 2024).

This fragmentation creates an additional barrier for the SCC, as it also complicates collaboration among actors. Currently collaborations and communication is based on a pure needs-basis. “If problems arise, there is a brief telephone contact. The problem is discussed. It is usually solved immediately.” states P4 from the EBO. While this approach has worked so far, Oldenburg is missing out on opportunities as actors are not aware if potential possibilities arise. Occasionally, there are collaborations, mostly between the OOWV and the city of Oldenburg or resident universities. The research projects “Water Laboratory of the Future” and “WISdoM 2.0” exemplify successful cooperation between the OOWV and the Carl von Ossietzky University (OOWV, n.d.); but such collaborations are for the most part limited to the research sector and organized independently by the actors. Therefore, collaborations depend on the willingness and social compatibility of the participants (Brown et al., 2019).

Aside from the research sector, collaborations pose a challenge, as actors additionally organize themselves independently which results in different administrative structures. In some cases, the structures are too different from one another to collaborate. This is also the case for interregional cooperation between the administrative districts, putting Oldenburg in an insular position. P1 from the public sector used the drinking water supply to describe the situation in Oldenburg:

“Oldenburg has the problem that the water supply in the city has a kind of insular situation. The three VWG waterworks are not very well connected to each other and are not networked at all with the pipeline system of the surrounding water suppliers. [...] This means that if one waterwork fails, this can relatively quickly lead to the overall water supply in the city collapsing.” (P1, 2024).

The fragmentation of the water sector and the sole dependence of collaborations on the willingness of actors is a barrier to the implementation of the SCC.

## **Distribution of responsibilities**

The unclear distribution of responsibilities in the water sector is a diverse problem. Overlapping responsibilities and a resistance to take responsibility in the public are contributing to this barrier.

Overlapping responsibilities are the result of multiple actors pursuing different objectives in the same area. P10 from the Haaren water and soil association, explains that the Haaren River in the city centre is listed as a historical monument, necessitating its preservation in its current state, while the water and soil board is also tasked with maintaining the river according to their statutes. In this case, the actors must find common solutions despite differing objectives and resources, and once a solution has been found, funds for financing must be found, also in case of repairs. P10 from the Haaren water and soil association elaborates: “When damages occur, who has to take care of it? We always point out that it was not built as planned. And if damages occur, then the actor who wanted it that way has to pay for it.” (P10, 2024).

Furthermore, especially the responsibilities for roadside ditches are not transparent to the public. Roadside ditches are water bodies of the third order and must therefore be maintained by the owner. However, the owner can be a water and soil association, the city or a private owner. In some cases, the boundary between two properties also runs across such a ditch, which means that two or more parties are responsible for its maintenance. P10 from the Haaren water and soil association explains:

“Roadside ditches are often tricky... The riparian owner usually thinks that it belongs to the road, so the local authority must take care of it. But it may well be that at least half of the roadside ditch belongs to the private property and then the private party must maintain the ditch.” (P10, 2024).

Another issue is the resistance to take responsibility in the public. P2 from the Jade University explains: “I am responsible for protecting my property to a certain extent and if I have a lowered entrance, then it will leak inside. [...] It's my own fault. And I don't think many people realize that this is the case.” (P2, 2024). Through the ‘black boxing’ of water management, citizens have come to expect uninterrupted service without needing to contribute actively or accept higher service costs. On the rare occasions when issues arise that are perceived by the public, responsibility is quickly attributed to the city or the OOWV, rather than prompting a broader discussion on shared responsibility or investments. P2 from the Jade University states: “When it comes to water, everyone points to the OOWV and says, that it is the expert in the city. They ought to do something.”, and goes on to point out: “As German citizens, we always like to point out: 'the city has to do this' and 'we pay for it' and 'why don't they do it?’” (P2, 2024). This resistance to take responsibility and the resulting displacement of responsibility is illustrated by P4 from the EBO:

“Everyone always relies on the other, saying 'I am not to blame' and points to the other, who is certainly not to blame. [...] I don't know what else needs to happen for people to get a feeling for doing something themselves or having to do something themselves.” (P4, 2024).

The combination of these issues of unclear responsibilities and resistance to take responsibility present a barrier to the development and implementation of the SCC

### 4.3 A changing policy discourse

The policy discourse in Oldenburg is currently centred around a paradigm shift, evidenced through various showcase projects. This shift involves moving away from traditional approaches centred solely on drainage and flood protection to addressing emerging challenges such as drought and UHIs. However, barriers and opportunities within the discourse enable or hinder this transition of Oldenburg to the SCC. In the following sections, the beginning paradigm shift in Oldenburg is outlined, and the showcase projects paving the way for Oldenburg’s transition into a Sponge City are presented.

## Oldenburg as a Sponge City?

Traditionally, water management in Oldenburg focused on drainage and flood protection, which are deeply embedded in the region's water management culture. P11 from the KB citizens association explains: "For decades or perhaps even centuries [...], it was always about drainage. Today, however, we need to consider not just drainage but also how we can repurpose our infrastructure to retain and even irrigate when needed." (P11, 2024). This focus is especially reflected in the water and soil associations, also referred to as 'drainage associations. P3, formerly OOWV, describes their deeply ingrained mindset as follows: "In a way, water drainage is in their DNA. [...] For decades, it was really only ever about drainage without causing damage. That is their core competence and their main task." (P3, 2024). The city's water infrastructure, such as the Hunte barrage and Haaren-Siel sluice, reflects this traditional emphasis, as it was designed to regulate water levels and prevent flooding. However, looking beyond drainage and flood protection, P4 from EBO emphasises that these infrastructures need to be adapted: "Many 'Siel structures' that discharge rainwater into the Hunte, can only drain but not irrigate." (P4, 2024). To be future-proof, these systems must be updated, "So that water management is not just a word but is actively lived by switching the pumps in the other direction." (P4, 2024).

First signs of this paradigm shift are becoming evident. Water and soil associations for instance are increasingly recognizing the need for a more comprehensive approach. P4 from the EBO notes, "The water boards have long since realized that this [drainage] is no longer the last word of wisdom." This reorientation is also reflected in broader societal changes. P1 from the OOWV observes, "I think people have realized that this self-evidence, especially here in the northwest, that we always have water and sometimes we have too much water, can also turn into the opposite" (P1, 2024). Despite these changes, the urban water cycle in Oldenburg remains largely invisible to the public (black-boxing). P2 from the Jade University explains that the system has functioned reliably for so long that it is often just taken for granted: "People still rely too much on the technical things that supposedly worked well in the past." (P2, 2024). The SCC represents a promising concept to trigger this paradigm shift in practice, as it entails a comprehensive approach including water surpluses and shortages. But despite the shift in norms and objectives, there remains a lack of a strategy to develop and implement the SCC.

Although the city administration of Oldenburg has issued numerous strategic master plans, none specifically address water management. Parts of the Oldenburg 2035 climate protection plan and the Urban Green Master Plan could be utilized to facilitate the development and implementation of the SCC, but neither provides a coherent strategy that can be used as a guideline for actors. There is, for example, the Local adaptation to climate change paper, which deals specifically with the implementation of the SCC in the local context (Vetter et al., 2024), as well as the referring to the SCC (BMVU, 2024); however, just as the Oldenburg 2035 Climate Protection Plan, National Water Strategy was not mentioned by any interviewee and is therefore not part of the discourse in Oldenburg, limiting its effectiveness in driving a paradigm shift. Among the Master Plans relating to the SCC, only the Urban Green Master Plan was briefly mentioned by interviewee P5 from the Urban Planning Office, underscoring its marginal role in the current discourse. P2 from the Jade University concludes that: "There is no overarching objective, no overarching strategy." (P2, 2024). P9 outlines why this is a barrier for the development and implementation of the SCC:

"If I don't raise this issue high in the administration and make it an issue of urban development [...], if I don't do that, then I'm not anchoring it in the administration and in city politics. [...] The issue needs to be higher up on the agenda." (P9, 2024).

Looking for an overarching strategy, P2 from the Jade University refers to the Netherlands as leading by example in water management strategies. These countries have the necessary political will to give such a strategy the required backing (P2):

“There is a strategy behind it and there is the political will to implement it. In other words, top-down, yes, we want that. We want to become resilient. We want to work in a climate-adapted way, we want to invest in it.” (P2, 2024).

The beginning paradigm shift in Oldenburg’s water management represents an opportunity to push the transition to the SCC, but the lack of an overarching strategy represents a barrier.

### **Focus on showcase projects**

The onset of this paradigm shift in Oldenburg's water management can be observed in its showcase projects. Especially since 2018, this shift has begun, as P3, formerly OOWV, points out: “Everything changed a bit in 2018 due to the long drought. People have since looked at things differently than before. The focus is no longer so much on drainage, but also on retention and the availability of water.” (P3, 2024). By examining these showcase projects at the Kreyenbrück district, the former military airbase, and the Climate Oases, it can be analysed how actors give meaning to and derive meaning from the content.

The Kreyenbrück district is a showcase project for Oldenburg in terms of the SCC, highlighting the ongoing paradigm shift. In Article 26 it is stated that in order to ensure future drainage continues as effectively as it has in the past in the district: “Efforts are underway to turn this district into a large sponge.” (Gloger, 2019). To achieve this the OOWV launched two pilot projects in the district: The Klingenbergplatz project and the MediTech Oldenburg (MTO). At the Klingenbergplatz a subsoil water storage system, storing excess rainwater on-site, was installed. The redevelopment of the MTO, the former AEG company site which today is industrial wasteland is to be transformed into a new urban district that aims to provide space for facilities and equipment for medical technology and hospital-related uses (Figure 9) (City of Oldenburg, 2024). The land-use plan of the site stipulates to incorporate multiple measures from the SCC, such as green roofs, integrating existing greenery, and renaturing the Krusenbusch watercourse. The construction of a rainwater retention basin in the district further supports water storage on-site (City of Oldenburg, 2020). A statement from article 23 explains how the SCC is implemented in this project:

“The so-called “SCC” is also being consistently continued. A large proportion of the rainwater from the road surfaces will infiltrate laterally into open swales. At the rainwater retention basin, native shrubs and vegetation on the ground and in the basin ensure that water is absorbed and stored like a sponge.” (Husmann, AEG-site turns into a Sponge City, 2020).





Figure 9. Views and planning MediTech Oldenburg. Photo: City of Oldenburg (City of Oldenburg, 2023).

The second showcase project is the former Oldenburger military airbase 'Fliegerhorst' (Figure 10). The Master Plan for the redevelopment of this area dedicates a section solely on water management. The transformation of the area into a district uses SSC measures. According to the City of Oldenburg, this approach is driven by the growing importance of water management in addressing the challenges posed by climate change (City of Oldenburg, 2023). This project uses multifunctional areas for rain retention purposes which are still rather alien to the German planning culture (UBA, 2019), but essential to the SCC. In article 27 it states that: "Public meeting spaces, such as barbecue areas or football pitches, are placed lower than the surrounding area", and thus used as potential retention areas during heavy rainfall events (Brockmeyer, 2023). The Master Plan was developed through a participatory process and includes additional SCC measures such as rainwater collection measures, and green roofs (City of Oldenburg, 2023; City of Oldenburg, 2016).

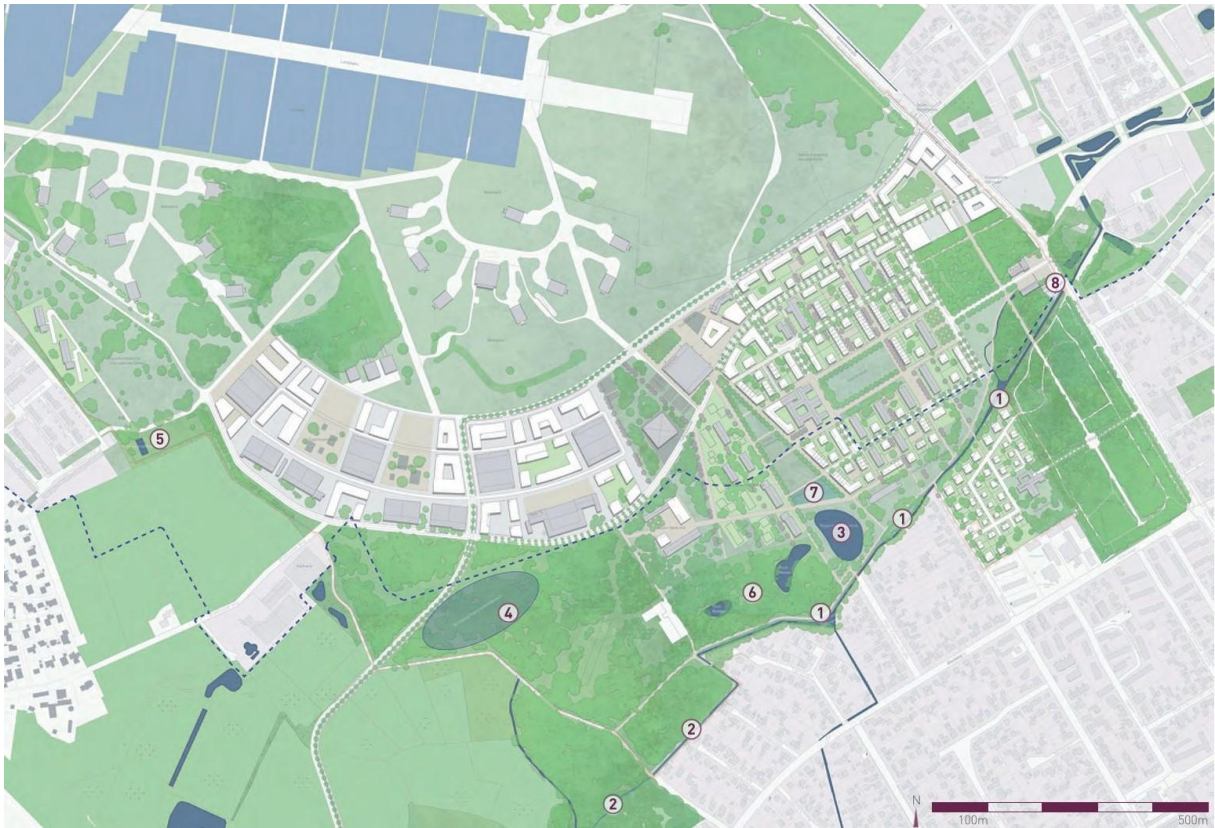


Figure 10. Plan drawing of the Master Plan 'Fliegerhorst' (City of Oldenburg, 2023)

Third, the two urban gardens 'Eversten Holz' and 'Schlossgarten' remains of the garden city are regarded as the 'green lungs' of Oldenburg and represent the project 'Climate Oases' Oldenburg (City of Oldenburg, 2024; State Museum of Nature and Man Oldenburg, n.d.). The project aims to future-proof these urban gardens for impacts from climate change by 2050. A key objective is to implement the SCC by integrating water retention and evapotranspiration measures to mitigate the UHI. These measures include restructuring drainage systems and installing floating islands to enhance water storage and biodiversity. Environmental education programs are also part of the initiative to engage the community in climate adaptation (State Museum of Nature and Man Oldenburg, n.d.).

While the onset of the paradigm shift in Oldenburg through these showcase projects represent an opportunity to transition to an SCC, an upscaling of such showcase projects is not in sight. P3, formerly OOWV, claims, "There is a lack of [...] large-scale implementation. And that is why, unfortunately, it remains a case of individual pilot or showcase projects. Because the obstacles are there, both in people's minds and in bureaucracy." (P3, 2024). Article 29 even goes so far as to state:

"But all this is just damage control," says Hövel. Sealed soil remains sealed. If Oldenburg is to become a sponge city that makes good use of water resources in the long term, then, according to Hövel, it is up to each and every one of us." (Hausmann, 2022).

Together, the showcase projects and the paradigm shift highlight present an opportunity for the development and implementation of the SCC in Oldenburg. These projects provide concrete, tangible examples of how the SCC functions and can be implemented locally. However, the lack of an overarching strategy is a clear barrier.

#### 4.4 Oldenburg's rules of the game

The rules of the game in Oldenburg revolve primarily around water and construction law, as these two are essential for the SCC. Central barrier to in this dimension is primarily reflected in the form of a bureaucracy challenge. An opportunity however represents the adapting water policies.

##### **Water and construction law**

According to the Federal Environment Agency, water law is the sum of all regulations that serve to protect water and regulates the sustainable management of water bodies (Federal Environment Agency, 2022). In Germany, water law is subject to federalism. Political responsibilities are therefore divided between the federal government and the federal states. Legislation is organised in a concurrent manner in which the federal states can make regulations as long as the federal government does not enact any laws to the contrary (Federal Environment Agency, 2022). This structure intends to provide each aspect of the water cycle with the appropriate attention in order to create tailor-made solutions. In this respect, water law is divided into state, national, EU and international levels. At the EU level, the Water Framework Directive is a strong regularity that sets guidelines and minimum standards for the member states. Their implementation is a central component of the German Water Resources Act, the Surface Water Ordinance and the Groundwater Ordinance (UBA, 2022). In Germany, at national level the federal law focuses on the Water Resource Act. It states water management regulations while allowing for regional differences by providing flexibility clauses for the states. Each state supplements the federal law with its own ordinance in the field of water supply, wastewater disposal and flood protection (UBA, 2022). At state level the Lower-Saxony Water Resource Act divides surface waters into three categories: I. order water bodies are those of considerable importance for water management. II. order water bodies those of supra-local importance for the area of a water and soil association, and III. order water bodies are defined as not waters of the I. or II. order (Lower Saxony Ministry for the Environment, Energy and Climate Protection, n.d.). Regulations specific to the regional context are, therefore, provided by the statutes water and soil associations that manage II. and, where applicable, III. order water bodies and the OOWV. This distinction, between II. and III. order, is particularly important for the SCC, as the Order of the water body determines the responsible actor. Due to the integrative nature of the SCC and the close links with water legislation, it is also essential that the Waste Water Charges Act and the corresponding Ordinance, the Federal Nature Conservation Act, the Soil Protection Act, the Federal Waterways Act and the Inland Waterways Act are taken into account when looking at the barriers and opportunities for developing and implementing the SCC.

According to the Federal Environment Agency, comprehensive water protection is no longer feasible at national level alone (Federal Environment Agency, 2022). Issues can only be resolved by coordinating measures at European and international level. Therefore, at international level, treaties promote transboundary cooperation in the management of shared resources that are important for environmental stability and public health (Federal Environment Agency, 2022).

Central guiding frameworks in the water sector are provided by the associations of the German Technical and Scientific Association for Gas and Water (DVGW) and the German Association for Water, Wastewater and Waste (DWA). The DVGW is the recognized standard-setting body for the gas and water industries, providing guidelines on the quality and safety of drinking water (DVWG, n.d.). The DWA is a politically and economically independent association that draws up regulations for wastewater technology and water management (DWA, n.d.).

In building law, which is also federally structured, the Building Code and the Building Utilisation Ordinance are particularly relevant. The Federal Building Code is the fundamental law governing construction planning. It regulates urban land-use planning and provides the legal framework for urban development. The Federal Land Utilization Ordinance complements the Federal Building Code and specifies its requirements (City of Oldenburg, n.d.). In particular, it regulates the type and extent of the structural use of land within residential areas, therefore of high relevance to the SCC.

### **The bureaucracy challenge**

As established in the previous section, numerous laws, ordinances, and guidelines could theoretically support the development and implementation of the SCC in Oldenburg. Accordingly, actors concur that a sufficient legal framework is in place to enable the SCC, but there is a lack of incentive to actually do it. P2 from the Jade University states: "In principle, the structures are there if they were applied well. The guidelines to think more in terms of the Sponge City and also to implement things. But we have to do it." (P2, 2024). P3, formerly OOWV, further clarifies that while the existing regulations do not oppose the SCC, they also do not actively promote it:

"I would say not against but also not in favour, not really in favour of it. If a drainage concept is drawn up accordingly, with all the possibilities that the Sponge City offers, then the lower water authority will certainly not say we won't do it." (P3, 2024).

Additional regulations were more so perceived as hindering the SCC, as P2 from the Jade University states: "The more regulations you impose, the more difficult it becomes. In this respect, I believe that overall, this is also an important braking factor." (P2, 2024). P9 from the NLWKN agrees and points out that additional regulations are not the decisive means and that the prevailing governance arrangement leaves enough room for innovative concepts such as the SCC: "The key is what you make of it. And laws always have leeway and administrative regulations always have leeway. In my opinion, it's all down to the willingness to overcome supposed obstacles." (P9, 2024).

P10 from the Haaren water and soil association points out that bureaucracy also uses up valuable time and resources needed to navigate the administrative process: "It consumes resources and costs time. And you produce lots and lots of paper, but nothing is implemented." (P10, 2024). P10 goes on to explain that proactive efforts to move towards the SCC are discouraged by the complexity of the bureaucracy: "You have to put in an incredible amount of effort if you want to do something in that field. And there are more and more guidelines and laws that have to be observed and implemented." (P10, 2024). P2 from Jade University believes that this leads to many resources not being utilised because applying for and managing these funds is too cumbersome: "There are many resources that we don't use because it's exhausting to apply for them, manage the funds, and adhere to EU-level rules. Instead, we just say, 'It's too much effort; things have worked fine as they are.'" (P2, 2024).

Additionally, the pace of change was criticized as too slow. P12 from the Ofenerdiek citizens association explains, "In the past, building permits provided for very tight development and encouraged sealing. Only now, in recent years, have the individual building areas been looked at again in detail and rededicated to meet the new requirements." (P12, 2024). While this shift is underway, it is a lengthy process. "It doesn't happen that quickly, it takes a long time, and in the meantime, new buildings are built that are eligible under the old building regulations, but would not be under the new ones." This means that developers, building under old but still valid regulations, shape the cityscape with lasting impact.

Furthermore, the financing of projects for new concepts such as the SCC depends heavily on the compliance with according directives. Consequently, delays in revising directives can lead to regulatory stagnation. This is currently the case for the inland flood protection directive. The former directive has expired, and a new one is not being revised. P10 from the Haaren water and soil association explains that actors have been waiting for it since the beginning of the year 2024: “The funds are there, but the directive is not being revised accordingly. And everything is waiting for this to happen and to be able to apply for funds.” (P10, 2024). This delay has put many projects on hold, affecting not only the measures themselves but also the companies commissioned with the implementation, creating a scenario where those companies face work shortages: “And next year, maybe the directive will be there but then there will be much more work than there are companies and you won't be able to implement anything at all and all.” (P10, 2024) In summation the bureaucracy challenge represents a barrier to the SCC.

### **Adapting water policies**

The paradigm shift described in chapter 4.2 is also gradually becoming evident in the regulatory framework for water. P9 from the NLWKN believes that, driven by the tangible impacts of climate change, water regulations are changing, “I think that we are currently on the brink of a paradigm shift in water management, on both the municipal and the state level.” (P9, 2024) According to P3, formerly OOWV, one example of such a regulatory framework is the updated DWA 102 guideline and explains (DWA, 2020), “The DWA 102, which is relatively new, is a bit of a paradigm shift that has now been incorporated into a set of regulations and is therefore state of the art.” (P3, 2024). P3 also emphasized that these changes have also reached the administration in Oldenburg, for example with regard to the rainwater retention basins:

“If we say that retention basins need to be built, that is immediately accepted. But then they also say it has to be semi-natural, with shallow slopes and correspondingly large. These demands are not only coming from us now, but also from the nature conservation authority and the lower water authority.” (P3,2024).

These adapting water policies represent an opportunity for the SCC to be developed and implemented.

### 4.5 Power and resources

Oldenburg has already plenty of resources that can be utilized to enable the development and implementation of the SCC. In the following, the existing policy instruments are being presented according to the typology of Mees et al. (2014)(Table 4). All of these tools represent opportunities to enable the implementation and development of SCC.



Table 4. Oldenburg’s policy instruments that can be utilized for the SCC based on typology from (Mees et al., 2014).

Type of Instrument	Hierarchical (public) governance	Interactive governance	Market (private) governance
Legal Instruments	Land-use plan, e.g., zoning for green spaces and infiltration areas		
Economic Instruments	Subsidies for greening and climate protection projects and (e.g., funding programs for green roofs and facade greening)	Smart subsidies, e.g., funding program for Ofenerdiek (rainwater storage tanks and surface unsealing)	Reduction of the precipitation fee (for properties with rainwater infiltration systems)
Communicative Instruments	Information campaigns on the importance of the urban green, and water management (e.g. climate bike tour and climate treasure hunt)	Educational partnerships (workshops and seminars with Jade University, University Oldenburg, and OOWV); AI-controlled early warning systems	Smart product information in form of apps for private households (e.g., b:rain Tank app by OOWV)

### Legal instruments

The land-use plan presents the major legal instrument in Oldenburg’s governance arrangement. This instrument allows for precise specifications regarding land-use and applicable construction requirements. The land-use plan can therefore push measures, such as green roofs and special requirements for rainwater management. This way the urban development and construction process can be anchored in urban development and construction process from the start of a project and thus have long-term effects on the city Oldenburg. According to P5 from the Urban Planning Office, there was momentum in Oldenburg from the ‘Fridays for Future’ movement, which ensured that standard stipulations made in the land-use plan were expanded to “include a very broad range of ecological and climate stipulations.” (P5, 2024). P5 further explains: “When we draw up new development plans or revise existing development plans, it is now standard practice to always include green roofs, pervious paving or various other measures.” (P5, 2024). This provides the urban planners in Oldenburg with a valuable tool: “We no longer have to discuss things individually with each investor or owner.” (P5, 2024), clarifies P5 from the Urban Planning Office. This integration of ecological and climate stipulations into the land-use plan exemplifies a hierarchical (public) governance approach, as it relies on top-down regulations and binding legal frameworks established by public authorities to steer urban development and enforce compliance with sustainability goals (Mees et al., 2014). The land-use plan therefore represents a valuable opportunity for the SCC.

## Economic instruments

Subsidies and funds are one of the main economic instruments within Oldenburg's governance arrangement. The city offers five distinct funding programs that can be utilized for the SCC. The VWG also provides a subsidy specifically for cisterns (Table 5).

Table 5. Oldenburg's funding programmes that could support the implementation of the SCC.

Funding Program	Provided by	Description	Max. Subsidy
Everyone for Climate	City of Oldenburg	To promote climate protection projects.	7,500 €
Rain water storage tanks in Ofenerdiek	City of Oldenburg	Promotes installation of rainwater storage tanks.	50-100€
Surface Unsealing in Ofenerdiek	City of Oldenburg	Promotes the unsealing of surfaces.	100-1000€
Green Roof funding program	City of Oldenburg	To promote green roofs on new and existing buildings.	20,000€
Façade Greening program	City of Oldenburg	To promote soil-bound and wall-bound facade greening with a contiguous green area.	25,000€
Cisterns subsidy	VWG	To conserve high-quality drinking water.	2000€

However, these funds are a voluntary service provided by the City of Oldenburg. There is no entitlement to a grant. The City Council decides annually on the total amount of funding available (City Of Oldenburg, 2022). P2 from the Jade University describes the funding programs as follows:

“There are funding programs from the City of Oldenburg for unsealing surfaces, for the conversion of areas. However, in my opinion, these are not attractive enough for many citizens to take advantage of them. There should certainly be done more.” (P2, 2024).

To encourage the implementation of green roofs, Oldenburg has established a dedicated funding program aimed at supporting property owners in transforming their rooftops. By transforming roofs into green roofs, they add to the storage and retention capacity of rainwater without taking up extra space. According to the article 31 the implementation of green roofs is a large resource for Oldenburg (Husmann, 2020). P3, formerly OOWV, reflects on the programs with regard to the municipal budget: “Green roofs are funded. But this is again a strain on the municipal budget. [...] So the city often shows good will.” (P3, 2024). The subsidies for roof, façade greening and climate protection projects reflect a hierarchical governance type, as they are initiated and regulated by public authorities to promote sustainable urban development through financial incentives that align with city-wide goals (Mees et al., 2014). However, P3 formerly OOWV and P5 from the Urban Planning Office agree, that overall, these funds are not sufficient to enable the entire transition to the SCC: “This is just a drop in the ocean.” (P2, 2024).

As one of the most severely affected districts, the smart subsidies for the Ofenerdiek district are aimed at improving rainwater storage on-site and promoting the unsealing of surfaces. P12 from the Ofenerdiek citizens' association, views this funding positively: “There are attempts to promote the purchase of a rain barrel or rainwater retention measures such as cisterns with the help of incentives

and funding incentives. That's great, that's fantastic." (P12, 2024). These smart subsidies exemplify interactive governance, as they are a collaborative effort between public authorities and private actors, enabling targeted action through localized incentives (Mees et al., 2014; City of Oldenburg, n.d.).

P5 from the Urban Planning Office points to another economic instrument, the reduction of the precipitation fee. If precipitation is infiltrated on-site, this deduction can be applied for. However, the costs for drinking water are 1.89 € per m<sup>3</sup> (EWE Netz, n.d.), wastewater costs 2.36 € per m<sup>3</sup> and rainwater 0.70 € per m<sup>2</sup> (OOWV, 2024). P9 from the NLWKN therefore emphasizes: "The fee for the rainwater system does not actually play a major role." (P9, 2024).

The reduction of the precipitation fee for properties with rainwater infiltration systems demonstrates market (private) governance, as it relies on economic incentives to encourage individual property owners to adopt sustainable practices through cost-saving mechanisms tied directly to their behaviour (Mees et al., 2014).

The funding programmes provided by the city of Oldenburg represent an opportunity for the SCC. However, actors agreed that in order to develop and implement the SCC on a larger scale economic instruments need to be expanded.

### **Communicative instruments**

In Oldenburg, various communicative instruments are fostering awareness of water in the urban context. These instruments play a crucial role in promoting sustainable practices, educating the public, and supporting the implementation of the SCC.

Numerous initiatives from institutions such as the OOWV and the City of Oldenburg aim to raise awareness of water management and climate change impacts. For instance, the City of Oldenburg runs a campaign on how to deal with extreme heat, including the "CoOl City Map," which highlights green spots and parks (City of Oldenburg, n.d.). Additionally, to address flooding risks, the city, in cooperation with the OOWV, has created a heavy rain hazard map in which each property owner is able to view the risk of their property being flooded. These campaigns exemplify hierarchical (public) governance, as they are initiated and managed by public authorities to systematically guide citizens' behaviour in response to climate challenges (Mees et al., 2014).

Public awareness is raised through interactive experiences as guided (bike) tours and a climate treasure hunt through 'Eversten Holz,' which partly focus on the SCC. The Oldenburg State Museum of Art and Culture, participating in these initiatives, emphasizes: "Oldenburg is adapting to climate change. Sometimes creatively and sometimes pragmatically. Sometimes through new structures and habits, sometimes simply by paying new attention to what has been there for a long time." These efforts by the KB citizens association and the State Museum counteract the 'black boxing' effect by giving water management a visible place in society (Griffiths, 2017). This communicative instrument lies between hierarchical and interactive governance, as it is initiated by the Oldenburg State Museum, a public institution under the responsibility of the state, while local associations and citizens are actively involved in its realisation and communication (Mees et al., 2014).

Oldenburg also offers a wealth of public education programs on water management. According to P4 from the EBO, there is "a wide range of educational opportunities" including webinars, and courses such as the seminar 'The water-conscious municipality' at Jade University (P4, 2024). However, P11 from the KB citizens association notes: "Our problem is that we don't get the people into our events



who actually need to hear about it.” (P11, 2024). Additionally, the OOWV offers a broad spectrum of environmental education on water management, true to the motto “Knowledge protects water”. Guided tours provide practical insights into water supply, wastewater disposal, and environmental protection (OOWV, n.d.). Additionally, flyers on water scarcity and protection against heavy rainfall highlight central SCC measures, such as permeable surfaces and green roofs (OOWV, n.d.). Further, educational partnerships between the Carl von Ossietzky University, Jade University, the OOWV, and the City of Oldenburg enable student-led research addressing local water management issues. These partnerships allow students to use OOWV data to develop new ideas and solutions. P6 from OOWV highlights their importance:

“It's always great for us when people use the data we have, pick out an issue, and then continue to work on topics and provide new impetus for something that we think urgently needs to be looked at, but we don't have time for.” (P6, 2024)

Lastly, the installation of the AI heavy rain early warning system “NIVUS RAIN” by the OOWV in the district of Ofenerdiek represents an innovation in local rainwater management. The AI is then to be coupled with rainwater retention basin controls to smartly store and release rainwater (OOWV, n.d.). P3 describes its value: “I can leave the water in the basin for the time being—Sponge City—it remains on hand, especially in summer. It can evaporate, there is evaporative cooling, and there is also water for irrigation and other things.” (P3, 2024). These initiatives represent interactive governance, fostering collaboration between public and private actors to exchange knowledge and drive collective action on water management (Mees et al., 2014).

The b:rain Tank app by the OOWV provides digital, visually appealing tools for private households to manage rainwater effectively (OOWV, 2024). This app reflects market (private) governance, as it empowers individual households to independently adopt sustainable practices through digital tools and information (Mees et al., 2014).

The diverse communicative instruments in Oldenburg represent an opportunity for the development and implementation of the SCC. P3, formerly OOWV, sees communicative tools as essential for the SCC and summarizes for Oldenburg: “We have a very good mix, and the water sector is pretty well positioned” (P3, 2024). However, as noted by P11, further efforts are needed to ensure their reach and impact, particularly among those who would benefit most from these initiatives.

#### 4.6 Summary

Chapter 4 presented an analysis of the existing Sponge City governance arrangement in Oldenburg, focusing on the four dimensions from the policy arrangement approach. The analysis revealed challenges such as the fragmentation of actors and unclear responsibilities, which hinders effective collaboration. Fragmentation has been limiting communication and collaboration, while overlapping responsibilities and the resistance to take responsibility of the public exacerbate those barriers.

The policy discourse demonstrated a gradual paradigm shift in water management, moving from traditional drainage to sustainable water retention, supported by showcase projects from Kreyenbrück and ‘Fliegerhorst’. However, the lack of an overarching strategy slows the progress down. Legal and economic instruments, as well as updated water policies, present opportunities for the SCC to be developed and implemented but required up-scaling to achieve an impact. Communicative

instruments, such as public campaigns, educational partnerships, and smart technologies, enhanced awareness and offered tools for integrating SCC measures, though public engagement.

Overall, Oldenburg's is facing multiple barriers but also has multiple opportunities at its disposal to further develop and implement the SCC. These findings are being reflected on in Chapter 5, and the research questions are answered to propose pathways for enabling the SCC in Oldenburg.

## 5. Conclusions and reflections

The aim of this research was to identify institutional conditions that promote the development and implementation of the SCC in mid-size cities. For that purpose, a qualitative single case study was conducted, the unit of analysis being the City of Oldenburg, Lower Saxony (Germany). This concluding chapter offers first, answers to the research questions. Second, policy recommendations are formulated based on the lessons learned from the case for institutional reforms. Third, the theoretical approach is reflected on and the contribution to literature is discussed. The fourth section provides a methodological reflection and lastly, suggestions for future research are being made.

### 5.1 Reflection and answering the research question

This section answers and reflects, first, on the sub-questions and second, on the main research question on which this study is based. The in this section identified barriers and opportunities to the development of the SCC, provide a basis for the formulation of policy recommendations and the lessons learned from Oldenburg (chapter 5.2.). These insights and conclusions also contribute to the scientific relevance of this study (chapter 5.3.).

*RQ 1: How can the SCC be conceptualized and what does a governance arrangement approach entail?*

The SCC is conceptualized as a holistic approach to urban water management that addresses key challenges such as urban flooding, droughts, and water pollution. It integrates blue, green, and grey infrastructure to create cities that absorb, store, filter, and reuse rainwater (Chan et al., 2018; Nguyen et al., 2019). This paradigm shift in urban water management recognizes water as a vital resource and ecological asset, moving away from traditional engineering solutions that rely solely on grey infrastructure (Li et al., 2017). Here, showcase projects play a key role in making SCC measures tangible, building public acceptance, and proving their feasibility on a local scale.

The governance arrangement approach provided a structured framework for analysing the existing governance arrangement and identifying institutional conditions critical for enabling the SCC's development and implementation. By leveraging the interdependent dimensions of discourse, actors and coalitions, rules of the game, and power and resources (Wiering & Immink, 2006), this approach highlighted barriers that hinder progress and opportunities that can be leveraged to create enabling institutional conditions for the SCC.

*RQ 2: How does Oldenburg's existing water governance arrangement and policies structure the development and implementation of the SCC?*

The existing governance arrangement in Oldenburg reflects a hybrid structure predominantly characterized by market and interactive governance (Mees et al., 2014). Market governance is evident from the fact that the initiative to implement SCC measures lies largely with private actors such as homeowners, companies and civil society organisations. However, showcase projects, such as the Kreyenbrück district redevelopment and the 'Fliegerhorst' airbase transformation, highlight interactive governance, where public institutions as the City of Oldenburg and the OOWV collaborate with private actors. These projects demonstrate the potential for partnerships to bridge gaps in technical expertise and funding (Liang, 2018). Hierarchical governance elements, such as land-use plans, further support SCC integration by offering the potential to embed measures as green roofs and façade greening into urban planning. However, this merely provides an option, and its actual implementation depends on

the decisions made by Oldenburg’s Urban Planning Office. Together, these governance elements form a diverse and flexible structure that promotes SCC initiatives in Oldenburg.

*RQ 3: What lessons can be learned about the institutional conditions that would enable the implementation and upscaling of the SCC in Oldenburg?*

The SCC is highly case-sensitive, making it essential to account for the local context, including climatic, geographical, but also governance structures (Nguyen et al., 2019). Generalisation should therefore be approached with caution. In the Oldenburg context, lessons can especially be learned from the showcase projects that anchor the SCC in the public, create awareness, and thus form the basis for upscaling (Li et al., 2017). In the German context, however, it can be stated that due to the federal structure of the administration, integration and collaboration between the actors needs to be increased to enable the development and implementation of the SCC. Supporting the mitigation of the current fragmentation in the water sector.

On a global scale, particularly in developing countries, social equity is a critical consideration for SCC implementation. As highlighted by Wang (2021), SCC initiatives also address existing social inequalities by ensuring that all groups, especially marginalized communities, benefit from improved urban water management. Therefore, in urban regions facing severe water scarcity and floods, the SCC offers a viable framework to enhance distributional equity through measures like improved access to clean water, flood protection, and green spaces (Wang et al., 2021). By integrating these benefits into urban planning, the SCC can help bridge gaps in resource allocation and resilience among different socio-economic groups (ibid).

*Main RQ: Which institutional conditions promote the development and implementation of the SCC in mid-size cities, and which lessons can be drawn from the case of Oldenburg in this respect?*

In order to answer the main research question, the barriers and opportunities identified in Oldenburg’s governance arrangement are presented in Tables 6 and 7. These findings are further analysed to derive the institutional conditions necessary for the SCC’s development and implementation.

*Table 6. Barriers within Oldenburg’s existing governance arrangement.*

Discourse	Lack of an overarching strategy
Actors and coalitions	Fragmentation and collaboration
	Unclear distribution of responsibilities
Rules of the game	Reducing the bureaucracy challenge
Power and resources	Currently no identified barriers

*Table 7. Opportunities within Oldenburg’s existing governance arrangement*

Discourse	Beginning of a paradigm shift in water management
	Tangible showcase projects
Actors and coalitions	Currently no identified opportunities
Rules of the game	Adapting water policies
Power and resources	Diverse policy instruments

The discourse dimension holds one barrier, the lack of an overarching strategy and two opportunities, the emerging paradigm shift and the showcase projects, for the SCC in Oldenburg. An overarching strategy is essential to enable the development and implementation of the SCC (Nguyen et al., 2019). There are a number of strategy papers for Oldenburg, the so-called master plans (City Of Oldenburg, 2024), provided by the city, as well as plans and strategies provided by the state and federal government, such as the National Water Strategy (BMVU, 2024). However, these are not legally binding and offer no benefits to actors when implemented. Therefore, for the most part, these plans and strategy are not part of the prevailing debate. Furthermore, the master plans, if at all, only partly touch the water sector such as the Urban Green Master Plan (City Of Oldenburg, 2024). There is no master plan on how to manage water in the Oldenburg context. The first opportunity for the emerging paradigm shift in Oldenburg is not only taking place at an institutional level, but also in the public sphere. Extreme weather events have triggered a process of rethinking that is favourable to the development of the SCC. However, the phenomenon of 'black-boxing' is hindering the pace of this development (Griffiths, 2017). The second opportunity in this dimension are the showcase projects. They present the SCC in a tangible way and prove its applicability and effectiveness in the local context (Li et al., 2017). By integrating these projects on a small-scale, acceptance can be increased and thus pave the way for large-scale implementation. Therefore, these projects also counteract the aforementioned 'black-boxing' effect (Griffiths, 2017). The showcase projects are therefore the centrepiece of this dimension. The case of Oldenburg demonstrates that developing an overarching strategy tailored to the local context, coupled with tangible showcase projects to foster public acceptance and institutional commitment, are key lessons to be drawn to enable the SCC's implementation for other mid-size cities.

In the actors and coalitions dimension, there are two institutional barriers that hinder the implementation of SCC within the existing governance arrangement: the fragmented structure of the water sector as well as the unclear distribution of responsibilities. Both are a consequence of the prevalent federalism (Federal Environment Agency, 2022). Although this ensures that more specific solutions can be found through the decentralisation of power, it disregards the interconnectedness between actors. The large number of actors in water management also leads to a lack of clarity of responsibilities in the public sphere and overlapping objectives. This leads to new concepts such as the SCC being implemented at a slow pace, as no one feels in charge and each actor points to the other (Hegger et al., 2012). In the public sphere, the large number of actors also means that it is often not clear which actor is responsible for which area (ibid). Overall, the actors and coalition dimension is the only one with two barriers and no opportunity. The case of Oldenburg underscores the importance of establishing clear roles and fostering collaboration among actors to address fragmentation and ensure accountability, demonstrating that well-defined responsibilities are critical for advancing SCC implementation in mid-size cities.

The rules of the game dimension holds both a barrier and an opportunity for the development and implementation of the SCC. The identified barrier in this dimension is the reduction in bureaucracy. The current bureaucratic effort is too high to enable the SCC. As the implementation of this new concept would be possible within the existing formal and informal rules, further regulations would only hinder its utilisation. A possibility, however, is the beginning adaptation of water policy that is taking place. Driven by climate change, the first guidelines and DIN standards (German Institute for Standardization) are being published by official institutions that aim towards the same objectives as the SCC (DWA, 2020). This provides an opportunity to the actors as it makes implementation easier

because there are tangible documents that provide a framework for orientation. The case of Oldenburg highlights that reducing the bureaucratic challenge is essential for enabling the development and implementation of the SCC. Aligning existing policies with the objectives of the SCC further emphasizes the need for adaptive governance frameworks that minimize administrative barriers and foster flexibility in mid-size cities.

The dimension of power and resources provides an opportunity for the SCC in Oldenburg with the three different types of policy instruments identified. The existing policy instruments allow and support the development and implementation of the concept and especially the diversity of the instruments, ranging from the land-use plan to interactive bicycle tours to subsidies, is an enrichment. However, it is important to find the right policy-mix for the prevailing governance type. In Oldenburg the governance type leans towards an interactive governance arrangement (Mees et al., 2014), evident in the city's reliance on collaborative actor efforts, including PPPs and local actors, as demonstrated by the showcase projects of Kreyenbrück district redevelopment and the 'Fliegerhorst' airbase transformation. Although Oldenburg provides a number of policy instruments, these are not sufficient to implement the SCC comprehensively and should be expanded. The case of Oldenburg demonstrates that leveraging a diverse mix of policy instruments tailored to the local governance type is crucial to enable the development and implementation of the SCC in mid-size cities.

## 5.2 Policy recommendations

The identified barriers within the existing governance arrangement highlight key areas for institutional reforms in the City of Oldenburg. This section provides policy recommendations addressing the four barriers identified in Oldenburg's governance arrangement and the course of this study.

### 1. Overarching strategy

In order to enable the development and implementation of the SCC in Oldenburg, an overarching strategy tailored to the city's needs is required. This strategy should provide clear guidance for all actors and promote coordination and co-operation. It needs to strike a balance between flexibility, enabling cooperation with neighbouring municipalities to counteract Oldenburg's isolation, and stability, ensuring robust local water management structures. At a supra-regional level, the promotion and integration of the national water strategy should be prioritised to improve in objectives.

### 2. A water agency

In order to implement the SCC in Oldenburg, actors involved in water management should be brought together under one coordinating body (Nguyen et al., 2019). This body would serve as a communication medium and a coordinating body between actors. Of the involved actors, the OOWV, with its expertise, responsibilities and objectives, currently fulfils a similar function. However, there are two major problems here. Firstly, the OOWV lacks the political decision-making power and resources to implement the SCC. Secondly, the OOWV does not offer the neutrality that such a coordination and management body requires. Ultimately, the OOWV is pursuing its own objectives. Other actors could therefore be penalised if the OOWV was entrusted with such a task without making major changes to this institution.

However, the introduction of a water agency in Oldenburg would open up opportunities in the form of co-operation, knowledge exchange and pooling of resources (Mees et al., 2014). At the same time, it

could be ensured that an overarching strategy/agenda, if available, is adhered to as well as ensuring alignment and coherence among actors in their objectives and actions.

### 3. Clarification campaign

The distribution of responsibilities in the water sector is not clear. There are multiple ways in which responsibilities are delegated or misplaced by the public. This barrier would be reduced by the introduction of an overarching water agency. However, it is also possible to start with the population. An information campaign with easily understandable and accessible content is a good way to do this. At the same time, educating the population will also promote the paradigm shift and thus reduce the 'black-boxing' effect.

### 4. Adaptations instead of extensions

The barrier of bureaucracy must be addressed. In order to do so, the SCC must be considered at all times during urban development. That means that, for example, if a new roof is to be installed on a building anyway, the SCC could be taken into account by installing a green roof. This means that the existing regulations need to be adapted instead of adding further ones. According to Vetter et al. (2024), one possibility is the introduction of the term BGI in the building code and the associated catalogue of regulations. This creates a legal basis for the SCC that brings the concept to the attention of urban planners.

## 5.3 Theoretical reflection and contribution to the literature

This thesis draws on the concepts of the SCC and the governance arrangement approach. While the SCC is well-defined in literature, governance strategies for its implementation remain underexplored. By applying the PAA, this study addresses a research gap by systematically linking barriers and opportunities to governance dimensions (Wiering & Immink, 2006; Nguyen et al., 2019).

This study contributes to the literature by providing a structured framework to analyse the discourse, actors and coalitions, rules of the game, and power and resources, offering insights into how institutional conditions influence SCC implementation. For instance, it identifies barriers such as fragmented governance and opportunities like showcase projects, highlighting the importance of fostering collaboration among diverse actors (Chan et al., 2018; Li et al., 2017). The findings extend theoretical knowledge by operationalizing the PAA in a mid-sized city context. Oldenburg's case demonstrates how governance arrangements require stronger integration to overcome fragmentation and improve SCC adoption. This underscores the relevance of adaptive governance to address water management challenges in urban contexts (Hegger et al., 2014). By projecting theoretical insights onto a practical case, this study bridges the gap between theory and practice and provides a governance framework that informs the development and scaling of SCC.

## 5.4 Methodological reflection

To better understand what institutional conditions promote the development and implementation of the SCC in mid-size cities, for this study a qualitative single case study was conducted. In the following the methodological approach chosen for the study is reflected on.

The case for this study was chosen based on its independent progress with the SCC. Due to the showcase projects carried out within the existing governance arrangement, Oldenburg presented a particularly good opportunity to learn from the city. The choice of the city proved to be useful as it offered valuable insights into the barriers and opportunities across all dimensions of the existing governance arrangement.

The data collection relied on a broad spectrum of methods using policy document analysis, media analysis, and semi-structured interviews as methods. This offered a wide range of views and insides on the topic. However, water management has become a prominent topic in light of the recent Christmas flood in Oldenburg, resulting especially for the semi-structured interviews, in numerous different opinions and experiences that participants had the urge to communicate. This made the following coding a challenge as it was difficult to categorize the various topics and to further compare them to each other. Additionally, with the case being situated in Germany, the interviews were conducted in the German. As a result, the interviews had to be translated into English bearing the risk that statements lose their meaning or are interpreted not as they were meant. In order to counter act this issue, a list providing the direct quotations from the interviews as well as the codebook are presented in both German and English in the Appendix. Same applies to the media analysis where articles were published in the German language. In the Appendix D, a list that presents the used articles is provided.

## 5.5 Suggestions for future research

The suggestions for future research cover two main aspects: The study of specific dimensions and a multiple or comparative case study.

The actors and coalitions dimension revealed two barriers and no opportunities, emphasizing its potential for transforming barriers into opportunities through institutional reforms. This finding is unique to this dimension, making it particularly compelling for further study. A focused analysis of this dimension in relation to the SCC would be valuable, as it appears to hold the largest number of institutional barriers. Therefore, exploring the objectives, responsibilities, and interactions between actors and coalitions in greater detail could yield crucial insights into addressing these barriers to the implementation of the SCC.

Since a single case study has now been conducted, providing a foundation for exploring multiple or comparative case studies. By assessing the institutional conditions in different governance arrangements, a broader perspective can be gained, enabling the derivation of more general lessons. It would be particularly valuable to examine mid-sized cities in other German federal states, such as Schleswig-Holstein or Mecklenburg-Vorpommern. These states are subject to varying state-specific ordinances, which could highlight how regional governance frameworks impact SCC development and implementation. Moreover, Schleswig-Holstein and Mecklenburg-Vorpommern are also influenced by the North Sea and the Baltic Sea, respectively, sharing similar hydrological conditions with Oldenburg. This makes them ideal candidates for identifying transferable insights while accounting for context specific variations.



## References

- Arnouts, R., van der Zouwen, M., & Arts, B. (2012). Analysing governance modes and shifts — Governance arrangements in Dutch nature policy. *Forest Policy and Economics*, 43-50. <https://doi.org/https://doi.org/10.1016/j.forpol.2011.04.001>
- ASTOB. (n.d.). *Members of the ASTOB*. Retrieved November 05, 2024, from <https://www.astob.de/b%C3%BCrgervereine-in-oldenburg/>
- ATLAS.ti Web. (2024). ATLAS.ti Scientific Software Development GmbH. Germany. [https://atlasti.com/de/atlas-ti-web?x-source=pmax&x-campaign=pmaxde&x-id=21759486841&x-term=pmaxde&utm\\_source=google&utm\\_medium=pmax&utm\\_campaign=21783336885&utm\\_term=&utm\\_content=&utm\\_adgroup=&device=c&placement=&matchtype=&network=x&gad\\_source=1&gclid=E](https://atlasti.com/de/atlas-ti-web?x-source=pmax&x-campaign=pmaxde&x-id=21759486841&x-term=pmaxde&utm_source=google&utm_medium=pmax&utm_campaign=21783336885&utm_term=&utm_content=&utm_adgroup=&device=c&placement=&matchtype=&network=x&gad_source=1&gclid=E)
- BMVU. (2024, July 17). <https://www.bmuv.de>. Retrieved October 26, 2024, from <https://www.bmuv.de/media/zukunft-schwammstadt>
- Brockmeyer, A. (2023, April 25). *This is how precious rainwater is to be stored in the area*. (NWZ, Editor) Retrieved November 26, 2024, from <https://www.nwzonline.de/region/oowv-projekt-regenwasser-speichern-im-nordweste-und-oldenburger-land-a-4,0,548403673.html>
- Brown, M., Rizzuto, T., & Singh, P. (2019). Strategic compatibility, collaboration and collective impact for community change. *Leadership & Organization Development Journal*, 40(4), 421-434. <https://doi.org/https://doi.org/10.1108/LODJ-05-2018-0180>
- Chan, F., Griffiths, J., Higgitt, D., Xu, S., Zhu, F., Tang, Y., Xu, Y., & Thorne, C. (2018). "Sponge City" in China-A breakthrough of planning and flood risk management in the urban context. *Land Use Policy*, 76, 772-778. <https://doi.org/https://doi.org/10.1016/j.landusepol.2018.03.005>
- City of Oldenburg. (2024, April 10). *Oldenburg climate neutral 2035*. Retrieved December 14, 2024, from <https://www.oldenburg.de/startseite/leben-umwelt/klimaschutz/oldenburg-klimaneutral-2035.html>
- City of Oldenburg. (2016). *Oldenburg Air Base: Future plan 2030+*. Oldenburg.
- City of Oldenburg. (2020, November 06). *As a "sponge city" against heavy rain and heat*. Retrieved November 20, 2024, from <https://www.oldenburg.de/metanavigation/presse/pressemitteilung/news/als-schwammstadt-gegen-starkregen-und-hitze.html>
- City of Oldenburg. (2020, May 08). *Construction plan S-835 MediTech (MTO)*. Retrieved August 27, 2024, from [https://www.oldenburg.de/fileadmin/oldenburg/Benutzer/Dateien/40\\_Stadtplanungsamt/400\\_Stadtentwicklung\\_Bauleitplanung/Bauleitplanung/rechtsverb.Bebauungsplaene/BPlan\\_Text/835\\_Text.pdf](https://www.oldenburg.de/fileadmin/oldenburg/Benutzer/Dateien/40_Stadtplanungsamt/400_Stadtentwicklung_Bauleitplanung/Bauleitplanung/rechtsverb.Bebauungsplaene/BPlan_Text/835_Text.pdf)
- City of Oldenburg. (2020, May 26). *Water maintenance is a high priority*. Retrieved September 04, 2024, from

<https://www.oldenburg.de/metanavigation/presse/pressemitteilung/news/gewaesserunterhaltung-hat-hohen-stellenwert.html>

City Of Oldenburg. (2022, December 19). *Directive on the promotion of building and solar checks for residential buildings in the city of Oldenburg*. Retrieved November 07, 2024, from [https://www.oldenburg.de/fileadmin/oldenburg/Benutzer/Dateien/22\\_Rechtsamt/Zuwendungsrichtlinien/20230307-Richtlinie\\_Gebaeude-Solar\\_vom\\_19.12.2022\\_b.pdf](https://www.oldenburg.de/fileadmin/oldenburg/Benutzer/Dateien/22_Rechtsamt/Zuwendungsrichtlinien/20230307-Richtlinie_Gebaeude-Solar_vom_19.12.2022_b.pdf)

City of Oldenburg. (2023, November 08). *Development MediTech Oldenburg*. Retrieved August 27, 2024, from <https://www.oldenburg.de/startseite/leben-umwelt/verkehr-mobilitaet/strassenplanungen/erschliessung-meditech-oldenburg.html>

City of Oldenburg. (2023, May 05). *Environment and urban nature*. Retrieved November 26, 2024, from <https://www.oldenburg.de/startseite/leben-umwelt/planen-bauen/fliegerhorst/umwelt-und-stadtnatur.html>

City of Oldenburg. (2023, 09 23). *Masterplan*. Retrieved 06 30, 2024, from <https://www.oldenburg.de/startseite/leben-umwelt/planen-bauen/fliegerhorst/masterplan.html>

City of Oldenburg. (2023, November 08). *Smart traffic guidance in heavy rain*. Retrieved Dezember 04, 2024, from <https://www.oldenburg.de/startseite/leben-umwelt/verkehr-mobilitaet/parken/aktuelles/smarte-verkehrslenkung-bei-starkregen.html>

City of Oldenburg. (2024, September 04). *Climate adaptation*. Retrieved December 14, 2024

City of Oldenburg. (2024, 04 22). *Flood 2023/24: Balance sheet*. Retrieved 06 09, 2024, from <https://www.oldenburg.de/startseite/buergerservice/notfall/aktuelles/bilanz.html>

City of Oldenburg. (14. November 2024). *Flood protection through climate adaptation*. Abgerufen am 20. November 2024 von <https://www.oldenburg.de/startseite/leben-umwelt/planen-bauen/stadtplanung/aktuelles/hochwasserschutz-durch-klimaanpassung.html>

City Of Oldenburg. (2024, May 08). *Masterplan urban green*. <https://www.oldenburg.de/startseite/leben-umwelt/umwelt/gruenes-oldenburg/masterplan-stadtgruen.html>

City of Oldenburg. (2024, January 26). *MediTech Oldenburg*. Retrieved August 27, 2024, from <https://www.oldenburg.de/startseite/wirtschaft/gewerbeflaechen/meditech-oldenburg.html?profile=GF-62515>

City of Oldenburg. (2024, October 16). *Nature protection areas*. Retrieved December 14, 2024, from <https://www.oldenburg.de/startseite/leben-umwelt/umwelt/naturschutz/schutzgebiete-und-schutzobjekte/naturschutzgebiete-nsg.html>

City of Oldenburg. (2024, September 20). *Oldenburg - Garden city*. Retrieved Dezember 04, 2024, from <https://www.oldenburg.de/startseite/leben-umwelt/umwelt/gruenes-oldenburg/oldenburg-gartengrossstadt.html>

City of Oldenburg. (2024, August 27). *Oldenburg in numbers*. Retrieved September 03, 2024, from <https://www.oldenburg.de/startseite/tourist/ueber-oldenburg/oldenburg-in-zahlen.html>

- City of Oldenburg. (2024, August 08). *Structure of the city administration*. Retrieved November 04, 2024, from <https://www.oldenburg.de/startseite/politik/verwaltung-finanzen/aufbau-der-stadtverwaltung.html>
- City of Oldenburg. (2024, May 08). *Untere Wasserbehörde*. <https://www.oldenburg.de/startseite/leben-umwelt/umwelt/technischer-umweltschutz/gewaesserschutz.html>.
- City of Oldenburg. (n.d.). *Förderprogramm Ofenerdiek*. Retrieved 06 27, 2024, from <https://serviceportal.oldenburg.de/buergerservice/dienstleistungen/foerderprogramm-ofenerdiek-900000985-0.html?myMedium=1>
- City of Oldenburg. (n.d.). *Heat protection*. Retrieved November 10, 2024, from <https://www.oldenburg.de/startseite/leben-umwelt/umwelt/hitzeschutz.html>
- City of Oldenburg. (n.d.). *Listed building licence/favourable conditions and public funding*. Retrieved December 05, 2024, from [https://serviceportal.oldenburg.de/buergerservice/dienstleistungen/denkmalrechtliche-genehmigung-verguenstigung-und-oeffentliche-foerderung-900000113-0.html?myMedium=1&selected\\_kommune=36200](https://serviceportal.oldenburg.de/buergerservice/dienstleistungen/denkmalrechtliche-genehmigung-verguenstigung-und-oeffentliche-foerderung-900000113-0.html?myMedium=1&selected_kommune=36200)
- City of Oldenburg. (n.d.). *Ofenerdiek funding programme*. Retrieved December 08, 2024, from <https://serviceportal.oldenburg.de/buergerservice/dienstleistungen/foerderprogramm-ofenerdiek-900000985-0.html?myMedium=1&auswahl=0>
- City of Oldenburg. (n.d.). *Urban land-use planning*. Retrieved November 24, 2024, from <https://serviceportal.oldenburg.de/buergerservice/dienstleistungen/bauleitplanung-900000455-0.html?myMedium=1&auswahl=0>
- DeepL. (2024, April). DeepL free version. Cologne, Germany. <https://www.deepl.com/de/translator>
- Driessen, P., & Leroy, P. (2010). *From climate change to social change : perspectives on science-policy interactions*. Utrecht: International Books. <https://library.wur.nl/WebQuery/titel/1931003>
- Durantón, G., & Puga, D. (2014). The Growth of Cities. In *Handbook of Economic Growth* (pp. 781-853). Elsevier. <https://doi.org/https://doi.org/10.1016/B978-0-444-53540-5.00005-7>
- DVWG. (n.d.). *The DVWG*. Retrieved November 15, 2024, from <https://www.dvgw.de/>
- DWA. (2020, December 12). *DWA Federal Office*. Retrieved December 15, 2024, from [https://de.dwa.de/de/regelwerk-news-volltext/DWA\\_A\\_102.html](https://de.dwa.de/de/regelwerk-news-volltext/DWA_A_102.html)
- DWA. (n.d.). *The DWA regulations*. Retrieved November 15, 2024, from <https://de.dwa.de/de/regelwerk-fachpublikationen.html>
- EWE Netz. (n.d.). Retrieved August 21, 2024, from <https://www.ewe-netz.de/privatkunden/trinkwasser/ihre-wasserversorgung>
- Federal Environment Agency. (2022, June 16). *Water law*. Retrieved September 03, 2024, from <https://www.umweltbundesamt.de/themen/wasser/recht-oekonomie-digitalisierung/wasserrecht#warum-muss-wasser-rechtlich-geschutzt-werden>

- Federal Ministry for Environment, Nature Conservation, Nuclear Safety and Consumer Protection. (2023). *National Water Strategy*. Federal Ministry for Environment, Nature Conservation, Nuclear Safety and Consumer Protection. <https://www.bmu.de/publikation/nationale-wasserstrategie>
- Federal Office of Justice. (1991). *Act on Water and Soil Associations (Water Association Act - WVG)*.
- Gabriel, M., Kessel, I., Quast, T., & Roth, E. (2023). Praxisbeitrag: Multimethodenansatz in der Evaluation am Beispiel der Dialogveranstaltung "Mensch Wissenschaft!". In P. Niemann, V. van den Bogaert, & R. Ziegler, *Evaluationsmethoden der Wissenschaftskommunikation* (pp. 333-350). Springer SV. [https://doi.org/10.1007/978-3-658-39582-7\\_21](https://doi.org/10.1007/978-3-658-39582-7_21)
- Gloger, S. (2019). *Kreyenbrueck as a large sponge*. (NWZ, Editor) <https://www.nwzonline.de/plus/kreyenbrueck-wasserspeicher-in-oldenburg-kreyenbrueck-als-grosser-schwamm-a-50,5,4004703585.html>
- Graham, S., & Thrift, N. (2007). Out of Order. *Theory, Culture & Society*, 24(3), 1-25. <https://doi.org/10.1177/0263276407075954>
- Griffiths, J. (2017). Sustainable Urban Drainage. In M. Abraham, *Encyclopedia of Sustainable Technologies* (Vol. 2, pp. 403-412). Ningbo: Elsevier. <https://doi.org/10.1016/B978-0-12-409548-9.10203-9>
- Hausmann, J. (2022, September 22). *How a "Sponge City" Oldenburg could store rainwater*. (NWZ, Editor) <https://www.nwzonline.de/oldenburg/schwammstadt-oldenburg-so-soll-in-zukunft-regenwasser-gespeichert-werden-a-51,9,3409948091.html>
- He, B., Zhu, J., Zhao, D., Gou, Z., Qi, J., & Wang, J. (2019). Co-benefits approach: Opportunities for implementing sponge city and urban heat island mitigation. *Land Use Policy*, 86, 147-157. <https://doi.org/10.1016/j.landusepol.2019.05.003>
- Hegger, D., Driessen, P., Dieperink, C., Wiering, M., Raadgever, G., & van Rijswijk, H. (2014). Assessing Stability and Dynamics in Flood Risk Governance. *Water Resour Manage*, 28, 4127-4142. <https://doi.org/10.1007/s11269-014-0732-x>
- Hegger, D., Lambers, M., Van Zeijl-Rozema, A., & Dieperink, C. (2012). Conceptualising joint knowledge production in regional climate change adaptation projects: success conditions and levers for action. *Environmental Science & Policy*, 18, 52-65. <https://doi.org/10.1016/j.envsci.2012.01.002>
- Husmann, T. (2020, November 02). *AEG-site turns into a Sponge City*. (NWZ, Editor) Retrieved October 16, 2024, from <https://www.nwzonline.de/oldenburg/aeg-gelaende-in-oldenburg-oowv-sorgt-fuer-entwaesserung-a-50,10,2970030954.html>
- Husmann, T. (2020, January 05). *Green roofs help against flash floods*. (NWZ, Editor) Retrieved November 07, 2024, from <https://www.nwzonline.de/wirtschaft/oldenburg-regenrueckhaltung-in-oldenburg-begrueente-daecher-helfen-gegen-sturzfluten-a-50,6,3682805791.html>

- Imhoff, M., Zhang, P., Wolfe, R., & L. Bounoua. (2010). Remote sensing of the urban heat island effect across biomes in the continental USA. *Remote Sensing of Environment*, 114(3), 504-513. <https://doi.org/https://doi.org/10.1016/j.rse.2009.10.008>
- Jia, H., Wang, Z., Zhen, X., Clar, M., & Yu, S. (2017, August 12). China's Sponge City construction: A discussion on technical approaches. *Frontiers of Environmental Science & Engineering*(11). <https://doi.org/https://doi.org/10.1007/s11783-017-0984-9>
- Jordan, A., & Lenschow, A. (2010). Policy Paper Environmental Policy Integration: a State of the Art Review. *Environmental Policy and Governance*, 20, 147-158. <https://doi.org/https://doi.org/10.1002/eet.539>
- Kessler, S., & Wicke, N. (2023). Grundlagenbeitrag: Inhaltsanalysen inklusive Medienanalysen. In P. Niemann, V. van den Bogaert, & R. Ziegler, *Evaluationsmethoden der Wissenschaftskommunikation* (pp. 221-238). Wiesbaden: Springer VS. [https://doi.org/doi.org/10.1007/978-3-658-39582-7\\_14](https://doi.org/doi.org/10.1007/978-3-658-39582-7_14)
- Lamers, M., Ottow, B., Francois, G., & Kroff, Y. (2010). Beyond dry feet? experiences from a participatory water-management planning case in the Netherlands. *Ecology and Society*, 15(1), 14. <https://www.ecologyandsociety.org/vol15/iss1/art14/>
- Lamond, J., & Everett, G. (2019). Sustainable Blue-Green Infrastructure: A practical approach to understanding community preferences and stewardship. *Landscape and Urban Planning*, 191. <https://doi.org/https://doi.org/10.1016/j.landurbplan.2019.103639>
- Li, H., Ding, L., Ren, M., Li, C., & Wang, H. (2017). Sponge City Construction in China: A Survey of the Challenges and Opportunities. *Water*, 9(9), 594. <https://doi.org/10.3390/w9090594>
- Li, X., Li, J., Fang, X., Gong, Y., & Wang, W. (2016). Case Studies of the Sponge City Program in China. *World Environment and Water Resources Congress* (pp. 295-308). ascelibrary. <https://doi.org/10.1061/9780784479858.031>
- Liang, X. (2018). Integrated Economic and Financial Analysis of China's Sponge City Program for Water-resilient Urban Development. *Sustainability*, 10(3), 669. <https://doi.org/https://doi.org/10.3390/su10030669>
- Lifferink, D. (2006). The Dynamic of Policy Arrangements: Turning Round the Tetrahedron. In B. Arts, & P. Leroy, *Institutional Dynamics in Environmental Governance* (Vol. 47, pp. 45-68). Dordrecht: Springer. [https://doi.org/https://doi.org/10.1007/1-4020-5079-8\\_3](https://doi.org/https://doi.org/10.1007/1-4020-5079-8_3)
- Low, N., Gleeson, B., & Rush, E. (2005). A multivalent conception of path dependence: The case of transport planning in metropolitan Melbourne, Australia. *Environmental Science*, 2(4), 391-408. <https://doi.org/https://doi.org/10.1080/15693430500405146>
- Lower Saxony Ministry for Environment, Energy, Building and Climate Protection. (2022). *Background document on the Lower Saxony water supply concept (Volume II)*. Lower Saxony Ministry for Environment, Energy, Building and Climate Protection. <https://www.umwelt.niedersachsen.de/download>
- Lower Saxony Ministry for Environment, Energy, Building and Climate Protection. (2022). *Water supply concept for Lower Saxony*. Lower Saxony Ministry for Environment, Energy, Building and

Climate Protection.  
[https://www.umwelt.niedersachsen.de/download/183413/Wasserversorgungskonzept\\_Niedersachsen.pdf](https://www.umwelt.niedersachsen.de/download/183413/Wasserversorgungskonzept_Niedersachsen.pdf)

Lower Saxony Ministry for the Environment, Energy and Climate Protection. (n.d.). *Watercourse maintenance*. Retrieved November 23, 2024, from [https://www.umwelt.niedersachsen.de/startseite/themen/wasser/flusse\\_bache\\_seen/gewas-serunterhaltung/gewaesserunterhaltung-7396.html](https://www.umwelt.niedersachsen.de/startseite/themen/wasser/flusse_bache_seen/gewas-serunterhaltung/gewaesserunterhaltung-7396.html)

Marlow, D., Moglia, M., Cook, S., & Beale, D. (2013, October 20). Towards sustainable urban water management: A critical reassessment. *Water Research*, 47(20), 7150-7161. <https://doi.org/https://doi.org/10.1016/j.watres.2013.07.046>

Mees, H. L., Dijk, J., Soest, D. v., Driessen, P. P., Rijswick, M. H., & Runhaar, H. (2014). A method for the deliberate and deliberative selection of policy instrument mixes for climate change adaptation. *Ecology and Society*, 19(2), 58.

Metag, J., & Scheu, A. (2023). Grundlagenbeitrag: Qualitative befragung im Kontext von Wissenschaftskommunikation. In P. Niemann, V. van den Bogaert, & R. Ziegler, *Evaluationsmethoden der Wissenschaftskommunikation* (pp. 105-116). Springer SV.

Morison, P., & Brown, R. (2011). Understanding the nature of publics and local policy commitment to Water Sensitive Urban Design. *Landscape and Urban Planning*, 99, 83-92. <https://doi.org/https://doi.org/10.1016/j.landurbplan.2010.08.019>

Nguyen, T., Ngo, H., Guo, W., Wang, X., Ren, N., Li, G., Ding, J., & Liang, H. (2019). Implementation of a specific urban water management - Sponge City. *Science of the Total Environment*, 147-162. <https://doi.org/https://doi.org/10.1016/j.scitotenv.2018.10.168>

O'Donnell. (2020). The blue-green path to urban flood resilience. *Blue-Green Systems*, 2(1), 28-45.

Ofenerdiek Citizens' Association. (n.d.). *Entwicklung*. Retrieved October 22, 2024, from <https://www.buergerverein-ofenerdiek.de/Entwicklung-des-Stadtteils>

OOWV. (2023, December 12). *Statutes of the Oldenburg-East Frisian Water Association*. Retrieved August 21, 2024, from [https://www.oowv.de/assets/media/downloads/service/weitere\\_downloads/oowv\\_satzung\\_2023.pdf](https://www.oowv.de/assets/media/downloads/service/weitere_downloads/oowv_satzung_2023.pdf)

OOWV. (2024, May). *Flyer Braintank*. Retrieved November 10, 2024, from [https://www.oowv.de/assets/media/downloads/flyer\\_infobl%C3%A4tter/flyer\\_braintank.pdf](https://www.oowv.de/assets/media/downloads/flyer_infobl%C3%A4tter/flyer_braintank.pdf)

OOWV. (2024, January 01). *Information on wastewater charges*. Retrieved November 10, 2024, from <https://www.oowv.de/service/abwasser/abwassergebuehren>

OOWV. (n.d.). *Downloads overview*. Retrieved November 10, 2024, from <https://www.oowv.de/service/downloads>

OOWV. (n.d.). *Knowledge protects water*. Retrieved December 05, 2024, from <https://www.oowv.de/umweltbildung>



- OOWV. (n.d.). *NIVUS RAIN - Heavy rain sensor network in Oldenburg*. Retrieved November 06, 2024, from <https://www.oowv.de/projekte-forschung/kritische-infrastruktur-und-krisensicherheit/starkregensensornetz-in-oldenburg-nivus-rain>
- OOWV. (n.d.). *Smart solutions for water management*. Retrieved December 05, 2024, from <https://www.oowv.de/projekte-forschung/smarte-loesungen-fuer-die-wasserwirtschaft>
- Pyke, C., Warren, M., Johanson, T., Jr, J. L., Scharfenberg, J., Groth, P., Freed, R., Schroeer, W., & Main, E. (2011). Assessment of low impact development for managing stormwater with changing precipitation due to climate change. *Landscape and Urban Planning*, 103, 166-173. <https://doi.org/doi:10.1016/j.landurbplan.2011.07.006>
- Qin, H., Li, Z., & Fu, G. (2013). The effects of low impact development on urban flooding under different rainfall characteristics. *Journal of Environmental Management*, 129, 577-585. <https://doi.org/http://dx.doi.org/10.1016/j.jenvman.2013.08.026>
- Restemeyer, B., Woltjer, J., & Brink, M. v. (2015). A strategy-based framework for assessing the flood resilience of cities - A Hamburg case study. *Planning Theory & Practice*, 16(1), 45-62. <https://doi.org/doi.org/10.1080/14649357.2014.1000950>
- Richter, H., & Roser, M. (2018). *Urbanization*. Our World in Data. <https://ourworldindata.org/urbanization>
- State Museum of Nature and Man Oldenburg. (n.d.). *Klimaoasen Oldenburg*. Retrieved 06 29, 2024, from <https://klimaoasen-oldenburg.de/de>
- Tagesschau. (2024, 01 06). *www.tagesschau.de*. Retrieved 01 18, 2024, from <https://www.tagesschau.de/inland/hochwasser-frost-niedersachsen-schnee-100.html>
- Tempels, B. (2022). Resilient Cities and Homeowners Action: Governing for Flood Resilience Through Homeowner Contributions. In T. Thaler, T. Hartmann, L. Slavíková, & B. Tempels, *Homeowners and the Resilient City: Climate-Driven Natural Hazards and Private Land* (pp. 17-34). Springer Nature Switzerland AG. [https://doi.org/10.1007/978-3-031-17763-7\\_2](https://doi.org/10.1007/978-3-031-17763-7_2)
- ten Veldhuis, J., Clemens, F., Sterk, G., & Berends, B. (2010). Microbial risks associated with exposure to pathogens in contaminated urban flood water. *WATER RESEARCH*, 44, 2910-2918. <https://doi.org/https://doi.org/10.1016/j.watres.2010.02.009>
- Trint. (2022). Trint Limited. London, United Kingdom. <https://trint.com/de>
- UBA. (2022, June 16). *Water law*. Retrieved November 22, 2024, from <https://www.umweltbundesamt.de/themen/wasser/recht-oekonomie-digitalisierung/wasserrecht#warum-muss-wasser-rechtlich-geschutzt-werden>
- UBA. (2024, July 03). *Sponge city - future concept for climate-resilient and liveable cities*. Retrieved November 28, 2024, from <https://www.umweltbundesamt.de/schwammstadt>
- Vetter, A., Schubert, S., & Meilinger, V. (2024). Akklimatisierung Lokale Anpassung an den Klimawandel. *politische ökologie*, 176(01), 9-47. <https://doi.org/https://doi.org/10.14512/POE012024041>

- Wang, D., Scussolini, P., & Du, S. (2021). Assessing Chinese flood protection and its social divergence. *Natural Hazards and Earth System Science*, 743-755. <https://doi.org/https://doi.org/10.5194/nhess-21-743-2021>
- Wang, T. (2006). Water sensitive urban design - the journey thus far. *Australian Journal of Water Resources*, 10(6), 213-222. <https://doi.org/http://dx.doi.org/10.1080/13241583.2006.11465296>
- Wiering, M., & Immink, I. (2006). When water management meets spatial planning: a policy-arrangements perspective. *Environment and PLanning C: Government and Policy*, 24, 423-438. <https://doi.org/10.1068/c0417j>
- Yan, Y., Zhang, N., & Zhang, H. (2023). Applications of Advanced Technologies in the Development of Urban Flood Models. *water*, 15(4), 622. <https://doi.org/10.3390/w15040622>
- Yin, R. (2003). *Case study research: Design and methods* (Vol. 3). SAGE.
- Yin, R. K. (2018). *Case Study Research and Applications: Design and Methods* (Vol. 6th). Thousand Oaks, CA: Sage.
- Zhou, Q. (2014). A Review of Sustainable Urban Drainage Systems Considering the Climate Change and Urbanization Impacts. *Water*, 6, 076-992. <https://doi.org/doi:10.3390/w6040976>



## Appendix A – Interview guide

The following provides Table A, presenting the interview guide that was created for the case study on the Oldenburg governance arrangement. The guide includes an introduction to the SCC and questions on each of the dimensions of the PAA. The interview guide remained the same for each interviewee, but based on the semi-structured nature of the interviews, more questions were asked about detailed processes depending on the participants' expertise in the relevant areas. In addition, follow-up questions were asked in the case of existing lay knowledge. Furthermore, a reflection on the Oldenburg case was carried out and important documents or interview partners were asked about.

Table A. Interview guide.

<b>Introduction</b>	Vielen Dank, dass Sie sich heute Zeit für das Interview genommen haben.  Zunächst möchte ich Ihnen einen kurzen Überblick über den Hintergrund meiner Masterarbeit geben. Das Ziel meiner Masterarbeit ist es herausfinden, wie/ob die Implementierungsbarrieren des Sponge City Konzepts durch Veränderungen von Governance-Regelungen überwunden werden können. Dies untersuche ich anhand einer Fallstudie von Oldenburg. Um dies zu erreichen, werde ich die bestehenden Governance-Vereinbarungen sowie politische Dokumente und Medien zu Oldenburg analysieren und mögliche Verbesserungen aufzuzeigen. Der Titel meiner Masterarbeit ist daher: Sponge City Oldenburg: How to enable the transition towards the Sponge City Concept via Governance Arrangements
<b>Discourse</b>	Ziele des Aktuellen Wassermangements/Politik
	Maßnahmen (z.B. Schlüsselprojekte) und Strategien
	Stimmen diese mit dem Schwammstadt Konzept überein?
	Inwieweit ermöglichen diese aktuellen Regelungen tatsächlich den Übergang Oldenburgs zu einer Schwammstadt?
<b>Actors and coalitions</b>	Welche öffentlichen und privaten Akteure
	sind beteiligt?
	Sind diese auch zentral für das Schwammstadt Konzept?
	Zusammenarbeit zwischen den Akteuren
	Gibt es Akteure die für die Umsetzung des Schwammstadt Konzepts mehr Aufmerksamkeit erhalten müssten?
	Akteure die das Schwammstadt Konzept behindern?
<b>Rules of the game</b>	Formale Regeln (Gesetze, Richtlinien) die den Übergang zur Schwammstadt Oldenburg unterstützen oder behindern?
	Informale Regeln (Gewohnheiten, Traditionen, Beziehung, Formen der Zusammenarbeit) die den Übergang zur Schwammstadt Oldenburg unterstützen oder behindern?
	Wie wird die notwendige integrierte Arbeitsweise derzeit organisiert?
	Erfolge/Probleme/Dilemmata?
	Verantwortliche und potentielle Finanzträger?
<b>Power and resources</b>	Inwieweit sind Ressourcen (Finanzen, Personal, Wissen, etc.) die für das Schwammstadt Konzept genutzt werden können vorhanden?

	Sind diese Ressourcen ausreichend um den Übergang herzustellen?
	Schulungs- und Bildungsmöglichkeiten für das Schwammstadt Konzept
	Wie wird die Öffentlichkeit einbezogen?
	Vorhandenes Hintergrundwissen
	Wo liegen die Entscheidungsgewalten (um das Schwammstadt Konzept umzusetzen)?
	Sind diese zugunsten des Schwammstadt Konzepts?
	Wie effektiv ist die Machtverteilung zwischen den verschiedenen Interessengruppen um die erfolgreiche Umsetzung der Schwammstadt Maßnahmen zu gewährleisten?
<b>Reflexion</b>	Was sind die wichtigsten Hindernisse und Chancen mit Blick auf die Zukunft?
	Was kann man von Oldenburger lernen?
	Gibt es etwas, das ich Sie bisher nicht gefragt habe, das Sie aber für wichtig halten?
<b>Schneeballeffekt</b>	Wen sollte ich Ihrer Meinung nach noch befragen, um einen guten Einblick in die Governance-Regelungen in Oldenburg in Bezug auf das Schwammstadtkonzept zu bekommen?
	Was sind Ihrer Meinung nach die wichtigsten politischen Dokumente, in die ich in diesem Zusammenhang schauen sollte?

## Appendix B – Code book

The following Table B presents the code book developed for the analysis of the data. The left column contains the respective dimensions of the PAA, reflections, and lessons learned. Each dimension is further divided into deductive and inductive codes. The right column contains the codes used. In order to stay close to the literature the coding was conducted in English.

Table B. Code book containing the dimension, reflexions, and lessons, categorised into deductive and inductive codes.

<b>Dimension</b>	<b>Codes (deductive/inductive)</b>
<b>Discourse</b>	
Deductive	Objectives of current water management
	Key projects and strategies and alignment with SCC
Inductive	Lack of dynamism in the water debate Comparison of water and energy issues; lower priority of water
	Paradigm shift (change in the use of resources and influence of extreme weather events)
	Political and social pressure (lack of pressure from civil society; need to put water on the political agenda)
<b>Actors and Coalitions</b>	
Deductive	Who are the public and private actors
	Collaboration between actors
	Actors preventing the implementation of the SCC
Inductive	Distribution of responsibilities
	Fragmentated structures
	Lack of a systematic approach (individual measures instead of harmonised concepts)
	Deficits in coordination (lack of integration of stakeholders)
	Randomness of realisation (dependence on individuals and actors)
<b>Rules of the Game</b>	
Deductive	Formal rules (laws, policies supporting or hindering SCC)
	Informal rules (informal norms, habits, relationships)
Inductive	Barriers due to existing regulations (conflicts in legal responsibilities)
	Barriers to adapting water policies (lack of acceptance of measures; inertia in switching from technical to adaptive concepts)
	Bureaucracy challenge
<b>Power and Resources</b>	
Deductive	Financial support
	Available policy instruments
	Availability of resources: finances, personnel, knowledge
	Training and education opportunities

	Public involvement and awareness
	Decision-making powers
	Distribution of power
Inductive	Technical challenges (limits of existing infrastructure)
	Dependence on funding; pilot projects are often dependent on external funding
<b>Reflections and Lessons</b>	Main barriers and opportunities
	Lessons learned from Oldenburg

## Appendix C – Translated quotes from the interviews

The quotations used in this study are listed in Table C. In the first column, the pseudonym each interviewee was assigned with, in order to ensure anonymity, is provided. The second and third column provide the translated quote, used in Chapter 4 of this study and the original German quote. This was done to avoid losing meaning or citing quotes that have been misinterpreted.

*Table C. Quotes used for the analysis in their original version, translated and listed according to the pseudonym of the owner.*

<b>Pseudonym</b>	<b>Translated quote (EN)</b>	<b>Original quote (DE)</b>
<b>P1</b>	Oldenburg has the problem that the water supply in the city has a kind of insular situation. The three VWG waterworks are not very well connected to each other and are not networked at all with the pipeline system of the surrounding water suppliers. [...] This means that if one waterwork fails, this can relatively quickly lead to the overall water supply in the city collapsing	Oldenburg hat halt einerseits das Problem, dass die Wasserversorgung in der Stadt eine Art Inselsituation hat. Die drei Wasserwerke der VWG sind hier in der Stadt Oldenburg wenig untereinander verbunden und gar nicht vernetzt mit dem Leitungssystem der umliegenden Wasserversorger. [...] Das heißt, wenn ein Wasserwerk ausfällt, dann kann das relativ schnell dazu führen, dass insgesamt die Wasserversorgung in der Stadt zusammenbricht.
<b>P1</b>	I think people have realized that this self-evidence, especially here in the northwest, that we always have water and sometimes we have too much water, can also turn into the opposite.	Da ist den Leuten, glaube ich klar geworden, dass diese Selbstverständlichkeit, vor allen Dingen hier im Nordwesten, wir haben immer Wasser und manchmal haben wir zu viel Wasser, dass das auch ins Gegenteil umschlagen kann.
<b>P2</b>	I am responsible for protecting my property to a certain extent and if I have a lowered entrance, then it will leak inside. [...] It's my own fault. And I don't think many people realize that this is the case.	Da bin ich eben als Besitzer, als Hausbesitzer dann verantwortlich dafür, Objektschutz bis zum gewissen Grade zu machen und wenn ich einen tiefergelegten Eingang habe, dann läuft das rein. [...] Da bin ich selbst schuld. Und das ist glaube ich vielen nicht bewusst, dass das so ist.
<b>P2</b>	When it comes to water, everyone points to the OOWV and says, that it is the expert in the city. They ought to do something.	Wenn es ums Thema Wasser geht. Dann zeigen alle auf den OOWV und sagen, das ist doch der Experte in der Stadt. Die sollen mal machen.
<b>P2</b>	As German citizens, we always like to point out: 'the city has to do this' and 'we pay for it' and 'why don't they do it'?	Da zeigen wir eigentlich so als deutsche Stadtbürger immer ganz gerne auf, hier das muss doch die Stadt machen und wir bezahlen doch usw. und warum machen die das nicht?
<b>P2</b>	People still rely too much on the technical things that supposedly worked well in the past.	Und da verlässt man sich dann doch zu sehr noch auf die technischen Dinge, die in der Vergangenheit angeblich gut funktioniert haben.

<b>P2</b>	There is no overarching objective, no overarching strategy.	Insofern gibt es nicht das übergeordnete Ziel, die übergeordnete Strategie.
<b>P2</b>	There is a strategy behind it and there is the political will to implement it. In other words, top-down, yes, we want that. We want to become resilient. We want to work in a climate-adapted way, we want to invest in it.	da steckt eben auch eine Strategie dahinter und da steckt der politische Wille dahinter, dass man das umsetzen möchte. Also Top-down, ja, wir wollen das. Wir wollen resilient werden. Wir wollen klimaangepasst arbeiten, wir wollen dafür investieren.
<b>P2</b>	In principle, the structures are there if they were applied well. The guidelines to think more in terms of the Sponge City and also to implement things. But we have to do it.	Ich glaube, dass im Prinzip die Strukturen, die gibt es, wenn man das gut umsetzt, diese Richtlinien, um eben auch mehr Richtung Schwammstadt zu denken und da auch Dinge umzusetzen. Aber wir müssen es dann auch tun.
<b>P2</b>	The more regulations you impose, the more difficult it becomes. In this respect, I believe that overall, this is also an important braking factor.	Und je mehr Auflagen man macht, umso schwerer wird es natürlich noch mal. Insofern glaube ich, ist das auch ein wichtiger Bremsfaktor insgesamt.
<b>P2</b>	There are many resources that we don't use because it's exhausting to apply for them, manage the funds, and adhere to EU-level rules. Instead, we just say, 'It's too much effort; things have worked fine as they are.'	Es gibt eben auch viele Ressourcen, die wir gar nicht nutzen als Oldenburg oder als deutsche Kommune, weil das vielleicht anstrengend ist, die zu beantragen und die Gelder zu verwalten und irgendwelche Regeln auf EU-Ebene einzuhalten. Und dann sagen wir lieber ach, das ist uns alles zu anstrengend. Hat doch so auch funktioniert
<b>P2</b>	There are funding programs from the City of Oldenburg for unsealing surfaces, for the conversion of areas. However, in my opinion, these are not attractive enough for many citizens to take advantage of them. There should certainly be done more	Es gibt ja auch gewisse Förderprogramme von der Stadt Oldenburg für Teilentsiedlung, für Umwandlung von Flächen. Die sind aber aus meiner Sicht jetzt nicht so attraktiv, dass sehr viele Bürger drauf anspringen und dass der Hausbesitzer und Grundbesitzer darauf anspringen. Da müsste man sicherlich mehr machen.
<b>P2</b>	I think that really is the main challenge. The knowledge is there, but it's fragmented in different places. We have to bring it together and we have to set off together.	Und das ist, glaube ich, wirklich die Hauptherausforderung, also das Wissen ist da, aber es ist eben fragmentiert bei verschiedenen Stellen da. Die müssen wir zusammenbringen und wir müssen uns zusammen auf den Weg machen.
<b>P3; P5</b>	This is just a drop in the ocean.	Dies ist nur ein Tropfen auf den heißen Stein.

<b>P3</b>	The ditches were created decades ago and this is a drainage culture that suits the region. [...] But over the decades, this system has been destroyed to some extent by the residents, by the high density and by car traffic and parking, which also plays a major role, so that it no longer works.	Die Gräben sind vor Jahrzehnten angelegt worden und das eben eine bestimmte Entwässerungskultur, die in die Region passt. [...] Aber das ist im Laufe der Jahrzehnte, durch die Anliegern, durch die hohe Verdichtung und durch den Autoverkehr und durch auch parkende Autos, das spielt auch eine große Rolle. Ist das ja ein stückweit zerstört worden, so dass es nicht mehr funktioniert.
<b>P3</b>	In a way, water drainage is in their DNA. [...] For decades, it was really only ever about drainage without causing damage. That is their core competence and their main task.	Ich sage mal, dieses Wasser ableiten in den Genen haben. [...] Jahrzehntlang ging es eigentlich immer nur darum, das Wasser schadlos abzuladen, das ist deren Kernkompetenz und deren Hauptaufgabe.
<b>P3</b>	Everything changed a bit in 2018 due to the long drought. People have since looked at things differently than before. The focus is no longer so much on drainage, but also on retention and the availability of water.	Dann hat sich da 2018 durch die lange Trockenheit hat sich das ja alles so ein bisschen gewandelt. Hat man vielleicht anders auf die Dinge geguckt wie vorher. Diesen Fokus nicht mehr so sehr nur auf Ableitung gelegt, sondern eben auch auf die Rückhaltung bzw.. die Verfügbarkeit des Wassers.
<b>P3</b>	There is a lack of [...] large-scale implementation. And that is why, unfortunately, it remains a case of individual pilot or showcase projects. Because the obstacles are there, both in people's minds and in bureaucracy.	Aber es fehlt dann eben [...] es fehlt an der flächendeckenden Umsetzung. Und deshalb ist es leider so, dass es bei einzelnen Pilot- oder Vorzeigeprojekt bleibt. Weil die Hemmnisse sowohl in den Köpfen als auch in der Bürokratie die sind da.
<b>P3</b>	I would say not against but also not in favour, not really in favour of it. If a drainage concept is drawn up accordingly, with all the possibilities that the Sponge City offers, then the lower water authority will certainly not say we won't do it.	Ich sage mal, nicht dagegen, aber auch nicht dafür, nicht wirklich dafür. Also wenn einer jetzt das Entwässerungskonzept entsprechend aufstellt mit all diesen Möglichkeiten, die man hat, die die Schwammstadt bietet, wird die untere Wasserbehörde mit Sicherheit nicht sagen, machen wir nicht.
<b>P3</b>	The DWA 102, which is relatively new, is a bit of a paradigm shift that has now been incorporated into a set of regulations and is therefore state of the art.	Die DWA 102. Die ist ja relativ neu, das ist ja so ein bisschen der Paradigmenwechsel, dass man den jetzt auch in ein Regelwerk gefasst hat und somit Stand der Technik ist.

<b>P3</b>	If we say that retention basins need to be built, that is immediately accepted. But then they also say it has to be semi-natural, with shallow slopes and correspondingly large. These demands are not only coming from us now, but also from the nature conservation authority and the lower water authority.	Wenn wir sagen, da müssen Rückhaltebecken hin, wird das sofort akzeptiert. Und dann wird auch gesagt, dann aber auch naturnah. Dann auch mit flachen Böschungen und entsprechend groß und entsprechend naturnah angelegt. Dann kommen diese Forderungen nicht nur von uns, sondern die kommen jetzt auch von der Naturschutzbehörde und der unteren Wasserbehörde.
<b>P3</b>	Green roofs are funded. But this is again a strain on the municipal budget. [...] So the city often shows good will.	Dachbegrünung wird bezuschusst. Aber klar, das belastet auch wieder den kommunalen Haushalt. Das auch wieder Geld. [...] Also die Stadt zeigt oft guten Willen
<b>P3</b>	I can leave the water in the basin for the time being—Sponge City—it remains on hand, especially in summer. It can evaporate, there is evaporative cooling, and there is also water for irrigation and other things.	Dann kann ich, das Wasser erst mal im Becken drin lassen. Schwammstadt-Konzept. Ich habe es dann zur Verfügung, gerade im Sommer. Dann kann es verdunsten habe Verdunstungskühlung und hab dann Wasser auch für die Bewässerung und für all diese Dinge.
<b>P3</b>	We have a very good mix, and the water sector is pretty well positioned.	Wir haben schon eine sehr gute Mischung und die Wasserschiene ist da schon ziemlich gut aufgestellt.
<b>P4</b>	Open systems that we have, roadside ditches in particular, remain open. [...] The absolute priority is the preservation of open waters.	Die offenen Systeme, die wir haben, Straßenseitengräben insbesondere, das ist die Regel, bleiben offen. [...] Den absoluten Vorrang hat der Erhalt von offenen Gewässern.
<b>P4</b>	We installed [...] warning signs that automatically come on and divert traffic so that cars, cyclists, and pedestrians don't have to drive through mixed water.	Da haben wir jetzt [...] Warntafeln angebracht, die automatisch angehen und die Verkehre so umleiten, dass Autos nicht durch Mischwasser fahren und Radfahrer und Fußgänger auch nicht durch Mischwasser warten/fahren müssen.
<b>P4</b>	If problems arise, there is a brief telephone contact. The problem is discussed. It is usually solved immediately.	Wenn Probleme auftauchen, gibt es einen kurzen telefonischen Kontakt. Das Problem wird besprochen. Es wird in der Regel auch sofort gelöst.
<b>P4</b>	Everyone always relies on the other, saying 'I am not to blame' and points to the other, who is certainly not to blame. [...] I don't know what else needs to happen for people to get a feeling for doing something themselves or having to do something themselves.	Jeder verlässt sich immer auf den anderen oder sagt ich bin nicht schuld und das zeigt dann immer auf den, der dann bestimmt keine Schuld hat daran. [...] Also, ich weiß nicht was noch passieren muss, damit die Leute ein Gefühl dafür bekommen, auch selbst mal was zu tun oder was selbst tun müssen.



<b>P4</b>	Many 'Siel structures' that discharge rainwater into the Hunte, can only drain but not irrigate.	Nun haben wir das Problem, dass viele Sielbauwerke, die zum Beispiel das Regenwasser abschlagen in die Hunte, dass sie nur entwässern können, aber die können nicht bewässern.
<b>P4</b>	So that water management is not just a word but is actively lived by switching the pumps in the other direction.	Das Wassermanagement nicht nur ein Wort bleibt, sondern auch aktiv gelebt wird, indem man nämlich die Pumpen mal in die andere Richtung schaltet.
<b>P4</b>	The water boards have long since realized that this [drainage] is no longer the last word of wisdom.	Die Wasserverbände haben aber schon längst erkannt, dass das nicht mehr der Weisheit letzter Schluss ist.
<b>P4</b>	a wide range of educational opportunities	es gibt vielfältige Weiterbildungsmöglichkeiten,
<b>P5</b>	include a very broad range of ecological and climate stipulations.	um ganz breiten Strauß auch von ökologischen und klimatischen Festsetzungen zu erweitern.
<b>P5</b>	When we draw up new development plans or revise existing development plans, it is now standard practice to always include green roofs, pervious paving or various other measures.	Das heißt, wenn wir jetzt neue Bebauungspläne aufstellen oder auch Bebauungspläne, die im Bestand sind, überarbeiten, dann ist es jetzt standardmäßig so, dass wir immer Gründächer, immer wasserdurchlässiges Pflaster oder verschiedene weitere Maßnahmen da halt standardmäßig mit reinbringen.
<b>P5</b>	We no longer have to discuss things individually with each investor or owner.	weil wir halt dann nicht mehr mit jedem Investor oder jedem Eigentümer einzeln durchdiskutieren müssen.
<b>P6</b>	It's always great for us when people use the data we have, pick out an issue, and then continue to work on topics and provide new impetus for something that we think urgently needs to be looked at, but we don't have time for.	Das ist für uns immer super, wenn da Leute mit den Daten, die wir haben, sich so eine Fragestellung herausgreifen und dann Themen weiter erarbeiten, und neue Impulse reingeben für etwas, wo wir sagen ja, müsste man dringend mal betrachten, haben wir aber keine Zeit für.

<p><b>P9</b></p>	<p>We have been dealing with the effects of climate change. This was particularly pronounced in 2018 and 2019, when many people first realized that something was happening. Although scientists have been warning us for 20 or 30 years, it is only now that the water management problems of climate change have become tangible. [...] The municipal levels are particularly affected, as they are having to contend with considerably heavy, locally very limited precipitation events, as well as increasingly dry months.</p>	<p>...haben wir es mit den Effekten des Klimawandels zu tun. Gerade massiv in den Jahren 2018, 2019, wo ich glaube vielen erst klar geworden ist, dass sich da was tut, wenngleich die Wissenschaftler eigentlich seit 20, 30 Jahren schon warnen und die Effekte in Aussicht stellen, sind es jetzt aber die Jahre, die für uns, sagen wir mal wasserwirtschaftlich, wo die Probleme des Klimawandels zu greifen waren. Auch in einem in den Sommermonaten ist es gerade das, was auch dann die kommunalen Ebenen betreffen, haben wir es oft mit erheblich ergiebigen, lokalen, sehr stark eingegrenzt Niederschlagsereignissen zu tun und wir haben es mit zunehmenden Trockenmonaten zu tun.</p>
<p><b>P9</b></p>	<p>If I don't raise this issue high in the administration and make it an issue of urban development [...], if I don't do that, then I'm not anchoring it in the administration and in city politics. [...] The issue needs to be higher up on the agenda.</p>	<p>wenn ich dieses Thema nicht hoch aufhängen, hoch in der Verwaltung aufhängen und das auch zum Thema der Stadtentwicklung mache [...]. Wenn ich das nicht tue, dann verankert ich das nicht in der Verwaltung und in der Stadtpolitik. [...] Es muss hoch in die Entscheidungsgremien, auf die Entscheidungsträger.</p>
<p><b>P9</b></p>	<p>The key is what you make of it. And laws always have leeway and administrative regulations always have leeway. In my opinion, it's all down to the willingness to overcome supposed obstacles.</p>	<p>Ich denke also, entscheidend ist das, was man daraus macht. Und Gesetze haben immer und administrative Regelungen haben immer Spielräume. Das liegt immer, meines Erachtens, an dem Umsetzungswillen vermeintliche Hemmnisse zu überwinden</p>
<p><b>P9</b></p>	<p>I think that we are currently on the brink of a paradigm shift in water management, on both the municipal and the state level.</p>	<p>Ich denke, dass wir im Moment in der Wasserwirtschaft mitunter auch vor allem sowohl auf der kommunalen als auch auf der Landesseite vor einem Paradigmenwechsel stehen.</p>
<p><b>P9</b></p>	<p>The fee for the rainwater system does not actually play a major role.</p>	<p>Die Gebühr für das Regenwassersystem, spielt eigentlich keine große Rolle.</p>
<p><b>P10</b></p>	<p>When damages occur, who has to take care of it? We always point out that it was not built as planned. And if damages occur, then the actor who wanted it that way has to pay for it.</p>	<p>wenn dann Schäden auftreten, wer sich darum zu kümmern hat. Wir verweisen immer schnell darauf, dass es ja nicht so ausgebaut wurde wie geplant. Und wenn dann eben Schäden auftreten, dann muss eben halt Derjenige dafür aufkommen, der sich das so gewünscht hat.</p>

<b>P10</b>	Roadside ditches are often tricky... The riparian owner usually thinks that it belongs to the road, so the local authority must take care of it. But it may well be that at least half of the roadside ditch belongs to the private property and then the private party must maintain the ditch.	Wegeseitengräben ist häufig knifflig, das... Der Anlieger meint ja immer das gehört zur Straße, da soll sich doch bitte die Kommune drum kümmern. Aber es kann durchaus sein, dass der Wegeseitengraben auch mindestens zur Hälfte, ist ja schon angesprochen worden Grenzgraben, auch zur privat, zum Privatgrundstück gehört und dann hat sich halt auch der Private da mit um diesen Graben zu kümmern.
<b>P10</b>	It consumes resources and costs time. And you produce lots and lots of paper, but nothing is implemented.	Das frisst Ressourcen und kostet Zeit. Und man produziert sehr, sehr viel Papier, Aber es wird nichts umgesetzt.
<b>P10</b>	You have to put in an incredible amount of effort if you want to do something in that field. And there are more and more guidelines and laws that have to be observed and implemented.	Da muss man unheimlich viel Aufwand betreiben, wenn man da etwas machen will. Und es gibt immer mehr Richtlinien und Gesetze, die man zu beachten und umzusetzen hat.
<b>P10</b>	The funds are there, but the directive is not being revised accordingly. And everything is waiting for this to happen and to be able to apply for funds.	Das Geld ist vorhanden, aber die Richtlinie, die wird nicht entsprechend neu entworfen oder neu aufgestellt. Und alles wartet darauf, dass es die gibt oder entsprechend Mittel beantragen zu können.
<b>P10</b>	And next year, maybe the directive will be there but then there will be much more work than there are companies and you won't be able to implement anything at all and all.	Und im nächsten Jahr, sage ich mal, ist dann vielleicht die Richtlinie da und dann ist viel mehr an Arbeit da, als es denn Firmen gibt und dann kriegt man das gar nicht so umgesetzt
<b>P11</b>	For decades or perhaps even centuries [...], it was always about drainage. Today, however, we need to consider not just drainage but also how we can repurpose our infrastructure to retain and even irrigate when needed.	Man hatte Jahrzehnte oder vielleicht sogar Jahrhunderte [...] immer entwässert. Und heute muss man halt gucken, dass man nicht nur entwässert, sondern dass man die Infrastruktur, die man zum Entwässern benutzt, auch wieder zum Bewässern nutzen kann.
<b>P11</b>	Our problem is that we don't get the people into our events who actually need to hear about it.	Die Leute, die wir jetzt eigentlich in Führungsstrichen belehren müssten und die darauf aufmerksam machen, das geht so nicht, die kommen nicht, die kriegen wir nicht.
<b>P12</b>	Retrofitting [...] can sometimes be very difficult, especially in areas with background development where large excavators can no longer access the site.	Die Nachrüstung [...] kann manchmal sehr schwierig sein, vor allem in Gebieten mit Hintergrundbebauung, wo große Bagger nicht mehr an das Gelände herankommen können.

<b>P12</b>	In the past, building permits provided for very tight development and encouraged sealing. Only now, in recent years, have the individual building areas been looked at again in detail and rededicated to meet the new requirements.	In der Vergangenheit sahen die Baugenehmigungen eine sehr enge Bebauung vor und förderten die Versiegelung. Erst jetzt, in den letzten Jahren, werden die einzelnen Baugebiete wieder genauer betrachtet und den neuen Anforderungen entsprechend umgewidmet.
<b>P12</b>	There are attempts to promote the purchase of a rain barrel or rainwater retention measures such as cisterns with the help of incentives and funding incentives. That's great, that's fantastic.	Es gibt Ansätze, den Kauf von Regentonnen oder Regenwasserrückhaltemaßnahmen wie Zisternen mit Hilfe von Anreizen und Förderungen zu unterstützen. Das ist großartig, das ist fantastisch.

## Appendix D – Documents for the media analysis

Table D provides the documents analysed for this study. The first column shows the number assigned to each article used in chapter 4. Column two and three present the Headline first in the original language, German, and second translated to English. The next three columns contain, in this order, the publisher, the date and the author.

Table D. Quotes used for the analysis during chapter 4.

Nr.	Headlines (DE)	Headline (EN)	Publisher	Date	Autor
1	Wie Brake zur Schwammstadt werden will Förderung Fragen und Antworten zum geplanten Naturbad	<b>How Brake wants to become a sponge city - Promotion, questions, and answers about the planned natural pool</b>	Nordwest-Zeitung	07.06.2024	Christian Quapp
2	Brake bekommt Naturbad mit Starkregen-Speicher	<b>Brake gets a natural pool with stormwater storage</b>	Nordwest-Zeitung	06.06.2024	Christian Quapp
3	Wie norddeutsche Städte sich auf Hitzewellen vorbereiten	<b>How northern German cities are preparing for heatwaves</b>	NDR	05.06.2024	n.d.
5	Mit dem Fahrrad in Oldenburg dem Klimawandel auf der Spur	<b>Cycling in Oldenburg to trace climate change</b>	Nordwest-Zeitung	11.04.2024	Thomas Husmann
6	Mit dem Fahrrad in Oldenburg dem Klimawandel auf der Spur	<b>Cycling in Oldenburg to trace climate change</b>	Nordwest-Zeitung	07.12.2023	Thomas Husmann
7	Der Herr des Wassers geht in den Ruhestand	<b>The master of water retires</b>	Nordwest-Zeitung	30.05.2023	Thomas Husmann
8	Umgang mit Wasser wird wichtiger – „Augen nicht verschließen“	<b>Dealing with water is becoming more important – "Don't close your eyes"</b>	Nordwest-Zeitung	25.05.2023	n.d.
10	OOWV verlegt am Flötenteich einen neuen Regenwasserkanal	<b>OOWV installs a new rainwater channel at Flötenteich</b>	Nordwest-Zeitung	28.04.2023	Thomas Husmann
11	Land unter am Möwenweg in Oldenburg	<b>Flooding at Möwenweg in Oldenburg</b>	Nordwest-Zeitung	20.03.2023	Thomas Husmann
13	Oldenburger Volkshochschule hat den Klimawandel im Blick	<b>Oldenburg Adult Education Center focuses on climate change</b>	Nordwest-Zeitung	17.01.2023	n.d.
17	Wie schwammig ist Oldenburg?	<b>How "spongey" is Oldenburg?</b>	Nordwest-Zeitung	24.09.2022	Johanna Hausmann
18	Es kommt auf die Zahl der Wohnungen an	<b>It depends on the number of apartments</b>	Nordwest-Zeitung	13.09.2022	Thomas Husmann
19	Wenn der Himmel die Schleusen öffnet...	<b>When the heavens open their gates...</b>	Entsorga Magazin	01.03.2022	Annette Meyer, Jens de Boer, Jannick Tiemann

20	Kampf gegen große Überschwemmungen	<b>Fight against major floods</b>	Nordwest-Zeitung	23.08.2021	Thomas Husmann
21	Wann wird Regen hier lebensgefährlich?	<b>When will rain become life-threatening here?</b>	Nordwest-Zeitung	22.07.2021	Susanne Gloger
22	Ohne Kooperation und neue Ideen geht es nicht	<b>It doesn't work without cooperation and new ideas</b>	Nordwest-Zeitung	09.04.2021	n.d.
23	AEG-Gelände wird zur Schwammstadt Stadtentwicklung OOWV sorgt mit Speicher und Becken für zeitgemäße Oberflächenentwässerung	<b>AEG site becomes a sponge city - Urban development: OOWV ensures modern surface drainage with storage and basins</b>	Nordwest-Zeitung	03.11.2020	Thomas Husmann
24	Wohin mit dem Wasser?	<b>Where to put the water?</b>	Nordwest-Zeitung	04.09.2020	Lea Bernsmann
25	Innovative Projekte am Wasser	<b>Innovative projects on water</b>	Nordwest-Zeitung	04.09.2020	n.d.
26	Kreyenbrück als großer Schwamm	<b>Kreyenbrück as a large sponge</b>	Nordwest-Zeitung	25.09.2019	Susanne Gloger
27	So soll kostbares Regenwasser in der Fläche gespeichert werden	<b>How precious rainwater should be stored in the area</b>	Nordwest-Zeitung	25.04.2023	Anke Brockmeyer
28	Kampf gegen die großen Überschwemmungen	<b>Fight against major floods</b>	Nordwest-Zeitung	23.08.2023	Thomas Husmann
29	Wie eine „Schwammstadt“ Oldenburg Regenwasser speichern könnte	<b>How a "sponge city" could store rainwater in Oldenburg</b>	Nordwest-Zeitung	22.09.2022	Johanna Hausmann
30	Ausgezeichnet – Diese Gräben erfüllen ihre Funktion	<b>Award-winning – These ditches serve their purpose</b>	Nordwest-Zeitung	01.08.2022	n.d.
31	Begrünte Dächer helfen gegen Sturzfluten	<b>Green roofs help against flash floods</b>	Nordwest-Zeitung	05.01.2020	Thomas Husmann

## Appendix E – Documents for the media analysis

In the following Table E the policy documents, their date of issue and respective objectives used for this study are presented. The column of the date of issue provides no dates for ordinances as they are considered extensions to the respective law and therefore according to German law need no date of issue. The regulations have no date of issue as well, as they are they are a collection of regulations, each regulation coming with different publication dates.

*Table E. Selected policy documents for the analysis.*

<b>Law/ Regulation</b>	<b>Date of issue</b>	<b>Objective</b>
<b>Water Resources Act</b>	2009	To protect water bodies as part of the ecosystem, as basis of human life, as habitat for animals and plants and as resource through sustainable water management.
<b>Lower- Saxony Water Resource Act</b>	2010	Regulates the protection and sustainable use of water resources in Lower Saxony in order to maintain the ecological status of water bodies and ensure their use for people and nature.
<b>Waste Water Charges Act</b>	1976	To create financial incentives to reduce the pollutant load of wastewater discharged into water bodies.
<b>Surface Water Ordinance</b>		To protect surface waters and the economic analysis of the uses of waters.
<b>Groundwater Ordinance</b>		To protect groundwater from contamination and to ensure its quality.
<b>Waste Water Ordinance</b>		Regulates the discharge of wastewater into bodies of water.
<b>Federal Nature Conservation Act</b>	2009	Protecting and developing nature and landscapes.
<b>Soil protection Act</b>	1998	sustainably safeguarding or restoring the functions of the soil
<b>Federal Waterways Act</b>	1968	To regulate the management, development and operation of federal waterways to ensure their navigability and to safeguard public interests.
<b>Inland Waterways Act</b>	1895	Regulates rights, duties and liability in inland navigation in order to ensure safety and clear responsibilities.
<b>Water framework directive</b>	2000	Comprehensive protection and sustainable management of surface and underground waters of all EU member states.
<b>Haaren Water and Soil Board Statute</b>	1995	Semi-natural development and maintenance of water bodies, flood protection, as well as the care and protection of nature, soil and landscape.
<b>Hunte Water and Soil Board Statute</b>	1995	To manage, maintain, and develop water bodies of the II. order and, where assigned, the III. order within its jurisdiction, ensuring flood protection and promoting ecological balance.
<b>Wüstring Water and Soil Board Statute</b>	1995	The development, semi-natural restoration and maintenance of water bodies of the II. and III. order, insofar as these are owned by the board or is obliged to maintain them.

<b>Moorriem-Ohmsteder Siel Water and Soil Board Statute</b>	2008	To manage and maintain designated water bodies of the II. and III. order, focusing on ecological preservation and flood protection.
<b>OOWV Statute</b>	2010	Define the organization, tasks and responsibilities for potable water and wastewater supply and water protection
<b>Federal Building Code</b>	1960	Governing construction planning
<b>Federal Land Utilization Ordinance</b>		Complements the Federal Building Code and specifies its requirements
<b>DWA Regulations</b>		To provide standardised technical rules for the effective and economical protection of material assets and the environment as well as for quality assurance in technology, business, science and administration (Voluntary work).
<b>DVWG Regulations</b>		To provide DIN standards for all technical and scientific activities in the gas and water sector



## Appendix F – Letter of consent for the interviews

The following figure A presents the translated version of the letter of consent the interviewees signed in order to agree to the participation and recording.



university of  
 groningen

### Agreement to participate - Research Ethics Committee (REC)

in research project:

**Title:** Sponge City Oldenburg: How to enable the transition towards the Sponge City Concept via Governance Arrangements

**by** Lena S. Sept

The master's thesis with the above title deals with concepts of urban water management. The aim of my research is to identify improvements and gaps in governance arrangements that enable the implementation of the Sponge City Concept in Oldenburg.

- I have read and I understand the information sheet of the research project.
- I understand that taking part in this research is voluntary and that I have the right to withdraw from it up to three weeks after the interview, as well as to decline to answer a question I do not wish to answer.
- I understand that my participation in this research is confidential. Without my prior consent, no material, which could identify me, will be used in any reports generated from this study.
- I understand that the interview data will be used in a master thesis publicly available on the University of Groningen website and may be used in academic articles, book chapters, published and unpublished work and presentations.
- I understand that all information I provide will be kept confidentially either in a locked facility or as a password protected encrypted file on a password protected computer.

Please highlight with **highlighting/circling** YES or NO to each of the following:

I consent to my interview being audio-recorded YES / NO

I wish to remain anonymous for this research YES / NO

**If YES**

My first name can be used for this research YES / NO

**OR**

A pseudonym of my own choosing can be used in this research YES / NO

If you wish to choose own pseudonym, please mark it here:

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**"I agree to participate in this interview and acknowledge receipt of a copy of this consent form and the research project information sheet."**

Signature of participant: \_\_\_\_\_ Date: \_\_\_\_\_

**"I agree to abide by the conditions set out in the information sheet and I ensure no harm will be done to any participant during this research."**

Signature of researcher: \_\_\_\_\_ Date: \_\_\_\_\_

Figure A. Letter of consent for the interviews.

