Ecologically Sound Urban Water Governance

Towards a successful integration of ecology in urban water governance, an analysis of required capacities

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Abstract:
Nowadays urban water governance is becoming more and more important. However, it is unknown how to effectively include ecology in urban water governance because ecology is a relatively new subject. There are however cities across the world that seem to be doing relatively good on the subject of ecological water governance. These cities can teach us how to effectively implement ecology in urban water governance. These cities are the frontrunner cities when it comes to ecologically sound urban water governance, and they can be compared to the cities that are struggling to implement ecology in their governance. This comparison has shown that there are a couple points that seem to be very important when it comes to ecologically sound urban water governance. Collaboration, production and sharing of cohesive knowledge, authority, and the presence of agents of change are important indicators of ecologically sound urban water governance.

Keywords: 'Urban Water Governance' 'Ecologically Sound' 'Urban Ecology' 'Urbanization' 'Systems Thinking'

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1. Introduction

1.1 The importance of ecologically sound urban water governance

Urban water governance has become increasingly focused on the environmental and ecological value of water (UN, 1992), the social value of water, which includes human rights (UN, 2000), and the economic value of water (UN, 1992). Additionally, more recently there have been callouts to increase and improve water governance and policy integration. Current urban water governance is primarily focused on the removal of wastewater and flood prevention (Mitchell, Mein & McMahon, 2001). However, ecologically sound urban water governance depends on a lot more than flood prevention and wastewater removal.

The term ecologically sound urban water governance in itself has not been defined before. The definition of the word ecology will be used to define the term 'ecologically sound'. According to Odum & Barrett (1971) the definition of ecology is "the totality or pattern of relations between organisms and the environment". Thus 'ecologically sound' means that something is done with this relation or pattern between organisms and the environment in mind. Olsson & Head (2015) define 'Water Governance' as "the included institutions, organization, policies, and practices, which shape and manage water resources, including the delivery of water services for diverse populations and industries.". Taking all this into account, Ecologically Sound Urban Water Governance is, in this paper, defined as "The institutions, organizations, policies, and practices, which shape and manage water resources in a way that takes the relations or patterns between organisms and the environment into consideration".

The importance of ecologically sound urban water governance mainly stems from the current interconnectedness of the urban environment and ecology. For example, it is said that even short-term visits to urban nature environments can have a positive effect on stress levels (Tyrväinen et al, 2014). Furthermore, urban ecology is currently a well-established science (Breuste, Qureshi & Li, 2013), and therefore as a science urban ecology is becoming more relevant. For this reason ecologically sound urban water governance and urban ecology are connected.

1.2 Knowledge gap and research objective

Knowledge gap

Over the years urban water management has become broader and increasingly embedded in socio-ecological systems thinking. Humans and the environment are increasingly linked, and influence each other's quality (Moore et al, 2014). As said in the introduction, urban water management is currently primarily focused on wastewater removal and flood prevention. More recently ecosystems are also recognized as having functions that benefit the health of humans and their well-being (Dieperink et al, 2016). However, it is currently unknown which key factors and capacities are put in place by cities to assure that their urban water governance is ecologically sound.

Current research is primarily focused on the necessities of ecological governance in urban areas. Guerry et al (2015) speak of an interdependence of ecosystems and human well-being. Gunderson & Light (2006) speak of the necessity of adaptive management regarding environmental issues in urban areas. And Kremer, Hamstead & McPhearson (2016) speak of the idea that urban governance should be focused on ecosystem services. These are all examples of recent research related to urban water governance. These points indicate that there is a clear necessity of ecologically sound urban water governance, however there is a clear knowledge gap on how to effectively achieve this.

Urban water governance is a very complex and intricate system, in which multiple governance modes can be discerned (Driessen et al, 2012). However, it is unclear which governance modes are involved in this progress, how their capacities perform, and which factors contribute to their capacities. Whether a combination of certain governance mechanics, or unique governance capacities increase the performance is unclear.

Research Objective

This research aims to address this knowledge gap by analyzing frontrunner cities in the field of ecologically sound urban water governance, and compare them to 'straggler' cities, which are cities that have fallen behind on the development of ecologically sound urban water governance. The end objective of this study is to use the results of the research to create recommendations on how these cities can improve their ecological water governance. Achieving the research objective and successfully filling up the knowledge gap makes this research scientifically relevant because it contributes to the scientific literature on how to effectively make urban water governance more ecologically sound. Furthermore, the recommendations that will stem from this research will help make their urban water governance more ecologically sound, making the research relevant to society.

1.3 Main question and research steps

Research question and framework:

In order to meet the research aim the following question must be answered:

What capacities should cities have in order to perform well in ecologically sound water management?

Figure 1 below shows the backbone of the research, with the arrows more or less indicating the flow of research over time. In figure 1 it is thus shown that the literature review has influence on the governance capacity analysis, but not on the city blueprint assessment. This means that the arrows are essentially a step taken in the research. The textboxes above and beside the arrows explain the information that is gathered during the research step.

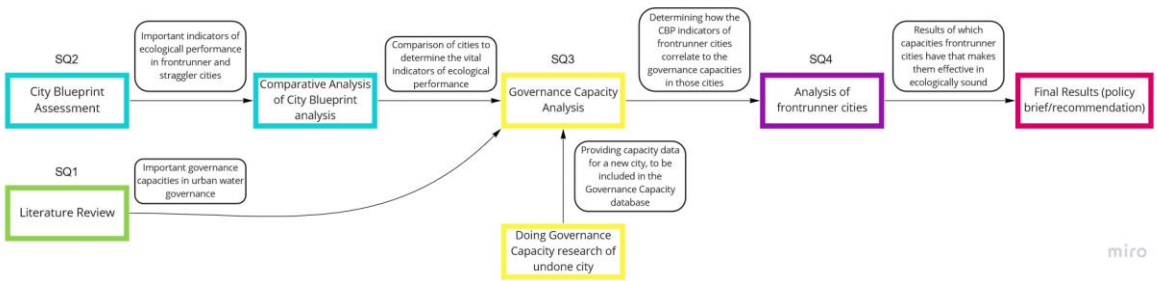

Figure 1: Research Framework, with the arrows indicating the flow of the research over time.

Answering the main question will be done step by step.

Firstly, a literature review will be done to find information on important factors that contribute to governance capacities that are already in place in frontrunner cities or lacking in straggler cities (SQ1). Secondly, the City Blueprint Framework (CBF) approach will be used to find relevant indicators of ecological performance. These indicators will be used in order to find which cities are frontrunners and which cities are stragglers regarding ecologically sound urban water governance. (SQ2). In the third step of the research the first two steps come together, as their information is necessary to perform the frontrunner/straggler analysis. This analysis looks at the difference in governance capacities between frontrunner and straggler cities (SQ3). Additionally, one city on which there is no governance capacity data available yet will be analyzed more in-depth. Lastly, the results of the case study will be compared to the results of the frontrunner-straggler analysis. This comparison will clearly show which capacities are in place in frontrunner cities to warrant their performance regarding ecologically sound urban water governance (SQ4).

The above implies that the following sub-questions must be answered:

1. Which factors contribute to the governance capacities necessary for ecologically sound urban water governance?
2. Which City Blueprint indicators are important for ecologically sound urban water governance, and how do frontrunner cities score on them compared to straggler cities?
3. How do the City Blueprint indicators correlate to the capacities in the relevant cities?
4. How do the frontrunner cities perform in ecologically sound urban water governance, and which capacities are in place to warrant their performance?

1.4 Outline of the report

Following the knowledge gap and the research objectives the following chapters will be discussed. In Chapter 2 the first subquestion 'Which factors contribute to the governance capacities necessary for ecologically sound urban water governance?' will be answered. This is done through a literature review of existing research on urban ecological water governance. The next chapter, chapter 3, will serve as a theory section for the City Blueprint approach and the Governance Capacity approach. the two frameworks that are used for the research on ecologically sound urban water governance. Chapter 4, the method section, will discuss how the empirical research will be handled. Additionally, the section will also explain how the case study will be done. Furthermore, this chapter also concerns itself with indicating which City Blueprint indicators are relevant in this research. Chapter 5 concerns itself with the results of the research. In this chapter sub questions 2, 3, and 4 will be answered. Additionally, this section will also showcase the results of the case study. Chapter 6 is the discussion, this chapter will serve as a synthesis for the results. All the sub questions will come together to form the answer for the main research question; 'What capacities should cities have in order to perform well in ecologically sound water management?'. Furthermore, in this chapter the shortcomings and further implications will also be discussed. The final chapter is the conclusion, and this chapter will offer concluding remarks after the entire research has been done. In addition to the concluding remarks a set of recommendations will be given on how to successfully integrate ecology in urban water governance.

2. Governance capacities for ecologically sound urban water governance, a literature review

2.1 Introduction

While ecologically sound urban water governance is an under researched topic, governance capacities and the factors that contribute to it are not. In order to better understand governance capacities in urban water governance and to answer the first subquestion a literature review has to be done to see which factors may contribute to the governance capacities necessary for ecologically sound urban water governance. The first step of the research is the literature review which is meant to answer sub-question 1. A thorough, preliminary literature review on governance capacities regarding ecologically sound urban water governance will be done. This is done in order to find out whether there is scientific information regarding capacities already in place, and to find more information on the topic of ecological management. For the literature review the scientific search engine Scopus will be used. However, in some cases the relevant literature cannot be accessed through scopus, in which case they will be accessed through google scholar. While using the search engines specific keywords are used. These keywords included: “Governance capacity”, “Ecological management”, “Ecologically sound”, “Nature based solutions”, “Urban Water Management”, and combinations of these keywords that simply used governance and ecology as an extra. A total of 11 relevant papers have been found. Furthermore, the resulting literature is first arranged according to the amount of citations the literature had. This was done to find the most relevant, and the most reliable literature. Secondly the literature is arranged according to time, to make sure that recently published literature is also included in the research. At the end of the literature review a synthesis of all the reviewed papers will be made in order to find how the papers correspond with each other, ending with a conclusion on which factors contribute the most to governance capacities surrounding ecologically sound urban water governance. The next sections include the literature review, in which the relevant papers are explained, and their relevance for this research is analyzed.

2.2 Constanza et al (1997). The value of the world's ecosystem services and natural capital.

The services of ecological systems are critical to the functioning of the earth. Ecosystem services contribute a very significant amount to human welfare (Constanza et al, 1997). However, ecosystem services are often not captured in market functions, or quantified in the same sense, therefore they are often neglected or given very little weight in policy decisions (Constanza et al, 1997). They suggest that natural capital stock that produces the ecosystem services is given more weight in the decision-making process. They state that giving ecosystem services a monetary value ($16-53 trillion annually) is unrealistic, as this is 1.8 times the global GNP. However, it would be feasible to have ecosystem services paid for when it is used, either by damaging it or benefitting from it. Whether a quantified value can be put on urban water ecology is unknown, however it is evident that ecosystem health is directly related to the economic development of a region (Han, Li & Zhang, 2019). This would mean that even though a quantified value is not possible, a qualitative value could be possible. What benefits would ecologically sound water management bring, and are these benefits actually valued in a society.

Constanza et al (1997) considers ecosystem valuation as an important factor to give ecosystems more weight in policy decisions. As interpreted from the article, it can be assumed that these policy decisions include the decisions made regarding ecologically sound urban water governance. As such, the valuation of ecosystems should be considered important.

2.3 Vos & Meekes (1999). Trends in European cultural landscape development: perspectives for a sustainable future.

Over the centuries there has been a lot of landscape use throughout Europe, with many of these landscapes being cultural landscapes with high qualities. However, the economic feasibility of the management practices these landscapes fall under has deteriorated. In this paper a comprehensive overview of landscape use in the past has been done, including the various ways in which people have regarded their landscape and the ever changing attitude towards landscape (Vos & Meekes, 1999). Furthermore, they state that perspectives for a sustainable future for historic European cultural landscapes are based on a couple of observations: society's demand for multifunctionality; the inclination of farmers to meet this demand of it economically profitable; decentralization of landscape ruling and legislations, which favors regional solutions; and perhaps most importantly, ecologically sound management (Vos & Meekes, 1999). Vos & Meekes also made a list of recommendations to increase the likelihood to meet the aforementioned observations: 1) To make economic development and ecological scientific research equal on a temporal scale and spatial scale. Currently scientific research lags behind economic development, and the main reason for that is a scaling issue. Scientific research often does not scale well, which means that the translation from insights from different scales needs extra attention. 2) Interdisciplinary integration. The spatial dimensions of landscape ecology require attention from multiple disciplines, such as economics, sociology, public administration and multiple sciences. 3) An increase in interaction between stakeholders, decision makers, and researchers. The importance of this tactic revolves around preventing a solution from being one-sided due to one of the three having more input. 4) Research on water systems. In order to create solutions for the problems arising within landscapes thorough knowledge of water systems is needed. This includes the knowledge of ecological and hydrological water systems such as the processes, environmental conditions, effects of climate change on relevant ecosystems etc. 5) Research on regulation functions. These functions regard themselves with the capacities of ecosystems to self regulate; the way an ecosystem regulates essential ecological processes and life support systems (Vos & Meekes, 1999). Knowledge of these processes will result in ecosystem maintenance of high quality. 6) Differentiating between the values of landscapes. This means that landscapes can be perceived as having values from different dimensions. For example, landscapes can be perceived as having inherent and historical value, but can simultaneously have value as a tool for monitoring certain ecological functions. Furthermore, values such as the perception of landscape by its inhabitants and the relation it has with the inhabitants are also important. 7) Science of public administration and how it relates to landscape research. This concerns itself with administrative boundaries such as the boundaries between urban and rural areas, but also these boundaries related to the boundaries of water systems, such as floodplains. It is important to create an administrative map surrounding these boundaries in order to come up with solutions related to them. 8) Socio-economic planning and research related to landscape. The importance of nature is still not reflected in economic planning and decision making. While it is understandable that businesses and societies have to have a high regard for profit, the intrinsic value of nature is often neglected. For example the financial requirements for conservation and development of natural systems.

Vos & Meeskes give a very comprehensive breakdown of the necessities for sustainable development. And while their paper is primarily about cultural landscapes, sustainability bridges their paper to this research. As such, the recommendations that come from this research are assumed to apply to ecologically sound urban water governance too. Vos & Meeskes mention

multiple factors that are important for ecological governance surrounding cultural landscapes. These factors include ecosystem valuation, equalized scaling, knowledge cohesion, stakeholder inclusiveness, and scientific involvement.

2.4 Pahl-Wostl & Hare (2004). Processes of social learning in integrated resources management.
Pahl-Wostl & Hare have, in this research, used a new approach to integrate social learning into management modeling. Their approach is called participatory agent based social simulation. This model differs from conventional modeling in that it includes the actors represented in the model into the modeling process. Not only do they participate in the modeling process, they are also supposed to later use this model themselves, thus it is only logical that they help build the model. The notion of social learning has come forth from the increasing evidence that the human dimension plays a key role in resource management, which means that an integrated approach is necessary. It is thus implied that resource management is not looking for the optimal solution, but is rather in the process of learning and negotiation. High priority is given to communication, perspective sharing and development of adaptive group strategies for problem solving. This process has become known as social learning. A case study was done in Switzerland in which a new management strategy for urban water management was to be developed. From that case study multiple important points came forward. These points include: 1) Awareness of each others' perspectives and goals. 2) Understanding actors' mutual interdependence and system complexity (perspective sharing). 3) Learning to work together. 4) And lastly, trust.

Considering their results come from the case study on new management strategies for urban water management in Switzerland it can be assumed that the important points in the results also apply to ecologically sound urban water management. The reason for this is that the model they used applies to management in general. The important factors are collaboration and stakeholder inclusiveness. They consistently state that working together and being aware of each others' perspectives is important when developing new management strategies, to ensure that governance capacities stay or become relevant when transitioning towards more ecologically sound management.

2.5 Patz et al (2004). Unhealthy landscapes: policy recommendations on land use change and infectious disease emergence.
Patz et al. speak of the consequences of land use change and how they can drive a range of infectious disease outbreaks and emergence events. The drivers for these outbreaks and events include encroachment, deforestation, road construction, dam building, irrigation, wetland modification, mining, the concentration or expansion of urban environments, coastal zone degradation, and other activities (Patz et al, 2004). As concluding solutions for this they speak of a working group that uses collective knowledge, and collaborative agents in order to tackle ecological challenges, which includes ecological challenges as a consequence of urbanization. This working group consists of three different initiatives that focus on health challenges, scientific integration, and a working ground for policy implementation. Even though their research is mainly focused on issues of land use and infectious disease emergence, land use is also a prominent factor in urbanization, and these infectious diseases also reach urban areas (Patz et al, 2004). Moreover, they speak of knowledge transfer to local communities to increase their knowledge of the links between environmental change and public health (Patz et al, 2004).

This article mainly revolved around land use change and infectious diseases outside of urban areas. However, the authors also state that urban areas are prone to the effects of land use and infectious diseases. Therefore it can be assumed that urban areas also require a high degree of collaboration and knowledge sharing. Thus it is important that urban water governance creates an interdisciplinary playing field where policy makers, scientists, citizens and other stakeholders can come together to make ecologically sound urban water governance possible. This means that they consider the factors of collaboration and stakeholder inclusiveness as important. When looking at or developing governance capacities for ecologically sound urban water governance it is thus important to take these factors in consideration.

2.6 Drew (2005). Use of traditional ecological knowledge in marine conservation.

Drew (2005) puts even more emphasis on the importance of knowledge. By using knowledge that has accumulated through many generations, in a traditional sense, ecological management can be enhanced. Most biologists that are relevant in these areas are trained in different methods, and are used to interpreting data differently. Therefore traditional ecological knowledge can be of help by giving data a baseline per area. Native and traditional knowledge comes in the form of very specific knowledge about the land or waters in a specific area. This knowledge can be translated into ecological management strategies that target specific areas that require more attention (Drew, 2005). Traditional ecological knowledge is complex knowledge that has been passed down over a long period of time. This knowledge encompasses regional knowledge on for example hunting, medicinal products, household economy and trade, and spiritual divination. More recently this knowledge has led to formalized customary ecological management practices (Drew, 2005). Furthermore, biologists increasingly use this knowledge to build ecological management and conservation plans.

The main point of this article is that developing and sharing knowledge is considered very important when dealing with ecological management systems. This knowledge is garnered and used in the collaboration of native people and scientists, therefore the factors collaboration and stakeholder inclusiveness are considered important in this article. Therefore it is interpreted that this paper argues that collaboration and stakeholder inclusiveness should be taken into consideration when looking at, or developing governance capacities for ecologically sound urban water governance.

2.7 Lindenmayer et al (2008). A checklist for ecological management of landscapes for conservation.

Ecological management for biological conservation and ecologically sustainable natural resource use are a crucial global issue (Lindenmayer et al, 2008). Even though their research is mostly concerned with ecological landscapes, and not much with water, they still speak of different approaches to ecological management. They state that using a variety of different management tactics reduces the risks of making the same mistakes. Furthermore, the same principle would be applied to the management of species and ecosystems; a variety of conservation tactics or governance approaches is required, some for single species, some for entire ecosystems (Lindenmayer et al, 2008). Moreover, contingency must be allowed. This is mainly due to uncertainty of the future regarding sustainability. Deep knowledge must be combined with factors such as context, conditions and processes in order to come up with suitable management strategies (Lindenmayer et al, 2008).

The paper ended with 4 management approaches: 1) manage in an experimental framework. This mainly concerns itself with the fact that there is not much knowledge in the field where the management is performed. This is relevant to this research considering that there is very little known about ecologically sound urban water governance. 2) manage both species and ecosystems. When speaking about species conservation, both single-species and ecosystem management is necessary. These conservation strategies have to be carefully considered to create a healthy environment. 3) manage at multiple scales. Multiple scales have to be considered when managing ecosystems. Single strategies will only meet a limited number of goals, and thus it is necessary to have multiple strategies that meet multiple goals. This is important because these processes are, just like the ecosystems they concern themselves with, interdependent. 4) allow for contingency. When considering ecosystems it is important to consider contingency. Some ecosystems behave differently because different variables present themselves within a region. This causes a necessity for different conservation strategies in order to have the same result as other regions. Deep knowledge of the relevant area/region is necessary in order to perform effective ecological management because of this contingency (Lindenmayer et al, 2008). Regarding ecologically sound urban water governance this is very important because it shows the different dimensions surrounding urban water governance. While there are certainly similarities between different cities around the world, they are also very different. This means that different governance strategies are necessary between different cities. Furthermore, the fact that there is currently little known about ecologically sound urban water governance complicates the matter. The contingency of the problem will thus have to be embraced, and worked around.

This paper is interpreted to favor the factors equalized scaling, scientific involvement, and contingency. They speak of experimental work in a specific field in which there is little knowledge is important, while accepting contingency during the experiments is just as important because in order to tackle wicked problems such as sustainability issues multiple solutions are necessary. This requires scientific involvement because scientists can create relevant information that is necessary to develop effective governance capacities for ecologically sound urban water governance.

2.8 Pahl-Wostl (2009). A conceptual framework for analyzing adaptive capacity and multi-level learning processes in resource governance regimes.

Pahl-Wostl (2009) has done research on the development of a framework that addresses the dynamics and adaptive governance capacities of resource management regimes. These regimes include for example land use and water regimes. Pahl-Wostl has stated that the current governance regimes are incapable of dealing with resource management problems. This phenomenon is dubbed governance failure. Governance regimes consist of multiple stakeholders. For example, formal and informal institutions, state and non-state actors, bureaucratic hierarchies, markets and networks are identified as major structural characteristics of governance regimes. Change towards a more adaptive and effective form of resource governance is conceptualized as a social and societal learning process, done step-by-step. Furthermore, the collaboration of formal and informal institutions is seen as desirable, provided that the institutions complement each other. Moreover, structural constraints can be tackled by creating room for participation and dialogue between different stakeholders, mainly non-state actors. It has been found that polycentric governance regimes are more capable of adaptation, and thus less vulnerable to disturbance. Furthermore, there is a need for the development of inter-disciplinary and systemic approaches in social sciences

because conceptual frameworks, such as the framework proposed by Pahl-Wostl, are just that, a framework. Further development of these frameworks is necessary.

The framework of Pahl-Wostl (2009) touches upon a lot of different factors that could be regarded as important for ecologically sound urban water governance. Firstly, collaboration is considered very important, even more so because most governance regimes consist of a very wide arrangement of stakeholders. Secondly, stakeholder participation is also an important factor. Poly-centric governance regimes are found to be more adaptive and suitable for resource governance regimes, especially regimes that include non-state actors. Lastly, scientific involvement is also an important factor due to the notion that we are currently trying to tackle problems of which there is currently not much knowledge. Therefore, frameworks developed around the problems of sustainability need further development and attention from the scientific communities.

2.9 Marlow, Moglia, Cook & Beale (2013). Towards sustainable urban water management: A critical reassessment.

Marlow et al (2013) very interestingly put a different perspective to use regarding sustainable urban water management (SUWM). They scrutinize the concepts surrounding current SUWM in order to highlight the limitations and strengths it holds. They have found that there are unaddressed complexities in the transformational agendas advocated by SUWM components (Marlow et al, 2013). The main points this article made is something termed 'system hybridisation'. This term captures the notion that current governance models have to retain capacity to manage governance strategies created in the past, while also trying to intercalate values, expectations and interpretations of the current world. While there is certainly consensus surrounding the fact that SUWM is something that is necessary, it is apparent that the opportunities for implementation have either been missed, or have not been seen at all. System hybridisation is very likely the reason for the fact that it has not been implemented yet. Furthermore, community expectations are scrutinized as well. Community expectations are very likely hurt by the proposition of very specific technical solutions, as these solutions are often value-based. When involving communities in the decision making it is more beneficial to make evidence-based arguments for solutions, since value-based arguments often lead to polarized positions (Marlow et al, 2013). While a change of SUWM, and the implementation thereof certainly has its risks, it promotes experimentation and infrastructure diversification, and thus science. It is argued by Marlow et al (2013) that overcoming the current issues regarding SUWM will imply that a better understanding of life cycle performance, costs, risks and benefits of specific SUWM innovations and broader system effects is gained.

There are two factors that are touched in this paper. Firstly, ecosystem valuation is considered very differently than by Constanza et al (1997) and Vos & Meekes. Not in the sense that it is not considered important, but with the idea that value-based solutions lead communities towards polarized positions. Therefore evidence-based solutions are more effective. Secondly, contingency
is considered important due to the notion that experimentation surrounding the implementation of SUWM is promoted. It is implied that the diversification through system hybridization promotes sustainable solutions by looking at the past, present and the future. This encourages the development of effective governance capacities, capacities that can remain adaptive and scientifically sound in the future.

2.10 Pereira et al (2015). Organizing a safe space for navigating social-ecological transformation to sustainability.

Pereira et al (2015) build their research around the notion of a *safe space.* This safe space will allow, and clear up the possibilities of multi-stakeholder learning and collaboration, and through this create resilience and transitions. While collaboration is not explicitly dealing with transformation and transition, it plays a vital role in the emergence of safe spaces, which, as said before, do deal with transformation and transition. The multi-stakeholder learning and collaboration that is the focus of the safe spaces concerns itself with collaborative research which brings impact-oriented action researchers and reflexive practitioners together. Furthermore, transparency in research is also important, as this drastically increases stakeholder and research practitioner involvement. This paper has a lot of similarities to the paper of Patz et al (2004). This was an interdisciplinary working group where a lot of different backgrounds met, which furthers the notion that such a safe space or working group is necessary in order to create ecologically sound urban water governance.

The factors contributing to governance capacities in this paper are collaboration and stakeholder inclusiveness. Collaborative research combined with multi-stakeholder learning is at the core of the safe spaces that are promoted.

2.11 Kabisch et al (2016). Nature-based solutions to climate change mitigation and adaptation in urban areas: perspectives on indicators, knowledge gaps, barriers, and opportunities for action.

Kabisch et al (2016) in their paper explore the various contexts in which nature-based solutions are relevant for climate mitigation and adaptation in urban areas. Furthermore, the effectiveness is also analyzed by finding indicators for their assessment. Moreover, existing barriers are explored, in combination with the potential of increasing the scale and effectiveness of the implementation of nature-based solutions. When dealing with nature-based solutions three main needs are identified. 1) The production of stronger evidence for climate change adaptation and mitigation is necessary, while also raising awareness by increasing implementation. 2) Governance regimes have to be ready to adapt to governance challenges that arise due to the implementation of nature-based solutions by having a reflexive stance towards these challenges. This implies that networks of ambassadors and practitioners of nature-based solutions have to be created. 3) A diverse set of actors have to be considered when dealing with nature-based solutions. social cohesion and socio-environmental justice has to be considered by using an integrative approach that surrounds transdisciplinary participation.

The research done by Kabisch et al (2016) touches multiple factors that can be considered important for governance capacities in ecologically sound urban water governance. Firstly, they speak of the necessity of stronger evidence. This can be interpreted as the necessity to include science into nature based solutions. This notion is further promoted by the fact that they also speak of a transdisciplinary approach. Secondly, collaboration and stakeholder inclusiveness are considered important. They speak of the idea that diverse sets of actors have to be considered, and a transdisciplinary approach is necessary.

2.12 Di Vaio et al (2021). Water governance models for meeting sustainable development Goals: A structured literature review.

Di Vaio et al (2021) have done research on the dimensions of water governance models in the context of sustainable development. Their aim was to understand which models have to be rethought in order to reach the sustainable development goals (SDGs). When looking at a wide

variety of articles it was concluded that collaboration, coordination, and stakeholder engagement are crucial elements that need to be included in water governance models in order to address sustainability challenges (Di Vaio et al , 2021). They have found it clear that “multilevel, shared and participative governance is required” (Di Vaio, 2021). This is due to the fact that water services involve a multitude of actors, and can thus not be ecologically managed on a single level.

In their research they have been very clear that collaboration, coordination and stakeholder engagement are at the center of sustainability challenges. Therefore it is considered that the factors of collaboration and stakeholder inclusiveness are important.

2.13 Synthesis of the literature

In the literature review several factors were found that may contribute to the governance capacities needed for a sound ecological management. Of course the reviewed papers are subject to certain interpretations, but the factors are always either directly or indirectly mentioned. The table below shows all the factors that were found during the review, combined with the explanation of the factor. This explanation should also clarify the interpretations of the papers.

The two outliers that seem most important are collaboration and stakeholder inclusiveness. Of the 11 papers reviewed, 8 of them have considered collaboration and/or stakeholder involvement as important factors contributing to governance capacities in ecologically sound urban water governance. Furthermore, scientific involvement is also considered quite important, as 5 papers have mentioned the factor. Lastly, ecosystem valuation, equalized scaling and contingency are also considered important, as they have all been found at least two times in the reviewed literature.

Factors	**Factor definition**	**Source**
Ecosystem valuation	Valuation of ecosystems in any form. This can include monetary value, health value, cultural value etc.	Constanza et al (1997); Vos & Meekes (1999); Marlow et al (2013);
Equalized scaling	Scaling from local to global. Or solution scaling from scientific research to political decision making.	Vos & Meekes (1999); Lindenmayer et al (2008)
Collaboration	Interdisciplinarity of knowledge. Ecosystems are often complex systems that require knowledge from multiple disciplines and perspectives. This knowledge can be gained from every party involved, and thus requires collaboration on every level and with every party.	Vos & Meekes (1999); Patz et al (2004); Pahl-Wostl & Hare (2004); Drew (2005); Pahl-Wostl (2009); Pereira et al (2015); Kabisch et al (2016); Di Vaio et al (2021)

Stakeholder inclusiveness	Inclusion of stakeholders. Stakeholders often bring new, but very important perspectives to sustainable development. Transparency can be considered stakeholder inclusion. Stakeholders can be considered community representatives, but also businesses that reside in the area.	Vos & Meekes (1999); Patz et al (2004); Pahl-Wostl & Hare (2004); Drew (2005); Pahl-Wostl (2009); Pereira et al (2015); Kabisch et al (2016); Di Vaio et al (2021)
Scientific involvement	Involvement of the scientific community. Regarded as important considering sustainability is often surrounded by science.	Vos & Meekes (1999); Drew (2005); Lindenmayer et al (2008); Pahl-Wostl (2009); Kabisch et al (2016)
Contingency	The variety of options which can be taken to progress towards sustainable development. Important considering that a single solution might not be all-embracing.	Lindenmayer et al (2008); Marlow et al (2013)

Table 1: Factors contributing to governance capacities for ecologically sound urban water governance. Explanation of the factors is included to increase coherency.

After the literature review 6 factors that contribute to the governance capacities of ecologically sound urban water governance are considered important. These factors are: 1) Ecosystem valuation. Ecosystems require certain values in order to 'catch the eye' of policymakers. Ecologically sound urban water governance is considered to be only possible when the urban water ecosystems have certain values attached to them. These values can be monetary, cultural, or regarding health. 2) Equalized scaling. In order to have effective ecologically sound urban water governance certain solutions have to be scaled properly horizontally and vertically. When scientific evidence or solutions are proposed to policy-makers these solutions have to be translated and scaled properly. Furthermore, when implementing certain solutions that are learned from other cities, these solutions have to be adapted to the needs of the city in which they are implemented. 3) Collaboration. Perhaps one of the two most important factors. Inter- and transdisciplinary collaboration is required in order to have ecologically sound urban water governance. Social sciences, natural sciences, community representatives, market representatives, businesses etc. all have to collaborate in order to tackle sustainability problems. 4) Stakeholder inclusiveness. The other factor that can be considered most important. The inclusion of stakeholders is considered very important. When developing sustainable solutions, all parties involved in the problem have to be included to make the most effective solutions. When including all stakeholders, transparency will

also increase. 5) Scientific involvement. Considering the dimensions of ecologically sound urban water governance the involvement of scientific fields can be considered very important in creating effective governance strategies. When certain problems arise, they have to be identified and researched in order to tackle them effectively. Furthermore, most governance strategies are built upon frameworks developed by science. These strategies in turn secure the improvement of these frameworks, and thus the improvement of the strategies. 6) Contingency. When looking at problems such as ecologically sound urban water governance it is important to consider contingency. Currently there is not much known about how to make urban water governance as ecologically sound as possible, therefore multiple solutions are expected to be implemented. These solutions can differ in scale, but also in intensity. And because so little is known not all these solutions might be effective.

2.14 Conclusion

In this section literature review has been reviewed. Several factors that may be relevant for governance capacities in ecologically sound urban water governance were found. Following the review it can be concluded that cities have better governance capacities for enhancing ecologically sound urban water governance in cases which: create valuation for ecosystems through monetary, cultural, or health benefits; cases that enhance equalized scaling in which vertical and horizontal scaling is taken into consideration; cases that emphasize the importance collaboration and stakeholder inclusiveness; cases that involve the scientific community; and lastly cases in which contingency is taken into account. This information can be important for establishing which governance capacities are important in the frontrunner cities that are chosen from the City Blueprint framework. The City Blueprint framework, together with the Governance Capacity framework, will be explained in the following chapter.

3. KWR's City Blueprint and Governance Capacity approach

3.1 Introduction

The focus of chapter 3 is to give an overview of the tools used in this research, namely the City Blueprint Framework and the Governance Capacity Framework. This overview will consist of a short explanation of how the data for these frameworks is gathered and presented. How the case study will be executed will be explained in chapter 4.

3.2 City Blueprint Framework

As mentioned earlier the research will be based on the City Blueprint approach. The City Blueprint approach is a diagnostic tool of the company 'KWR' that consists of multiple frameworks that complement each other. Firstly there is the *Trends and Pressures Framework* which assesses the main challenges of the cities. This framework will not be used for the research and will thus also not be elaborated upon. The next framework is the *City Blueprint Framework (CBF)* which assesses how cities are managing their water cycle. And the last framework is the *Governance Capacity Framework (GCF)* which concerns itself with the ways cities can improve their water governance (IPR Northwestern, n.a.).

The CBF provides a clear overview of the performance and bottlenecks of Integrated Water Resources Management (IWRM) in cities. In order to do this indicators are developed with which a city can be scored. The indicators to assess cities are divided over seven categories: water quality, solid waste treatment, basic water services, wastewater treatment, infrastructure, climate robustness, and governance. Furthermore, there are also 3 or 4 indicators in each of these categories (Koop & Van Leeuwen, 2021b). In Table 2 below a scoring table is shown in which all 24 indicators of the CBF.

Category	Indicator	Score
I Basic water services	1 Access to drinking water	
	2 Access to sanitation	
	3 Drinking water quality	
II Water Quality	4 Secondary WWT	
	5 Tertiary WWT	
	6 Groundwater quality	
III Wastewater treatment	7 Nutrient recovery	
	8 Energy recovery	
	9 Sewage sludge recycling	
	10 WWT energy efficiency	
IV Water infrastructure	11 Stormwater separation	
	12 Average age sewer	
	13 Water system leakages	
	14 Operation cost recovery	
V Solid waste	15 MSW collected	
	16 MSW recycled	
	17 MSW energy recovered	
VI Climate adaptation	18 Green space	
	19 Climate adaptation	
	20 Climate-robust buildings	
VII Plans and actions	21 Management & action plans	
	22 Water efficiency measures	
	23 Drinking water consumption	
	24 Attractiveness	

Table 2: City Blueprint Framework indicators (KWR, 2021).

The data of these indicators is already present in the database of the CBF. The indicators are used to assign a number to cities, this number will correspond with the performance of the city; Blue City Index (BCI) (IPR Northwestern, n.a.). The database consists of data on 135 cities around the world.

Figure 2: Visual representation of all 24 CBP indicators, with their score in the city of Amsterdam (KWR, 2021)

The 24 indicators in the database are standardized to a scale of 0 to 10. On this scale a score of 10 implies an excellent, perfect score, and 0 a poor score. The score is found by comparing values from an international range, using natural boundaries of 0 and 100%, or by using ordinal classes. Often the min-max method is applied as well (Koop & Van Leeuwen, 2021b). This method uses the

$$\frac{value - minimum\ value}{maximum\ value - minimum\ value}\ X\ 10 \quad = \text{Indicator score}$$

following function:
Furthermore, the values that are necessary to find the indicator score are found through a seven-step process (Koop & Van Leeuwen, 2021b). These steps are:

1) Municipalities and regions are contacted to participate, or they often contact KWR too.
2) If the decision regarding a CBF scoring has been taken, and approved, a coordinator appointed by the city will collect the necessary information. This coordinator contacts stakeholders in the municipality or region to provide this information.
3) The coordinator then completed the questionnaire provided for the CBF. This questionnaire is then used to collect the necessary information step by step.
4) The scoring information for each indicator is gathered. This information, including the sources from which it is gathered, is then included in the questionnaire file.
5) The information gathered is then used to garner a score for each indicator. This is done by mathematical formulas made specifically for each indicator.
6) After completion of calculations the values are converted to a radar chart (as done in Figure X above).
7) The coordinator has to find contact with KWR again, at which point the information will be reviewed and discussed. After mutual agreement the information will be added to the CBF database, and can be used to make reports.

3.3 Governance Capacity Framework

KWR, the company that developed the CBF and GCF, mentions that governance capacity (GC) is required "to find dynamic long-term solutions that are supported with flexible intermittent targets to anticipate emerging barriers and changing solutions." (KWR, 2021). Which means that they view governance capacity as something that tackles governance challenges, in which case governance capacities are things such as institutions or functions of institutions. This notion is enforced by Healey (1998) who wondered which governance capacities were necessary to deliver improvements to the quality of places. Furthermore, Knill & Lehmkuhl (2002) define governance capacity as "the formal and factual capability of public or private actors to define the content of public goods and to shape the social, economic, and political processes by which these goods are provided.". As said in the introduction, in this research governance capacity refers to the ability of actors to solve collective problems and is shaped by institutional and structural settings as well as individual actors (Dang, Visseren-Hamakers, & Arts, 2015).

The Governance Capacity Framework (GCF) concerns itself with the governance gaps, barriers and capacities, and how to overcome these obstacles. As such, the GCF can be seen as a governance capacity assessment method. The method consists of 3 dimensions, with each dimension consisting of 3 conditions, and each condition consisting of 3 indicators. So there are 3 dimensions, 9 conditions and 27 indicators (Table 3).

Dimensions	Condition	Indicators
Knowing	1 Awareness	1.1 Community knowledge 1.2 Local sense of urgency 1.3 Behavioral internalization
	2 Useful knowledge	2.1 Information availability 2.2 Information transparency 2.3 Knowledge cohesion
	3 Continuous learning	3.1 Smart monitoring 3.2 Evaluation 3.3 Cross-stakeholder learning
Wanting	4 Stakeholder engagement process	4.1 Stakeholder inclusiveness 4.2 Protection of core values 4.3 Progress and variety of options
	5 Management ambition	5.1 Ambitious and realistic management 5.2 Discourse embedding 5.3 Management cohesion
	6 Agents of change	6.1 Entrepreneurial agents 6.2 Collaborative agents 6.3 Visionary agents
Enabling	7 Multi-level network potential	7.1 Room to manoeuver 7.2 Clear division of responsibilities 7.3 Authority
	8 Financial viability	8.1 Affordability 8.2 Consumer willingness-to-pay 8.3 Financial continuation
	9 Implementing capacity	9.1 Policy instruments 9.2 Statutory compliance 9.3 Preparedness

Table 3: Governance Capacity Framework indicators (KWR, 2021)

The indicators in the GCF database are scored with values ranging from 0 to 5. In order to find these values a triangular method is used (Koop & Van Leeuwen, 2021c). The three 'steps' in this method are:

An Analysis of policy documents and reports can provide a preliminary score on each indicator. These sources can include a wide variety of literature, including gray literature. The important part is the argumentation behind the score.

Personal interviews have to be conducted with stakeholders that are relevant to the chosen governance challenge. In case of this research the relevant challenge is different from the 5 initial challenges. This research focuses on Ecological Water Management as a governance challenge. These stakeholders have to come from different areas of expertise and different levels of decision-making. 27 predefined questions are given, one for each GCF indicator. In Appendix A all 27 predefined questions can be found. Appendix A also sheds light on what each indicator means, and how they are scored. For the case study the predefined questions will be rephrased to be more fitting for the city and this research.

After the interviews are processed and the preliminary values are altered the interviewees are contacted again to provide constructive feedback and additional information. This will lead to a very transparent and very complete assessment of the governance capacities in place in a given city.

The figure below shows a visual representation of a previously done GCF assessment of the city Amsterdam. All the indicators are individually assessed and visualized in a spider diagram.

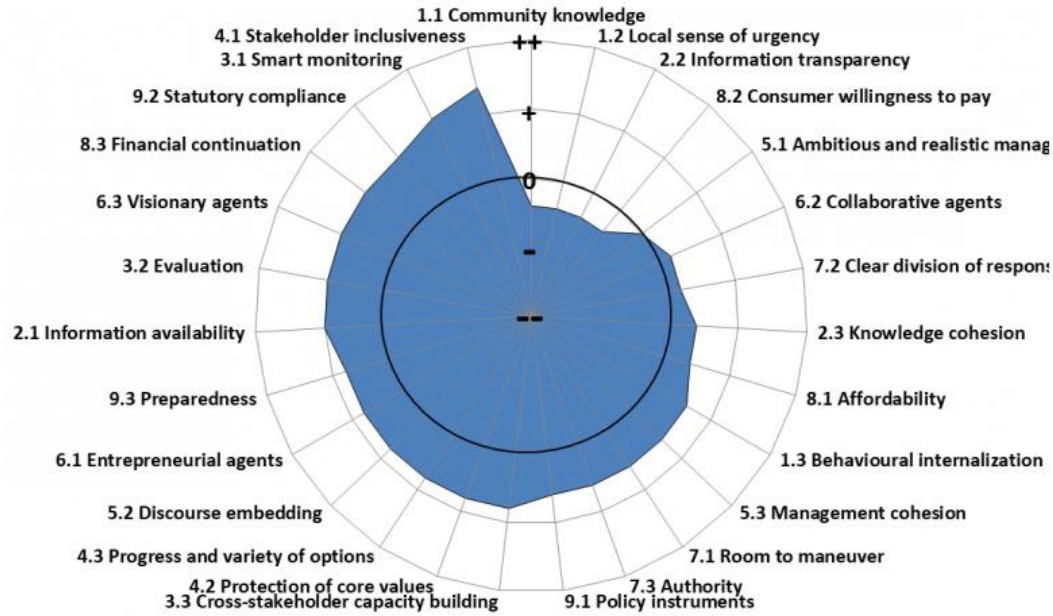

Figure 3: Visual representation of the Governance Capacity analysis of the city of Amsterdam, with all 27 indicators present (KWR, 2021).

3.4 Water Challenges of the Governance Capacity Framework

When a governance capacity analysis is conducted, it has to be done concerning a very specific water challenge. These challenges are challenges that cities across the world run into when dealing with urban water governance. These challenges are considered very complex problems for cities, and are therefore some of the most important challenges that widely occur in accordance with climate change and urbanization (IPR Northwestern, n.a.) Currently 10 challenges are researched with the GCF. These challenges are:

1. Flood risk
2. Water scarcity
3. Wastewater treatment

4. Solid waste treatment
5. Urban heat islands
6. Resource-oriented sanitation and waste management
7. Clean and sufficient water
8. Water pollution
9. Desalination
10. Integrated Water Resource Management

These 10 governance challenges also typically have very fragmented scopes, viewpoints, and responsibilities. This leads to problems that are complex, and thus create disagreements in their solutions. This means that dynamic long-term solutions are necessary, solutions that stem from governance capacity.

It has to be noted that not all cities in the CBF database have undergone this GCF analysis. For example, only 9 cities have undergone an assessment on Wastewater treatment, and only 7 on the challenge Solid waste treatment. Therefore, these challenges will be used to cluster cities into relevant datasets used for the Frontrunner/straggler analysis.

3.5 Conclusion

The CBF and GCF are very complete and transparent frameworks of assessment. They incorporate collaboration into the framework seamlessly and are thus capable of providing a fair assessment of cities. In the next chapter of the research the application of these frameworks to this research will be explained.

4. Methods

4.1 Introduction

In order to find which governance capacities cities need to perform ecologically sound urban water governance several research methods are necessary. In this chapter these research methods are extensively clarified.

Firstly, a CBP analysis will be done in order to find which of the 24 indicators of the City Blueprint Framework are relevant to ecologically sound urban water governance. Secondly, it is necessary to find which of the predefined challenges used in previous GCF analyses are relevant to ecologically sound urban water governance. Thirdly, the cities that have undergone a GCF analysis will be picked from the CBF database. This means that the only data used is on cities that have undergone both the CBF analysis, and the GCF analysis. Lastly, the cities will be clustered per challenge. After this the cities will be ranked in a table according to their CBF score, which should show patterns in the different governance capacities between frontrunner and straggler cities. These steps will effectively answer subquestion 2: 'Which City Blueprint indicators are important for ecologically sound urban water governance, and how do frontrunner cities score on them compared to 'straggler' cities?' and subquestion 3: 'How do the City Blueprint indicators correlate to the capacities in the relevant cities?'. It should be noted that It is only possible to compare frontrunner and straggler cities if they have undergone both a CBF analysis and a GCF analysis, because the CBF analysis defines whether they are a frontrunner or straggler, and the GCF analysis shows the governance capacities present in cities. This allows for a comparison in governance capacities between frontrunners and stragglers.

Furthermore, a GCF analysis in the form of a case study will be done on the City of Dordrecht regarding the water challenge 'Ecological Water Governance'

4.2 Selection of relevant CBF indicators

The data in the CBP database will be used to answer sub-question 2. The first step in answering this question is to identify which indicators are important for ecologically sound urban water governance. From the 24 indicators in the CBP database, the following 10 assumed to be the most important for assessing whether cities are frontrunners or stragglers regarding ecologically sound urban water governance:

5. Tertiary WWT: Measure for the urban population connected to tertiary wastewater treatment plants. This treatment step is important for water quality because many nutrients and chemical compounds are removed from the water before it enters the surface water (Koop & Van Leeuwen, 2021b). '*Tertiary WWT*' as an indicator is chosen because the third treatment of water in water treatment plants is primarily done when the water will be released into sensitive ecosystems (Boundless, 2022, p 987-988). *Secondary WWT* is not chosen because generally speaking secondary WWT happens in a controlled environment. Furthermore, if the water is not adequately clean to be released into the ecosystems, it will undergo further treatment through tertiary WWT (Boundless, 2022, p 987-988).

6. Groundwater Quality: Measure of relative groundwater quality, A lower indicator score is given for poorer quality. The value in the database is based on calculations that use national or regional data IF city-level data is not unavailable. A general limitation to this is that city water is generally of worse quality than the national average (Koop & Van Leeuwen, 2021b). '*Groundwater quality*' is chosen because it pertains to the growth and recovery of ecological systems (Oişte, 2014; Hodgkinson, Daigger & Skeels, n.a.).

7. Nutrient Recovery: Measure of the level of nutrient recovery from the wastewater system. Wastewater treatment plants sometimes use nutrient recovery techniques when treating wastewater (Koop & Van Leeuwen, 2021b). '*Nutrient recovery*' are chosen because they pertain to the growth and recovery of ecological systems (Oişte, 2014; Hodgkinson, Daigger & Skeels, n.a.).

11. Stormwater Separation: A measure of the proportion of the wastewater system for which sanitary sewage and storm water flows are separated. In principle, a separate system is better than a combined system as extreme weather events may lead to sewer overflows into surface water. These sewer overflows are a major source of pollution. Also flooding vulnerability is larger if stormwater separation ratio is low. A lower indicator score is given where the proportion of combined sewers is greater (Koop & Van Leeuwen, 2021b). '*Stormwater Separation'* is chosen because seperating stormwater and sewage water can prevent sewage water from flowing into ecosystems during flood events (Koop & Van Leeuwen, 2021b).

14. Operating costs recovery (ratio): Measure of revenue and cost balance of operating costs of water services. A higher ratio means there is more money available to invest in water services, e.g. infrastructure maintenance or infrastructure separation (Koop & Van Leeuwen, 2021b). '*Operating Costs Recovery (ratio)'* is chosen because it implicates cost-balance ratios of projects, in which case a higher ratio can mean that there is more money available to be invested in water services (Koop & Van Leeuwen, 2021b). Which can be relevant for the performance of Ecologically Sound Urban Water Governance.

15. Solid Waste Collected: Represent waste collected from/produced by households, small commercial activities, official buildings, institutions such as schools and government buildings, and small businesses that treat or dispose of waste (Koop & Van Leeuwen, 2021b). '*Solid waste collected*' is chosen because it concerns itself with the levels of waste in an urban environment, and the infrastructure surrounding solid waste collection is related to the quality of urban ecology (Nielsen, 1999).

18. Green Space: Represents the share of green and blue area which is essential to combat the heat island effect in urban areas (Koop & Van Leeuwen, 2021b). '*Green space*' is chosen because the amount of green space in a city is linked to a number of issues that are at the forefront of urban ecology. Issues such as sustainability, biodiversity and the provision of ecosystem services (Jorgensen & Gobster, 2010).

19. Climate Adaptation: A measure of the level of action taken to adapt to climate change threats. A lower indicator score is given where actions or commitments are more limited (Koop & Van Leeuwen, 2021b). '*Climate adaptation*' and '*Management and action plans*' are chosen because it shows that a city is willing and capable to adapt due to environmental and ecological issues.

21. Management and action plans: A measure of the application of the concept of Integrated Water Resource Management (IWRM) in the city. A lower indicator score is given where plans and actions are limited (Koop & Van Leeuwen, 2021b). '*Management and action plans*' is chosen because it shows that a city is willing and capable to adapt due to environmental and ecological issues.

22. Water Efficiency Measures: Measure of the application of water efficiency measures by the range of water users across the city. A lower indicator score is given where efficiency measures are more limited (Koop & Van Leeuwen, 2021b). '*Water Efficiency Measures'* is chosen because measures to decrease water usage, and increase the efficiency of water usage have an effect on the overall groundwater level. The groundwater level and *quality* have an effect on ecosystems. This

data will be used to define which indicators are important for the performance of ecologically sound urban water governance, after which it can be used to find which cities are frontrunners or stragglers.

4.3 Selection of relevant water challenges

The GCF analysis is done according to several predefined water challenges. However, as said in the previous chapter, not all cities in the CBF database have undergone a CBF analysis, therefore it is important to specify which challenges are relevant to ecologically sound urban water governance. This makes it possible to find the cities on which a frontrunner/straggler analysis can be done. The governance challenges that can be included in the GCF analysis are:

1. Wastewater Treatment (WWT): As governance regarding wastewater can have close ties to ecological governance.
2. Solid Waste Treatment (SWT): Governance regarding solid waste treatment can have close ties to ecological governance considering waste is always linked to the environment.
3. Urban Heat Islands (UHI): This governance challenge is primarily linked to the green spaces that are present in urban areas.
4. Flood-Risk: While Flood-Risk management does not directly relate to ecology in this challenge, it can have indirect effects on ecology when the water is directed towards, or away from certain areas.
5. Water scarcity: Water scarcity can manifest in a variety of different challenges. It can pertain to drinking water, but also to drought, which is harmful for ecology. On the same note, an abundance of water can have positive effects on water.

The cities that have undergone a GCF analysis according to these challenges can be used for a frontrunner/straggler analysis.

4.4 Finding the frontrunner and straggler cities

From the previously mentioned water challenges several cities can be clustered according to their challenges. The 10 previously mentioned indicators of the CBF database will now be summed up to a total score. All the cities are then, per cluster, compared to each other with the CBF score, which will result in a clear vision of which cities are frontrunners and stragglers when it comes to ecologically sound urban water governance.

4.5 Comparing the governance capacities of frontrunner and straggler cities

The identification of which cities are frontrunners and which are stragglers allows for the possibility to compare the cities to each other and have a closer look at which governance capacities are more dominant in frontrunner cities. This is done by creating a table in which the cities are ranked according to the accumulated score of the 10 predefined CBF indicators. The table will also visualize the score of all the GCF indicators these cities have received. This will show whether certain GCF indicators score higher in frontrunner cities. The results will then show a pattern of which governance capacities are important for ecologically sound urban water governance.

4.6 Case study frontrunner

4.6.1 Introduction

For this research a case study on a frontrunner city will be done in order to see what the governance capacities of a frontrunner city of ecologically sound urban water governance looks like. The city that will be subject to the case study has to meet 3 conditions for it to be a possible target. The first condition is that it has to have data available in the City Blueprint database. The second condition is

that it has no Governance Capacity data yet, as this is the data meant to be acquired with the case study. The third condition is that it has to be a city in the Netherlands in order to make it easier to connect with relevant stakeholders. This will also increase the quality of the interviews as there is no language barrier.

4.6.2 Case study data collection

The process of this case study will be as follows:

1) A literature study will be done in order to find a preliminary score for each of the 27 indicators in the Governance Capacity Framework. This literature can come from various different sources including government documents, policy documents and scientific papers, but is not limited to this literature because gray literature can also be used.

2) Main stakeholders of various organizations and institutions are interviewed to refine the score. These stakeholders will be identified according to the challenge chosen for the Governance Capacity analysis. The challenge for this research is ecological management. These stakeholders can, for example, include government officials, Rijkswaterstaat personnel, and nature organizations. But citizen organizations can also be included. For privacy reasons all interviewees will remain anonymous, as there have previously been issues with researchers oversharing information of the stakeholders. The interview data will be processed by using an online transcription tool to convert the interview to a text file. This text file will then be processed in NVivo, which is a tool that can be used to organize text files. In this research the responses of the interviewees will be filed according to the information they give on the GCF indicators.

3) The interviewees and clients are given the possibility to give feedback on the score given to the city. After a discussion the (possibly) revised scores given for the indicators will be implemented in the score list, after which the database will be updated.

Once all these steps are completed the definitive score for each will be turned into a radial diagram, which will visualize the score of each indicator. With all this information it is possible to see how Dordrecht scores with regards to the water challenge ‘ecological water governance’. The case study will give insights into how Dordrecht performs regarding ecologically sound urban water governance, and whether there is a pattern when compared to the frontrunner-straggler analysis. The final comparison of the frontrunner/straggler analysis and the Dordrecht case study will answer sub-question 4.

4.7 Conclusion

These methods will ensure that subquestions 2, 3, and 4 are answered. The important CBF indicators are used to rank the cities according to whether they are a frontrunner or straggler. The water challenges are used to filter and cluster the cities. This will allow for a comparison of the governance capacities of frontrunner and straggler cities. And finally the results of the frontrunner/straggler analysis can be compared to the case study of Dordrecht.

5. Results

5.1 Introduction

Firstly, the frontrunner and straggler cities have to be identified, which is done in section 5.2. Secondly, section 5.3 concerns itself with the frontrunner/straggler analysis of each relevant water challenge. The water challenges which are analyzed are Wastewater Treatment (WWT), Solid Waste Treatment (SWT), Urban Heat Islands (UHI), and an overall datasets which combines the scores of all cities that have undergone an assessment regarding the first 5 challenges (WWT, SWT, UHI, Flood-Risk, and Water scarcity), this last dataset will be called '5 Challenge Dataset'. Lastly, section 5.3 goes over the results of the case study of Dordrecht.

5.2 Identifying the frontrunner and straggler cities

By filtering the cities in the CBF database with the water challenges it is possible to find which cities have undergone a GCF analysis. There are 27 cities in total that have undergone a CBF and GCF analysis. In table 4 the frontrunner/straggler analysis is visualized. The table shows all the cities and their score on the 10 predefined scores in the CBF database. The rightmost column shows the sum of the scores which is sorted from a high to low total score. This means that, for example, Amsterdam and Milton Keynes are frontrunner cities and Ahmedabad and Antofagasta are straggler cities.

Country	CITY	CBF6 Groundwater quality	CBF6 Groundwater quality	CBF7 Nutrient recovery	CBF15 Solid waste collected	CBF18 Green space	CBF19 Climate adaptation	CBF21 Management and action plans	CBF11 Stormwater separation	CBF14 Operation cost recovery	CBF22 Water efficiency measures	Total Score All 10
NL	Amsterdam	6	6	10	3	6	10	9	8	8	10	77
UK	Milton Keynes	10	10	0	4	10	10	10	5	5	10	74
AU	Melbourne	6	6	10	2	6	8	10	10	5	9	72
KR	Seoul	10	10	1	6	4	10	10	4	6	10	70
GA	Libreville	9	9	0	9	10	9	7	0	9	5	67
IL	Jeruzalem	5	5	8	1	1	10	10	10	4	10	64
ES	Seville	6	6	10	4	3	10	9	1	4	10	63
ZA	Durban	9	9	0	3	10	7	9	3	2	7	59
NL	Rotterdam	6	6	0	3	6	10	8	1	8	10	58
CA	Toronto	8	8	0	0	4	8	5	9	10	6	57
CN	Tianjin	2	2	0	10	3	7	10	2	9	10	55
ZA	Cape Town	5	5	0	0	10	7	7	10	4	6	54
UK	Leicester	6	6	5	4	2	9	8	0	7	6	53
MN	Ulaanbaatar	10	10	0	5	4	5	5	6	3	5	52
EC	Quito	6	6	0	8	0	8	7	8	1	8	52
ID	Bandung	5	5	0	7	0	7	8	8	6	6	51
US	New York City	3	3	7	0	1	10	10	4	3	10	51
TW	Taipei	5	5	0	7	0	6	6	10	7	5	51
BR	Rio de Janeiro	10	10	0	4	0	6	6	8	1	6	50
NL	Utrecht	6	6	0	3	2	9	7	4	5	7	49
IE	Cork	9	9	5	2	1	6	6	6	0	5	49
NA	Windhoek	10	10	0	0	1	7	3	3	7	7	48
ES	Sabadell	7	7	0	4	4	6	7	0	2	4	41
NG	Lagos	4	4	0	9	1	2	0	10	3	7	40
IN	Ahmedabad	4	4	0	9	1	5	4	3	3	6	39
CL	Antofagasta	0	0	0	6	0	4	4	0	9	4	27

Table 4: Overview of frontrunner and straggler cities in ecologically sound urban water governance.

5.3 Analyzing the governance capacities of frontrunner and straggler cities

The analysis is done on datasets that contain cities based on a specific water challenge. The tables in the analysis will show each city in the dataset. The cities are ranked according to their score in the CBF database. This means that they are ranked from frontrunner to straggler. Furthermore, each cities' score in the GCF database is also shown. This makes it possible to see which indicators have a

higher score in frontrunner cities than in straggler cities. The table shows a color at the bottom of each indicator. A green color indicates an increased score in frontrunners compared to stragglers. A red color means that there is no pattern visible between frontrunners and straggler for that indicator.

5.3.1 Analyzing frontrunners and stragglers of the Wastewater Treatment water challenge

City	CBF Score	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	4.3	5.1	5.2	5.3	6.1	6.2	6.3	7.1	7.2	7.3	8.1	8.2	8.3	9.1	9.2	9.3
Amsterdam	77	1	1	4	2	2	2	4	4	4	4	2	2	3	2	4	4	3	3	2	3	3	3	2	3	3	4	3
Melbourne	72	1	2	4	2	3	3	3	3	4	4	4	4	2	3	1	4	3	2	3	3	3	3	2	4	3	3	3
Seoul	70	2	1	1	2	2	3	3	2	3	3	3	2	2	2	2	3	3	3	3	3	3	4	2	2	3	3	3
Toronto	57	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	3	3	3	3	3	2	2
Cape Town	54	2	4	1	4	3	3	4	1	3	2	3	3	4	3	3	3	4	3	3	2	3	1	4	4	3	3	3
Bandung	51	2	2	1	2	2	2	1	1	2	3	3	3	2	2	2	3	3	3	2	3	2	2	2	2	2	1	1
New York City	51	2	2	2	3	2	2	3	2	3	3	2	2	2	3	2	3	2	2	2	3	4	3	2	3	2	2	2
Rio de Janeiro	50	1	3	1	3	2	1	1	1	1	1	1	1	2	2	2	3	3	3	1	2	1	2	3	1	2	1	2
Ahmedabad	39	2	1	2	2	2	2	2	1	1	1	1	1	3	2	2	1	2	3	1	1	3	3	2	3	1	1	1

Table 5: Frontrunner/straggler analysis of cities in the WWT dataset

The first water challenge is Wastewater Treatment. This dataset contains 9 cities on which a GCF analysis has been done concerning this water challenge. Table 5 shows all 9 cities ranked from a high CBF score to a low CBF score, from frontrunner to straggler.

There are 9 GCF indicators in which the score of the Governance Capacity indicators goes up when the city moves from straggler to frontrunner.

- 1.3 Behavioral Internalization
- 3.1 Smart Monitoring
- 3.2 Evaluation
- 3.3 Cross-stakeholder learning
- 4.1 Stakeholders Inclusiveness
- 4.2 Protection of core values
- 6.1 Entrepreneurial Agents
- 9.1 Policy Instruments
- 9.2 Statutory Compliance

5.3.2 Analyzing frontrunners and stragglers of the Solid Waste Treatment water challenge

City	CBF Score	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	4.3	5.1	5.2	5.3	6.1	6.2	6.3	7.1	7.2	7.3	8.1	8.2	8.3	9.1	9.2	9.3
Amsterdam	77	2	2	3	2	1	2	4	4	2	2	3	2	2	4	3	3	2	2	3	2	4	3	2	3	3	3	3
Melbourne	72	2	0	2	3	2	2	3	2	4	3	2	2	2	2	2	3	2	3	2	2	2	0	0	4	2	2	4
Seoul	70	4	2	3	2	3	3	3	3	3	3	3	3	3	3	3	3	2	3	2	3	3	3	2	2	3	3	3
Bandung	51	3	3	3	2	2	2	1	1	3	3	3	3	3	2	3	2	3	3	2	3	3	2	2	2	2	1	2
New York City	51	2	3	3	2	2	2	2	2	2	2	2	2	3	2	3	3	2	4	1	2	3	3	2	3	2	3	3
Rio de Janeiro	50	1	1	1	1	2	1	1	1	1	1	1	1	2	2	2	2	1	1	1	2	2	2	1	1	2	1	2
Ahmedabad	39	2	1	2	1	2	2	1	1	2	2	2	2	3	1	2	2	1	2	2	2	2	2	2	3	2	1	1

Table 6: Frontrunner/straggler analysis of cities in the SWT dataset

The second water challenge is Solid Waste Treatment. This dataset contains 7 cities on which a GCF analysis has been done concerning this water challenge. Table 6 shows how the 7 cities in this dataset are ranked according to their CBF score.

There are 11 GCF indicators in which there is a clear difference between the frontrunners and stragglers:

- 2.1 Information availability
- 3.1 Smart Monitoring

- 3.2 Evaluation
- 3.3 Cross-stakeholder learning
- 5.2 Discourse Embedding
- 6.1 Entrepreneurial agents
- 6.2 Collaborative agents
- 7.3 Authority
- 8.1 Affordability
- 9.2 Statutory Compliance
- 9.3 Preparedness

5.3.3 Analyzing frontrunners and stragglers of the Urban Heat Islands water challenge

City	CBF Score	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	4.3	5.1	5.2	5.3	6.1	6.2	6.3	7.1	7.2	7.3	8.1	8.2	8.3	9.1	9.2	9.3
Amsterdam	77	1	1	1	2	1	3	1	1	1	4	1	2	0	1	1	1	1	3	2	0	0	3	2	2	2	2	0
Melbourne	72	3	3	4	3	4	4	2	2	4	3	3	3	4	3	3	3	4	4	2	2	2	2	4	2	2	2	3
Seoul	70	2	1	1	2	3	3	2	2	2	3	3	3	2	3	2	2	2	2	2	2	2	3	1	1	3	3	3
Bandung	51	1	1	1	1	1	2	1	1	3	2	2	1	2	2	2	2	2	3	2	3	1	2	1	2	2	1	1
New York City	51	2	2	2	2	3	3	0	0	1	1	1	2	3	3	3	3	2	2	1	2	3	3	2	2	3	3	2
Rio de Janeiro	50	2	1	1	2	2	2	2	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1
Ahmedabad	39	3	3	3	3	2	2	3	3	2	3	3	2	3	4	2	3	3	3	2	3	3	3	3	3	2	3	4

Table 7: Frontrunner/straggler analysis of cities in the UHI dataset

The third water challenge is Urban Heat Islands. This dataset contains 7 cities on which a GCF analysis has been done concerning this water challenge. Table 7 shows how the 7 cities in this dataset are ranked according to their CBF score.

There are 4 GCF indicators in which there is a clear difference between the frontrunners and stragglers:

- 2.2 Information Transparency
- 2.3 Knowledge Cohesion
- 4.1 Stakeholder Inclusiveness
- 4.2 Protection of core values

5.3.4 Analyzing frontrunners and stragglers of the 5 Challenge Dataset

City	CBF Score	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	4.2	4.3	5.1	5.2	5.3	6.1	6.2	6.3	7.1	7.2	7.3	8.1	8.2	8.3	9.1	9.2	9.3
Amsterda	77	1	2	3	3	2	2	3	3	3	4	3	3	2	3	3	3	2	3	3	2	3	3	2	3	3	3	3
Melbourn	72	2	2	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	2	3	2	2	2	3	2	2	3
Seoul	70	3	2	2	2	3	3	3	2	2	2	3	3	2	3	2	3	2	3	2	2	2	3	2	2	3	3	2
Bandung	51	2	2	2	2	2	2	1	1	3	2	2	2	2	2	2	2	2	3	2	3	2	2	2	2	2	1	2
New York	51	2	2	3	2	2	3	2	2	2	2	2	2	3	3	3	3	2	3	2	2	3	3	2	3	2	3	3
Rio de Jar	50	2	2	2	3	3	2	2	2	2	2	2	2	3	3	2	3	2	2	2	2	2	2	2	2	1	2	1	2
Ahmedab	39	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	2	3	3	2	2	2

Table 8: Frontrunner/straggler analysis of cities in the 'First 5 Water Challenges' dataset

The last water challenge analyzed is the combined dataset of the first 5 challenges. As visualized in the table above there were 7 cities in which a GCF analysis was done on the governance capacities concerning the first 5 water challenges.

Firstly, there are 9 GCF indicators in which there is a clear difference between the frontrunners and stragglers. In this case all the increases are very minor. A difference in score of no more than 1.

- 2.3 Knowledge Cohesion
- 3.1 Smart Monitoring
- 3.2 Evaluation

- 4.1 Stakeholder Inclusiveness
- 4.2 Protection of core values
- 4.3 Progress and variety of options
- 6.3 Visionary Agents
- 8.1 Affordability
- 9.3 Preparedness

5.4 Case Study: Ecological Water Governance Capacity analysis of Dordrecht

For the city of Dordrecht each indicator has been given a score. In the figure below is a radial diagram that showcases the score of each indicator. The full case study with the complete argumentation for the scores can be found in Appendix B.

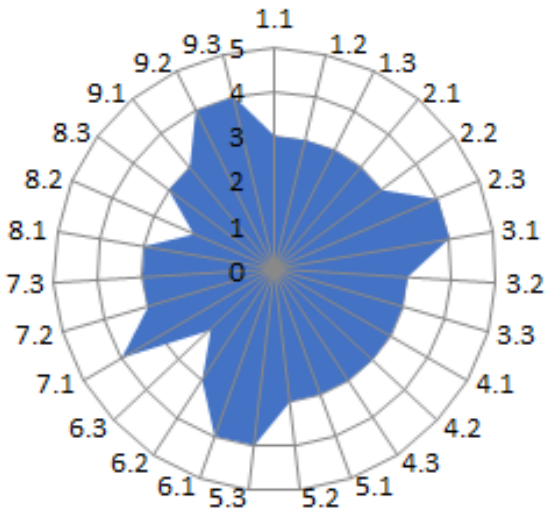

Figure 4: Radial diagram of the GCF indicator scores of the city of Dordrecht

According to these scores Dordrecht is not perfect regarding ecological water management. However, there are a couple of indicators that score relatively high. Out of the 27 indicators there are 7 indicators which score 4. There are 18 indicators with a score of 3. And only 2 indicators with a score of 2.

In Dordrecht the subject of water ecology has only recently become a topic for dialogue. However, it has to be mentioned that awareness is very lacking amongst the citizens. In politics water ecology is generally considered a side topic, and not seen as very urgent. The public awareness is growing however. Therefore policies regarding water ecology are lacking, and are mostly present as a by-product or side-subject of new or already existing policies. It has been proven difficult to break away from the status quo. This has sparked the need for entrepreneurial agents in Dordrecht that make the subject of water ecology palpable. This has resulted in the development of a green policy plan.

Furthermore, the acquisition of information on water ecology has proven to be difficult. Firstly, there does not seem to be a lot of public information available. The authorities have created policy plans that are publicly available, but the rest is difficult to find. There is however a law in place that obligates the authorities to freely provide information when people ask for it. This however hinders free availability. It has to be noted however that knowledge cohesion is a strong point of Dordrecht. While the information may not be readily available, there is a collaborative effort to keep

the information up to date. The authorities closely work together, and even outside organizations share their information.

This also directly ties into another strong point of Dordrecht, namely their monitoring network. This monitoring network directly produces data on the water quantity and water quality of the water bodies in and surrounding Dordrecht. New tests are also constantly added to the network, such as the DNA test which wins information on the biodiversity in the water.

When talking about collaboration it has to be said that the collaboration mainly happens between the authorities. As such smaller organizations are often left out of the decision-making and are only included in rare cases. This is where the difference in knowledge cohesion and stakeholder inclusiveness becomes apparent. Outside organizations are often included for information, as they are often specialized in very specific subjects. However, they are often not included in the decisions. More recently this has been changing, smaller organizations are more and more included. The new plan published by the water authority board even suggests that this is an important point they have to work on. Internal collaboration is very active however, as there are many different working groups that closely work together on projects.

Ambition is certainly rising, and a budget has been opened for more ecological subjects, but current initiatives are focused mainly on the stabilization or improvement of already existing systems. So far it seems that the ideas are realistic, as it also aims to include smaller, more ambitious organizations. The whole scope of whether it is realistic is however unknown, as ecology is a subject easily dropped, and has been given lower priority before during the crisis of 2008. Furthermore, existing and new plans are mostly focused on short-term targets that have a running time of 4 years. The long-term targets are often very vague, incohesive and open for interpretation.

Meaning of the scores

There are 7 indicators that indicate the main strengths of Dordrecht. These are the indicators on which the city has scored a 4: Knowledge cohesion, smart monitoring, management cohesion, entrepreneurial agents, room to manoeuver, statutory compliance and preparedness. These indicators show that cooperation between stakeholders is important when it comes to ecological urban water governance. This cooperation can be the sharing of knowledge, but also collaboration on projects or policy development. Furthermore, the development of knowledge necessary for ecological water governance is also important. The smart monitoring network in Dordrecht does this really well as it provides a wide variety of information necessary for ecological control of the water. This goes hand in hand with the necessity for a city to be prepared to tackle issues that arise. The monitoring network makes the city prepared to quickly react when something happens. Additionally, it is important that there are people present that can ‘break’ the status quo. Ecological water governance in Dordrecht has only recently started to gain more momentum, but this momentum is mainly due to policy entrepreneurs that are actively trying to get the ecology and the environment included in the policies.

The 18 indicators that have scored a 3 are mainly associated with the fact that ecological water management is not yet fully on the agenda. However, it is gaining momentum, and is increasingly seen as important. In Appendix A the assessment format for Dordrecht can be found. The tables show that a score of 3 (a score of 0 in the table) is mostly associated with recent implementations of measures regarding the water issue, or that it is considered a side topic. In short, a score of 3 means that progress on the water challenge has been slow.

There are two indicators that have a score of 2. Firstly, Visionary agents scores low in the assessment because it is very difficult for actors to push forward policies that include water ecology. The political landscape of Dordrecht prefers the status quo, making the water ecology a very unilateral subject in the politics of Dordrecht. Secondly, the consumer willingness-to-pay in Dordrecht scores a 2. This score is low because the budget for water ecology has been very low for a long time. Only recently have stakeholders succeeded in creating more policies with ecology in mind. This means that the willingness-to-pay is very low, but surely rising.

5.5 Synthesis of the results

Water Challenge → ↓ GCF Indicator	**WWT**	**SWT**	**UHI**	**5 Challenge Dataset**	**Total**	**Strong GC in Dordrecht**
1.1 Community Knowledge						
1.2 Local sense of urgency						
1.3 Behavioral internalization	X				1	
2.1 Information availability		X			1	
2.2 Information transparency			X		1	
2.3 Knowledge Cohesion			X		1	**X**
3.1 Smart Monitoring	X	X		X	3	**X**
3.2 Evaluation	X	X		X	3	
3.3 Cross-stakeholder learning	X	X			2	
4.1 Stakeholder inclusiveness	X		X	X	3	
4.2 Protection of core values	X		X	X	3	
4.3 Progress and variety of options				X	1	
5.1 Ambitious and realistic management						
5.2 Discourse embedding		X			1	
5.3 Management cohesion						**X**
6.1 Entrepreneurial agents	X	X			2	**X**
6.2 Collaborative agents		X			1	
6.3 Visionary agents				X	1	
7.1 Room to manoeuver						**X**

7.2 Clear division of responsibilities						
7.3 Authority		X			1	
8.1 Affordability		X		X	2	
8.2 Consumer willingness-to-pay						
8.3 Financial continuation						
9.1 Policy instruments	X				1	
9.2 Statutory compliance	X	X		X	3	**X**
9.3 Preparedness		X		X	2	**X**

Table 9: Visualization of the frontrunner-straggler analysis, combined with the strong governance capacities of Dordrecht. The X indicates that the indicator has a higher score in frontrunners than straggler regarding the water challenge at the top. X also indicates which governance capacities are the strengths of Dordrecht

The table above (table 9) it has become apparent that multiple governance capacities are very important regarding ecologically sound urban water governance:

2.3 Knowledge Cohesion: Knowledge cohesion has only been seen to increase in frontrunners in the UHI water challenge. However, knowledge cohesion is a strength of Dordrecht. This shows that cohesive knowledge, and a wide variety of stakeholders specialized in different disciplines is important in ecologically sound urban water governance.

3.1 Smart Monitoring: Smart Monitoring is seen to increase in frontrunners in the WWT, SWT and the 5 Challenge datasets. Furthermore, this is also a very prominent governance capacity in Dordrecht. From this it can be concluded that the implementation of a smart monitoring network is a very important capacity necessary for making urban water governance ecologically sound.

3.2 Evaluation: Evaluation is seen to increase in frontrunners in WWT, SWT and the 5 Challenge dataset. From this it can be concluded that it is important to evaluate policies and projects to see how they perform regarding urban water ecology. Dordrecht seems to be evaluating their data, and how to handle calamities. However, water ecology is still a difficult subject in Dordrecht. Therefore, it is difficult to evaluate how ecological water governance is performing.

3.3 Cross-stakeholder learning: Cross-stakeholder learning is increased in frontrunners of the WWT and SWT challenges. As such cross-stakeholder learning can be seen as an important governance capacity in ecologically sound urban water governance. Furthermore, this governance capacity is one of the two weaknesses of Dordrecht. So the city can improve a lot by focusing more on this capacity.

4.1 Stakeholder Inclusiveness: Stakeholder inclusiveness seems to be an important governance capacity as it is seen to increase in the WWT, UHI and the 5 Challenge datasets. Therefore the

inclusiveness of stakeholders and collaboration with them is an important aspect of ecologically sound urban water governance.

4.2 Protection of core values: This indicator sees a higher score in frontrunner cities than in straggler cities for the WWT, UHI and 5 Challenge datasets. This means that in order to make urban water governance more ecologically sound there should be more commitment to the process instead of early end-results. Furthermore, stakeholders that align with the core values of water ecology should have the opportunity to be actively involved.

5.3 Management Cohesion: Management Cohesion does not seem to increase in the frontrunners of any of the datasets. However, it is one of the strong capacities of Dordrecht. This could mean that cohesive management can be an important capacity for ecologically sound urban water governance. Cities should aim to make policy relevant and coherent across sectors and government levels.

6.1 Entrepreneurial Agents: The WWT and SWT datasets show that this indicator scores higher in frontrunners than in stragglers. Furthermore, this is also one of the strengths of Dordrecht. This strengthens the idea that entrepreneurial agents are necessary for ecologically sound urban water governance. In order to make urban water governance ecologically sound there is a need for change. This change happens through agents that have access to enough resources to be influential on the decision-making.

7.1 Room to manoeuver: This governance capacity sees no increase in the frontrunner-straggler analysis. However, it is one of the strengths of Dordrecht. Therefore it can be assumed that in order for agents to be influential on ecologically sound urban water governance they require freedom and opportunities to come up with multiple strategies on how to tackle the issues.

8.1 Affordability: This Governance Capacity sees an increase in value in the analysis of the SWT and 5 Challenge datasets. This means that the affordability of ecologically sound urban water governance is an important factor. However, this can not be confirmed with the case study, as in Dordrecht affordability is not an issue.

9.2 Statutory Compliance: Statutory compliance can be seen as a very important governance capacity regarding ecologically sound urban water governance. It sees an increase in value in the WWT, SWT and 5 Challenge datasets, and is also a strength of Dordrecht. This means that legislation and compliance is very important when it comes to proper implementation of ecologically sound urban water governance. Dordrecht has a governing body of authority, the water authority, that has the final say when it comes to water policies or issues. Furthermore, the water authority also respects European and National legislation of water bodies.

9.3 Preparedness: This governance capacity sees an increase in value in the SWT and 5 Challenge datasets. Furthermore it is also a strength of the city of Dordrecht. Being prepared to handle issues or calamities is an important aspect of ecologically sound urban water governance. Dordrecht for example is prepared to quickly react to disturbances in water quality, or drought.

There are a couple of more indicators that have only seen an increase in one of the analyzed datasets. These indicators are:

1.3 Behavioral Internalization
2.1 Information Availability
2.2 Information Transparency
4.3 Progress and variety of options
5.2 Discourse Embedding
6.3 Visionary Agents
7.3 Authority
9.1 Policy Instruments

These indicators only increase in one of the datasets, and are not a strength of Dordrecht. Therefore The increase of these indicators will not be deemed relevant.

6. Discussion

6.1 What capacities should cities have in order to perform well in ecologically sound water governance?

The results of the frontrunner-straggler analysis and the case study shed some light on which governance capacities are important when looking at ecological water governance. Firstly, it seems that the generation of knowledge is an important capacity to handle ecological water governance. Smart monitoring and cross-stakeholder learning are important governance capacities. Learning from different stakeholders and monitoring the water to produce data can have a large influence on the success of policies regarding ecologically sound urban water governance. Furthermore, it is also important that the knowledge generated is cohesive across different policy fields and between different stakeholders. Evaluating policies on ecological water governance is also a form of learning, and deemed an important governance capacity. Governing bodies should be able to evaluate policies in order to see if they are actually effective in creating ecologically sound urban water governance.

Secondly, collaboration is a very important governance capacity. Not only can stakeholders directly learn from each other, they can also combine their experience and expertise to increase the effectiveness of ecological water governance. It is also important to include the stakeholders that actively want to be involved. These are often organizations or institutions with experience in water ecology, or with something closely related to water ecology. Management should also be cohesive across different stakeholders. It is important that policies are cohesive for all involved stakeholders, at all levels.

Thirdly, it is important that cities have the resources and possibilities to move towards water governance that is ecologically sound. This means that there are agents present with enough resources and knowledge to influence the system, to make a change towards improving the ecology. This goes hand-in-hand with the notion that stakeholders in general should have room to maneuver; if the stakeholders have no room for change, then the influential agents have nothing to change.

Fourthly, the importance of authorities. Compliance with legislation and policies is very important, which means that there is a need for the establishment of socially accepted authorities. The presence of authorities will also ensure that policies surrounding ecologically sound water governance are more affordable. This is important because affordability is also an important governance capacity.

Lastly, preparedness. It is very important that cities are prepared to handle issues and calamities should they arise. This goes hand-in-hand with the generation of knowledge. This will ensure that cities have knowledge on what to actually prepare for.

Very interestingly these governance capacities align very well with the results of the literature review (Table 1). Ecosystem valuation is a factor that aligns perfectly with the governance capacity protection of core values. Water ecology can only be included in policies if ecosystems are valued in any form. Equalized scaling aligns perfectly with knowledge cohesion and management cohesion. Policies and laws need to be cohesive across disciplinary and sectoral boundaries. In the literature review it was found that collaboration is a very important aspect of ecologically sound urban water governance. This is confirmed in the frontrunner-straggler analysis with the indicators cross-stakeholder learning and stakeholder inclusiveness. Collaboration between stakeholders is very necessary for effective ecological water governance. Furthermore, the involvement of the scientific community is important. This is seen by the importance of the generation and usage of knowledge regarding ecologically sound urban water governance. Lastly, the necessity for

contingency is shown through the governance capacity room to manoeuver. Development of sustainable policies regarding water ecology requires multiple options, and maneuverability of stakeholders makes these options a lot more tangible.

6.2 Interesting outliers

The results of the frontrunner-straggler analysis shows some very interesting extra results. For the analysis of the WWT and SWT water challenges the local sense of urgency (GCF indicator 1.2) seems to increase in the beginning, only to decrease again halfway. This could mean that a local sense of urgency is an important governance capacity in the very early stages of ecologically sound urban water governance. This could mean that once policy on ecological water governance has started rolling the local sense of urgency is not as important anymore, because the subject has already gained enough attention to pave the way for policy.

6.3 Challenges and shortcomings

The data used for the analysis does not specifically concern itself with ecologically sound urban water governance. The data was deemed relevant because it has common ground with the ecology. While this common ground is certain to show patterns in governance capacities, it is still open to some amount of interpretation. Furthermore, the cities are deemed a frontrunner or straggler based on their score in the CBF analysis. This database scores cities based on the water facilities there are. The presence of these facilities is assumed to be an indication of whether the city performs well regarding ecologically sound urban water governance. Additionally, this research does not take cultural and social differences between cities and countries into account. Some countries may have a different score simply based on a social or cultural difference, which would mean they require different solutions as well. Moreover, there are a couple of indicators which have only seen an increase in the analysis of one dataset. It is difficult to assess a pattern when only a single dataset shows an increase in governance capacities. For that reason these indicators have not been included as important governance capacities for ecologically sound urban water governance.

This also concerns the case study of Dordrecht as it is used as an example for how ecologically sound urban water governance should be. However this also means that Dordrecht can be an outlier in the data it has provided on the governance capacities. Furthermore, the case study was done with a limited amount of data. It seems that ecological water governance is a new subject for the city, therefore a limited amount of data was available. Additionally, it was difficult to find interviewees for the case study due to holidays and because the stakeholders were relatively busy during the timeline of my research (Dordrecht struggled with a heavy drought this season). There have also been issues with previous researchers in Dordrecht that have caused issues among the stakeholders, therefore the stakeholders were sometimes reluctant to be interviewed. Moreover, the case study was very open to interpretation. Even in Dordrecht water ecology is a relatively new subject, therefore it was not always explicitly mentioned. For example, if a policy plan was made on the subject of ecology, it was assumed that this also meant water ecology. This was also the case with interviewees. Not all interviewees had a background in governance.

7. Conclusion

Comparing cities that are frontrunners, and cities that are stragglers regarding ecologically sound urban water governance has given interesting insights into which governance capacities are important when implementing policies regarding ecological water management. Generating and sharing cohesive knowledge has been found to be a very important governance capacity. This knowledge can be used to further develop new policies, or evaluate existing policies. It can also be used to prepare for ecological issues or calamities that may arise in the future. Furthermore, collaboration between relevant stakeholders is also an important governance capacity, as this allows for the sharing of knowledge, and the development of the most effective policies. Additionally, it is important that there are enough resources available to allow stakeholders to make a difference in ecological water governance. It is important that innovative stakeholders have enough resources and possibilities to change the system, otherwise subjects such as water ecology are not given enough attention. Lastly, the presence of authorities is also necessary. The authorities implement policies and laws necessary for ecological water governance to strive. These previous points also create the recommendations for cities that aim to implement ecologically sound urban water governance. Collaboration, generating and sharing knowledge, authority, and the cohesiveness of policies are very important points, and cities should aim to make these priority governance capacities.

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Appendix A: Governance Capacity Framework indicator definitions and associated interview questions. (KWR, 2021)

Condition 1: Awareness

Awareness refers to the understanding of causes, impact, scale and urgency of the water challenge.

Indicator 1.1: Community knowledge

Predefined question: To what extent is knowledge regarding the current and future risks, impacts, and uncertainties of the water challenge dispersed throughout the community and local stakeholders which may results in their involvement in decision-making and implementation?

Rephrasing of predefined question for Dordrecht:

Is there a strong awareness in the community regarding the risks, impacts and uncertainties of water ecology in the city of Dordrecht? How about the stakeholders? Are they involved in the decision making and/or implementation of ecological water management?

++	**Balanced awareness**	Nearly all members of the community are aware of and understand the actual risks, impacts and uncertainties. The water challenge is addressed the local level. Local communities and stakeholders are familiar with or are involved in the implementation of adaptation measures
+	**Overestimation**	The community is knowledgeable and recognize the many existing uncertainties. Consequently, they often overestimate the impact and probability of incidents or calamities. The water challenge has been raised at the local political level and policy plan may be co-developed together with local communities
0	**Underestimation**	Most communities have a basic understanding of the water challenge. However the current risks, impacts and frequencies are often not fully known and underestimated. Future risks, impacts and frequencies are often unknown. Some awareness has been raised amongst or is created by local stakeholders and communities
-	**Fragmented knowledge**	Only a small part of the community recognizes the risks related to the water challenge. The most relevant stakeholders, have limited understanding of the water challenge. As a result, the issue is hardly or not addressed at the local governmental level
--	**Ignorance**	The community, local stakeholders and decision-makers are unaware or ignore the water challenge. This is demonstrated by the absence of articles on the issue in newspapers, on websites or action groups addressing the issue

Indicator 1.2: Local sense of urgency

Predefined question: To what extent do actors have a sense of urgency, resulting in widely supported awareness, actions, and policies that address the water challenge?

Rephrasing of predefined question for Dordrecht:

Is there a sense of urgency surrounding ecological water management in Dordrecht? Does this result in demand and support to take action, through for example media attention?

++	**Strong demand for action**	There is a general sense of importance regarding the water challenge. There is continuous, active, public support and demand to undertake action and invest in innovative, ground-breaking solutions. This is evident, since the issue receives much media attention and action plans are implemented
+	**General sense of urgency of long-term sustainability goals**	There is increasing understanding of the causes, impacts, scale and urgency of the water challenge. It leads to general sense of urgency of the need for long-term sustainable approaches. However, measures requiring considerable efforts, budget, or substantial change with sometimes uncertain results are often receiving only temporal support. The water challenge is a main theme in local elections
0	**Moderate willingness for small changes**	There is growing public awareness and increasing worries regarding the water challenge. However, the causes, impact, scale and urgency are not widely known or acknowledged leading to the support for only incremental changes. It is a side topic in local elections
-	**Raising of awareness by small groups**	A marginalized group (e.g. the most vulnerable, environmentalists, NGOs) express their concerns, but these are not widely recognized by the general public. Adaptation measures are not an item on the political agenda during elections
--	**Resistance**	There is generally no sense of urgency and sometimes resistance to spend resources to address the water challenge. It is not an item on the political agenda during elections, as is evident from the lack of (media-) attention

Indicator 1.3: Behavioral internalization

Predefined question: To what extent do local communities and stakeholders try to understand, react, anticipate and change their behavior in order to contribute to solutions regarding the water challenge?

Rephrasing of predefined question for Dordrecht:

Are local communities trying to understand water ecology? And are they reacting, anticipating and changing their behavior in order to contribute to solutions regarding the water ecology?

++	**Full internalisation**	Because actors are fully aware of the water challenge, their causes, impacts, scale and urgency, the it is integrated into long-term and joint strategy, practices and policies. All actors are encouraged to participate. At this point, the water challenge is integrated into everyday practices and policies
+	**Moderate internalisation**	Awareness has evolved to mobilization and action. There are various incentives for actors to change current practices and approaches regarding the water challenge. The water challenge, however, is not yet fully integrated into clear strategy, practices and policies
0	**Exploration**	There is a growing awareness, often as a result of local, exploratory research regarding the causes and solutions of the water challenge. There are only incremental changes in actions, policy and stakeholder's behaviour
-	**Recognized as an external pressure**	The water challenge is partly recognized, mainly due to external pressure instead of intrinsic motivations. There is no support to investigate its origin or to proceed to action or changing practices
--	**Unawareness**	There is unawareness of the water challenge with hardly any understanding of causes and effects or how current practices impact the water challenge, the city or future generations

Condition: 2 Useful knowledge

This condition describes the qualities of information with which actors have to engage in decision-making.

Indicator 2.1: Information availability

Predefined question: To what extent is information on the water challenge available, reliable, and based on multiple sources and methods, in order to meet current and future demands so as to reveal information gaps and enhance well-informed decision-making?

Rephrasing of predefined question for Dordrecht:

To what extent is information on water ecology or the management thereof available? Does this show whether there is information missing, leading to sound decision making, or further research?

++	**Comprehensive information enabling long-term integrated policy**	A comprehensive and integrated documentation of the issue can be found on local websites and policy papers. It is characterized with adequate information, an integrated description of social, ecological and economic processes regarding the water challenge, as well as goals and policies. Furthermore, progress reports on effective implementation can be found
+	**Information enhancing integrated long-term thinking**	Strong effort is put in providing integrated information from various fragmented sources. Information gaps are identified and attempted to be bridged. This may be clear from extensive documentation on the long-term process. Also citizen knowledge may be taken into account
0	**Information fits demand, limited exploratory research**	Information on the water challenge is available. Knowledge on understanding or tackling the water challenge is progressing and is produced in a structural way. Knowledge gaps are hardly identified due to lock-in into existing disciplines and policy. This is apparent from the quantity of factual information, but the causes, risks and impacts of long-term processes are lacking behind
-	**Information scarcity and limited quality**	Limited information is available which does not grasp the full extent of the water challenge. In some cases not all information is of sufficient quality to generate a comprehensive overview
--	**Lack of information**	No information on the water challenge can be found. Or the scarce available information is of poor quality

Indicator 2.2: Information transparency

Predefined question: To what extent is information on the water challenge accessible and understandable for experts and non-experts, including decision-makers?

Rephrasing of the predefined question for Dordrecht:

Is the information on water ecology or the management thereof accessible and understandable by both experts and non-experts?

++	**Easy access to cohesive knowledge**	Information is easily accessible on open source information platforms. There are multiple ways of accessing and sharing information. Information is often provided by multiple sources and is understandable for non-experts
+	**Sharing of partly cohesive knowledge**	All interested stakeholders can access information. Action has been taken to make knowledge increasingly understandable. Still, it is a time-consuming search through a maze of organizations, protocols and databases to abstract cohesive knowledge and insights
0	**Sharing of very technical knowledge**	There are protocols for accessing information; however, it is not readily available. Although information is openly available, it is difficult to access and comprehend because it is very technical. The water challenge is reported on local websites and reports
-	**Low sharing of fragmentized knowledge**	Information is sometimes shared with other stakeholders. However, information is inaccessible for most stakeholders. Furthermore, knowledge is often technical and difficult to understand for non-experts. The water challenge may be addressed on local websites
--	**Not transparent and inaccessible knowledge**	Information is limitedly available and shared. sharing may be discouraged. The information that is available is difficult to understand. The water challenge is not addressed on local websites

Indicator 2.3: Knowledge cohesion

Predefined question: To what extent is information cohesive in terms of using, producing and sharing different kinds of information, usage of different methods and integration of short-term targets and long-term goals amongst different policy fields and stakeholders in order to deal with the water challenge?

Rephrasing of the predefined question for Dordrecht:

Are both short-term and long-term goals integrated in the information and decision-making? Does the information account for context (social, past problems such as Waternoodsramp)?

++	**Implementation of cohesive knowledge**	Stakeholders are engaged in long-term and integrated strategies. Information can be found that is co-created knowledge and will contain multiple sources of information, multiple and mixed methods taking into account the socio-, ecological and economic aspects of the water challenge
+	**Substantial cohesive knowledge**	Sectors cooperate in a multidisciplinary way, resulting in complete information regarding the water challenge. Besides multiple actors, multiple methods are involved to support information. Too many stakeholders are involved, sometimes in an unbalanced way. Knowledge about effective implementation is often limited
0	**Insufficient cohesion between sectors**	Data collection within sectors is consistent and is sustained in multiple projects for about two to three election periods. Knowledge on the water challenge, however, is still fragmented. This becomes clear from different foci of the stakeholders as stated in their organisation's strategies and goal setting
-	**Low-cohesive knowledge within sectors**	Information that is found is sector specific and information is inconsistent within and between sectors
--	**Non-cohesive and contradicting knowledge**	A lack of data strongly limits the cohesion between sectors. Information that is found can even be contradictory

<u>Condition 3: Continuous learning</u>

Continuous learning and social learning is essential to make water governance more effective. The level of learning differs from refining current management, critical investigation of fundamental beliefs or questioning underlying norms and values.

Indicator 3.1: Smart monitoring

Predefined question: To what extent is the monitoring of process, progress, and

policies able to improve the level of learning (i.e., to enable rapid recognition of alarming situations, identification or clarification of underlying trends)? Or can it even have predictive value?

Rephrasing of the predefined question for Dordrecht:
Is progress, process and policy monitored in order to improve learning (i.e., rapid recognition of alarming situations, identification of trends)? Is it possible to predict certain relevant events?

++	**Useful to predict future developments**	Monitoring system is adequate in recognizing alarming situations, identifying underlying processes and provides useful information for identifying future developments. Reports of monitoring will display discrepancies between fundamental beliefs and practices. The monitoring is changed in order to act upon these findings by altering the fundamental beliefs. Often regulatory frameworks are changed, new actors are introduced, new risk management approach are used
+	**Useful to recognize underlying processes**	The abundant monitoring provides sufficient base for recognizing underlying trends, processes and relationships. Reports of monitoring will display discrepancies between assumptions and real process dynamics. Acting upon these findings by altering the underlying assumptions characterizes this level of smart monitoring. Often also system boundaries are re-defined, new analysis approach introduced, priorities are adjusted and new aspects are being examined
0	**Quick recognition of alarming situations**	Monitoring system covers most relevant aspects. Alarming situations are identified and reported. This leads to improvement of current practices regarding the technical measures. There is only minor notification of societal and ecological effects
-	**Reliable data but limited coverage**	Monitoring occurs, however the monitoring system does not cover all facets of the water challenge, with sometimes incomplete description of the progress and processes of technical and policy measures. Monitoring is limited to singular effectiveness or efficiency criteria and cannot identify alarming situations
--	**Irregular, poor quality or absent**	There is no system to monitor the water challenge or monitoring is irregular

Indicator 3.2: Evaluation
Predefined question: To what extent are current policy and implementation continuously assessed and improved, based on the quality of evaluation methods, the frequency of their application, and the level of learning?

Rephrasing of the predefined question for Dordrecht:
Is current policy also being assessed and evaluated in order to find whether it can be improved?

++	**Exploring the fitness of the paradigm**	Frequent and high quality evaluation procedures fully recognize long-term processes. Assumptions are continuously tested by research and monitoring. Evidence for this is found in sources (primarily online documents) that report on the learning process and progress. Uncertainties are explicitly communicated. Also, the current dominant perspective on governance and its guiding principles are questioned
+	**Changing assumptions**	There is continuous evaluation, hence continuous improvements of technical and policy measures and implementation. Innovative evaluation criteria are used. This is evidenced by reports containing recommendations to review assumptions or explicitly indicating the innovative character of the approach
0	**Improving routines**	The identified problems and solutions are evaluated based on conventional (technical) criteria. Current practices are improved. This becomes clear from information of the used and existing criteria, the small changes recommended in reports and short-term character
-	**Non-directional evaluation**	Evaluation is limited regarding both frequency and quality. Evaluation occurs sometimes, using inconsistent and even ad-hoc criteria. Also the evaluation is not systematic. There is no policy on the performance of evaluations, only the evaluation(s) itself are reported
--	**Insufficient evaluation**	There is no evaluation of technical or policy measures regarding the water challenge. Otherwise it is not documented

Indicator 3.3: Cross-stakeholder learning

Predefined question: To what extent are stakeholders open to and have the opportunity to interact with other stakeholders and deliberately choose to learn from each other?

Rephrasing of the predefined question for Dordrecht:

To what extent are stakeholders open to and have the opportunity to interact with other stakeholders and deliberately choose to learn from each other?

++	**Putting cross-stakeholder learning into practice**	There is recognition that the water challenge is complex and that cross-stakeholder learning is a precondition for adequate solutions and smooth implementation. This is evidenced by broad support for policy measures and implementation. Moreover, continuous cross-stakeholder learning programs are in place or may be institutionalized
+	**Open for cross-stakeholder learning**	Stakeholder interaction is considered valuable and useful for improving policy and implementation. Various initiatives for cross-stakeholder learning have been deployed, yet the translation into practice appears difficult. The programs may not be structural and the learning experience may not be registered and shared
0	**Open for stakeholder interaction**	Stakeholders are open to interaction, though not much learning is going on due to the informative character of the interaction. Often, a number of stakeholders, that do not necessarily share interests or opinions, are involved in the decision-making process
-	**Small coalitions of stakeholders with shared interest**	Interaction occurs in small coalitions based on common interests. Opinions of those outside the coalition are generally withheld. Only information for the shared point of view is sought. This is evidenced by the finding of only one perspective regarding the water challenge or few perspectives that are supported by means of circle-referencing
--	**Closed attitude towards cross-stakeholder learning**	There is no contact with other parties, contact may even be discouraged. This is apparent from limited sharing of experience, knowledge and skills. No information is shared outside organisation and sector, nor is external information used

<u>Condition 4: Stakeholder engagement process</u>

Stakeholder engagement is required for common problem framing, gaining access to a wide variety of resources and creating general support that is essential for effective policy implementation.

Indicator 4.1: Stakeholder inclusiveness

Predefined question: To what extent are stakeholders interact in the decision-making process interaction (i.e., are merely informed, are consulted or are actively involved)? Are their engagement processes clear and transparent? Are stakeholders able to speak on behalf of a group and decide on that group's behalf?

Rephrasing of the predefined question for Dordrecht:
Are stakeholders included in the decision-making progress, or are they merely informed? Are there spokespersons that can speak on behalf of certain groups? Is it clear how these stakeholders can engage on the subject?

++	**Transparent involvement of committed partners**	All relevant stakeholders are actively involved. The decision-making process and the opportunities for stakeholder engagement are clear. It is characterised by local initiatives specifically focussing on water such as local water associations, contractual arrangements, regular meetings, workshops, focus groups, citizen committees, surveys
+	**Timely, over-inclusive and active involvement**	Stakeholders are actively involved. It is still unclear how decisions are made and who should be involved at each stage of the process. Often too many stakeholders are involved. Some attendants do not have the mandate to make arrangements. Stakeholder engagement is abundantly done for often overlapping issues
0	**Untimely consultation and low influence**	Stakeholders are mostly consulted or informed. Decisions are largely made before engaging stakeholders. Frequency and time-period of stakeholder engagement is limited. Engagements are mainly ad hoc consultations where stakeholders have low influence on the end-result
-	**Non-inclusive involvement**	Not all relevant stakeholders are informed and only sometimes consulted. Procedures for stakeholder participation are unclear. If involved, stakeholders have but little influence
--	**Limited supply of information**	No stakeholders are included, or their engagement is discouraged. Information cannot be found on the extant decision-making process.

Indicator 4.2: Protection of core values
Predefined question: To what extent 1) is commitment focused on the process instead of on early end-results? 2) do stakeholders have the opportunity to be actively involved? 3) are the exit procedures clear and transparent? (All three ensure that stakeholders feel confident that their core values will not be harmed.)

Rephrasing the predefined question for Dordrecht:
Do stakeholders have the opportunity to be actively involved? When dealing with policy or progress on water ecology, is there more focus on the process or the end-result?

++	**Maximal protection of core values**	Stakeholders are actively involved and have large influence on the end-result. There are clear exit possibilities and leading to more stakeholders more committed to the process. The participation opportunities and procedure of implementation are clear.
+	**Requisite for early commitment to output**	Stakeholders are actively involved and expected to commit themselves to early outcomes in the process. Hence relevant stakeholders may be missing in contractual arrangements as they do not want to commit themselves to decisions to which they have not yet contributed. At this point involved stakeholders have influence on the end-result and therefore the output serves multiple interests
0	**Suboptimal protection of core values**	As stakeholders are consulted or actively engaged for only short periods, alternatives are insufficiently considered. Influence on end-result is limited. Decisions comply with the interests of the initiating party primarily. There are no clear exits in the engagement process
-	**Non-inclusive and low influence on results**	The majority of stakeholders is engaged, but the level of engagement is low (informative or sometimes consultative). There is a low influence on the result which invokes resistance, for example on internet platforms and newspapers
--	**Insufficient protection of core values**	Because stakeholders are hardly engaged or informed, core values are being harmed. Implementation and actions may be contested in the form of boycotts, legal implementation obstructions and the invoking of anti-decision support. There may be distrust and an absence of participation

Indicator 4.3: Progress and variety of options

Predefined question: To what extent are procedures clear and realistic, are a variety of alternatives co-created and thereafter selected from, and are decisions made at the end of the process in order to secure continued prospect of gain and thereby cooperative behavior and progress in the engagement process?

Rephrasing the predefined question for Dordrecht:

Are procedures in water ecology clear and realistic? When choosing a procedure for issues or progress, are there multiple alternative options to choose from? Are process decisions made at the end of the process?

++	**Active engagement with choice selection at the end of the cooperation**	There is active engagement of all relevant stakeholders and clarity of participation procedure and realistic deadlines. The range of alternatives is fully explored and selection of the best alternatives occurs at the end of the process. Reviews of stakeholder meetings provide the alternatives addressed. Stakeholders are engaged throughout the whole process as specified in contractual agreements
+	**Active involvement with abundant choice variety**	Stakeholders are actively involved and there is sufficient room for elaborating alternatives. Procedures, deadlines and agreements are unclear. There is no or few specification on deadlines in terms of dates. Due to inexperience with active stakeholder engagement, decisions are taken too early in the process leading to the exclusion of argument and solutions. Hence, decisions may not be fully supported
0	**Consultation or short active involvement**	There is a clear procedure for consultation or short active involvement of stakeholders, but the opportunities to consider all relevant alternatives is insufficient. Decisions are therefore still largely unilateral and solutions suboptimal. The suboptimal character of a solution can be observed from evaluations or difference in opinions
-	**Rigid procedures limit the scope**	Informative and consultative approaches are applied, according rigid procedures with low flexibility. The period of decision-making is short with a low level of stakeholder engagement. These unilateral decision-making processes may lead to slow and ineffective implementation. The latter can be observed from critique via public channels
--	**Lack of procedures limit engagement and progress**	The lack of clear procedures hinder stakeholder engagement. This unilateral decision-making limits progress and effectiveness of both decision-making and implementation. It might result in conflicting situations. Often, much resistance can be found online and implementation may be obstruct

Condition 5: Management Ambitions

Policy ambitions assesses if current policy is ambitious, feasible, well-embedded in local context and if it forms a cohesive set of long-term and short-term goals within and across sectors.

Indicator 5.1: Ambitious and realistic management

Predefined question: To what extent are goals ambitious (i.e., identification of challenges, period of action considered, and comprehensiveness of strategy) and yet realistic (i.e., cohesion of long-term goals and supporting flexible intermittent targets, and the inclusion of uncertainty in policy)?

Rephrasing of the predefined question for Dordrecht:

Are the objectives of ecological governance ambitious, but also realistic? Is uncertainty included in the policies?

++	**Realistic and ambitious strategy**	Policy is based on modern and innovative assessment tools and policy objectives are ambitious. Support is provided by a comprehensive set of intermittent targets, which provide clear and flexible pathways. Assessment tools and scenarios analyses identify tipping points that may be found in policy documents
+	**Long-term ambitious goals**	There is a long-term vision that incorporates uncertainty. However, it is not supported by a comprehensive set of short-term targets. Hence, achievements and realistic targets are difficult to measure or estimate. Visions are often found online as an organisation's strategy. They often entail a description of the water challenge and need for action
0	**Confined realistic goals**	There is a confined vision of the water challenge. Ambition are mostly focused on improving the current situation where unchanging conditions are assumed and risk and scenarios analyses are lacking
-	**Short-term goals**	Actions and goals mention sustainability objectives. Actions and goals are "quick fixes" mainly, not adhering to a long-term vision or sustainable solutions. Uncertainties and risks are largely unknown
--	**Short-term, conflicting goals**	Goals consider only contemporary water challenges, are short-sighted and lack sustainability objectives. Goals are arbitrary and sometimes conflicting and the character of policy is predominantly reactive

Indicator 5.2: Discourse embedding

Predefined question: To what extent is sustainable policy interwoven in historical, cultural, normative and political context?

Rephrasing of the predefined question for Dordrecht:

To what extent is policy interwoven in historical, cultural, normative and political context?

++	**Embedding of sustainable implementations**	Local context is used smartly to accelerate policy implementation. Innovations are subdivided into suitable phases which are more acceptable and effectively enables sustainable practices. Effective policy implementation is enabled by a general consensus that long-term integrated policy is needed to address the water challenge
+	**Consensus for sustainable actions**	There is a consensus that adaptation is required, but substantial effort is necessary as there is little experience in addressing the water challenge in a long-term integrated approach. Furthermore, the decision-making periods are long as trust relations with new unconventional partners need to be built
0	**Low sense of urgency embedded in policy**	Current policy fits the local context. The water challenge is increasingly identified, framed and interwoven into local discourse, but the disregard of uncertainty prevents a sense of urgency that is necessary to adopt adequate adaptation measures. Decision making often results in very compromised small short-term policy changes
-	**Persistent reluctance and poor embedding**	Actors feel reluctant to execute current policy as it conflicts with their norms and values. Policy hardly takes the local context and existing discourses into account. And the policy does not correspond with societal demands. This may lead to distrust between actors, inefficient use of resources and ineffective overall implementation
--	**policy mismatch**	Cultural, historical and political context is largely ignored, leading to arduous policy implementation. Actors may not understand the scope, moral or to whom it applies or how to implement it (total confusion)

Indicator 5.3: Management cohesion

Predefined question: To what extent is policy relevant for the water challenge, and coherent regarding 1) geographic and administrative boundaries, and 2) alignment across sectors, government levels, and technical and financial possibilities?

Rephrasing of the predefined question for Dordrecht:

Is policy relevant for water ecology? Is the policy coherent across geographical boundaries? Is policy aligned across the different technical and financial possibilities?

++	**Cohesive synergetic policies**	Policies are coherent and comprehensive within and between sectors. There is an overarching vision resulting in smooth cooperation. Goals are jointly formulated, evaluated and revised to adapt to new challenges. This is evidenced by thematic instead of sectoral approaches. Many inter-sectoral meetings, interdisciplinary reports and cohesiveness in goals and strategies are formulated
+	**Overlapping comprehensive policies**	There is cross-boundary coordination between policy fields to address the water challenge. Policies are cohesive, but have not yet resulted in broad multi-sectoral actions. Efforts to harmonize different sectors are evident by employee functions or assignments and protocols
0	**Fragmented policies**	Policy is fragmented and based on sector's specific scope and opportunities for co-benefits are hardly explored. However, effort may be made to balance the resource allocation between sectors
-	**Opposing sectoral policies**	Overall water and climate adaptation policy is characterised by fragmentation and imbalance between sectors. The majority of resources is spent on the dominant policy field and overlap between sectors lead to inefficient use of resources
--	**Incompatible policies**	Policies between and within sectors are strongly fragmented and conflicting. This is evidenced by contradicting objectives and the squandering use of resources

<u>Condition 6: Agents of change</u>

In order to drive change, agents of change are required to show direction, motivate others to follow and mobilize the resources required.

Indicator 6.1: Entrepreneurial agents

Predefined question: To what extent are the entrepreneurial agents of change enabled to gain access to resources, seek and seize opportunities, and have influence on decision-making?

Rephrasing of the predefined question for Dordrecht:

Is there need for continuous innovation? Does research into innovation surrounding water ecology have access to sufficient resources? Does the research have the opportunity to influence the decision-making?

++	**Long-term support for entrepreneurship**	There is recognition of the need for continuous innovation, hence applied research is enabled that explores future risk management and supports strategy formulation. The experiments yield increased benefits and new insights. This is recognized by other actors, thereby providing access to new resources. Continuous experimentation is secured by long-term and reliable resource allocation
+	**Tentative experimental entrepreneurship**	There is a growing understanding of the water challenge's uncertainty, complexity and need for innovative approaches that entail a certain level of risk. Tentative experimental projects set in but are paid by conventional resources. Projects are small-scale pilots
0	**Conventional and risk-averse entrepreneurship**	Entrepreneurial agents of change are better able to seize low-risk opportunities. Therefore opportunities for innovative approaches and synergies are hardly pursued. Small changes can be observed
-	**Room for short-sighted entrepreneurship**	Agents of change struggle to gain access to resources to address imminent water challenges. Windows of opportunity to identify and to act upon perceived risks are limited. Opportunities to address stakeholders with potential access to resources are rarely seized
--	**Insufficient entrepreneurship**	Ignorance for risk and threats leads to ineffective rigid governance and lack of opportunity for entrepreneurial agents to enable improvements. Moreover, distrust by other actors and potential investors, further decrease access to resources

Indicator 6.2: Collaborative agents

Predefined question: To what extent are actors enabled to engage, build trust-collaboration, and connect business, government, and sectors, in order to address the water challenge in an unconventional and comprehensive way?

Rephrasing the predefined question for Dordrecht:

Are different actors of water ecology enabled, and actively seeking out collaboration between businesses, government and sectors?

++	**Agents of change enhances wide-spread synergetic collaboration**	There is on-going build-up of productive and synergetic collaborations. Facilitators may even be administered to coordinate this through mediation and authority. There is a conception of the ideal collaboration composition
+	**Agents of change can push for collaboration between new stakeholders**	There is an understanding that water challenges requires long-term and integrated solutions. Hence, wide-spread collaborations between a variety of stakeholders and sectors are being established. New collaborations with unconventional actors, result, more and more, in valuable new insights and effective networks
0	**Agent are enabled to enhance conventional collaboration**	Traditional coalitions are preserved to maintain status quo. There is trust within these coalitions. There is limited space to create new collaborations. If new collaboration occurs solutions are still mostly sectoral and short- to mid-term
-	**Insufficient opportunities for collaborative agents**	There is insufficient opportunity for agents of change to go beyond conventional collaboration. The current collaborations are deemed sufficient to deal with the water challenge whereas the vision is limited to ad hoc command and control approaches
--	**Lack of collaborative agents**	Collaboration is discouraged, because of a strong hierarchical structure. There is distrust between stakeholders and the willingness and thereby opportunities for collaborative agents are largely lacking

Indicator 6.3: Visionary agents

Predefined question: To what extent are actors in the network able to manage and effectively push forward long-term and integrated strategies which are adequately supported by interim targets?

Rephrasing the predefined question for Dordrecht:

Are stakeholders able to promote long-term strategies that are integrated in the system? Are these strategies assessed, for example through interim targets?

++	**Long-term vision supported by short-term targets**	Visionary agents of change in different positions and with different backgrounds actively and successfully promote a sustainable and tong-term vision regarding the water challenge, that is communicated clearly. Short-term targets fit the long-term visions. There is interest and employment in trend analysis.
+	**Long-term vision with flawed communication**	There is a clear long-term, integrated and sustainable-oriented vision. There is still some discrepancy between short-term targets and implementation strategies and the long-term vision from visionary agents of change. This means that agents are not always clear in their formulation regarding the effect and impact of envisioned strategies
0	**Defense of status quo**	The visions of the existing agents of change are limited to promoting the business as usual. They do not oppose nor promote long-term, integrative thinking. Interest or employment in trend analysis is limited
-	**Unilateral and short-term vision**	There is a unilateral vision regarding the water challenge, which considers a limited groups of actors. The vision often has a short-term focus, with a maximum of 3 to 4 years
--	**Deficient sustainability vision and short-term focus**	There is a lack of visionary agents that promote change towards a long-term, sustainable vision regarding the water challenge. Diverging expectations and objectives of stakeholders are the result. This may be evidenced by indecisiveness or even conflicts. Long-term and integrative initiatives may also be blocked

<u>Condition 7: Multi-level network potential</u>

Urban water governance involves a plethora of actors and interests from all levels of

government, organizations and (private) stakeholders. For sustainable solutions, working in networks is an essential determinant for effective solutions.

Indicator 7.1: Room to manoeuver

Predefined question: To what extent do actors have the freedom and opportunity to develop a variety of alternatives and approaches (this includes the possibility of forming ad hoc, fit-for-purpose partnerships that can adequately address existing or emerging issues regarding the water challenge)?

Rephrasing the predefined question for Dordrecht:

Do actors have the freedom and opportunity to come with alternative innovative approaches, by for example finding new partnerships?

++	**Freedom to develop innovative solutions**	There is a common and accepted long-term vision for dealing sustainably with the water challenge. Within the boundaries of this vision, actors are given the freedom to develop novel and diverse approaches and partnerships, resulting in continuous improvements and exploration. These partnerships are most likely institutionalized
+	**Redundancy to address uncertainty**	There is recognition that a high degree of freedom is necessary to deal with complex situations in the form of experiments and looking for new unconventional collaborations. There is a dynamic mix of cooperative partnerships and a redundant set of diverging alternative solutions. A clear overall vision to steer research is however lacking
0	**Limited room for innovation and collaboration**	Actors are given the means to perform predefined tasks for dealing with problems that are framed with a narrow, short-term and technical-oriented scope. There is limited room to deviate. Solutions are sought in own sectoral field and expertise
-	**Limited autonomy**	Only a few actors receive some degree of freedom, there are limited opportunities to develop alternatives, and there is hardly any opportunity to form partnerships with unconventional actors
--	**Strictly imposed obligations**	The actions of stakeholders are strictly controlled and there are rigid short-term targets. Freedom to form new partnerships is strongly limited as actor network composition is fixed and small. There are no resources made available for exploring alternatives that might be more effective or efficient whereas many actors that are affected by the water challenge do not have a voice

Indicator 7.2: Clear division of responsibilities

Predefined question: To what extent are responsibilities clearly formulated and allocated, in order to effectively address the water challenge?

Rephrasing the predefined question for Dordrecht:

Are responsibilities of water ecology clear for everyone involved?

++	**Dynamic, fit-for-purpose cooperations**	There are many synergetic cooperations within the urban water network that can provide solutions for the water challenge. The roles and responsibilities are clearly divided amongst actors. These cooperations are dynamic and result in fit-for-purpose problem solving necessary to solve complex, multi-level and unknown challenges
+	**Innovative cooperative strategies**	Actors recognize that knowledge and experience are scattered within the local network. Therefore, extra effort is made to bundle the scattered expertise and to reach fit-for-purpose division of clear roles and responsibilities. New cooperation compositions are explored
0	**Inflexible division of responsibilities**	Responsibilities are divided over a limited set of conventional actors. Opportunities for new cooperation and more effective division of responsibilities are not seized or even recognized. Sometimes conventional actors get more tasks to deal with new water challenges
-	**Barriers for effective cooperation**	Authorities are fragmentized or they lack interest. Moreover, miscommunication and lack of trust are causes that block effective water governance
--	**Unclear division of responsibilities**	There is an unclear division of responsibilities and often the relationships are over-hierarchical. Everybody expects someone else to make required effort and trust is hardly found

Indicator 7.3: Authority

Predefined question: To what extent are legitimate forms of power and authority present that enable long-term, integrated and sustainable solutions for the water challenge?

Rephrasing the predefined question for Dordrecht:

Are legitimate forms of power and authority present, and supported both politically and socially?

++	**Strong well-embedded authority**	Long-term, integrated approaches regarding the water challenge are well embedded in policy and regulatory authorities. Authoritative figures receive much support both politically and by society. Their opinions and statements also receive much media attention
+	**Stirring authority**	There is recognition of the need for long-term and integrated approaches by both the public and the political arena. Sustainability approaches regarding the water challenge are now implemented as declarations of intent and sustainability principles in policy and regulation. Legitimate authorities are assigned to coordinate long-term integrated policy and implementation
0	**Restricted authority**	The water challenge is addressed as long as the status quo is not questioned. Long-term policy visions are limited and new policy mainly needs to fit into existing fragmentized structure. This means small (technical) changes are occurring
-	**Unfruitful attempts**	The water challenge is put forward by individuals or a groups of actors, but there is only little interest which is also fragile due to poor embedding of sustainability principles in current policy mechanisms, interests, and budget allocation. The challenge may have been mentioned in reviews or reports but left unaddressed
--	**Powerlessness**	The addressing of the water challenge is regularly overruled with contradicting and competing interests and so it is hardly included in policy, regulation or administrative principles

<u>Condition 8: Financial viability</u>

Sufficient financial resources are crucial for good water governance. Willingness to pay for water challenge adaptation services is important to gain access to reliable funding for

long-term programs. At the same time, water and climate adaptation services need to be affordable for everyone including poor people or people being disproportionally affected.

Indicator 8.1: Affordability
Predefined question: To what extent are water services and climate adaptation measures available and affordable for all citizens, including the poorest?

Rephrasing the predefined question for Dordrecht:
Are measures that support water ecology available and affordable for all citizens, including the poor?

++	**Climate adaptation affordable for all**	Programs and policies ensure climate adaptation for everyone. This includes public infrastructure and private property protection. The solidarity principle is clearly percolated in policy and regulation
+	**Limited affordability of climate adaptation services**	Serious efforts are made to support climate adaptation for everyone, including vulnerable groups. There is often recognition that poor and marginalized groups are disproportionately affected by the water challenge. This is increasingly addressed in policy and regulation
0	**Unaffordable climate adaptation**	Basic water services are affordable for the vast majority of the populations, however poor people and marginalized communities have much difficulty to afford climate adaptation measures to protect themselves against impacts such as extreme heat, flooding or water scarcity.
-	**Limited affordability of basic water services**	A share of the population has serious difficulty to pay for basic water services such as neighbourhoods with low-income or marginalized groups. There is hardly any social safety net regarding water services, let alone for climate adaptation measures
--	**Unaffordable basic water services**	Basic water services are not affordable or even available for a substantial part of the population. This may be due to inefficient or obsolete infrastructure, mismanagement or extreme poverty

Indicator 8.2: Consumer willingness to pay
Predefined question: How is expenditure regarding the water challenge perceived by all relevant stakeholders (i.e., is there trust that the money is well-spent)?

Rephrasing the predefined question for Dordrecht:
How is the expenditure of the water challenge perceived by all relevant stakeholders?

++	**Willingness to pay for present and future risk reductions**	The water challenge is fully comprehended by decision-makers. There is political and public support to allocate substantial financial resources. Also expenditure for non-economic benefits is perceived as important. There is clear agreement on the use of financial principles, such as polluter-pays- and user-pays- or solidarity principle
+	**Willingness to pay for provisional adaptation**	Due to growing worries about the water challenge, there are windows of opportunity to increase funding. However, the perception of risk does not necessarily coincide with actual risk. Financial principles, such as polluter-pays principle, may be introduced. Due to inexperience, implementation is often flawed. Focus groups decide on priority aspects regarding the water challenge, but there is confusion regarding the extent and magnitude of the water challenge
0	**Willingness to pay for business as usual**	There is support for the allocation of resources for conventional tasks. There is limited awareness or worries regarding the water challenge. Most actors are unwilling to financially support novel policies beyond the status quo. Generally, there is sufficient trust in local authorities
-	**Fragmented willingness to pay**	Willingness to pay for measures addressing the water challenges are fragmented and insufficient. The importance and risks are perceived differently by each stakeholder. Generally, their estimates of the cost are substantially lower than the actual costs
--	**Mistrust and resistance to financial decisions**	There is a high level of mistrust in decision making of resource allocation. At this level financial decisions are based on prestige projects, projects that benefit small groups or specific interests. As expenditures often do not address the actual water challenges, there is a high degree of resistance regarding resource allocation

Indicator 8.3: Financial continuation

Predefined question: To what extent do financial arrangements secure long-term, robust policy implementation, continuation, and risk reduction?

Rephrasing the predefined question for Dordrecht:

Does the financial situation of Dordrecht allow for the implementation of long-term policy implementation, continuation, and risk reduction?

++	**Long-term financial continuation**	There is secured continuous financial support for long-term policy, measures and research regarding the water challenge. These costs are included into baseline funding. Generally, both economic and non-economic benefits are considered and explicitly mentioned
+	**Abundant financial support with limited continuation**	Abundant financial resources are made available for project based endeavours that are often exploring new solutions but lack long-term resource allocation or institutionalized financial continuation. Hence, long-term implementation is uncertain
0	**Financial continuation for basic services**	Financial resources are available for singular projects regarding basic services of the water challenge. The allocation of financial resources is based on past trends, current costs of maintenance and incremental path-dependent developments. Costs to deal with future water challenges are often not incorporated. Limited resources are assigned for unforeseen situations or calculated risks
-	**Inequitable financial resource allocation**	There are potential resources available to perform basic management tasks regarding the water challenge, but they are difficult to access, are distributed rather randomly and lack continuity. No clear criteria can be found on the resource allocation. Resources allocation is ad hoc and considers only short-time horizons
--	**Lack of financial resources**	There are insufficient financial resources available to perform basic tasks regarding the water challenge. Financing is irregular and unpredictable leading to poor policy continuation

Condition 9: Implementing capacity

Implementing capacity is about the effectiveness of policy instruments with respect to the water challenge. Part of the effectiveness is also due to the level of compliance to policy and regulation and the familiarity with (calamity) action plans.

Indicator 9.1: Policy instruments

Predefined question: To what extent are policy instruments effectively used (and evaluated), in order to stimulate desired behavior and discourage undesired activities and choices?

Rephrasing the predefined question for Dordrecht:

Are policy instruments effectively used to stimulate the desired state of water ecology in Dordrecht, or to discourage an undesired state?

++	**Effective instruments enhance sustainable transformations**	There is much experience with the use of policy instruments. Monitoring results show that the current use of instruments proves to be effective in achieving sustainable behaviour. Continuous evaluation ensures flexibility, adaptive capacity and fit-for-purpose use of policy instruments
+	**Profound exploration of sustainability instruments**	Instruments to implement principles such as full cost-recovery and polluter-pays principle, serve as an incentive to internalize sustainable behaviour. The use of various instruments is explorative and therefore not yet optimized and efficient. The use of instruments is dynamic. There are a lot of simultaneous or successive changes and insights
0	**Fragmented instrumental use**	Policy fields or sectors often have similar goals, but instruments are not coherent and may even contradict. Overall instrumental effectiveness is low and temporary. There is sufficient monitoring and evaluation leading to knowledge and insights in how instruments work and actors are getting a more open attitude towards improvements
-	**Unknown impacts of policy instruments**	Instruments are being used without knowing or properly investigating their impacts on forehand. The set of instruments actually leads to imbalanced development and inefficiencies that are hardly addressed
--	**Instruments enhance unsustainable behavior**	Policy instruments may enhance unwanted or even damaging behaviour that opposes sustainability principles, e.g., discount for higher water use stimulates spilling and inefficiency. There is hardly any monitoring that can be used to evaluate the counterproductive effects of these policy instruments

Indicator 9.2: Statutory compliance

Pre-defined question: To what extent is legislation and compliance, well-coordinated, clear and transparent and do stakeholders respect agreements, objectives, and legislation?

Rephrasing the predefined question for Dordrecht:

Are stakeholders compliant with the legislation and policies implemented?
Are the agreements and objectives of policies respected?

++	**Good compliance to effective sustainable legislation**	Legislation is ambitious and its compliance is effective as there is much experience with developing and implementing sustainable policy. Short-term targets and long-term goals are well integrated. There is a good relationship among local authorities and stakeholders based on dialogues.
+	**Flexible compliance to ambitious explorations**	New ambitious policies, agreements and legislations are being explored in a "learning-by-doing" fashion. Most actors are willing to comply. Some targets may be unrealistic and requires flexibility
0	**Strict compliance to fragmentized legislation**	Legal regulations regarding the water challenge are fragmented. However, there is strictly compliance to well-defined fragmentized policies, regulations and agreements. Flexibility, innovations and realization of ambitious goals are limited. Activity may be penalized multiple times by different regulations due to poor overall coordination
-	**Moderate compliance to incomplete legislation**	The division of responsibilities of executive and controlling tasks is unclear. Legislation is incomplete meaning that certain gaps can be misused. There is little trust in local authorities due to inconsistent enforcement typically signalled by unions or NGO's
--	**Poor compliance due to unclear legislation**	Legislation and responsibilities are unclear, incomplete or inaccessible leading to poor legal compliance by most actors. If legislation is present it enjoys poor legitimacy. Actors operate independently in small groups. Fraudulent activities may take place

Indicator 9.3: Preparedness

Predefined question: To what extent is the city prepared (i.e. there is clear allocation of responsibilities, and clear policies and action plans) for both gradual and sudden uncertain changes and events?

Rephrasing the predefined question for Dordrecht:

Is the city prepared for issues that arise either gradually or suddenly?

++	**Comprehensive preparedness**	Long-term plans and policies are flexible and bundle different risks, impacts and worst case scenarios. They are clearly communicated, co-created and regularly rehearsed by all relevant stakeholders. The required materials and staff are available on short-term notice in order to be able to respond adequately. Evaluations on the rehearsals or reviews on dealing with calamities are available
+	**Fragmented preparedness**	A wide range of threats is considered in action plans and policies. Sometimes over-abundantly as plans are proactive and follow the precautionary principle. Awareness of risks is high, but measures are scattered and non-cohesive. They may be independent or made independently by various actors. Allocation of resources, staff and training may therefore be ambiguous
0	**Low awareness of preparation strategies**	Based on past experiences, there are action plans and policies addressing the water challenge. Actions and policies are clear but actual risks are often underestimated and the division of tasks is unclear. They are not sufficient to deal with all imminent calamities or gradually increasing pressures. Damage is almost always greater than is expected or prepared for
-	**Limited preparedness**	Action plans are responsive to recent calamities and ad hoc. Actual probabilities and impacts of risks are not well understood and incorporated into actions or policies. Reports can be found on how the water sector deals with recent calamities
--	**Poor preparedness**	There are hardly any action plans or policies for dealing with (future) calamities, uncertainties and existing risks. The city is highly vulnerable

Appendix B: Case Study Dordrecht: Assessment of the governance capacities regarding ecological urban water governance

Governance Capacity Assessment Dordrecht

Below you can find my assessment of ecological water governance in Dordrecht. This assessment is done on this subject specifically. Generally standard ecology is not included in my assessment, however some assumptions or interpretations have stemmed from this. The sourcing used in this assessment is not standard sourcing due to the nature of the framework used for this assessment. In the argumentation for each score referencing is done in the form of numbers, for example **S1** refers to the first interviewee, while **S20** refers to the green policy plan in Dordrecht. The source list for these sources can be found at the end of the case study.

List of individual scores for each GCF indicator.

1.1 Community Knowledge	3
1.2 Local sense of urgency	3
1.3 Behavioral internalization	3
2.1 Information availability	3
2.2 Information transparency	3
2.3 Knowledge Cohesion	4
3.1 Smart Monitoring	4
3.2 Evaluation	3
3.3 Cross-stakeholder learning	3
4.1 Stakeholder inclusiveness	3
4.2 Protection of core values	3
4.3 Progress and variety of options	3

5.1 Ambitious and realistic management	3
5.2 Discourse embedding	3
5.3 Management cohesion	4
6.1 Entrepreneurial agents	4
6.2 Collaborative agents	3
6.3 Visionary agents	2
7.1 Room to manoeuver	4
7.2 Clear division of responsibilities	3
7.3 Authority	3
8.1 Affordability	3
8.2 Consumer willingness-to-pay	2
8.3 Financial continuation	3
9.1 Policy instruments	3
9.2 Statutory compliance	4
9.3 Preparedness	4

Condition 1: Awareness - Awareness refers to the understanding of causes, impact, scale and urgency of the water challenge.

Indicator 1.1: Community knowledge

Predefined question: To what extent is knowledge regarding the current and future risks, impacts, and uncertainties of the water challenge dispersed throughout the community and local stakeholders which may results in their involvement in decision-making and implementation?

Scoring:

It has been said that the local citizens generally have very little knowledge on the subject of ecological water governance (**S1, S2).** Due to this there is a large gap in awareness between the people responsible and the citizens. The responsible people do their best to inform the public by supporting citizen initatives (**S5)** and giving lessons at schools about trees (**S6)**. Furthermore, the waterschap has taken to social media, on which they actively share projects and information (**S7).** It has to be noted that the two biggest organizations, the Waterschap and the municipality basically do everything, smaller organizations are involved when necessary, and are represented in an elected council **(S8)**. Furthermore, the issue of sustainability, and with it ecology to a certain extent has been raised at the political level, and is slowly gaining footing (**S5, S6).** Additionally, it has been stated in the interviews that current and future impacts, risks and uncertainties are considered, especially due to climate change, an example of this is the recent drought (**S4).** Furthermore, it has also been stated that it is thought that people do not have a very good idea of the importance of water to ecology (**S1-2)** With this information, and the notion that awareness surrounding the topic is slowly growing (**S3, S4),** *this indicator will be scored a **3.** The subject of water ecology has only recently become a topic for dialogue, however it has to be mentioned that awareness is very lacking amongst the citizens. Stakeholders are trying to increase awareness though.*

Indicator 1.2: Local sense of urgency

Predefined question: To what extent do actors have a sense of urgency, resulting in

widely supported awareness, actions, and policies that address the water challenge?

Scoring:

In Dordrecht the discussion surrounding climate change and the energy transition is surely present. However, the main institution of water governance only shortly started procedures surrounding ecology **(S5-6).** This is however seen as revolutionary (**S6).** In times of climate change problems such as drought and salt intrusion are clearly important topics in Dordrecht (**S4).** However, whether this relates to ecology is a question. Politically speaking ecology is generally a side topic of municipal parties (**S11, S18).** In case of the water authorities of Dordrecht ecology is also generally a side topic (**S12-15).** While climate change in general creates uncertainty (**S16),** it should be noted that in Dordrecht this is generally not considered as uncertainty, since they expect climate change (**S4).** The general population is concerned about the quality of water, however this is mostly due to the notion that if the water is not clean, dead fish may float up, which will also smell (**S1).** *Considering all this, this indicator will be scored a **3.** In general water ecology is considered, however it is mostly a side topic in politics and not seen as urgent. The public awareness is growing however (**S3)***

Indicator 1.3: Behavioral internalization

Predefined question: To what extent do local communities and stakeholders try to

understand, react, anticipate and change their behavior in order to contribute to solutions

regarding the water challenge?

Scoring:

Firstly, awareness is growing (**S4).** This is evident from interviews, but also seems to be the case when looking at for example the facebook page of the water authority (**S7).** Furthermore, further research and improvement of monitoring systems is also present, which results in the idea that the water challenge is seen as somewhat urgent (**S2, S4, S5, S6).** While local communities might not see water ecology as an urgent phenomenom, this is mostly due to the fact that they lack awareness (**S2).** Furthermore, there is incentive to implement policies surrounding water ecology (**S18),** considering that Dordrecht is a 'water city' (**S19).** However, most policies are focused on water safety and water quality (**S2).** While water quality is surely related to ecology, it seems to be a by-product of policies (**S2).** It seems the 'revolution' towards more ecologica policies has started, thus the current changes seem to be incremental (**S5).** *As such, this indicator will be scored a **3.***

Condition: 2 Useful knowledge

This condition describes the qualities of information with which actors have to engage in decision-making.

Indicator 2.1: Information availability

Predefined question: To what extent is information on the water challenge available, reliable, and based on multiple sources and methods, in order to meet current and future demands so as to reveal information gaps and enhance well-informed decision-making?

Scoring:

Information on water ecology is rather scarce. While there are sources available that show that (water) ecology was important before (**S17**). It seems that information is lacking now. The governance program of 2019-2023 also showcased that most of the focus of sustainability is on the energy transition, and not on ecology (**S11**). As of recently however Dordrecht has acquired a 'city ecologist' as they say, who adds a necessary set of skills (**S2**). Furthermore, it has become clear that the water authority is the main authority when it comes to water governance, and thus also ecological water governance. As the water authority can decide things OVER the municipality when it comes to water governance **(S2**). The website of the water authority (**S21**) is a rather clear websites that also shows governance documents about green governance plans **(S20).** One thing that I found concerning is information on the election programs of the parties involved in the water authority was hard to find. There was no page on the website of the water authority that showcased the plans of the parties, they only had their own **(S11-S15**). Furthermore, the authorities in Dordrecht do have to abide by an information transparency law, which forces them to allow access to information when requested (**S3**). It has however become clear that the implementation of a monitoring network (water quantity and quality) increases the available information that is necessary to make well informed decisions (**S1-2**). *With all this in mind this indicator will be scored a **3**. Information available on water ecology in Dordrecht is rather scarce, however the relevant*

authorities do have information at their disposal to make informed decisions, this is the monitoring network. This has however not resulted in readily available public information.

Indicator 2.2: Information transparency

Predefined question: To what extent is information on the water challenge accessible

and understandable for experts and non-experts, including decision-makers?

Scoring:

Information is accessible. However, not all the information is readily accessible, certain information can be requested at the relevant authorities because the authorities are obligated by law to provide that information if requested (**S2, S3).** This notion is further strengthened by a recent article published by AD (**S22)**, however the article does mention future improvements regarding transparency. Furthermore there are several policy programs published by the water authority and the municipality (**S11, S20)** , however I reckon these policy programs are difficult to comprehend for non-experts. It is also believed that when dealing with policies and projects, giving out too much information can harm certain projects and policies as people irrelevant to the project may then hinder it (**S3).** The municipality is very transparent in sharing policy documents on the website of its council (**S23),** this website is directly accessible through its main website. *With this information this indicator will score a **3.** The most important factor in this decision is regarding the information not being readily available, but available through request. Furthermore, information is, in my idea, not fully comprehensible by non-experts.*

Indicator 2.3: Knowledge cohesion

Predefined question: To what extent is information cohesive in terms of using,

producing and sharing different kinds of information, usage of different methods and

integration of short-term targets and long-term goals amongst different policy fields and

stakeholders in order to deal with the water challenge?

Scoring:

The cooperation in Dordrecht is mainly between the municipality and the water authority (**S5, S6),** it is stated that it can often be difficult for smaller organizations to be included, even when they bring specialized expertise (**S6)** and that the water authority is difficult to approach by smaller organizations (**S11).** However, it also seems that there are working groups dedicated to connecting the municipality and the water authorities, which are the two main governing organs in Dordrecht (**S2).** Additionally, working groups including smaller organizations are slowly being created as well (**S2, S5, S6).** As with a lot of larger organizations, the municipality and water authority have working

groups dedicated to a variety of topics such as asset management and policy (**S4)**. From this it is assumed that there is sufficient internal and external cooperation to create an integrated view of water ecology in the area. *Due to the aforementioned reasons this indicator will be scored a **4.** While it may be true that information on water ecology is mainly limited to the water authorities, this is very understandable, considering water is their authority. Furthermore, it has become clear that smaller organizations have made their influence as well (**S6)**, even though they are struggling to reach contact, and that interdisciplinary and intersectoral cooperation is used to gain information.*

Condition 3: Continuous learning

Continuous learning and social learning is essential to make water governance more effective. The level of learning differs from refining current management, critical investigation of fundamental beliefs or questioning underlying norms and values.

Indicator 3.1: Smart monitoring

Predefined question: To what extent is the monitoring of process, progress, and policies able to improve the level of learning (i.e., to enable rapid recognition of alarming situations, identification or clarification of underlying trends)? Or can it even have predictive value?

Scoring:

While there was initially no information to be found of the monitoring network that is in place in Dordrecht, the interviews helped shed some light on this indicator. Currently there is a monitoring network in place to monitor water quanitity and quality (**S1, S2),** however this monitoring network is not yet complete (**S1)** and new measurement points are constantly being added to increase the amount of information gathered **(S4).** There are also new tests added to the network, namely DNA tests, which win information on the amount of different plants and animals in the water **(S6).** It has been stated that the implementation of a monitoring network is a lot easier these days due to technological advancements, which also explains that the network is yet to be completed (**S6).** Furthermore, the state forest management also wins information with their own monitoring and is happy to share this information to improve processes and policy (**S2).** Furthermore, environmental laws also state that certain levels of monitoring are mandatory (**S3).** Furthermore, in Dordrecht there is a system implemented called smart water management, which implies that processes and policies are closely monitored in order to steer them in the right direction. *With the aforementioned information this indicator scores **4.** The network that is present in Dordrecht is certainly qualified to give information on water quality, and the addition of dna tests makes it even further viable for ecological monitoring. The information that is won through this network is then used to further*

*increase water quality (**S2).** As such system boundaries are found, and priorities are adjusted with the information that is won.*

Indicator 3.2: Evaluation

Predefined question: To what extent are current policy and implementation

continuously assessed and improved, based on the quality of evaluation methods, the

frequency of their application, and the level of learning?

Scoring:

Ecological water governance is a relatively new part of governance in Dordrecht, this will be taken into account with the evaluation. Back in 2008 a new policy paper called the Stedelijke Ecologische Structuur Dordrecht was implemented. And by 2014 it was said that roughly ⅔ of the goals mentioned in the paper had been completed (**S9).** Furthermore, the program for the upcoming governance period of the board of the water authority has multiple mentions in its policy paper that indicate they are evaluating their decisions and policies (**S11).** Additionally, the new green policy paper made by the water authority indicates the setup of a multitude of new projects, which I interpret as the idea that the current status of the water and its policies is continuously evaluated in order to improve (**S20).** Moreover, there are also discussion groups that include smaller organizations to have discussions about policies and projects (**S2),** and it is also seen as normal to evaluate projects and policies (**S3, S5),** and that this is always done in order to optimize the system (**S4).** This is also visible in the policy paper of the water authority, as they have long-term goals with intermediate focal points that correlate with the long-term goals (**S20).** The governing board of the water authority also receives a biennial report the indicates the current situation of the water network in Dordrecht, and this information is used to change/evaluate the system (**S6).** However, it also seems that politically it is very difficult make sustainable and ecological progress, as seen with the fact that ecology is a rather new subject in political Dordrecht (**S6).** *With the aforementioned information the score of this indicator will be **3.** There is a lot of evaluation present in the policy landscape of Dordrecht. However, water ecology is politically still a difficult subject. And it seems that breaking away from the conventional (technical) policy is difficult.*

Indicator 3.3: Cross-stakeholder learning

Predefined question: To what extent are stakeholders open to and have the opportunity

to interact with other stakeholders and deliberately choose to learn from each other?

Scoring:

The water authority and municipality consult each other on projects (**S1),** there are groups that promote dialogue between organizations, whether they are small or large (**S2).** There are small organizations, or external organizations that provide information to the water authority and the municipality in order for them to increase the effectiveness of their policy (**S2).** Furthermore it has

been mentioned in the governing plans of the water authority that they are often difficult to approach as the distance between them and the smaller organizations/civilians is rather large (**S6, S11).** Furthermore, it has been mentioned that there is an advance in ecological discussions in the board of the water authority, and that this is very beneficial for ecology (**S6),** however, ecology is also still a touchy subject since a lot of parties still consider it a side-subject at best (**S5, S12-15).** A 'green-blue' programme has been created in which the entire idea is to promote, among other things, biodiversity and climate diversity. The programme has been made with civilians and partners of the municipality in order to make the best possible programme (**S24).** This collaboration shows ambition to learn from different partners. *Due to the aforementioned information this indicator is scored **3.** This is due to the idea that collaboration for the sake of ecology is currently rising, however it is at the same time still struggling. There are initiatives for cross-stakeholder learning, and this is also evident from the sources mentioned before, however in reality cross-stakeholder learning for the sake of water ecology is still difficult.*

Condition 4: Stakeholder engagement process

Stakeholder engagement is required for common problem framing, gaining access to a wide variety of resources and creating general support that is essential for effective policy implementation.

Indicator 4.1: Stakeholder inclusiveness

Predefined question: To what extent are stakeholders interact in the decision-making process interaction (i.e., are merely informed, are consulted or are actively involved)? Are their engagement processes clear and transparent? Are stakeholders able to speak on behalf of a group and decide on that group's behalf?

Scoring:

When looking at stakeholder inclusiveness it becomes a bit difficult to make an assessment. On the one hand it has been shown that when the water authority or the municipality make a decision then all relevant stakeholders, such as a neighborhood or the owner of farmland are involved, because those decisions or policies apply to them (**S1-S5).** It has also been shown that in the past there have been complaints about the difficulty to approach the water authority, which they are conscious of (**S11),** up until now it was difficult to find a way in to actually influence policy (**S6).** Moreover, it is thought that the citizens of Dordrecht would like to be included more, but that they have difficulty finding out how to (**S3).** Furthermore, it has been stated that collaboration often happens due to the fact that issues overlap (**S2).** For example, when the municipality wants to start a new project, the water authority is notified to prematurely develop a waterway in the area (**S2).** Furthermore,

farmland in the area is very important, and the farmers have an influential lobby within the water authority's board (**S5).** Another aspect of stakeholder inclusiveness is the governing board of the water authority (consisting of 30 councilors and a board of 5 people from that council), which is voted for by the citizens every 4 years (**S25).** Furthermore, the green policy plan of 2023-2027 (**S20)** mentions collaboration with organizations of multiple different disciplines such as natural history, insects and ecological governance **(S20).** *With the aforementioned information this indicator is scored a **3.** The main reason for this is that collaboration is definitely present and even increasing, but the decision making remains with the water authority and the municipality. There is very active collaboration between the water authority and the municipality. It is difficult to be included into the decision making for smaller organizations, and when it happens it is often due to overlapping projects/policies.*

Indicator 4.2: Protection of core values

Predefined question: To what extent 1) is commitment focused on the process instead

of on early end-results? 2) do stakeholders have the opportunity to be actively involved?

3) are the exit procedures clear and transparent? (All three ensure that stakeholders feel

confident that their core values will not be harmed.)

Scoring:

While stakeholder involvement is a difficult subject, it is undeniable that once stakeholders are included they will have some influence (**S4, S5).** There are multiple working groups in which multiple stakeholders are involved to promote dialogue. For example, there is a working group with more focus on ecology, but it seems that the turnout for important organizations can be lacking (**S5, S6).** Furthermore it seems that within the water authorities council the subject of ecology is a difficult subject (**S5).** While ecology is still a subject that is brought up (**S20),** it seems that the policy clashes with the interests of different groups (**S5).** One bright aspect of this controversy however is that policy output serves the interests of multiple stakeholders. *With the aforementioned information this indicator scores a **3.** The idea behind this score is that there is still difficulty of inclusiveness for smaller organizations that are focused more on ecological subjects. However this is changing. But it seems that not all stakeholders have a direct influence on the end-result.*

Indicator 4.3: Progress and variety of options

Predefined question: To what extent are procedures clear and realistic, are a variety of

alternatives co-created and thereafter selected from, and are decisions made at the end

of the process in order to secure continued prospect of gain and thereby cooperative

behavior and progress in the engagement process?

Scoring:

When problems arise most stakeholders have a clear idea of what to do (**S2).** A variety of options is not present in the general sense that there are multiple options available to be picked, but more that through discussion and research the best options is chosen from the start (**S3, S4).** In order to help with this information meeting or public plans are made in order to preemptively tackle issues, and to pick the best course of action for policy and projects (**S3, S4).** Furthermore, the green policy plan 2022-2027 (**S20)** shows that there are a variety of projects being initiated that all aim to help biodiversity and water quality (thus ecology) in the area. The aim is to also include more stakeholders in the process (**S11).** Deadlines in the policies and projects are clear, as there are long-term and short-term policy plans that range from 4 years (2023-2027 for example) all the way to 2050 (**S20).** Decisions are not always made at the end of these policy plans, as it may happen that they change after evaluation (**S4).** *Due to the aforementioned information this indicator will be scored a **3.** The main reason for this is that there is as far as I know not long-during active involvement of multiple stakeholders. The authorities do closely work together, however further collaboration with stakeholders is limited. It is becoming clearer how to engage with the authorities, but so far it has seemed lacking. However, a bright point is that the current solutions do seem optimal given how much actually can be done, considering resources (**S1, S2).***

Condition 5: Management Ambitions

Policy ambitions assesses if current policy is ambitious, feasible, well-embedded in local context and if it forms a cohesive set of long-term and short-term goals within and across sectors.

Indicator 5.1: Ambitious and realistic management

Predefined question: To what extent are goals ambitious (i.e., identification of challenges, period of action considered, and comprehensiveness of strategy) and yet realistic (i.e., cohesion of long-term goals and supporting flexible intermittent targets, and the inclusion of uncertainty in policy)?

Scoring:

The board plan and the green policy plan of the water authority both mention biodiversity (**S11, S20).** While the board plan focuses more on the implementation of the plan, and how it fits in the current policy landscape (**S11),** the green policy plan focuses a lot on biodiversity (**S20).**

Furthermore, a 'greenblue' plan that has been made by the municipality ties into the plans of the water authority perfectly (**S24)**. While interviews have mentioned that ambition to do green is certainly present, it was lackluster (**S1, S2)**, and it had been mentioned that to get anything done you had to invoke the nature conservation law (**S2).** However, the new green policy plan is brand new, and it seems that the ambition of the city of Dordrecht is rising. One thing that does stand out in the new green policy plan however is that most plans concerning water are either focused on stabilizing current systems, or improving current systems (**S20).** *Due to this information this indicator will be scored a **3.** As ambition is certainly rising, but current initiatives are focused mainly on the stabilization or improvement of already existing systems. So far it seems that the ideas are realistic, as it also aims to include smaller, more ambitious organizations (**S11, S20).** The whole scope of whether it is realistic is however unknown, as ecology is a volatile subject, and has been given lower priority before during the crisis of 2008 **(S1, S5).***

Indicator 5.2: Discourse embedding

Predefined question: To what extent is sustainable policy interwoven in historical,

cultural, normative and political context?

Scoring:

The local context of Dordrecht consists of multiple factors. One of these factors is the presence of valuable nature closeby, the Dordtse Biesbos (**S2).** Another factor is the large presence of the farming sector which has a large lobby in the local policy field (**S1).** This context has certainly influenced policy-making, as the last four years have seen increasing influence of ecology on decision-making, as there has also been more budget for this topic (**S3, S4).** This also brings us to the next topic, which is economy. Dordrecht has seen a lower priority of ecology on its agenda after the economic crisis of 2008, this makes it seem that ecology certainly has a lower priority (**S4).** However, it seems to have worked as the new plans of the water authority, the board plan (**S11)** and the green policy plan (**S20)** both include it as an important topic. Furthermore, the municipality has also stepped up, as the 'greenblue' plan of Dordrecht also has biodiversity and ecology as an important topic (**S24).** *With the aforementioned information this indicator is scored a **3.** The new plans made by the authorities surely reflect their ambition for a more ecological Dordrecht. However it seems that ecology has just recently been identified as an important subject. From the policy plans however it seems that uncertainty (such as climate change) is not included in the policy, a sense of urgency is missing.*

Indicator 5.3: Management cohesion

Predefined question: To what extent is policy relevant for the water challenge, and

coherent regarding 1) geographic and administrative boundaries, and 2) alignment

across sectors, government levels, and technical and financial possibilities?

Scoring:

The importance of policy for ecology is reflected in the laws that stakeholders have to abide by (**S2).** Furthermore, ecology has been a side topic for a long time, especially politically speaking. This means that in order to make a change policy is necessary (**S5).** However from the past it has seemed that policy is not always coherent (**S6),** in the sense that policy evaluation briefs given to the council are often written vague and incoherent (**S6).** Something that has to be noted however is that cross-boundary and cross-sectoral collaboration is very good (**S2).** It seems that internal and external collaboration is very effective when it comes to projects, and it is expected to also be the case when it comes to water ecology (**S3, S4).** This collaboration is also reflected in the green policy plan (**S20)**, which states multiple organizations that have a stake in ecology, and in the council plan (**S11),** which mentions that internal and external collaboration should be increased. *With the aforementioned information this indicator will be scored a **4.** There is cross-boundary and cross-sectoral collaboration between stakeholders of different policy fields. Policies are cohesive (namely **S11 and S20),** but have recently been implemented and thus not yet resulted in broad action. From the interviews it has become clear that there is a wide variety of employee functions, assignments and protocols, which shows cohesive management.*

Condition 6: Agents of change

In order to drive change, agents of change are required to show direction, motivate

others to follow and mobilize the resources required.

Indicator 6.1: Entrepreneurial agents

Predefined question: To what extent are the entrepreneurial agents of change enabled

to gain access to resources, seek and seize opportunities, and have influence on

decision-making?

Scoring:

There is a budget for innovation within the organization of the authorities (**S3).** There is also the recognition for the necessity of innovation (**S2).** It also seems that within the water authority there is political innovation, as the advocates of ecology are outnumbered (**S6)**. From this it is interpreted that the implementation of the green policy plan (**S20)** is in itself rather innovative. Within the plan however there are only small-scale projects. Total system overhauls cannot be seen, it might be because it is too soon, since the policy plan is in its early stages. *With the aforementioned information this indicator will be scored a **4.** The initiation of such a policy plan clearly shows that the challenge of (water) ecology is understood and accepted. While the plan currently only promotes the*

implementation of plans, it will also pave a way for future innovation in order to meet the goals laid out.

Indicator 6.2: Collaborative agents

Predefined question: To what extent are actors enabled to engage, build trust-

collaboration, and connect business, government, and sectors, in order to address the

water challenge in an unconventional and comprehensive way?

Scoring:

The council plan (**S11)** promotes internal and external collaboration and discourse. However, it seems that for smaller organizations it is currently difficult to find collaboration with the authorities, namely the water authority (**S5, S6).** While there are certain working groups that promote collaboration with a multitude of stakeholders, these collaborations are often temporary and sectoral(**S2-S5).** It has become apparent that in Dordrecht there is a traditional coalition of the municipality and water authority that govern over (water) ecology. This is however understandable, as it is trusted, and the distance between the authorities and smaller organizations is rather large. *With the aforementioned information this indicator is scored a **3.** There is the presence of a traditional coalition between the municipality and the water authority that make up the main body of the policy landscape. While there is certainly space for collaboration between more stakeholders, and while it sometimes happens, it is often temporary and mostly sectoral.*

Indicator 6.3: Visionary agents

Predefined question: To what extent are actors in the network able to manage and

effectively push forward long-term and integrated strategies which are adequately

supported by interim targets?

Scoring:

It is unsure whether there is a lot of room for effective long-term strategies. Current long-term strategies are rather vague and abstract (**S3).** While there are indeed long-term strategies, such as being climate proof by 2035 (**S26),** the interim targets are still in their early stages, consisting of set-up plans ranging to 4 years (**S20).** Moreover, there are some plans that are more visionary, such as the environmental vision made by the municipality (**S27).** From this it is interpreted that it has been difficult to break free from the status-quo regarding water ecology, but that there are visionaries in Dordrecht that aim to promote the importance and urgency of ecology **(S5, S6).** Politically speaking the council of the water authority tends to lean more towards the status quo, which inhibits the development of ecological projects, and hinders it vision of urgency (**S5, S6).** Trend analyses are

difficult to find. There is a trend analysis published such as **(S28)** however, other trend analyses are old. *With the aforementioned information this indicator is scored a **2.** There are long-term projects in place that also have interim targets, however these interim targets of 3-4 years are the most important. However, concerning (water) ecology these projects are mostly in their early stages. Furthermore, it seems that the political landscape prefers the status quo, and the notion of water ecology is politically very unilateral.*

Condition 7: Multi-level network potential

Urban water governance involves a plethora of actors and interests from all levels of government, organizations and (private) stakeholders. For sustainable solutions, working in networks is an essential determinant for effective solutions.

Indicator 7.1: Room to manoeuver

Predefined question: To what extent do actors have the freedom and opportunity to develop a variety of alternatives and approaches (this includes the possibility of forming ad hoc, fit-for-purpose partnerships that can adequately address existing or emerging issues regarding the water challenge)?

Scoring:

There is very little information publicly available on variety of options and partnerships. However, the more recent policy plans (**S11, S20, S24)** do all have a focus on increasinging multi-level and multi-sector cooperation. The interviewees generally think that cooperation with organizations other than the municipality and the water authority is lackluster. However, it is also mentioned that when projects are started, interdisciplinary partnerships are created internally (such as an asset management team, and a policy team) (**S3, S4),** and when projects concerned citizens, the citizens are informed and sometimes consulted (**S1, S3, S4, S5).** *With the aforementioned information this indicator will be scored a **4.** While cooperation with smaller organizations might be lacking, it has become apparent that the cooperation does happen when it is necessary. Furthermore, internal cooperation is widely happening, as project teams are often consisting of a wide variety of disciplines.*

Indicator 7.2: Clear division of responsibilities

Predefined question: To what extent are responsibilities clearly formulated and

allocated, in order to effectively address the water challenge?

Scoring:

New policy plans have been created that clearly show that cooperation is seen as important (**S11, S20, S24).** Furthermore, when a project is started multiple stakeholders and experts on relevant disciplines are included. For example when a new waterway runs through farmland, farmers are included in the decision making (**S2).** Additionally, internal cooperation is high within the authorities as they have working groups focused on different disciplines. This makes running projects very fluid. The collaborations created are fit-for-purpose, and have clear responsibilities for the people involved (**S3, S4).** In the new green policy plan (**S20)** it is also visible that external organizations such as the Knowledge Center for Insects and an Ecology and Landscape Consultancy firm, are included. *With the aforementioned information this indicator is scored a **3.** This is due to the idea that yes internal cooperation is high, however it seems that this is more focused on ecology in general. So far it seems water ecology does not get as much attention and that there is a limited amount of stakeholders involved in water ecology. As such the division of responsibilities is limited.*

Indicator 7.3: Authority

Predefined question: To what extent are legitimate forms of power and authority

present that enable long-term, integrated and sustainable solutions for the water

challenge?

Scoring:

It is unclear how far public support for water ecology goes. Politically speaking it does not have much support. This can be due to the fact that water ecology is a rather new concept in politics, but it can also be due to the idea that there are lobbies present that inhibit the expansion of water ecology as a concept (**S5).** There are certainly authorities higher up that promote, or atleast inhibit ecological degradation, through environmental laws etcetera (**S2)**. These laws however do not contribute to a sense of urgency on the subject. In past election programs (**S10-S15)** it is visible that ecology has mostly been a side subject. As such this indicator *will be scored a **3** considering the idea that most policy on water ecology is made with the idea that it has to fit into an already existing policy. And while the new green policy plan (**S20)** is certainly revolutionary, it consists of a lot of small projects.*

Condition 8: Financial viability

Sufficient financial resources are crucial for good water governance. Willingness to pay

for water challenge adaptation services is important to gain access to reliable funding for

long-term programs. At the same time, water and climate adaptation services need to be

affordable for everyone including poor people or people being disproportionally affected.

Indicator 8.1: Affordability

Predefined question: To what extent are water services and climate adaptation

measures available and affordable for all citizens, including the poorest?

Scoring:

Firstly, normally this indicator concerns equal affordability between more welfaring and more marginalized groups. However, in this case I do not think it applies as (most?) costs are made in the form of taxes (**S29).** In **S29** it is also visible how much each stakeholder in Dordrecht pays in general in the year 2022. However we are now looking at ecological water management. In the case of ecological water management the budget is lacking (**S2, S5, S6),** this is also visible in the notion that so far most things done in the area of water ecology are the minimum that is required. The budget however is increasing (**S1, S2, S5)** and thus the affordability of water ecology is increasing. *With the aforementioned information this indicator will be scored a **3** because the budget is limited and so far most policy on water ecology has just started. (**This indicator could also be scored a 0 in the sense that it simply does not apply in the case of water ecology in Dordrecht, as I do not believe that there are marginalized groups that cannot afford water ecology).*

Indicator 8.2: Consumer willingness to pay

Predefined question: How is expenditure regarding the water challenge perceived by

all relevant stakeholders (i.e., is there trust that the money is well-spent)?

Scoring:

The willingness to pay is again not scored in a general sense here, considering that most tasks are performed with a budget made from taxes, and most people that pay these taxes have very little indication what is done with the money (**S2, S5).** Furthermore the new policy plan (**S20)** is very indicative of the planned ideas for ecological policy. The policy in that plan is very focused on biodiversity, and thus ecology in general. However the plan seems to be lackluster on the subject of water. With the additional information about the notion that stakeholders had to fight for a budget allocation for sustainability, it seems that willingness to pay for ecology in Dordrecht is lackluster. *With the aforementioned information, this indicator is scored a **2.** It seems that the wide variety of stakeholders that are present in Dordrecht each have a different view of the importance and risks associated with water ecology. While budget currently allows for ecological policy, it is politically mostly seen as something that can also be fixed once the problems arise, instead of preventing problems (**S5),***

Indicator 8.3: Financial continuation

Predefined question: To what extent do financial arrangements secure long-term,

robust policy implementation, continuation, and risk reduction?

Scoring:

A very good sign for the budget allocation for water ecology in Dordrecht is the fact that there is continuation present. For example, project 'Waterkraan' is a project that makes water from a nearby nature reserve run through the city of Dordrecht, increasing the water quality in the city (**S30).** According to the recent budget allocations this project is being continued, and has already started its early stages (**S29).** This is however but a single project that is in line with water ecology, and as such *this indicator will be scored a **3.** As there is surely some budget being allowed for the implementation of measures to ensure ecological water management, but not enough to warrant projects aimed at water ecology specifically. One thing that catches the eye is that in the budget there is a line that states that a 'potential' investment is an investment to be more in line with the European water framework directive. Meaning that this investment is not certain, but planned (#5 on the list of potential investment projects).*

Condition 9: Implementing capacity

Implementing capacity is about the effectiveness of policy instruments with respect to

the water challenge. Part of the effectiveness is also due to the level of compliance to

policy and regulation and the familiarity with (calamity) action plans.

Indicator 9.1: Policy instruments

Predefined question: To what extent are policy instruments effectively used (and

evaluated), in order to stimulate desired behavior and discourage undesired activities

and choices?

Scoring:

There is a polluter-pays principle in effect in Dordrecht, however it is uncertain whether this applies in water bodies as well. According to a news article from June 2022 this is not the case, meaning that this is a lacking policy instrument (**S31).** Furthermore, there are certain instruments that are in use and very effective (not necessarily effective in water ecology) such as the system of voting in the water authority, which is also home to a lobby where stakeholders can promote their own ideals (**S5).** There is a system of information sharing because the water authority is actively sharing videos

on social media to inform the public (**S1, S6).** There are also planned information nights which stakeholders and interested people can join to be informed (**S3, S4, S18).** This means that there are certainly policy instruments in use, however whether these instruments are used for water ecology is unsure. Currently it is assumed that they do. Furthermore, preventative measures could not be found, and from the interviews it is assumed that most measures are reactive. *With the aforementioned information this indicator scores a **3.***

Indicator 9.2: Statutory compliance

Pre-defined question: To what extent is legislation and compliance, well-coordinated,

clear and transparent and do stakeholders respect agreements, objectives, and

legislation?

Scoring:

This indicator seems very clear. There are a lot of regulations that the authorities need to abide by, such as the water framework directive (**S32).** Furthermore, the two authorities in the city are the municipality and the water authority. As of recently new ambitious projects have been started, such as the green policy plan (**S20)** and the greenblue project (**S24).** These plans have recently been started, therefore it is assumed that they have been started with a 'learning-by-doing' attitude. *With the aforementioned information this indicator is scored a **4.** This is because it seems compliance in Dordrecht is not an issue. Once policy is in place most actors are willing to comply, even if they might not agree (**S5).***

Indicator 9.3: Preparedness

Predefined question: To what extent is the city prepared (i.e. there is clear allocation of

responsibilities, and clear policies and action plans) for both gradual and sudden uncertain

changes and events?

Scoring:

Online information is lacking in case of this indicator. However, from the interviews it has been shown that there is a widespread monitoring network in place which monitors for a wide variety of indicators such as water quality and biodiversity (**S2, S6),** which means that once these indicators reach a value that is problematic it is possible to respond to them. Furthermore, the recent drought has shown that sudden/gradual changes (drought is sudden, but also gradual) are prepared for in the city of Dordrecht, and there is also budget allocations for it. *With the aforementioned*

*information this indicator is scored a **4.** Once something goes down the city of Dordrecht is prepared to tackle the issue, however it is unsure if all issues are foreseen. There are measures in place, with a monitoring network which is used to keep the water quality in check.*

Source List Case Study

S1: Interview 1

S2: Interview 2

S3: Interview 3

S4: Interview 4

S5: Interview 5

S6: Interview 6

S7: Waterschap Hollandse Delta Facebook https://www.facebook.com/hollandsedelta

S8: Algemene Vergadering WSHD https://www.wshd.nl/bestuur

S9: Nieuws over Stedelijke Ecologische Structuur van Dordrecht https://www.dordrecht.net/nieuws/54840/2014-02-12-13175-piet-sleeking-natuur-in-stad-moet-verder-versterkt-worden

S10: Partijen van de Dordtse verkiezingen https://indebuurt.nl/dordrecht/verkiezingen/gemeenteraadsverkiezingen-2022-dordrecht-op-deze-16-partijen-kan-je-stemmen~181448/

S11: Bestuursprogramma Waterschap Hollandse Delta 2019-2023 https://www.wshd.nl/_flysystem/media/bestuursprogramma-2019-2023-def-versie.pdf

S12: Verkiezingsprogramma 2019-2023 WSHD Water Natuurlijk https://www.waternatuurlijk.nl/home/verkiezingen/landelijk-verkiezingsprogramma/

S13: Verkiezingsprogramma 2019-2023 WSHD CDA https://docplayer.nl/126265330-Cda-waterschap-hollandse-delta-verkiezingsprogramma.html

S14: Verkiezingsprogramma 2019-2023 WSHD PvdA https://issuu.com/pvdazh/docs/verkiezingsprogramma-pvda-hollandse

S15 Verkiezingsprogramma 2019-2023 WSHD ChristenUnie https://hollandsedelta.christenunie.nl/l/library/download/urn:uuid:06d0ff6e-cceb-4b62-a003-cf59c4bc476d/cu_programma_waterschap%2C+voorl.+versie.pdf

S16: Heal, G., & Kriström, B. (2002). Uncertainty and climate change. *Environmental and Resource Economics*, *22*(1), 3-39.

S17: Stedelijk Ecologische Structuur Dordrecht 2008-2013 https://www.deltaexpertise.nl/images/7/7b/Beleid_Dordrecht_Stedelijke_Ecologische_Structuren.pdf

S18: Verkiezingscafé: Urgentie voor een duurzaam Dordrecht https://www.youtube.com/watch?v=13Gq-v7Xcu4&t=571s

S19: Dordrecht: waterstad van de toekomst https://www.waterwereldwerk.nl/2018/09/07/dordrecht-waterstad-van-de-toekomst/

S20: Groenbeleidsplan WSHD 2022-2027 https://www.wshd.nl/_flysystem/media/whd068-groenbeleidsplan-210909-ow9-mvl.pdf

S21: Website Water Authority Dordrecht (WSHD) https://www.wshd.nl/

S22: Rekenkamercommissie: ' Dordrecht moet opgevraagde informatie voor iedereen bekendmaken' https://www.ad.nl/dordrecht/rekenkamercommissie-dordrecht-moet-opgevraagde-informatie-voor-iedereen-bekendmaken~a09f02dd/?referrer=https%3A%2F%2Fwww.google.com%2F

S23: Documenten Raad van Dordrecht https://raad.dordrecht.nl/documenten

S24: Groenblauwprogramma Dordrecht https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwiLjK-skbv6AhVQPuwKHbZ7AIoQFnoECAcQAQ&url=https%3A%2F%2Fcms.dordrecht.nl%2FInwoners%2FOverzicht_Inwoners%2FNatuur_en_milieu%2FGroen%2FGroenblauw_programma%2FGroenblauwprogramma.pdf&usg=AOvVaw12D5PYgFpZeegJEGYZ_mca

S25: Bestuur WSHD https://www.wshd.nl/bestuur

S26: Doel 5: Dordrecht is in 2035 klimaatbestendig: https://www.omgevingsvisiedordrecht.nl/doelen/doel-5-klimaatbestendig/doel-5-dordrecht-is-in-2035-klimaatbestendig

S27: Omgevingsvisie Dordrecht https://www.omgevingsvisiedordrecht.nl/doelen

S28: Trends & Ontwikkelingen in Dordrecht in beeld https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjbro2Hyb36AhURhv0HHT1gBusQFnoECAoQAQ&url=https%3A%2F%2Fallecijfers.nl%2Fgemeente%2Fdordrecht%2F&usg=AOvVaw02rbJhOnRTM63bqTbaJ67R

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S31: Steun onze strijd en geef water een stem https://www.dordrecht.net/nieuws/88227/steun-onze-strijd-en-geef-water-een-stem

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