Work Package 3: Identifying the state of the art and scoping needs of midsize cities

Final Report – 24 May 2019

Gül Özerol[1], Hans Bressers[1] , Kris Lulofs[1], Helge Bormann[2], Mike Boege[2], Susan Lijzenga[3], Nanco Dolman[4]

1 University of Twente, The Netherlands
2 Jade University of Applied Sciences, Germany
3 Vechtstromen Regional Water Authority, The Netherlands
4 Royal HaskoningDHV, The Netherlands

CATCH

An Interreg North Sea Region project

CATCH stands for 'water sensitive Cities: the Answer To CHallenges of extreme weather events'. The overall objective of CATCH is to demonstrate and accelerate the redesign of urban water management of midsize cities in the North Sea Region in order to become climate resilient cities that are sustainable, liveable and profitable on the long term.

This will be achieved by the joint development of decision support tools that will support midsize cities to formulate long term climate adaptation strategies. The design of the tools is based on the specific needs and characteristics of midsize cities. The tools will be tested in the formulation, execution and evaluation of 7 pilots.

CATCH addresses the special needs of midsize cities to deal with climate change adaptation and the resulting extreme weather events. In the North Sea Region 80% of the population live in urban areas of which a majority lives in midsize cities. Due to its scale, limited resources and expertise and tight connection with the surrounding region, midsize cities face a number of specific challenges to deal with climate change adaptation compared to large cities.

Inspired by the water sensitive cites theory, the experienced partnership will develop a decision support tool and roadmap to support midsize cities in designing long term climate adaptation strategies. CATCH will demonstrate that midsize cities in cooperation with their partners can accelerate the urgent process to become climate resilient. This results in inspiring examples in the 7 pilot cities, accompanied with a practical and usable set of generic tools for further uptake and dissemination in the North Sea Region.

The CATCH project offers the partnership the unique possibility to join forces (on European and regional level) and creates a unique momentum to change local behaviour, create European awareness, and support NSR midsize cities to make a significant step forward to become a water sensitive city.

Table of contents

1 Introduction

Midsize cities in the North Sea Region (NSR) has several characteristics that call for paying attention to their specific needs in term of adapting to climate change. The public authorities responsible for climate change adaptation often lack the capacity in terms of personnel and funds. At the same time, the pressure to deal with climate change becomes urgent, with increasing impacts of extreme weather events. With this trade-off between capacity and urgency, the midsize cities need decision-support tools that are both easy to use and appealing to create awareness and dialogue among relevant stakeholders.

Despite their commonalities regarding high-level political and economic indicators, the midsize cities of the NSR have different social, climatic and geographic conditions. Therefore, over the centuries, these cities evolved divergently in terms of how they deal with the impacts of climate change. A common 'language' is necessary that can be used both to communicate about climate change adaptation in NSR cities, and also constitute a joint basis for tailored-made strategies for midsize cities in the NSR. Workpackage 3 of the CATCH project establishes such a language by assessing the current situation of the cities in terms of their vulnerabilities and strengths in terms of adapting to climate change. The workpackage contributes to reaching the first objective of the project, which is "identifying state of the art and scoping needs of midsize cities". For this purpose, the Urban Water Transitions and the Water Sensitive Cities frameworks were utilized as the underlying conceptual frameworks. The partners and stakeholders of the CATCH project co-produced a self-assessment of the current status and the needs of the CATCH partner cities. The outcomes of the workpackage also contribute to the foundation of the workpackage 4, which focuses on the design of the CATCH decision support tool.

This report summarizes the conceptual framework, methodology and the results of the self-assessment and needs assessment, each of which are presented in the respective chapters.

2 Conceptual Framework

This chapter presents the conceptual framework of the workpackage in terms of its two key elements, namely the "self-assessment" and the "needs assessment". The underlying theoretical foundation of these elements are the Water Sensitive Cities (WSC) framework and the Urban Water Transitions (UWT) framework.

2.1 Self-assessment of Midsize cities

Within the scope of the WSC framework, 'benchmarking' is used to refer to a process and a tool for identifying the vulnerabilities and strengths of cities in terms of the three pillars of the WSC framework and for positioning them using the city-states of the UWT framework. Accordingly, the term 'benchmarking' was used in the CATCH proposal and during the early phases of the project. However, due to the understanding that benchmarks are often used for ranking according to scores, concerns were raised regarding the usefulness of the term for the CATCH purposes. In order to emphasize the knowledge exchange that this process creates among CATCH partners and for general users, and upon the recommendation of the advisory group, the project team decided to use the term 'self-assessment' instead of 'benchmarking'.

As explained further below, the self-assessment was developed to test the current situation in CATCH partner cities. At the same time, it created the foundations of a tool for general use by other midsize cities in the NSR and their stakeholders. The further development of the tool takes place in Workpackage 4 of the CATCH project.

Developing and Applying the Indicator Set

To develop and categorize the set of self-assessment indicators, the project team used the three pillars of the WSC framework as the basis. The major elements of these three pillars are listed in Table 1.

Table 1. Pillars of the WSC framework

Pillar 1: Cities as Water Sensitive Communities	**Pillar 2: Cities as Water Catchments**	**Pillar 3: Cities as Ecosystem Service Providers**
• *Socio-political and governance capacity* • *Stakeholder awareness and participation* • *Regulations*	• *Flood hazard and flood risk information* • *Water storage and infiltration* • *Status and maintenance of water infrastructure*	• *Built environment that supplements and supports the functions of the natural environment*

The three pillars of the WSC framework integrate the governance, infrastructure and ecosystems dimensions of urban resilience under the following principles:

1) **Cities as water sensitive communities and networks**: The implementation of integrated solutions requires improved perception of the benefits from decision makers, businesses and the public across multiple levels of governance. This makes collaboration a key requirement.
2) **Cities as catchments**: The urban water system is often part of a larger catchment area. The intensive exploitation of the urban landscape resulted in the progressive decrease of natural water system to the detriment of the surrounding region. The goal is to restore the water balance between these regions.
3) **Cities as ecosystem services providers**: The same water that poses the biggest threat to society also brings life and energy to the cities. Ecological services are the benefits that people derive from ecosystems. A river area for instance can be used multifunctionally for flood protection, groundwater recharge, recreation and for the improvement of the quality of life.

To develop the list of indicators in each pillar and to assign the indicator scores, the whole set of WSC indicators was used as the starting point and a co-production process was carried out by the CATCH practice partners. This process is explained in Appendix 1. The key principle behind the process was to develop a set of indicators that the partners see as relevant for their city and pilot and have the necessary data to assess the indicator. The final list of self-assessment indicators is presented in Table 2 and the detailed self-assessment scoring scheme is provided in Appendix 2.

We considered to have additional, city-specific indicators to take into account the local context of pilots. However, since the CATCH pilots are very different from each other, the effort for developing such specific indicators was not seen as worthwhile and thus such indicators were not developed. Furthermore, using a common set of indicators ensured that each partner city compared itself to the principles of the WSC framework using the same framework, and enabled identifying more comprehensive mutual exchange and learning opportunities across cities.

To reach a final score for each pillar and an aggregate overall score, a decision had to be made regarding the weights of the indicators. The option of using different weights for different pilots and/or cities was considered to reflect the relative importance of the pillar for different CATCH partners. However, we concluded that this would make the justification of the indicator weights and final scores complicated. Therefore, equal weights were used for all indicators.

Table 2. Self-assessment indicators

Cities as Water Sensitive Communities	**Cities as Water Catchments**	**Cities as Ecosystem Service Providers**
Organizational capacity for climate change adaptation at the city level	Availability and use of both flood hazard and flood risk maps for areas at risk	Attention to the needs and protection of vulnerable groups
Water as a key element in city planning and design/redesign	Areas to temporally store water in the city without expected damage	Healthy and biodiverse habitat
City-level integrative arrangements across sectors	Measures to increase infiltration	Protection of surface water quality and flow regime

Stakeholder participation in water and climate change adaptation at the city level	Status of infrastructure for water supply	Protection of groundwater quality and groundwater levels
Leadership, long-term vision and commitment by the city-level administration	Maintenance of infrastructure for water supply	Activation of connected urban green and blue space
Level of flood risk awareness of the population	Status of infrastructure for wastewater	Vegetation coverage at the city level
Organisation of emergency management	Maintenance of instrastructure for wastewater	
Regulations to reduce potential flood damage in the city	Status of infrastructure for flood protection	
	Maintenance of infrastructure for flood protection	

Assigning the City-states

As shown in Figure 1, there are six city-states included in the UWT Framework. A cities path towards greater water sensitivity has traditionally followed a sequential way in which each 'state' is building on the development of the previous stage. This is captured in the UWT Framework of Brown et al. (2009), which is shown in Figure 1. Based on a historical analysis of the technical and institutional arrangement in urban water management over time, the framework identifies six distinct development stages that cities go through when they progress towards greater water sensitivity.

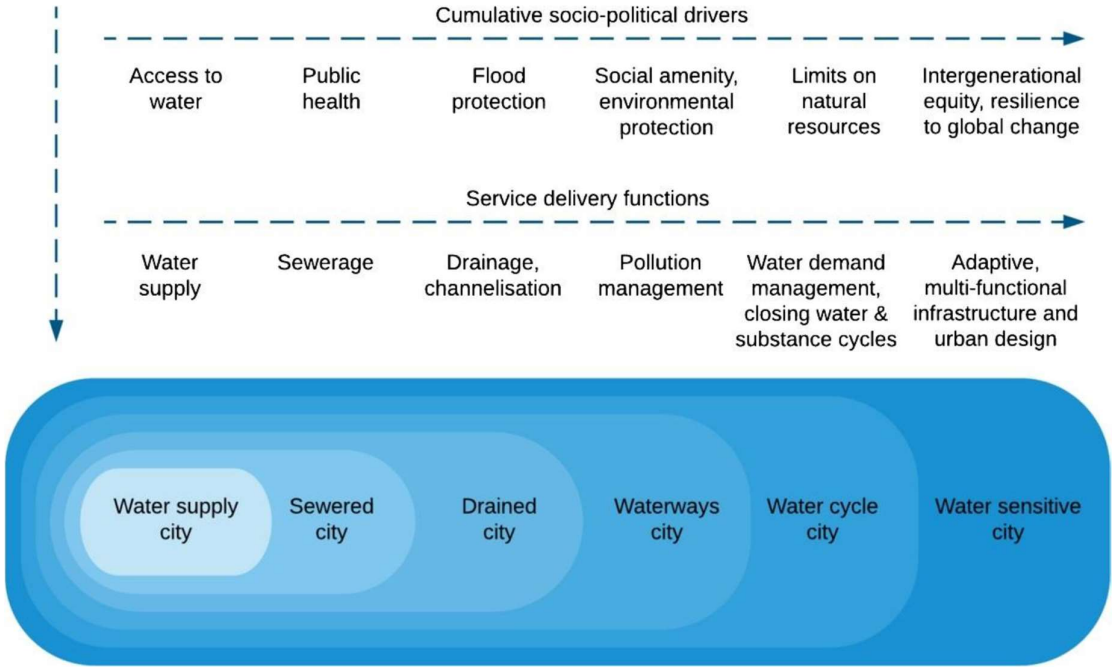

Figure 1. Characteristics of the city-states in the NSR

Source: Adapted from the UWT Framework by Brown et al. (2009) cited in Wong and Brown (2009)

The six states are mapped against two dimensions:

1. **Cumulative Socio-Political Drivers**: "the socio-political drivers (demands and expectations) that emerge from society's growing environmental awareness, amenity expectations and evolving attitudes toward water management" (Brown et al., 2016).
2. **Service Delivery Functions**: "the increasingly diverse services required to address those drivers as cities transition to greater sustainability" (Brown et al, 2016).

The different stages of development are included in Box 1. Each definition is taken from Brown et al. (2016) and, if needed, adapted for the NSR situation.

City state and definition (Source: Brown et al., 2016)	***Situation in the NSR***
Water supply City	
"The most basic state of modern water management, whereby a centralized system provides water to a growing urban population that expects cheap and equitable water for all. Large quantities of water are extracted from the environment using infrastructure such as pipes and dams. The public expects that water is cheap, harmless to the environment and limitlessly available."	All cities in the NSR are fitted with a water supply system providing a safe, clean and sufficient supply of water. In general, the price of (potable) water is low. The water supply infrastructure is not perfect and water leakage is considerable, though with varying percentages.
Sewered City	
"Building on the previous state, the Sewered City is drive by a desire for better public health and hygiene. Diseases caused by domestic and industrial waste effluent leads to the development of sewerage systems that divert effluent away from housing and into waterways outside of cities. As in the earlier state, it is assumed that the discarding of effluent does not harm the environment."	Some of the world's oldest sewers are found in urban areas in the NSR. Almost 100% of built-up areas are sewered. Historically by combined sewers, followed more recently by separated systems. Many cities in NSR are dealing with issues in maintenance, environmental impacts and overwhelming of systems (see drained city).
Drained City	
"A need to protect homes and infrastructure from flooding is the driver behind the Drained City. The channelling of rivers enables the development of floodplains for housing and rapid urban growth. Like effluent, stormwater is directed away from urban areas and into waterways, generally thought of as dumping grounds for waste. The community expects water supply, sewerage and drainage services to be provided cheaply."	Most cities in the NSR are fitted with a discharge driven water system. Because of historic covering and filling of water ways, storage capacity is limited.
Waterway City	
"The environmental impacts of both water extraction and waste processing are taken into account for the	Many cities in the NSR are putting a lot of effort into implementing

first time. As the social and aesthetic values of clean waterways are extolled, urban planning begins to integrate water as an important consideration. The unfettered extraction of freshwater is now being curbed, and receiving waterways are protected by filtering stormwater through bio-filtration systems such as rain gardens and artificial wetlands distributed throughout the city."	"making room for water" in its city planning, following these "Waterway City" sub-states: a. Follows infrastructural network – adaptive, b. Co-organizing in urban network, c. Retro-fit natural network – regenerative.
Water Cycle City	
"In this state, water is actively conserved and supplies from diverse sources such as stormwater, greywater and recycled wastewater are used in a fit-for-purpose manner. Sustainability is now widely embraced, and the former hydro-social contract, in which government was expected to deliver risk-free water supply services, has been replaced with co-management arrangements between government, business and community."	Cities in the NSR cities mainly focus on dealing with too much of water and floods. Prolonged heat and dryness during recent 2018 summer led to drought in many countries across Europe. This is an instant wake-up call for the NSR, which must also consider adaptation to more severe droughts, water scarcity and heat stress.
Water Sensitive City	
"Based on holistic and integrated water cycle management that meets the city's water needs while also delivering a range of associated liveability benefits. A Water Sensitive City manages water in a way that protects the health of receiving waters, mitigates flood risk and creates green public spaces that also harvest and recycle water. Infrastructure, technology and urban design will be flexible, recognizing the link between society and technology. The community is actively engaged with water, through recreational enjoyment of irrigated green spaces throughout the city, and have opportunities for more active involvement in the water system."	Some front runner cities in the NSR started to develop and implement blue-green infrastructure to enhance urban liveability. The city's strategies show elements of greater water sensitivity, e.g. education, community outreach and raising awareness. The transition towards water sensitive cities in the NSR can be promoted in coherence with other transitions, such as clean energy and circular economy.

Box 1. Descriptions of city-states included in the UWT Framework and situation in the NSR

The transitional nature of the UWT framework implies that becoming a water sensitive city requires demonstrating the characteristics of the previous city-states. For instance, based on the characterization in Figure 1, a waterway city should show the characteristics of a water supply city, sewered city and drained city, and in addition it should incorporate social amenity and environmental protection, as well as point and diffuse source pollution management.

In the publicly available documents related to the development and application of the UWT and WSC frameworks, there is very little information on how to assign a city to one of the six states on the UWT framework. Brown et al. (2016:12), however, make a distinction between the first three and the second three city states, which also demonstrates a clear transition from one category to another:

- *Water supply city, sewered city, and drained city*: Exclusively large-scale centralized infrastructure and institutions. Priority given to controlling environmental variation through technocratic engineering.
- *Water ways city, water cycle city, and water sensitive city*: Integrated, distributed and flexible infrastructure and institutions. Priority given to maintaining resilience through adaptability and reflexivity.

The first three stages of the embedded continuum describe the evolution of the water system to provide essential services such as secure access to potable water (Water Supply City), public health protection (Sewered City) and flood protection (Drained City). These are followed by the Waterways City, Water Cycle City and ultimately a Water Sensitive City, which describe the anticipated evolution of the urban water system to deliver higher order services such as social amenity and environmental protection, provide reliable water services under constrained resources, and ensure intergenerational equity and resilience to climate change. The analysis of the indicators through this framework gives users important insights on their progress towards a Water Sensitive City.

The self-assessment benchmarks cities in the NSR across three pillars or practices (see Table 1), essential to deliver water sensitive services (Wong and Brown, 2009). The indicators of each pillar (Table 2) are scored qualitatively and quantitatively from 1 to 5 to describe a city's current situation. The indicators have been further designed to enable users to measure progress towards achieving water sensitive city goals and assist decision-makers to prioritise actions, and define responsibility and foster accountability for water-related practices.
As explained further in the Chapters 2 and 3, within the CATCH project the self-assessment has been applied to seven city-scale case studies in the NSR. The aim of these case studies was to test the functionality of the UWT framework in delivering reliable, useful and transferable benchmarks in different country contexts. The results for the seven case studies were also compared to city-states of a Drained City, Waterways City and Water Cycle City in the NSR (Figure 2).

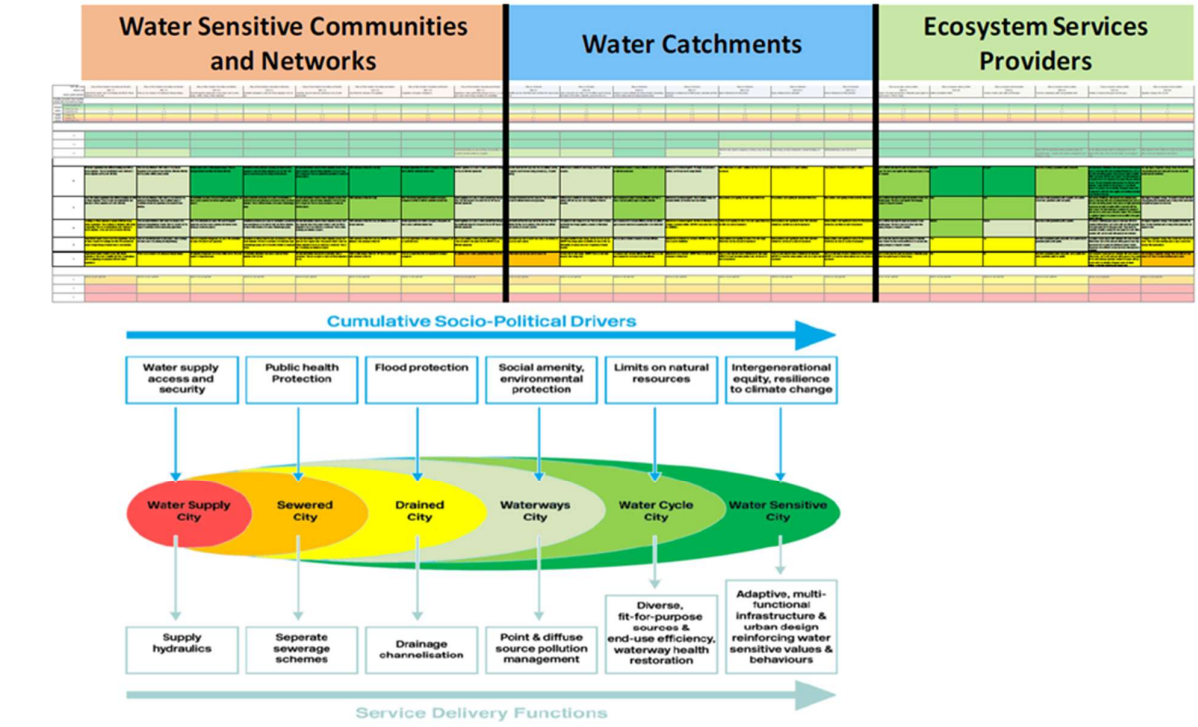

Figure 2. Assigning of indicators to idealised city-states in the NSR

Source: Dolman et al. (2018) adapted from Brown et al. (2009)

2.2 Needs Assessment of Midsize cities

In the proposal phase, the partners of the CATCH project identified a list of challenges that midsize cities have to deal with regarding the problematic of climate change adaptation. These challenges can be listed as follows (Adapted from Kunzmann, 2009):

- A lack of expertise in dealing with climate challenges in an integrated manner.
- Insufficient human resources to develop and implement a thorough climate change adaptation strategy.
- Relatively low budgets and few opportunities to make large investments for climate change adaptation.
- Compared to metropolitan areas, midsize cities often do not benefit from research programs and publicly funded initiatives.
- Relatively less autonomy due to dependency on and/or limitations by the surrounding region.

The needs assessment conducted within the CATCH project aimed to create an elaborate explanation on how these challenges unfold in different cities, and which specific needs each partner city has in terms of designing, implementing, monitoring and evaluating climate change adaptation measures and strategies. The three layers of the Contextual Interaction Theory, which had been developed at the University of Twente (Bressers et al., 2016), and the three pillars of the WSC framework were used to identify and categorize the potential needs of the mid-size cities. A preliminary list of these needs is shown in Figure 3. Given the objective of developing a decision support tool that matches the needs of the midsize cities, the existence and use of the current tools has also been investigated as part of the needs assessment process.

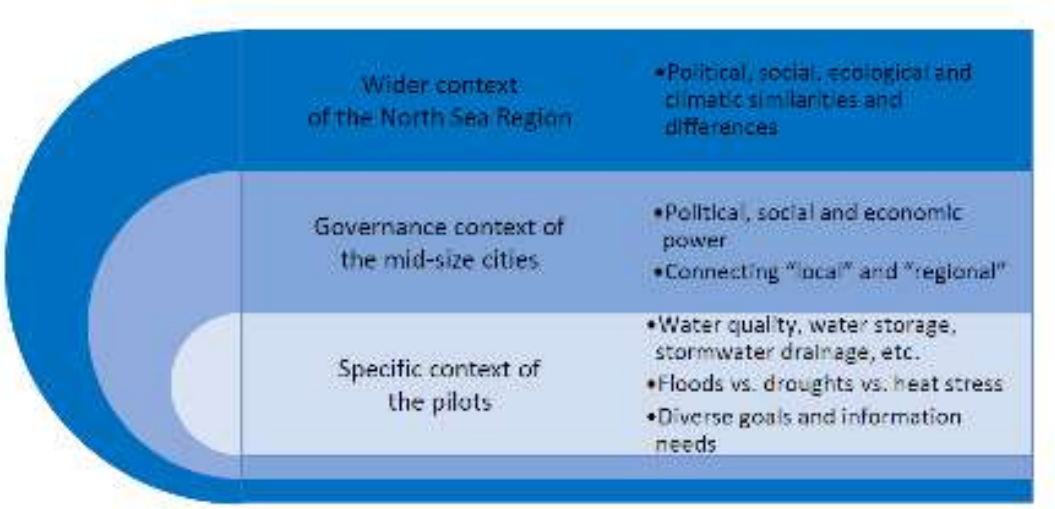

Figure 3. WSC Framework Adapted to CATCH Needs Assessment

To collect the necessary data for the needs assessment in a systematic manner in each CATCH partner city, we prepared a standard guide, addressing the following topics:

- Stakeholder involvement
- Perceptions about climate change adaptation problems
- Climate change adaptation goals and strategies
- Responsibilities and resources for climate change adaptation
- Existing decision support tools for water management or climate change adaptation
- Monitoring and evaluation of projects on climate change adaptation

These topics were investigated using a set of questions, shown in Appendix 4, which were answered using the methodology explained in the next chapter.

3 Methodology: Co-production of the Assessments

The CATCH partners co-produced the results of the self-assessment and needs assessment through applying four types of methods: partner visits, partner meetings, advisory group meeting, and the review of relevant documents.

3.1 Partner Visits

Partner visits took place between January and September 2018, as shown in Table 3. These visits mainly aimed to have a comprehensive understanding about water management and climate change adaptation in CATCH partner cities, to become familiar with the characteristics of the cities and their pilot projects, and thereby to collect data for assessing the needs of the cities.

Table 3. Overview of CATCH partner visits

City	CATCH partner	Dates of the partner visit	Number of interviewees
Zwolle	Zwolle Municipality	22 and 25 January 2018	11
Enschede	Enschede Municipality	23-24 January 2018	5
Oldenburg	OOWV	14-15 February 2018	6
Norwich	Norfolk City Council	5-6 March 2018	6
Vejle	Vejle Municipality	27-28 August 2018	8
Arvika	Arvika Teknik	30-31 August 2018	9
Herentals	VMM	24-25 September 2018	8

The visits consisted of interviews and excursions. Standard guidelines were used to shape the agenda of the partner visits (Appendix 3) and the scope of the interviews (Appendix 4). A total of 49 experts were interviewed, including representatives from CATCH partner cities as well as other relevant stakeholders such as regional authorities, water authorities, housing associations, non-governmental organizations, etc. These experts provided their knowledge from different perspectives, which helped to create a full picture of the current status and the needs of the cities. In addition to experts, we also interviewed four citizens from two households in Norwich, who were affected by the flooding events that took place in the past decade, and had responded in different ways due to their divergent resources. We recorded and transcribed the interviews conducted in each partner city and used these transcripts for conducting the needs assessment. During each partner visit, the host partner city also arranged an excursion, which included a visit to the site of the pilot project and other locations in the city, which were considered important for water management and/or climate change adaptation in the partner city.

3.2 Partner Meetings

Since the start of the CATCH project, four partner meetings took place, which were in November 2017, March 2018, June 2018 and September 2018. At each meeting there was at least one session dedicated to needs assessment or self-assessment. The partner meetings created a

collaborative, transdisciplinary platform to co-produce the self-assessment. Before the partner meetings in Norwich and Oldenburg, the cities prepared their reflections on several topics, such as the availability of information to assess the indicators, the relevance of the indicators for their city and pilot project, the difficulty level of the indicators, the usefulness of the indicators in emphasizing their key concerns, etc. These inputs were presented by each partner during the partner meetings, and further discussed in plenary sessions and dedicated workshops. Partner meetings also provided a platform for the partners to explain, justify and adjust the scores that they gave for the indicators.

3.3 Advisory Group Meeting

The first advisory group meeting of the CATCH project took place in June 2018. Recommendations of the advisory group addressed both the ongoing and planned activities of CATCH. As explained earlier, one of the recommendations was on the possible negative connotations of the term 'benchmarking', which encouraged us to adopt the term 'self-assessment'. Furthermore, the advisory group recommended to keep the decision support tools as simple as possible to be appealing to practitioners. This gave us additional motivation to apply the simplicity as one of the key criteria for developing the CATCH tools, including the self-assessment tool.

3.4 Document Reviews

To enrich and verify the information that we collected through other data sources, we also reviewed various documents. We collected various documents from the partners and publicly available online sources, such as policy papers, regulations, project reports. These documents helped to have a comprehensive overview of the policy and practice about climate change adaptation and urban water management in the partner cities, and more broadly in the CATCH partner countries. We also reviewed the scientific and professional literature on urban climate change adaptation and the WSC framework.

4 Results of the Self-assessment

Using the process explained in the previous chapter, the self-assessment scores of the seven CATCH partners cities were calculated and analysed. In the sections below, we present the results of these self-assessments, first for each city, and then at the overall level for each WSC pillar.

4.1 City-level Self-assessments

Arvika

The city of Arvika made diverse assessments for 21 indicators, whereas they preferred not to assess two indicators: C2.1 (*Availability and use of both flood hazard and flood risk maps for areas at risk*), and C2.6.1 (*Maintenance of infrastructure for flood protection*). The reason for not assessing the indicator on flood hazard and flood risk maps was that Arvika is not identified as a high-risk flood area by the Swedish Civil Contingencies Agency, which is the responsible authority in Sweden for the EU Flood Directive. Among the three pillars, the city assessed the pillar on ecosystem services as the weakest, especially regarding indicator C3.3 (*Protection of surface water quality and flow regime*), which was scored with 1. The other two pillars were assessed relatively higher, with many scores of 3 and 4, while one indicator, C1.6 (*Level of flood risk awareness of the population*) was scored with a 5, which is attributed to the flood of year 2000 and to the construction of the flood barrier.

Enschede

Similar to Arvika, the city of Enschede scores relatively better in the first two pillars, with lower scores in the pillar on ecosystem services. Three indicators in this pillar were scored with a 2, namely C3.1 (*Attention to the needs and protection of vulnerable groups against the negative impacts of climate change*), C3.4 (*Protection of groundwater quality and groundwater levels*), and C3.5 (*Activation of connected urban green and blue space*). The city didn't give a specific score to the indicators C3.2 (*Healthy and biodiverse habitat*) and C3.3 (*Protection of surface water quality and flow regime*), as they differed in different parts of the city and also in the outer areas of the city. The only indicator that was scored with a 5 is C2.1 (*Availability and use of both flood hazard and flood risk maps for areas at risk*), demonstrating that the city has up-to-date flood hazard and risk maps, which are published and regularly used for decision making processes.

Herentals

The self-assessment results of Herentals are consistent with Enschede and Arvika given the relatively lower scores for the pillar on ecosystem services. The city of Herentals assessed two indicators in this pillar with a score of 1. These indicators are C3.1 (*Attention to the needs and protection of vulnerable groups against the negative impacts of climate change*), and C3.3 (*Protection of surface water quality and flow regime*). Among the indicators in other two pillars, only one indicator, C1.6 (*Level of flood risk awareness of the population*) was assessed with a score of 2, which is attributed to the fact that there is no data on public awareness, but at the same time there have been no major floods in Herentals. The remaining scores range between

2.5 and 4. Similar to Norwich and Oldenburg, the city of Herentals didn't assess any of the indicators with a score of 5, indicating being receptive to improvement in all the indicators.

Norwich

The pattern of the self-assessment scores of the city of Norwich differs from most of the other CATCH partner cities. Overall, all three pillars were assessed with similar scores, most of them being assessed with a 3. Two indicators in the pillar on communities and networks were scored with a 2, namely C1.2 (*Water as a key element in city planning and design/redesign*) and C1.5 (*Leadership, long-term vision and commitment by the city-level administration*). These low scores for both indicators demonstrate a clear lack of attention to water and climate change adaptation at the city level. The highest scores were 4, which was given only to two indicators, namely C2.1 (*Availability and use of both flood hazard and flood risk maps for areas at risk*) and C2.4 (*Status of infrastructure for water supply*). Similar to Herentals and Oldenburg, the city of Norwich didn't score any of the indicators with a 5.

Oldenburg

The city of Oldenburg assessed all three pillars with a diverse range of scores, having similar scores for all three pillars, with the third pillar having slightly lower scores. The city scored four indicators with a score of 1, two of which were assessed at the city level, i.e., C2.2 (*Areas to temporally store water in the city without expected damage*) and C3.2 (*Healthy and biodiverse habitat*), and two at the pilot level, i.e., C2.6 (*Status of infrastructure for flood protection*), and C2.6.1 (*Maintenance of infrastructure for flood protection*). These scores demonstrate ample room for improving the water storage capacity and the habitat. On the other hand, the low scores for the two indicators on flood protection infrastructure are attributed to the problems with flood protection from rainfall, which is also the core of the CATCH pilot in Oldenburg. Similar to Herentals and Norwich, the city of Oldenburg didn't score any of the indicators with a 5, but they scored six indicators with a 4.

Vejle

The self-assessment pattern of Vejle is also diverse, with scores that range between 2 and 5. Similar to most other cities, the city of Vejle scored relatively low in the pillar on ecosystem services, although its scores are relatively higher. No indicators were scored with a 1, and only one indicator was scored with a 2, namely C3.6 (*Vegetation coverage at the city level*), which is also on the pillar in ecosystem services. For each pillar, the city of Vejle scored at least one indicator with a 5, having a total of four indicators scored with 5. These four indicators are C1.7 (*Organisation of emergency management*), C2.4 (*Status of infrastructure for water supply*), C2.4.1 (*Maintenance of infrastructure for water supply*) and C3.4 (*Protection of groundwater quality and groundwater levels*).

Zwolle

Compared with all CATCH partner cities, the city of Zwolle assessed the total of 23 indicators with relatively higher scores. Similar to Vejle, no indicators were assessed with a 1, and only one indicator in the pillar on ecosystem services was assessed with a score of 2. However, it was a different indicator, namely C3.1 (*Attention to the needs and protection of vulnerable groups against the negative impacts of climate change*). Again, similar to Vejle, the city of Zwolle assessed several indicators with a score of 5. These included one indicator each in pillars on

community and networks, namely C1.7 (*Organisation of emergency management*), and ecosystem services, namely C3.6 (Vegetation coverage at the city level), and 7 out of 9 indicators in the second pillar on "cities as water catchments", indicating a very high strength in data and infrastructure management.

4.2 Self-assessment Results per WSC Pillar

The average score for each pillar was calculated by dividing the total of the score by the total number of CATCH cities, i.e. seven. Cities of Arvika and Enschede didn't give scores to several indicators. For these indicators the average score was calculated based in the six available scores. When the average scores for the three WSC pillars is compared, we observe that the pillar "cities as catchments" has the highest average score (=3.6), followed closely by the pillar "cities as communities and networks" (=3.4), and the pillar "cities as ecosystem services providers" has the lowest average score (=2.9). In the sections below, the indicators with lowest and highest score for each pillar are presented and discussed.

C1. Cities as water sensitive communities and networks

The lowest score in this pillar is for the indicator C1.5 (*Leadership, long-term vision and commitment by the city-level administration*), with a score of 3.14, and the highest score is for the indicator C1.7 (*Organisation of emergency management*), with a score of 3.86. The indicator with the lowest score also shows the need for mainstreaming water and climate change adaptation measures and goals into other sectors, and for implementing integrated projects. When we look at the individual scores of the cities, it is also noticeable that none of the cities assessed themselves with a score of 5, whereas the individual scores ranged between 2 and 4.

C2. Cities as water catchments

The lowest score in this pillar is for the indicator C2.2 (*Areas to temporally store water in the city without expected damage*), with a score of 2.86, and the highest score is for the indicator C2.4 (*Status of infrastructure for water supply*), with a score of 4.29. The low average level of the indicator on temporary water storage is due to the fact that one city (Oldenburg) assessed itself with 1, one city (Zwolle) with 4 and the rest with 3. Overall, this shows the need for both increasing the options to store water and improving the regulations and incentives to implement such measures. We also observe for this pillar that the indicator on the status of water supply infrastructure has the highest average score among the 23 indicators. For this indicator, two cities (Vejle and Zwolle) assessed themselves with 5, and the others with 4, indicating a relatively low need for improving the water supply infrastructure.

Cities as ecosystem services providers

With an average score of 2.9, this pillar shows ample room for improvement in ecosystem services that are relevant for water management and climate change adaptation in cities. The lowest score in this pillar is for the indicator C3.1 (*Attention to the needs and protection of vulnerable groups*), with an average score of 2.57, and the highest score is for the indicator C2.4 (*Protection of groundwater quality and groundwater levels*), with an average score of 3.43. We also observe that two other indicators, namely C3.2 (*Healthy and biodiverse habitat*) and C3.3 (*Protection of surface water quality and flow regime*) have an average score of 2.58, which is very close to the lowest level. The indicator on the attention to the needs and protection of vulnerable groups also has the lowest average score among the total of 23 indicators. This finding is consistent with the impressions shared by the practice partners during the definition of

the indicator, as they communicated that there was relatively low awareness and data regarding the needs of vulnerable groups.

5 Results of the Needs Assessment

This chapter presents the results of the needs assessment conducted for seven CATCH partner cities. The First section includes the assessments at city-level, presenting the results in terms of the six topics covered by the needs assessment. The second section provides an overview of the needs assessment in terms of the broader results that apply to most of the partner cities as well as the differences between the cities.

5.1 City-level Self-assessments

Arvika

- ***Stakeholder involvement***: According to the municipality, there is no platform to collaborate with private sector, such as power companies, who are dependent on water. The local stakeholders know each other, and citizens can be easily reached, informed and invited for participation, and likewise the citizens can reach out to the municipality to express their needs and complaints directly. The CATCH pilot project constitutes a typical example of this advantage of being a small city.
- ***Perceptions about climate change adaptation problems***: Floods due to heavy rainfall are perceived as the main problem and it is expected that floods will happen more frequently in the coming years. The flood that happened in November 2000 seems to have triggered several actions, such as the ongoing flood barrier project, and the CATCH pilot project. Nevertheless, the priority put on climate change is seen as lower than needed, especially in terms of the availability of data, and in terms of public awareness.
- ***Climate change adaptation goals and strategies***: There is a regional climate change adaptation plan, but no strategy or goal at the city level. The goals and plans of several departments of the municipality, such as the water and sewage plan, and Arvika Teknik itself are relevant for climate change adaptation. According to the crisis department of the municipality, the concept of “resilience” is adopted and goes beyond water and climate change, but according to Arvika Teknik, the concept is too complicated to communicate in Swedish, and thus not widely used. For the municipality, having legislation on any issue makes it easier to implement, as the Swedish society is seen as rather rule-compliant.
- ***Responsibilities and resources for climate change adaptation***: Since water and climate issues are seen as public responsibility and there is little budget at the national level, the municipality raises and allocates funding for most of the climate-related projects and leads their implementation. However, it is questioned whether the local governmental level should carry all the costs of climate change. The municipality doesn’t have a dedicated team or department for climate change adaptation, and therefore several departments share the tasks, which creates unclarity and inefficiency. Arvika Teknik is starting to take the initiative to clarify the division of tasks.
- ***Existing decision support tools for water management or climate change adaptation***: A 100-indicator scorecard has been developed within the SENDAI project, and a basic cost-benefit analysis was done for the CATCH pilot project. However, there are no specific

tools for climate change adaptation. There is no knowledge on the economic consequences of climate change, either.

- ***Monitoring and evaluation of projects on climate change adaptation***: There are goals and indicators in annual operational plans, and each project refers to those goals and indicators. Arvika Teknik organizes workshops to discuss what works and what doesn't within their projects, but there is no systematic way for reporting and communication the information that comes out of such workshops. Since the CATCH pilot project is rather innovative in Sweden, the municipality and Arvika Teknik are willing to share the results extensively and to use it for more support in similar projects on climate change adaptation.

Enschede

- ***Stakeholder involvement***: The municipality involves many governmental, non-governmental, knowledge institutes and private organizations in climate change adaptation projects, and more broadly in urban water management. Vechtstromen, the regional water authority, is one of the key partners in projects related to rainwater and sewage, since Enschede is the largest city in its jurisdiction. Currently, the municipality is leading the projects related to climate change adaptation. Both the municipality and the water authority expect a more active involvement of the private sector, such as housing corporation, project developers and insurance companies. According to the city development plan (*bestemmingsplan*), which shows the dedicated use of land in the city, the municipality makes a collaboration agreement with relevant stakeholders. Similarly, the housing corporation has a citizen participation toolbox, which is applied to involve citizens in making choices about how to use public space in housing projects. Knowledge is needed on what motivates the citizens to be involved in climate change adaptation projects, since they often have no "business case", which is easier to develop for energy transition projects.
- ***Perceptions about climate change adaptation problems***: Keeping the groundwater and surface water levels under control is a key issue, especially with the long-lasting groundwater problem in several districts and the heavy rainfalls that are expected to occur more frequently. The municipality and the water authority also see this as an infrastructure problem in terms of increasing the capacity of the sewage pipes or decoupling rainwater and sewage. Experts from different disciplines come together for water and climate projects, but a common problem perception is yet to emerge among the different departments and organizations.
- ***Climate change adaptation goals and strategies***: A climate change adaptation strategy will be developed within the framework of the Deltaplan Spatial Adaptation (DPRA). The stresstest, which has been done to identify the vulnerable locations in the city, is also one of the requirements of the DPRA. As compared to bigger cities in the Netherlands, Enschede has a relatively connected community, which makes it easier for the municipality to reach to citizens, for instance using information campaigns.
- ***Responsibilities and resources for climate change adaptation***: In Enschede, climate change adaptation is seen as a public responsibility. Municipality has been funding most of the projects, and it expects more contribution from other governmental organizations such as the province and the regional water authority. For calculating and sharing the costs of damages, e.g., from heavy rainfalls, the municipality and the water authority need more data and a legal basis, which will also be useful for insurance companies and housing corporations.

- ***Existing decision support tools for water management or climate change adaptation***: The water test (*watertoets*) is used for new development projects in the city. The municipality also uses a risk assessment model that they developed to identify the where the "hotspots" in the city are. There is concern on making the information sharing more user-friendly, to make sure the citizens can understand and interpret the information correctly. The calculation of the benefits of climate change adaptation is seen as useful, but not urgent.
- ***Monitoring and evaluation of projects on climate change adaptation***: No specific tools are available to evaluate the projects. A specific need is expressed in terms of the impact of public participation efforts.

Herentals

- ***Stakeholder involvement***: Flanders has the issue of "multiple claims on urban space", resulting in the involvement of numerous stakeholders in every project that is related to urban planning and development. This is also experienced in Herentals, where nature and agricultural organizations are seen as relatively more dominant. The municipality doesn't see itself as a leading stakeholder. The VMM and the Province express concerns about how to engage the citizens and the private sector.
- ***Perceptions about climate change adaptation problems***: Floods have been the major climate problem, although the drought in summer 2018 created awareness, too. Climate change adaptation is not a concern for all stakeholders, for instance the Heritage Agency, who has more interest in mitigation measures such as energy saving.
- ***Climate change adaptation goals and strategies***: The Province has a climate change adaptation plan for the regional level, however there is not a specific strategy or plan for climate change adaptation at the city level. CATCH pilot project in Herentals is part of a bigger river restoration project for the Kleine Nete River, which combines different types of water measures. In general, there is also effort to combine water- and climate-related projects with city development projects, to increase the acceptance by stakeholders. Most of the activities on climate change adaptation aim to raise awareness, more than concrete actions by citizens. This is explained by the lacking economic incentives for citizens.
- ***Responsibilities and resources for climate change adaptation***: The VMM, as a regional authority, has the capacity and mandate to take responsibility about climate change adaptation. The problem regarding limited space in cities creates the need for the different actors to work together and often pool resources, but it can also cause frictions between different interests, such as nature, agriculture and cultural heritage. A flood insurance system has been introduced by the federal government, which is only applied for old houses. For the new houses the citizens have to protect themselves.
- ***Existing decision support tools for water management or climate change adaptation***: A water assessment is done to evaluate building projects in terms of their vulnerabilities regarding flood and drought. The results of the assessment are used to decide on whether to give building permits. A 24/7 flood forecasting system is in place. In September 2018, a "climate portal" was launched for sharing climate information with broad stakeholders, also targeting citizens to increase their awareness. The need is expressed in terms of data and tools to communicate with the stakeholders.
- ***Monitoring and evaluation of projects on climate change adaptation***: There are no formal evaluation requirements for plans or projects. A need is expressed in terms of

such evaluation tools and also for demonstrating the added value of measures that combine multiple functions, for instance water storage with less-intensive agriculture.

Norwich

- ***Stakeholder involvement***: The County council's organization has often been reorganized and experienced 6-7 years of government spending cuts. County council set up the services at county level. There is also an emergency team. The County works with many stakeholders, partially due to official links, but also with community organisations (e.g. social service organisations). Better links with "the people on the ground" are needed. More funding would also create more opportunities to link with stakeholders. Working more with Anglian Water and the highway department would be most important. Other are relevant for minor parts of their work. But unless laws or local government changes it will be difficult. A lot of the drainage is private; thus, they cannot solve everything, even not with stand-alone systems or infiltration. Anglian Water covers a much bigger area. They collaborate in making an inventory on county level together, but the joint implementation of measures is more difficult to justify. The last years there were good contacts with the municipality (city), but people move and then you have to restart building such contacts. The municipality does have good contacts with citizen groups.
- ***Perceptions about climate change adaptation problems***: The County flood and water team has also the task to comment on developments from a flood risk perspective. That has a high case load. They are also doing flood risk assessment for the whole area. Pressures are very changeable with the weather. There is room for improvement in all the areas. Respondent would like to work more at schools to create awareness. The people don't realize that their individual actions have collective consequences. The perspective of flood prevention is as such accepted, but staff has no time to accept all invitations. However, there are also some that "have things done this way always".
- ***Climate change adaptation goals and strategies***: In principle, there are good options for improvement in the context of city (re)development, but developers just go as far as the required "not making things worse". Often options are reduced by "cost-benefit" calculations. The environment agency is the only one pushing the climate change issue. They have to report to this DEFRA ministry, the environment agency. Natural England does that too, but they are not working together with them. Most pressures come from individual councillors or MPs or city groups: political pressure. Sometimes you have active councillors, but not in the most vulnerable areas. Others are just monitoring legal obligations, like making a strategy document. Buying out households from vulnerable places is politically sensitive, while it is seen as giving up the task of protecting the dwellings. In the period 2020-2025 a big project will carry on, (re)developing areas, but in the meanwhile smaller interventions can be done.
- ***Responsibilities and resources for climate change adaptation***: There is a Flood and water management Act, the legal response to the 2007 flooding, which is operational from 2010. Its funding is based on risk ranking. The County CES flood and water team has 9 officers. Its maximum is 12 staff. The flood and water team has enforcement powers, for instance when people fill a water course. The County flood and water team has also the task to comment on developments from a flood risk perspective. That has a high case load. They are also doing flood risk assessment for the whole area. There is also a project team, that seeks funding and partnerships. Only activities that can be done by themselves can be realized from the yearly budget. It is quite difficult to get support

from external sources. More funding would also create more opportunities to link with stakeholders. In the Act there are a lot of duties, but not many powers. Flexibility is low due to disagreeing subsidy requirements and time scales and many different organisations that need to agree (at least three per water course).

- ***Existing decision support tools for water management or climate change adaptation***: There is sufficient data and modelling. It's a matter of getting things done.
- ***Monitoring and evaluation of projects on climate change adaptation***: The County flood and water team has also the task to comment on developments from a flood risk perspective. That has a high case load.

Oldenburg

- ***Stakeholder involvement***: The OOWV leads the process, and they feel that other actors should be involved more actively.
- ***Perceptions about climate change adaptation problems***: Floods caused by heavy rainfalls are seen as the major problem, attributed to insufficient drainage due to the increase of impervious areas in the city. While the OOWV perceives the floods as a joint problem of all relevant stakeholders, it seems that there is no such common understanding. Climate change is often connected to other mainstream topics such as groundwater management and water quality. The changing climate conditions, e.g. warmer summers, is also seen as a problem, which requires long-term solutions, such as increasing green areas in the city. However, this competes with the goal of urban development, which focuses on increasing the attractive of the city through keeping the parking spaces and shopping areas.
- ***Climate change adaptation goals and strategies***: There is no climate change adaptation strategy at the city level. Similarly, climate goals are not integrated into existing norms and ways of working. This can be attributed to the fact that water and climate are not seen as high priority issues by many stakeholders, but the OOWV is trying to raise awareness. For OOWV, improving the communication with citizens is a key instrument for raising awareness, and they see the CATCH pilot as instrumental for reaching this goal. There are non-binding regulations for green roofs in new buildings.
- ***Responsibilities and resources for climate change adaptation***: The OOWV takes over the responsibility of managing heavy rainfalls, although they believe it is a joint problem of all the stakeholders. The lack of a regional authority between the municipal and ministerial level is seen as a problem, as the water and climate issues cannot be upscaled at the moment. It is perceived that financial resources are allocated to climate change, only when there is crisis or catastrophe. In this respect, the need for being more proactive for adapting to climate change is expressed, e.g., through improving the digitalization of the climate data.
- ***Existing decision support tools for water management or climate change adaptation***: There is no specific decision support tool. From the experience about the design of the CATCH pilot project, it seems that the decisions are made according to perceived urgency and reduce potential damage. There are risk maps, which have been prepared as part of the requirements of the EU directives. However, sharing those maps with the lay public is seen as controversial as it can create misinterpretations and cause loss of property value.

- ***Monitoring and evaluation of projects on climate change adaptation***: Specific needs are expressed in terms of assessing and visualising the climate change impacts at the city level, such as heat island effect, on vulnerable target groups.

Vejle

- ***Stakeholder involvement***: The municipality is the main actor that leads the process, while the wastewater company, the housing company, and knowledge institutions, such as Aalborg University and DHI, are also involved. Housing associations also enable direct representation for citizens through the principle of 'tenants democracy', which allows all the citizens to vote for proposed solutions, and use their veto power. The representation of environmental interests is seen as lower than ideal, as the environmental NGOs are not strong and the current government is relatively farmer-friendly, thus focusing on economic interests.
- ***Perceptions about climate change adaptation problems***: There is a common understanding that urgent actions are needed to alleviate the impacts of heavy rainfalls, such as flooding of basements, and that these actions require joint investments both from the governmental organizations (mainly the municipality and the wastewater company) and from citizens. The ongoing projects on the decoupling of wastewater and rainwater are typical examples of this. The cloudbursts in 2011 and 2013 created an increasing attention to climate change problems, and some of the actions being taken are attributed to these 'shock' events.
- ***Climate change adaptation goals and strategies***: There is a climate change plan which covers the period until 2030 and is revised every four years based on the progress made. For the next revision, the municipality should make a planning regarding the flooding from the fjord. Vejle is also a member of the "100 Resilient Cities" global platform, in which climate resilience is seen as the strongest theme.
- ***Responsibilities and resources for climate change adaptation***: The wastewater company is responsible for the maintenance and renovation of the sewage system, while the citizens are responsible for the infrastructure at their private property, and the municipality (owner of the sewage pipes and pumps) and the housing company (owner of housing projects) also contributes with funds. According to several respondents from the municipality, the local and regional level has been losing power and financial resources, and the communication with the national level has become increasingly difficult. This encourages the small cities to implement smaller projects, and also to collaborate more with each other, whereas the big cities (Copenhagen, Aarhus and Odensee) compete for large funds. Overall some stakeholders perceive that the responsibilities are not fully clear in terms of who has the final say in the decision make regarding climate change.
- ***Existing decision support tools for water management or climate change adaptation***: The municipality has separate risk plans for heavy rainfall, flooding and combined events.
- ***Monitoring and evaluation of projects on climate change adaptation***: Although there is interest in evaluating the projects implemented, there are no specific indicators or tools for monitoring and evaluation of projects.

Zwolle

- ***Stakeholder involvement***: Municipality is in the lead of climate change adaptation actions in the city, whereas the province, the regional water authority (WDO Delta) and housing companies are also involved in the planning, funding and implementation of actions towards climate change adaptation. The municipality has a core team on climate and a working team with staff members from different departments that have tasks related to climate change adaptation. The involvement of private sector, such as gardeners and insurance companies, is lacking.
- ***Perceptions about climate change adaptation problems***: Water nuisance is seen as the key issue that is to be dealt with regarding climate change, while heatstress and water safety are also gaining increasing attention. While climate change adaptation is seen as a priority issue, most of the actions taken are linked to other objectives and themes, such as energy transition (e.g. combination of green roofs with solar panels), community building or making the city more liveable. This is also aligned with the perspective of several respondents that refer to the need for multidisciplinary projects or teams, since some departments are not aware of the climate change problem.
- ***Climate change adaptation goals and strategies***: Zwolle has the ambition to become a frontrunner city in climate change adaptation, and to be recognized as a 'resilience delta city' at the national and international levels. The secondary ambition is to also create economic value from this challenge through innovations and concrete business cases, which is seen as already happening with energy transition. The ongoing programme 'Climate Campus' entrails several measures towards this direction, such as awareness raising campaigns, introducing 'climate coaches', new financing models, and new expertise for the municipality staff.
- ***Responsibilities and resources for climate change adaptation***: The measures to make the city 'water proof' are seen as a public task, whereas there is an ongoing debate on the role of house owners (both individuals and companies), especially in terms of insurance and investing in making houses 'water proof'. According to the municipality, the division of responsibility between the municipalities and the water authorities should be clearer in time. Respondents from the municipality also address the need for greater flexibly in terms of responsibilities, so that not everything is strictly controlled, and the stakeholders can experiment with new governance and financing models.
- ***Existing decision support tools for water management or climate change adaptation***: The financial damage of flooding from the river is calculated, which can be taken into account for decisions on flood protection. The municipality commissioned consulting companies (Witteveen en Bos and Tauw), to investigate urban heatstress, water, energy transition. The results were used to initiate discussions on climate change. However, no decision-support tool was developed.
- ***Monitoring and evaluation of projects on climate change adaptation***: There are not specific indicators or tools used for monitoring and evaluation of projects. Several respondents refer to the need for quantifying and valuing the social benefits and networks, which are seen as a strength of the city.

5.2 Needs Assessment Results per Topic

Based on the six topics covered for each city, the overall needs of the partner cities' that should be addressed regarding climate change adaptation are summarized below.

Stakeholder involvement

- In every city, various stakeholders with diverse interests are involved in urban water management and climate change adaptation.
- The involvement of the private sector (e.g., insurance companies and housing corporations) is seen as lower than expected.
- There is limited formalization and customization of participatory tools according to the needs and expectations of different type of stakeholders.

Perceptions about climate change adaptation problems

- Climate change is often not seen as a priority. Nevertheless, in several cities (e.g., Arvika, Enschede and Oldenburg) major floods that occurred in the past few decades triggered action on measures towards climate change adaptation.
- Based on the historical context, floods are perceived as the main climate problem, often linked to heavy rainfalls, whereas heatstress and drought is becoming an issue, especially after the relatively warmer summer of 2018.

Climate change adaptation goals and strategies

- None of the CATCH partner cities have a climate change adaptation strategy, nor clear goals about climate change adaptation. Cities that are relatively advanced in this regard are Vejle, where climate change is part of the city's resilience programme, and Zwolle, where a climate change strategy is under preparation.
- Experimentation with several instruments, such as green roofs in Oldenburg, Enschede and Zwolle, is taking place. However, there is no oversight yet, on what works and what doesn't.

Responsibilities and resources for climate change adaptation

- Climate change is seen as a problem in the public domain, pushing the responsibilities to the local governmental authorities. Exception is the case of Norwich, where there is a private insurance system that makes the citizens responsible to take their own measures and to cover the damages.
- Due to the comprehensive stakeholder network, all responsibilities are allocated to one or more stakeholders, and the distribution is seen as clear and acceptable. However, it seems difficult for some cities to create a change in the distribution of tasks, which they see should be more on the shoulders of the municipality, as it is the case in most of the CATCH partner cities.
- Due to funding and personnel constraints, climate change adaptation is often part of larger water-related projects, and initiatives remain ad-hoc or at pilot level. Here, the two exceptions are Zwolle and Vejle. In Zwolle, there is a dedicated team, with members from different climate-related sectors and organizational departments, and a dedicated budget for climate change, and in Vejle climate change is part of the city's resilience programme.

- Cities are often dependent on higher-level stakeholders of urban water management and climate change adaptation. At the same time, the CATCH partners differ in terms of their role regarding climate change adaptation in their cities. Three partners are municipalities and thus the key local authority in their city (i.e., Enschede, Zwolle and Vejle). Two partners are local or regional authorities that are responsible for climate change adaptation in the respective cities (i.e., Norwich and Herentals). Finally, two partners are local authorities, and depend on other stakeholders, including the municipality, for their climate change adaptation actions and decisions in the pilot cities (i.e., Oldenburg and Arvika).

Existing decision support tools for water management or climate change adaptation

- Data and knowledge are scattered among various organizations. However, this is not necessarily a problem, as long as mechanisms for sharing data and knowledge exist.
- In several cities (e.g. Oldenburg), there are concerns about how to share risk-related information with public, e.g., the flood risk maps.

Monitoring and evaluation of projects on climate change adaptation

- Limited monitoring and evaluation of project results and impacts takes place. This is usually not a requirement, but the common need is expressed in terms of using clear criteria to monitor and evaluate projects.
- It is difficult for the cities to value/quantify the economic, social and environmental benefits of investments made for climate change adaptation.

6. Conclusions and the Way Forward

Here we briefly synthesize the key results and lessons from the self-assessment and needs assessment processes. Then we end with an outlook of the use of these results and lessons in the other work packages of the CATCH project.

The overall self-assessment results indicate a strong current status in all three pillars of the WSC framework. However, the scores are relatively lower for the pillar “cities as ecosystem services providers” as compared to the other two pillars. This indicates a common need of the cities to identify and value the different social, environmental and economic benefits of climate change adaptation measures. As for the pillar “cities as communities and networks”, again a common need is observed in terms of mainstreaming climate change adaptation. While the cities scored on average the highest for the pillar “cities as water catchments”, this pillar also has the largest range of the scores that the partner cities gave. Such a large range indicates the differences between the cities in terms of the management of data and infrastructure.

The needs assessment results highlight several issues, some of which are common, and some are differing among the cities. On the one hand, similarities are observed in terms of the high number of stakeholders involved in climate change adaptation, which calls for effective participation mechanisms, the lack of clear criteria to monitor and evaluate projects, and the difficulty of valuing the benefits of investments. These similarities are consistent with the results of the self-assessment with respect to the areas that the cities can improve themselves regarding the three pillars of the WSC framework. On the other hand, for some of the identified needs, the cities (and sometimes the partners which represent them in the CATCH project) have different needs. For instance, it is clear that similar to other mid-size cities, the cities involved in the CATCH project share the common feature of being dependent on high-level stakeholders. However, the CATCH partners differ in terms of their authority for making decisions at the city level. The partner cities also differ in terms of the priority given to climate change as a problem or a strategic issue. While Zwolle and Vejle have relatively advanced positions in this regard, the other cities have a clear need for awareness raising and strategizing about climate change.

The results of the self-assessment will be transferred to WP4 through visualizing the positioning of the cities on the UWT framework in CATCH dashboard. Similarly, the different needs and experiences of the partner cities will be taken into account, when determining the feedback and recommendations within the elements of the navigation tool.

References

Bressers, H., de Boer, C., Kuks, S., Özerol, G., Vinke-De Kruijf, J. (2013). Water Governance Assessment Tool - Summary. CSTM Studies and Reports nr. 368, Enschede: University of Twente.

Bressers H., Bressers N., Kuks S., Larrue C. (2016). The Governance Assessment Tool and Its Use. In: Bressers H., Bressers N., Larrue C. (eds) Governance for Drought Resilience. Springer, Cham.

Brown, R., Rogers, B., Werbeloff, L. (2016). Moving toward Water Sensitive Cities: A guidance manual for strategists and policy makers. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

Chesterfield, C., Rogers, B.C., Beck, L., Brown, R.R., Dunn, G., de Haan, F., ... & Wong, T. (2016). A Water Sensitive Cities Index to support transitions to more liveable, sustainable, resilient and productive cities. *Proceedings for Singapore International Water Week, Singapore*, 11-14 July 2016.

Dolman, N. J., Lijzenga, S., Özerol, G., Bressers, H., Böge, M., & Bormann, H. (2018). Applying the Water Sensitive City framework for climate adaptation in the North Sea Region: First impressions from the CATCH project. *Proceedings of the Singapore International Water Week*, 8-12 July 2018.

Gunn, A. W., Werbeloff, L., Chesterfield, C., Hammer, K., Rogers, B.C. (2017). Benchmarking, Envisioning and Transition Planning for a Water Sensitive Adelaide: Final Case Report. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

Kunzmann, K.R. (2009). Medium-sized Towns. Strategic Planning and Creative Governance in the South Baltic Arc.

Lloyd, S., Roberts, S., Beck, L. (2016). Water Sensitive Cities Benchmarking and Assessment: Moonee Valley City Council Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.

Wong, T.H.F., Brown, R.R. (2009). The water sensitive city: principles for practice. *Water Science and Technology*, *60*(3), 673-682.

List of Appendices

The appendices of the report are as follows and they are provided as separate documents:

Appendix 1. Self-assessment Guidelines

Appendix 2. Self-assessment Scoring Scheme

Appendix 3. Partner Visit Guidelines

Appendix 4. Partner Visit Interview Guide