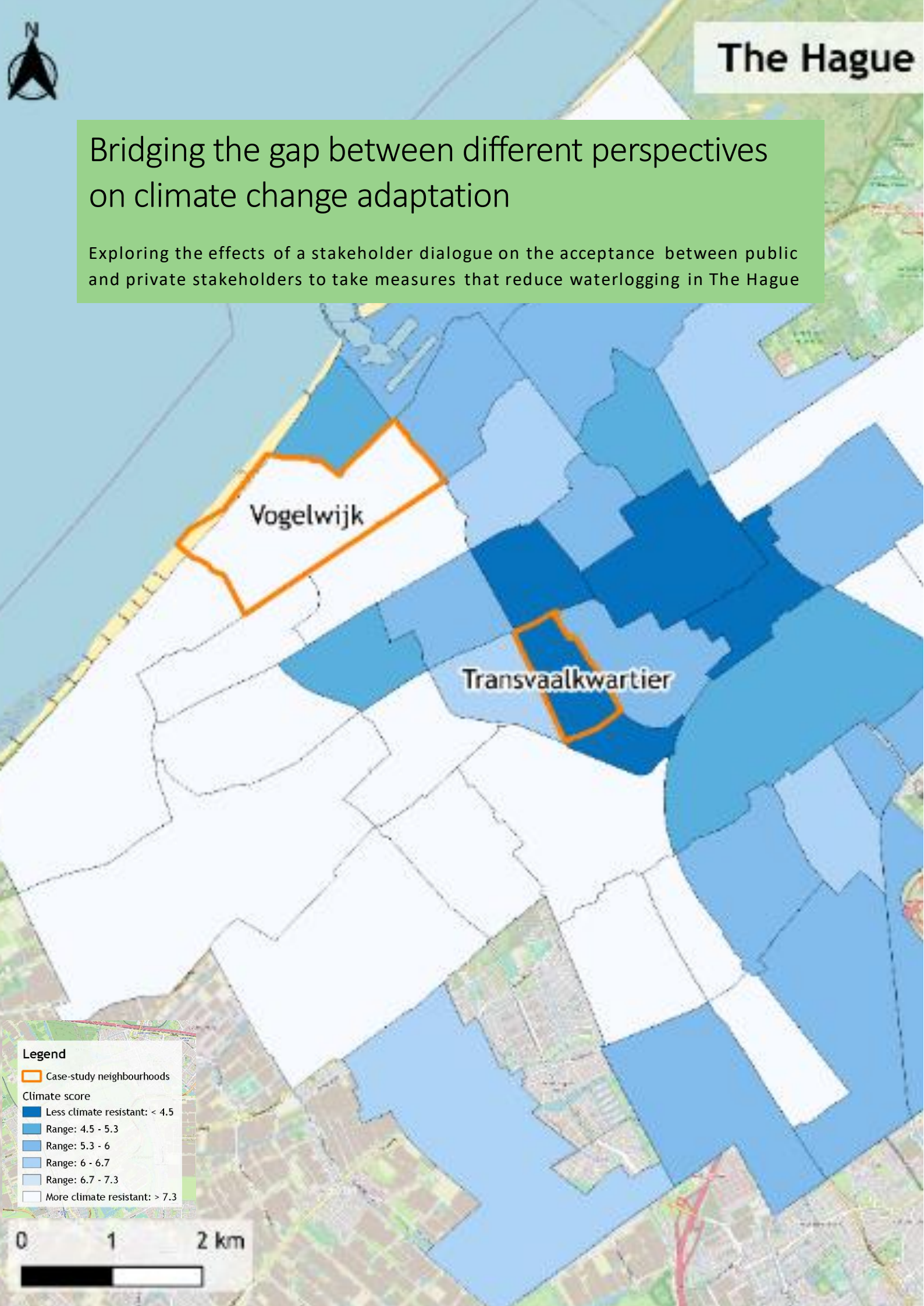
Bridging the gap between different perspectives on climate change adaptation

Exploring the effects of a stakeholder dialogue on the acceptance between public and private stakeholders to take measures that reduce waterlogging in The Hague



Cover image: The Hague Climate Atlas: Climate Proof score (Municipality The Hague, n.d.-c)

Bridging the gap between different perspectives on climate change adaptation

Exploring the effects of a stakeholder dialogue on the acceptance between public and private stakeholders to take measures that reduce waterlogging in The Hague

Master thesis submitted to Leiden University and Delft University of Technology in partial fulfilment of the requirements for the degree of

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Tessa Baart

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First supervisor	Dr. F.L. (Fransje) Hooimeijer: Architecture and the Built Environment, Urbanism
Second supervisor	Dr. ir. F.H.M. (Frans) van de Ven: Civil Engineering and Geoscience, Water Management
External supervisor	A. Hagen, Municipality of The Hague

Leiden University, Faculty of Science, s2137291
Delft University of Technology, Faculty of Technology, Policy and Management, 4903927

Universiteit Leiden TU Delft The Hague

Preface

In front of you lies my thesis, which marks the end of an era. I realise that I could not have reached this point without the help of many people.

I would like to give a special thanks to Fransje and Frans, whom from the start of this project made me feel comfortable and gave me the confidence to continue throughout. I am thankful for the feeling that I could always ask for support. During our meetings, we had the help of Arthur, whom I would like to give special thanks to for supporting me with his knowledge and experience around the urban water system.

This thesis is could not have been written without the help of many participants. You made this thesis very valuable and made it possible for me to interact during this otherwise isolated journey.

I also benefited from the support of my friends, thank you for listening to my endless complaints of *thesis life*. Especially during these COVID-times, I am grateful for my wonderful roommates Flo, Jaime, and Ies. Your little surprises, kind words and constructive feedback made my 'office days' a lot more enjoyable. I was also very lucky with the warm welcome the IE community offered, I have fond memories of the time we all spend together.

Eva, my thesis buddy, I am grateful that we got to share this ride. Even though we mostly met online, I have the feeling I saw you every day. Rens, my boyfriend and personal comedian, you made me smile throughout the entire process, zelfs wanneer het huilen me nader stond dan het lachen.

Last but definitely not least, mam & pap! Ik ben echt ontzettend dankbaar voor jullie steun en vertrouwen in mij. Jullie houden me met beide benen op de grond en hebben me geholpen om door te zetten in moeilijke tijden. Ik hou van jullie.

I hope you enjoy the read.

Tessa Baart
The Hague, January 2021

Summary

Climate change is affecting the urban environment in the Netherlands, which increases the risks of droughts, floods, waterlogging, and heatwaves. Due to these extreme weather events and urbanisation, the cities we build many years ago are not resilient to climate change in the long run. Adapting to these extremes to achieve a climate-proof and water robust urban environment, is climate change adaptation. This research focuses solely on waterlogging. Depending on local circumstances, the urban environment can be vulnerable to waterlogging due to heavy rainfall and/or excessive groundwater levels.

In the past, a central approach of governance was applied, with governmental bodies taking the sole responsibility for water management. This approach was suitable, for example, to lower the risk of coastal flooding, as this required a national plan to build dikes along the coast of the Netherlands. However, climate adaptation requires a more local approach, as the effects of climate change can differ per neighbourhood. Municipalities and water authorities are key players in taking measures in the public space. However, these local governments cannot carry the sole responsibility to adapt the urban areas on their own as the majority of the urban environment is owned by private stakeholders.

As a result, public and private stakeholders will have to collaborate and agree on their roles and responsibilities to reduce waterlogging. Yet, this is not always the case, as a gap has been found between the prescribed and perceived responsibilities of private stakeholders. Municipalities and water authorities are stimulating and expecting private stakeholders to take climate change adaptation measures. However, besides increasing the perceived responsibility of the private stakeholders, public stakeholders can accept that there is a limit to the roles and responsibilities private stakeholders are willing to accept. This research is applied to two neighbourhoods of The Hague and addresses the following research question:

How can the acceptance between public and private stakeholders on taking climate adaptation measures to reduce waterlogging on the larger urban scale be increased?

Firstly, desk research is applied to uncover the different local circumstances that affect the waterlogging vulnerability of both neighbourhoods. Hereafter, the potential and needed measures to reduce the risk of waterlogging are assessed. Consequently, the potential influences of these vulnerabilities and measures on the acceptance of climate change adaptation measures are discussed.

Secondly, a stakeholder analysis is applied to describe the interest and power of the main public and private stakeholders to reduce waterlogging. The municipality and water authority are key players, as they have a high interest and power to influence the spatial planning on the larger urban scale. Owners have a high power to adapt their property (or not) and a blocking power to influence the public space when they are not satisfied. Tenants have the least power to influence spatial planning. Both private owners and tenants have a far more local interest in spatial planning. It differs per neighbourhood what type of homeowners and tenants influence the urban environment.

Thirdly, the Q methodology is applied to find out what the different perspectives of public and private stakeholders are on taking measures to reduce waterlogging. Three perspectives are found: 1) **Together we adapt**, 2) **The government should act now**, and 3) **All In(volved)**. For *Together we adapt* and *All in(volved)* a sense of unity is important and there is a sense of shared responsibility to adapt. For *The government should act now* the current set of laws and regulation are leading, resulting in a perceived responsibility for the government. Lastly, there is a difference in perspective of whether it is important to use regulation to stimulate owners to take measures: *Together we adapt* perceives this as a bad idea, *All in(volved)* is very enthusiastic, and *The government should act now* is neutral. Consensus was found on the following topics: 1) subsidy is a good way to stimulate owners to take measures, 2) the municipality should financially support local initiatives, 3) taking preventative measures has benefits, 4) it is a primary task of housing corporations to take measures to reduce waterlogging, and 5) it is not expected that damage of waterlogging is covered by insurance.

Fourthly, a combination of the constructive conflict methodology and the risk dialogue is applied. In a risk dialogue the waterlogging vulnerabilities, acceptability of the risks, and potential measures are discussed. Based on the perspectives a diverse selection of public and private stakeholders is invited to participate. After the dialogue, the Q methodology is applied again to evaluate whether the participants changed perspective. Also, a control group is formed to make sure the stakeholders did not just change perspective over time. No drastic changes were found in what the dialogue participants found most important and why. *The government should act now* did not increase in perceived responsibility in response to the sense of unity. In addition, *Together we adapt* and *All in(volved)* did not come closer regarding whether to use regulation to enforce change. The control group even had some more drastic shifts compared to the dialogue group.

In conclusion, this research did not bring different perspectives closer together. This entails that public stakeholders would have to limit their expectations to change a perspective using the risk dialogue. However, in the control group, some more drastic changes were found, which means that the perspectives are not static over time. And there is still the opportunity for public stakeholders to influence perspectives. For example, the method applied during this research can be used to filter what the involved participants most disagree and most agree before the dialogue, including their argumentation. Having this knowledge can help the municipality to prepare their argumentation, which they can use during the dialogue. Now argumentation was used that did not appeal to the participants, for example, arguments linked to the sense of unity to a stakeholder will not convince a stakeholder that is more focused on the current laws and regulation. This method can also be applied when there are differences within the municipality between departments, for example, urban planners and water managers

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1. Introduction

This chapter introduces the problem and determines the scope of this research. Consequently, the knowledge gap that leads to the research questions is determined. Subsequently, the objectives and societal relevance of the research is discussed. Lastly, a structural overview of the report is presented.

1.1. The effects of climate change in the Netherlands

The climate on Earth is changing due to human activities (IPCC, 2014). The rise of anthropogenic greenhouse gases in the atmosphere has led to the observed warming of the atmosphere (IPCC, 2014). The global average temperature has increased by circa 1° Celsius from 1907 till 2019 (Kennisportaal Ruimtelijke Adaptatie, n.d.-b). In the same period, the average temperature in the Netherlands has increased by 2.1° (KNMI, n.d.-a). It is due to the rising temperature that extreme weather events will occur more often. In the summer, we will experience more heatwaves in the Netherlands and the intensity of the extreme precipitation is increasing. The winters will be warmer, the amount of precipitation and the frequency of extreme precipitation will increase. Furthermore, hail and thunderstorms will intensify. Also important for the Netherlands is that the sea level will keep on rising and that the rate at which this happens is increasing. Climate change thus increases the risk of drought, heat, waterlogging, and flooding.

These extreme conditions affect the urban environment. The sea-level rise can challenge the liveability of the once viable locations for cities. Heatwaves result in heat stress since paved areas do not offer cooling. Droughts can lead to land subsidence, which can damage the foundations of buildings. Depending on the source, climate change can also stress the water supply and potentially lead to water scarcity. More heavy precipitation events can lead to pluvial flooding and an increase in groundwater levels (Brockhoff et al., 2019).

The effects of climate change can also be expressed in monetary terms to increase the feeling of urgency. The Dutch Association of Insurers (Verbond van Verzekeraars) is noticing the increase of damage reports. For instance, extreme weather on the 23rd of June in 2016 caused 600 million euros of insured damage (Kennisportaal Ruimtelijke Adaptatie, 2020b). In the future, when risks are becoming too big or too uncertain, it will become more difficult to insure properties, buildings, and cars in the urban environment.

1.2. Climate change adaptation in the Netherlands

Although it is of utmost importance to prevent or reduce the anthropogenic greenhouse gas emissions that have initiated this climate change in the first place, it is also vital to adapt to the already rapidly changing climate. Reducing anthropogenic greenhouse gas emissions is called climate change mitigation. On the contrary, there is climate change adaptation: “the process of adjustment to actual or expected climate and its effects, a gradual process of long-term adaptation to irreversible climate change” (IPCC, 2014, p. 1758). Climate change forces us to change the way we think about spatial (re)developments.

The Delta Plan on Spatial Adaptation

Similar to the time in which we needed to build dikes in the Netherlands to reduce the threat of coastal flooding, a Delta Plan is being developed (Deltacommisaris, 2018b). The aim of the Delta Plan on Spatial Adaptation (Deltaplan Ruimtelijke Adaptatie - DPRA) is a water robust and climate-proof country by 2050. The plan describes how municipalities, water authorities, provinces, and the government want to accelerate and intensify the process of spatial adaptation. To achieve this goal seven ambitions have been formulated (Figure 1). The municipalities will be in charge of mapping the vulnerabilities of their environment to climate change, because even though The Netherlands is small compared to other countries; the effects of climate change will vary regionally. Hence, there is a decentralised approach.

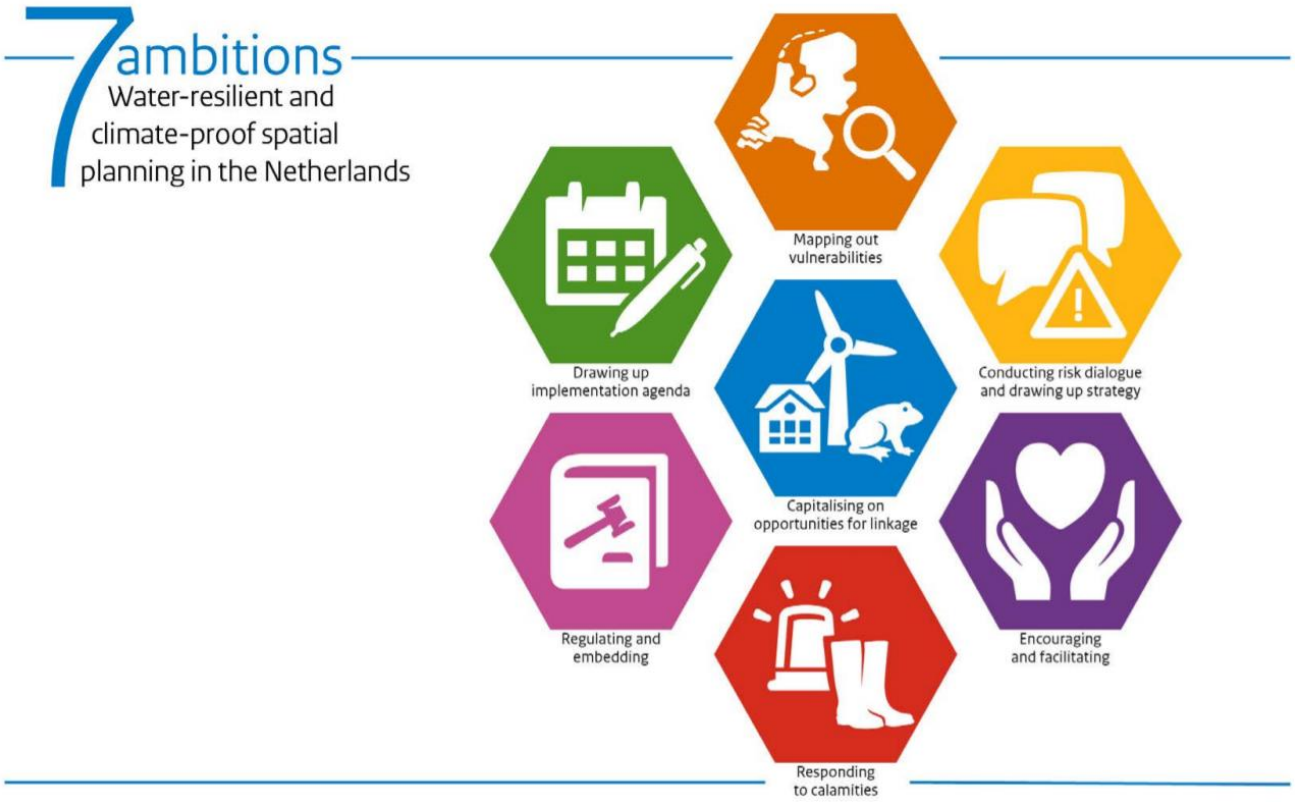


Figure 1. The seven ambitions of the Delta Plan on Spatial Adaptation (Deltacommisaris, 2018a)

1.3. Scope definition

Climate change adaptation is a very complex issue, the scope needs to be scaled down in order for the research to remain feasible.

Urban environment

This research focusses on the adaptation of the urban environment. Even though the urban environment does not cover a large fraction of the world's land surface, it is home to about half of the total population and this number it is predicted to increase (Ritchie & Roser, 2020; United Nations, 2018). Another reason to adapt our urban environment to more extreme weather is the increased vulnerability. Namely, the monetary value that is to be protected nowadays has drastically increased over the past decade, if we would like the *risk* to remain the same, we have to reduce the probability of exposure to an extreme event – and hence the risk of failure.

The Hague: climate-proof city

The scope of the research is narrowed down to the city of The Hague. Making the city more climate-proof is one of the four priorities of the Sustainable Agenda 2015-2020 of The Hague (Municipality The Hague, 2015a). In 2012 the municipality of The Hague published an implementation plan (Municipality The Hague, 2012). Three strategies to combat the effects of climate change in The Hague are mentioned in this plan: (1) to create more space for water and green, (2) to provide information about the negative effects of hardening in the gardens, and (3) communication. Later on, the action program Climate-proof city 2015/2016 was published by the Municipality (Municipality The Hague, 2016). Here, it is stated that there will be no separate policy, but instead, *climate-proof thinking* is incorporated in the acting and thinking of all parties that are involved with (re)design of the city. It is also mentioned that making the city climate-proof is the responsibility of many parties, namely: the municipality, other governmental bodies, businesses, and residents.

DPRA theme waterlogging

Four issues are addressed in the DPRA: drought, heat, urban flooding, and waterlogging (Deltacommisaris, 2018b). This master thesis focuses solely on waterlogging (Dutch: wateroverlast) in the urban environment. There are three types of waterlogging: (1) waterlogging caused by short and severe precipitation, (2) waterlogging caused by prolonged precipitation, and (3) excessive groundwater levels (**Appendix I**: *Waterlogging*). In the Delfland regions, there are many houses, buildings, streets, squares, and gardens are full of tiles, preventing infiltration. Rainwater from these paved areas is drained via the sewage system. However, the sewage system cannot drain all the rainwater during extreme downpours, and this sometimes creates floods and overflow problems after rain showers. There can also be waterlogging underneath houses, caused by excessive groundwater levels. This can be due to increased precipitation, however in urban areas also human interference can cause an increase in the groundwater level for example when installing a new sewage system.

Public and private property

Both the public and private space within the urban environment is considered. On the one hand, municipalities oversee the spatial planning of the local urban environment and it is their public task to implement measures for climate change adaption in the public space. This planning system regulates the public and private surface. Specifically, it organises the interdependency between public and private stakeholders to realise liveable cities (Trell & van Geet, 2019). On the other hand, since residents and businesses are in control of the majority of the ground in urban environments, they need to act as well. In the spatial planning process, it is important that private parties also participate to successfully realise climate-resilient cities (Uittenbroek et al., 2019). They can take measures concerning gardens, roofs, school squares, and industrial sites.

Risk dialogue

This thesis focuses on the second ambition of the Delta Plan on Spatial Adaptation: the risk dialogue (Deltacommisaris, 2018b). The first ambition is mapping the vulnerabilities with stress tests, and the third ambition is to draw up implementation agendas (Kennisportaal Ruimtelijke Adaptatie, n.d.-a). The aim of the risk dialogue to raise awareness of the vulnerabilities (determined by the stress tests) and to discuss measures that can limit damage and nuisance from climate change.

During the risk dialogue, waterlogging situations are discussed that are more likely to occur in future, the current norms for these situations should be either revaluated or created. The participants (government, residents, companies) classify climate risks as acceptable, undesirable, or unacceptable. Also, the urgency of risks is discussed. The risk dialogues provide input for a climate adaptation strategy and an implementation agenda and thus, have to be conducted in 2020.

1.4. Knowledge gap

New roles & responsibilities to reduce waterlogging

In the past, a central approach of governance was applied, with governmental bodies taking the sole responsibility for water management. However, the challenges we are facing nowadays such as climate change and urbanisation require a more local approach. Therefore, there has been a change in governance and more responsibilities are given to municipalities and water authorities. The local governments are now taking measures in the public space to reduce the risk of waterlogging. However, the local governments cannot carry the responsibility to adapt the urban areas on their own since the majority of the urban environment is owned by private stakeholders. Therefore, the municipalities and water authorities are stimulating and expecting private stakeholders to take climate change adaptation measures. This decentralisation introduces new roles and responsibilities to reduce waterlogging. The following paragraph addresses how these new roles and responsibilities are perceived by private stakeholders.

The acceptance of the roles & responsibilities by private stakeholders

As mentioned above, governments perceive a shared role and responsibility between public and private stakeholders to reduce waterlogging. For example, national-level policy documents about climate adaptation mention the individual responsibility as a pivotal strategy to cope with climate change impacts (Deltacommisaris, 2018b). However, research shows that among private stakeholders, there is little awareness when it comes to the responsibility to help process rainwater (Brink & Wamsler, 2018). In the Netherlands, citizens feel that the municipality and water authority are responsible for flood risk management and they have a high level of trust that they will *fix the problem*. There seems to be a gap between the prescribed and perceived responsibilities of a key stakeholder group (Brink & Wamsler, 2018). In previous studies, an association between the awareness of legal responsibilities and implementing measures to protect against waterlogging is found (Trell & van Geet, 2019). However, only focussing on the legal rules and regulations will not be sufficient to motivate residents to take measures for climate adaptation (Trell & van Geet, 2019; Wamsler et al., 2019). The risk dialogue proposed by the DPRA is seen as an opportunity to increase the acceptance of the new role and responsibility by private stakeholders to realise a climate-proof city.

Increasing the acceptance between public and private stakeholders

The aim of a dialogue about a complex problem, such as reducing waterlogging in the urban environment, is to enhance learning, which is not always easy. Up until now, only the acceptance of the private stakeholders of their roles and responsibilities is addressed. However, also the public stakeholders can learn during the dialogue and increase their acceptance of the roles and responsibilities private stakeholders are willing to accept. This can prevent the decentralisation to lead to roles and responsibilities for the private stakeholders they cannot handle.

1.5. Research questions

This study aims to have fruitful dialogue between public and private stakeholders: a dialogue that leads to an increase in the acceptance between public and private stakeholders of the perceived roles and responsibilities to take climate change adaptation measures. In particular, the acceptance of measures meant to reduce waterlogging on the larger urban scale. This research will address the knowledge gap with the following research question:

How can the acceptance between public and private stakeholders on taking climate adaptation measures to reduce waterlogging on the larger urban scale be increased?

In order to answer the main research question, the following four sub-research questions have been formulated:

1. *What is the influence of potential vulnerabilities to and measures against waterlogging on the larger urban scale on the acceptance of climate change adaptation?*
2. *What are the interests and power of the main public and private stakeholders to influence the urban environment on the larger urban scale to reduce waterlogging?*
3. *What are the main perspectives of public and private stakeholders on taking measures to reduce waterlogging in the urban environment on the larger urban scale?*
4. *What is the influence of the risk dialogue on the relations between stakeholders and acceptance of responsibility to take climate adaptation measures to reduce waterlogging in the urban environment on the larger urban scale?*

1.6. Research objectives

This research aims to provide a better understanding of the relation between the public and private stakeholders in the urban environment to reduce waterlogging. To achieve this objective, the different perspectives of public and private stakeholders about climate change adaptation measures are researched. Are there differences? And if so, how do the perspectives differ from each other? Another aim is to see whether the constructive conflict methodology is suitable to be applied to the risk dialogue design. If so, the effect of the risk dialogue can be analysed.

1.7. Study relevance

To achieve a water robust and climate-proof country by 2050, the public and private space in the urban environment will have to adapt to the effects of climate change. Hence, local governments are looking for ways to stimulate and cooperate with private stakeholders such as housing corporations, homeowners, and tenants. This study is particularly relevant since it aligns with the DPRA. The risk dialogue is applied, which is currently also done by municipalities and water authorities to collaborate with private stakeholders. Furthermore, the objective is to see what the effect is of the risk dialogue on the stakeholders. Does it bring different perspectives closer together? In times where perspectives, on all types of societal challenges, can be very divided this is very relevant.

1.8. Reading guide

In the following chapter, the conceptual framework is presented to explain the key concepts of this research (chapter 2). Consequently, the approach of this research is clarified, including an explanation of the research methods applied to collect the required data (chapter 3). In the following four chapters, the results of the four sub-research questions are discussed (chapter **Error! R eference source not found.**, **Error! Reference source not found.**, 6 and 7). The research will conclude with a discussion and conclusion (chapter 8 and 9).


2

2. Conceptual framework

In answering the research questions, three concepts are used: spatial planning, participation, and COM-B model. Spatial planning is discussed, as taking climate change adaptation measures is part of the planning system in the urban environment. Participation is used in this research to balance conflicting interest of public and private stakeholders. The COM-B model argues that behaviour is a result of Capability, Opportunity, and Motivation. In this research, the model is used to study the likelihood of climate adaptive behaviour.

2.1. Spatial planning of the urban environment

Spatial planning defines the context in which measures are taken to reduce waterlogging on the larger urban scale. Water is an important aspect of spatial planning, for example, the need for a sewage system to discharge wastewater and collect rainwater to avoid flooding. This research considers the planning system in the Netherlands.

The planning system in the Netherlands

The governance of the planning system operates on four scales: local, local-regional, regional, and national (Figure 2). The municipality operates on a local level, the water authority operates between the local and regional level, the province at a regional level and the government at a national level. Every scale has policy, law, regulations and institutions that work together and influence each other, these are the planning conditions (Hooimeijer & Tummers, 2017). The planning system creates planning conditions on four scales for the urban redevelopment process. The urban development process can be divided into two main processes: planning and implementation (Figure 2). The planning process consists of a) the initiative and b) the planning phase, and the implementation process of c) the realisation and d) maintenance phase.

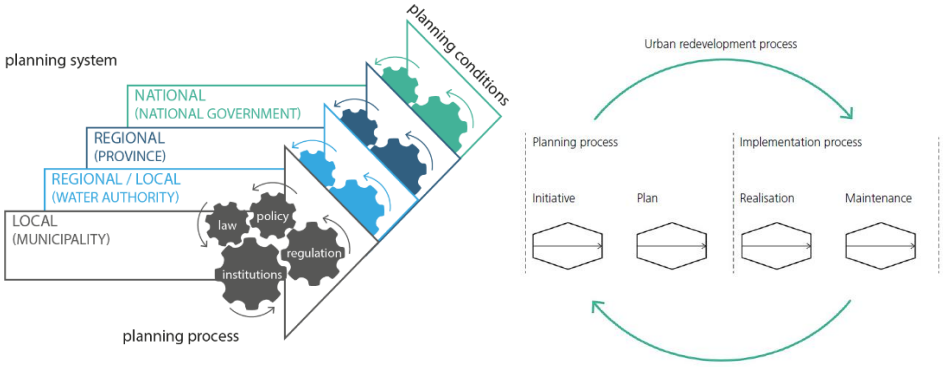


Figure 2. Planning system creates planning conditions on four scales for the urban redevelopment process (Hooimeijer & Tummers, 2017)

History of Dutch water management

In the Netherlands water has always played a very important role, as a large fraction of the Netherlands is below sea level and many large rivers cross the country to find their way to the sea (Rijkswaterstaat, n.d.). The water authorities played a very important role in water management, the first water authority is founded in 1255 (Waterschappen, n.d.). The water authorities were formed because the wet and soft soil conditions required management for agricultural activities to be possible and to avoid coastal flooding (Hooimeijer & Tummers, 2017). The challenges the Netherlands were facing thus required strong governance on a national scale. For example, the central government build dikes along the coast to protect the Netherlands from coastal flooding.

Local effects require a local approach

Currently, the central role of the Dutch government is reconsidered and more responsibilities are entrusted to lower governments and the market (Hooimeijer & Tummers, 2017). This decentralised approach suits the current challenges posed by climate change and urbanisation because the effects of climate change effects can differ per neighbourhood. Climate change adaptation in the urban environment therefore requires local measures. The urban environment consists of public and private space, for the whole city to be climate-adaptive the local governments require the help of private stakeholders.

The provinces and municipalities are being given greater authority for spatial planning since they are in more direct contact with the private parties (Government of the Netherlands, n.d.-g). The aim is to have a 'participatory society', where private parties are engaged with urban development (Hooimeijer & Tummers, 2017). Within the Dutch planning system participation is done regularly and is compulsory by law. For example, to inform private parties about new developments the provinces and municipalities must make their plans publicly available (Government of the Netherlands, n.d.-f). And before provinces and municipalities can make final decisions about spatial developments private parties can submit their ideas and/or to lodge a complaint (Government of the Netherlands, n.d.-c).

Integration spatial planning and urban water management

Besides the decentralisation, there is a process of integration happing within governmental organisations (Hooimeijer & Tummers, 2017). For example, on a national level, the ministries of water and spatial planning are merged, at the provincial level, the departments of soil and spatial planning; and at the municipal level, engineering and urban development departments are coming together (Government of the Netherlands, n.d.-d; Hooimeijer & Tummers, 2017). Also, the municipality of The Hague and water authority Delfland recognised that the water in The Hague is a joint responsibility, hence they joint forces and developed an integrated policy document, the Water Plan, for the urban water management (**Appendix II:** *The Water Plan*).

In addition, the Environment and Planning Act (Dutch: Omgevingswet) is renewed to simplify the current building and environment licenses (Government of the Netherlands, n.d.-g). Instead of having many different laws about the environment, the Act integrates the rules into one legal framework which enables a more integrated approach. One of the instruments of the Act is the 'Omgevingsvisie' (environment vision).

The national government, provinces, water authorities and municipalities each draw up a strategic vision for the long term for the entire physical living environment (Government of the Netherlands, n.d.-a). The environmental vision relates to all areas of the living environment and examines the relationship between space, water, environment, nature, landscape, traffic and transport, infrastructure, and cultural heritage. The integration of water management and urban planning is very important to create a climate-adaptive city.

2.2. Public participation

Balancing conflicting interest is a core task of spatial planning, participation is a tool to have a fair balance. The definition of participation in the scholarly literature is "involvement in knowledge production and/or decision-making of those involved in, affected by, knowledgeable of, or having relevant expertise or experience on the issue at stake" (Van Asselt & Rijkens-Klomp, 2002, p. 168). This section will go more in-depth on why participation is important, what levels of participation there are, how it can be executed, and what the critiques are.

The importance of participation

Climate change adaptation in the urban environment is considered a *wicked problem*, as it is "complex, messy, ill-structured, various societal stakes are involved and there are (scientific) uncertainties" (Cuppen, 2012, p. 23). Being a wicked problem also entails that involved stakeholders can disagree about what the problem is exactly and how to solve the problem. Participation can avoid an overrepresentation of technocratic values when discussing climate change adaptation (Fiorino, 1990). Firstly, the private stakeholders can be more open to social and political values which leads to more integrated decisions, about for example the acceptability of the risks of the waterlogging situation. Next, when applied correctly participation can help to weigh the common interest during spatial planning. Lastly, it is argued by Fiorino (1990) that participation can lead to more legitimate decisions, in the context of this study this can mean that private stakeholders do not receive a responsibility they cannot handle. Thus, it is important to involve private stakeholders with climate adaptation in urban environments to make decisions that work, are democratic and integrated

In theory, participation can lead to an increase of relevance, fairness, the help of local knowledge, and the acceptance of decisions (Brink & Wamsler, 2018; Uittenbroek et al., 2019). However, when participation is applied in practice it is often criticized for being ineffective, inefficient, or unjust power is be exercised and an unfair representation of citizen. For example, when only private stakeholders with enough resources can participate because they have the knowledge and time to make their way through the bureaucratic system. In the literature, it is still questioned how to make participation meaningful for climate adaptation (Brink & Wamsler, 2018; Brockhoff et al., 2019; Burton & Mustelin, 2013; Hegger et al., 2017; Trell & van Geet, 2019; Uittenbroek et al., 2019; Wamsler et al., 2019). Within the municipality, the department spatial planning often takes the lead in dialogues, however, for climate change adaptation the water managers must be closely involved with the dialogue as well.

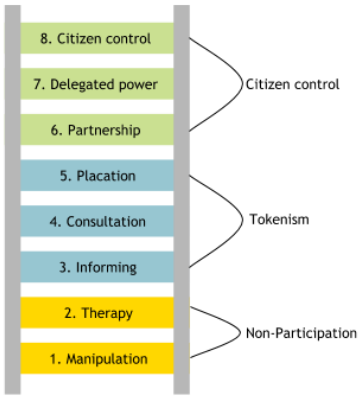
Level of participation

Participation can be operated on many levels of citizen power, Arnstein (1969) created a 'Ladder of Participation' to distinguish between the levels of participation (

Figure 3). It is important to have a clear topology when applying participation, to manage expectations and avoid that the term participation is wrongfully used (Arnstein, 1969). The lowest part of the ladder, manipulation & therapy, is considered nonparticipation. The middle part of the ladder is tokenism and consist of the levels: informing, consultation and placation. Tokenism is when the powerholders still get to decide, but the private stakeholders can hear and be heard. The top of the ladder is referred to as citizen control and consists of the levels: partnership, delegated power,

and citizen control. On these levels, the private stakeholders have the most influence on the decisions.

The risk dialogue of the DPRA is also a form of participation, between the municipality, water authorities, companies, and residents. The risk dialogue appears to be on level 6 (partnership), since the responsibilities of taking measures are shared and it has been jointly determined which damage and nuisance are (un) acceptable.



Level	Description
1	Cure / educate participants
2	Cure / educate participants
3	One-way flow of information and no channel for feedback.
4	Appears attractive, but not yet legitimate participation
5	Citizens advise, power-holders judge the legitimacy/feasibility
6	Planning and decision-making responsibilities are shared
7	Citizens have delegated powers to make decisions
8	Citizens handle the planning and policymaking

Figure 3. The eight levels on the Ladder of Citizen Participation (Arnstein, 1969)

Participation methods

Participatory methods are "methods to structure group processes in which non-experts play an active role to articulate their knowledge, values and preferences" (Van Asselt & Rijkens-Klomp, 2002, p. 168). There are many methods available, for example, focus group, interactive backcasting, a referendum, and brainstorming. The methods differ in who is involved and how the stakeholders are involved (degree of participation) Participation methods can be applied in various phases of the (re)development process discussed in the previous section. Figure 4 visualises how the DPRA relates to the (re)development process. The risk dialogue is conducted in the initiative phase of the plan process. The risk dialogue is input for the climate adaptation strategy, which relates to the plan phase of the plan process. The implementation & investment agenda is the next phase in the DPRA, which relates to the realisation phase of the implementation process. There is no aspect of the DPRA that relates to the maintenance phase of the implementation process.

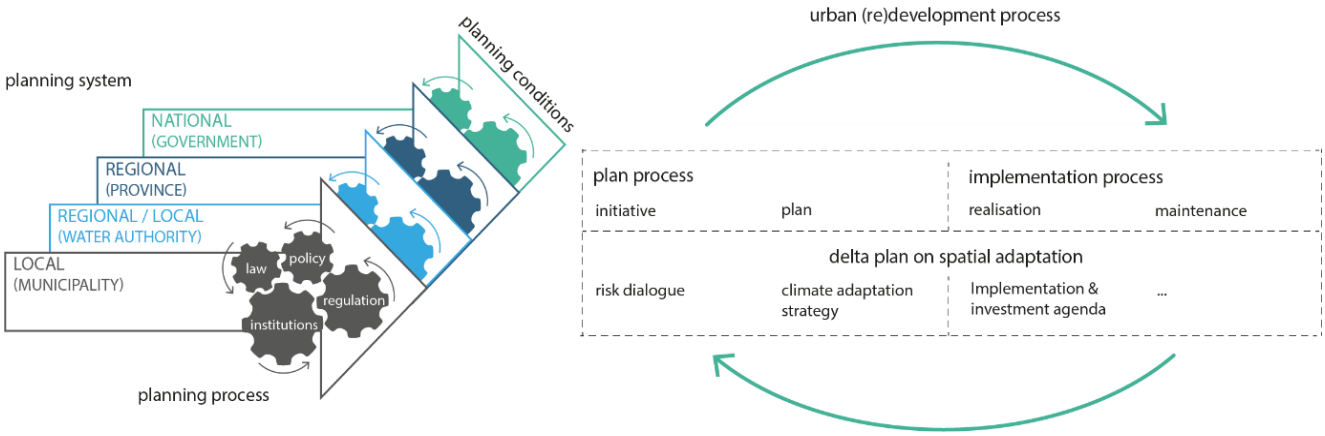


Figure 4. The urban redevelopment process related to the delta plan on spatial adaptation (Hooimeijer & Tummers, 2017)

2.3. Climate-adaptive behaviour

The COM-B model is applied to study the acceptance of taking climate adaptation measures to reduce waterlogging of public and private stakeholders. The COM-B model is used to analyse behaviour, and it argues that the components *capability*, *opportunity*, and *motivation* interact and generate *behaviour*, which in turn influences these components (Figure 5). Capability is divided into physical and psychological capability; motivation in reflective and automatic motivation; opportunity in physical and social opportunity (West & Michie, 2020).

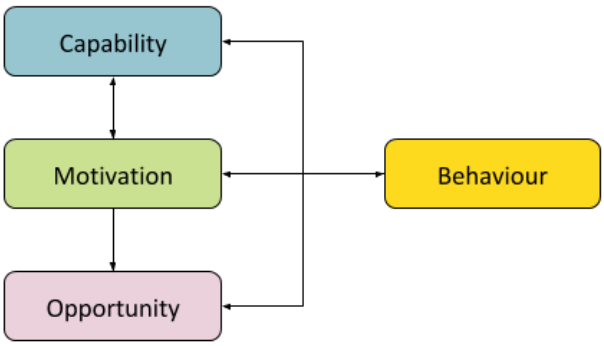


Figure 5. The COM-B model: a framework for understanding behaviour (Michie et al., 2011)

Previous research searched for factors that influence climate-adaptive behaviour and classified the factors according to the COM-B model (Kreemers et al., 2020). Some factors relate to climate-adaptive behaviour in general and some are specifically about taking measures to reduce waterlogging. The capability factors are on a personal level and about whether someone has the necessary knowledge and skills. The opportunity factors are about whether the social and physical environment stimulates or hinders the acceptance. The motivation factors are about conscious and unconscious drives to accept climate change adaptation, beliefs, habits, and resistance play a role. See Table 1 for an overview of the factors and their description.

Table 1. Overview of the COM-B model factors influencing climate adaptive behaviour (Kreemers et al., 2020)

COM-B	Factor	Description
Capability	Physical capability	Physical skills, strength, and endurance.
	Psychological capability	The knowledge or mental skills, strength
Opportunity	Social and cultural norms	National attention for climate change The perceptions of what other people do (the descriptive norm)
	Physical environment	Existing legislation and regulations. Mandating measures and penalties for non-compliance Climate-related stimuli (such as extreme weather conditions)
Motivation	Risk perception	Risk perception
	Negative emotions	For example, fear, concern, and anxiety
	Self-efficacy Outcome-efficacy	Self-efficacy: trust to take measures Outcome-efficacy: trust in the effectiveness of measures to achieve the desired result in removing or reducing the risk
	Perceived responsibility	Personal responsibility to take climate adaptive measures When people have a low self-efficacy concerning the measures, their sense of responsibility can decline.
	Perceived costs	The observed costs: financial costs, time investment or having to sacrifice space or aesthetics.
	Sense of unity	The power of being and acting together.

2.4. Conclusion

The urban environment consists of public and private property, and a key element of spatial planning is balancing conflicting public and private interest. The more bottom-up and integrated approach of urban water management will create shifts in the roles and responsibilities of involved private and public stakeholders. Participation between public and private stakeholders can be used to discuss these new roles and responsibilities. The COM-B can be applied to analyse the individual perspectives on taking climate change adaptation measures and to evaluate whether these perspectives come closer together due to the dialogue (Figure 6).

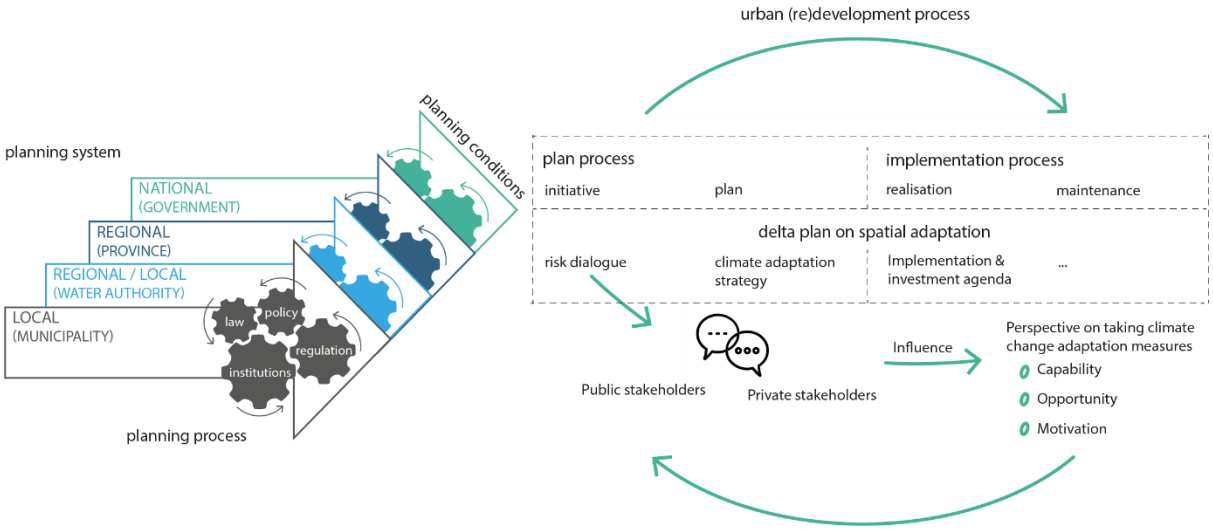


Figure 6. The planning system related to the delta plan on spatial adaptation and the COM-B model (Hooimeijer & Tummers, 2017)


3

3. Research approach & methods

This research applies a case study approach, the design and location The Hague are presented in this chapter. Hereafter, the structure of the research is shortly described, complemented with a research flow diagram. Consequently, it is explained which research methods are applied to gather the data needed to answer the research questions.

3.1. Case study approach

During this research, a case study approach is applied, which is recommended when studying a contemporary phenomenon within a real-world context and there is little control over events (Yin, 1994). In addition, this approach will provide participants for the risk dialogue to ensure an authentic instead of artificial dialogue (Cuppen, 2012). The case study locations are two neighbourhoods of the city The Hague in the Netherlands. A holistic multiple-case design is applied, as it considers two neighbourhoods, and both are researched in a similar way (single-unit of analysis).

The Hague is located on the west coast next to the North Sea, it is the capital of the province of South Holland and the seat of the national government is located here. The Hague is divided into eight districts, which are again divided into 44 neighbourhoods. These neighbourhoods differ extremely, some are the most prosperous and some the poorest neighbourhoods of the Netherlands. When researching climate adaptation measures, different groups of residents should be involved, based on socio-economic characteristics, behaviours and climate change adaptation attitude (Brink & Wamsler, 2018; Brockhoff et al., 2019). It is also interesting to research more than one neighbourhood because water is a network of communicating vessels. This case study focusses on the neighbourhoods Transvaalkwartier and Vogelwijk, one on each side of the extremes (Figure 7). The publicly available information that emphasizes some differences, for example, income, between the neighbourhoods are presented in **Appendix III:** *Case study neighbourhoods*, including a short impression of both neighbourhoods and the aims of the neighbourhood programmes.

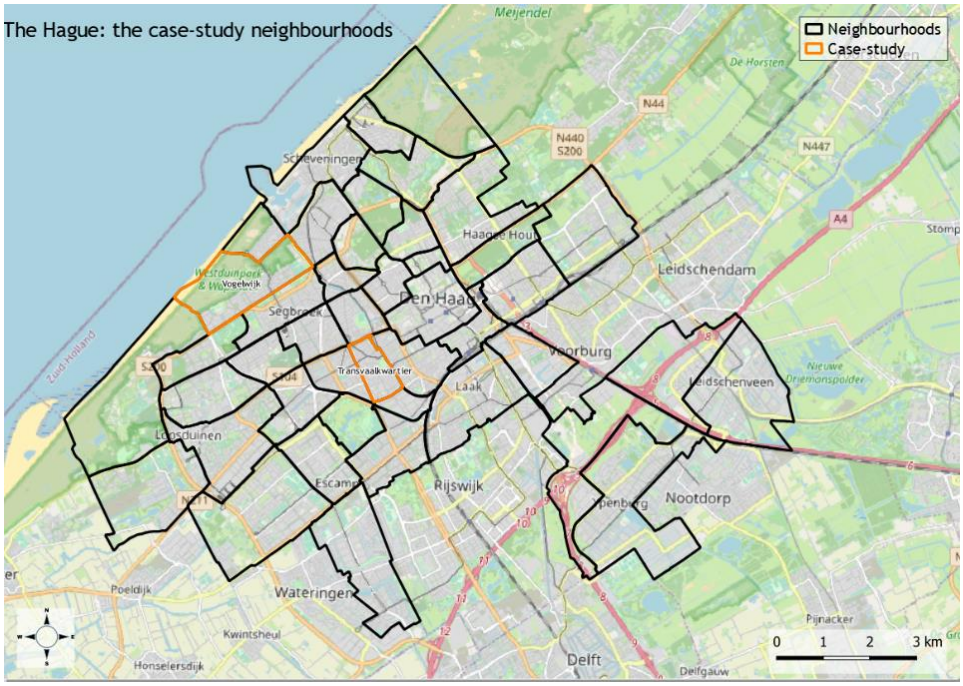


Figure 7. Map of the two case study neighbourhoods in The Hague

3.2. Research flow diagram

The structure and logical process flow of the research design are visualised in a research flow diagram (Figure 8). The research flow diagram is clarified below:

- First, the local circumstances that influence the waterlogging vulnerabilities of the two neighbourhoods are considered. Hereafter, the potential climate adaptation measures to reduce waterlogging are discussed. Lastly, it is assessed what the influence of the potential vulnerabilities and measures are on acceptance of climate change adaptation, using the factors of the previously mentioned COM-B model.

- Secondly, the main public and private stakeholders that have an impact on the climate change adaptation of the two neighbourhoods are identified, including their responsibilities regarding urban water management. Consequently, the relations between the stakeholders are described. Lastly, it is analysed what the interest and power of the stakeholders are to influence the spatial planning of the urban environment.

- Thirdly, it is researched what the different perspectives of the public and private stakeholders are on taking adaptation measures to reduce waterlogging. The perspectives are also linked to the factors of the COM-B model to see which factors are most important for the perspectives.

- Fourthly, a selection of the stakeholders with different perspectives participates in a risk dialogue. The information about the local circumstances, potential vulnerabilities, and measures of the two neighbourhoods assessed above is used as input for the dialogue. After the risk dialogue, it is again researched what the perspectives of the participants are on taking adaption measures in the urban environment. The previously found perspectives serve as a baseline to assess what the effect of the risk dialogue is. There is a control group to make sure the stakeholders did not just change perspective over time.

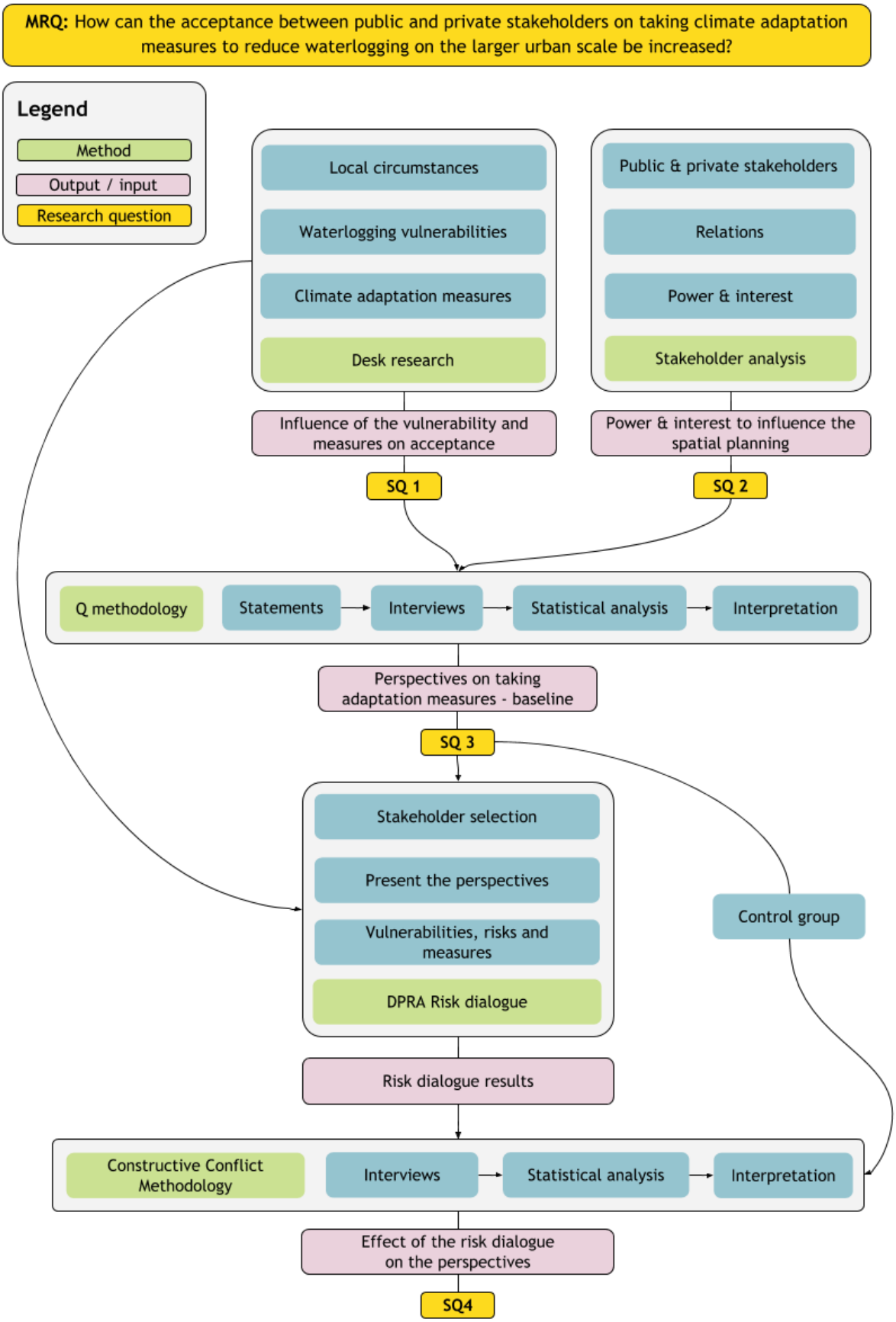


Figure 8. Research Flow Diagram

3.3. Data collection

In this section, it is described per sub-research question which methods are applied to collect the required data.

SQ1: Desk research

What is the influence of potential vulnerabilities to and measures against waterlogging on the larger urban scale on the acceptance of climate change adaptation?

Desk research is applied to assess the following local circumstances of the two neighbourhoods: the neighbourhood typology, type of surface, slope of the terrain, sewage system, soil type, and groundwater levels. Mostly, information published by the municipality of The Hague will is consulted. Following, the *Drainage Depth* and *Waterlogging* stress tests of The Hague, a national map about groundwater nuisance and the *Climate Proof score* map provide information about the waterlogging vulnerabilities (**Appendix IV:** *Waterlogging The Hague*). Lastly, desk research and an interview with the municipality of The Hague will provide information about the potential measures against waterlogging.

SQ2: Stakeholder analysis

What are the interests and power of the main public and private stakeholders to influence the urban environment on the larger urban scale to reduce waterlogging?

The stakeholder analysis method of Enserink (2010) is applied to determine the main public and private stakeholders, their relation, and their interests and power to influence spatial planning. "A stakeholder is a social entity, a person or an organization, able to act on or exert influence on a decision" (Enserink et al., 2010, p. 79). The stakeholder analysis consists of the following five steps (Figure 9):

Figure 9. The four steps of the stakeholder analysis (Enserink et al., 2010)

- For the first step, various actor identification techniques are applied, namely the imperative, position, reputational, social participation, opinion leadership and demographic approach. The conceptual framework provided knowledge about the four levels of public stakeholders involved. In addition, desk research about the neighbourhoods provided information about what type of private property owners and tenants are present.
- In the second step, the hierarchical, formal, and informal relationships between the stakeholders are determined based on the stakeholder information. The relations are visualised in a formal chart.
- In the third step, the interest of the stakeholders to influence spatial planning are determined. The interests of stakeholders are the issues that matter the most, these are relatively stable and do not rely on a concrete situation. This is useful information to see whether the stakeholder supports or opposes the interest of the problem owner.

- In the fourth step, the power of the stakeholders to influence the spatial planning of the neighbourhoods are described. The power of the stakeholders is discussed because it is important to map out the interdependencies between stakeholders. A high level of power is for example having important resources. Resources are the means that a stakeholder has to realise their objectives, for example, information, knowledge (and skills), manpower, money, formal power, position in the network (support from or access to other stakeholders), legitimacy, organization (ability to mobilize and use resources effectively and efficiently), instruments (subsidies) and blocking power.

SQ3: Q methodology

What are the main perspectives of public and private stakeholders on taking measures to reduce waterlogging in the urban environment on the larger urban scale?

The goal of the Q methodology is to find the perspectives of public and private stakeholders on taking climate adaptation measures to reduce waterlogging in the urban environment. The Q methodology is a research method established in 1935 by William Stephenson (Stephenson, 1935). The Q methodology studies the subjectivity of participants, which can be opinions, beliefs, values, tastes, and perspectives (Brown, 1996). The method is a combination of a qualitative and quantitative approach. The qualitative part of the study is conducting interviews. The quantitate aspect is the use of factor analysis of Charles Spearman to analyse the interviews (Watts & Stenner, 2012). When executed properly, the method results in key viewpoints of its participants and these viewpoints are understood holistically (Watts & Stenner, 2012). The Q method is well suited for empirical research since it aims to explore, discover, and understand its subject matter in an open-ended manner. The Q methodology consists of the following six steps (Figure 10):

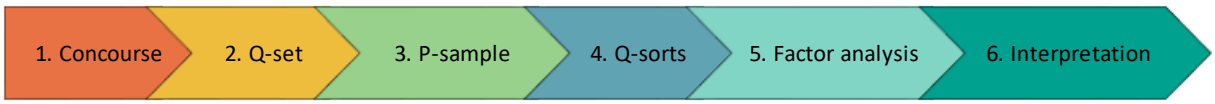


Figure 10. The six steps of the Q methodology (Watts & Stenner, 2012)

- The first step is defining the concourse, which is "the full range of discussions and discourses on the particular issue under study" (Cuppen, 2010, p. 105). To define the concourse, sources are identified that contain opinions, ideas, values, preferences, knowledge claims on this issue.

- In the second step, the concourse is translated into statements. The statements are divided over themes, in this study, these are the factors of the COM-B model. The concourse is reduced by merging similar statements, deleting irrelevant statements, and finding a balance in categories of the COM-B model. The number of statements is limited since the interviews are aimed to last approximately one hour. The selection of statements is referred to as the Q-set. The Q-set must reflect the diversity of the concourse, thus statements of all themes must be present. Especially statements that trigger friction is valuable. The statements are changed as little as possible from the source to limit the researcher bias. The statements must be easy to read and understand, standalone sentences, capture an opinion (not a fact), and short. Lastly, the statements are reframed to make sure that there is a balance in positive and negative framed statements.

- In the third step, the participants are selected, the selection is referred to as the P-sample. The R methodologies (e.g., survey, questionnaire) aim to gain insight into the amount of support for perspectives among the population (balance). Therefore, the R methodology needs as much participants as possible (large sample size) and the participants are selected randomly. For the Q methodology, the participants are selected with a purpose (purposive sampling). The idea is to have as different opinions, ideas, values, preferences, knowledge claims on the issue as possible. The Q method has a smaller sample size and purposive sampling.

In the fourth step, the selected participants rank the statements in a bell-shaped distribution from most disagree to most agree (
Appendix V: *Q methodology*). When using R methodologies (survey/questionnaire) the participants only respond to isolated statements. In contrast, when using the Q method, the participants rank a statement in comparison to all statements. This is known as the Q-sort technique, the distribution is fixed thus the statements are ranked relatively from each other (Brown, 1996). The Q-sorts are performed online due to COVID-19 measures. A website is developed to enable the participants to rank the statements (

- **Appendix V:** *Q methodology*). During the ranking, the participants share their screen via MS Teams or Zoom.

- In the fifth step, the data from the Q-sorts is analysed using KEN-Q Analysis (Banasick, 2019). The analysis aims to deduct the data of the Q-sorts to factors, which are groups of Q-sorts that have ranked the statements similarly. The factor analysis is explained in
  Appendix V: *Q methodology*, to keep the research approach readable and still have the space to give an in-depth explanation about the analysis (Watts & Stenner, 2012). In short: First, the correlation matrix between the Q-sorts was calculated. The matrix is factor analysed using the centroid factors, and the factors are rotated using Varimax.

- The factors retrieved in the previous step are to be interpreted as perspectives in the sixth and final step. A report is made with a description of the different perspectives.

SQ4: Combination of DPRA risk dialogue & Constructive Conflict Methodology

What is the influence of the risk dialogue on the relations between stakeholders and acceptance of responsibility to take climate adaptation measures to reduce waterlogging in the urban environment on the larger urban scale?

The constructive conflict methodology is applied to the risk dialogue design and used to evaluate the effect of the dialogue. The constructive conflict methodology aims to have a fruitful stakeholder dialogue by sharing the divergent perspectives found in the Q methodology (Cuppen, 2012). The combination of the constructive conflict methodology and the risk dialogue consists of the following five steps (Figure 11):

Figure 11. The six steps of the constructive conflict methodology applied to the risk dialogue (Cuppen, 2010)

- In the first step, a diverse group of stakeholders are selected, the selection is often based on the stakeholder type (e.g., an academic, a resident, an NGO, and a policymaker) (Cuppen, 2010). However, the assumption that different stakeholder types have diverse perspective is not always the correct. Stakeholders from the same group can have different perspectives, and stakeholders from different groups can have the same perspective (Cuppen, 2010). In order to have a diverse group of stakeholders, it is fruitful to base the selection on their perspective and not solely on their stakeholder group. The Q methodology supports the stakeholder selection by including disparate and/or marginal perspectives. Due to COVID-19, the dialogue is held online via Microsoft Teams. The aim is to have between 6-10 participants. The low number of participants made it possible to increase speech time and opportunity to participate.

- In the second step, the participation method is chosen. The risk dialogue of the DPRA is a "process that consist of several dialogues with all kinds of parties" (Kennisportaal Ruimtelijke Adaptatie, 2020c). Thus, during a risk dialogue, a wide range of participation method can be applied, depending on the specific dialogue and participants. In this study, the participation method applied during the dialogue a focus group. The risk dialogue complies with core elements of a focus group (Vaughn et al., 1996, p. 5):
    - The risk dialogue group consist of a small group
    - The goal is to find the perspectives, feelings, attitudes, and ideas about the topic
    - A moderator prepares questions and induces participants responses
    - Does not generate quantitative information that can be projected to a larger population

- In the third step, during the dialogue, the perspectives are presented to the participants. This can help the participants to understand their perspectives and those of others. Once the perspectives are articulated, this can give structure to the knowledge claims, ideas, and presumptions of the participations (Cuppen, 2010). The knowledge claims, ideas and presumptions can be confronted with each other. However, the perspectives themselves must be never confronted with each other as there is no way to falsify perspectives. The discussion should remain on a concrete level of discussion about technological or policy options. Also, the participants do not need to reach a consensus or agreement. A moderator facilitates the dialogue to bridge between disparate perspectives/ideas/claims.

- In the fourth step, the DPRA risk dialogue components are applied during the dialogue. A summary of the DPRA guidelines can be found in **Appendix VII:** *Risk dialogue*. The components are
    - Vulnerabilities to waterlogging of both case study neighbourhoods,
    - Acceptability of risks of waterlogging situations
    - Potential measures.

- For the fifth step, the participants of the dialogue repeat the Q-sorts, to be able to evaluate the effect of the risk dialogue on the original perspectives. Besides the dialogue group also a control group was formed that also repeated the Q-sort. This is to check whether perspectives also changed over time without the intervention of the risk dialogue. The selection of the control group are participants that had a similar perspective in the Q methodology but did not participate in the dialogue. See Figure 12 for a schematic overview of the design of the dialogue and control group. Since the participants were all familiar with ranking the statements via the website, the participants could rank the statements themselves.

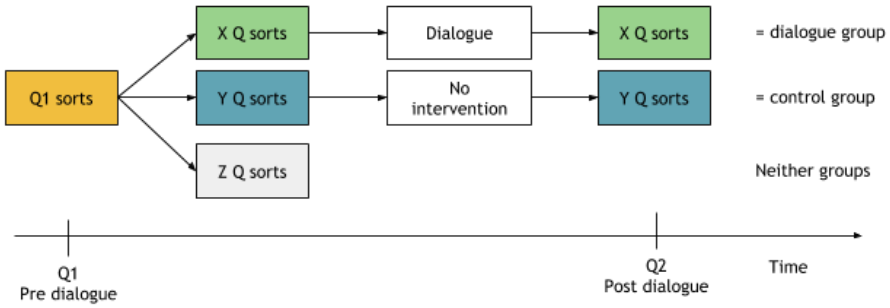


Figure 12. Schematic overview dialogue and control group

- In the sixth step, the differences of the Q1 and Q2 sorts of the dialogue and control group are analysed. Only using the pre-Q-sort data of the dialogue and control group will result in different perspectives because the Q-sorts that were in neither the dialogue nor control group are missing. The perspectives that were presented during the dialogue were also based on these pre-Q-sorts. Therefore, the Q1 sorts of the participants that were in neither group are included in the analyses and the data of the Q2 sorts are added to the Q1 sorts. Again a factor analysis is applied to this dataset, to retrieve perspectives using the Ken-Q Analysis (Banasick, 2019). This resulted in three *new* factors, these need to be similar to the *initial* factors, because these new factors will be used to compare the difference in perspective between Q1 and Q2 of the dialogue and control group. See Figure 13 for a schematic overview. If these factors have a high correlation a repeated measures MANOVA is applied. The independent variables are:
  - Group: dialogue & control (between subject)
  - Q variable: Q1 & Q2
  - Factor variable: number of factors found in the Q methodology

  The dependent variable is:
  - Factor loading on the three perspectives at Q1 and Q2.

  Besides the quantitative analysis described above, there is also a comparison between qualitative data of the pre-and post-dialogue Q-sorts. Namely, the statements that are placed at the extremes of the Q-sorting grid are compared, including the argumentation on why these are the most important for the participant.

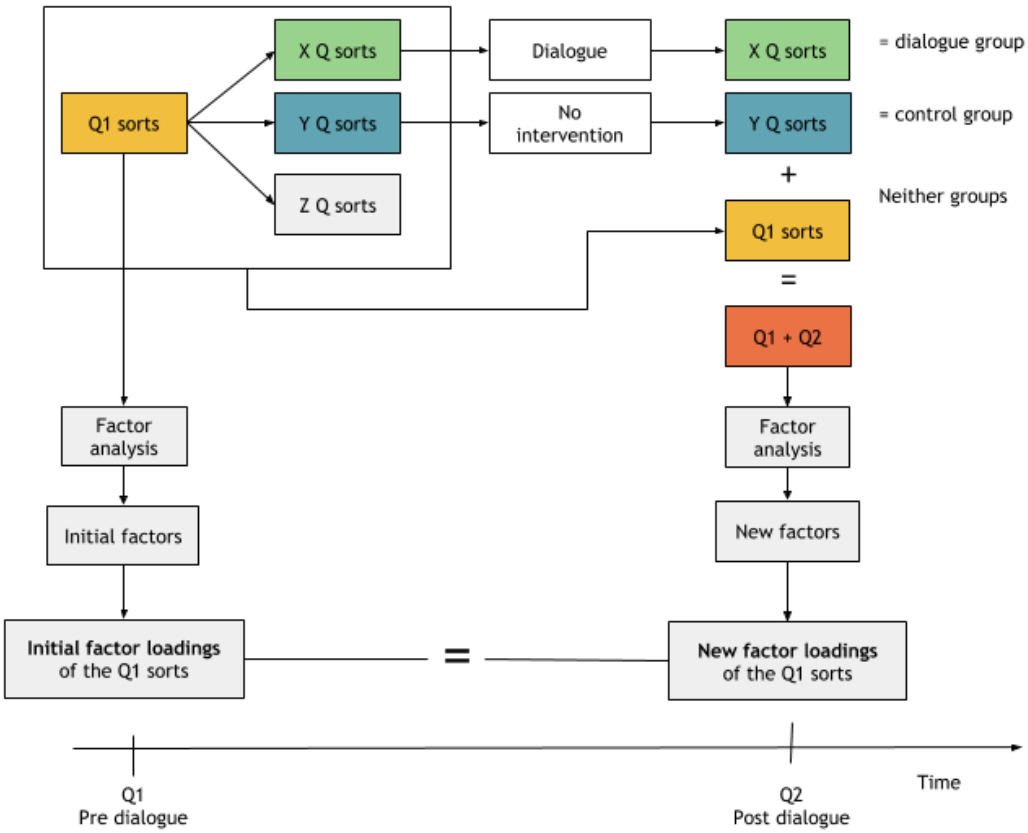


Figure 13. Schematic overview of the correlation between initial and new factor loadings


4

4. Influence of local circumstances on acceptance measures

To start, the results of the desk research on the local circumstances that influence the vulnerability of the case study neighbourhoods to waterlogging are presented. Hereafter, the potential and needed measures to reduce waterlogging in the neighbourhoods are presented. Finally, the influence of the vulnerabilities and measures on the factors related to the perspective on climate change adaptation is discussed.

4.1. Local circumstances

Whether precipitation leads to waterlogging depends on the intensity and duration of the shower, and the local circumstances. Some examples of local circumstances are the sewage system, the slope of the terrain, and characteristics of the soil and surface. The relevant local circumstances of both neighbourhoods will be discussed in this section.

Neighbourhood typology

The neighbourhoods in the Netherlands often represent the urban concepts and regulations of the time the streets were built. When investigating the vulnerability of a neighbourhood, it is handy to make a distinction between the different types of neighbourhoods. A typology is developed based on the architecture and layout of the public space, complemented with characteristics that indicate the vulnerability (Klimaateffectatlas, n.d.-b).

Transvaalkwartier-North has a couple of different typologies, but the dominant one is urban building block (Dutch: Stedelijk bouwblok) from before 1940. The characteristics of this typology are that there are no gardens in front of the houses and the houses are 4-8 layers. There are many typologies in Transvaalkwartier-Middle and South, the most dominant one being renewed (Dutch: Vernieuwd) from 1990 till the present. The existing buildings are renovated and often there is a high density of houses.

The houses in the Vogelwijk are mostly built in the period from 1925 until 1950 (AlleCijfers, 2019a; Oude Luttikhuis & De Jong, 2010). According to Klimaateffectatlas Vogelwijk has a couple of different typologies, with the most dominant one being working-class district (Dutch: Volkswijk) (Klimaateffectatlas, n.d.-b). The characteristics of the typology are no gardens in front of the houses, very little municipal green, 2-3 layers, and one-family-houses. However, the impression of the Vogelwijk shows a lot of green and there are gardens in front of the houses (Figure 14).

Figure 14. Impression of Vogelwijk (Vogelwijk, 2019)

Surface

Whether precipitation results in waterlogging depends on the surface, the precipitation that becomes runoff causes waterlogging when the sewage system reaches its limits. The portion of precipitation that becomes runoff depends on the runoff coefficient Ψ of the surface. The higher the coefficient the higher the portion resulting in runoff and the lower the coefficient the more infiltration and evaporation. A paved surface has a higher coefficient compared to an unpaved surface. When scanning the satellite images of Transvaalkwartier there seems to be a high percentage of paved surface, and less municipal and private green (Figure 15). In the Vogelwijk there is a lot of municipal and private green visible (Figure 16). Droplets that fall in Vogelwijk have a higher chance to infiltrate or evaporate compared to Transvaalkwartier.

Figure 15. Screenshot google maps satellite Transvaalkwartier

Figure 16. Screenshot google map satellite Vogelwijk

Altitude

The direction of the slope of the terrain roughly indicates where the water will flow when it rains, and the steepness of the slope determines the rate of the flow. In the geological cross-section of The Hague the differences in altitude are visible, from higher ground in the east to lower in the west (Figure 17). The cross-section is positioned more or less perpendicular to the coast. Vogelwijk is located near the coast and lays around 2 meters above NAP. Transvaalkwartier is around 0 m NAP, with some small areas below 2 meters NAP. The grey layer shown in Figure 17 is named a 'city layer', which is formed over the centuries by raising areas or filling ditches with household and demolition waste (Municipality The Hague, 2011). The location of Transvaalkwartier is more vulnerable than Vogelwijk.

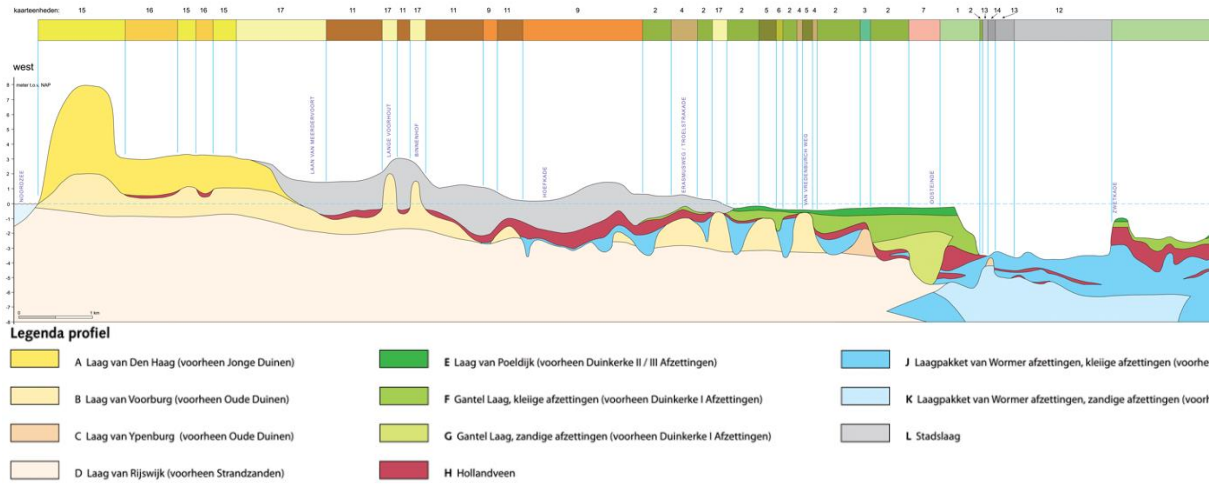


Figure 17. Geological cross-section of the subsurface in The Hague (Municipality The Hague, n.d.-a)

Sewage system

The sewage system collects and discharges wastewater of households and businesses and often rainwater. The capacity of the sewage system influences the vulnerability to waterlogging, when there is a low-capacity runoff can result in water on the streets for example. In The Hague, the sewage system consists of about 1,400 kilometres of sewer pipes and 30,000 inspection wells (Municipality The Hague, 2019a). In addition, there are about 300 sewage pumping stations (Municipality The Hague, 2019a). The sizes of the pumping stations range from small ones that can only serve one house and big ones can serve an entire neighbourhood. The pumping stations pump the sewage towards one of the two wastewater treatment plants: Houtrust and Harnaschpolder. Both plants are owned by water authority Delfland. After the water has been purified, it is discharged into the North Sea.

All municipalities in the Netherlands must have a Municipal Sewage Plan according to the Environmental Protection Act (Government of the Netherlands, 2019). This plan explains how the municipality carries out or intends to carry out its tasks. The Municipal Sewage Plan of The Hague (2016-2020) highlights the need for a durable and climate-resistant sewage (Gemeente Den Haag, 2015). In the past, the sewage system did not receive the attention it deserved, out of sight out of mind. This resulted in deferred maintenance, and in the late 1980s, there was an enormous task of overdue maintenance, delayed improvements, and innovations. In 2015 the replacement backlogs were finished, and now it is time to focus on the future and prepare for climate change.

There are two types of sewage systems in The Hague, namely the combined and separate sewage system (Figure 18). The water in the combined sewage system consists of water from the toilet, shower, kitchen, and rainwater from the roofs and roads. With the separate sewage system, the rainwater is collected separately and discharged towards nearby ditch or infiltrated. This way the relatively clean rainwater does not need energy-intensive cleaning and the wastewater treatment plant.

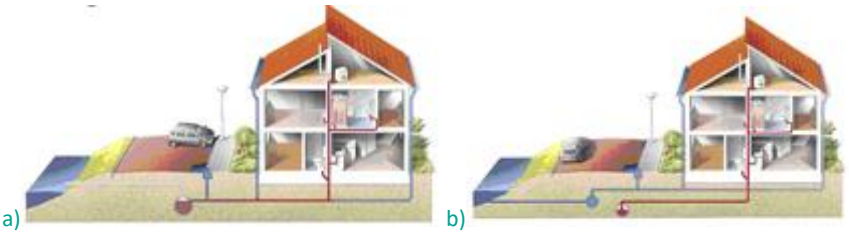


Figure 18. Schematic representation of the a) combined and b) separate sewage system (Municipality The Hague, 2019a)

In the Vogelwijk the combined sewer system is replaced with a separate sewer system and infiltration facilities (Municipality The Hague, 2015c). The rainwater from the road (15 km) is now transported towards the infiltration facilities via pipes, instead of the wastewater treatment plant (Wareco, 2014). Via the infiltration facilities, the water slowly infiltrates and supplements the groundwater (Figure 19). In total nine infiltration facilities are placed in the neighbourhood between 2008 and 2014. These nine facilities add up to about 3,000 m^2 and placed at 1.5-2 metres below the ground level.

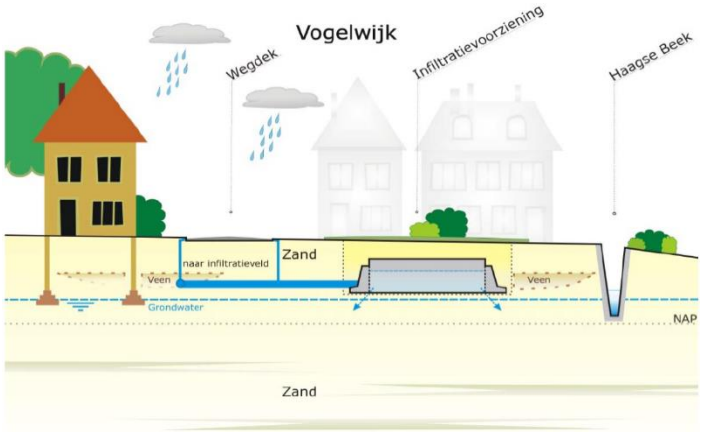


Figure 19. Schematic overview of the separate sewage system and infiltration facilities in the Vogelwijk (Wareco, 2014)

In Transvaalkwartier there is a combined sewage system. Research has been conducted into areas where the groundwater level is relatively close to ground level. Due to the expected groundwater levels in the future, sewer replacement projects in Transvaalkwartier included drainage over approximately 3 kilometres (Municipality The Hague, 2021).

Soil

When taking climate adaptation measures in an urban environment it is also very important to realise what is underneath the surface. For example, when considering infiltrating rainwater, a peat ground may not be ideal. The soil in The Hague various from a sand ground near the coast (west) to a peat ground (east) (Figure 20). The soil in Transvaalkwartier and Vogelwijk have differences and similarities (Figure 21).

The soil in the Vogelwijk consists of a sand layer of more than 2 meters, a sand layer of more than 2 meters on top of peat, a sand layer less than 2 meters, and peat (Figure 21a). The subsurface of Transvaalkwartier consists of a sand layer less than 2 meters, peat, and a layer of peat on top of clay (Figure 21b). See Table 2 for an overview of the differences and similarities between the neighbourhoods.

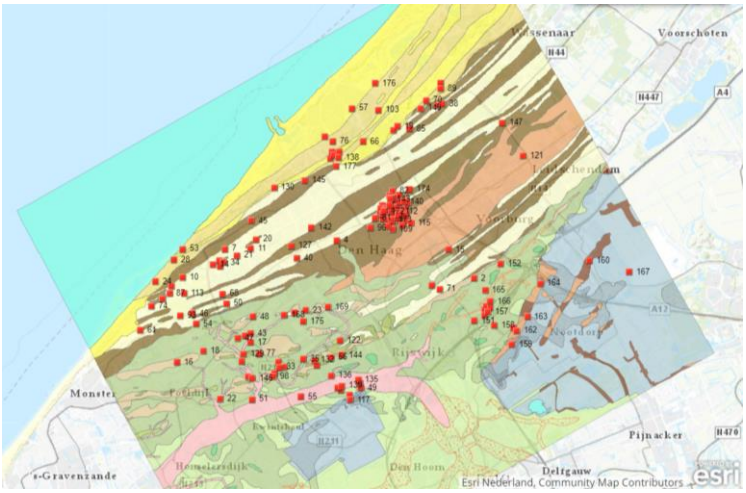
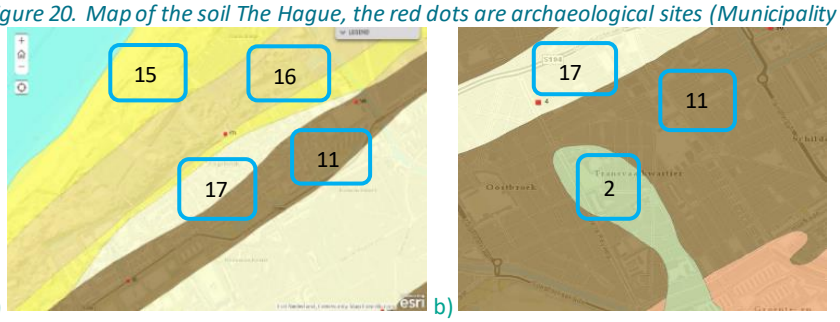


Figure 20. Map of the soil The Hague, the red dots are archaeological sites (Municipality The Hague, n.d.-a)



a) b)

Figure 21. The soil of the case study neighbourhoods a) Vogelwijk and b) Transvaalkwartier (Municipality The Hague, n.d.-a)

Table 2. Overview similarities and differences between the soil in Transvaalkwartier and Vogelwijk

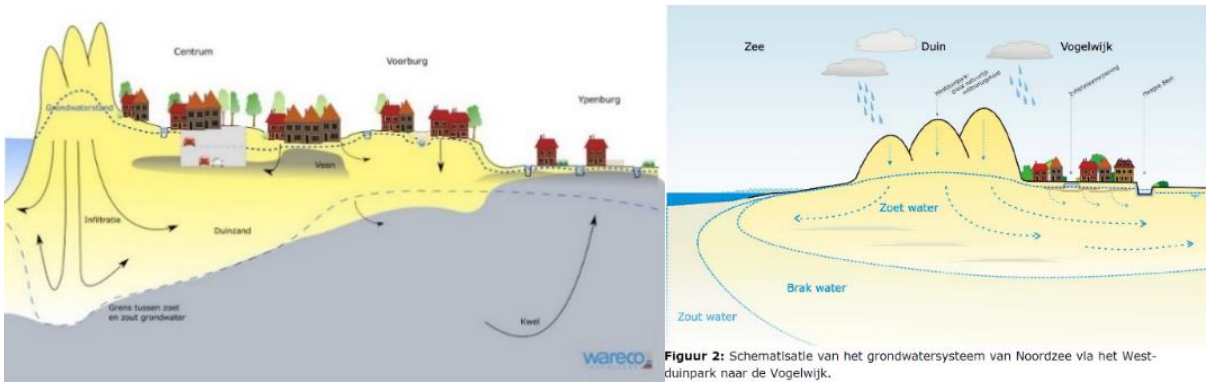
#	Layer	Transvaalkwartier	Vogelwijk
17	Sand layer of fewer than 2 meters		
11	Peat		
2	Layer of peat on clay		
15	Sand layer that is more than 2 meters deep		
16	Sand layer that is more than 2 meters deep on peat		

Groundwater

The depth of the groundwater level influences the vulnerability to waterlogging due to excessive groundwater levels (type 3). The groundwater system is complex and influenced by many factors. The municipality aims to maintain the groundwater level 70 centimetres below street level. There are 540 groundwater measuring points throughout the city, of which 50 are measuring constantly (Wareco, n.d.). The data is used as input for a groundwater model, which can visualize the effects of changes in the city and determine trends for the future (Wareco, n.d.). The groundwater system is divided into five types: the dunes, the inner dunes, land on outlet-water level (Dutch: boezemland), deep polders, and shallow polders. Vogelwijk is part of the dune type and Transvaalkwartier of the *boezemland*.

In the Vogelwijk the distance between street level and the groundwater varies from 1.5 to 2.5 meters. There is almost no pavement in the dunes and as discussed in the previous section the rain can easily infiltrate and recharge the groundwater. The groundwater flows slowly to the sea and inland towards the polders (Figure 22). After a rain event, it takes some time before the water has moved through the sand and reached Vogelwijk. The rises and falls of the groundwater level take up multiple months. At the end of the winter the groundwater level is at its highest, and at the end of the summer at its lowest. There is a difference of about 0.6-0.8 meters (Wareco, 2014). As mentioned in the previous section, there is some peat ground in the Vogelwijk. Unlike sand ground, rainwater does not pass peat easily. Locally, this can create higher groundwater levels. The Haagse Beek is a watercourse that passes the Vogelwijk at the bottom edge. The Haagse Beek is equal to or a little bit higher than the groundwater level and has a clay layer on the bottom to avoid leakage. Thus, there is little exchange between the groundwater and the Haagse Beek.

The groundwater level in Transvaalkwartier is higher. The groundwater level reacts faster in the *boezemland*, the level changes within a few days after precipitation. The groundwater level is influenced by waterways, drainage, and underground construction. There is no surface water in Transvaalkwartier.



Figuur 2: Schematisatie van het grondwatersysteem van Noordzee via het West-duinpark naar de Vogelwijk.

Figure 22. Groundwater system The Hague (Adviesgroep Grondwater Den Haag, n.d.)

The local circumstances of the case study neighbourhoods that influence waterlogging vulnerability are summarised in Table 3.

Table 3. Overview of the local circumstances of the case study neighbourhoods

Local circumstances	Transvaalkwartier	Vogelwijk
Surface	82 hectares	271 hectares
Residents	16,180	5,339
Housing	Tenants (71%)	Homeowners (87%)
Type of surface	Paved, little green	Paved, dunes & green
Altitude	-2 to 0 m NAP	3 to 30 m NAP
Sewage	Combined sewage	Separate sewage + infiltration facilities
Soil	Peat, clay & sand	Sand, peat
Groundwater level	Varies (-0.6 to -0.8 m)	Varies (-1.5 to -2.5 m)

4.2. Waterlogging vulnerabilities

In this section, it is explained which maps are used to analyse the waterlogging vulnerabilities the case study neighbourhoods. Then waterlogging vulnerabilities of Transvaalkwartier are discussed, following the vulnerabilities of Vogelwijk and lastly the map 'climate-proof score' is presented.

Mapping waterlogging vulnerabilities

The second ambition of the DPRA is to map out vulnerabilities of urban and rural areas to extreme rain, heat, droughts, and floods (Deltacommisaris, 2018b). The process of identifying and mapping vulnerabilities is called a stress test, local authorities must have completed four stress tests by 2019. The stress tests must be updated every six years. The stress tests help to determine where the city can expect problems due to climate extremes. This provides a basis for discussions for policymakers, administrators, residents, companies, institutions, and interest groups. However, the aim of the stress test is not to provide mandatory standards or tailor-made adaptation measures. Whether a vulnerability is indeed a problem is determined in the risk dialogues. The stress tests must be publicly available, the stress tests of The Hague are available via the Climate Atlas (Municipality The Hague, n.d.-c). This study considers the 'Drainage Depth' (Dutch: ontwateringsdiepte) and 'Waterlogging' (Dutch: Wateroverlast klimaatbui) stress tests, the maps, and the explanations on how they are made can be found in **Appendix IV:** *Waterlogging* .

However, the stress tests lack information about the third type of waterlogging, the excessive groundwater level. The Hague has no maps on groundwater nuisance, but on a national level, there is a map named the 'Development risk of groundwater nuisance' (Klimaateffectatlas, n.d.-a). The map shows the degree to which the probability of groundwater nuisance for urban functions (buildings, infrastructure, gardens, and landscaping) will increase between now and 2050 (**Appendix IV:** *Waterlogging*).

Transvaalkwartier

This section presents the three maps that visualise the waterlogging vulnerabilities of Transvaalkwartier.

'Drainage Depth' stress test

Drainage depth is the difference between the surface and the groundwater level. The shades of blue in the map of Transvaalkwartier are very light, and the lighter the colour the lower the drainage depth (Figure 23). Thus, the groundwater level is close to the ground surface in Transvaalkwartier.

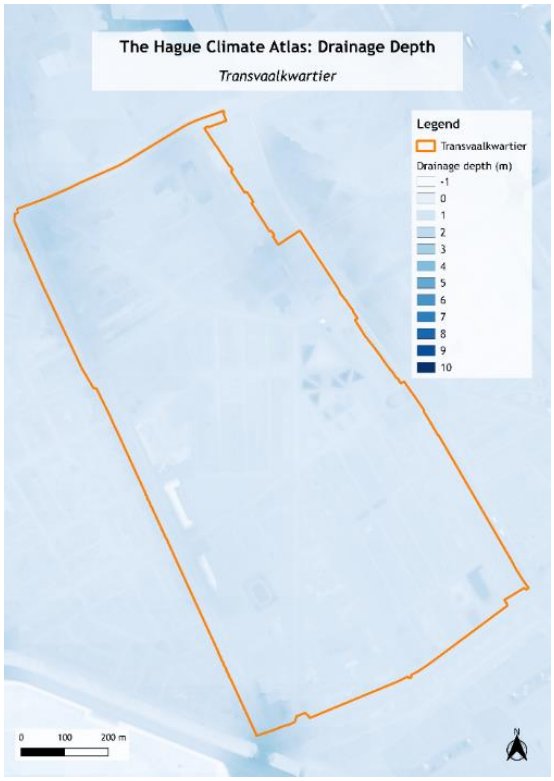


Figure 23. The Hague Climate Atlas: Drainage Depth – Transvaalkwartier (Municipality The Hague, n.d.-c)

'Waterlogging' stress test

The map 'Waterlogging' shows where floods can arise after an extreme downpour of 100 millimetres in two hours. The map does not show how long the water remains on the streets whilst this is a very important factor when determining whether the waterlogging is unacceptable or not (Kennisportaal Ruimtelijke Adaptatie, n.d.-c). In Transvaalkwartier many streets will flood in the case of the downpour of 100 mm in two hours (Figure 24).

Figure 24. The Hague Climate Atlas: Waterlogging 100 mm – Transvaalkwartier (Municipality The Hague, n.d.-c)

'Development risk of groundwater nuisance' map

There is no detailed map of a current groundwater level situation. The 'Development risk of groundwater nuisance' map is a national model that cannot predict the exact groundwater nuisance, the model resolution is too high and there is no national information about drainage. Therefore, the map is about the probable change in groundwater levels. However, whether the nuisance really happens depends on the local conditions and processes. In Transvaalkwartier most of the area is light green, which means that there is a small chance of the development of risk of groundwater nuisance due to rising groundwater levels (Figure 25). There is also a small area with the colour bright green, which means that there is a small increase. Lastly, there is a small area orange, this means that there is a high increase in probability.

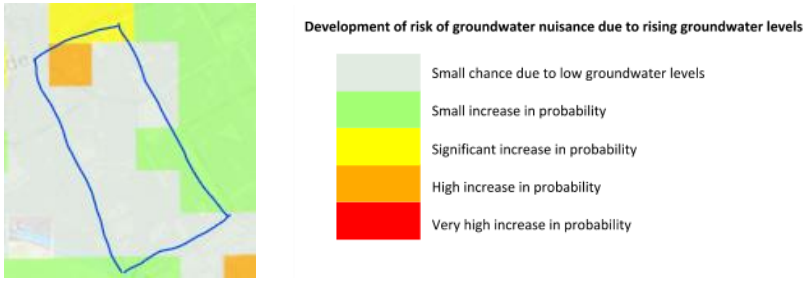


Figure 25. Map 'Development risk of groundwater nuisance' – Transvaalkwartier (Klimaateffectatlas, n.d.-b)

Vogelwijk

This section presents the three maps that visualise the waterlogging vulnerabilities of Vogelwijk.

1. 'Drainage Depth' stress test

In the Vogelwijk the drainage depth differs between the dunes and the rest of the Vogelwijk, the dunes have a dark shade of blue (Figure 26). Underneath the sports field at the left and right of the neighbourhood, the drainage depth is quite low. It is possible that there is a drainage system that is not incorporated in the model, meaning that in reality, the drainage depth is lower than the stress test indicates.

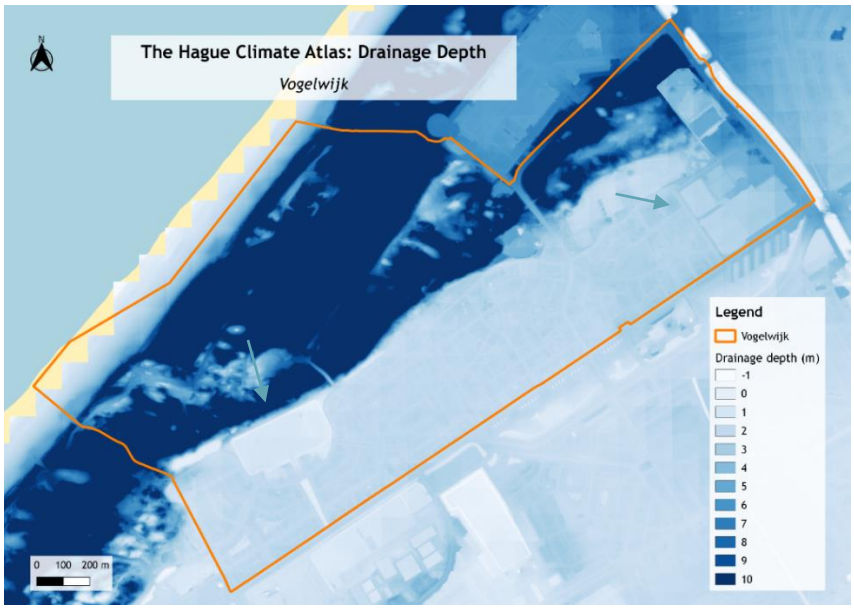


Figure 26. The Hague Climate Atlas: Drainage Depth – Vogelwijk (Municipality The Hague, n.d.-c)

2. *'Waterlogging' stress test*

In the Vogelwijk waterlogging due to short and severe precipitation seems to have less impact compared to the Transvaalkwartier (Figure 27). In the map, it is visible that the sports field at the right bottom are flooded, again this could be because the drainage system is not incorporated in the model.

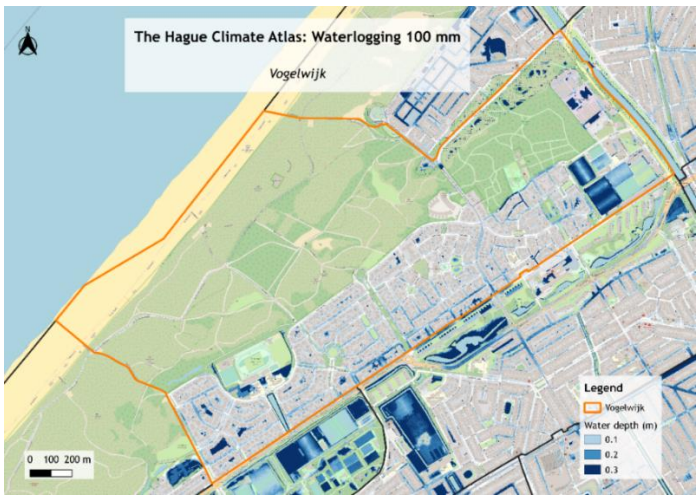


Figure 27. The Hague Climate Atlas: Waterlogging 100 mm – Vogelwijk (Municipality The Hague, n.d.-c)

3. *'Development risk of groundwater nuisance' map*

The 'Development risk of groundwater nuisance' map shows that Vogelwijk is light green and falls completely under the first category, which means that there is only a small chance of the development of risk of groundwater nuisance (Figure 28). This is because the groundwater is lower than 1.1 meters. However, as explained in the local circumstances, the houses in the Vogelwijk were built a long time ago. At the time the basements were built 2 meters below the ground level. It was not necessary to build watertight basements, because the groundwater level was always below 2 meters. Currently, the groundwater level sometimes reaches basements, this causes water to leak into the basements. The reported nuisance is visualised in Figure 29.

Groundwater is very complex, and it is difficult to determine the exact reason for the rise of the groundwater level. As mentioned before, the municipality connected 15 km of road to infiltration facilities in Vogelwijk. However, at the same time precipitation events are changing, causing groundwater levels to increase (**Appendix I**: *Waterlogging*). The groundwater level is measured once per month, which is not enough to measure the effect of the infiltration facilities after rain. In the weeks after rain, the groundwater level recovers again. It could be that without the facilities, the extreme rain also could have caused excessive groundwater levels. It is beyond the scope of this research to determine the cause of the groundwater levels.

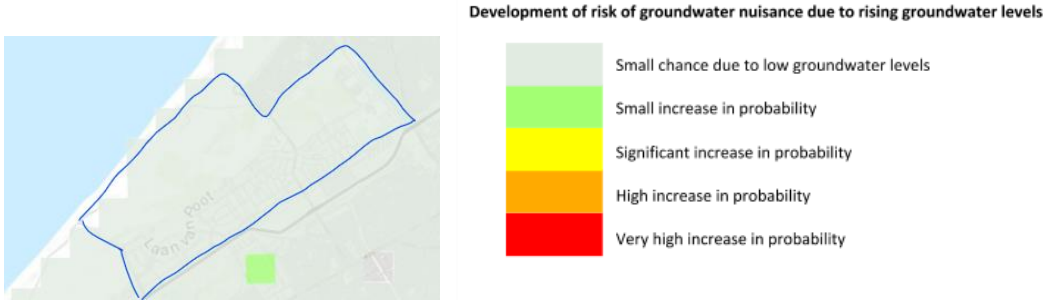


Figure 28. Map 'Development risk of groundwater nuisance' – Vogelwijk (Klimaateffectatlas, n.d.-b)

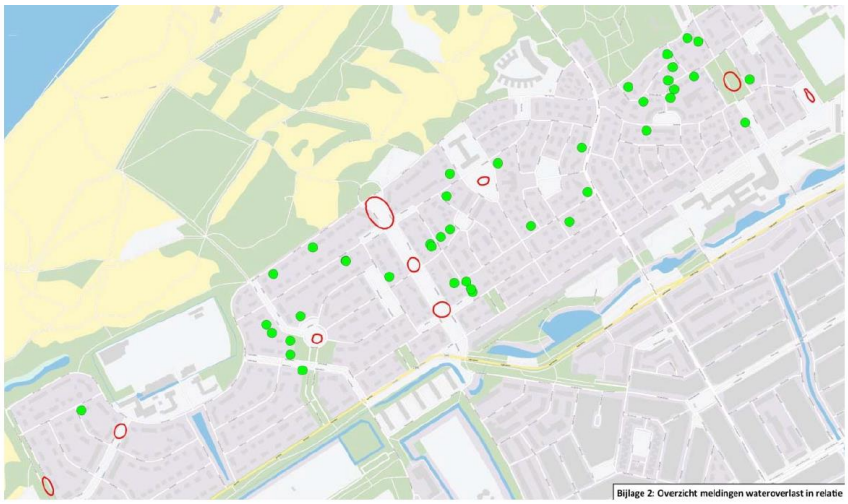


Figure 29. Reported groundwater nuisance in the Vogelwijk. Green dots = complaints, red circles = infiltration facilities (Wareco, 2014)

Climate Proof Score

Besides the vulnerabilities map discussed above, there is also a 'Climate Proof Score' map of The Hague which presents the climate-proof score per neighbourhood (Figure 30). The score is based on 1) potential damage, 2) vulnerable buildings, and 3) vulnerable roads. The score for vulnerable buildings is calculated by dividing the number of vulnerable buildings by the total number of buildings. The score for the vulnerable road is the ratio is calculated by dividing the kilometres of vulnerable road by the total kilometres of road. Then the average amount of damage per square metres is calculated. This is translated into an average score per neighbourhood. Transvaalkwartier has the lowest score (less climate-adaptive), and Vogelwijk the highest (more climate-adaptive).

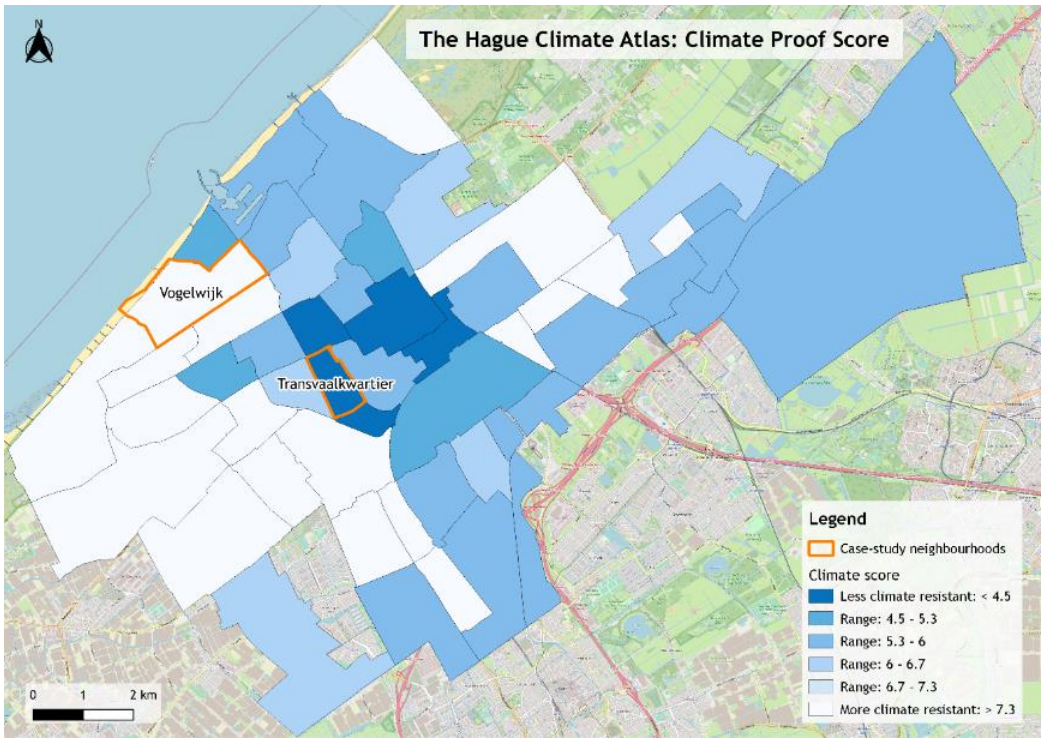


Figure 30. The Hague Climate Atlas: Climate Proof score (Municipality The Hague, n.d.-c)

The vulnerabilities to waterlogging of Transvaalkwartier and Vogelwijk are summarised in Table 4. In Transvalkwartier a heavy shower can result in water on the streets up until 30 cm. This water can go into buildings and cause damage. The combined sewage system can overflow in Transvaalkwartier and due to the groundwater levels crawl spaces can become wet. In Vogelwijk a heavy shower can result in some water on the streets, but not so much that it can go into buildings. There is no vulnerability to combined sewage overflows, as there is a separate sewage system. The basements can become wet because the basements are two meters deep and not waterproof since the groundwater level used to be lower.

Table 4. Overview of the vulnerabilities to waterlogging of the case study neighbourhoods

Vulnerabilities to waterlogging	**Transvaalkwartier**	**Vogelwijk**
Water on the street	✓	✓
Water in buildings	✓	✗
Combined sewage overflow	✓	✗
Wet crawlspaces/basements	✓	✓

4.3. Climate adaptation measures

The local circumstances and vulnerabilities determine whether adaptation measures are needed and whether it is possible to implement them in the neighbourhoods (Table 5). In both neighbourhoods, measures are needed to reduce the vulnerability to waterlogging below ground, and taking these measures is possible. In Transvaalkwartier all measures that can reduce the vulnerability of waterlogging above the ground are needed. However as there is little space and because infiltration is not possible, the possibility of measures to be implemented is low. In Vogelwijk there are no measures needed to reduce the vulnerability of waterlogging above ground. It is, however, possible to apply climate adaptation measures as there is a lot of space and infiltration is possible. This creates an interesting dynamic between the neighbourhoods. The measures are implemented locally, but the water system performs on a larger scale under the law of communicating vessels. This entails that sometimes solving a water problem in one area, should be done in another area where the problem does not occur. The problems and solutions are separated in space.

Table 5. Overview of the needed and possible climate adaptation measures of the case study neighbourhoods

	Transvaalkwartier		**Vogelwijk**	
Vulnerabilities	**Needed**	**Possible**	**Needed**	**Possible**
Water on the street	✓	✗	✗	✓
Water in buildings	✓	✗	✗	✓
Combined sewage overflow	✓	✗	✗	✓
Wet crawlspaces/basements	✓	✓	✓	✓

4.4. Conclusion

The local circumstances of the case study neighbourhoods differ, resulting in different waterlogging vulnerabilities and needed and possible measures to reduce waterlogging. The vulnerabilities to waterlogging and needed measures to solve reduce waterlogging can influence climate-adaptive behaviour. The factors of the COM-B model that influence the acceptance of climate adaptation measures derived in the conceptual framework are linked to the neighbourhoods (Table 6).

Transvaalkwartier is a neighbourhood that is at risk for waterlogging from short and severe precipitation. The area is lower than the surroundings, there is no subsurface drainage system to control groundwater levels, it is a very densely build area, and there is a peat ground. A large fraction of the inhabitants rent their house via housing corporations or private landlords. The housing can provide regulation in their contract. Social tenants do not have a big budget thus the perceived costs can be high, however, the measures in Transvaalkwartier can be small and are not so expensive. The waterlogging from short and severe precipitation is however not yet happening, thus the urgency is not tangible. It can be difficult to have this long-term time scale in mind when taking measures to reduce waterlogging. Also, there is little green in the neighbourhood, this can lower the feeling of having a social norm to have a green garden.

The Vogelwijk is less at risk for waterlogging from short and severe precipitation. The area is near the dunes (high lying area), there is a separate sewer system for precipitation, it is not a very densely build area, and there is sand ground. In the Vogelwijk the houses are mostly privately owned. In Vogelwijk the inhabitants experience waterlogging from excessive groundwater levels. The groundwater levels are now higher than when the houses were built, thus the basements are not watertight. For owners with nuisance from groundwater levels are not agreeing with the municipality to increase the groundwater level since their houses are all not watertight and they never needed to be. Taking measures to make a basement watertight are very expensive. The area is very green thus the social norm can influence acceptance of taking measures.

Table 6. The link between the COM-B model and case study neighbourhoods (Kreemers et al., 2020)

COM-B	Factor	Transvaalkwartier	Vogelwijk
Capability	Physical capacity	Depends on the stakeholder	
	Psychological capacity	Depends on the stakeholder	
Opportunity	Social and cultural norms	Green is not the social norm	Green is the social norm
	Physical environment	Housing corporations can put regulation in their renting contracts	Regulation: lower groundwater level or waterproof basements
Motivation	Risk perception	No perceived climate-related stimuli	Some property owners already experience waterlogging via the basements
	Negative emotions	Depends on the stakeholder	
	Self-efficacy Outcome-efficacy	Depends on the stakeholder	
	Perceived responsibility	Depends on the stakeholder	
	Perceived costs	Mostly social rent, small budget However, measures can be small and thus the costs low	The costs of making a basement waterproof are very high
	Sense of unity	Depends on the stakeholder	


5

5. Influence of stakeholders on spatial planning

This chapter discussed the results of the stakeholder analysis and begins with an overview of the main public and private stakeholder that have an impact on climate adaptation in the urban environment. When applicable, the responsibilities related to urban water management are included. Following, the relations between the stakeholders are visualised and described. Lastly, the interest and power of public and private stakeholders to influence the spatial planning of the urban environment to reduce waterlogging are discussed.

5.1. Main public and private stakeholders

The main public and private stakeholders of this study are listed and described below, including their responsibilities regarding urban water management.

National government

The national government operates on the highest level of the planning system. The government bears responsibility for the primary flood defence systems, these are the dikes and dunes that protect the country against water from the sea and the major rivers (Government of the Netherlands, n.d.-i). The government has twelve ministries, these ministries all prepare policies and legislation (Government of the Netherlands, n.d.-h). The ministry related to this study is the Ministry of Infrastructure and Water Management (Government of the Netherlands, 2019a).

The Ministry of Infrastructure and Water Management strives to create an efficient network of roads, railways, waterways and airways, effective water management to protect against flooding, improved air, and water quality. All European member states have to draw up a climate adaptation strategy, hence the Ministry developed a National Adaptation Strategy (NAS) in 2016 (Ministry of Infrastructure and Water Management, 2016). In 2018 the implementation program was published, these activities are supplementary to the Delta Program (Ministry of Infrastructure and Water Management, 2018). The third aim of the Delta Programme is to make the country climate-proof (Government of the Netherlands, n.d.-b). To realise the third aim the Delta Programme contains a Delta Plan on Spatial Adaptation as of 2018 (Deltacommisaris, 2018b).

Province South-Holland

Provinces operate on the regional level of the planning system. In the Netherlands, twelve provinces are responsible for translating national policy into regional measures. The Hague falls under the supervision of the province of South Holland (Municipality The Hague, 2017; Province South Holland, 2019).

The provincial authorities are responsible for matters such as spatial planning in rural areas, regional accessibility, and regional economic policy (Government of the Netherlands, n.d.-e). The province maintains the provincial waterways, checks the quality swimming water, and regulates the use of deep groundwater. The Soil Protection Act stipulates that the management of groundwater quality is a task vested with the provinces (Government of the Netherlands, n.d.-i). Every year, municipalities must submit their budget and annual accounts to the provincial executive for approval. The province works together with water authorities and municipalities to limit damage and nuisance due to weather extremes and subsidence. The measures that will be taken are stated in the Provincial climate adaptation strategy 'Resilient South Holland' (Province South Holland, 2018).

Water authority Delfland

The twenty-two water authorities in the Netherlands operate on the third level of the planning system, between regional and local. According to the Water Act, regional water authorities have to make the management plans regarding the water quality of the waters within their region (Government of the Netherlands, n.d.-i, 2009). The water authorities are also responsible for the regional flood defence systems and wastewater treatment.

The Hague falls under the responsibility of the water authority Delfland, founded in 1289 (Municipality The Hague, 2017). The region of Delfland is the area (Delfland Water Authority, n.d.). Delfland, together with the municipalities The Hague, Zoetermeer, Rotterdam, and Hoek van Holland and the province of South Holland, have an incentive scheme for climate adaptation (Delfland Water Authority, 2020). The goal is to motivate residents, companies, and organisations to take measures. Delfland subsidizes up to 25% of the costs of climate change adaptation measures, for example for greening a garden.

Municipality The Hague

The municipalities operate on the local level of the planning system, hence they are a very important stakeholder in the climate change adaptation of the urban environment. Municipalities implement the policies that are written by the national government, for example, the Delta Plan on Spatial Adaptation.

The municipality is responsible for collecting and processing rainwater of the public space according to the Water Act article 3.5 (Brockhoff et al., 2019; Government of the Netherlands, 2009; Trell & van Geet, 2019). According to the Environmental Protection Act (Dutch: Wet milieubeheer), article 10.32a municipalities can determine whether private parties can discharge their rainwater into the sewage system (Government of the Netherlands, 2019). However, this law is not applied in practice. Furthermore, according to the Environmental Protection Act municipalities are responsible for the collection and discharge of wastewater through the sewage system (Government of the Netherlands, 2019). In addition, municipalities must prevent structural groundwater flooding according to Water Act article 3.6 (Government of the Netherlands, 2009). They have a “duty of care” (Dutch: zorgplicht) and must try to prevent excessive groundwater levels rather than achieving a certain result. Municipalities must have a Municipal Sewage Plan (Dutch: Gemeentelijk Rioleringsplan), in this plan the municipality indicates when it does or does not act.

The municipality of The Hague is a very large organisation, it has about 6,800 employees and is divided into nine departments (Municipality The Hague, 2019c). Various departments and employees of the municipality must collaborate to create a more climate-resilient city, for example, urban planners, engineers, landscaping managers, and cable, road, and pipe operators. In this study, the municipality will be divided into urban planners and water managers, as mentioned in the conceptual framework (chapter 2).

The three departments that are mostly involved with the problem and their functions are (bold is related to this thesis):

- *Department of City Management:* general affairs, archaeology and nature and environmental education, **city management**, accessibility and traffic management, parks & recreation and cemeteries, street cleaning, **environment and permits**, markets, **public space, and infrastructure**.
- *Department of Urban Development:* town planning, existing buildings, and houses.
- *Department of Public Service:* products and services, public library, municipal archives, tax department, **city districts and neighbourhoods**.

Private homeowners

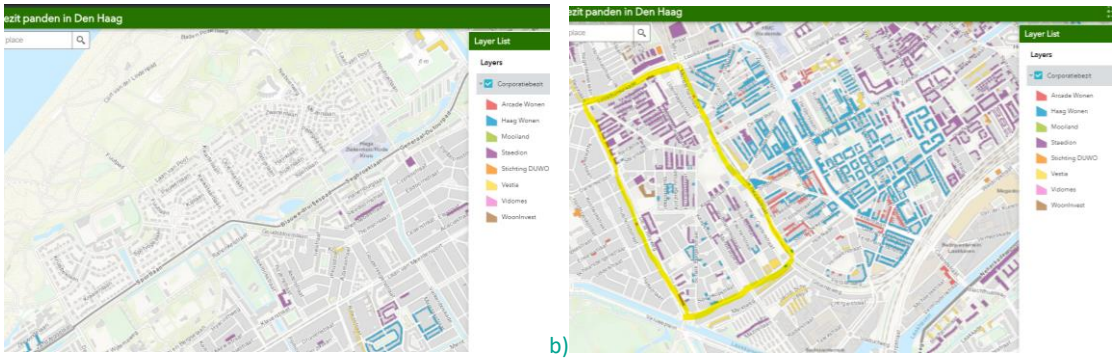
Private homeowners are an important stakeholder because they own space in the urban environment. In Vogelwijk the majority owns their house (87%), in Transvaalkwartier this is 29% (Municipality The Hague, 2019b). Homeowners have some responsibilities regarding water management on their plot. According to the Water Act, a property owner is responsible for the groundwater level under his house and garden (Government of the Netherlands, 2009). Furthermore, property owners are responsible for processing rainwater on their land through either infiltration or discharge towards surface water according to Water Act article 3.5 (Government of the Netherlands, 2009). However, this is not applied in practice and thus the municipality collects the rainwater of private parties. Owners are responsible for a watertight basement when it is used as a living space. However, according to the 2012 Building Decree, it is not necessary for basements and crawl spaces to be water- or moisture-tight when they are used as a storage space (Government of the Netherlands, 2012). Lower-lying parcels must receive runoff from higher-lying areas, Civil Code of The Netherlands (Dutch: Burgelijk Wetboek) article 5.38 (Government of the Netherlands, 2014). The higher-lying areas are thus not responsible for damage due to their runoff.

Landlords

Landlords have the same responsibilities as homeowners. In Vogelwijk only 9% rents a private house, in Transvaalkwartier this is 27% (Municipality The Hague, 2019b). Private rental in Transvaalkwartier often indicates a relatively high dependence on private landlords. Which increases the risk of abuse of power, overdue maintenance, illegal rental or illegal occupancy (jb Lorenz, 2020). Landlords do not live in the house of which they have the responsibility, thus it could be that the incentive to take climate change adaptation measures is lower.

Housing corporations

A housing corporation is a type of landlord, they are mentioned separately because they own many houses and have different interests than regular landlords. They rent their homes to residents with a relatively low income, to ensure that everyone can afford housing. Since the corporation owns many houses, it will have a lot of impact when they apply climate change adaptation measures In Transvaalkwartier 44% of the houses are social rent, in Vogelwijk this is only 2% (Municipality The Hague, 2019b). Staedion is the biggest corporation in Transvaalkwartier, furthermore WoonInvest, Haagwonen and Vestia are present (Figure 31). The responsibilities are the same as mentioned at homeowners.



a) b)

Figure 31. Housing association property in the a) Vogelwijk and b) Transvaalkwartier (Municipality The Hague, n.d.-b)

Private rent tenants

Tenants have fewer responsibilities compared to owners. They can ask the owners to take adaptation measures, but they are not obliged to do so (Trell & van Geet, 2019). If they want, they can take measures themselves, however, the incentive could be lower. A tenant may want to take measures such as greening the garden but is not allowed to do so by the owner (Kreemers et al., 2020). When the property of the tenant damages due to pluvial flooding, they are responsible for the belongings inside the property (Trell & van Geet, 2019). As mentioned above, in Vogelwijk 9% rents their house via a landlord, in Transvaalkwartier 27% (Municipality The Hague, 2019b).

Social rent tenants

As mentioned above, the landlord of social rent tenants is a housing corporation. In order to apply for a social rent house, your yearly income cannot be too high. Housing associations must annually allocate at least 80% of their vacant social rented housing to households with an income of up to € 39,055. 10% is allowed to households with an income between € 39,055 and € 43,574. And 10% can go to higher incomes. As mentioned above, in Transvaalkwartier 44% of the houses are social rent, in Vogelwijk this is only 2%.

Non-residential buildings

Besides houses, there are also non-residential buildings in cities. These buildings can have various functions, there are for example shops, businesses, catering industry, medical facilities, offices, schools, sports facilities, recreational facilities, churches and prayer rooms, and entertainment facilities. In Transvaalkwartier there are 6,514 buildings, of which 6,070 (93%) have a residential function and 444 (7%) addresses a non-residential function (Municipality The Hague, 2019b). The division of the functions of the buildings in Transvaalkwartier is presented in Figure 32. In the Vogelwijk there are 2,134 addresses in total, of which 2,085 (98%) addresses have a residential function and 49 (2%) a non-residential function (Municipality The Hague, 2019b). The functions of the non-residential buildings presented in Figure 33. In both neighbourhoods, the fraction of houses is much higher than non-residential buildings. Hence, from now on the non-residential building owners and tenants are discarded.

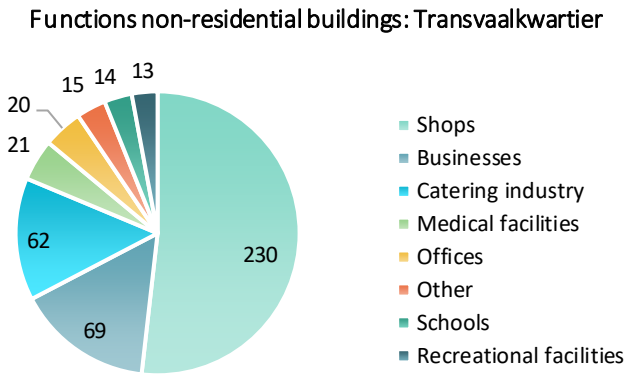


Figure 32. Functions of non-residential buildings in Transvaalkwartier (AlleCijfers, 2019b)

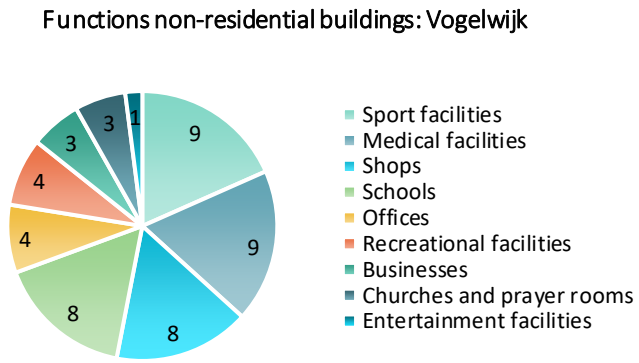


Figure 33. Functions of non-residential buildings in Vogelwijk (AlleCijfers, 2019a)

Insurers

The Dutch Association of Insurers (Dutch: Verbond van Verzekeraars) represents the interests of 95% of the insurance companies operating in the Netherlands (Dutch Association of Insurers, n.d.-a). Climate change is an increased risk for the insurance sector (Trell & van Geet, 2019). Houses, commercial buildings, and vehicles have a greater chance of being damaged by lightning, flood, rain, snow, frost, and wind. The association is investigating how insurers and society can respond effectively to the changing climate. Together with the Ministry of Infrastructure and Water Management, the Dutch Association of Insurers made an overview of what damage is insured and what damage is not insured, and what damage can be insured optionally (Dutch Association of Insurers, n.d.-b). Insurers can play a role by helping clients to keep their (climate) risks manageable and inform clients about the measures they can take to prevent damage (Kennisportaal Ruimtelijke Adaptatie, 2020b).

The gardening industry

The Dutch Gardening Industry (Dutch: Tuinbranche Nederland) is the branch organisation of the entire garden chain. From manufacturers, importers, wholesalers of garden items, garden centres, and garden retailers. The Garden industry helps to inform garden centres and customers about how they can implement measures in their garden to make it more climate-resilient (Kennisportaal Ruimtelijke Adaptatie, 2020a).

Foundation: Sustainable The Hague

Sustainable The Hague (Duurzaam Den Haag) is a foundation that aims for a city with clean air, a green environment, sustainably generated energy, and that can handle a heavy rain shower. Sustainable The Hague organises the campaign *Operatie Steenbreek* (Duurzaam Den Haag, 2020). The goal is to lower the amount of paved surface in the city, by greening gardens, squares, and streets. Through *Operatie Steenbreek* inhabitants, businesses, schools can trade their tiles for plants for free.

Research institutions

Research institutions provide knowledge about climate change and climate change adaptation in the urban environment. Rainproof Amsterdam is a well-known organisation that spreads knowledge about waterlogging and potential measures. Also, universities (of applied sciences) help knowledge development by the research of professors and students. For example, the Delft University of Technology has a research department 'Urban water system' that focuses on the technological aspects of the urban water cycle and 'Urbanism' that focuses on spatial planning. Research institutions can advise governments, water authorities, and housing corporations.

5.2. Relations between stakeholders

In this section, the formal and informal relations between the stakeholders are discussed (Figure 34). The single arrow represents a hierarchical, the two-sided arrow a formal and the dotted line an informal relation. The description of the relation between the stakeholders is presented in Table 7, the numbers correspond with Figure 34.

Table 7. Description of the relations between the main public and private stakeholders

#	Description
1	• Policies: e.g., Delta plan on Spatial Adaptation & National Adaption Strategy • Legislation: e.g., Water Act, Environmental and Planning Act, Soil Protection Act
2	• Approval yearly budget and accounts • Policy: e.g., Provincial climate adaptation strategy 'Resilient South Holland'
3	• Incentive scheme climate adaptation (Klimaatkrachtig Delfland)
4	• Subsidy climate adaptation measures (Klimaatkrachtig Delfland) • Taxes • Water authority elections
5	• Public participation - Make information about urban (re)development publicly available - Submit ideas and/or lodge complaint - Risk dialogues • Legislation homeowners: groundwater, rainwater • Taxes
6	• Insurance against waterlogging • Insurers can inform clients about preventing damage
7	• Rental agreement
8	• Inform and stimulate residents to take measures
9	• Collaboration with Ministry of Infrastructure and Water Management: • Infographics insurability climate risks (Dutch Association of Insurers, n.d.-d)
10	• Provide knowledge and advice about climate change (adaptation)

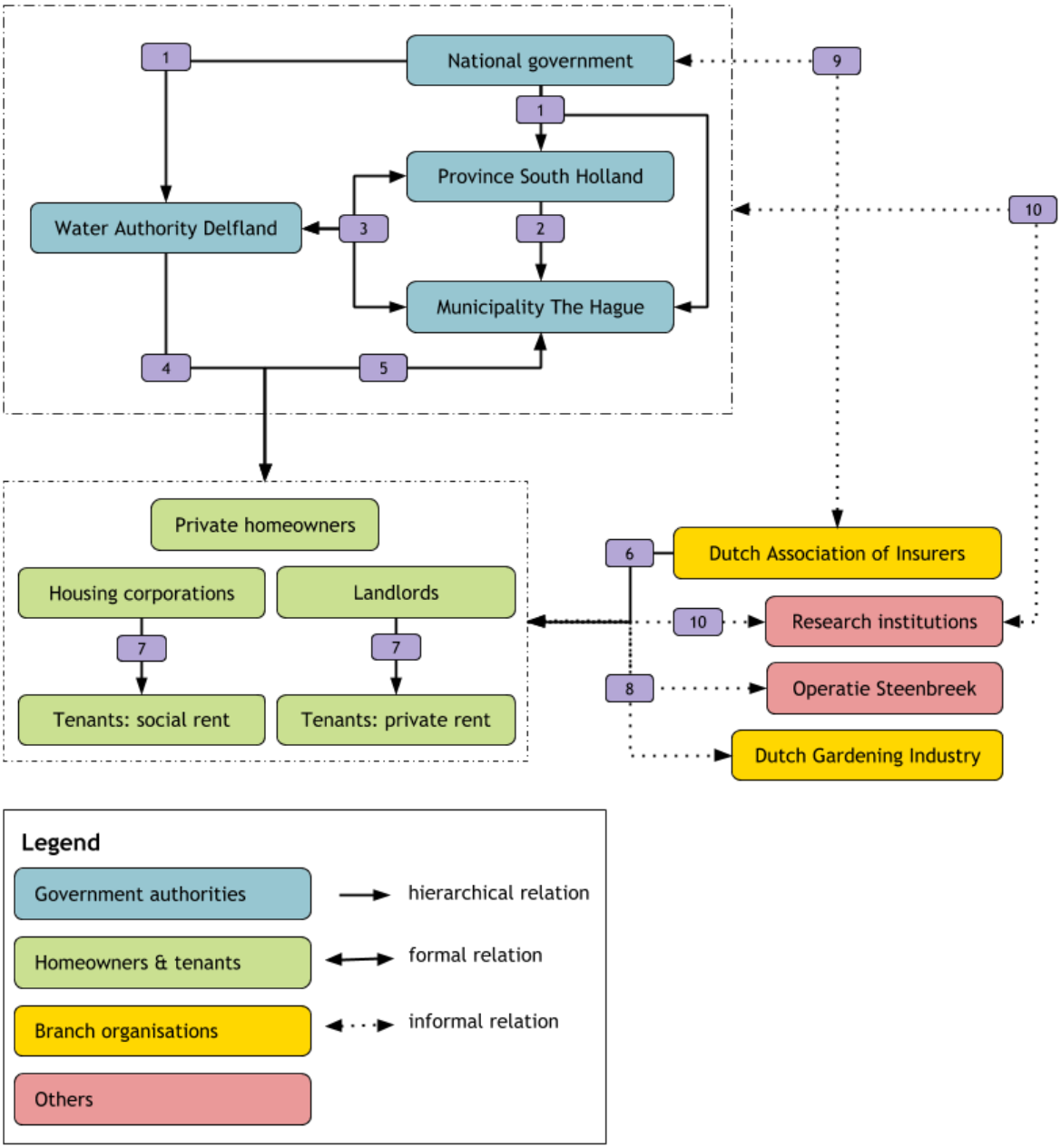


Figure 34. Overview of the relations between the main stakeholders

5.3. Interest and power to influence spatial planning

The aim of the Delta Plan on Spatial Adaptation is to reduce waterlogging, both public and private parties must contribute to make the urban environment climate adaptative. Some examples of potential measures that the public and private stakeholders can take are discussed in section 4.3. The underlying assumption here is that adaptation is needed, that there is indeed a (future) problem in the pilot areas. This problem can be perceived differently by the other stakeholders. In this section, the interest and power of the stakeholders to influence the spatial planning are discussed (Table 8). Consequently, the stakeholders are mapped in a power-interest matrix (Figure 35).

The government stakeholders considered are the water authority Delfland and municipality The Hague because they have a close connection to the spatial planning of the urban environment. The government and province operate on a more abstract (policy) level, the policies are executed by the lower governments scales. The owners and tenants that best represent the neighbourhoods are private homeowners in the Vogelwijk, and the housing corporation and tenants (social rent) in Transvaalkwartier.

Table 8. Overview of the interest and power of the main public and private stakeholders

Stakeholder	Interest	Power
Governments		
Water Authority Delfland	• Climate adaptive city (e.g., reduce risk waterlogging) • Wastewater treatment → high water quality → less diluted water → less rainwater in sewage system • Quality surface water • Interest larger urban scale	• Knowledge about climate change (adaptation) • Money to take measures (taxes) • Authority (elections) • Strong relation municipality • Subsidy to stimulate residents
Municipality The Hague	• Climate adaptive city (e.g., reduce risk waterlogging) • Prevent the need of larger sewage capacity (very costly) • Balance common interest of spatial planning e.g., realise more housing, energy transition, mobility, climate adaptation. Thus, e.g., use the space under the ground to store rainwater • Interest larger urban scale	• Knowledge about climate change effects, waterlogging vulnerabilities, and measures • Money to take measures (taxes) • Authority (elections) • Strong relation water authority • Participation with homeowners & tenants (e.g., risk dialogue) • No subsidy to stimulate residents to reduce waterlogging
Homeowners & tenants		
Private homeowners (Vogelwijk)	• Stop waterlogging basements (e.g., decreases value real estate & health risk) • Very local interest	• Knowledge about legislation • More budget tenants Transvaalkwartier • Participation: blocking power & send ideas • Strong organisation within neighbourhood (e.g., energy cooperation)
Housing corporations (Transvaalkwartier)	• Safe & attractive living tenants (e.g., reduce risk waterlogging) • Very local interest	• Money must be well spent since provide housing for tenants with a small budget • Organisation to take measures (climate adaptation team) • Municipality can more easily communicate with housing corporation then separate homeowners
Tenants social rent (Transvaalkwartier)	• Some tenants have waterlogging in storage spaces (e.g., health risk) • No water on the streets (yet) • Very local interest	• Tenants: so more dependent on housing corporation to take measures • No (official) strong organisation within neighbourhood • Little participation between housing corporation and tenants, • Less budget compared to Vogelwijk

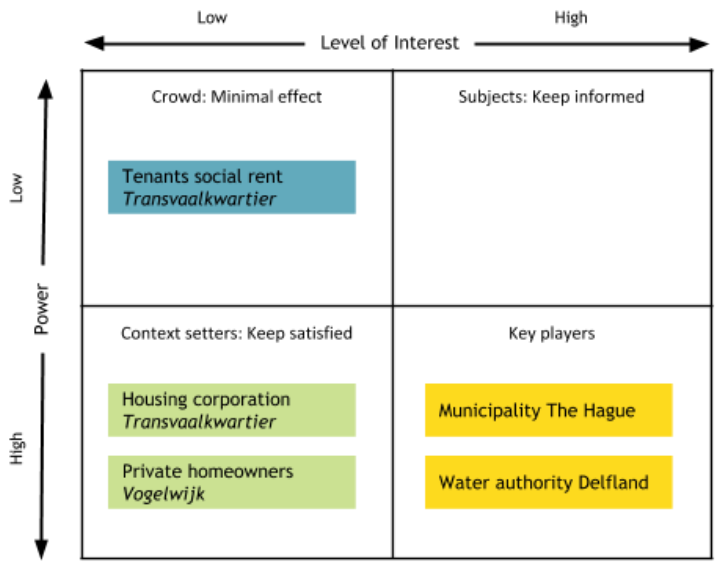


Figure 35. Mapping stakeholder interdependencies: power-interest matrix

5.4. Conclusion

The following stakeholders are considered to have an impact on the urban environment: national government, province South-Holland, water authority Delfland, municipality The Hague, private homeowners, landlords, housing corporations, private rent tenants, social rent tenants, non-residential buildings, insurers, the gardening industry, the foundation Sustainable The Hague, and research institutions. The stakeholders either have direct legal responsibilities regarding urban water management such as discharging rainwater, or they can stimulate and inform private and public stakeholders. The stakeholders are connected by hierarchical, formal, and informal relations, for example by policies, legislation, and stimulation. In Figure 36 the most important stakeholders for this research are visualised in the overview of the planning system from chapter 2.

The stakeholders have different levels of interest and power to influence the urban environment. The municipality The Hague and water authority Delfland the governments are closely connected with urban water management They have a high interest in realising a climate-adaptive environment according to their policies. They also have high power to influence the spatial planning, for example, they have the authority to take measures and money to stimulate residents to take measures.

It differs per neighbourhood what type of homeowners and tenants influence the urban environment. In the Vogelwijk the majority of the residents are private homeowners and in Transvaalkwartier the majority is owned by housing corporations. Homeowners have a high level of power to either take private measures or not. Also, they can use their blocking power to hinder public measures if they are not satisfied. Compared to the municipality and water authority they have less interest in the spatial planning, and definitely less interest in spatial planning on the larger urban scale. In Transvaalkwartier, the housing corporations rent their houses to tenants who have a small budget. Tenants have lower power to influence the spatial planning and a lower interest since they are not accountable for damage due to waterlogging.

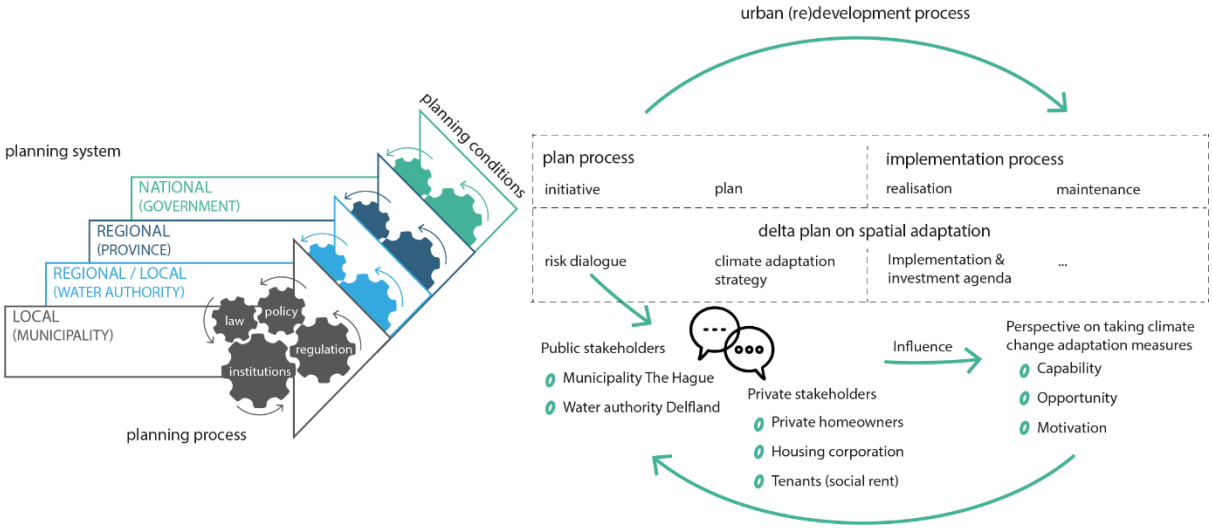


Figure 36. The planning system related to the stakeholder analysis (Hooimeijer & Tummers, 2017)


6

6. Three different perspectives

In this chapter the results of the Q methodology are presented, the three different perspectives on taking climate adaptation measures to reduce waterlogging. Firstly, the results of the statements and interviews are presented. Consequently, the results of the factor analysis of the interview data are discussed. Then, the similarities and differences between the derived factors are analysed. Then, the interpretation of the three factors, the perspectives, are presented. Lastly, the three perspectives are linked to the acceptance of climate adaptation measures.

6.1. Results: 26 statements & 16 interviews

In this section, the results of the first four steps of the Q methodology are presented: the concourse, Q-set, P-sample, and Q-sorts.

Definition of the concourse

The aim of defining the concourse is to gather the full range of discussion about taking climate change adaptation measures to reduce waterlogging. The sources used in this study are online articles from the newspapers NRC, the website of climate change adaptation, google search 'measures against waterlogging' resulting in various websites, LinkedIn, policy documents of The Hague on climate adaptation, and five interviews. The interviewees are from the 1) Dutch Association of Insurers, 2) municipality The Hague district employee of Transvaalkwartier and 3) Vogelwijk, 4) housing corporation Staedion, and 5) climate-proof together (Dutch: Samen Klimaatbestendig). The concourse consists of 117 statements. The factors of the COM-B model discussed in chapter 3 are used to categorise the statements. In addition, there is a category about the psychological distance to the consequences of climate change. A psychological distance can hinder the motivation to act.

Deciding on the Q-set

The aim is to reduce the concourse to about 20-30 statements, which is the Q-set. The Q-set is revised by the thesis supervisors. Unclear, similar, irrelevant, or missing statements are identified. The final Q-set of 26 statements is presented in Table 9, the original Q-set in Dutch is presented in **Appendix V:** *Q methodology*. The factors physical capability, negative emotions, and self/outcome-efficacy are not included in the statements as they were thought to depend too much on the individual.

Table 9. Overview of the Q-set

COM-B model	Factors COM-B model	#	Statements
Capacity	1.2. Psychological capability	1	The municipality should communicate the consequences of waterlogging to property owners
	1.2. Psychological capability	2	Taking measures against waterlogging clearly benefits property owners
	1.2. Psychological capability	3	It is clear what the municipality and the water authority expect from property owners and tenants to prevent waterlogging
	1.2. Psychological capability	4	The city of The Hague must be more climate-proof
Opportunity	2.1. Social & cultural norm	5	Many property owners are already taking measures against waterlogging
	2.2. Physical environment	6	More regulation is a good idea to encourage property owners to take measures against waterlogging
	2.2. Physical environment	7	Tiled gardens should be banned to oblige property owners to take measures against waterlogging
	2.2. Physical environment	8	It is not up to tenants but up to property owners to take measures against waterlogging
Motivation	3.1. Risk perception	9	The financial consequences of damage caused by waterlogging is for property owners
	3.4. Perceived responsibility	10	Owners have taken adequate measures if no rainwater from their property enters the sewage system
	3.4. Perceived responsibility	11	The municipality and water authority are able to prevent waterlogging, they do not need the help of property owners
	3.4. Perceived responsibility	12	Taking measures in the public areas offers enough space to prevent waterlogging
	3.4. Perceived responsibility	13	Taking measures to prevent waterlogging is at the expense of the primary task of a housing corporation
	3.4. Perceived responsibility	14	Property owners of higher-lying neighbourhoods must take measures to prevent waterlogging in lower-lying neighbourhoods
	3.4. Perceived responsibility	15	Property owners are not responsible for taking measures against waterlogging
	3.4 Perceived responsibility	16	Property owners pay taxes; hence they can expect that the municipality and water authority prevent waterlogging
	3.5. Perceived costs	17	For property owners taking measures to prevent waterlogging is a good investment
	3.5. Perceived costs	18	A subsidy from the water authority is a good way to encourage property owners to take measures to reduce waterlogging
	3.5 Perceived costs	19	It is a good idea that the municipality financially supports climate-adaptive initiatives by residents
	3.5. Perceived costs	20	Damage from waterlogging is reimbursed by the insurance anyways, thus it is not necessary for property owners to take measures
	3.5. Perceived costs	21	The insurance premiums for property owners will rise because the risk of damage from waterlogging increases
	3.6. Sense of unity	22	The slogan "Only together can we make the Netherlands climate-proof" is accurate
	3.6. Sense of unity	23	It is equally doable for residents from different neighbourhoods to start a climate-adaptive initiative
Challenges	Psychological distance	24	There is little interest from property owners and tenants to think about the design of the outdoor space
	Psychological distance	25	It is an urgent matter to prevent waterlogging, action must be taken as soon as possible
	Psychological distance	26	For property owners it is useful to take measures against waterlogging before they experience damage

Selection of the P-sample

See Table 10 for an overview of the 16 participants that performed the Q-sorts. The stakeholder analysis (chapter **Error! Reference source not found.**) provided insight into the potential participants f or the Q methodology.

Table 10. Overview of the P-sample

#	Organisation / neighbourhood	Function
2	Municipality The Hague	Policy maker Water (technical background)
3		Urban planner
4		Senior project engineer building environment
5		Urban water management – sewage system
6	Water Authority Delfland	Senior policy advisor
7	Dutch Garden Industry	Deputy Director
8	TU Delft faculty Architecture, urbanism department	Associate professor Technology & Design
9	Sustainable The Hague	Organiser *Operatie Steenbreek*
10	Housing corporation Staedion Transvaalkwartier	Program manager sustainability
11		Member of the team sustainability Coordinator climate change adaptation
12	Housing corporation Staedion Transvaalkwartier	Tenant
13		
14	Vogelwijk	Homeowner
15		
16		

Performing the Q-sort

The interviews are performed online using Zoom or Microsoft Teams. The participants opened the website (

Appendix V*: Q methodology*) and shared their screen during the interview. The interview started with an introduction about the topic of the research, namely taking climate adaptation measures to reduce waterlogging. It is emphasized that the other climate adaptation themes (flooding, heat stress, drought) are not considered. Then, the participants performed the Q-sorting technique (

Appendix V*: Q methodology*) and ranked the statements in the bell-shaped distribution. After ranking the statements there was a small interview to gain more insight into their perspective. For example, whether the participant has taken preventative climate adaptation measures.

6.2. Results: three factors

The correlation matrix of the Q-sorts, results of the centroid factor extraction, and unrotated factor matrix can be found in

Appendix VI*: Q1 factor analysis*

. Factor 1 accounts for 43% of the variance, factor 2 of 10% and factor 3 for 8%, which is a cumulative explained variance of in 61%. This is promising as +/- 40% is already considered a sound solution. The Kaiser-Guttman criteria are used to determine how many factors are kept for rotation, three factors meet the requirement and have an EV above 1 (

Appendix VI*: Q1 factor analysis*

The first three factors account for 61% of the variance and adding the fourth factor only adds 2% explained variance. Varimax is used to rotate the factors, since it the first Q methodology of the

researcher and it is an explorative study. This step resulted in a matrix with factor loadings on the three factors after rotation (
Appendix VI*: Q1 factor analysis*

In the fifth step, the significant[1] factor loadings are auto flagged, see Table 11 for an overview of the significant loadings. Factor 1 has eight Q-sorts, factor 2 has three Q-sorts, factor 3 has five Q-sorts and there are no confounded or non-significant Q-sorts. In the sixth step the factor arrays are reconstructed, see
Appendix VI*: Q1 factor analysis*
for the three factor arrays of this study.

Table 11. Overview significant loadings (p < 0.01)

Factor number	Q-sort number	Total
1	1, 3, 6, 7, 8, 12, 14, 16	8
2	2, 5, 13	3
3	4, 9, 10, 11, 15	5
Confounded		0
Non-significant		0

6.3. Similarities and differences between factors

The factors found in the previous sections have similarities and differences. The correlation matrix between the factors shows that factor 1 and 3 are most similar with a correlation of 0.57
Appendix VI*: Q1 factor analysis*
). Factor 2 and 3 follow with a correlation of 0.28, and the least similar are factor 1 and 2 with a correlation of 0.23.

In addition, the factor analysis generated a ranking of the statements, from the lowest till the highest Z-score variance (
Appendix VI*: Q1 factor analysis*
). The Z-score variance indicates the level of agreement about the statement between factors, when the factors ranked the statements similarly then this leads to a low Z-score variance. When the statements are statistically non-significant[2], they are referred to as consensus statements. This already gives an impression of the similarities and differences between the factors.

Consensus statements

Seven of the 26 statements are labelled consensus statements (
Table 12). The participants agree that the subsidy of the Delfland water authority is a good way to stimulate owners to take measures and that the municipality should support financially support local initiatives [18; 19]. There is agreement that measures should be taken preventively and that taking measures has benefits, but it is uncertain (neutral) whether the investment pays off [26; 2; 17]. It is

[1] A factor loading is significant (p<0.01) when it is above 0.51: 2,58 * standard error (SE); SE=1/√(number of statements) (Watts & Stenner, 2012)
[2] Non-significant p > 0.05

part of the primary task of housing corporations to take measures to prevent waterlogging [13]. It is not expected that damage of waterlogging is covered by insurance [20].

Disagreement statements

The top six disagreement statements give a hint about the differences between the perspectives (Table 13). For instance, whether obligation is a good way to realise that owners take climate adaptation measures to prevent waterlogging [6; 7]. Further, the financial consequences of damage due to waterlogging and the amount of measures owners should take [9; 10]. Lastly, the role and responsibilities of the government to prevent waterlogging [11; 16].

Table 12. The seven statement with most agreement amongst the factors (non-significant at p > 0.05)

#	Statement	Z-Score variance	F1	F2	F3
18	A subsidy from the water authority is a good way to encourage property owners to take measures to reduce waterlogging	0.006	2	2	1
26	For property owners it is useful to take measures against waterlogging before they experience damage	0.022	3	2	1
13	Taking measures to prevent waterlogging is at the expense of the primary task of a housing corporation	0.026	-1	-1	0
20	Damage from waterlogging is reimbursed by the insurance anyways, thus it is not necessary for property owners to take measures	0.037	-1	-2	-2
17	For property owners taking measures to prevent waterlogging is a good investment	0.046	1	0	0
2	Taking measures against waterlogging clearly benefits property owners	0.061	1	2	0
19	It is a good idea that the municipality financially supports climate-adaptive initiatives by residents	0.067	2	1	2

Table 13. Top six disagreement statements

#	Statement	Z-score variance	F1	F2	F3
9	The financial consequences of damage caused by waterlogging is for property owners	0.662	0	-2	-1
11	The municipality and water authority are able to prevent waterlogging, they do not need the help of property owners	0.782	-2	1	-3
7	Tiled gardens should be banned to oblige property owners to take measures against waterlogging	0.901	-1	0	3
6	More regulation is a good idea to encourage property owners to take measures against waterlogging	1.054	-2	-2	2
10	Owners have taken adequate measures if no rainwater from their property enters the sewage system	1.373	0	-3	1
16	Property owners pay taxes; hence they can expect that the municipality and water authority prevent waterlogging	1.772	-3	3	0

6.4. Interpretation of the perspectives

In this section the distinguishing statements of the three factors are interpreted, these are the statements a factor ranked in a significantly different fashion compared to the other factors (Watts & Stenner, 2012). The qualitative data from the interviews is used to complement the quantitative data. The interpretation results in three perspectives on taking measures to reduce waterlogging in the urban environment. The statements used during the Q methodology are linked to the COM-B model, hence the description of the perspectives is divided into the categories of the COM-B model: capability, opportunity, and motivation.

Perspective 1: Together we adapt

Factor 1 has an eigenvalue of 4.71 and explains 29% of the study variance. Eight participants are significantly associated with this factor, five males and three females. Three of the participants work for the municipality of The Hague, one at the Water Authority Delfland, one at the branch association of the gardening industry, two at a housing corporation, and one is a tenant at a housing corporation. The distinguishing statements of factor 1 are presented in Table 14. The title of the perspective is *Together we adapt* (Dutch: De stimulerende stad).

Table 14. Distinguishing Statements for Factor 1: significance P < .05 (*), P < .01(**)

#	Statement	F1	F2	F3
26	For property owners it is useful to take measures against waterlogging before they experience damage	3		
22	The slogan "Only together can we make the Netherlands climate-proof" is accurate	3**	0	0
4	The city of The Hague must be more climate-proof	2*	0	3
9	The financial consequences of damage caused by waterlogging is for property owners	0**	-2	-1
24	There is little interest from property owners and tenants to think about the design of the outdoor space	0**	-1	-1
8	It is not up to tenants but up to property owners to take measures against waterlogging	0*	1	-1
10	Owners have taken adequate measures if no rainwater from their property enters the sewage system	0*	-3	1
7	Tiled gardens should be banned to oblige property owners to take measures against waterlogging	-1**	0	3
16	Property owners pay taxes; hence they can expect that the municipality and water authority prevent waterlogging	-3**	3	0
15	Property owners are not responsible for taking measures against waterlogging	-3		

Capability

This perspective has knowledge about the effects of climate change and finds it important that measures are implemented to adapt the city [4]. The positive consequences of taking measures are also mentioned. Especially preventive measures are preferred, this makes it possible to implement measures that not only reduce waterlogging but also have other benefits such as increasing biodiversity.

Opportunity

For this perspective, the implementation of regulation against tiled gardens that would force owners to take climate adaptation measures is not a preferred option [7]. This perspective however does agree that tiled gardens are not favoured, but they would rather stimulate owners to take measures in their garden. Tenants can have a stimulating role towards their landlord or housing corporation to take measures [8]. Still, the owner remains primarily responsible to take measures.

Motivation

This perspective states that only when the municipality and water authority have fulfilled their task and comply with policy, for example a functioning sewage system, the costs of damage due to waterlogging are for the owners [9].

For this perceptive, it goes too far to state that owners should take sufficient measures to prevent precipitation to be discharged towards the sewer since it depends on the local circumstances whether this is possible [10]. It is however agreed upon that owners definitely have a responsibility to take measures to prevent waterlogging, just not very extreme [15]. Everyone has to contribute to a climate adaptive The Hague. This perspective does not agree that since owners pay taxes, they do not have to take any measures [16]. Namely, the municipality and water authority cannot prevent waterlogging without the help of owners.

This perspective agrees that the city is a unity, and that cooperation is important to achieve the climate-roof and water robustness goals of the Netherlands [22].

Challenges

This perspective is unsure whether private parties are interested to participate in the spatial planning process of the municipality [24]. The interest of induvial owners and tenants is less visible than the interest of the housing corporation, which is one party that can more easily organize cooperation with the municipality. Tenants and owners should be at some sort of risk will it be (directly) beneficial to take preventative measures against waterlogging [26]. Therefore, it is important that the municipality communicates whether owners and tenants are at risk for the (and which) consequences of climate change.

Perspective 2: The government should act now

Factor 2 has an eigenvalue of 1.79 and explains 11% of the study variance. Three participants are significantly associated with this factor. All three participants are male, homeowners, and live in the neighbourhood of the Vogelwijk. The distinguishing statements are presented in Table 15. The title of the perspective is *The government should act now* (Dutch: De overheid is in staat).

Table 15. Distinguishing Statements for Factor 2: significance P < .05 (*), P < .01(**)

#	Statement	F2	F1	F3
16	Property owners pay taxes; hence they can expect that the municipality and water authority prevent waterlogging	3**	-3	0
25	It is an urgent matter to prevent waterlogging, action must be taken as soon as possible	3**	1	1
8	It is not up to tenants but up to property owners to take measures against waterlogging	1*	0	-1
5	Many property owners are already taking measures against waterlogging	1**	-1	-1
11	The municipality and water authority are able to prevent waterlogging, they do not need the help of property owners	1**	-2	-3
3	It is clear what the municipality and the water authority expect from property owners and tenants to prevent waterlogging	1*	0	-1
7	Tiled gardens should be banned to oblige property owners to take measures against waterlogging	0**	-1	3
4	The city of The Hague must be more climate-proof	0*	2	3
1	The municipality should communicate the consequences of waterlogging to property owners	0**	1	2
12	Taking measures in the public areas offers enough space to prevent waterlogging	0**	-2	-2
14	Property owners of higher-lying neighbourhoods should take measures to prevent waterlogging in lower-lying neighbourhoods	-3**	0	0
10	Owners have taken adequate measures if no rainwater from their property enters the sewage system	-3**	0	1

Capability

This perspective finds it important that the municipality communicates the potential consequences of waterlogging beforehand, especially when it comes to excessive groundwater levels [1]. However, besides communicating the consequences the municipality should take measures to prevent waterlogging. For this perspective it is clear what the municipality expects from owners in the Vogelwijk, however, they do not agree upon the expectations that owners should make the basement waterproof [3]. The statement is even reversed: it is clear what the residents expect from the municipality. This perspective agrees that The Hague should be more climate-proof, there are quite some neighbourhoods that have groundwater nuisance [4].

Opportunity

This perspective agrees that owners are already taking measures against water nuisance, in the Vogelwijk owners are taking measures to make their basement waterproof [5].

This perspective is neutral on whether there should be rules that force owners to take climate adaptation measures to make sure precipitation can infiltrate. It is agreed upon that gardens that prevent water from infiltrating are not preferred, however, the question remains whether adapting all gardens will substantially prevent waterlogging [7]. This perspective sees no direct role for tenants to take climate adaptation measures or stimulate their landlord, their landlord is primarily responsible for the building and plot as stated in the lease agreement [8].

Motivation

This perspective agrees that wrong to expect that owners will take sufficient measures to prevent rainwater from being discharged to the sewer [10]. The municipality and water authority are responsible for discharging the rainwater via the sewage system and it is beyond the ability of property owners to take sufficient measures. The municipality and water authority are able to prevent waterlogging [11]. Owners can help by taking measures (e.g., rain barrel), but they do not have to be so not so extreme that they prevent discharge to the sewage. Even though currently there might not be enough public space to take prevent waterlogging, this can be created by the municipality for example with a water square [12]. This perspective does not agree that it is the responsibility of higher-lying neighbourhoods to take measures to prevent waterlogging in lower-lying neighbourhoods, it is an unjustified appeal to solidarity by the municipality [14]. It is legally determined that the water authority and municipality have the task of preventing waterlogging, they also receive money to do so via taxes [16].

Challenges

For this perspective, there is an urgency to take measures to prevent waterlogging, since it is unpredictable when exactly owners will receive the nuisance [25]. When taking measures to prevent waterlogging it is important that drought is also considered.

Perspective 3: All in(volved)

Factor 3 has an eigenvalue of 3.20 and explains 20% of the study variance. Five participants are significantly associated with this factor. Four females and one male. One participant works for the Delft University of Technology (TU Delft), one at the municipality of The Hague, one at Sustainable

The Hague, a homeowner in the Vogelwijk, and a tenant at a housing corporation in Transvaalkwartier. The distinguishing statements are presented in Table 16. The title of the perspective is ***All in****(volved)* (Dutch: Stimuleren als het kan, verplichten als het moet).

Capability

This perspective agrees that cities all over the world, and thus also The Hague, should be more climate-proof [4]. Including nature in the urban environment could benefit human health as well.

Table 16. Distinguishing Statements for Factor 3: significance P < .05 (*), P < .01(**)

#	Statement	F3	F1	F2
7	Tiled gardens should be banned to oblige property owners to take measures against waterlogging	3**	-1	0
4	The city of The Hague must be more climate-proof	3*	2	0
6	More regulation is a good idea to encourage property owners to take measures against waterlogging	2**	-2	-2
10	Owners have taken adequate measures if no rainwater from their property enters the sewage system	1*	0	-3
16	Property owners pay taxes; hence they can expect that the municipality and water authority prevent waterlogging	0**	-3	3
8	It is not up to tenants but up to property owners to take measures against waterlogging	-1**	0	1
23	It is equally doable for residents from different neighbourhoods to start a climate-adaptive initiative	-3		
11	The municipality and water authority are able to prevent waterlogging, they do not need the help of property owners	-3		

Opportunity

This perspective agrees that regulation against tiled gardens is a good idea [6]. This could reach those owners who normally would not take measures when only trying to stimulate them. Legislation can cause create big breakthroughs, it is however only one aspect of the solution, for example, enforcement and education about the *why* are important things to consider. This perspective also agrees that banning *completely* tiled gardens to oblige property owners to take measures against waterlogging is a good idea, for example, 75% should be green [7]. Besides owners, also tenants have a role in climate adaptation. They can take measures in their garden or balcony to prevent waterlogging.

Motivation

This perspective agrees that it too extreme to expect from owners that they take adequate measures, so no rainwater is discharged to the sewage system [10]. However, it is a nice goal to discharge as little as possible or at least have a delay in the discharge. Still, the sewage system should always remain available for rain showers that the private stakeholders cannot process. It is also agreed upon that it is not preferable that the municipality and water authority prevent waterlogging without the help of measures on private land [11]. Even if it is possible, it would require very technical solutions which would not make the living environment an attractive place to live. There is a shared responsibility between the municipality, water authority, property owners and

tenants to prevent flooding [16]. Climate change puts more pressure on the water system, so the current taxes may no longer suffice to prevent waterlogging. However, for example, the municipality should definitely make sure the sewage system is operating properly.

This perspective agrees that it could be more difficult to start a climate-adaptive initiative for residents from, for example, Transvaalkwartier [23]. It is can be a bureaucratic hassle to arrange subsidies and it depends on how the residents from the neighbourhood are organised among themselves.

6.5. Conclusion

Three different perspectives on taking climate adaptation measures in the urban environment were found (Figure 37).

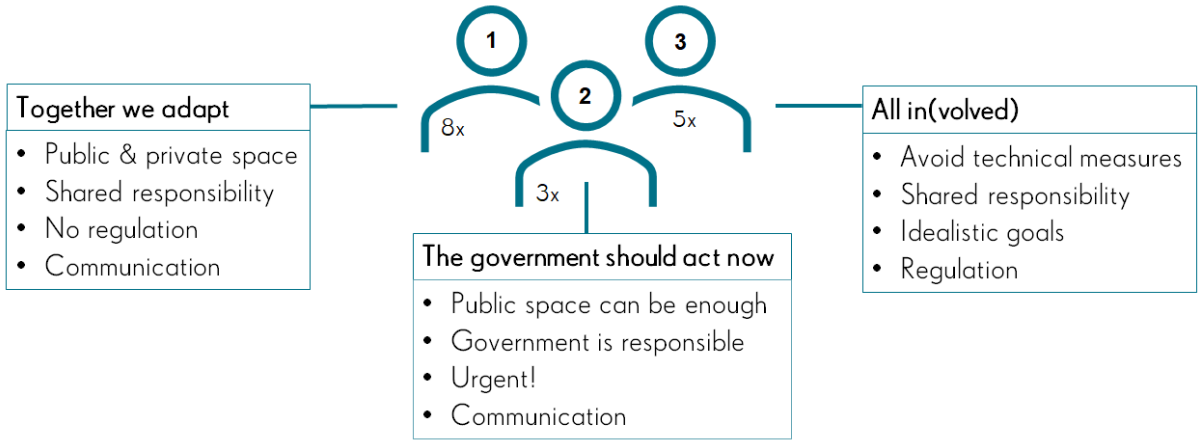


Figure 37. Overview of the three different perspectives on taking measures to reduce waterlogging

The perspectives have different ideas about which components of the COM-B model are more important. *Together we adapt* and *All (in)volved* agree that cooperation is very important to achieve the climate-resilient and water robust goals, the factor sense of unity is very important. For the perspective *The government should act now* the sense of unity is of less importance and sees a smaller role for the owners.

Together we adapt sees stimulation as the most important instrument to increase the opportunity of private stakeholders to take climate adaptation measures. *All in(volved)* also finds stimulation important, however, when this is not enough regulation can be applied as an instrument to enforce change. *Together we adapt* finds regulation an undesirable instrument and *The government should act now* is neutral about whether regulation is a desired instrument to increase the opportunity of private stakeholders. For *The government should act now* the current laws and regulation are very important, the municipality and water authorities have the responsibility to prevent waterlogging.

The perspectives see different opportunities for the public and private space of the urban environment. *The government should act now* sees an opportunity in the public space, when it would adapt it could prevent waterlogging. *Together we adapt* does not see the opportunity of solely the public space to reduce the risk of waterlogging, the help of owners is needed since they own a large fraction of the urban environment. *All in(volved)* also sees the need for both the public

and private space to adapt. Climate change and urbanisation are putting more pressure on the current urban water system, with the help of owners and tenants it is possible to prevent waterlogging without the need for major (technical) measures.

Together we adapt and *The government should act know* agree that the psychological distance to climate change effects should be lowered. The municipality and water authority should spread knowledge about the (specific) waterlogging risks of owners.


7

7. Effect of the risk dialogue

In this chapter, the results of the combination of the constructive conflict methodology and risk dialogue are discussed. Firstly, the discussion of the risk dialogue is summarized. After the dialogue, the participants and a control group repeated the Q-sorts. These are compared on a quantitative and qualitative level to the pre dialogue Q-sorts, to evaluate the effect of the dialogue on the perspectives of the participants. Finally, it is concluded what the effect of the dialogue was on the relation between the stakeholders and the acceptance of responsibility to take climate adaptation measures.

7.1. Summary of the discussion

The dialogue is held via the online platform Microsoft Teams, due to COVID-19, with five stakeholders. A facilitator of the Community of Practice in the region of The Hague was the moderator during the dialogue. The Community of Practice organises meetings with municipalities and water authorities about climate change adaptation. The five participants present at the dialogue were from the following stakeholder types: municipality The Hague, water authority Delfland, housing corporation, homeowner, and TU Delft. Three participants were from the perspective *Together we adapt*, one from *The government should act now*, and one from *all (in)volved*. Due to practicalities, such as cancellations and unavailability, and by trying to avoid an overrepresentation of one of the stakeholder groups, the perspectives were not balanced. The risk dialogue is summarised below per agenda item:

1. Vulnerabilities to waterlogging of the case study neighbourhoods.

Transvaalkwartier: The heavy shower that is modelled in the stress test '*Waterlogging*' has not occurred yet in Transvaalkwartier. The vulnerability to waterlogging on the streets is therefore not recognised. The vulnerability to waterlogging due to groundwater levels is recognised since some storage spaces underground cannot be used anymore due to waterlogging nuisance.

Vogelwijk: The waterlogging on the football fields in the Vogelwijk could be because the sewage system is not incorporated in the model. Waterlogging due to groundwater is not visualised in a map but is the nuisance in the Vogelwijk was highlighted verbally, it could be that the nuisance felt underestimated as the nuisance was highlighted again in the discussion afterwards.

2. The perspectives

The three perspectives found in the previous chapter were presented and the participants were asked in which perspective they belonged (Table 17). The Delfland-participant stated that it could be that her/his perspective became stricter in the past weeks. The participant from the municipality and housing corporation were similar to the Q analysis. The homeowner is missing the nuance in the presentation of the perspectives and is thus not comfortable with choosing a perspective. The feedback of the homeowner is that there are no clear differences between the perspectives and the legal framework is missing. The Delfland participant responds to this and points out that there is a functioning legal framework for some waterlogging situations. However, the DPRA risk dialogues are about new situations and these situations either have no norms or the current norms need to be reviewed. Hence the risk dialogues are happening, to determine the ambitions. The participant from the TU Delft already knew the result beforehand.

Table 17. Dialogue group: self-assessed categorisation of perspective and the Q analysis

#	Participant	Self-assessed perspective	Q analysis
1	Water authority Delfland	3 (became stricter)	1
2	Municipality The Hague	1	1
3	Housing corporation Transvaalkwartier	1	1
4	Homeowner Vogelwijk	Not comfortable deciding	2
5	TU Delft	Not applicable	3

3. Acceptability of waterlogging situations

During the dialogue, four waterlogging situations were presented, and the participants argued whether they thought the situation was acceptable, undesirable, or unacceptable.

Situation 1: Heavy rain causes the mixed sewage system to overflow into the street.

The participants mentioned four dimensions of the situation that determines the category: 1) how often the situation occurs, 2) how long the wastewater is on the street, 3) the water depth, and 4) the location. Even though the situation is not simply placed within one category, it is useful to know the dimensions that are considered as important by the participants. It is remarkable that the water authority finds once every year unacceptable and the municipality has a policy of maximum once every two years. Furthermore, it is questioned whether there is an awareness that if this happens in Transvaalkwartier (vulnerable for this situation) it is wastewater.

Situation 2: Homes, shops and public buildings are inaccessible for a few hours or accessible by water (> 15 cm) on the street.

The second situation is more specific compared to the first situation, hence fewer dimensions are proposed by the participants. The first dimension is how often the situation occurs, for example when this situation occurs after a shower with a return period of once every two years it is unacceptable. However, the municipality says that in the current system, it is almost impossible to prevent this from happening when there is a force majeure such as the stress test models. The second dimension is the location of the situation, for example, whether the building has a vital function. Thus, in general, the situation is undesirable, and for vital functions, it is unacceptable to be inaccessible. It is important that it becomes clear what the liability is of the municipality at the moment in the scenario homes, shops and public buildings are inaccessible, for example, can the municipality invoke force majeure when a stress test scenario occurs? Or are they liable according to the current law and legislation, even though it is an extreme shower.

Situation 3: Rainwater flows into the building from the public space or the property of the neighbour.

The four dimensions that were mentioned during the dialogue:

1. How often the situation occurs: The more often the more undesirable.
2. The consequences: Rainwater is clean, unlike the wastewater from situation 1, but still the aim is to have no water in the house.
3. Location: The location of the situation can determine the responsibility to solve the problem. It was discussed whether the acceptability should be based on the consequences of the situation or the responsibility to prevent the situation. The water authority argues that the consequences should be considered when categorising and not the responsibility. The private parties from the external dialogue labelled this situation as the responsibility of the municipality.

4. The measures needed to solve the situation: Sometimes taking measures immediately is too costly, and this needs to wait to be implemented simultaneously with other activities such as replacing a sewage system.

Situation 4: Due to higher groundwater levels cause crawl spaces and basements become moist.
In this situation waterlogging due to excessive groundwater levels is discussed. The situation is labelled as undesirable, and for owners and tenants, the situation is unacceptable. Both property owners have experienced nuisance from groundwater. The point of view of the participants is described below.

The homeowner in the Vogelwijk is having nuisance after the change from a combined towards a separate sewage system and argues that the storage of rainwater underground should not cause the groundwater level to rise above basements level. When the cause would be natural the municipality would still need to try to prevent nuisance by keeping the groundwater level below the basement level, as the Water Act states that the municipality should try to prevent structural nuisance. The municipality is responsible to be the first to act, after this both parties can talk since the cost should remain reasonable.

The housing corporation in Transvaalkwartier, especially the South-West of the neighbourhood, has many underground storage spaces. Due to waterlogging some of the storage spaces cannot be used anymore, in this case, the tenants receive a reduction of rent. The nuisance is because the groundwater levels are higher than the storage spaces, but also because the property is not waterproof. It is best to cooperate and see what the possibilities are for the municipality to lower the groundwater level and for the corporation to make their property waterproof.

The participant from the TU Delft mentions that owners are responsible for the groundwater underneath their property. Which can be unfair since the municipality is more in control than a property owner, thus perhaps this responsibility should change.

The water authority mentions that the climate is changing, it is to be expected that groundwater levels will become higher in winter in many areas and lower in summer. Communication about this change is key. Owners need the information that this is going to happen, and what their responsibilities are. This message is extremely difficult, but it does not help to not mention it.

The municipality mentions that the groundwater levels in The Hague are expected to rise, especially close to the sea if the sea level rise is continuing. There is a dilemma: taking climate change adaptation measures that store water under the ground and make buildings waterproof or limit the climate adaptation measures and not use the space under the ground to store water. It is about finding an optimum.

4. Potential measures to prevent waterlogging

During the dialogue, three packages of measures were presented, and the participants were asked which package they would prefer. However, it turned out to be rather difficult for the participant to choose one of the packages. This was anticipated and thus the participants were not forced to decide, the remarks of the participants are summarised in Table 18.

Table 18. Overview of the remarks on the climate adaptation measures during the risk dialogue

Perspective	Participant	Remark
1	Water authority	• Measures are situation depended • Taking measures in the public space is not enough if there is a lot of nuisance • In case of nuisance a rain barrel will not have a lot of effect.
	Municipality	• All packages contribute • Only taking public measures is not enough, since 60% is private space • Only taking big public measures (e.g., water square & urban water buffer) requires a lot of money • Research needed about how efficient and useful the measures are
	Housing corporation *Transvaalkwartier*	• All three packages are needed • Taking small measures can be a starting point, from then it can grow into something bigger • Difficult to force tenants to take measures, rather try to stimulate them and explain the benefits • Participation with tenants difficult, climate change adaptation it is not at the top of their priority list. • Housing corporation is an easy stakeholder for the municipality to communicate with instead individual (uninterested) property owners.
2	Homeowner *Vogelwijk*	• All packages have interesting elements. • Subsidy to help private owners to take measures to waterproof buildings. The subsidy should not be for the houses that are currently build since they must be watertight to meet the requirements of the Bouwbesluit. • There is a legal framework, and the laws are developed over many decennia and are developed with foresight. For example, the Water Act is broadly applicable to water storage, drought, too much water, and too little water. For now, use the current laws and see within this legal framework what can we do within this space. If needed laws could be changed.
3	TU Delft	• All packages are needed, it is a system and all parts work together. • Regulation could be useful, to stimulate those that otherwise would not take measures. • Currently, there is a transition, and we have to adjust to the new situation. However, we still have the rules from the old situation, perhaps some need to change. • The transition should avoid only technical solutions. First, try to see whether water can be given space more naturally.

7.2. Quantitative comparison

In order to analyse the effect of the dialogue, the five participants that participated in the dialogue repeated the Q-sort. The control group consists of four participants because one participant was not able to execute the Q-sort in time. Seven participants are neither part of the dialogue nor the control group (Figure 38).

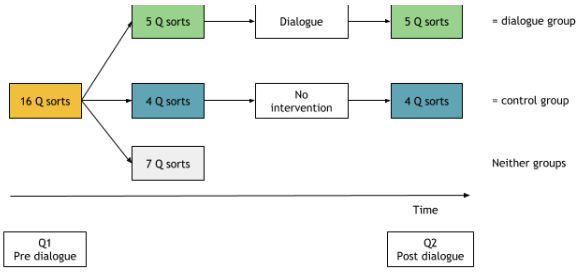


Figure 38. Schematic overview dialogue (N=5) and control group (N=4)

The aim of the quantitative analysis is to compare the perspectives from Q1 and Q2 sorts of the dialogue and control group. As explained in chapter 3, the data of the Q2 sorts (N = 9) are added to the Q1 sorts (N = 16), resulting in 25 Q-sorts. The factor analysis is applied to this dataset (N = 25), to retrieve the three *new* perspectives using the Ken-Q Analysis (Banasick, 2019). The results of the second factor analysis are presented in **Appendix VIII:** *Q2 factor analysi*. Next, the factor loadings of the 16 Q1 sorts on the *new* and *initial* three factors are correlated to check whether the factor loadings are indeed comparable (Table 19). The correlations of factor 1 and factor 2 are high, however, factor three has a negative correlation. This means that the *new* perspective 3 does not compare to the *initial* perspective 3. It is therefore not possible to continue the quantitative analysis.

Table 19. Correlation between initial three factors (N=16) and the new three factors (N=25) of the Q1 sorts

	Factor 1		**Factor 2**		**Factor 3**	
	Initial	**New**	**Initial**	**New**	**Initial**	**New**
1	0.85	0.71	0.04	-0.12	0.12	0.33
2	0.05	0.06	0.62	0.60	0.31	0.44
3	0.73	0.76	-0.05	-0.01	0.48	0.44
4	0.19	0.54	0.13	0.28	0.72	0.16
5	-0.03	0.01	0.78	0.73	0.03	0.02
6	0.70	0.60	0.14	0.08	0.17	0.39
7	0.85	0.59	0.03	-0.15	0.14	0.65
8	0.62	0.71	0.00	0.07	0.41	0.22
9	0.36	0.68	-0.18	0.01	0.67	0.08
10	0.28	0.43	0.07	0.16	0.60	0.32
11	0.02	0.40	0.40	0.70	0.70	-0.04
12	0.67	0.76	0.26	0.23	0.37	0.15
13	0.37	0.21	0.53	0.50	-0.11	0.13
14	0.72	0.80	0.16	0.17	0.54	0.42
15	0.47	0.74	0.13	0.19	0.56	0.10
16	0.52	0.39	0.40	0.29	0.28	0.55
		0.76		**0.89**		**-0.25**

7.3. Qualitative comparison

In this section, the change in *most agree* and *most disagree* statements between Q1 and Q2 of the dialogue and control group is analysed. The *most agree* and *most disagree* statements are placed at the extremes of the Q-sorting grid and indicate what the participants find most important.

An overview of the changes in extreme statements of the dialogue group is presented in Table 20. There are no to only subtle changes in the extreme statements. The water authority highlights the importance that everyone is needed at after the dialogue, instead of highlighting the importance of stimulation and communication. After the dialogue, the housing corporation highlights that regulation is not a good idea to stimulate residents. And the TU Delft highlights that there is a transition happening. The homeowner and municipality The Hague did not have any changes in their extreme statements, these participants are on opposite sides.

Table 20. Overview changes (Q1 vs Q2) in 'most disagree' and 'most agree' statements of the dialogue group

Participant	Factor	Changes in extreme statements?
1. Water authority Delfland	**1**	The most disagree statements are similar at Q2 as Q1: private space majority of city and thus private parties' measures needed
		The most agree statements have shifted from stimulation and communication focus towards emphasis that everyone is needed to prevent waterlogging
2. Municipality The Hague		The most disagree statements mainly mention the responsibility for owners to prevent waterlogging at both Q1 and Q2
		The most agree statements mention at both Q1 and Q2 that property owners benefit by taking measures and that properties should be watertight
3. Housing corporation		The most disagree statements mention at both Q1 and Q2 that the help of property owners is needed, however at Q2 it is emphasized that regulation is not a good way to stimulate residents, first awareness is needed.
		The most agree statements at Q2 focus solely on financial support, whilst Q1 also mentions that taking measures is useful for property owners.
4. Homeowner	**2**	The most disagree statements at Q1 and Q2 mention that owners should not have to pay for the financial consequences when it is the wrongdoing of the government and owners should not have to take measures to limit discharging to the sewer (Q1) and prevent waterlogging somewhere else (Q2)
		The most agree statements are similar at Q1 and Q2: government has the task to prevent waterlogging, and there is an urgency
5. TU Delft	**3**	The most disagree statements mention at both Q1 and Q2 that property owners need measures, to avoid very technical solutions
		The most agree statements shift from Q1 about regulation to stimulate property owners to Q2 emphasises the system change and transition of climate change adaptation

An overview of the change in the extreme statements of the control group is presented in Table 21. The control group did not participate in the dialogue, but three of the four participants had a shift in the extreme statements. The housing corporation participant first had a focus on the importance of the shared responsibility and that everyone is needed. However, this shifted towards a focus on the difficulties of taking private measures and emphasizes that the municipality needs to take on a coordinating role. The argumentation of the municipality participant remained very similar, private space is needed to prevent waterlogging. However, it was added that it is a nice aim for property owners have as little as possible discharge to the sewer. The garden industry participant first focussed more on the fact that regulation is not the way to stimulate. However, the second time it is emphasized that that communication is needed to make sure the expectations of the municipality and water authority towards property owners are clear. The extreme statements of the homeowner remained similar over time.

Table 21. Overview changes (Q1 vs Q2) in 'most disagree' and 'most agree' statements of the control group

Participant	Factor	Changes in extremes?
1.Housing corporation		The most disagree statements shifted from emphasis on a responsibility of all parties to take measures (Q1) towards the difficulties of property owners to take measures (Q2)
		The most agree statements in both Q1 and Q2 emphasize the role of the municipality (coordinate, inform and stimulate), at Q1 it emphasized everyone is needed to prevent waterlogging
2. Municipality	**1**	The most disagree statements at both Q1 and Q2 mention the need of the private space to adapt since it is a large fraction of the city
		The most agree statements also mention the need of the private space to adapt. At Q1 the need for awareness that private parties are part of a system is mentioned and at Q2 the aim to have minimal discharge to the sewer is mentioned
3.Garden industry		The most disagree statements shift from disagreement of regulation to the need to communicate about expectations of private parties. Both Q1 and Q2 mention the need of property owners to take measures
		The most agree statements emphasize at Q 1 and Q2 that measures should be made easy and have a benefit & that cooperation in stimulating residents is key
4. Homeowner	**2**	The most disagree statements are similar in the argumentation that it is the task of the municipality and not property owners to prevent waterlogging in lower-lying neighbourhoods. And ground cannot be used as storage when damaging property
		The most agree statements remained the same: water authority and municipality are in control to prevent waterlogging and adaptation is urgent to prevent waterlogging

7.4. Conclusion

The interaction between the participants during the dialogue is presented in Figure 39. The statistical analysis to evaluate the effect of the dialogue from the constructive conflict methodology was not possible, because the *new* factor 3 was not comparable with the *initial* factor. It was however possible to compare the qualitative data of the pre- and post-dialogue Q-sorts. Three participants had minor shifts in what they ranked as most important after the dialogue. However, these changes do not mean they increased the acceptance of another perspective. The changes were made to highlight their own argument also applied during the dialogue. Two participants had no shift in their *most agree* and *most disagree* statements after the dialogue. One private stakeholder already had a perceived responsibility prior to the dialogue. One private stakeholder did not have a perceived responsibility, and this did not change during or after the dialogue. The public stakeholders also did not lower their perceived responsibility for private stakeholders. Lastly, it was remarkable that the control group also had shifts in perspective, the shifts were even more extreme compared to the dialogue group. This indicates that the perspectives are not static over time.

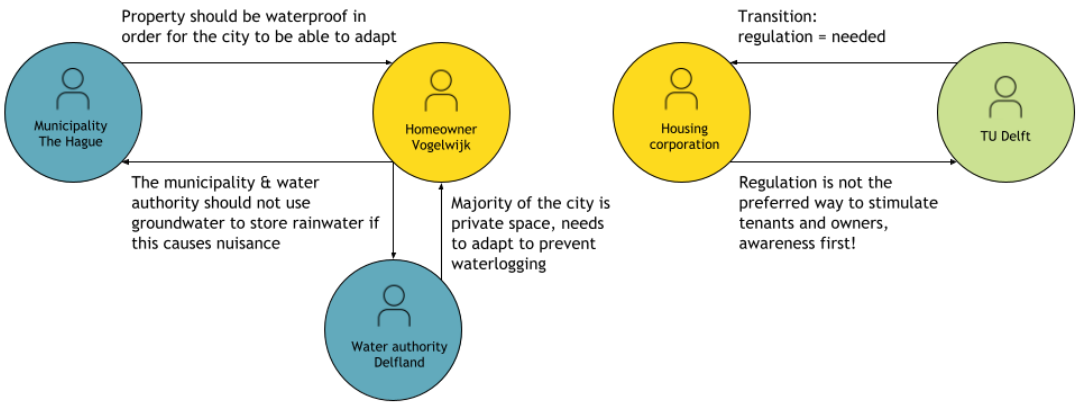


Figure 39. Interaction between the participants of the risk dialogue


8

8. Discussion

First, the scientific contribution of this study is discussed. Hereafter, the implications of conducting the research online and the ethics related to private responsibility of groundwater are considered. Lastly, the limitations of this study and the recommendations for future research are presented.

8.1. Scientific contribution

A stakeholder group is not a perspective

This research supports the theory discussed in the constructive conflict methodology, that stakeholders from the same stakeholder group (e.g., municipality) can have different perspectives (Cuppen, 2010). Hence, when aiming for a diverse group of perspectives in a dialogue, it is more useful to select stakeholders based on the results of the Q methodology instead of the stakeholder group.

Different perspectives on the roles & responsibilities

Previous research about climate-adaptive behaviour of residents in the Netherlands concluded that even though residents are aware of climate change and the potential damage, they see no role for themselves in taking measures (Kreemers et al., 2020). Also, Brink & Wamsler (2019) concluded that there is a gap between the prescribed and perceived responsibility of residents to help process rainwater. This research suggests that there are different perspectives within the stakeholder group owners and tenants on the role and responsibilities to reduce waterlogging. Some private stakeholders perceive a shared role and responsibility between public and private stakeholders, whilst others view the public stakeholders as responsible. It is not realistic to conclude that an entire stakeholder group views the roles and responsibilities to reduce waterlogging in a similar way.

Awareness of responsibilities does not equal taking measures

Previous research argued that there is an association between the awareness of the legal responsibilities and implementation of measures to reduce waterlogging (Trell & van Geet, 2019). In this research, the stakeholders from the perspective *The government should act now* were very aware of the legal responsibilities of public and private stakeholders regarding urban water management. However, this did not result in taking measures to reduce waterlogging, instead, they perceived a sole responsibility for the government. The differences in the perceived responsibilities are a result of laws and regulation leaving room for interpretation.

No radical change in perspective

The constructive conflict methodology concluded that there were no radical shifts in perspectives after the dialogue (Cuppen, 2010). This study could not statistically analyse a shift in perspective between the pre- and post-dialogue perspectives. Yet, this study confirms that the *most agree* and *most disagree* statements after the dialogue reflected their pre-dialogue perspective.

8.2. Online Q methodology and risk dialogue

In the literature it is recommended that the Q methodology is performed face-to-face, this way the participant can ask for clarification about statements and the researcher can ask follow-up questions during the sorting (Watts & Stenner, 2012). However, in this study, the Q methodology was performed online as a result of the COVID-19 measures. Luckily, the acceptance of online meetings drastically increased during the COVID-19 pandemic. The participants sorted the statements on the website whilst sharing their screen in a video call. Two of the participants preferred a face-to-face interview. This is less desirable since it is difficult to see how the participant ranks the statements from 1.5-meter distance. When comparing the online to the face-to-face interviews there is no indication of a reduction in the quality of the retrieved data.

The risk dialogue was also performed online due to the COVID-19 measures. To keep the participants engaged, the number of participants was very limited. The meeting lasted two hours and included a 10-minute break. The participants seemed engaged and the moderator would make sure that there was a balance between the speaking time of the participants. The risk dialogue is not performed in real-life, thus it is not possible to say what the influence was of having an online dialogue compared to a real-life dialogue. A benefit of an online meeting is that it is less time-intensive, this improves the likelihood of participants to join that otherwise be located too far away or would have no time to come to a meeting.

8.3. Water ethics

In the current laws and regulation, it is stated that private owners are responsible for the groundwater underneath their property. However, they are not able to influence these groundwater levels, the risk of groundwater nuisance is not visible, and the measures needed to reduce groundwater nuisance are very expensive. This makes it questionable whether all private stakeholders are capable of handling this responsibility, also considering the nuisance from groundwater level is expected to increase due to climate change. It is important that when responsibilities are delegated to residents, the government empowers them to be able to handle the responsibility. It must be avoided that inequality between residents increases, because they rely on self-efficacy.

8.4. Limitations of the study

Limited scope of climate adaptation themes

The broad focus on public and private stakeholder groups in this research increased the complexity, thus to keep the research doable the climate adaption themes were narrowed down to solely waterlogging. This means that the interactions between waterlogging and the other climate change adaptation themes droughts, heat stress, and floods were disregarded. Although when taking measures, it is too limited to focus solely on waterlogging. For example, sometimes there is an excess of water (waterlogging) and other times a lack of water (drought), this can complement each other. Another example is that taking measures such as replacing tiles with green both reduces waterlogging as heat-stress.

Framing of statements

The way the statements are framed has an influence on the ranking because the participants all have their own interpretation of the statements. For example, some participants mentioned their dislike for slogans and hence ranked statement 22[3] lower than they would have otherwise. Also, some participants viewed the responsibilities to reduce waterlogging as how the current responsibilities are stated by law, whilst other participants interpreted the responsibilities as how they should be divided in an ideal scenario. Furthermore, the Q methodology requires the statements to be framed as an opinion and they cannot be factual. However, during the interviews, it became clear that some participants were more comfortable with giving their own opinion, whilst others struggled and would much rather keep it to the facts. Additionally, some statements were framed in a way they did not represent the COM-B model factor they were linked to. For example, statement 9[4] was poorly framed and is more about *who* carries the financial damages instead of what *the risk* is of having financial damage due to waterlogging.

Imbalance of the COM-B factor perceived responsibility

Every statement of the Q methodology is linked to a theme. In this study, they are linked to the factors of the COM-B model, for example, sense of unity, perceived costs, and risk perception. The themes are supposed to be equally represented in the Q set. In this study, there was a specific interest in the perceived responsibility to take measures thus this theme was overrepresented in the Q set. However, this resulted in an imbalance because sometimes all extreme statements in the Q-sorting grids were linked to sense of responsibility providing little insight into the other factors.

Diversity participants

The P-sample of the Q methodology should represent as much diversity as possible. This study aimed but did not succeed in interviewing owners and tenants with a negative view on climate change adaptation. For example, those who have a garden full of tiles and are unwilling to adapt. This study is definitely missing a perspective, as there are many gardens with tiles. The homeowners in the Vogelwijk did offer a different perspective compared to the other stakeholders. However, the waterlogging nuisance of the basements after the change of the sewage system was a conflict situation. This made the participants of the Vogelwijk and the involved employee of the municipality more rigid in their perspective.

Risk dialogue design

Prior to the dialogue, the perspectives should have been communicated to the participants. This would have given the participants more time to digest the information and the researcher more room to describe the perspectives. In addition, the results of the stress tests can be sent to the participants prior to the risk dialogue to give them the opportunity to prepare the validation of the vulnerabilities. By sharing the perspectives and the vulnerabilities only shortly during the dialogue, it is unknown how much of the information the participants were able to digest. It could be that they did not yet internalise the new information.

[3] The slogan "Only together can we make the Netherlands climate-proof" is accurate

[4] The financial consequences of damage caused by waterlogging is for property owners

Besides, the moderator could have been better informed by the researcher about the existing conflicts between the perspectives. For example, by showing the moderator the different responses of the participants to the same statement. This way the moderator could have steered the conversation towards the conflicts. Lastly, during the dialogue, the vulnerability of waterlogging due to groundwater nuisance was not emphasized well enough. Perhaps because it was not visible on a map like waterlogging due to an extreme rain event.

Ability to generalise the results

The goal of the Q methodology is to explore the perspectives of a target group. Thus, the method does not claim that it represents the variety and content of opinions of the larger population. Hence, the findings of this study do not claim to have captured all perspectives on taking measures to reduce waterlogging. If the study would be repeated with a larger P-sample, or with a more diverse target group, then there could be another representation of the same perspectives or even new perspectives could arise. Thus, the results cannot be generalised to other municipalities in the Netherlands. It does mean that the perspectives presented in this study exist and that they potentially exist in other municipalities as well.

8.5. Recommendations future research

Climate change adaptation themes

As mentioned in the previous section, only the DPRA climate adaption theme waterlogging was applied in this research. The other themes (droughts, heat-stress, and floods) can be included to increase the understanding of the perspectives on climate change adaptation as a whole. However, to keep the research doable perhaps the diversity in stakeholders should be limited. To limit the stakeholder complexity, the risk dialogue can be applied to internal risk dialogues. These are risk dialogues within different departments of the municipality. This can provide more knowledge of the differences between the urban planners and water managers.

Improve connection between COM-B model and statements

As mentioned above, the link between the COM-B model and the statements could have been more refined. Some themes were missing (e.g., physical capability) and the sense of responsibility was overrepresented. Improving the link between the COM-B model and the statements could increase the understanding of what behaviour the perspective is linked to.

Diversity of the participants

It is recommended that this research is repeated with a larger variety in the P-sample. More effort should go towards finding other perspectives on climate change adaption. There are plenty of gardens full of tiles, however, this study failed to find them. One could go door by door, this is not done during this study because of the COVID-19 measures.

Pre- and post-risk dialogue design

The participants of this research invested a lot of time on a voluntary basis, namely, they executed the Q-sorting twice (total of 75 minutes) and some also participated in a two-hour dialogue. Hence, it was chosen not to ask the participants to prepare anything in the preparation phase of the dialogue. However, ideally, the perspectives and waterlogging vulnerabilities are shared prior to the dialogue. This gives the participants the ability to digest the information and to give the researcher more space to explain the perspectives and vulnerabilities. To limit the amount of effort for the participants to understand the perspectives beforehand, the researcher could record a video wherein the perspectives are explained. Or the participants could be paid for the time they invest in the research.

Additionally, the design of the post dialogue should be improved. The repeated Q-sorts can be accompanied with a short survey. The survey can give insight in how the participants experienced the dialogue, whether they were given enough opportunity to share their thoughts, if they have learned something new during the dialogue, and whether the perspectives were insightful.

9

9. Conclusion

First, the answers to the sub-research questions are revisited to answer the main research question. Hereafter, the contribution of the research to the Delta Plan on Spatial Adaptation is discussed. Lastly, the implications of the result are highlighted.

9.1. Answers to the research questions

SQ 1: What is the influence of potential vulnerabilities to and measures against waterlogging on the larger urban scale on the acceptance of climate change adaptation?

The local circumstances, potential vulnerabilities, and measures against waterlogging of a neighbourhood can influence the factors of climate-adaptive behaviour. For example, the waterlogging vulnerability due to heavy rain is visualised in the stress test of the DPRA, which can increase the *risk perception*. In contrast, waterlogging due to excessive groundwater levels is not visible this makes it difficult for private stakeholders to *perceive it as a risk*. Consequently, there are numerous adaptation measures against waterlogging due to heavy rainfall, ranging from very small and cheap measures to large and expensive (*perceived costs*). Taking measures to reduce groundwater nuisance is always very expensive. Next, when climate adaptation measures are visible in neighbourhoods this can increase the *social norm* of taking measures. Lastly, housing corporations can use their renting contracts to enforce measures (*physical environment*).

Furthermore, it was found that the local circumstances of neighbourhoods can differ extremely, which results in different vulnerabilities to waterlogging. The circumstances and vulnerabilities determine which adaptation measures are needed and whether it possible to implement them locally. When measures are needed, but it is not possible to implement them locally there is a dependency on other neighbourhoods. On the other hand, some neighbourhoods do not need measures whilst it is possible to implement them. Public stakeholders operate on the larger urban scale and are aware of this dynamic between neighbourhoods, whereas private stakeholders perhaps not realise this dependency.

SQ 2: What are the interests and power of the main public and private stakeholders to influence the urban environment on the larger urban scale to reduce waterlogging?

Municipalities and water authorities are considered key players; they have a high interest and power to influence the urban environment on the larger urban scale to reduce waterlogging. The interest within municipalities can differ between urban planners and urban water managers. With urban planners more focused on participation and the design of the urban environment and water managers more focussed on the technological aspects such as the capacity of the sewage system.

Property owners are considered context setters, who need to be satisfied. They have a high power to influence their private property in the urban environment, and they have blocking power to influence the public space. Tenants are considered as crowd as they have minimal power. They can influence the property they rent and/or stimulate their landlord. However, this influence is to a lesser extent compared to owners. Owners and tenants are assumed to have a very local interest in the spatial planning and less so on the larger urban scale. It differs per neighbourhood what type of homeowners and tenants influence the urban environment.

SQ 3: What are the main perspectives of public and private stakeholders on taking measures to reduce waterlogging in the urban environment on the larger urban scale?

In this study three different perspectives are found on taking measures to reduce waterlogging in the urban environment on the larger urban scale: 1) **Together we adapt**, 2) **The government should act now**, and 3) **All in(volved)**. The perspectives found different factors of the COM-B model important. For *Together we adapt* and *all in(volved)* a sense of unity is very important, there is a shared responsibility to adapt. Both *Together we adapt* and *all in(volved)* find stimulation to motivate private stakeholder very important, e.g., by lowering the perceived costs with subsidies. Furthermore, only *all in(volved)* sees an opportunity in using regulation to enforce private stakeholders to take measures. Lastly, to *The government should act now* the current laws and regulations are very important, hence they view the municipality and water authority as responsible. For example, the municipality should increase the psychological capability of private stakeholders by sharing information about groundwater nuisance.

SQ 4: What is the influence of the risk dialogue on the relations between stakeholders and acceptance of responsibility to take climate adaptation measures to reduce waterlogging in the urban environment on the larger urban scale?

In this research, it was not possible to apply the statistical analysis of the constructive conflict methodology to evaluate the effect of the dialogue. Still, the qualitative data from the pre- and post-dialogue Q-sorts made it possible to evaluate whether there are differences between the statements that were ranked as most important.

Prior to the risk dialogue the perspective *Together we adapt,* and *The government should act now* were already quite similar, for example, both put a lot of emphasis on the shared responsibility to reduce waterlogging. However, they differed in whether regulation should be applied to increase the amount of climate adaptation measures taken by private stakeholders. During the dialogue, this difference again was highlighted between two participants: on the one hand, it was argued that regulation is needed for the transition of the urban water system and on the other hand it was argued that this will not work in practice, and that first awareness is needed. After the dialogue, the participants from these two perspectives did not come closer together. Furthermore, two stakeholders, from *Together we adapt* and of *The government should act now*, remained very similar in their most important statements and argumentation. They have an opposite perspective and did not change their opinion after the dialogue. Lastly, it is important to realise that even without a dialogue, some participants of the control group changed their most important statements.

MRQ: How can the acceptance between public and private stakeholders on taking climate adaptation measures to reduce waterlogging on the larger urban scale be increased?

The issue 'taking climate adaptation measures to reduce waterlogging on the larger urban scale' is very complex. Firstly, due to local circumstances, the effects of climate change can differ per neighbourhood. Consequently, the waterlogging vulnerabilities and needed measures also differ per neighbourhood. Secondly, the urban environment is both owned and thus influenced by public and private stakeholders. Whilst public stakeholders balance the interest of spatial planning on a larger urban scale, the private stakeholders are interested in their own situation. Thirdly, all these stakeholders have a different perspective on taking measures to reduce waterlogging, and these perspectives do not per se align with the stakeholder group they belong to. Having knowledge about the local circumstances, waterlogging vulnerabilities, measures, local stakeholders influencing spatial planning, and their perspectives is all useful information prior to a risk dialogue.

This research did not bring the different perspectives closer together, both the public and private stakeholders barely had differences in what they found important pre versus post dialogue. This research concludes that public stakeholders have to limit their expectations to change a perspective using the risk dialogue. For example, public stakeholders did not convince the private stakeholders that did not perceive responsibility to take measures. But also, private stakeholders within the dialogue did not come any closer to each other on whether regulation is a good idea. Lastly, the difference within the municipality between the urban planners and water managers about taking measures in the urban environment could not be analysed., as only a water manager was present.

However, the method applied during this research filters what the involved participants most disagree and most agree with prior to the dialogue, including their argumentation. Having this knowledge can help the municipality to prepare their argumentation, which they can use during the dialogue to increase the shared responsibility. Now argumentation was used that did not appeal to the participants, for example by using an argument linked to the sense of unity to a stakeholder that is more focused on the current laws and regulation. Explaining that the water system performs on a larger scale under the law of communicating vessels and thus higher-lying areas can prevent waterlogging in lower-lying areas, would rather evoke anger than convince the stakeholder as this is not stated by the law. This method can also be applied when there are differences within the municipality between departments, for example urban planners and water managers

This research focuses a lot on the conflicts since this is most interesting to solve. However, also consensus was found on some topics. Namely, there is agreement that subsidy is a good way to stimulate owners to take measures and that the municipality should financially support local initiatives. There is agreement that measures should be taken preventively and that taking measures has benefits. It is part of the primary task of housing corporations to take measures to prevent waterlogging, also the housing corporation themselves agreed. It is not expected that damage of waterlogging is covered by insurance.

9.2. Contribution to the DPRA risk dialogue

The DPRA risk dialogue is a type of participation used by public stakeholders, that is applied to discuss the acceptability of e.g., waterlogging situations that are more likely to occur due to climate change with private stakeholders. The risk dialogue aims to raise awareness of the vulnerabilities of the urban environment and to discuss measures public and private stakeholders can take to limit damage and nuisance. The implication is that the risk dialogue will increase the acceptance of private stakeholders to take measures. In this research stakeholders with different perspectives were gathered in a dialogue, it was aimed to increase the acceptance between stakeholders and bring their perspectives closer together.

During this research, it was found that the constructive conflict methodology is a suitable method to apply in the context of the risk dialogue. Firstly, prior to the dialogue, the Q methodology can determine the perspective of a stakeholder. This enables the municipality to invite stakeholders with different perspectives. Secondly, the municipality already has knowledge about what the perspectives will be of the stakeholders that are invited. This makes it possible to improve the preparation of the dialogue and enhances the ability to have suitable counterarguments. Thirdly, these perspectives can be presented prior to the dialogue which makes the participants become aware of their own and other perspectives. Lastly, the Q methodology can be applied again after the dialogue to evaluate the effect on the stakeholders' perspectives.

9.3. Implications of the findings

A stakeholder group is not a perspective

This research developed a more nuanced understanding of the different perceptions within stakeholder groups on the responsibilities to take climate change adaption measures. In addition, besides the differences in perceived responsibilities, there are also differences in the approach on how to stimulate private stakeholders. A good example is whether to use regulation or not to as stimulation for private stakeholders to take adaptation measure. The perspectives ranged from being against regulation, to having no opinion, to pro regulation.

Reaching consensus

This study suggests that governments should lower their expectations of using the dialogue to reach consensus. It could well be that participants will not change perspective during the dialogue and not all participants will agree with each other. When trying to reach consensus in an early stage it could be that decisions are made that in the end, no one will benefit from. For example, when excluding diverse perspectives, consensus can be reached too quickly. When having the dialogue, appreciate different perspectives and deliberately search for marginalised perspectives to enable informed decision making.

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APPENDICES

Appendix I: *Waterlogging*

The three types of waterlogging

In the Netherlands local precipitation of more than 25 mm in an hour is called a downpour (Dutch: hoosbui) (KNMI, n.d.-b). If there is more than 50 mm in one day than this is considered a day with heavy precipitation. Extreme precipitation is more than 50 mm in one hour and/or 100 mm in one day. The extremes 50 mm/hour and 100 mm/day have a return period of 1/100 year. Whether precipitation leads to waterlogging depends on the intensity and duration of the shower, and the local circumstances. As mentioned in the introduction there are three types of waterlogging (Kennisportaal Ruimtelijke Adaptatie, n.d.-d).

The first type of waterlogging, caused by short and severe precipitation, is most likely to occur in the summer and in the urban environment. Paved areas prevent the rainwater from infiltrating the soil. The rainwater turns into runoff and flows from the roads and roofs into the sewer system. The sewer system either drains the water to a wastewater treatment plant or to nearby surface water. The current capacity of the sewer system (20-30 mm/hour) is not designed for extreme downpours (Kennisportaal Ruimtelijke Adaptatie, n.d.-d). If the amount of precipitation exceeds the capacity of the sewer system, there is water in the streets. When there is not enough storage capacity in the streets, the water could runoff towards (vulnerable) objects or locations. Waterlogging happens if water flows into buildings or when important roads are inaccessible.

The second type of waterlogging, caused by prolonged precipitation, is most likely to occur in the winter. For rural areas, this type is a bigger problem than the first type of waterlogging. The large amount of precipitation does not pour down at once but is spread over days. This way the water system in rural areas can fill the water system, ditches and streams will inundate the land.

The third type of waterlogging is due to excessive groundwater levels caused by precipitation, groundwater levels are higher in the winter and lower in the summer. The average highest groundwater level and thus this type of waterlogging happens mostly at the end of the winter. When there is heavy precipitation, it is normal for the groundwater level to rise. This will slowly decrease when the water further infiltrates to deep subsoil, flows to ditches, or when the plants and trees absorb and evaporate the water. It is also possible that there are drainage facilities, that drain the water when the groundwater reaches a certain level. However, when the amount of precipitation is very long and/or severe it is possible that the subsoil and/or drainage facilities cannot process the water quickly enough. It is expected (KNMI'14 scenario) that the precipitation in the winter will increase, whilst evaporation will remain the same (Klimaateffectatlas, n.d.-b). This can cause a groundwater level that is too high. In urban areas, excessive groundwater levels can be very local and caused by human interference. For example, when replacing the sewer system, placing underground constructions that impact the groundwater flow, or when terminating groundwater extraction. In urban areas, excessive groundwater levels can lead to high humidity in the house and fungus formation due to wet crawl spaces/basements, saturated gardens, and drowning tree roots.

Climate adaptation measures to reduce waterlogging

Adapting the sewer system to extreme rainfall events would require very large and expensive sewers. In addition to the economic constraints, most of the time the large sewer system would be idle because the extreme downpours happen only for a short period of time. Thus, this would be a waste of sparse underground, which is also needed for the roots of trees to decrease the heat island effect and electricity for the energy transition. Instead of only focussing on expanding the sewer system, it is also possible to retain and store the water, drain above ground, infiltrate, reuse, and built water robust. See Table 22 for a description of the solution to reduce waterlogging and possible measures. Depending on the measures it can be applied in neighbourhoods, a building, the roof, the garden, the street, a square and a park.

Table 22. Climate adaptation solutions to reduce waterlogging and related measures (Amsterdam Rainproof, n.d.)

Solution	Description	Related measures
Retain and store	The peak of the extreme rainfall to the sewer is shifted and flattened, the water now flows slowly toward the sewer pipe when it is empty again.	Green roofs, bioswales, trenches, above-ground water buffers, ponds, underground storage facilities, water squares, or rainwater use installations.
Drain above ground	By draining the water above ground instead of via a sewer system, the water is visible again and it is less costly than a larger or separated sewer system.	gutters, ditches, watercourses, hollow roads, canals, IT-sewage
Infiltrate	If the soil conditions allow it, the rainwater can also be infiltrated by decreasing the percentage of pavement in the city. However, to limit damage during heavy cloud burst this must always be combined with other water-retaining facilities. This is especially the case if infiltration is not possible due to high groundwater levels.	replacing pavement with green, infiltration crates, turf pavement, greening tramlines, height differences in a garden
Reuse	Rainwater is relatively clean and therefore can be reused in the laundry machine, toilet or to water the garden. This will also reduce the amount of import of potable water.	rain barrels, helophyte filter, rainwater fence
Built water robust	This requires rainwater-resistant structures, choice of materials, installations, and infrastructure. In the future, vital infrastructure such as electricity, communication and drinking water will also have to be constructed in such a way that they can withstand a flood and continue to function.	Elevated buildings, shutters, pump with non-return valve, make basements water-robust

Appendix II: *The Water Plan*

The municipality of The Hague and water authority Delfland recognised that the water in The Hague is a joint responsibility, hence they joint forces and developed one plan for the urban water management. Namely the Water Plan covering the period 1998-2012 (Municipality The Hague, 1999). Delfland had the intention to pay more attention to the urban environment since the majority of the Delfland inhabitants lived in an urban environment (Witjes et al., 1999). The aim was to integrally improve and manage the surface, ground, and sewage water in the city. In the Water Plan the following characteristic of integrated urban water management are key:

1) Cohesion within water management, sustainable and functional use of water
2) Coherence with other functions within the urban area, such as spatial planning, green and recreation
3) Cooperation and consultation with other municipalities, water authorities, and residents

An important aspect of the Water Plan is to define and seek agreement on the objectives and ambitions. To increase the effectiveness of the discussions The Hague is divided into 10 subareas. The division is based on differences in water management, user function, groundwater situation, type of sewer system, and the possibilities to develop and recover the ecosystem (Roos et al., 1997). The Water Plan defined three different levels of ambition for the subareas: 1) water that decorates, 2) water that pleases, and 3) water that is alive. In the first ambition level amenity is key. The second level pays more attention to urban water management and the "wet" nature is strengthened. At the third and highest level, sustainable water management and developing water-dependent nature are important. The Vogelwijk is part of the area 'de Haagse Beek' of ambition level 3 and Transvaalkwartier of 'het Boezemgebied' ambition level 1, see the orange circles in Figure 40.

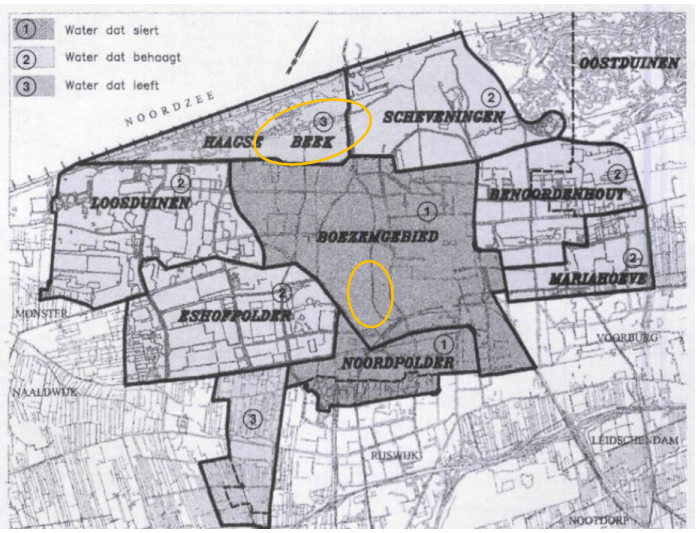

Figure 40. Levels of ambition of the different subareas (Witjes et al., 1999)

Appendix III: *Case study neighbourhoods*

Impression of Transvaalkwartier

Transvaalkwartier is part of the city district centre, which makes it an attractive location. The neighbourhood is divided in Transvaalkwartier-North, Transvaalkwartier-Middle and Transvaalkwartier-South. Especially Transvaalkwartier-South is densely populated (AlleCijfers, 2019b). Within Transvaalkwartier there is a neighbourhood park, and Zuiderpark, a large city park, is just around the corner. The largest outdoor market of the Netherlands is located in Transvaalkwartier, which is an attractive place to buy fresh food and clothes. In addition, in the Kempstraat and Paul Krugerlaan there are various shops. Within the neighbourhood, there is relatively little space for green. The neighbourhood has two welfare organizations, two neighbourhood organisations, various prayers rooms, a library, many primary schools, and a sports hall (Municipality The Hague, 2015b).

Impression of the Vogelwijk

Translated to English Vogelwijk means bird neighbourhood. The neighbourhood lives up to the name, there is a lot of space for trees and other green. The neighbourhood is bordering the dunes and the beach. The neighbourhood has three times the surface of Transvaalkwartier but is not divided unlike Transvaalkwartier, this is not needed since the entire neighbourhood is not so densely populated. In the neighbourhood, there are very little shops. There are many facilities for outdoor sports. On the edge of the Vogelwijk, there are green areas, *Bosjes van Poot* and *Westduinpark*. Westduinpark is a protected nature area (Natura 2000).

The neighbourhood programs

The activities mentioned in the Transvaalkwartier neighbourhood program of the municipality (2015-2019) are focused on creating more employment opportunities, the neighbourhood economy and living, education and upbringing, participation and integration, liveability and safety, social cohesion, and image improvement (Municipality The Hague, 2015b). This list of activities shows that there is little room for climate change adaptation. The activities mentioned in the Vogelwijk neighbourhood program of the municipality (2015-2019) focus on the sustainable living environment, liveability and safety, involving elderly, and neighbourhood involvement (Municipality The Hague, 2015c).

Table 23. Publicly available information about Transvaalkwartier and Vogelwijk (AlleCijfers, 2019b, 2019a)

	Transvaalkwartier	Vogelwijk
Inhabitants	16,180	5,339
Households	9,955	2,020
Surface	82 hectares	271 hectares
Average density of addresses	7,819 addresses/km^2	2,821 addresses/km^2
Houses	6,149	2,126
• **Social rent**	44%	2%
• **Private rent**	27%	9%
• **Private ownership**	29%	87%
Average price of the house	€140,000	€667,000
Average yearly income	€15,600	€43,800
Unemployment	1,540	40
Age		
• **0-14**	21%	22%
• **15-24**	12%	15%
• **25-44**	31%	14%
• **45-64**	24%	33%
• **65+**	9%	20%
Native inhabitants	7%	72%
Migration background	93%	28%
• **Europe, North America, Oceania, Indonesia, or Japan**	20%	80.5%
• **Morocco**	14.8%	
• **Turkey**	29.2%	1%
• **Suriname**	21%	3.8%
• **Antilles**	2%	1.7%
• **Rest of Africa, Latin Amerika, Asia**	21%	13

Appendix IV: *Waterlogging The Hague*

The Hague stress-test: Drainage Depth

Drainage depth is the difference between the surface and the groundwater level. The surface data is derived from the General Elevation map of the Netherlands AHN3 (*Dutch:* Actueel Hoogtebestand), the owner of the dataset is Rijkswaterstaat and the data is collected between 2014 and 2019. The groundwater level is derived from the groundwater data of Wareco. With the urban groundwater model of The Hague, produced by Wareco in 2008, the groundwater levels with climate change are calculated. The climate scenarios KNMI from 2006 G+ and W of 2050 are used as input, this represents a wet winter situation. The KNMI scenarios are based on the Intergovernmental Panel on Climate Change report. It consists of four scenarios that describe how the climate will change. The scenarios vary in the amount of increase of the global temperate (moderate and warm) and how much the air flow patterns changes (low and high value). The scenario G+ is a moderate increase of 1 °C in 2050 compared to 1990 and more wind currents causing warmer and wetter winters due to western winds and warmer and dryer summers due to eastern wind (KNMI, n.d.-a). The scenario W is an increase of 2 °C in 2050 compared to 1990 and no changes in wind current patterns. All these inputs combined lead to the climate atlas drainage depth of The Hague (Figure 41).

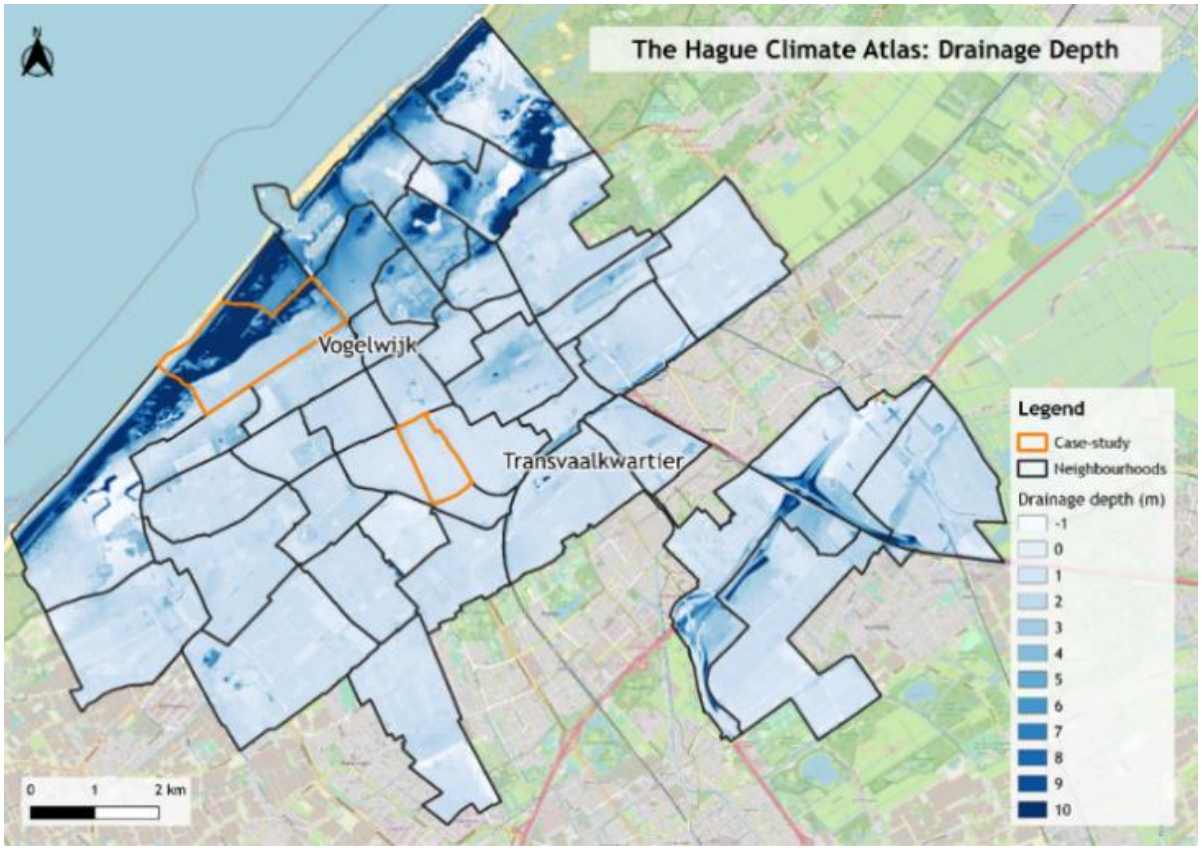

Figure 41. The Hague Climate Atlas: Drainage Depth (Municipality The Hague, n.d.-c)

The Hague stress-test: Waterlogging

The map Waterlogging (Dutch: Wateroverlast klimaatbui) shows where floods can arise after an extreme downpour of 100 millimetres in two hours (Figure 42). Be aware that the map only shows the first and second type waterlogging, the third type of waterlogging will be discussed in the next paragraph. The 2D terrain model (3Di) is based on three things: 1) the filtered and interpolated General Elevation map of the Netherlands AHN2 (derived between 2007 and 2012), 2) information about land use (for run-off) and the soil (for infiltration). The resolution of the map is 0.25 m^2. The map shows the water depth, this is the difference between the ground surface and the water level directly after the downpour. One of the assumptions of the map is that the buildings in the terrain model have a floor level of 15 centimetres above the surface. The following factors are considered with the integrated model that is used: the runoff coefficients, the infiltration, the discharge via the sewer system, and discharge via the surface water. The maps do not show how long the water remains on the streets whilst this is a very important factor when determining whether the waterlogging is unacceptable or not (Kennisportaal Ruimtelijke Adaptatie, n.d.-c).

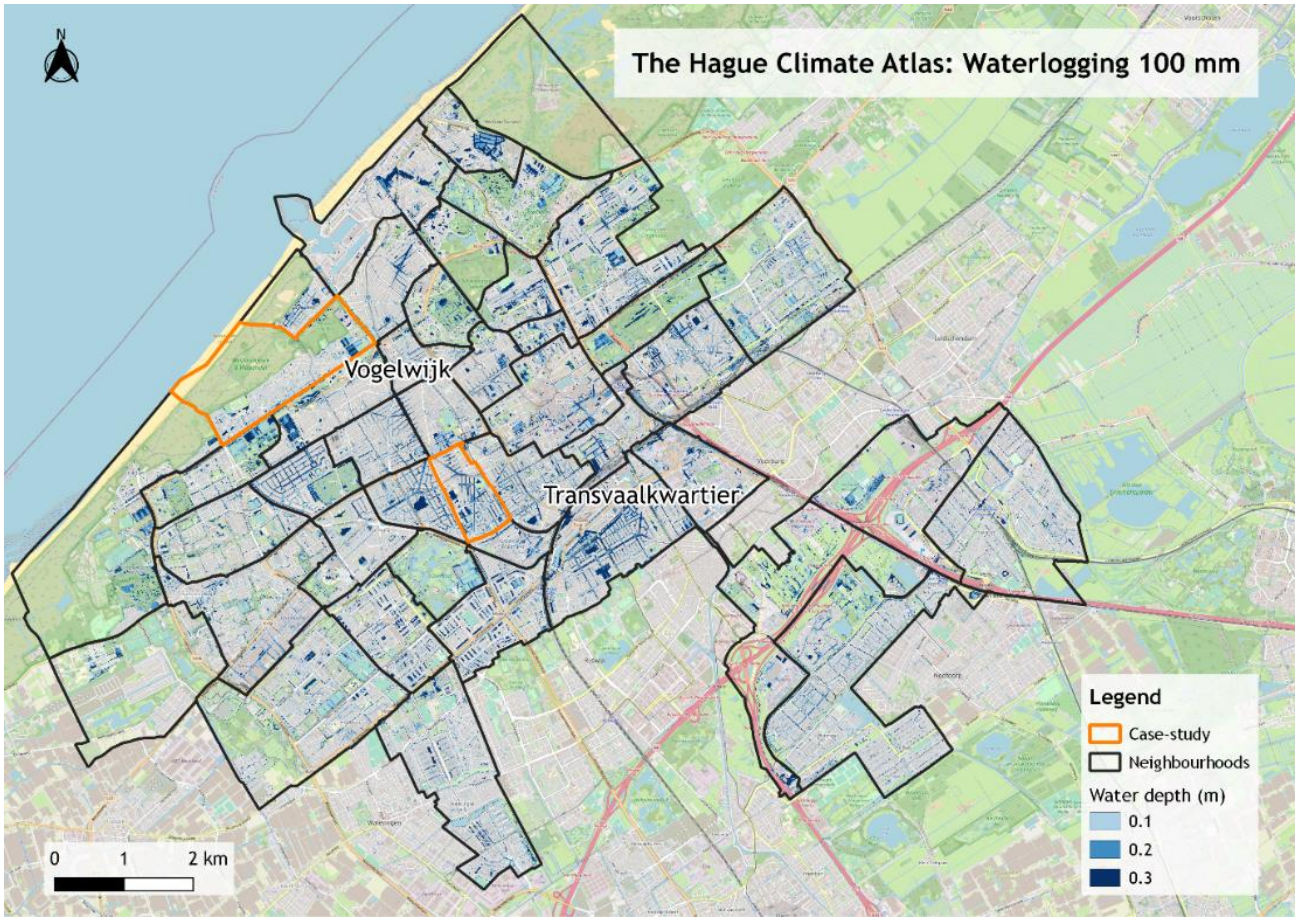

Figure 42. The Hague Climate Atlas: Waterlogging 100 mm (Municipality The Hague, n.d.-c)

Development risk of groundwater nuisance

The map is based on the National Water Model, including KNMI'14 W_h leading to highest increase of average highest groundwater level. Be aware the map shows the increase of probability and it does not show the occurrence of nuisance at the moment. The map including the two neighbourhoods is displayed in Figure 43, the background information of the legend is provided in Table 24.

Table 24. Background information legend map 'Development risk of groundwater nuisance' (Klimaateffectatlas, n.d.-b)

Category	National groundwater increase (m)	Groundwater level (m)
1 low groundwater levels		> 1.1
2 small increase in probability	< 0.05	< 1.1
3 Significant increase in probability	0.05 - 0.2	< 1.1
4 High increase in probability	0.2 - 0.5	< 1.1
5 Very high increase in probability	> 0.5	< 1.1

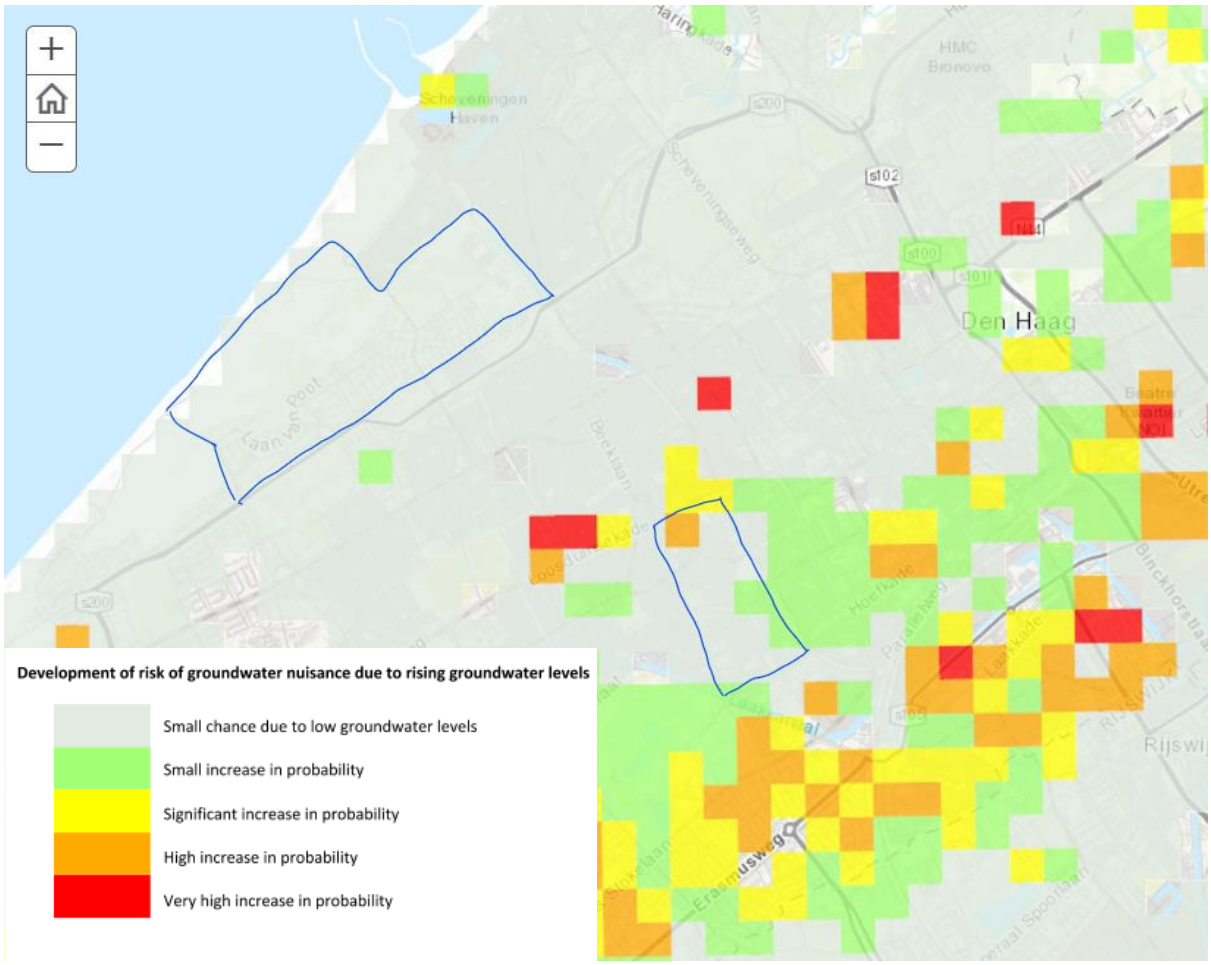

Figure 43. Map 'Development risk of groundwater nuisance' (Klimaateffectatlas, n.d.-b)

Appendix V: *Q methodology*

Statements

Table 25. The 26 statements of the Q methodology - Dutch version

COM-B model	Factoren die klimaatadaptief handelen beïnvloeden	#	Statement
Capaciteit	1.2. Psychologische capaciteit	1	Het is aan de gemeente om de gevolgen van wateroverlast voor pandeigenaren te communiceren
	1.2. Psychologische capaciteit	2	Het nemen van maatregelen tegen wateroverlast levert duidelijk voordelen op voor pandeigenaren
	1.2. Psychologische capaciteit	3	Het is duidelijk wat de gemeente en het waterschap van pandeigenaren en huurders verwachten om wateroverlast te voorkomen
	1.2. Psychologische capaciteit	4	De stad Den Haag moet klimaatbestendiger
Gelegenheid	2.1. Sociale culturele norm	5	Volgens mij nemen veel pandeigenaren al maatregelen tegen wateroverlast
	2.2. Fysieke omgeving	6	Regelgeving, zoals een 'tegelbelasting', is een goed idee om pandeigenaren te stimuleren om maatregelen te nemen tegen wateroverlast
	2.2. Fysieke omgeving	7	Er moet een verbod komen op betegelde tuinen om pandeigenaren te verplichten maatregelen te nemen tegen wateroverlast
	2.2. Fysieke omgeving	8	Het is niet aan huurders maar aan pandeigenaren om maatregelen te nemen tegen wateroverlast
Motivatie	3.1. Risicoperceptie	9	Het is aan pandeigenaren om de financiële gevolgen van schade door wateroverlast te dragen
	3.4. Verantwoordelijkheidsgevoel	10	Pandeigenaren hebben pas voldoende maatregelen genomen als er geen regenwater van hun terrein het riool in gaat
	3.4. Verantwoordelijkheidsgevoel	11	De gemeente en het waterschap zijn zelf in staat om wateroverlast te voorkomen, daar hebben ze niet de hulp van pandeigenaren voor nodig
	3.4. Verantwoordelijkheidsgevoel	12	Het nemen van maatregelen in de openbare ruimte biedt genoeg plek om wateroverlast te voorkomen
	3.4. Verantwoordelijkheidsgevoel	13	Het nemen van maatregelen om wateroverlast te voorkomen gaat ten koste van de primaire taak van een woningbouwcorporatie
	3.4. Verantwoordelijkheidsgevoel	14	Pandeigenaren van hoger gelegen wijken moeten maatregelen nemen om wateroverlast in lagergelegen wijken te voorkomen
	3.4. Verantwoordelijkheidsgevoel	15	Pandeigenaren zijn niet verantwoordelijk voor het nemen van maatregelen tegen wateroverlast
	3.4 Verantwoordelijkheidsgevoel	16	Pandeigenaren betalen niet voor niets belasting en zij kunnen daarom verwachten dat het waterschap en de gemeente wateroverlast voorkomen
	3.5. Waargenomen kosten	17	Voor pandeigenaren is een maatregel tegen wateroverlast een investering die zich terugbetaalt
	3.5. Waargenomen kosten	18	Een subsidie vanuit het waterschap is een goede manier om pandeigenaren te stimuleren om maatregelen tegen wateroverlast te nemen
	3.5 Waargenomen kosten	19	De gemeente doet er goed aan om klimaatadaptieve initiatieven van bewoners financieel ondersteunen
	3.5. Waargenomen kosten	20	Schade van wateroverlast wordt toch wel vergoed door de verzekering, dus voor pandeigenaren is het nemen van maatregelen niet nodig
	3.5. Waargenomen kosten	21	Ik verwacht dat de verzekeringspremies voor pandeigenaren gaan stijgen omdat de kans op schade door wateroverlast toeneemt
	3.6. Eenheid	22	De slogan "Alleen samen maken we Nederland klimaatbestendig" slaat de spijker op zijn kop
	3.6. Eenheid	23	Het is voor bewoners uit verschillende wijken even makkelijk om een (klimaatadaptief) initiatief op te starten
Uitdagingen	Psychologische afstand	24	Vanuit pandeigenaren en huurders is er weinig interesse om mee te denken over de inrichting van de buitenruimte
	Psychologische afstand	25	Het voorkomen van wateroverlast is een urgente zaak en er moet zo snel mogelijk actie ondernomen worden
	Psychologische afstand	26	Het is voor pandeigenaren nuttig om maatregelen te nemen tegen wateroverlast voordat ze de gevolgen ervaren

Q-sorting technique

At first, the participants divided the 26 statements in three categories: disagree, neutral, or agree (Figure 44). The neutral category is for when the participant has no opinion about the statement, is uncertain or has mixed feelings. Whilst dragging the statements the participant argued why they chose the category, this provided valuable qualitative data for the interpretation of the perspectives.

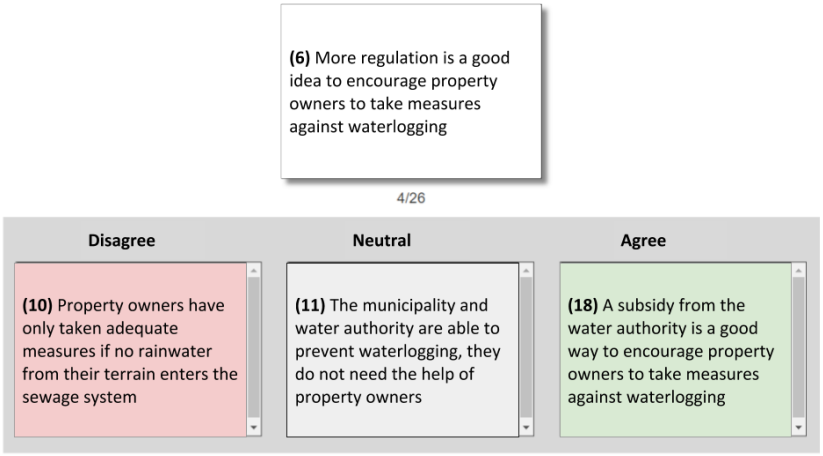

Figure 44. Q-sort dividing statements in three categories: disagree, neutral, and agree.

Subsequently, the participants ranked the 26 statements in a Q-sorting grid (Figure 45). At first, the statements from the agree pile are ranked. Hereafter, the participants rank the disagree in the same manner and at last the statements from the neutral pile are ranked in the remaining cells. After ranking the statements there was a small interview to gain more insight into their perspective. For example, whether the participant has taking preventative climate adaptation measures.

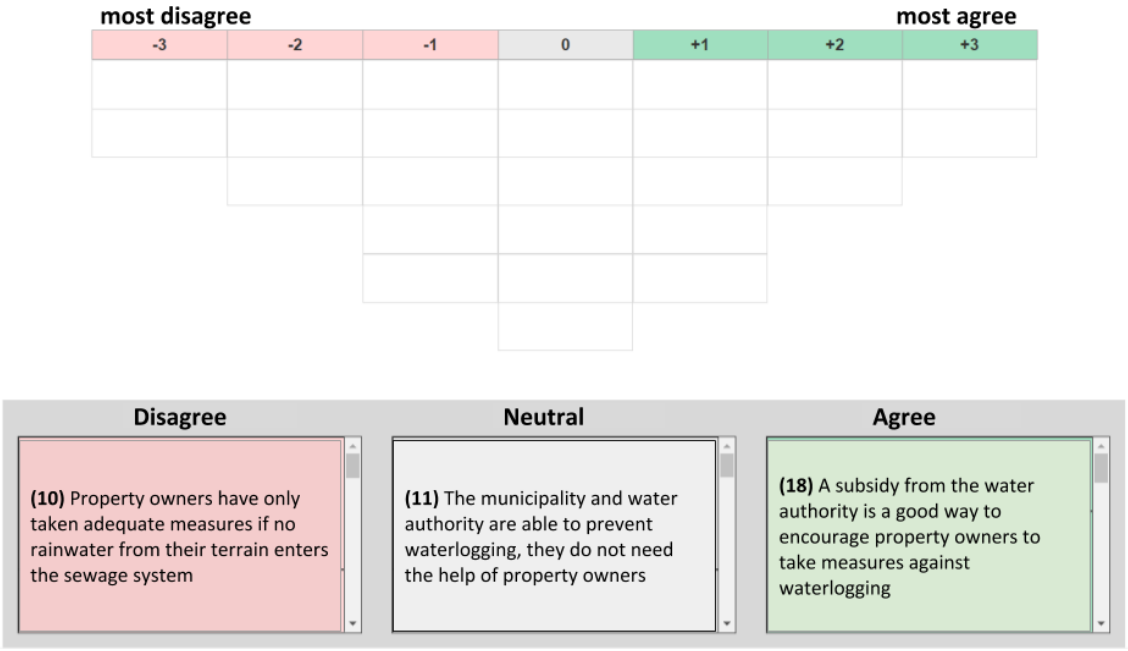

Figure 45. The Q-sorting grid

Making the website for the Q-sort

Part of the Q methodology is ranking the statements from most disagree to most agree in a fixed distribution, this is called the Q-sort. Under normal circumstances the Q-sort would have been executed in person. The statements would have been printed on paper and participants would sort them on a board. However, this study is executed during the COVID-19 pandemic, therefor it is decided to execute the Q-sort online. Hence a website needs to be built to enable the participants to see all the statements and rank them. The preference of a Q-sort is to have interaction, this way participants can ask questions when they do not understand a statement and the interviewer can ask clarification. Therefor the participants shared their screen during a videocall via Zoom or Microsoft Teams.

Luckily, this is not the first research in need of a website to execute Q-sorts. With the help of Shawn Banasick who posted guidelines on how to build a website for Q-sorts and Sue-Z Q who posted YouTube videos on how to execute these guidelines. At first, the repository of Shawn Banasick is downloaded, named Easy-HtmlQ-master. The files in the settings folder are modified to personalise the website. The introductory text, the statements, and the number of rows and columns of the Q-sort distribution are modified. Brackets is used to modify the files. After the files are personalised, the repository is stored on GitHub. The GitHub repository is then uploaded to the web host Netlify. The data of the Q-sorts is stored in a database created on Firebase. When all Q-sorts are executed, the data will be downloaded as a JSON file and Ken-Q Analysis is used to analyse the data. See Figure 46 for an overview of the tools used to create the website. Executing these steps resulted in the following website: https://baart-scriptie.netlify.app/#/.

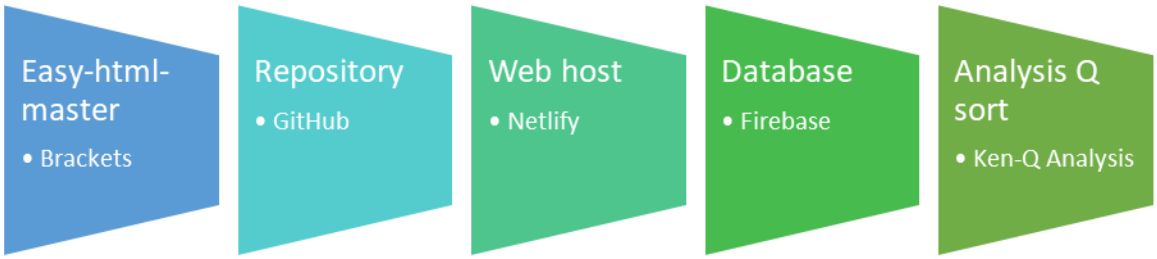

Figure 46. The tools used to create the Q-sort website

Appendix VI: *Q1 factor analysis*

The six steps of the factor analysis

The first step of the analysis is calculating a correlation matrix of the Q-sorts. The correlation matrix is the full variability of the study, the aim of the Q methodology is to capture as much of the variance with the factors as possible.

The second step is the factor extraction, this is a statistical inspection of the correlation matrix that identifies patterns of similarity. Once a pattern of similarity is identified (Factor 1) it is removed from the correlation matrix (residual matrix), then another group of similarities is found (Factor 2), and again removed from the matrix, etc. Until there is no variance left. At first seven factors are extracted to have a closer look at the data, using centroid factor extraction. This results in an overview of factor loadings per participant per factor. A factor loading is a measure (correlation coefficient) that indicated how well this Q-sort exemplifies the factor pattern. The higher the coefficient, the more the Q-sort exemplifies the factor. In addition, the eigenvalues (EVs) and explained variance are calculated. This indicates the strength and potential explanatory power of an extracted factor. This is needed to decide on how many factors to keep later on. As mentioned before, the aim is to have as much variability as possible.

In the third step it is decided how many factors are extracted and kept for rotation. The EVs is the common criterion used for making the decision on how many factors to keep. If an EV is below 1.00, it has very low statistical strength and explanatory power. The Kaiser-Guttman criteria is that all factors with an EV above 1 are extracted.

In the fourth step the factors are rotated, there are two options a judgemental (by-hand) and varimax rotation. By-hand rotation is difficult when the study is exploratory, and it is skill that comes with practice. The varimax rotation is for beginners and when the majority of the group is important.

In the fifth step the significant factor loadings are auto flagged, the factors loading requires the majority of the common variance. This determines which Q-sort belongs to which factor, and whether there are Q-sorts that belong to more than one or none of the factors.

In the sixth step the factor arrays are reconstructed, this is a representative Q-sort per factor. The representative Q-sort is calculated by aggregating the Q-sorts of the factor. However, the Q-sorts differed in how much they exemplify the factor. Hence, a weighted averaging procedure is applied and where the most significant factor loading is given the most weight. Then, the weighted average scores of the Q statements of the Q-sorts are calculated This resulted in an overview of the Z-scores per statements. The Z-scores of the statements are listed from the lowest till the highest score, then the Z-scores are ranked.

Table 26. Correlation matrix Q-sorts

#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	100	13	63	23	10	63	71	61	47	41	10	66	30	71	44	51
2	13	100	26	51	47	20	21	4	7	36	37	24	27	33	21	44
3	63	26	100	53	4	67	76	67	64	51	30	56	11	81	54	44
4	23	51	53	100	17	27	23	34	50	57	54	39	-1	53	63	39
5	10	47	4	17	100	16	-1	10	0	-11	46	21	56	7	6	24
6	63	20	67	27	16	100	71	60	34	26	20	51	30	61	36	40
7	71	21	76	23	-1	71	100	64	37	36	10	56	23	70	50	61
8	61	4	67	34	10	60	64	100	50	39	50	50	19	61	51	37
9	47	7	64	50	0	34	37	50	100	53	46	49	-7	64	53	31
10	41	36	51	57	-11	26	36	39	53	100	41	43	4	51	49	41
11	10	37	30	54	46	20	10	50	46	41	100	31	36	49	43	39
12	66	24	56	39	21	51	56	50	49	43	31	100	50	71	77	53
13	30	27	11	-1	56	30	23	19	-7	4	36	50	100	33	24	31
14	71	33	81	53	7	61	70	61	64	51	49	71	33	100	67	60
15	44	21	54	63	6	36	50	51	53	49	43	77	24	67	100	43
16	51	44	44	39	24	40	61	37	31	41	39	53	31	60	43	100

Table 27. Unrotated factor matrix

#	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
1	0.71	0.36	0.34	0.14	0.02	-0.03	-0.21
2	0.43	-0.56	0.00	0.15	-0.49	-0.17	0.17
3	0.80	0.34	-0.04	0.10	-0.20	0.22	0.06
4	0.61	-0.09	-0.43	0.15	-0.17	-0.15	0.14
5	0.26	-0.70	0.25	0.29	0.26	0.19	0.19
6	0.66	0.20	0.26	0.05	-0.03	0.26	0.13
7	0.71	0.37	0.32	0.14	-0.25	0.10	0.01
8	0.70	0.25	-0.02	0.06	0.15	0.36	0.10
9	0.61	0.26	-0.42	0.21	0.07	0.01	-0.17
10	0.58	0.01	-0.31	0.08	-0.16	-0.22	-0.12
11	0.57	-0.41	-0.40	0.22	0.22	0.09	0.02
12	0.79	0.06	0.13	0.00	0.26	-0.34	0.10
13	0.38	-0.27	0.46	0.11	0.34	-0.08	0.22
14	0.91	0.15	-0.01	0.02	-0.01	-0.02	-0.04
15	0.73	0.06	-0.17	0.04	0.09	-0.25	0.17
16	0.68	-0.13	0.18	0.00	-0.14	-0.07	-0.08
Eigenvalues	**6.81**	**1.64**	**1.25**	0.30	0.76	0.59	0.30
% explained variance	**43**	**10**	**8**	2	5	4	2
Cumulative % expl. var.	**43**	**53**	**61**	63	68	72	74

Table 28. Factor matrix with defining sorts flagged

#	Factor 1	Factor 2	Factor 3
1	0.85	0.04	0.12
2	0.05	0.62	0.31
3	0.73	-0.05	0.48
4	0.19	0.13	0.72
5	-0.03	0.78	0.03
6	0.70	0.14	0.17
7	0.85	0.03	0.14
8	0.62	0.00	0.41
9	0.36	-0.18	0.67
10	0.28	0.07	0.60
11	0.02	0.40	0.70
12	0.67	0.26	0.37
13	0.37	0.53	-0.11
14	0.72	0.16	0.54
15	0.47	0.13	0.56
16	0.52	0.40	0.28
Eigen Value	**4.71**	**1.79**	**3.20**
%Explained Variance	**29**	**11**	**20**
Cumulative % Expln Var	**29**	**40**	**60**

Table 29. Factor scores with corresponding ranks

	factor 1		factor 2		factor 3	
Q-sort	**Z-score**	**Rank**	**Z-score**	**Rank**	**Z-score**	**Rank**
1	0.85	6	-0.06	15	1.09	5
2	0.85	7	0.92	4	0.37	12
3	-0.4	16	0.39	10	-0.72	18
4	0.93	5	0.28	13	1.48	2
5	-0.49	17	0.72	8	-0.78	19
6	-1.05	22	-1.06	22	1.13	4
7	-0.67	18	0.31	11	1.65	1
8	0.07	14	0.73	7	-0.65	17
9	0.55	11	-1.36	24	-0.9	20
10	-0.09	15	-2.18	26	0.57	9
11	-1.34	24	0.5	9	-1.42	25
12	-1.24	23	-0.14	16	-1.14	22
13	-0.91	19	-0.53	18	-0.6	16
14	0.12	13	-1.4	25	0.12	14
15	-1.61	26	-0.59	19	-1.17	23
16	-1.47	25	1.78	1	0.03	15
17	0.7	9	0.28	12	0.21	13
18	0.96	4	0.84	5	0.78	7
19	1.26	3	0.78	6	1.38	3
20	-0.95	21	-1.31	23	-1.39	24
21	0.79	8	-0.19	17	0.42	10
22	1.98	1	0.2	14	0.4	11
23	-0.92	20	-0.92	21	-1.61	26
24	0.12	12	-0.83	20	-0.93	21
25	0.58	10	1.78	2	0.62	8
26	1.37	2	1.06	3	1.05	6

Table 30. Overview correlations between factors

	factor 1	factor 2	factor 3
factor 1	1		
factor 2	0.23	1	
factor 3	0.57	0.28	1

Table 31. Correlations between Q-sorts factor 1

Q-sort	1	2	3	4	5	6	7	8
1	100							
2	71	100						
3	63	76	100					
4	71	70	81	100				
5	63	71	67	61	100			
6	66	56	56	71	51	100		
7	61	64	67	61	60	50	100	
8	51	61	44	60	40	53	37	100

Table 32. Correlations between Q-sorts factor 2

Q-sort	1	2	3
1	100		
2	47	100	
3	56	27	100

Table 33. Correlations between Q-sorts factor 3

Q-sort	1	2	3	4	5
1	100				
2	54	100			
3	50	46	100		
4	57	41	53	100	
5	63	43	53	49	100

Table 34. Distinguishing Statements in Dutch for Factor 1: significance P < .05 (*), P < .01(**) including Z-scores

#	Statement	F1	Z-score	F2	Z-score	F3	Z-score
26	Het is voor pandeigenaren nuttig om maatregelen te nemen tegen wateroverlast voordat ze de gevolgen ervaren	3	1.37				
22	De slogan "Alleen samen maken we Nederland klimaatbestendig" slaat de spijker op zijn kop	3**	1.98	0	0.197	0	0.397
4	De stad Den Haag moet klimaatbestendiger	2*	0.93	0	0.28	3	1.481
9	Het is aan pandeigenaren om de financiële gevolgen van schade door wateroverlast te dragen	0**	0.55	-2	-1.363	-1	-0.895
24	Vanuit pandeigenaren en huurders is er weinig interesse om mee te denken over de inrichting van de buitenruimte	0**	0.12	-1	-0.834	-1	-0.928
8	Het is niet aan huurders maar aan pandeigenaren om maatregelen te nemen tegen wateroverlast	0*	0.07	1	0.726	-1	-0.653
10	Pandeigenaren hebben pas voldoende maatregelen genomen als er geen regenwater van hun terrein het riool in gaat	0*	-0.09	-3	-2.176	1	0.573
7	Er moet een verbod komen op betegelde tuinen om pandeigenaren te verplichten maatregelen te nemen tegen wateroverlast	-1**	-0.67	0	0.31	3	1.649
16	Pandeigenaren betalen niet voor niets belasting en zij kunnen daarom verwachten dat het waterschap en de gemeente wateroverlast voorkomen	-3**	-1.47	3	1.783	0	0.029
15	Pandeigenaren zijn niet verantwoordelijk voor het nemen van maatregelen tegen wateroverlast	-3	-1.61				

Table 35. Distinguishing Statements in Dutch for Factor 2: significance P < .05 (*), P < .01(**) including Z-scores

#	Statement	F2	Z-score	F1	Z-score	F3	Z-score
16	Pandeigenaren betalen niet voor niets belasting en zij kunnen daarom verwachten dat het waterschap en de gemeente wateroverlast voorkomen	3**	1.78	-3	-1.47	0	0.029
25	Het voorkomen van wateroverlast is een urgente zaak en er moet zo snel mogelijk actie ondernomen worden	3**	1.78	1	0.58	1	0.623
8	Het is niet aan huurders maar aan pandeigenaren om maatregelen te nemen tegen wateroverlast	1*	0.73	0	0.07	-1	-0.653
5	Volgens mij nemen veel pandeigenaren al maatregelen tegen wateroverlast	1**	0.72	-1	-0.49	-1	-0.777
11	De gemeente en het waterschap zijn zelf in staat om wateroverlast te voorkomen, daar hebben ze niet de hulp van pandeigenaren voor nodig	1**	0.5	-2	-1.34	-3	-1.417
3	Het is duidelijk wat de gemeente en het waterschap van pandeigenaren en huurders verwachten om wateroverlast te voorkomen	1*	0.39	0	-0.4	-1	-0.717
7	Er moet een verbod komen op betegelde tuinen om pandeigenaren te verplichten maatregelen te nemen tegen wateroverlast	0**	0.31	-1	-0.67	3	1.649
4	De stad Den Haag moet klimaatbestendiger	0*	0.28	2	0.93	3	1.481
1	Het is aan de gemeente om de gevolgen van wateroverlast voor pandeigenaren te communiceren	0**	-0.06	1	0.85	2	1.091
12	Het nemen van maatregelen in de openbare ruimte biedt genoeg plek om wateroverlast te voorkomen	0**	-0.14	-2	-1.24	-2	-1.14
14	Pandeigenaren van hoger gelegen wijken moeten maatregelen nemen om wateroverlast in lagergelegen wijken te voorkomen	-3**	-1.4	0	0.12	0	0.121
10	Pandeigenaren hebben pas voldoende maatregelen genomen als er geen regenwater van hun terrein het riool in gaat	-3**	-2.18	0	-0.09	1	0.573

Table 36. Distinguishing Statements in Dutch for Factor 3: significance P < .05 (*), P < .01(**), including Z-scores

#	Statement	F3	Z-score	F1	Z-score	F2	Z-score
7	Er moet een verbod komen op betegelde tuinen om pandeigenaren te verplichten maatregelen te nemen tegen wateroverlast	3**	1.65	-1	-0.67	0	0.31
4	De stad Den Haag moet klimaatbestendiger	3*	1.48	2	0.93	0	0.28
6	Regelgeving, zoals een 'tegelbelasting', is een goed idee om pandeigenaren te stimuleren om maatregelen te nemen tegen wateroverlast	2**	1.13	-2	-1.05	-2	-1.06
10	Pandeigenaren hebben pas voldoende maatregelen genomen als er geen regenwater van hun terrein het riool in gaat	1*	0.57	0	-0.09	-3	-2.18
16	Pandeigenaren betalen niet voor niets belasting en zij kunnen daarom verwachten dat het waterschap en de gemeente wateroverlast voorkomen	0**	0.03	-3	-1.47	3	1.78
8	Het is niet aan huurders maar aan pandeigenaren om maatregelen te nemen tegen wateroverlast	-1**	-0.65	0	0.07	1	0.73
23	Het is voor bewoners uit verschillende wijken even makkelijk om een (klimaatadaptief) initiatief op te starten	-3	-1.61				
11	De gemeente en het waterschap zijn zelf in staat om wateroverlast te voorkomen, daar hebben ze niet de hulp van pandeigenaren voor nodig	-3	-1.42				

Table 37. Factor Q-sort Values for Statements sorted by Consensus vs. Disagreement

#	Z-Score variance	F1	F2	F3
18	0.006	2	2	1
26	0.022	3	2	1
13	0.026	-1	-1	0
20	0.037	-1	-2	-2
17	0.046	1	0	0
2	0.061	1	2	0
19	0.067	2	1	2
23	0.107	-1	-1	-3
21	0.163	1	-1	1
15	0.176	-3	-1	-2
3	0.216	0	1	-1
24	0.223	0	-1	-1
4	0.241	2	0	3
1	0.245	1	0	2
12	0.247	-2	0	-2
25	0.31	1	3	1
8	0.317	0	1	-1
5	0.422	-1	1	-1
14	0.512	0	-3	0
22	0.637	3	0	0
9	0.662	0	-2	-1
11	0.782	-2	1	-3
7	0.901	-1	0	3
6	1.054	-2	-2	2
10	1.373	0	-3	1
16	1.772	-3	3	0

*Table 38. Consensus Statements (all non-significant at P > 0.01, and * are non-significant at P > 0.05)*

#	Statement	F1	Z-score	F2	Z-score	F3	Z-score	
2	Het nemen van maatregelen tegen wateroverlast levert duidelijk voordelen op voor pandeigenaren	1	0.848	2	0.922	0	0.367	*
26	Het is voor pandeigenaren nuttig om maatregelen te nemen tegen wateroverlast voordat ze de gevolgen ervaren	3	1.372	2	1.057	1	1.052	*
13	Het nemen van maatregelen om wateroverlast te voorkomen gaat ten koste van de primaire taak van een woningbouwcorporatie	-1	-0.908	-1	-0.533	0	-0.604	*
17	Voor pandeigenaren is een maatregel tegen wateroverlast een investering die zich terugbetaalt	1	0.697	0	0.28	0	0.21	*
18	Een subsidie vanuit het waterschap is een goede manier om pandeigenaren te stimuleren om maatregelen tegen wateroverlast te nemen	2	0.962	2	0.839	1	0.777	*
20	Schade van wateroverlast wordt toch wel vergoed door de verzekering, dus voor pandeigenaren is het nemen van maatregelen niet nodig	-1	-0.948	-2	-1.311	-2	-1.386	*
23	Het is voor bewoners uit verschillende wijken even makkelijk om een (klimaatadaptief) initiatief op te starten	-1	-0.92	-1	-0.922	-3	-1.61	
19	De gemeente moet klimaatadaptieve initiatieven van bewoners financieel ondersteunen	2	1.264	1	0.782	2	1.38	*

Table 39. Relative Ranking of Statements in factor 1

	Highest Ranked Statements	F1	Consensus Distinguishing	F2	F3
22	De slogan "Alleen samen maken we Nederland klimaatbestendig" slaat de spijker op zijn kop	3	D*	0	0
26	Het is voor pandeigenaren nuttig om maatregelen te nemen tegen wateroverlast voordat ze de gevolgen ervaren	3	C*	2	1
	Positive Statements Ranked Higher in factor 1 Array than in Other Factor Arrays				
19	De gemeente moet klimaatadaptieve initiatieven van bewoners financieel ondersteunen	2	C*	1	2
18	Een subsidie vanuit het waterschap is een goede manier om pandeigenaren te stimuleren om maatregelen tegen wateroverlast te nemen	2	C*	2	1
21	Ik verwacht dat de verzekeringspremies voor pandeigenaren gaan stijgen omdat de kans op schade door wateroverlast toeneemt	1		-1	1
17	Voor pandeigenaren is een maatregel tegen wateroverlast een investering die zich terugbetaalt	1	C*	0	0
9	Het is aan pandeigenaren om de financiële gevolgen van schade door wateroverlast te dragen	0	D*	-2	-1
24	Vanuit pandeigenaren en huurders is er weinig interesse om mee te denken over de inrichting van de buitenruimte	0	D*	-1	-1
14	Pandeigenaren van hoger gelegen wijken moeten maatregelen nemen om wateroverlast in lagergelegen wijken te voorkomen	0		-3	0
	Negative Statements Ranked Lower in factor 1 Array than in Other Factor Arrays				
5	Volgens mij nemen veel pandeigenaren al maatregelen tegen wateroverlast	-1		1	-1
7	Er moet een verbod komen op betegelde tuinen om pandeigenaren te verplichten maatregelen te nemen tegen wateroverlast	-1	D*	0	3
13	Het nemen van maatregelen om wateroverlast te voorkomen gaat ten koste van de primaire taak van een woningbouwcorporatie	-1	C*	-1	0
6	Regelgeving, zoals een 'tegelbelasting', is een goed idee om pandeigenaren te stimuleren om maatregelen te nemen tegen wateroverlast	-2		-2	2
12	Het nemen van maatregelen in de openbare ruimte biedt genoeg plek om wateroverlast te voorkomen	-2		0	-2
	Lowest Ranked Statements				
16	Pandeigenaren betalen niet voor niets belasting en zij kunnen daarom verwachten dat het waterschap en de gemeente wateroverlast voorkomen	-3	D*	3	0
15	Pandeigenaren zijn niet verantwoordelijk voor het nemen van maatregelen tegen wateroverlast	-3		-1	-2

Table 40. Relative Ranking of Statements in factor 2

	Highest Ranked Statements	F2	Consensus Distinguishing	F1	F3
16	Pandeigenaren betalen niet voor niets belasting en zij kunnen daarom verwachten dat het waterschap en de gemeente wateroverlast voorkomen	3	D*	-3	0
25	Het voorkomen van wateroverlast is een urgente zaak en er moet zo snel mogelijk actie ondernomen worden	3	D*	1	1
	Positive Statements Ranked Higher in factor 2 Array than in Other Factor Arrays				
2	Het nemen van maatregelen tegen wateroverlast levert duidelijk voordelen op voor pandeigenaren	2	C*	1	0
18	Een subsidie vanuit het waterschap is een goede manier om pandeigenaren te stimuleren om maatregelen tegen wateroverlast te nemen	2	C*	2	1
8	Het is niet aan huurders maar aan pandeigenaren om maatregelen te nemen tegen wateroverlast	1	D	0	-1
5	Volgens mij nemen veel pandeigenaren al maatregelen tegen wateroverlast	1	D*	-1	-1
11	De gemeente en het waterschap zijn zelf in staat om wateroverlast te voorkomen, daar hebben ze niet de hulp van pandeigenaren voor nodig	1	D*	-2	-3
3	Het is duidelijk wat de gemeente en het waterschap van pandeigenaren en huurders verwachten om wateroverlast te voorkomen	1	D	0	-1
12	Het nemen van maatregelen in de openbare ruimte biedt genoeg plek om wateroverlast te voorkomen	0	D*	-2	-2
	Negative Statements Ranked Lower in factor 2 Array than in Other Factor Arrays				
17	Voor pandeigenaren is een maatregel tegen wateroverlast een investering die zich terugbetaalt	0	C*	1	0
4	De stad Den Haag moet klimaatbestendiger	0	D	2	3
22	De slogan "Alleen samen maken we Nederland klimaatbestendig" slaat de spijker op zijn kop	0		3	0
1	Het is aan de gemeente om de gevolgen van wateroverlast voor pandeigenaren te communiceren	0	D*	1	2
21	Ik verwacht dat de verzekeringspremies voor pandeigenaren gaan stijgen omdat de kans op schade door wateroverlast toeneemt	-1		1	1
13	Het nemen van maatregelen om wateroverlast te voorkomen gaat ten koste van de primaire taak van een woningbouwcorporatie	-1	C*	-1	0
24	Vanuit pandeigenaren en huurders is er weinig interesse om mee te denken over de inrichting van de buitenruimte	-1		0	-1
6	Regelgeving, zoals een 'tegelbelasting', is een goed idee om pandeigenaren te stimuleren om maatregelen te nemen tegen wateroverlast	-2		-2	2
20	Schade van wateroverlast wordt toch wel vergoed door de verzekering, dus voor pandeigenaren is het nemen van maatregelen niet nodig	-2	C*	-1	-2
9	Het is aan pandeigenaren om de financiële gevolgen van schade door wateroverlast te dragen	-2		0	-1
	Lowest Ranked Statements				
14	Pandeigenaren van hoger gelegen wijken moeten maatregelen nemen om wateroverlast in lagergelegen wijken te voorkomen	-3	D*	0	0
10	Pandeigenaren hebben pas voldoende maatregelen genomen als er geen regenwater van hun terrein het riool in gaat	-3	D*	0	1

Table 41. Relative Ranking of Statements in factor 3

	Highest Ranked Statements	F3	Consensus Disting.	F1	F2
7	Er moet een verbod komen op betegelde tuinen om pandeigenaren te verplichten maatregelen te nemen tegen wateroverlast	3	D*	-1	0
4	De stad Den Haag moet klimaatbestendiger	3	D	2	0
	Positive Statements Ranked Higher in factor 3 Array than in Other Factor Arrays				
19	De gemeente moet klimaatadaptieve initiatieven van bewoners financieel ondersteunen	2	C*	2	1
6	Regelgeving, zoals een 'tegelbelasting', is een goed idee om pandeigenaren te stimuleren om maatregelen te nemen tegen wateroverlast	2	D*	-2	-2
1	Het is aan de gemeente om de gevolgen van wateroverlast voor pandeigenaren te communiceren	2		1	0
10	Pandeigenaren hebben pas voldoende maatregelen genomen als er geen regenwater van hun terrein het riool in gaat	1	D	0	-3
21	Ik verwacht dat de verzekeringspremies voor pandeigenaren gaan stijgen omdat de kans op schade door wateroverlast toeneemt	1		1	-1
14	Pandeigenaren van hoger gelegen wijken moeten maatregelen nemen om wateroverlast in lagergelegen wijken te voorkomen	0		0	-3
13	Het nemen van maatregelen om wateroverlast te voorkomen gaat ten koste van de primaire taak van een woningbouwcorporatie	0	C*	-1	-1
	Negative Statements Ranked Lower in factor 3 Array than in Other Factor Arrays				
22	De slogan "Alleen samen maken we Nederland klimaatbestendig" slaat de spijker op zijn kop	0		3	0
2	Het nemen van maatregelen tegen wateroverlast levert duidelijk voordelen op voor pandeigenaren	0	C*	1	2
17	Voor pandeigenaren is een maatregel tegen wateroverlast een investering die zich terugbetaalt	0	C*	1	0
8	Het is niet aan huurders maar aan pandeigenaren om maatregelen te nemen tegen wateroverlast	-1	D*	0	1
3	Het is duidelijk wat de gemeente en het waterschap van pandeigenaren en huurders verwachten om wateroverlast te voorkomen	-1		0	1
5	Volgens mij nemen veel pandeigenaren al maatregelen tegen wateroverlast	-1		-1	1
24	Vanuit pandeigenaren en huurders is er weinig interesse om mee te denken over de inrichting van de buitenruimte	-1		0	-1
12	Het nemen van maatregelen in de openbare ruimte biedt genoeg plek om wateroverlast te voorkomen	-2		-2	0
20	Schade van wateroverlast wordt toch wel vergoed door de verzekering, dus voor pandeigenaren is het nemen van maatregelen niet nodig	-2	C*	-1	-2
	Lowest Ranked Statements				
11	De gemeente en het waterschap zijn zelf in staat om wateroverlast te voorkomen, daar hebben ze niet de hulp van pandeigenaren voor nodig	-3		-2	1
23	Het is voor bewoners uit verschillende wijken even makkelijk om een (klimaatadaptief) initiatief op te starten	-3	C	-1	-1

Appendix VII: *Risk dialogue*

DPRA guidelines

The risk dialogue is the second of seven ambitions of the Delta Plan on Spatial Adaptation (Deltacommisaris, 2018b). The first ambition is mapping the vulnerabilities with stress tests, and the thirds ambition is to draw up implementation agendas (Kennisportaal Ruimtelijke Adaptatie, n.d.-a). The risk dialogues have to be conducted in 2020. The aim is raising awareness of the vulnerability (determined by the stress tests) and to discuss measures to that can limit damage and nuisance from climate change. Also, the participants (government, residents, companies) discuss and determine whether a risk is acceptable or not. In addition, the urgency to lower the risk is discussed. The risk dialogues provide input for a climate adaptation strategy and an implementation agenda.

The process of the risk dialogue varies per municipality, it can be simple or a very extensive process. It consists of multiple dialogues on varies scale levels: internal, external, region, city, neighbourhood. Depending on the situation, the time available and the capacity one can customize the process. The process of the risk dialogue is divided into three phases: preparation, having the dialogue and finishing (Figure 47). Although the process of the risk dialogue is never really finished, the end goal is that climate adaptation becomes mainstream when discussing spatial developments. The phases will be discussed in the following paragraphs.

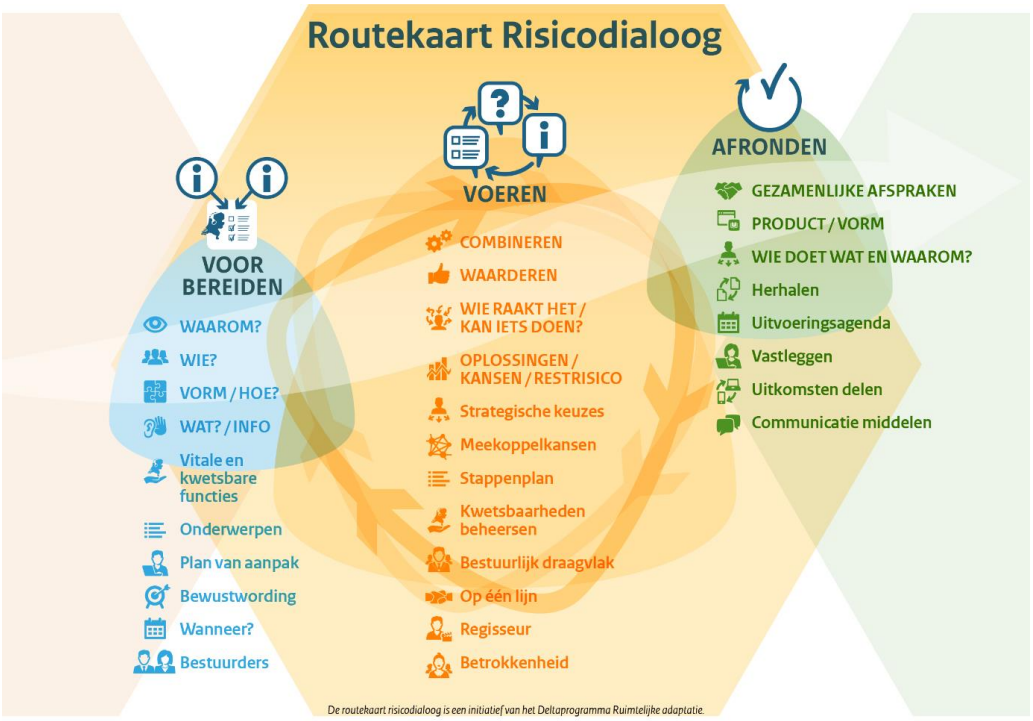

Figure 47. Roadmap risk dialogue DPRA (Kennisportaal Ruimtelijke Adaptatie, n.d.-a)

Preparation

The reason to have a risk dialogue can vary per situation, it can be due to a calamity, another spatial adaptation project such as replacing the sewer system or simply because you have to according to the DPRA. It is emphasized that the preparation phase does not need to be completely finished before having a dialogue (Kennisportaal Ruimtelijke Adaptatie, 2020d).

There is a distinction in an internal and an external risk dialogue. The internal dialogue is between municipality employees from various departments, and the external dialogue is between the municipality and external parties. Most of the time the process starts with internal dialogues, to increase awareness and support within the municipality. Consequently, the external dialogues are held with a broad group of stakeholders. But these dialogues can also be held simultaneously. For both types it is recommended to hire an independent professional that is specialised in facilitating dialogues. Due to COVID-19 the risk dialogues had to switch from being in person to online meetings.

Involving the property owners and tenants is considered the most difficult. For these parties, especially, there needs to be concrete information about the risk they are at. It is important to have mapped the vulnerabilities of the neighbourhood, this is already obtained with the stress test. The stress test can be complemented with information about the soil, the height of the neighbourhood, the fraction of paved area, and groundwater levels. It needs to be emphasized why they have a role in preventing waterlogging and what that role is. For private parties, the risk dialogue can create awareness about the problems, by using visualisation and facts. It is expected that property owners and tenants will realise that they also have a role in contributing to prevent waterlogging.

Conduct risk dialogue

Conducting the risk dialogue(s) is an iterative step in the process. The risk dialogue is an intensive collaboration and about shared responsibility between all involved stakeholders. The two goals of conducting a risk dialogue are 1) to obtain a shared picture of the potential vulnerabilities and opportunities of the climate effects and 2) to determine shared ambitions and required commitments. The ambitions state what the goal is, for example making the city become a sponge.

The four themes (waterlogging, drought, heat, and flooding) can be discussed individually or there can be a combination of themes. The themes are somewhat linked to the scale of the urban environment. Waterlogging and heat stress are very local issues and drought, and flooding are more regional issues. During the risk dialogue following matters are discussed: the vulnerabilities of an area to weather extremes, the urgency of the problem, the potential consequences of for involved stakeholders, acceptability of risk, the role stakeholders can and want to have when it comes to preventing nuisance. Some municipalities changed the name from risk dialogue to climate-dialogue, to avoid a sole focus on risks and include opportunities.

During the dialogue you work towards a shared problem formulation and discussing potential solutions to this problem. It is important to understand each other's perspectives, it is important that the dialogue is well facilitated. There can be a diversity of perspectives during the dialogue. It is important to understand and listen to each other.

Property owners also need to adapt, since governments cannot do it alone. There needs to be a feeling of shared responsibility for achieving the climate-proof and water robust goals, *shared ownership*. To achieve shared ownership, you need to involve stakeholders in an early stage and make sure there is no hierarchy in the dialogue.

Completing the risk dialogue

The third and final step of the risk dialogue process is completion. However, it should be noted that the dialogue is never really completed. This is because the climate and urban environment keep on changing as well. There will always be new circumstances leading to a new dialogue, hence the risk dialogue process must be repeated at least every six years just like the stress test. Completing the dialogue is more about having an end goal in mind, for example creating a climate adaptation strategy or putting together an implementation agenda. Concrete agreements are formulated about what the stakeholders can and want to do to contribute to prevent nuisance.

It should also be reported when parties do not agree in the dialogue or dilemmas that were faced during the dialogue. What are the consequences of the conflicts and what should be done next? In the communication about the results of the dialogue, it should be clear what will change for stakeholders, what they can do and what is expected of the stakeholders.

Appendix VIII: *Q2 factor analysis*

Table 42. Correlation matrix pre- and post-dialogue Q-sorts

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1	100																								
2	13	100																							
3	63	26	100																						
4	23	51	53	100																					
5	10	47	4	17	100																				
6	63	20	67	27	16	100																			
7	71	21	76	23	-1	71	100																		
8	61	4	67	34	10	60	64	100																	
9	47	7	64	50	0	34	37	50	100																
10	41	36	51	57	-11	26	36	39	53	100															
11	10	37	30	54	46	20	10	50	46	41	100														
12	66	24	56	39	21	51	56	50	49	43	31	100													
13	30	27	11	-1	56	30	23	19	-7	4	36	50	100												
14	71	33	81	53	7	61	70	61	64	51	49	71	33	100											
15	44	21	54	63	6	36	50	51	53	49	43	77	24	67	100										
16	51	44	44	39	24	40	61	37	31	41	39	53	31	60	43	100									
17	49	43	63	76	7	46	39	44	54	61	33	57	9	64	69	29	100								
18	60	30	64	44	13	40	56	63	54	27	33	49	23	71	44	39	51	100							
19	69	20	81	53	4	67	74	70	66	46	34	71	21	84	64	60	60	77	100						
20	71	40	73	36	26	60	80	53	41	39	26	63	40	77	63	70	49	57	74	100					
21	-33	44	-23	1	66	3	-19	-4	-23	-6	53	0	56	-10	-9	19	-19	-9	-11	-4	100				
22	57	31	70	44	4	76	79	61	41	46	26	60	29	67	63	53	57	61	77	76	-1	100			
23	61	-3	63	30	-7	69	64	59	46	19	14	64	16	73	50	37	41	47	79	57	-27	57	100		
24	9	59	11	24	67	30	10	17	-4	3	44	27	64	17	16	29	10	24	20	33	74	24	-1	100	
25	17	46	50	29	7	27	33	26	29	41	44	14	11	53	21	43	34	27	39	44	24	37	10	19	100

Table 43. Unrotated factor matrix pre- and post-dialogue Q-sorts

Participant	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
1	0.69	0.41	-0.03	0.25	-0.14	0.08	0.05
2	0.48	-0.54	-0.21	-0.16	0.08	0.21	-0.14
3	0.81	0.32	-0.09	-0.10	0.25	0.04	0.07
4	0.61	-0.02	0.15	-0.51	0.18	0.18	-0.25
5	0.29	-0.65	0.16	0.27	0.06	0.12	-0.05
6	0.70	0.18	-0.08	0.30	0.28	0.11	-0.06
7	0.73	0.36	-0.37	0.29	0.06	0.09	0.11
8	0.70	0.24	0.12	0.09	0.22	-0.06	0.18
9	0.59	0.29	0.21	-0.30	0.06	0.00	0.23
10	0.55	0.04	-0.06	-0.47	-0.07	0.21	0.10
11	0.56	-0.45	0.37	-0.23	0.10	0.01	0.29
12	0.77	0.13	0.23	0.13	-0.36	0.23	-0.09
13	0.42	-0.36	0.09	0.48	-0.18	0.20	-0.04
14	0.90	0.18	0.00	-0.08	-0.03	0.04	0.20
15	0.71	0.15	0.27	-0.13	-0.18	0.19	-0.11
16	0.68	-0.11	-0.25	0.06	-0.14	0.09	0.21
17	0.69	0.14	0.03	-0.41	0.01	0.16	-0.32
18	0.70	0.15	0.13	0.02	0.16	-0.14	0.05
19	0.88	0.31	0.09	0.08	0.13	-0.03	0.13
20	0.84	0.07	-0.28	0.17	-0.11	0.11	0.04
21	0.09	-0.91	0.10	0.22	0.20	0.17	0.09
22	0.81	0.21	-0.16	0.11	0.12	0.02	-0.13
23	0.61	0.50	0.17	0.24	0.05	0.10	0.03
24	0.41	-0.68	0.07	0.31	0.15	0.07	-0.18
25	0.48	-0.15	-0.28	-0.28	0.12	0.08	0.30
Eigenvalues	**10.67**	**3.44**	**0.89**	**1.74**	**0.63**	**0.42**	**0.66**
% Explained Variance	**43**	**14**	**4**	**7**	**3**	**2**	**3**

Table 44. Factor loadings pre- and post-dialogue Q-sorts

Q-sort	Factor 1	Factor 2	Factor 3
1	0.71	-0.12	0.33
2	0.06	0.60	0.44
3	0.76	-0.01	0.44
4	0.54	0.28	0.16
5	0.01	0.73	0.02
6	0.60	0.08	0.39
7	0.59	-0.15	0.65
8	0.71	0.07	0.22
9	0.68	0.01	0.08
10	0.43	0.16	0.32
11	0.40	0.70	-0.04
12	0.76	0.23	0.15
13	0.21	0.50	0.13
14	0.80	0.17	0.42
15	0.74	0.19	0.10
16	0.39	0.29	0.55
17	0.63	0.13	0.29
18	0.68	0.15	0.21
19	0.88	0.07	0.32
20	0.59	0.18	0.64
21	-0.29	0.87	0.00
22	0.67	0.07	0.51
23	0.78	-0.18	0.11
24	0.06	0.78	0.16
25	0.20	0.24	0.48
	34	14	12