

# **Facilitating Private Gardens to Reduce Pluvial Flooding in the City of Groningen**

A research about raising awareness of pluvial flooding and the use of impermeable surface.

Master thesis Socio-Spatial Planning  
Faculty of Spatial Sciences, University of Groningen

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## **Abstract**

The increase in short but intense rainfall and the increase in the use of impermeable surface cause excessive runoff in the form of pluvial flooding, which causes hindrance and nuisance through water on the streets, flooded tunnels and basements. By decreasing the use of impermeable surface in private gardens, citizens can contribute to decrease the chances of pluvial flooding. However, citizens are not always aware of the problem and solutions, or willing to act. By engaging citizens, the municipality can work together with its citizens to find solutions that do not only have positive impact on the individual level, but also on a social level. This type of engagement can be described as the governance form of co-production. In this form of governance, the municipality has a facilitating role, supporting its citizens in the process of taking measures to decrease the chance of pluvial flooding. The citizens have an active role, producing the measures in their private garden. To accomplish this, citizens need to be active. Active citizenship depends on the awareness and willingness of people. Awareness is influenced by the knowledge, risk perception, attitude and behaviour of people. Willingness, in term, is influenced by the awareness and available information on the benefits, costs and inconvenience of the problem and measures.

By interviewing policy workers of the municipality of Groningen, insights in the policy concerning pluvial flooding and citizen engagement have been obtained. Interviews with citizens throughout the city of Groningen have given insights in the awareness and willingness of citizens to take adaptation measures in their private gardens. These interviews have shown that there is no specific policy in engaging citizens to reduce the impacts of climate change, or pluvial flooding, although the municipality expects citizens to be active and facilitates citizens if they are willing to take action. Most of the citizens are aware of the problems caused by pluvial flooding, but have not experienced it at first hand, which causes a low risk perception. Because of this, citizens are not willing to act on their own. However, if they are more informed by the municipality about the problems and consequences, and about the possible measures that can be taken in private gardens, citizens of Groningen are open to take measures in their private gardens.

*Keywords: Pluvial Flooding, Impermeable Surface, Citizen Engagement, Active Citizens, Awareness, Willingness*

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## **1. Introduction**

The climate is changing, and the Netherlands has to prepare and adjust to the effects of climate change. Despite the measures that are taken to minimize the effects of global warming through mitigation, the Netherlands has to accept the fact that it will have to deal with more rainfall, floods, heat and droughts (Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, 2010). The global changes of the climate have great regional impacts. With the Netherlands becoming warmer due to global warming, the chances of extreme weather events, such as short but intense periods of rain, will increase. With every degree increase in average warmth, short rainfall with high intensity increases with 12 percent per year (KNMI, 2016). These cloudbursts can cause pluvial flooding. Pluvial flooding occurs when the urban drainage system cannot absorb the excess water during heavy rainfall. As a result, overland flows and pooling in urban areas occur (Spekkers et al., 2011). For example, on May 30<sup>th</sup>, 2016, heavy rainfall and thunderstorms caused the flooding of many streets and basements (Volkskrant, 2016). In Zevenaar, a supermarket was flooded due to the heavy rainfall. Furthermore, June 2016 has seen the heaviest rainfall in the Netherlands since the start of the measurements in 1901, breaking the previous record in 1966 (Weeronline, 2016). In the first three weeks of June, several places have had to deal with 250mm of rainfall, with 800mm of precipitation in a year being normal in the Netherlands. The heavy rainfall has led to flooded houses, roads and tunnels in the Netherlands (KNMI, 2016). On June 7<sup>th</sup>, 2016, a fitness centre was flooded in Roermond (Nu.nl, 2016). On the 23<sup>rd</sup> of June, heavy rainfall caused flooding of tunnels and streets in Rotterdam. A flooded basement in the city of Rotterdam caused a fatal accident (NOS, 2016).

### **1.1. Problem statement**

As a consequence of impermeable surface, the volume of runoff and peak discharges will increase during rainfall (Zwaagstra, 2014). This increase causes an impact on neighbouring areas through a higher speed and amount of runoff to these areas, which in turn increases the risk of erosion and ponding. According to Perry and Nawaz (2008), an increase in the extent of sealed surfaces has the potential to increase the risk of urban flooding. In the urban context, impermeable surfaces increase the pressure on the sewer system – the sealed surface creates a short-circuit of the natural water cycle and increases the rate at which run-off water reaches the drainage network (EEA, 2016). The saturation of the sewer system intensifies floods and endangers the quality of the surface water. In recent decades, these intensified floods have become more frequent. According to the EEA (2016) the quality of life in urban areas is under pressure, as floods can shut down basic infrastructure and can interrupt economic activity. In extreme cases flooding may destroy homes, businesses and public infrastructure. To deal with these negative impacts, adaptation measures are needed. Failure of climate-change mitigation and adaptation has been termed

the number one global risk in terms of impact in the Global Risks Report 2016 (World Economic Forum, 2016).

An important adaptation measure for pluvial flooding could thus be to unseal these impermeable surfaces. This will allow for the precipitation to infiltrate into the soil and the possibility to create retention areas, where water can be stored temporarily. Consequently, there will be less pressure on the sewer system, which can prevent events such as flooding and pooling in the urban area. Natural cover is often sealed through residential, commercial and industrial developments, such as paving for car parks and gardens, and transport infrastructure including roads. Furthermore, Verbeeck et al. (2011) confirm the importance of urban gardens as infiltration and retention areas. In general, sealed surface are applied near the street or near the house, so a large connected sealed area can be obtained. As nearly 40% of the urban area is owned by individuals, civic actors can have a great influence on the amount of sealed surface in a city (Operatie Steenbreek, 2016).

However, several studies show that in recent years, the impermeable surface in private gardens has increased. A study in Leeds (Science for Environmental Policy, 2012) has found that the individual decisions by home owners to pave their garden, contribute significantly to the long-term build-up of the total area of impermeable surfaces in a suburb of Leeds, UK, increasing the chance of flooding. The study shows an increase in paved gardens caused by the wishes of the home owners. A study in the city of Groningen, shows that between 1998 and 2013, the total paved area in gardens increased with 3.3 to 14.3 percent in the three studied neighbourhoods (Zwaagstra, 2014).

It is clear that the changes in precipitation and increase in surface sealing may have a great impact on the urban life. Through spatial water management measures, such as retention- and infiltration areas, water permeable and -passable surface sealing, and the stimulation of green roofs, the government can adapt to the impacts of climate change (Hartmann & Driessen, 2017). With these interventions, the impacts of heavy rainfall may be reduced within cities.

Nevertheless, these interventions do not address the surface sealing in private gardens. As private gardens are private property of citizens, it is difficult for the government to utilize or take adaptation measures in this space. The political-social relationship between the government, private sector and the civil society in the Netherlands is changing, however. Citizens and social entrepreneurs are becoming more active in the public domain. The Dutch government considers this to be a positive development and stimulates this by increasing the capacity of governments to connect with these initiators and giving them more room for their initiatives. The Dutch government calls this the 'Do-Democracy' (Ministry of Internal Affairs and Kingdom Relations, 2013). This means that there is greater control over interventions, ownership of the public domain and more space for the initiatives.

Furthermore, governments aim to act as a partner, creating space and conditions for the initiatives. With citizens becoming more active in the public domain, civic initiatives could contribute to the adaptation of climate change, and increase the adaptive capacity within cities, along adaptation measures taken by local governments. One of the adaptation measures citizens can take, possibly in association with the local municipality, is decreasing impermeable surface in their private garden.

### *1.1.1. Research questions*

The goal of this research is to find out to what extent citizens in the city of Groningen are aware of the consequences of the increase in impermeable surface in the face of pluvial flooding, and what adaptation measures can be taken in their private gardens to adapt to these consequences. The municipality of Groningen is involved in a national campaign “Operatie Steenbreek”. This campaign aims to enthruse citizens to unseal their private gardens for more green by bringing the negative consequences of impermeable surface under the attention (Operatie Steenbreek, 2016). The campaign and rainwater regulation of the municipality should influence the choices citizens make concerning sealing or not sealing their private gardens. However, to understand the problem, citizens should at least be aware of the increase in cloudbursts, the regulations and campaigns of the municipality, and the problems that the increase of impermeable surface cause. Furthermore, citizens should be willing and able to take measures to reduce the impacts of pluvial flooding.

#### *Research question:*

The research question this thesis proposes focusses on the balance between the facilitating role the municipality can take and the awareness and actions of the citizens in the municipality of Groningen. The research question is:

*What role does the municipality of Groningen take to increase the awareness of its citizens about pluvial flooding and the consequences of the use of impermeable surface, and increase the willingness of them to take measures to reduce the impacts of pluvial flooding in their private garden?*

#### *Sub questions:*

Several sub questions have been drawn up to answer the research question. These questions will be answered in the theory and results of this thesis.

What is pluvial flooding and what are its consequences and solutions?

What is citizen engagement and active citizenship?

What are conditions or incentives for citizens to act, and what can the municipality do about this?

## **1.2. Theoretical approach**

The key concepts for this research are citizen engagement, active citizenship and the awareness and willingness of citizens to act. Both citizen engagement and active citizenship are types of participation. But there are fundamental differences. Citizen engagement is a top-down initiative by a governmental body to engage citizens to participate in their policy making process. Governments provide citizens with tools to discuss, monitor and contribute to their projects. This requires formal procedures by integrating citizen engagement within the governance strategy (Bucci et al., 2015). On the other hand, an active citizen is a person who takes a certain role in the community by actively taking initiatives and responsibilities in areas of public concern, which means active citizenship is a bottom-up initiative (EESC, 2012). Participation through active citizenship is an informal procedure because it doesn't require rules or a governance strategy. This thesis will focus on types of citizen engagement that focus on climate adaptation in urban climate governance and on active citizenship concerning climate change adaptation measures (Sarzynski, 2015). For active citizenship, this thesis will focus on the concepts of awareness and willingness of citizens to act, which are two crucial elements for success (Masud et al., 2015; Tobler et al., 2012). In order to act, and be active citizens, citizens first need to be aware of the problem of pluvial flooding and the climate change adaptation measures and they need to be willing to act. If they are willing, citizens can become active and come up with initiatives to unseal sealed surfaces. The municipality can engage its citizens in their policy making, and together work towards measures that decrease the chance of pluvial flooding. These concepts will be further discussed in the next chapter.

## **1.3. Research design**

The scope of this research will be the municipality of Groningen and civic actors with private gardens in the city of Groningen. Since the researcher resides in the city of Groningen, conducting interviews with citizens in Groningen and policymakers of the municipality of Groningen will be convenient. Furthermore, as stated earlier, the municipality of Groningen is involved in the campaign Operatie Steenbreek. The research will focus on climate change adaptation measures concerning pluvial flooding, due to the increase in cloudbursts, that can be realised in private gardens.

To get information on the policy and experience on pluvial flooding, surface sealing and how the municipality of Groningen engages citizens in their policy making and implementation plans, interviews with several policymakers will be held. Furthermore, policy documents of the municipality and documents on Operatie Steenbreek will be used to gather more information on this subject. Information from Operatie Steenbreek can give information about actual adaptation measures citizens can use in their private garden. Furthermore, the experiences the municipality has with Operatie Steenbreek gives insights in the relationship between initiators and the municipality. Citizens throughout the city of Groningen will be

interviewed to gain knowledge about their knowledge of pluvial flooding and surface sealing in their private gardens, if they are active in their living environment (active citizenship) and their willingness to take action.

#### **1.4. Relevance**

In 2013, the European Commission adopted an EU strategy on adaptation to climate change. This strategy aims to make Europe more climate-resilient by promoting action by Member States, with better informed decision-making, and focusing on and promoting adaptation in key vulnerable sectors (European Climate Adaptation Forum, 2016). The Netherlands published its first National Adaptation Strategy in 2007 (Adaptatieprogramma Ruimte en Klimaat) and has released its latest strategy in September 2017 (Deltaplan on Spatial Adaptation 2018). The goal of the program is to make spatial plans in the Netherlands climate resilient. On the long-term, the program aims at anchoring adaptation to climate change in the awareness, policies and regulations (Ministry of Infrastructure and the Environment & Ministry of Economic Affairs, 2017).

However, in these strategies there has not been much written about the contribution of civic initiatives to the adaptation of climate change. However, raising awareness is a topic that is discussed in the latest adaptation strategy. Much of the literature on adaptation of climate change focuses on the effectiveness of the adaptation measures and the role of the government, but, at the same time, also underline the importance of the influence of civic actors (van Buuren et al., 2014; Hartmann & Spit, 2014; Termeer et al., 2011).

This thesis will try to fill the knowledge gap of what could be the potential role of citizens and the willingness of citizens to contribute to the adaptation of climate change, in particular the increase in pluvial flooding, through unsealing their private garden. The changing role of the government asks for a greater contribution of citizens, but, as has been shown, there has been an increase in sealed surface in private gardens, rather than a decrease. This knowledge can then be put into action to create a city that is pluvial flood proof, with less impermeable surface, increasing the liveability for its inhabitants. Awareness of the problem and adaptation measures that can be taken in private gardens by citizens can be increased to stimulate social action and knowledge.

#### **1.5. Thesis outline**

In chapter two, the conceptual framework is developed. In this chapter, the causes and consequences of pluvial flooding will be discussed, with a focus on surface sealing in private gardens. The unsealing of private gardens will be discussed as a possible solution. Furthermore, the concepts of citizen engagement and active citizenship be discussed. Different characteristics and types of citizen engagement by Sarzynski (2015) will be used to get a better understanding of the concept. For active citizenship, the theory focusses on the

social limits of active citizenship, awareness and willingness to act. The third chapter describes the methodology for this research and gives an insight in the scope and participants for this thesis, and the instruments and procedures that have been used. Chapter four gives the results of the literature research and interviews with the municipality, which have been based on the theoretical framework of this thesis. The results with the interviews with the citizens of Groningen will be discussed in chapter 5. Lastly, chapter six will discuss and reflect the outcome of the results.

## 2. Engaging citizens in pluvial flooding

For this research, it is important to understand the concept of pluvial flooding and what the causes, consequences and solutions for pluvial flooding are. Furthermore, to activate citizens in to taking action against pluvial flooding with adaptation measures, the concepts of citizen engagement and active citizenship should be understood.

### 2.1. Flooding

A flood occurs when land that normally is not covered by water gets emerged by water (European Union, 2007). This can occur by the overflow of water from rivers, lakes or oceans. Alternatively, flooding can occur due to the accumulation of rainwater on saturated ground. There are several types of floods that can affect urban life. Van Riel (2011) distinguishes five types of flooding, which can be divided into two categories. The first category is failure of coastal or river defences or failure of pipes and pumping stations.

- Coastal flooding caused by failure of coastal defences.
- Fluvial flooding caused by failure of river defences, often caused by heavy precipitation upstream.
- Flooding due to failure of pipes or pumping stations (e.g. drinking water flooding or flooding due to failure of ground water pumping station).

The second category is flooding caused by extensive periods or intense but short precipitation.

- Pluvial flooding caused by local heavy precipitation exceeding drainage capacity.
- Groundwater flooding, caused by extensive periods of precipitation (weeks or months) that lead to a slow move of groundwater to low-laying areas where the groundwater table breaks the ground surface.

This research focusses on the last category, in particular pluvial flooding. In the literature, several specific definitions of pluvial flooding are given. The European Standard EN 752 defines flooding as “a condition where wastewater and/or surface water escapes from or cannot enter a drain or sewer system and either remains on the surface or enters buildings” (CEN, 1996). A similar definition is stated by Terpstra et al. (2006). They state that pluvial flooding occurs when there is “abnormal amounts of water in the streets or on the land due to heavy rain fall”. Falconer et al. (2009) describe pluvial flooding as an excess of rainwater, causing overland flow and ponding before it can be absorbed by open water, the drainage system or sewer system. What these definitions show, is that water remains on the streets as ponds due to a temporary lack of capacity of the drainage system during local heavy precipitation. RIONED (2006) has categorised the nuisance of flooding, based on the impact of the flooding. The three categories given by RIONED are:

- 1 Hindrance: small amount of water on the streets for a short term (15-30 minutes).
- 2 Severe hindrance: large amount of water on the streets, flooded tunnels, buoyant manhole covers (longer term: 30-120 minutes).
- 3 Nuisance: water on the streets on a bigger scale, water in businesses, houses with material damage and obstruction of (economic) traffic for a long term.

With hindrance and severe hindrance, the water stays within the boundaries of the streets, causing traffic hindrance and inconvenience. These categories do not cause significant property damage, unlike the third category, nuisance. Hindrance and severe hindrance cause inconvenience for transportation, especially biking and traffic hindrance. Next to that, nuisance also causes property damage. However, it is difficult to distinguish these categories based on measurements, since the urban features differ across cities and even within cities. For example, not every street has the same profile. Also, some flood events cannot be allocated to one of these categories, since the impacts flood can vary over an area. This makes it difficult to categorize flood events.

## **2.2. Causes of pluvial flooding**

Normally, during rainfall, water can run off towards the drainage system without any problems and infiltrate into the ground. But during heavy rainfall, the drainage system is under an excessive amount of pressure, up to the point it cannot longer process the rainwater. When this occurs, water will remain on the streets and form ponds. If we take a closer look to the hydrological cycle – the continuous process of evaporation, condensation, precipitation, infiltration in the soil, interception by vegetation, seepage, and surface, sub-surface and overland flow, we can distinguish three separate sub-systems according to Chow (1988): the atmospheric system, the surface system and the sub-surface system (such as drainage/sewer systems). These sub-systems have different causes for pluvial flooding. Here we will focus on the atmospheric and surface systems. These sub-systems are primarily affected by (changing) weather patterns and human activities such as soil sealing.

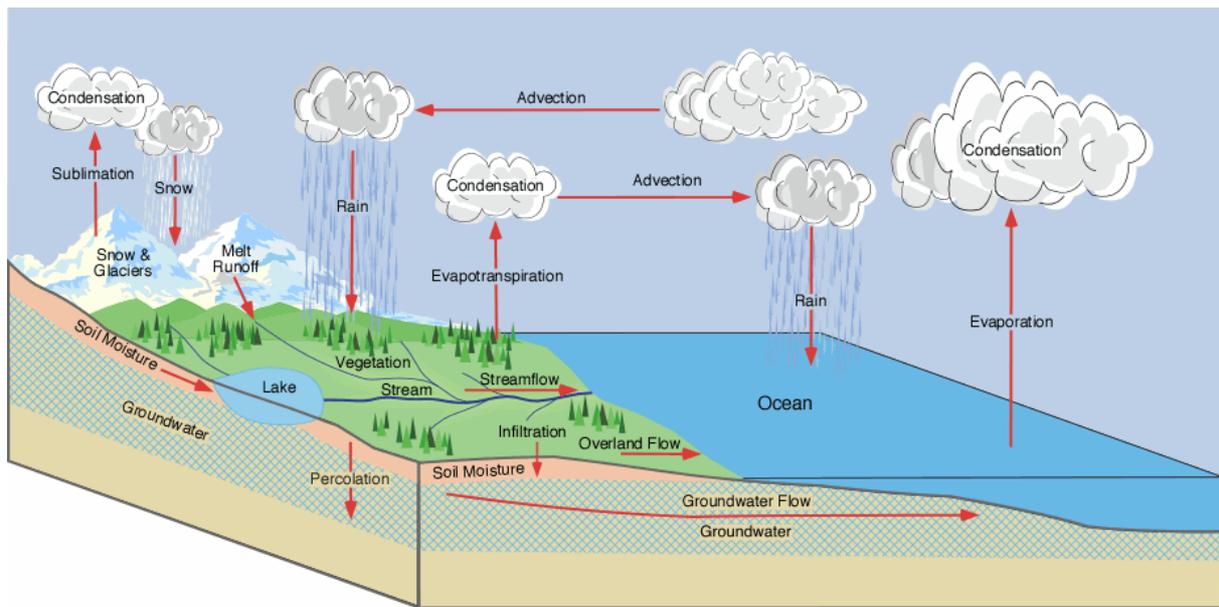


Figure 1: Hydrological Cycle (Pidwirny, M., 2006).

### 2.2.1. Atmospheric system affected by climate change

One of the main reasons for pluvial flooding is extensive rainfall in a short period. The KNMI (Dutch meteorological institute) defines extensive rainfall in a short period as 25 millimetres of precipitation in an hour, and/or at least 10 millimetres in five minutes (in comparison: in a normal year, there is 800 millimetres of rainfall in the Netherlands). This type of rainfall occurs more in the summer months because of the higher temperature and consequently the greater instability of the atmosphere (KNMI, 2016). Due to climate change, chances of this type of rainfall will increase. The KNMI expects that extremes in intense but short rainfall (hour-precipitation) will increase more than long-term rainfall (day-precipitation). The institute expects an intensity-increase of 14% for extreme precipitation per degree increase. This is due to the strong relation between the amount of moisture in the air (humidity) and extremes in the hour-precipitation. The average precipitation per month or year does not have a strong relation to temperature. When the air temperature increases, the humidity in the atmosphere increases too. This means that the chance of extreme precipitation grows faster than expected.

### 2.2.2. Surface system affected by soil sealing

Next to the changing weather patterns due to climate change, another reason for pluvial flooding is the sealing of the soil. The soil is a precious, non-renewable resource according to the European Commission (2012). The essential environmental, economic and social functions of soil are interfered by impervious sealing of the soil. Soil provides food and materials, it regulates the water, energy and matter. Furthermore, it provides a habitat for biodiversity, the space for recreational purposes and adds aesthetic and cultural value to the land.

Here we will focus on how soil regulates the water. An important part of the surface system is runoff. Runoff occurs when rainfall does not infiltrate into the soil or is not intercepted by vegetation. The amount of runoff depends of the intensity of the rainfall, the infiltration capacity of the soil and the presence of vegetation (Zwaagstra, 2014). The infiltration capacity of the soil varies for different types of soil, the saturation of the soil and the land cover. Soil sealing generally reduces the infiltration capacity of the soil. Naturally, the overland flow of surface runoff increases when the soil is saturated, the intensity of the rainfall is greater than the infiltration speed or when the soil is sealed. A smooth sealed surface increases the flow speed of runoff, compared to vegetated surfaces. Accordingly, with a sealed surface, infiltration and travel time are reduced, resulting in an increased peak discharge and runoff (Jacobson, 2011).

### *Surface sealing*

Urbanisation is one of the main reasons why soil is being sealed. The increase in demand for housing, transportation and social infrastructure for people in cities is leading to greater urbanisation of previously rural areas (European Commission, 2012). As a result, large areas of land are being covered in impenetrable artificial surfaces, such as roads, buildings, pavements, driveways, car parks and airports. In many European countries, more than ten percent of the land area has been urbanised and used for settlement and transportation, although not all this urban land area has been sealed. The degree of soil sealing as a percentage of the total land area in the Netherlands in 2005 was 7.33 (European Environment Agency, 2011).

### *Sealing of private gardens*

Another surface area that is increasingly covered by impervious material are private gardens. The total surface of private gardens (front and back gardens) in the Netherlands is more than 56,000 hectares. Over 70 per cent of the Dutch homeowners have a garden and three per cent of the homeowners have a shared garden or patio. This means that there are more than five million private gardens in the Netherlands. Over two million of the gardens are 100 square meters, or more. Operatie Steenbreek (2017) calculated that 44 per cent of the private gardens are covered with impervious material. Furthermore, research shows that the amount of green in private gardens decreases – there is an evident ‘grey’ trend for gardens, meaning more tiles and other impervious material.

For this grey trend, there are different explanations. In recent decades, there has been an increase in car ownership. In order to park cars in neighbourhoods with limited parking space, home-owners paved their front garden to turn it into a parking spot for their car. Another explanation is the preference for a maintenance-free garden. Additionally, the function of gardens is changing. People are using their garden as an extension of their living room, creating outdoor kitchens, space for lounges and furniture, and a place for barbecues.

These trends lead to more pavements in gardens, and thus increasing the amount of impermeable surface. (Hommes et al., 2016)

By making private gardens grey, the gardens need less maintenance. Three consecutive researches show that the amount of green in gardens has systematically reduced in favour of grey gardens: from 46% to 44% to 39% (Kullberg, 2016). At least a quarter of the surface of most of the back gardens is sealed. 25% of the back gardens is 'fairly green'. Usually, the bigger the garden, the greener it is with more trees, hedges, bushes and grass and relatively less pavement. Research shows that in 2013, 64% of the homeowners with a private garden prefers a green garden, which is lively and flourishing. However, in practice, 44% of them rather seals their garden with tiles or gravel (Beumer, 2013).

Additionally, in the Netherlands, there are 4.5 million homeowners with a front garden. Unlike the back garden, the front garden is less seen as the homeowner's own domain. More than half of the front garden is four or more meters deep. A third of the front gardens is two to four meters deep and ten per cent of the front gardens is less than a meter deep, usually part of the public sidewalk or street. In city centre areas there are usually less front gardens. In 2006, only 17% of the front gardens was completely green (Kullberg, 2016).

### *2.2.3. Peak discharge and the capacity of the sewer system*

The increased peak discharge during heavy rain events increases the load to sewer and drainage pipes, increasing the possibility of overflows. In addition, in the case of a mixed sewer system (i.e. draining of runoff and dry weather flows in one system) the increased runoff flows increase the pressure on water treatment facilities.

### **2.3. Consequences and impacts of pluvial flooding**

This grey trend is not only visible in the Netherlands. Private gardens across Europe get sealed more and more. The sealing of the gardens with impervious material, causes trouble with the drainage of the water, or runoff, during extreme rainfall (European Commission, 2012). As stated above, with sealed surface, the water cannot infiltrate into the ground, which in turn causes excessive runoff. Because of this, the sewer system will be under more pressure. Another consequence is that because of soil sealing, the groundwater will not be replenished. Groundwater is used as a source for drinking water and a buffer for times of drought. As has been described earlier, the atmospheric system will be affected through climate change. For the Netherlands, it is expected that climate change will cause more intense short rainfall and an increasing chance of pluvial flooding, but also longer periods of heat and drought. In urban areas, this can have negative effects on the environment and health (Claessens et al., 2012).

The consequences of pluvial flooding depend on the category of the flooding described earlier: hindrance, severe hindrance and nuisance. Van Riel (2011) distinguishes five impacts of pluvial flooding, which are:

- Material impacts: damage to objects caused by rainwater – such as the flooding of cellars
- Economic impacts: the interruption of economic activities – such as interruption of traffic, communication, electricity or business activities.
- Health impacts: defined as impacts to physical health and associated social costs resulting from contact with floodwater directly or potential effects of damp houses in combination with fungi. Mental health impacts are assumed negligible.
- Emergency assistance impacts: defined as induced costs resulting from the provision of emergency assistance by police, fire department or municipality in case of a flood event. This includes costs for labour, training and capacity building, maintenance of equipment and hardware for rescue operations.
- Discomfort: defined as overall inconvenience due to a combination of multiple pluvial flood impacts.

Discomfort is a consequence of pluvial flooding that counts for all the three categories. Flooded streets cause inconvenience for pedestrians, cyclists and car users for instance. Hindrance, due to that it is limited to the boundaries of the streets and its limited time (15-30 minutes), has no or very limited economic impacts and impacts on emergency assistance. With flooded tunnels and buoyant manhole covers, as is the case with the third category severe hindrance, the economic and emergency assistance impacts are more radical. Certain traffic routes become inaccessible, which can cause severe delays for traffic and consequently emergency assistance and specific economic activities that are dependent on traffic. Material impacts occur only in the third category, severe hindrance.

Ten Veldhuis (2011) writes in her quantitative risk analysis of urban flooding in lowland areas that pluvial floods cause more traffic delays than material damage to private properties, based on reports given by citizens after pluvial flood events. Additionally, based on this information, health impacts were small compared to material damage.

#### *Economic/Traffic impacts*

Flooded streets and tunnels caused by pluvial floods can cause traffic delays. Some economic activities depend heavily on traffic and infrastructure. For them, delays have a negative economic consequence. Material damage can have economic impacts as well, such as damage to business property. Furthermore, pluvial floods could interrupt communications and electricity supply by damaging cables. Power outages and loss of certain types of communication could have negative economic impacts for business relying on them.

### *Material impacts*

There has not been written much about material damage due to pluvial floods. Most research focuses on damage caused by coastal and fluvial floods. The difference between these kinds of floods is the water depth. In studies about coastal and fluvial floods, the water depth varies from a half to several meters. However, pluvial floods in the Netherlands will likely not exceed 0.5 meter (Van Riel, 2011).

### *Health impacts*

Pluvial flooding can cause serious health impacts. Especially when combined sewer systems overflow due to an excess of rainwater. Water that stays on the street after pluvial floods in areas that use combined sewer systems have a high chance of being contaminated with pathogens. Research has shown faecal contamination of water on the streets and that the health-risks in these situations is as high as swimming in surface water receiving untreated sewage from an outfall pipe (Ten Veldhuis, 2011). Additionally, increased runoff washes of more of the soil, dust and debris from the surface. This causes more pollutants to reach surface water, which in turn causes higher contamination of the surface water (Brun, 2000).

### *Additional impacts*

Increased speed and volume of runoff by heavier rainfall and the increase in impervious surface can cause soil erosion in lower downstream areas. Additionally, impervious surface causes less infiltration and seepage into the soil. This will decrease groundwater recharge in certain areas (Brun, 2000). For a healthy soil and the animal and plant life they support, groundwater recharge is necessary (Harbor, 2007). Furthermore, there is a relation between the temperature in a city and the loss of green. The increased temperature caused by the growth of the use of impervious material cause health issues, especially for the elderly.

## **2.4. Solutions for pluvial flooding**

Through climate change mitigation, the Dutch government tries to limit the magnitude or rate of long-term climate change. The ambitions, goals and actions are outlined in national climate agendas (Deltaplan of Spatial Adaptation 2018, Klimaatadaptatiestrategie). The purpose of this agenda is to prevent further climate change as much as possible. Next to mitigation measures, the agenda includes national and international adaptation measures to the consequences of climate change. Furthermore, the climate agenda 'aims to reach out to businesses, civil society organizations and citizens to work together on a sustainable society' (Government of the Netherlands, 2014).

Next to mitigation measures that are taken on a national and international scale, climate change adaptation is also needed. Mitigation and adaptation call for different kinds of measures. Whereas climate change mitigation are actions that limit, stop or reverse the magnitude and/or rate of long-term climate change, climate change adaptation tries to reduce the vulnerability of groups of people to the impacts of climate change. As there lies a

realization that a certain amount of climate change will occur inevitably, and that society can take steps to reduce the impacts, adaptation measures can be taken to minimize the costs that are associated with the consequences of climate change (Grothmann & Patt, 2005). This also means that, as climate change is a case of “the tragedy of the commons”, climate change mitigation calls for collective action, as effective climate change mitigation cannot be achieved if individuals, institutions or countries act independently (Cole, 2008).

Climate change adaptation, however, may also have the characteristics of a private good instead of a public good. Depending on the type and scale of the adaptation measures, climate change adaptation may benefit individuals, confined groups, or communities without exclusion and can be labelled as a private good, club good, or public good respectively (Meijerink & Dicke, 2008). This thesis focusses on climate change adaptation that will reduce the impacts of pluvial flooding through individual choices and measures citizens take in their private gardens. These measures reduce the stress on the sewage system, which decreases the chance of pluvial flooding during cloudburst, and will benefit communities without exclusion and areas in the city of Groningen that are prone to pluvial flooding. Therefore, climate change adaptation measures in private gardens is a public good.

#### *2.4.1. Unsealing surfaces*

One of these climate change adaptation measures that can be taken to reduce the impacts of climate change through pluvial flooding is the unsealing of surfaces. As has been discussed earlier, surface sealing affects the surface system. To reduce the increased peak discharge and runoff, sealed surfaces can be unsealed. This research focusses on the unsealing of surfaces in private gardens by the citizens of the city of Groningen.

#### *2.4.2. Private gardens*

The lay-out of a garden can have an influence on the amount of water that can be infiltrated in the soil or evaporate. Additionally, private gardens can influence the amount of rainwater in a city that can be used for water retention and storage, exonerating the sewer system because it has to catch and drain less rainwater. When choosing the lay-out of a garden, garden owners can keep this in mind. Using permeable materials, less surface sealing, creating ponds or ditches where water can infiltrate in the soil are examples that accommodate the function of a garden to increase water infiltration, evaporation and water storage. An infiltration ditch is a lower piece of land, where rainwater can be collected, forming a controlled pond. The infiltration ditch can be supplied naturally or via small channels throughout the garden. A pond or infiltration ditch retains water during heavy and intense rainfall, relieving the sewer system. Using a permeable surface for the infiltration ditch, the water can be infiltrated into the soil. By using permeable surface throughout the garden, the amount of runoff can be decreased drastically. In gardens where the soil has

been surfaced with impermeable material completely, 85 per cent of the water runs off to the sewer system, while green gardens only have 15 per cent runoff (Dirven et al. 2011).

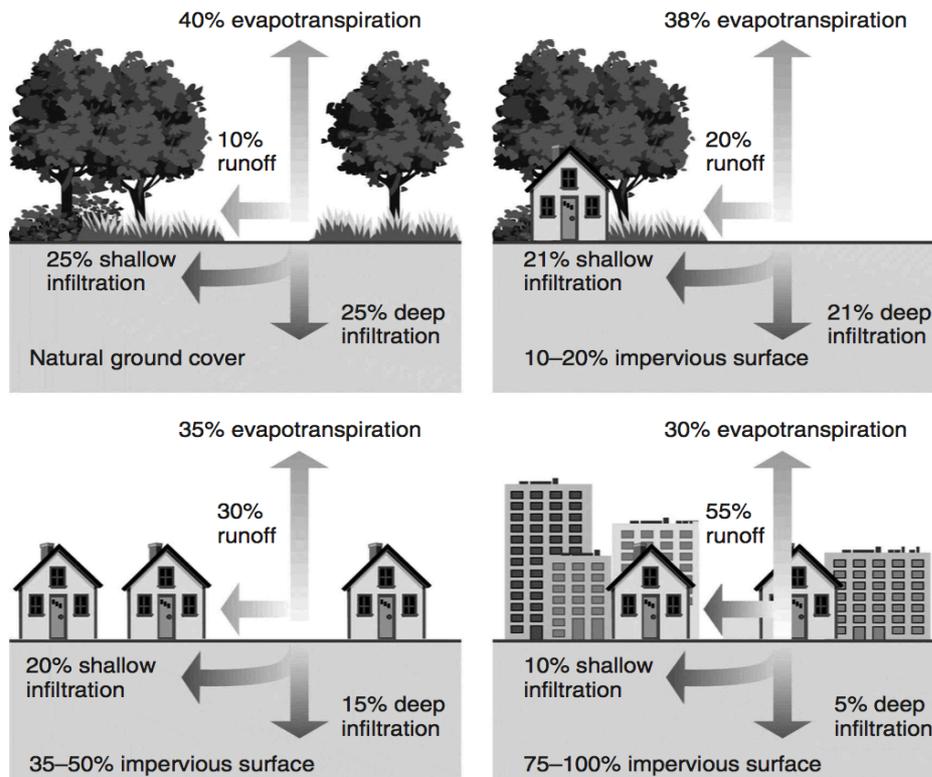


Figure 2: Land-use and corresponding runoff (USEPA)

Research has shown that a grey garden has a runoff of 81.6 cubic meters of water into the sewer system, whereas a green garden (with 20% surface sealing) only has a runoff of 13.9 cubic meters into the sewer system (Endreny, 2006). This means only 17 percent of the runoff in grey gardens. Endreny (2006) state that when grey gardens are transformed to green gardens, the runoff towards the sewer system can be reduced by 83 percent. This would mean a total of 304.775 million cubic meters of water less. Accordingly, if ten percent of the grey gardens are transformed to green gardens, this would mean 30.47 million cubic meters less of runoff towards the sewer system. Based on the cost for transportation and treatment of €0.28 per cubic meter, a possible €8.6 million could be saved (Hommes et al., 2016).

However, a green garden does not have the same effect everywhere. Characteristics of the area can have influence of the impacts of a green garden. Within neighbourhoods, or even within streets, interventions can have different impacts. One of these characteristics is the altitude of the garden. Water runs from higher grounds to lower grounds. The soil can have an influence on the impacts as well. Soil like sand and gravel have a higher infiltration capacity than clay for example. These different characteristics call for different approaches. Additionally, the distance to and the capacity of the sewer system determines the runoff

speed for the excess of rainwater. The size of the sewer system influences the amount of water it can drain. Furthermore, the groundwater level determines how much water can be infiltrated into the soil. When there is higher a groundwater level than usual, less water can be infiltrated into the soil.

## **2.5. Citizen engagement**

Local governments can engage its citizens in urban climate adaptation. Without citizens' engagement, it will be difficult for local governments to utilize citizens' private property for the common good. Citizen engagement is a concept of civil participation in governance that is not consistently conceived or defined; Ekman & Amna (2012) argue that "'citizen engagement' as a concept is ready for the dustbin". As "it has been used as a buzzword, to cover everything from voting in elections to giving money to charity, or from bowling in leagues to participate in political rallies and marches" (Berger, 2009 in Ekman & Amna, 2012). Adler & Goggin (2005, in Ekman & Amna, 2012) argue that citizen engagement is confined as specific action, such as "community service, collective action and even political involvement". In their typology, Ekman & Amna (2012) distinguish two types of civil participation: 'social involvement (attention)' and 'civic engagement (action)', both with an individual and collective form. On the individual level, social involvement takes the form of personal interest in politics and societal issues. Civic engagement takes the form of activities based on personal interest in and attention to politics and societal issues. On the collective level, social involvement takes the form of a sense of belonging to a group, or life-style related involvement. While civic engagement takes the form of voluntary work to improve the conditions in a community and to help others.

Additionally, to understand the concept of citizen engagement, Sarzynski (2015) has defined five elements that characterize how participation, or citizen engagement, is structured: who participates, when participation happens, what happens, how much participation, and why the actors participate.

In the case of engaging citizens to act in their own gardens, "who participates" in the governance process are the citizens of the city of Groningen. However, for the remaining elements, the answer is not so clear.

The second element, "when participation happens" indicates when the citizens participate in the governance process. Sarzynski gives the following possible stages of involvement. For climate adaptation, the phases are: the pre-planning phase, where information is collected and decided who will plan, the planning phase, where the plans are being developed for mid- to long-term plans, the action development phase, where actions for the near-term are selected, the implementation phase, where the plans and actions are being implemented, and the evaluation phase, where the impacts of the implemented plans and actions are reviewed.

“What happens”, the third element, depends on the intensity and influence citizens have throughout the decision-making process. On the lower end of the scale of intensity and influence, engagement includes attendance at public meetings held by the local government where citizens can speak on narrow, pre-defined topics. This top-down form of governance is usually used to deploy and obtain information. In citizen panels, for example, citizens become moderately involved and provide feedback or oversight on policy but may have no to little influence on the set goals or alternatives. On the higher end of the scale, engagement can include intensive collaborations in the development of policy recommendations over a longer period.

Intensity also influences “how much participation” citizens have, as intensity captures the time and amount of times citizens are involved. Collaborative and participatory governance, where there is a more shared role between government and other participants, are the result of intensive engagement, for example.

For “why the actors participate”, participation can be valued intrinsically, developmental and instrumentally, according to Sarzynski. In most cases, public participation in processes are expressions of democracy and procedural justice, thus intrinsically. Participation with developmental value help citizens to understand problems and to explain certain values and preferences for policy. Participation valued instrumentally, is characterized by the public sharing knowledge, resources, trust, accountability, or acceptability (Sarzynski, 2015).

#### *2.5.1. Types of engagement*

Sarzynski (2015) describes six arrangements of participation (or engagement) in urban climate governance and divides them into two groups with three each: planning and action. The three arrangements of participation in planning are; traditional, non-governmental, and inclusive planning. The traditional form are government-led climate initiatives, in which participation is limited in duration, intensity and influence. In some cases, climate initiatives are led by non-governmental organizations. They pursue a broader scope of participants and intrinsic goals than government-led planning. Inclusive climate planning initiatives integrate broader participation into decision-making processes, led by the government. However, these three arrangements have a low openness to them, as participation only happens in the planning processes, which also means there is a low intensity of participation. The influence the participants have are limited to informing and consulting – they do not empower the participants (see table 1). The arrangements of participation for climate action initiatives are more open, as they include the decision and implementation phases. Participants have more influence, as there is more collaboration and empowerment. The three arrangements of participation in action on climate adaptation are; partnerships, non-governmental provision, and co-production. As this research is about taking action, the latter three will be used and are further discussed below.

Type	Breadth (who)	Openness (when)	Intensity (how much)	Influence (what)	Goals (why)
Traditional government-led planning	Narrow to moderate	Low (planning only)	Low	Inform & Consult	Instrumental
Non-governmental planning	Moderate	Low (planning only)	Low to moderate	Inform & Consult	Instrumental & intrinsic
Inclusive Planning	Moderate to broad; government-led	Low (planning only)	Low to moderate	Inform & Consult	Instrumental & some intrinsic
Partnerships	Moderate	Moderate (decision & implementation)	Moderate to high	Consult & collaborate	Instrumental
Non-governmental provision	Broad	Moderate (decision & implementation)	Moderate to high	Empower	Instrumental
Co-production	Broad	High (planning, decision, implementation)	Moderate to high	Collaborate & empower	Instrumental & intrinsic

Table 1: Characteristics of public participation in climate change adaptation in cities. (source: Sarzynski, 2015)

Public-private partnerships are a collaborative governance approach to coordinate and implement specific urban climate adaptation actions. This form of governance is becoming more prevalent as a local climate response. However, partnerships are more used for climate change mitigation than for adaptation. The partnerships expand institutional capacity for governance because they bring more financial, managerial, organizational and political resources than governments in an era of tight budgets. Partnerships may also suggest a more sustained and meaningful participation than arrangements set for the planning phase only. On the downside, partnerships may be less transparent and have less accountability when the persons making the decisions have not been elected or pressured by private-sector participants (Sarzynski, 2015).

Non-governmental provision of urban climate adaptation is an arrangement where non-governmental actors step in to lead urban adaptation projects when and where governmental bodies have not. This is a form of ‘self-help’ by private businesses and citizens to adapt to existing hazards caused by climate change. Sarzynski (2015) discusses that this form of governance can be tapped for building civic capacity, as “a vital civil society, with communities taking the initiative themselves, results in activities which are not always government led, but which are often as relevant as formalized initiatives taken by government authorities or private sector led developments, because of their scope and potential to connect individual stakeholders – sometimes in unexpected or even unorthodox

ways” (Holstein, 2010 in Sarzynski, 2015). Sarzynski mentions that the actions that are taken in the form of ‘self-help’ in effect supply public benefits for urban climate adaptation.

Co-production of urban climate adaptation is a form of participation where government and the community are involved intensively in the planning and implementation of urban climate adaptation response. Parks et al. (1981) describe co-production as “the mix of activities that both public service agents and citizens contribute to the provision of public services. The former is involved as professionals, or ‘regular producers’, while ‘citizen production’ is based on voluntary efforts by individuals and groups to enhance the quality and/or quantity of the services they use”. This type of participation is different from partnerships because of the explicit involvement of civil society and citizens. The concern that this type of governance raises, is that it only engages usual suspects who are already engaged in research and policy debates (Stringer et al., 2006). Community-based adaptation is an approach that tries to engage citizens beyond the usual suspects. Community-based adaptation is often targeted to poor communities, is emerging as a means for promoting public participation in assessments, fostering community self-reliance, and raising awareness of vulnerability vis-a-vis climate impacts in areas such as disaster planning and public health” (Anguelovski and Carmin, 2011, p. 172). Other approaches that try to engage citizens into adaptation planning are, for example, community-based risk assessment, community action planning, and scenario-based stakeholder engagement (Sarzynski, 2015). These forms of citizen engagement are used to share knowledge between citizens and (local) governments and to stimulate participation.

#### *2.5.2. Co-production and citizens initiatives*

The latter of the arrangements of participation, co-production, can be used for adaptation measures in private gardens. Citizens are needed to take measures in their private gardens to reduce the impacts of pluvial flooding. Local governments and citizens can work closely together to take adaptation measures. The municipality of Groningen can share knowledge about proven solutions and in turn, citizens can share their experiences and knowledge amongst each other and with the municipality. Nesti (2017) discusses that co-production, at the local level, can “be viewed as a practical solution to improve the quality and efficiency of services”. By involving citizens, the solutions that are produced are better tailored to citizens’ needs, and are considerably saving costs (Nesti, 2017). In the light of citizen initiatives, local governments can have a facilitating and advisory role, while citizens produce their own, tailor-made, solutions. In the case of this thesis; producing solutions in their private gardens. The solutions produced have benefits on both the individual level and on the social level, because individuals have less nuisance from water in their gardens, and the society as a whole has a reduced chance of pluvial flooding. Co-production between the municipality and the citizens can take place individually, in groups or collectively (Brudney & England, 1983). For citizens initiatives, this means that a single citizen can work together with the municipality to take measure in their own garden, but also groups of citizens, for

example a neighbourhood through a neighbourhood association.

Next to the improvement of quality and efficiency of services, co-production additionally promotes democracy and accountability (Verschuere et al., 2012), it helps to identify the needs of citizens and tailor-made solutions, and it empowers citizens (Ostrom, 1996). Furthermore, Verschuere et al. (2012) state that the government should understand the needs of the citizens, and to communicate and define all the different stages of the process of co-production and its goals, and that the government should adopt an organisational structure with sufficient autonomy and coordination capacity.

Based on the theory previously discussed, the specific forms of participation and roles that the citizens and municipality can take in taking measures in private gardens to reduce pluvial flooding are given below.

### *2.5.3. Roles of citizens and the municipality in Co-production*

Co-production of climate adaptation can take different forms of collaboration between citizens and the municipality. Within this type of citizen engagement, citizens and the municipality can have different roles. The role of the citizens will depend on the degree of participation. Edelenbos (2000), based on the participation ladder of Arnstein (1969), distinguishes the degree of participation on five levels:

1. Informing: the municipality informs citizens. Citizens don't have any influence.
2. Consulting: the municipality asks citizens' meanings but doesn't necessarily use those meanings in their decision making.
3. Advising: citizens advise the municipality. Their advice is generally leading for decision making.
4. Coproducing: citizens and the municipality are equal partners. Decisions are made by working together.
5. Co-deciding: citizens have the most power. The municipality only checks if the decisions made by the citizens meet the conditions.

In the first two degrees of participation, the citizens hardly have any, if any, influence. These forms of participation are described as tokenism by Arnstein (1969). The municipality tries to give the citizens the feeling they are involved, but all the decisions are made by the municipality. Citizens have more power in the last three forms of participation, in which they have influence on the decision making. For the co-production of measures taken in private gardens to reduce the impacts of pluvial flooding, at least one of these degrees of participation is needed. Citizens can advise the municipality on how to form policy and how to take action. Citizens and the municipality can work together to make policy or implement measures. Or the citizens can come up with their own plans or measures.

Furthermore, in order to identify the roles for the municipality, Pröpper & Steenbreek (1999) distinguish seven management styles. The first style is a closed authoritarian style in which the municipality conducts their policy independently, without informing citizens. The second style is an open authoritarian style in which the municipality also conducts their policy independently but does provide information about it in order to convince or overrule citizens. The third style is the consultative style, in which the municipality consults citizens about closed topic or problem. The fourth style is the participative style, in which the municipality asks the citizens for an open advice. The citizens have the freedom to define their own problem and solution. The fifth style is the delegating style, in which the citizens get the authority to take decisions or to implement policy within set conditions. The sixth style is the collaborative style, in which the municipality and citizens work together on equal terms. The seventh style is the facilitating style, in which the municipality offers support, in terms of money, time, expertise or material resources.

In table 2, a combined overview of the degrees of participation by Edelenbos (2000), the management styles of Pröpper & Steenbreek (1999) and the corresponding roles of the citizens and municipality is given.

<b>Degree of participation (Edelenbos, 2000)</b>	<b>Management style (Pröpper &amp; Steenbreek, 1999)</b>	<b>Role citizen</b>	<b>Role municipality</b>
No participation	Closed authoritarian style	None	Independent policy making, no information is given
Informing	Open authoritarian style	Informed, gives no input	Independent policy making, information is given
Consulting	Consultative style	Consulted conversation partner	Makes/decides policy and gives the opportunity to comment on it, but does not have to use the information
Advising	Participative style	Advisor	Makes/decides policy, but is open to suggestions
Coproducing	Delegating style Collaborative style	Co-decider within certain conditions. Collaborative partner on equal terms	Decides within set conditions. Works and decides on equal terms
Co-deciding	Facilitating style	Initiator	Offers support and leaves decision making to citizens

*Table 2: Degrees of participation, management styles and roles for citizens and the municipality (sources: Edelenbos, 2000; Pröpper & Steenbreek, 1999)*

As has been stated above, according to Parks et. al (1981), co-production is a mix of activities by the municipality and the citizens to contribute to the provision of public services. Furthermore, according to Sarzynski (2015) co-production of climate change adaptation is a form of participation where the municipality and the citizens are involved intensively in the different stages of involvement. This means that the degree of participation for citizens is at least advising, as only then citizens have influence on the decision making. For the same reason, the management style of the municipality should be at least participative. Therefore, the roles that citizens can take are: advising, co-deciding/partner and initiator. For the municipality the roles can be: open (to suggestions), co-deciding/partner and facilitator.

## 2.6. Active citizenship

Active citizenship can be described as *citizens' ability to organize themselves in a multiform manner, to mobilize resources and to act in the public [...] in order to protect rights and take care of common goods* (Moro, 2012 in Buijs et al., 2016). Buijs et al. (2016) discuss that active citizenship operates independently from public authorities, and that it does not start as a government intervention. Furthermore, active citizenship depends on the capacity and capability of people to take part in actions around spaces they value. In order for citizens to act, and take adaptation measures in their private garden, active citizenship is needed. However, adaptation to climate change can be limited by social limits, the awareness of the citizens and their willingness to act. These limitations will be further discussed in this chapter.

### 2.6.1. Social limits

Adger et al. (2009) propose adaptation to climate change is limited by values, perceptions, processes and power structures within society. Limits to climate change adaptation depends on ethical standpoints, the emphasis placed on climate change projections, risk perceptions and the extent to which places and cultures are valued. This means that limits to climate change adaptation for one, may not be a limit to somebody else. Adger et al. (2009) suggest four elements that limit successful adaptation responses of society. The first one is *ethics*. Here the diverse goals of adaptation of different actors is critical. What is a limit or a failure of adaptation to one actor, may be a successful adaptation to another. This can result in different priorities and values within a society. The second element is *knowledge*. Adaptation action is often delayed because of a lack of precise knowledge about climate change and its future impacts. Adger et al. (2009) argue that greater knowledge about the future will not facilitate adaptation, but that robust decision-making circumvents the need for precise knowledge. *Risk* is the third element. If the society does not think the risk of, for example, climate change impacts is great, it is difficult to justify adaptation action. The last element is the value of *places and cultures*. When places and cultures are undervalued, adaptation actions may be limited. Cultural and symbolic values are currently not included in the methods of valuing loss. This leads to an undervaluation of certain places in comparison with more easily valued and tangible places.

These four elements of diverse and contested values; ethical, cultural, risk and knowledge considerations, underlie climate change adaptation action and define mutable and subjective limits to adaptation. Adger et al. (2009) believe that there is a need to identify and recognize implicit and hidden values and interests in advance of purposeful adaptation interventions. They suggest that there should be acknowledgement and negotiation about these diverse and contested values and that adaptive action needs to involve a wide set of stakeholders.

Climate change adaptation is not only limited by physical and ecological characteristics, but more importantly by social limits as has been described above. However, these social limits can possibly be overcome. Through awareness of the diverse and contested values, acceptance of loss through adaptive action, and the awareness and understanding of the impacts of pluvial flooding, the society can change in a more adaptable society.

### *2.6.2. Awareness*

Awareness of climate change and the awareness of the consequences, or risks, of increasing rainfall and of soil sealing are an important factor in this discussion. If citizens do not have the knowledge and are not aware of these problems, they do not feel the urge to act. The awareness of climate change has been examined in several studies (Madus et al., 2015; OECD, 2014). Masud et al. (2015) state that even though people are aware of the climate change issues and challenges, they have little knowledge of the actual impacts or consequences. Their study shows a significant relationship among awareness, knowledge, risk perceptions, attitudes and pro-environmental behaviour. People who are aware of climate change vulnerabilities are more likely to act towards reducing the impacts of climate change – and thus take adaptive action. The study shows that people who have pro-environmental knowledge are willing to reduce the impacts of climate change (Masud et al., 2015). A study of OECD (2014) shows that there is a large awareness gap among citizens about key water management functions, how they are performed and by whom. The report states that the awareness gap is a result of the trust that the citizens have in the government. The government has successfully avoided major flood events since 1953. OECD (2014) states that the lack of awareness is seen as the biggest threat.

Figure 3 (Leet et al., 2015) shows the awareness of climate change (a) and the awareness of the risks of climate change (b). The figure shows that although over 75 percent of the Dutch are aware of climate change, only between 50-69 percent believe climate change is a real threat (Lee et al., 2015). A survey, conducted by Gallup (an American research and consultancy firm), in 2007 and 2008 shows the same figures (Pugliese & Ray, 2009). According to their survey, 96% of the Dutch are aware of climate change. However, 57 percent of them believe that climate change is not a serious personal threat. Furthermore, Tobler et al. (2012) write that people that are concerned about climate change, often perceive it as less important than other issues, be it environmental, personal or social. This lack of concern about climate change might be because of a lack of visible issues for most individuals that climate change causes, time lags in the climate and more immediate problems for society.

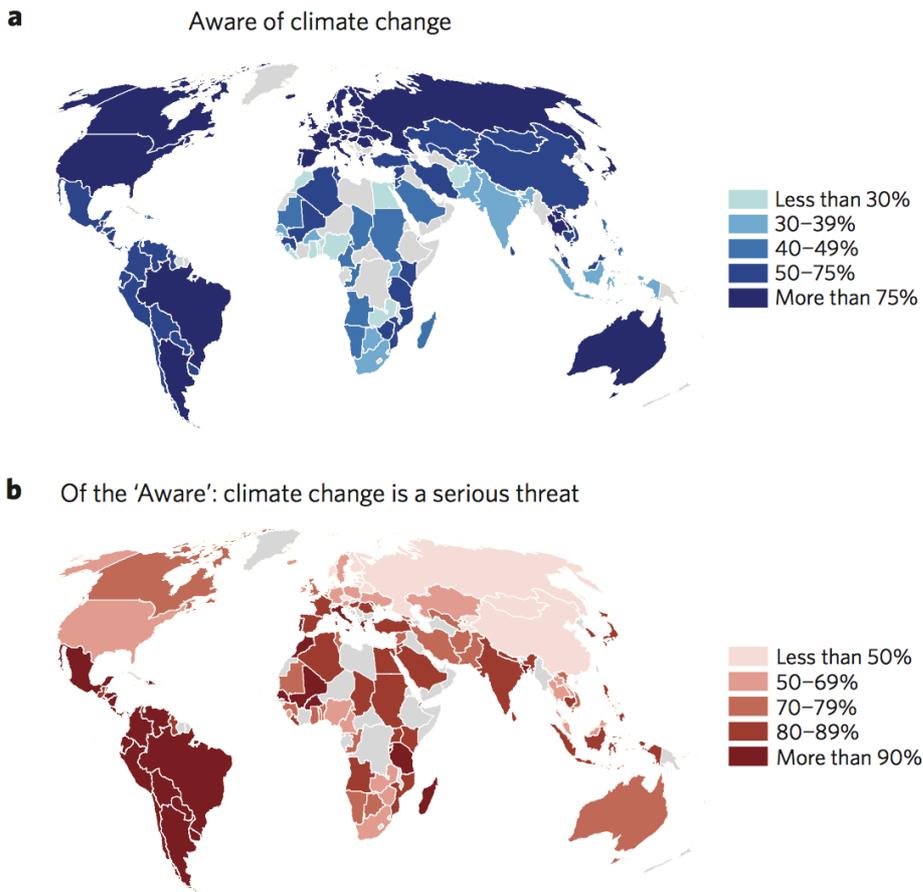


Figure 3: Awareness of climate change and threat (Lee et al., 2015)

### 2.6.3. Willingness to act

Awareness of climate change alone is not enough to engage citizens to act against climate change. To really take adaptive action, citizens also need to be willing and able to act. To increase the willingness to act, people need to have knowledge of the adaptive action that can be taken, need to know the seriousness of the risks involving pluvial flooding and need to be aware that climate change adaptation is important for the public good. Tobler et al. (2012) show that, in order to stimulate effective adaptive action, citizens need to be informed about recommended action and instruction on how they can feasibly take action. They write that it is not the concerns about climate change that has the most influence on climate-friendly action, but that the perception of the benefits and costs were the strongest predictors of the willingness to act amongst citizens. Tobler et al. (2012) recommend communication about and emphasize the climate benefit of climate-friendly action and reduce the citizens' perception of the costs and inconveniences. Giving information about how citizens can take action can give citizens a feeling of control.

## **2.7. Conceptual framework**

The concepts used in this chapter are merged together in a conceptual framework (table 2). The framework shows the connections between the different concepts. The two main concepts for this research are citizen engagement and active citizenship. Citizen engagement is the municipality's role to stimulate and incorporate participation amongst its citizens. The form that suits participation in climate change adaptation action, and especially climate change adaptation action in private gardens, is the participation arrangement of co-production. The municipality and the citizens can co-produce adaptation measures, by working together towards more quality and efficiency of services. The municipality and citizens both have their own roles within this arrangement. The citizens have an advisory role, the role of co-decider or partner, or the role of the initiator. The municipality has a role open for suggestions, a co-deciding/partnering role, or the role of facilitator. The citizens produce the solutions in their own gardens, while having an advisory through giving feedback. For this co-production of adaptation measures, citizens need to become active, since they will have to work together with the municipality and carry out their solutions. Active citizenship, however, is limited by social limits, such as ethical, cultural, risk and knowledge considerations. Important for this is the experiences of citizens, as well as the feeling of responsibility and incentives to take action. Furthermore, active citizenship depends on the awareness and willingness of citizens. The concept of awareness can overcome some of the social limits, as awareness is dependent on the knowledge, risk perception, attitude and behaviour of citizens. Willingness depends on the awareness and information about the benefits, costs, and inconvenience of certain problems or solutions/measures. The municipality can have an important role in raising awareness through giving citizens information about the risks of pluvial flooding, the benefits of solutions, by giving good examples, etcetera.

Active citizenship supplements the co-production arrangement of participation in climate change adaptation action by the municipality, which will lead towards measures and solutions that can be taken by citizens in their private gardens to reduce the problems caused by pluvial flooding and the use of impermeable surface.

Citizen Engagement	Co-production in climate change adaptation	Role of the municipality <ul style="list-style-type: none"> <li>- <i>Open to ideas and suggestions</i></li> <li>- <i>Co-decider/partner</i></li> <li>- <i>Facilitator</i></li> </ul>
		Role of the citizens <ul style="list-style-type: none"> <li>- <i>Advisor</i></li> <li>- <i>Co-decider/partner</i></li> <li>- <i>Initiator</i></li> </ul>
Active Citizenship	Social Limits	Experience of citizens with climate change, feeling of responsibility to take action, incentives to take action (money, time, information)
	Awareness	Awareness of climate change, pluvial flooding, measures to decrease (consequences of) climate change and measures that can be taken in private gardens to decrease the chance of pluvial flooding
	Willingness	Measures that are already taken by citizens in their private garden and their willingness to take more measures

Table 3: Conceptual framework

### 3. Method & methodology

#### 3.1. Scope

The research focuses on the city of Groningen. Groningen is the hometown of the researcher, making it easy to conduct the interviews with officers of the municipality and the citizens of Groningen. In this chapter, the location and sample for the research will be given. Furthermore, the philosophy that is used by the researcher for this research will be explained and the limitation of the research is described. After that, the strategy of the research will be given, which is divided in two parts – a strategy for the municipality, and a strategy for the citizens. The strategy consists of the instruments that are used, the procedure, and how the data is analysed. Lastly ethical issues concerning the research approach that is used will be discussed.

#### *Location*

This research is conducted in the city of Groningen. Groningen is a city with 200.000 inhabitants in the north of the Netherlands (Gemeente Groningen, 2015). Groningen has the youngest average population in the Netherlands, due to its high percentage of students by total population; approximately 17.5 per cent (Gemeente Groningen, 2015). Because of the high number of students, the city's extensive cycling network, and pedestrianized zone in the city centre, 61% of journeys within the city are made by bicycle.



Figure 5: The Netherlands, the city of Groningen in the north (source: google maps)

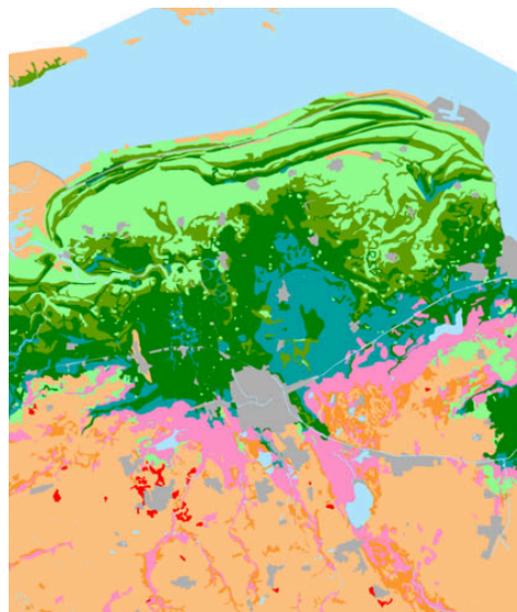


Figure 4: Soil types near the city of Groningen: sand (orange), sea clay (green), peat (pink) (source: Wageningen UR – Alterra, 2006)

Groningen is located on the northern-most part of the Hondsrug, a ridge of sand located in the north of the Netherlands. This 70-kilometer-long ridge is pronounced in the landscape by the formation of artificial dwelling hills. The average height of the ridge is 20 meters above sea-level. The height of the ridge in the city centre of Groningen is 9 meters high. The type of soil in the west and east of the ridge in Groningen is peatlands. To the north of the city, the type of soil is clay.

Among other cities in the Netherlands, Groningen has had to deal with pluvial floods in recent decades. The municipality of Groningen participates in several national campaigns concerning climate change. Operatie Steenbreek is the most prominent if it comes to involving citizens to take measures against pluvial flooding. Operatie Steenbreek conducted several activities, such as a TV-series, like 'GoudGroen' and 'Tegel eruit, plant erin', where several gardens got transformed from grey gardens to green gardens and laid out several façade gardens in two streets and at a church. The façade gardens are realized by opening a stroke of approximately 30 centimetres against the façade of a building, usually on the sidewalk, and planting greenery in place of the tiles.

### **3.2. Research paradigm - Interpretivist philosophy**

~~To gain knowledge about the motivation and willingness of citizens to take adaptive actions to decrease the impacts of pluvial flooding, a qualitative research has been carried out in the city of Groningen.~~ From the literature, it has been made clear that awareness about climate change is high amongst citizens (Lee et al., 2015). However, people are not aware of the risks and impacts climate change can have. Sealing surfaces in private gardens has been increasingly popular in the last few decades, increasing the chances of pluvial flooding. As the risks of and beliefs about climate change are subjective, the research philosophy for this research is interpretivist. This research is conducted in the social realm, which can be understood externally and internally. Views on climate change, motivation and willingness are based on meanings and understandings of people. These meanings and understandings can change in time. Knowledge generated through this research is therefore not permanent, but subject to change. It is relative to time, context and culture in which the research is conducted. The goal is understanding the subject, rather than making predictions for the future (Neuman, 2000).

#### *Limitations*

Due to the research topic and philosophy, this research knows various limitations. The data collected by the researcher is subject to interpretation of the researcher, an interpretivist philosophy. Therefore, the quality of the results is dependent on the skills of the researcher and can be influenced by the researchers' bias. As the understanding of opinions about the risks of pluvial flooding, the awareness and willingness are subjective, answers of the participants can be influenced by the presence of the researcher. Furthermore, the volume of the collected data can make the interpretation of the data time consuming. To deal with

these limitations the researcher must acknowledge the limitations and should take them into account. The researcher should have an open attitude towards the participants and their answers and should deal with them in an objective manner.

### **3.3. Research strategy**

Research can be done either qualitative or quantitative. Qualitative research focuses on human behaviour – for example why people act the way they do. Methods used for qualitative research can be interviews, questionnaires or observations. Quantitative research focuses on numerical data, by collecting numbers or views from large samples or a large number of people. This research focuses on human behaviour – adaptive action – and the views and meanings of the municipality and the citizens on climate change and surface sealing. Furthermore, as has been described in chapter 3.2, the research paradigm for this thesis is interpretivism. Because of this, a qualitative research is preferred over a quantitative research as this thesis tries to understand the subject and context of this research, not to generate numerical data to formulate facts.

The research methods, procedures and analysis for the municipality and the citizens have been divided and are given below.

#### *3.3.1. Municipality*

To gain a basic understanding of the situation concerning pluvial flooding and surface sealing in the city of Groningen, documents about Operatie Steenbreek and policy documents (table 4) about the policy on water and green in the municipality of Groningen have been read and analysed. In order to gain more specific information, representatives of the municipality who are concerned with Operatie Steenbreek and the policy on green and water have been selected (table 4). The research method used to gain more information are interviews. Interviews are a way to collect individuals personal experiences and perspectives. Other qualitative methods are questionnaires – a set of fixed questions to gain knowledge of a group of people – or observations – collecting data on natural occurring behaviour. Through interviews, the researcher can get a better understanding on how the municipality is engaging its citizens in processes to reduce pluvial flooding and about the broader concept of active citizenship in the municipality of Groningen.

#### *Research methods*

The interviews with the municipality have been conducted with open-ended questions (DiCicco-Bloom & Crabtree, 2006) and were semi-structured. Open-ended questions generally give longer responses, which can help to indicate the knowledge and understanding of the subject. The semi-structured method is used with a set of goals in mind – the topics the researcher wants to gain knowledge in, but also gives opportunities to ask different questions when other interesting topics come up during the interview. These

interviews will give insight in the problems and measures/solutions of pluvial flooding, citizen engagement, co-production and active citizenship.

### *Research procedure*

Policymakers and representatives of the municipality of Groningen are selected based on their knowledge about the topics concerning this research, which are Operatie Steenbreek, water policy and green policy related. After contacting the municipality about their campaign Operatie Steenbreek, an interview has been held with a representative of the municipality. With gaining knowledge and insight about the policies concerning Operatie Steenbreek through this review, a water policymaker and a green policymaker have been selected and interviewed in accordance with the representative of the municipality. An overview with the interviewees is given in table 4.

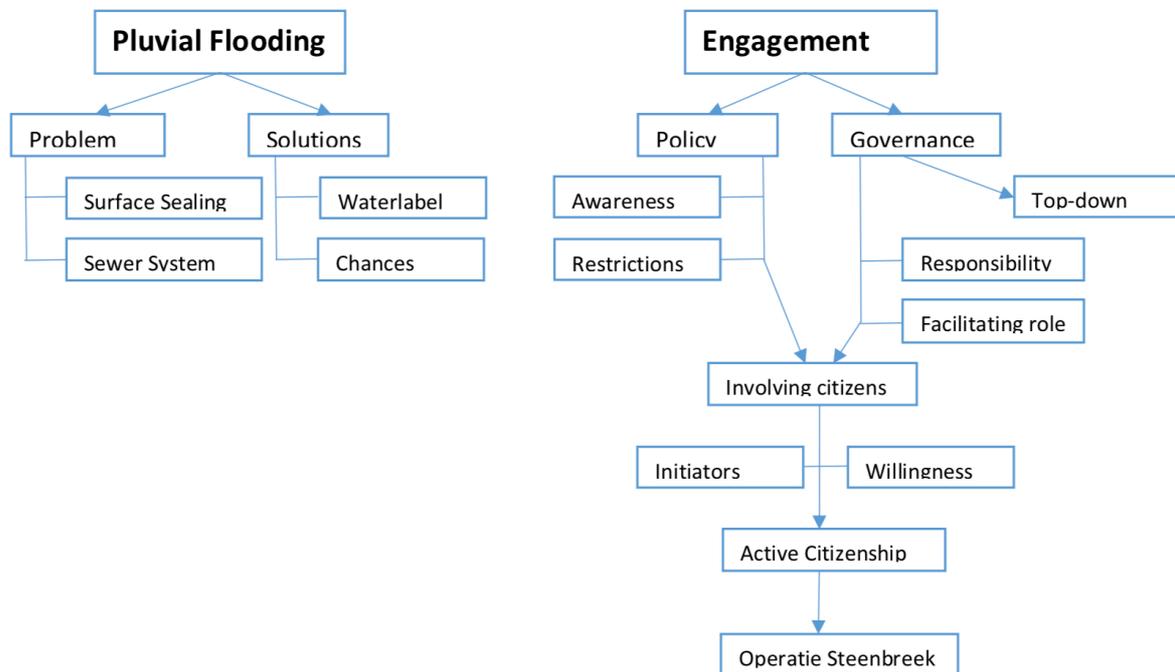
<b>Interviewee</b>	<b>Time</b>	<b>Location</b>
Marc Remijn & Carla Veldhuis (Operatie Steenbreek)	Februari 21, 2017; 10:00	Gemeente Groningen Gedempte Zuiderdiep 98
Laurens Stiekema (green policy maker)	June 20, 2017; 10:00	Gemeente Groningen Duinkerkenstraat 45
Dries Jansma (water policy maker)	June 22, 2017; 09:00	Gemeente Groningen Duinkerkenstraat 45
<b>Key Policy Documents</b>		
Gemeente Groningen: <i>Waterwerk. Groninger Water- en Rioleringsplan 2014-2018</i> Gemeente Groningen: <i>Groene Pepers. Groenstructuurvisie voor Groningen</i> Gemeente Groningen: <i>Groningen Groeit Gezond. De Voedselvisie van de Gemeente Groningen.</i> Gemeente Groningen: <i>Stadsmonitor.</i> Gemeente Groningen: <i>Jaarverslag 2016</i>  Operatie Steenbreek: <i>Een geveltuin op maat voor een gezellige en gezonde straat.</i> Operatie Steenbreek: <i>Het goede van een groene tuin</i>		

Table 4: Interviewees Municipality of Groningen & Key Documents

### *Data analysis*

For the interviews with the municipality officers and the interviews with the citizens, different coding schemes have been used, as they focus on different parts of the conceptual framework. The coding for the interviews with the municipality focus on the experiences with pluvial flooding and citizen engagement. For pluvial flooding, the problems the municipality faces and the solutions they take have been questioned. For citizen engagement, their policy on raising awareness and citizen involvement has been touched upon. Furthermore, the governance strategy of the municipality has been discussed in the interviews. Furthermore, the experience of the municipality about the willingness of citizens to take action has been questioned. The coding is done in qualitative research data analysis

and research software Atlas.ti. For the analysis of the interviews with the municipality, the following coding scheme has been used:



### 3.3.2. Citizens

This research seeks to explore the phenomena of increased surface sealing in private gardens and the willingness to take adaptive action to reduce the impacts of pluvial flooding. The goal of the research was to find and describe variations, relationships and experiences on the willingness of citizens to take adaptive action. For the citizens, awareness of the interviewees has been determined on their knowledge about the subjects and divided into four groups; only hears/reads about it in the news, knows effects to some extent, behaves environmentally friendly, and experienced pluvial flooding. The willingness of the interviewees has been determined on their activeness and has been scaled down to three scales; passive, passive but wants to be involved, and actively involved. The participants for the citizens study were selected through a probability sampling technique (William et al., 2014), meaning that the participants have a random chance to be selected. The selection of the participants is further explained in chapter 3.3. Furthermore, the study was conducted in a cross-sectional way (William et al., 2014), meaning that the data collected from the study population was taken at a specific point in time.

#### Research methods

The research questions that are to be answered through primary data are about meanings and understanding of people. For this, an in-depth semi-structured survey questionnaire will be held to retrieve information from the citizens of the city of Groningen about their views

on climate change, pluvial flooding, their awareness of climate change and awareness of adaptation measures, and their willingness to take adaptive action. The questionnaires will give insight into the concepts of awareness, willingness and active citizenship.

An in-depth semi-structured questionnaire is generally organised around a set of predetermined open-ended questions (DiCicco-Bloom & Crabtree, 2006). From these open-ended questions, other questions can emerge from the dialogue between the researcher and the participant to understand the participant better and to delve more deeply into different aspects of the research issue. In this case, a questionnaire suits better than interviews, as the researcher tries to find phenomena amongst a group of people, rather than a single subject.

#### *Research procedure*

The target population for this study has already been defined in the scope of this research. These are the citizens of the city of Groningen with a private garden. The sampling frame for this study will be defined by the selection of several streets in various neighbourhoods in the city of Groningen. This will be done by geographical cluster sampling of neighbourhoods in the city of Groningen, and then streets will be selected through a simple random sampling method. This makes the sampling method a two-stage cluster sampling. Through google maps and statistics from the municipality of Groningen, neighbourhoods with different characteristics have been selected. This way, the samples have different backgrounds, such as social and economic status, age and gender. Furthermore, the size and location (which determines soil types and the garden location relative to house) of the private gardens will be different. Figure 6 shows the selected neighbourhoods. Table 3 shows characteristics of these neighbourhoods.

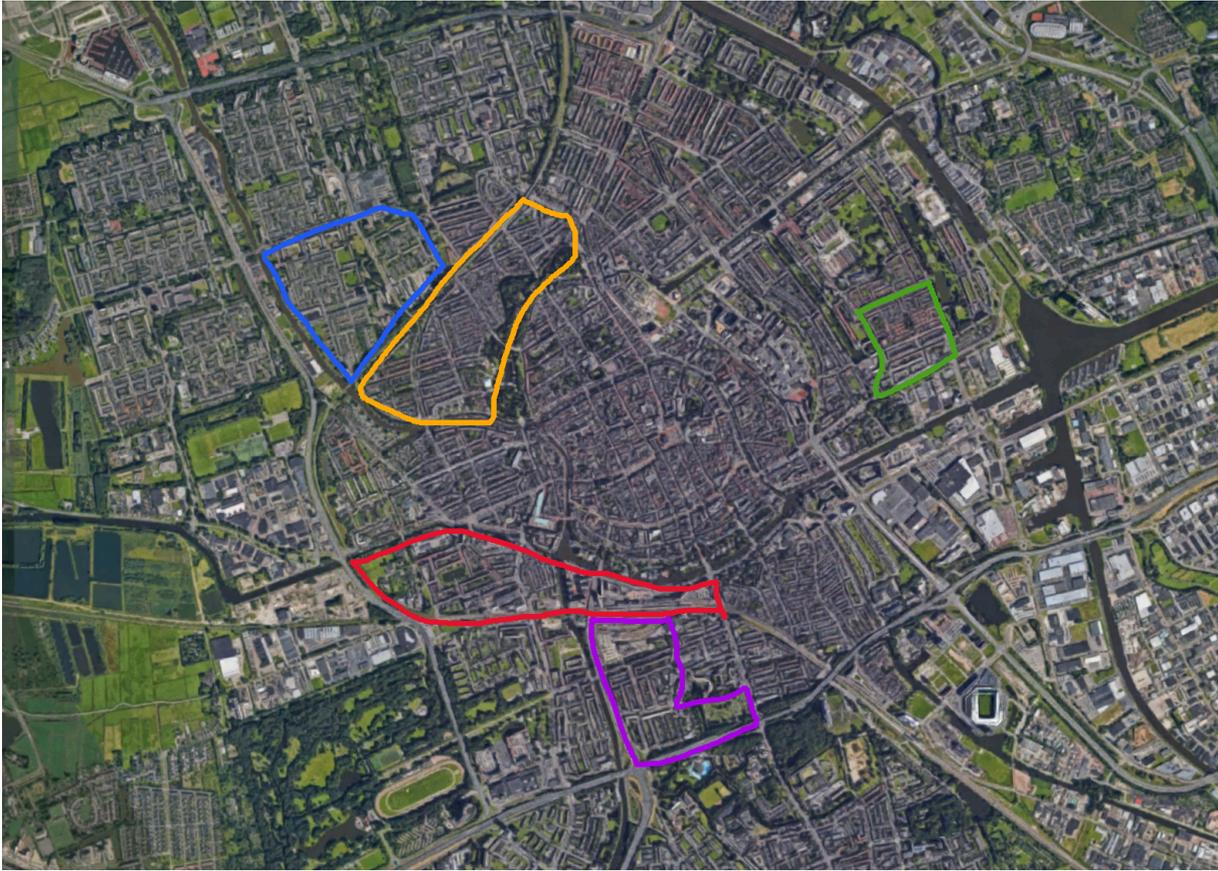


Figure 6: Selected neighbourhoods: Paddepoel-Zuid (blue), Oranjebuurt (orange), Gorechtbuurt (green), Zeeheldenbuurt (red), Rivierenbuurt (purple). (source: google maps)

	Unemployed <sup>1</sup> (%) [2017]	Feels unsafe <sup>2</sup> (%) [2014]	Neighbourhood satisfaction <sup>2</sup> (%) [2014]	Students <sup>2</sup> (%) [2016]	Income <sup>3</sup> (x €1000) [2014]	Higher education <sup>4</sup> (%) [2016]
Groningen	9.5	21	93	17.7	29.6	52.2
Zeeheldenbuurt	4.0	15	96	33.3	26.5	59
Bloemenbuurt	21.5	28	93	7.6	21.6	53
Oranjebuurt	9.5	17	99	14.9	33.1	64
Rivierenbuurt	6.7	19	98	20.1	27.2	58
Paddepoel-Zuid	16.7	29	89	5.9	26.7	46

Table 5: Neighbourhood characteristics (sources: <sup>1</sup>UWV werkbedrijf, <sup>2</sup>O&S Groningen, <sup>3</sup>CBS, <sup>4</sup>Gemeente Groningen sociale zaken).

After selecting streets where the interviews have been conducted, the researcher went by the houses door to door to take the interviews. After a maximum of four respondents, the researcher then went to go to another selected street in a different neighbourhood. This allows the researcher to get a heterogeneous sample. The interviews have been recorded or, when recording was not possible, documented by writing down the answers and taking notes on a printed list of questions.

### *Participants*

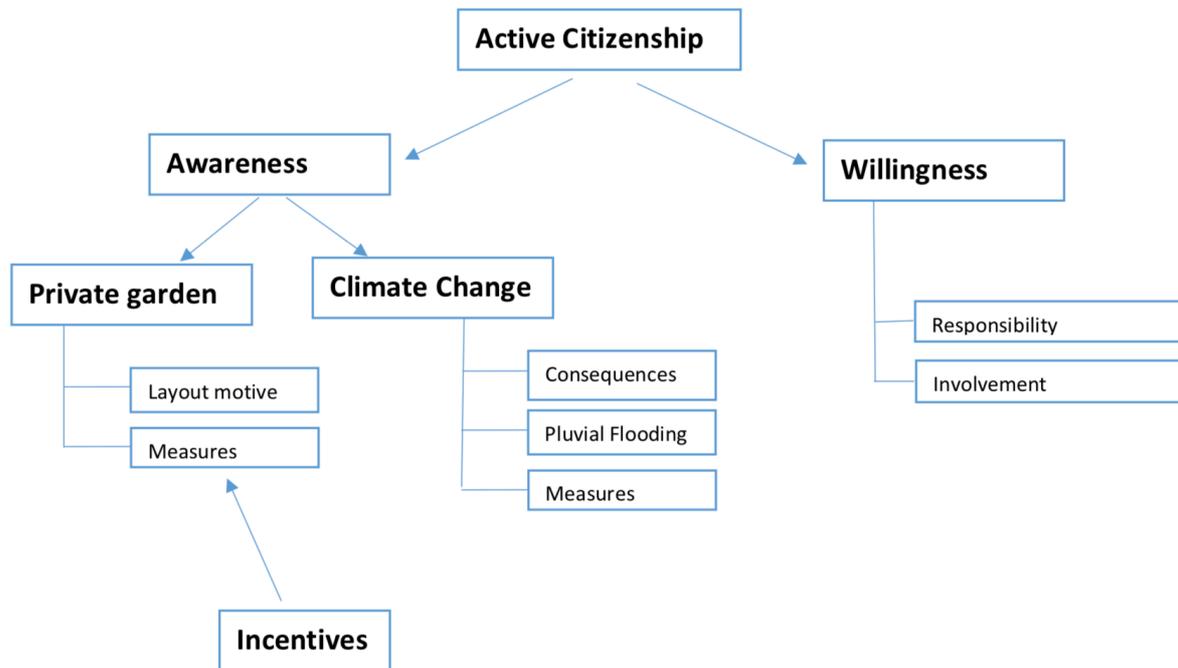
The following table shows the participants for this research. The participants have been anonymized and named interviewee 1, interviewee 2, etc.

	Name	Neighbourhood
1	Interviewee 1	Rivierenbuurt
2	Interviewee 2	Rivierenbuurt
3	Interviewee 3	Rivierenbuurt
4	Interviewee 4	Bloemenbuurt
5	Interviewee 5	Oranjebuurt
6	Interviewee 6	Oranjebuurt
7	Interviewee 7	Paddepoel-Zuid
8	Interviewee 8	Paddepoel-Zuid
9	Interviewee 9	Zeeheldenbuurt
10	Interviewee 10	Zeeheldenbuurt
11	Interviewee 11	Zeeheldenbuurt
12	Interviewee 12	Zeeheldenbuurt

*Table 6: Interviewees and their corresponding neighbourhood.*

### *Data analysis*

The analysis of the data collected with the interviews with citizens occurs at the same time as the data collection so that the researcher generates an understanding about the research questions. This way, the researcher can adjust questions to get a better overall understanding of the topics that are being studied. Additionally, this will lead to a point where no new information of categories or themes appear. When no new information emerges, the information is saturated, signalling that the data collection is completed (DiCicco-Bloom & Crabtree, 2006). Through the interviews, data is collected in the form of text. The first step to analyse the content of the text. For this, themes, ideas and views that emerge within the different answers are identified and coded. The codes are related to the conceptual framework, as is shown below. The coding is done in qualitative data analysis and research software Atlas.ti. To gather evidence, the identified themes, ideas and views of the participants are then grouped together. The coding scheme for the analysis of the interview with the citizens that has been used is as follows:



### 3.4. Ethical issues

To protect the participants in this research, it is necessary to take ethical issues or risks serious. For this research, mainly confidentiality issues and matters around the participants, the recruitment of participants, and researcher are important. The participants should be guaranteed confidentiality and anonymity (if not otherwise indicated by the participant) to make sure no harm can be done to the participant. It is possible that participants are vulnerable people (elderly, physically or mentally ill, people with learning difficulties) or do not understand verbal explanations of the questions, and therefore cannot answer coherently. The researcher should always treat the participants respectfully and respect the opinions of the participants. The recruitment of participants should be voluntarily, and participants should have informed consent before taking part in this research. The participant should always have the right to service and withdraw from the study without further explanation. The researcher must acknowledge the work of other authors with the use of referencing. Communication In relation to the research should always be done with honesty and transparency. The representation of primary data findings should not be biased in any way and any type of misleading information must be avoided.

## **4. Pluvial flooding in Groningen and unsealing with ‘Operatie Steenbreek’**

This chapter discusses the results of the interviews with the municipality of Groningen and Operatie Steenbreek and is divided in two sections. The concepts that are discussed in this chapter are citizen engagement and awareness. The first section is about the policy in the municipality of Groningen, in which the focus lies on the water management tasks of the municipality and how the municipality involves and engages citizens in this process, how the municipality communicates with its citizens about the subject, and how the municipality tries to raise awareness about water. The second section is about the campaign Operatie Steenbreek, which will focus more on raising awareness of citizens in Groningen about the problems of and solutions for pluvial flooding. Furthermore, some practical examples of Operatie Steenbreek are discussed. Lastly, a conclusion will be given.

### **4.1. Municipality of Groningen**

The municipality of Groningen has put down their policy on water and their sewage system in the ‘Plan for water and sewage system of Groningen 2014-2018’ (Groninger Water- en Rioleringsplan 2014-2018), called Waterwerk. This policy document is required by law under the Laws of Environmental Conservation (Wet Milieubeheer) and describes the situation and duties of care for water and sewage in the city and the choices the municipality makes for the coming 5 years (from 2014 onwards). Next to plans for treatment of sewage in the urban area, the document also describes plans on how to cope with changing weather patterns due to climate change and how to prevent and reduce flooding due to heavy rainfall. The duties of the municipality of Groningen are the care for collecting and transporting urban wastewater, care for effective collection and processing of effluent rainwater, and the care for taking groundwater measures. The water- and sewer system policy is written in accordance of the two water boards that are active in the municipality of Groningen and the Province of Groningen. Although the policy on water and sewage system is written down, there will always be room for interpretation according to the policymaker in the water department of the municipality of Groningen (from now on this interviewee will be referred to as the water policymaker) (interview). This way, unexpected or uncertain events, such as climate change and citizen initiatives, have room for development within, or alongside, the plans of the municipality.

#### *4.1.1. Water chain*

The water chain within the city is managed by the municipality, the two water boards and water companies. Each of these actors have different roles and tasks within the water chain. The water boards are responsible for wastewater treatment and the water companies are responsible for drinking water. The municipality is responsible for transportation of wastewater produced in the urban area, the collection of rainwater that cannot or is not allowed to be used for local water management, limiting structural adverse effects of

groundwater, transporting the collected water to suitable discharge points, limiting undesirable discharge to surface water, the soil and groundwater, and limiting environmental pollution and nuisance. Furthermore, citizens of the city of Groningen are expected to use drinking water responsibly and to disconnect and process rainwater that falls on their private property if possible or asked for by the municipality. The citizens are responsible for their own internal drainage and connection to the main sewage system.

The municipality of Groningen has put the citizens and businesses of Groningen central in the water chain and has made a distinction of four elements; the environment, public health, safety and the legal framework. The environment exists of surface water, groundwater, recreation, stimulation and nuisance. Wastewater, treatment of water and innovative techniques are part of public health. Safety consists of climate change, keeping dry feet, rainwater, and business- and asset management. Lastly, the legal framework consists of laws and regulations, future developments and finance (Waterwerk, 2013).

#### *4.1.2. Current situation and tasks*

The main element in the water system in the city of Groningen is its sewage system. The sewage system prevents untreated waste water from flowing into the soil or surface water. Nearly all of the 102,074 buildings are connected to the sewage system, with the exempt of 67 plots that discharge their waste water through an individual treatment installation. The sewage system in the city of Groningen comprises 935 kilometres of pipes, of which 577 kilometres is an (improved) mixed system (where waste water and rainwater get drained together). Separate drainage consists of two pipes of which one drains waste water and one rains rainwater. The system in Groningen has 118 kilometres and 147 respectively. The rest of the pipes are overflows and pressure pipes. The municipality of Groningen currently has 177 overflows for mixed sewage systems. There are 291 rainwater outlets, about 65,000 street and sidewalk columns. There are also 106 municipal sewage mills (Groninger Water- en Rioleringsplan 2014-2018). Due to the age and current state of the sewage system, there will be no intensive replacements in the coming years, but only when the quality of the pipes asks for replacement. The municipality expects a peak in replacements in the period of 2030-2040.

Many of the ponds in the city have an important role within the sewage system, they originally were laid out to make room for overflows. Therefore, the quality of the water in the ponds in general is of average or bad because with heavy rain, these overflows discharge waste water into these ponds. The ponds are usually not connected to other ponds, which impedes flow and refreshing of the water. To fight this, the municipality wants to connect solitary ponds and disconnect rainwater from the sewage system. Disconnecting the rainwater leads to less load on the sewage, thus less chance of waste water through the overflows, and for more clean rainwater that runs off directly to the ponds, which in turn has a positive effect on the flow and refreshment of water.

The municipality does not disconnect rainwater from the mixed sewage system by any means. Costs and effect of the measures are always taken into consideration. If the effects are minimal, rainwater will not be plainly disconnected. Separating rainwater and waste water is one of the responsibilities of the municipality. Though, since the arrival of the “Law Anchoring and Financing Municipal Watertasks” (Wet Verankering en Bekostiging Gemeentelijke Watertaken) in 2008 and the “Waterlaw” (Waterwet) in 2009, separating rainwater and wastewater is also the responsibility of private businesses and citizens on their private property.

For water on the streets during heavy rainfall, the municipality of Groningen makes a distinction of three levels: hindrance, severe hindrance and nuisance (Groninger Water- en Rioleringsplan 2014-2018). Hindrance is when there is a limited amount of water on the streets during a period of 15 to 30 minutes. Severe hindrance is when there is a large amount of water on the streets, with flooded tunnels and rising manhole covers for a period of 30 minutes to two hours. Nuisance is when there is water on the streets on a large scale for a long period of time that causes flooded houses and businesses, material damage and severe obstruction of economic activities and traffic. The sewage system of the municipality of Groningen is designed so that heavy rainfall that occurs once every two years should not cause any hindrance or nuisance. Heavy rainfall that occurs once every one-hundred years should not cause nuisance.

According to the water policymaker (interview), there are two realities due to climate change and the increase in short but heavy rainfall. Firstly, “you have the reality that the sewage system should be properly functioning and be able to collect and transport the rainwater, with or without overflows, during heavy rainfall. But, secondly, if, on a certain moment in the future due to climate change, the intensity of the rainfall gets too high, it will be impossible to arrange a sewage system that can deal with that. The costs of such a system would simple be too high. On average the sewage pipes last 80 years” (water policymaker). To change the whole system would mean a radical change in course. Instead of changing things underground, the water policymaker proposes to change things above the ground.

#### *4.1.3. Goals and ambitions*

One of the main goals for the municipality of Groningen is to prevent discharge of untreated wastewater in the soil or surface water. The first of three main reasons for the sewage system is to secure public health - the sewage system makes sure that waste water is removed from the human environment. The second reason is to keep the quality of the living environment up to date – the sewage system prevents nuisance due to rainwater, the system collects and transports excess rainwater (next to waste water) from the roofs of households and companies, roads, and squares for example. The third main reason for

having a sewage system is to protect the soil, the groundwater, and the surface water – this is accomplished by preventing untreated waste water from reaching the soil and surface water through the sewage system and wastewater treatment systems.

The municipality of Groningen has translated their goals and ambitions in different themes (Groninger Water- en Rioleringsplan 2014-2018). The themes that are relevant for this thesis will be discussed here.

#### *Quality of the environment*

The municipality of Groningen believes that water and green contribute to the quality of the built environment – surveys have shown that people that are living in a green environment rate their living environment higher. Their goal is to strengthen the green-blue structure in the city and to manage water according to its function. With continuation of subsidies for green roofs they want to reduce the runoff during heavy rainfall and reduce urban heat-islands.

#### *Quantity of the water*

The ambition for water quantity is to bring the water system of surface water, groundwater and the sewage system in order and keep it in order. For this the municipality of Groningen considers the developments of climate change and human action, such as soil sealing.

#### *Water and spatial planning*

To strengthen the water system in the city, the municipality of Groningen acknowledges the importance of taking water into account in the early stages of processes and special development. For example, for newly built neighbourhoods, the municipality always strives to use a separated sewage system, where wastewater and rainwater are separated.

#### *Rainwater*

The city of Groningen believes rainwater is an important source for clean water, and to keep rainwater clean, the municipality of Groningen wants to collect rainwater directly where it falls. Instead of mixing rainwater with waste water, they want to use rainwater to refresh and replenish surface water. The municipality of Groningen wants to stimulate private businesses and citizens to use rainwater more carefully and to prevent fresh rainwater from flowing to the sewage system.

#### *Awareness of water*

The municipality of Groningen not only wants the municipality and water corporation to be aware and responsible for water, but also its citizens. The municipality wants to accomplish this with targeted communication about water projects and to inform citizens on how they can contribute.

#### *4.1.4. Citizen Engagement and Communication*

The tasks, goals and ambitions of the municipality of Groningen have impacts on the built environment and its citizens. Sometimes the measures that will or are being taken have consequences for certain groups or citizens and businesses. It is important to inform and communicate with the citizens and businesses about these consequences and measures that will be taken. The municipality believes that the common interest is more important than individual interests. To accomplish this, the municipality has set three goals (Groninger Water- en Rioleringsplan 2014-2018). The first is to inform as many stakeholders and interested people about the municipal plans for the sewage system and the spatial and social effect. The second goal is to positively influence the attitude of targeted groups, and the third goal is to conduct a change of behaviour, which makes the citizens of Groningen more aware of water in their environment and to make them act in a responsible way.

The municipality of Groningen wants to engage citizens in making policy, at both the city level and the neighbourhood level. Participation is one of the key tools to improve the relationship between citizen and politics. The municipality of Groningen wants to achieve this by engaging neighbourhood organizations in the early processes of policy making and implementation plans. In the decision-making stage, the neighbourhood organization have an important advisory role. According to the municipality, citizens are also responsible for a clean and whole city. Citizens initiatives are supported. The municipality believes that citizen involvement leads to less pollution and damage – which in turn leads to higher satisfaction.

The municipality acknowledges that citizens have little interest in forming policy for water, as “citizens think: we pay sewage charges to the municipality, and it’s their job. The municipality has to fix the problems” (interview water policymaker). The interest increases when concrete activities are being formed or when citizens experience hindrance. The municipality times their communication towards citizens during important phases in the process and “just before periods with heavy rain. If there is heavy rain, not per se the kind that people would drown, but than people become more aware” (interview water policymaker). Most of the citizens’ initiatives that the municipality facilitates, are related to community kitchen gardens and urban agriculture and the management and maintenance of urban green, playing facilities and sealed surfaces. In 2016, the objective of 340 initiatives was met; 350 projects for cleaning the public space were supported, 29 initiatives for improving the living environment were facilitated, such as urban gardening and the maintenance of urban green, and five initiatives concerning urban agriculture were facilitated (Jaarverslag 2016, Kwaliteit van de leefomgeving, Gemeente Groningen).

Most of the citizen initiatives focus on green, and not on water or water management. The lack of interest in water related initiatives could be due to former policy of the municipality of Groningen. For example, former alderman Visscher wanted to ‘green’ the city of Groningen (Policymaker in the green department of the municipality of Groningen (will be

referred to as the green policymaker), interview). The green policymaker says that “the greening of Groningen was not based on water management, but rather reducing the amount of particulate matter and heat in the city”. Furthermore, there was a policy note, *Groene Pepers* (English: Green Peppers), that came out in 2009 that also focused on green reducing the urban heat island effect and particulate matter, and on engaging citizens in the maintenance of the green in the city. Later, in 2012, the municipality of Groningen released their ‘food vision’ ‘Groningen Grows Healthy’ (Groningen Groeit Gezond), in which the municipality stimulated initiatives focusing on urban gardening and agriculture. This policy document caused an explosive growth in citizen initiatives concerning urban kitchen gardens. According to the green policymaker (interview) “the floodgates were open. But that’s because people want something, for that it needs an edible component”. The initiators will get something back for it eventually: food. Since 2014, the municipality is involved in a nationwide campaign *Operatie Steenbreek* to raise awareness about the use and consequences of impermeable surface in private gardens in the light of climate change and short but intense rainfall. This campaign is discussed later in this chapter.

Another important factor in the lack of water related initiatives, according to the water policymaker (interview), could be that citizens of Groningen have not experienced any water related problems, and therefore lack motivation to take any kind of action. People living on the second floor of a building, for example, will experience less damage from nuisance due to pluvial flooding than people living on the ground floor.

#### *4.1.5. Raising citizens’ awareness about pluvial flooding and impermeable surface*

The municipality of Groningen wants to raise the awareness of its’ citizens about pluvial flooding and climate change. The water policymaker, a technical policymaker for the municipality of Groningen and responsible for the water and sewer system policy, aspires to raise the awareness of citizens through a water label. The water label is a project that is being created by a nationwide group of policy workers from cities across the Netherlands. “It’s just like the energy label used for houses, or the label on a new washing machine” (interview water policymaker). The water label is an instrument that shows the performance on water - affected by the type of sewage system, green roofs, the use of a water tank, etc. - of houses. “If you’re connected to a separated sewage system, have a green garden, a water tank, and a green roof, you get label A. What we want, is to show people, if they all have label G - because they only use tiles in their garden, that they’re drowning themselves, figuratively” (interview water policymaker). The water label should be a way of communicating citizens’ efficiency on water and raise their interest and awareness in water related topics. Next to communicating with citizens about the process with a certain ‘timing’, as mentioned earlier, the municipality also tries to communicate to its’ citizens about the water label just before heavy rainfall to increase awareness (The water policymaker, interview). According to the water policymaker, it is important to respond to short-term memory, as people will not be aware of the increase in short but intense rainfall if it has not

rained for the last couple of weeks. An example is a case on the Meeuwerderweg, a street in Groningen which experienced nuisance through pluvial flooding, including material damage. The people affected were much more involved after the incident than before, the water policymaker recalls.

Additionally, heavy rainfall is also important to raise awareness about water-permeable and –passable surface sealing, which is a solution that can be taken above ground level, as it will show citizens it works. ‘Infiltration’ areas, where permeable and passable surface sealing is used, could be indicated with comprehensible street signs to raise awareness about the possible solutions to reduce hindrance and nuisance through pluvial flooding. For new neighbourhoods, rainwater could flow directly to surface water above ground, this way, instead of being discharged under the ground through pipes, people will become more aware of rainwater (The water policymaker, interview).

Furthermore, the municipality, in co-operation with RIONED, wants to make a sample book with examples of a water friendly garden – using green instead of impermeable surface, so water can infiltrate – to raise awareness and inspire its’ citizens to take action against pluvial flooding and to reduce strain on the sewage system (The water policymaker, interview).

#### **4.2. Co-producing adaptation measures through Operatie Steenbreek**

Cities across the Netherlands are seeking for solutions to deal with excessive rainfall and to make cities climate resilient. The municipality of Groningen got involved with the national campaign Operatie Steenbreek three years ago, in 2014 (Municipality officials involved with Operatie Steenbreek, interview). This campaign currently involves 35 cities/municipalities in the Netherlands. The goal of the campaign is to start a country-wide movement to raise awareness of climate change that we will have to deal with in the future and the consequences of using impermeable surface in private gardens (Municipality officials involved with Operatie Steenbreek, interview). The campaign runs until 2022.

The ambition of the municipality of Groningen is to activate citizens in turning their grey gardens into green gardens. Grey gardens are heavily surfaced with impermeable surface, such as bricks and tiles, whereas green gardens are mostly green, including grass, trees, bushes and plants. Green gardens help reduce the excessive run-off during peak rainfall and reduce the stress on the sewer system, which in turn reduces the chances of pluvial flooding. The municipality tries to activate as many citizens as possible, they do not have a specific group of people they want to reach. The working group for Operatie Steenbreek meets once a month to discuss the progress and goals of the campaign. Other organizations involved in the campaign are the Nature and Environment Federation (Natuur- en Milieufederatie), the Royal Dutch Nature History Association (KNNV Groningen), the Institute for Nature Education and Sustainability (IVN Groningen), Ecological Gardeningbureau Michiel Coesèl,

Ecological Gardeningbureau De Wilde Weelde, De Korenbloem Garden Consultancy, Carla Veldhuis Communication and Presentations and Liesbeth Stoker Groen Doen & Wel zijn. Funding for Operatie Steenbreek comes from the municipality of Groningen.

#### *4.2.1. Raising awareness and providing solutions with Operatie Steenbreek*

One of the most important solutions citizens can take to reduce the consequences of pluvial flooding in their own private space is using less impermeable surface that causes excess rainfall to runoff towards the sewage system. This unsealing of gardens is the focus of the campaign Operatie Steenbreek, which literally translates to 'Operation Stonebreak' – breaking away the stone surfaces in private gardens. The municipality of Groningen promotes the campaign by airing TV-shows on a local broadcasting channel. One of which, 'Steen eruit, tegel erin' focusses on transforming grey gardens into green gardens. With the publicity, the municipality hopes to raise awareness about impermeable surface and inspire its' citizens to take action and to transform their own garden. 'GoudGroen' is another TV-show where all kind of green citizens' initiatives are being treated, also to inspire people to become more active in the public domain. The municipality hopes that participants in the TV-shows also persuade others to transform their grey gardens into green gardens (Municipality officials involved with Operatie Steenbreek, interview). By working with schools and festivals in the city of Groningen, the municipality tries to make Operatie Steenbreek recognizable and that it becomes a brand – with enthusiastic gardeners and other businesses that engage with the concept (Municipality officials involved with Operatie Steenbreek, interview).

Several leaflets, distributed by the municipality, inform people about the importance of green gardens and actions that citizens can take in their private garden. One of the leaflets (Makkelijk Groen in 7 Stappen, Operatie Steenbreek) offers a step-by-step plan for a simple and easy maintainable green garden and stresses the importance of getting rid of impermeable surface, like tiles. Another leaflet by Operatie Steenbreek (Het Goede Van Een Groene Tuin, Operatie Steenbreek), stresses the importance of a green garden and gives eight benefits: a green garden is good for your health, reduces ambient noise, brings nature closer to your home, offers life to multiple animal species, provides cooling and a better air quality, reduces flooding and damage by water, reduces energy costs, and increases the value of houses. Furthermore, the leaflet offers tips and tricks on how to make a green and water friendly garden, which does not acquire a lot of maintenance. The municipality officials involved with Operatie Steenbreek (interview) also state that the transformation of grey to green gardens should be accessible, by being low-budget. Plants should be re-used from other gardens. Furthermore, the municipality stimulates the use of rain barrels by spreading a discount voucher for rain barrels.

Another solution to unseal surfaces, are façade gardens, small front gardens against the façade of a building. The façade garden is usually one sidewalk tile deep, with a maximum of

45 centimetres and a minimum width of 150 centimetres, planted with wild flowers. Operatie Steenbreek also has a leaflet on façade gardens (Een geveltuin op maat voor een groene en gezellige straat, Operatie Steenbreek) that states seven reasons to get a façade garden;

1. A green environment is good for your health and mood
2. Façade gardens decorate the living environment and make the different seasons noticeable
3. Façade gardens attract animals and insects and increase the sense of nature in a city
4. Façade gardens protect the façade of a building by keeping the façade warm in the winter and cold during the summer
5. The plants cool off the city during hot periods and reduce particulate matter
6. Removing impermeable surface reduces the stress on the sewage system and increases the supply of groundwater
7. Façade gardens increase the sociability of a neighbourhood

The municipality of Groningen facilitates the construction of the façade gardens. Interested citizens are asked to ask neighbours if they are interested too and write down how many people want a façade garden. If they contact the municipality and the municipality agrees to the plans, the municipality will construct the façade gardens. According to the green policymaker (interview) façade gardens are easier to realise than persuading citizens into transforming their garden.

However, the municipality officials involved with Operatie Steenbreek acknowledge that people who have a heavily surfaced garden often are not interested in having a green garden and that solutions should be as easy as possible. The municipality officials involved with Operatie Steenbreek also state that leaflets often do not get the wanted attention, although people become more interested if they see it in person (the construction of façade gardens for example). According to the municipality, people often state that they do not have the time to transform their gardens, or that they are afraid of cats getting in their garden. However, green neighbourhoods often have greener private gardens as well – so visible green municipal gardens might stimulate citizens to take action, according to the municipality officials involved with Operatie Steenbreek.

#### *4.2.2. Practical examples*

Some of the projects Operatie Steenbreek conducted, are good examples to raise awareness by making green visible. These projects have been realized in the public space, in co-operation with the community. Together with a gardener, eight members of the Immanuelkerk, a church in Groningen, laid out several façade gardens around the church. The façade gardens are maintenance friendly and are planted with herbs (Gezinsbode, 2017). In a neighbourhood in Groningen, De Zaaier, ten façade gardens were laid out by its

residents. The project was initiated by a resident who was inspired by other façade gardens and wanted to 'green' her street as well (Operatie Steenbreek, 2017). The resident informed her neighbours and contacted the municipality, who were very positive and contributed to the project with plants. Eventually twenty square meters of tiles were removed and replaced with façade gardens.

### **4.3. Conclusion**

The municipality of Groningen tries to minimize the consequences of pluvial flooding by using their sewage system as efficient as possible. However, to deal with the predicted short but intense rainfall in the future, the municipality does not see potential in the system underground, as it will be too expensive to expand or replace the system that has a lifespan of approximately 80 years. Therefore, measures above ground level are taken, like reducing the amount of impermeable surface by replacing it with green or water permeable or passable surfaces.

Next to these solutions that are taken top-down, the municipality also stimulates its citizens to take adaptation measures to reduce the impacts of pluvial flooding – the municipality wants to engage citizens in climate change adaptation measures. The municipality does this through both the water policy of the municipality and with the campaign 'Operatie Steenbreek'. The municipality actively informs or wants to inform its inhabitants through leaflets and example books – like the one that is produced together with RIONED and the leaflet 'Operatie Steenbreek' uses. Furthermore, the municipality wants to actively inform people about the 'water'-performance of their homes and gardens, with the innovative idea of the water label.

These actions have a clear link with the concept of co-production in climate change. Together with the citizens, the municipality wants to tackle the problems that pluvial flooding causes, through stimulating and informing citizens about the measures they can take in their private garden. Although it is not written in policy, by facilitating and informing citizens about possible solutions that citizens can take in their private garden with Operatie Steenbreek, the municipality wants to engage its citizens and co-produce climate change adaptation measures. With the campaign Operatie Steenbreek the municipality hopes to stimulate citizens to reduce the amount of impermeable surface in private gardens and to take other water-friendly solutions like the use of rain barrels and create awareness about pluvial flooding and the consequences of choices citizens make regarding their private garden.

The role the municipality corresponds to the higher degrees of participation shown in table 2 in chapter 2.5.3. In order to co-produce the municipality should take an advisory, facilitating role. This is what the municipality does through 'Operatie Steenbreek'. The municipality

facilitates citizens in taking adaptive action in their gardens and informs/advises them about the best possible solutions.

Furthermore, the actions of the municipality have influence on the social limits, awareness and willingness of the citizens of Groningen. As has been described in chapter 2.6.1, climate change adaptation can be influenced by ethical, cultural, knowledge and risk perceptions. By informing the citizens with leaflets, examples and the water label for example, the municipality increases the knowledge and risk perception of the citizens. By showing the risks, the municipality can also influence citizens' perception of places and culture, since the consequences of climate change and pluvial flooding can also have great impacts on places and culturally important subjects. By informing citizens about tested solutions that they can take in their private gardens that work, ethical perceptions of what are or are not the limits of adaptive action can be influenced. Additionally, these matter have a clear influence on the awareness of citizens and the willingness of citizens to take action. As has been written in chapter 2.6.3, willingness is highly influenced by the available information, especially on the benefits and costs of the adaptive action citizens can take in their private gardens.

In the next chapter, the actual awareness and willingness of the citizens will be discussed.

## **5. Citizens' view on participation and pluvial flooding.**

In this chapter, the results of the interviews with the citizens of Groningen are given. Firstly, the concept of awareness is being discussed in three sections, awareness of pluvial flooding, awareness of measures and responsibility, and lastly awareness of measures that can be taken in private gardens. After that, the concepts of willingness and involvement/active citizenship is touched upon. Lastly, a conclusion for this chapter is given.

### **5.1. Social limits: knowledge and risk perception.**

All the respondents are aware of climate change. Although, not everybody has the same knowledge or understanding of climate change and the risks it has. Most of the awareness is created by the (social) media, where the respondents hear or read about climate change and its effects. Only one interviewee mentioned the effect that climate change has on something they experience first-hand, as "in the previous twenty years there has not been an 'Elfstedentocht' (an ice-skating competition on natural occurring water in the province of Friesland in the Netherlands), if you compare that to other years, you notice that the earth is warming up" (interviewee 1).

The knowledge can be divided into three groups of people: people that have only read or heard about it in the media; people that know the effects to some extent; and people that behave consciously in an environmentally friendly way. The division is based on the answers given in the interviews about the respondents' opinion on climate change and the effects of climate change.

#### *5.1.1. Only reads about it in the media*

The first group seems to recall recent events more easily than older events, like interviewee 7, who mentions President Trump in a negative way (in the light of climate change): "from what I read about it, despite what president Trump says, I think we should take action" (interviewee 7). These people do not feel effected by climate change and feel like it is a 'far away from home' problem. They do not seem to be afraid of the consequences either, trusting on the government or others to deal with the consequences. Interviewee 5 says that they read about global warming and feel the need that something must change but holds the government accountable: "We're a low-lying country, so they (government, water boards) should build some more dykes. I assume they are doing that already. They are keeping an eye on that. I do not know exactly how it works but I hope that the government will take appropriate action" (interviewee 5)

#### *5.1.2. Knows effects to some extent*

The second group is more aware of the effect of climate change and the effects certain choices have on the climate. Although interviewee 3 also mentions that they think it is

difficult to read into climate change more because they don't experience the effects of climate change drastically, they are aware that their choices effect the climate: "I think it would help if we would all eat more vegetables. Eating less meat, I think that helps. And that we should not drive our cars often or take flights" (interviewee 3).

#### *5.1.3. Behaves environmentally friendly*

Some of the interviewees make certain choices in their life based on the impact it has on the environment. They believe that the choices they make has a positive impact on climate change and that it reduces the consequences climate change brings. For example, interviewee 2 often brings their kids to school on the bike, even when it rains, and goes on cycling holidays instead of going by airplane. Furthermore, they use GreenChoice (energy company) as their energy supplier, because they "want to be 100% sure it is green energy" (interviewee 2). Interviewee 4 behaves in an environmentally friendly, or conscious, way: "because of climate change, I am a vegetarian and eat as much organic food as possible" (interviewee 4). Furthermore, interviewee 4 would like to drive an electric car.

#### *5.1.4. Experience with pluvial flooding*

Experience with pluvial flooding was low among the group of interviewees. If interviewees experienced pluvial flooding, the consequences were not big and were not deemed as hindrance or nuisance. Interviewee 1 has had experience with water on the streets a long time ago but did not believe it was a consequence of climate change, rather a poor choice of land-use and management. Interviewee 3 mentioned they experienced water on the streets just two weeks ago, "I've seen it happen, but did not think of it as nuisance, but rather something funny" (interviewee 3). Three of the other respondents experienced hindrance because of clogged sewerage, which is more due to bad maintenance than excessive rainfall.

## **5.2. Awareness of measures and responsibility**

The measures that can be taken against climate change can either be mitigating measures – dealing with the source of the problem, such as reducing CO<sub>2</sub> emissions – or adaptation measures, such as building dikes to keep the rising sea-level from flooding the country. The interviewees that were less aware of climate change and only heard or read about it in the media, often did not know many measures that can be taken to either reduce climate change or reduce the impacts of climate change. If they did, they usually were more familiar with mitigating measures. The group that was more engaged with, and had more knowledge about climate change, usually knew more about adaptation measures as well.

### *5.2.1. Climate change mitigation*

When asked about measures that can be taken, nearly all the respondents mentioned mitigation measures, such as reducing co2 emissions, the use of renewable energy, drive electric cars or use public transport, and eat less meat.

### *5.2.2. Climate change adaptation*

Four of the interviewees mentioned adaptation measures that can be taken to reduce the impacts of climate change. Only one of the interviewees mentioned surface sealing in private gardens; interviewee 2, who experienced a clogged drainage pipe in their garden, causing excessive water in their garden, said to each other: “the neighbours a couple of houses further down the street only have tiles in their garden. We are curious if the rainwater can find its way there” (interviewee 2). Interviewee 4 and 6 mentioned infiltration areas and buffer zones for water. Interviewee 7 named building dikes to protect ourselves against sea level rise and improving the sewage system to deal with the increase in rainwater. Furthermore, interviewee 7 said that “erosion should be stopped by reducing logging activities in wooded areas, such as Canada” (interviewee 7).

### *5.2.3. Raising awareness*

Furthermore, one of the respondents also mentioned measures the municipality could take to raise awareness about the consequences of climate change and pluvial flooding. Interviewee 3 said that “the government should just make more and more advertisements until it penetrates us all” (interviewee 3). According to the interviewee, the government should come up with big examples to raise awareness, just like the ‘vulgar’ pictures on cigarette packages. They believe that awareness should start with acknowledging the problem is made by the people, and that the problem can also be prevented by the people.

### *5.2.4. Responsibility*

When it comes to who is responsible for taking measures and solving the problem that pluvial flooding causes, the interviewees are not consentient. According to the respondents, measures should be taken by either the (local) government, the water boards, the citizens (or themselves), or the society. Mostly, people believe that the government is responsible for solving the problem of pluvial flooding. As interviewee 1 says, the (local) government is chosen as public representatives “and therefore should take responsibility” (interviewee 1). According to interviewee 2, the municipality of Groningen is responsible for facilitating and stimulating citizens to turn their grey gardens into green gardens, and to construct façade gardens. However, interviewee 2 also believes that citizens should maintain their gardens in such a way that water can infiltrate into the soil. Some interviewees, like interviewee 3, 5 and 6 believe that the water boards are responsible. According to interviewee 3, “the water boards have the most knowledge about water related problems. And therefor can come up

with better plans to prevent such events” (interviewee 3). Interviewee 6 believes that fixing the water problems is “their duty, that is why they are on this earth” (interviewee 6). The interviewees that mention that citizens themselves are responsible to take measures, did not name measures specifically to reduce the problems caused by pluvial flooding, but rather climate change as a whole. For example, interviewee 4 believes that the people should have conscious choices to battle climate change. Interviewee 3 believes that we are all responsible to takes measures to reduce the impacts of climate change, but on the other hand does not think that one person can make big of a difference.

### **5.3. Awareness of private garden solutions**

The interviewees were also questioned about their private gardens and measures they could take in their private garden to reduce pluvial flooding. To indicate the types of gardens the interviewees have, three categories have been defined:

1. Green garden: maximum of one third of the surface sealed
2. Mixed garden: between a third and two thirds sealed
3. Grey garden: more than two thirds of the surface sealed

Seven out of twelve interviewees have a green garden, four have a mixed garden and only two have a grey garden. People with a green garden often have a larger garden than average. Most of the respondents have a terrace with a seating area and/or fireplace. Only one of the respondents does not have a sealed terrace, but only a sealed pathway through the garden. Five of the respondents have a small shed in their garden and two of them have a vegetable garden. Furthermore, one of the respondents has a pond in their garden.

The participants were also asked about the motives for the layout of their garden. Seven out of the twelve gardens were already laid out like it is before the participants moved there. For interviewee 1, the garden was one of the reasons they bought the house. Interviewee 2 made a minor adjustment to the layout of their garden - after they got children, they removed a pond. The other four made bigger adjustments and made conscious choices about the layout of their garden. Interviewee 3, for example, completely refurbished the garden. Their garden is a mixed garden now, with a terrace with a seating area and a place to dry laundry, a patch of grass to lay in the sun and a vegetable garden to grow their own vegetables. Interviewee 6 made changes “mainly for more comfort and usability. We wanted to create a place where our children could play soccer and at the same time look aesthetically” (interviewee 6). Interviewee 8 changed their garden to cope with excessive water. They removed some of the tiles in their garden to get the rainwater to infiltrate into the soil.

Not all the respondents are aware of the measures that can be taken in their private garden to reduce pluvial flooding. However, some have added drainage pipes and wells to their

garden to transport the rainwater to the sewerage. Interviewee 5 added gutters to their terrace to lead the water to a draining well, which connects to the main sewage system. Interviewee 6 uses their pond to collect rainwater and uses a green roof to reduce pluvial flooding. Other measures the respondents mentioned are rain barrels and less impermeable surface.

#### **5.4. Active citizenship: involvement and willingness to act**

To get information about the involvement of the participants in the public domain, the first question asked was if they felt that the municipality involves them in decision making in their neighbourhood. Only two of the interviewees felt involved and were also more active in the decision making. Others were passive, but some wanted to be involved more.

##### *5.4.1. Passive*

Most of the participants are passive when it comes to involvement. They know about initiatives or receive information from the municipality, but do not get involved. Interviewee 2 for example knows there is a public kitchen garden in the neighbourhood, but although they like the initiative, they do not want to get involved. They feel like they have to take care of their own life first, before getting involved within the public domain. Additionally, interviewee 5 received information about a crossing that would be reconfigured near their home, but only used it as information and did not cast their vote for the best alternative.

##### *5.4.2. Passive but wants to be involved*

As interviewee 1 says: “there are regular meetings, but mostly about the train station area. But there is a threshold, it’s not easy to reach” and suggests there should be a platform where citizens can express their ideas and suggestions easily. Furthermore, interviewee 3 often gets flyers or brochures in their mailbox, but they just see it as information, not active involvement. However, they would like to become more involved, but only on topics they feel like that would be useful and interesting to themselves. The same goes for interviewee 4, who would rather have the opportunity to decide over the choices the municipality makes, rather than just being informed. Others stated that they would become more involved, but because they just moved to their new house, they want to settle in first.

##### *5.4.3. Actively involved*

As mentioned, two of the respondents were actively involved. Interviewee 6 was not only involved in his direct environment, but also takes measures to improve the quality of life and to reduce CO<sub>2</sub> emissions by having a green roof and solar panels. Interviewee 7 got actively involved after they “were displeased with the municipalities policy concerning a public park. The municipality is too tolerant as to what is allowed to happen in the public park” (interviewee 7), resulting in nuisance for the residents and damage to public property.

#### *5.4.4. Active citizenship*

The next question asked was if the respondents were active in the public domain, which can be contributing to a neighbourhood association, organizing events in the neighbourhood, doing voluntary work in the neighbourhood, or setting up other initiatives. Only one of the interviewees is active in a group of people that wants to improve and resurrect a former prostitution neighbourhood. Two others have mentioned that they were 'sometimes' active in their neighbourhood association or that they make notifications about unwanted activities in their neighbourhood. All the other respondents are not active. The reason for that is that they either only just moved to their neighbourhoods or that they do not have any time to be active.

#### *5.4.5. Incentives to take (more) measures*

One of the last questions asked to the interviewees was if there were any incentives to take measures in their private garden to reduce the impacts of pluvial flooding. Three of the respondents wanted it to be cheap or economic interesting to them. They do not want to spend a lot of money on measures that can be taken. Information is an important factor too. For example, interviewee 2 and 3 would take measures if the municipality informed them about the measures that can be taken and the status of the garden concerning water management, as "you don't know how good or bad your garden is" (interviewee 2). Other respondents (mostly with a grey garden) think taking measures to reduce pluvial flooding, like reducing the amount of impermeable surface, was impractical, as they would have to mow their grass. On the other end of the scale, people with a green garden, often do not feel the urge to take measures as their garden is green already and can cope with heavy rainfall, and thus do not need any incentives.

### **5.5. Conclusion**

Citizens, although they are aware of climate change, are often not aware of the consequences and impacts – or risks – of pluvial flooding. Most of the citizens are aware of climate change mitigations, where action is taken to reduce the source of the problem, and not aware of the adaptation measures that can be taken to reduce the consequences. An important reason for this is that virtually no citizen has experienced flooding caused by rainfall but only reads or hears about the problems in the media - the problem does not have a direct effect on the people. This is also seen in the literature, as the EOCED states that the biggest threat is the lack of awareness. Furthermore, in figure 3 in chapter 2.6.2, the risk perception of people in the Netherlands is shown to be low, less than 50%. The knowledge and risk perception, or social limits, as shown in chapter 2.6.1, have a great impact on the awareness and willingness to act. This is translated in chapters 5.3 and 5.4: citizens are not all aware of the measures they can take in their private gardens to reduce the risk and consequences of pluvial flooding. Generally, citizens are not active in the public domain.

Only one of the respondents has made a conscious choice concerning the layout of their private garden to adapt to heavy rainfall

Furthermore, half of the people believe that the government or water boards are responsible for the solutions that should be taken. Few people think the society is responsible and that citizens should also take action. If the municipality informs citizens about the effect certain choices in the layout of private gardens have, give them possible solution and tips to maintain their garden, and give information about the costs and benefits of solutions, the willingness of citizens may increase, as has been shown in the literature, discussed in chapter 2.6.3, and some citizens may take climate change adaptation measures in their gardens.

## 6. Discussion and reflection

Based on the results of the research that have been given in chapter 4 and 5, the research questions proposed in chapter 1 can be answered. The main question for this thesis is:

*What role does the municipality of Groningen take to increase the awareness of its citizens about pluvial flooding and the consequences of the use of impermeable surface, and increase the willingness of them to take measures to reduce the impacts of pluvial flooding in their private garden?*

The main question is an exploratory question; the question is answered through gaining insights through qualitative research and the interpretation of the researcher. This also means that the answer given is not a definite answer. The information gathered in this research is obtained through primary and secondary research. To answer the main question, three sub-questions have been proposed in chapter 1. For the first two questions: *what is pluvial flooding and what are its consequences and solution?* and; *what is citizen engagement and active citizenship?*, a literature review has been conducted and have been answered in chapter two. For the third question: *what are conditions or incentives for citizens to act, and what can the municipality do about this?*, a qualitative, primary research has been conducted by open-questioned interviews and questionnaires with the municipality of Groningen and its citizens. This question is answered in chapter four and in the recommendations in this chapter.

This thesis has shown that pluvial flooding is an event that is becoming more and more common, however citizens of the city of Groningen are not always aware of the consequences and impacts of pluvial flooding. Furthermore, the measures that can be taken in private gardens are not always known, but are plentiful however – be it with or without the help of the municipality of Groningen. Below, the results of the empirical study conducted will link these matters to the theories of citizen engagement and active citizenship and discuss them.

Firstly, a summary and reflection on the empirical side of this thesis will be given, using the concepts from the conceptual framework. Secondly, recommendations based on the research will be given, the main question will be answered in the conclusion and a generalization of the findings will be given. Thirdly, the theory and method for this thesis will be reflected upon and a reflection on the process and outcomes is given.

### 6.1. Empirical summary and reflection

The policy on water of the municipality of Groningen gives room for unexpected and uncertain events such as climate change and citizen initiatives. The key focus of their policy is the quality of the environment, public health, safety and the legal framework.

Furthermore, the goals and ambitions of the municipality are: a higher quality of the environment, a balance in the quantity of water, to account water in the early stages of processes and spatial development, to keep rainwater clean and to improve awareness and responsibility for water. According to the municipality, the sewage system in the city will likely be insufficient in the future due to climate change. As it is too costly to improve the system underground, the municipality proposes to change things above the ground. This gives room for citizen initiatives.

#### *Citizen engagement*

As the municipality believes that the common interest is more important than the individual interest, it looks to positively influence the attitude and a change of behaviour about water amongst its citizens. The municipality wants to engage citizens in their policy making and implementation plans. Citizens have an advisory role and initiatives are supported and facilitated. Although the municipality acknowledges that citizens show little interest in forming water policy, it tries to find ways to gain their interest by communicating to citizens during important phases in the process and during events that have an impact on citizens, such as flooding.

#### *Raising awareness*

To engage citizens in participating in climate change adaptation through unsealing their gardens, the municipality focusses on raising awareness. This is important, as awareness is a main factor for active citizenship. The municipality does this through having an open policy on water, by taking measures above the ground where citizens can actually see them, and through Operatie Steenbreek. Furthermore, the municipality tries to raise awareness about pluvial flooding and surface sealing through innovative ideas, such as the water label, and to respond to short-term memory. A sample book with examples of water friendly gardens should inspire citizens and make them aware of the consequences of impermeable surface in their gardens. This is further done through the involvement in Operatie Steenbreek. Unsealing private gardens is one of the most important solutions to reduce pluvial flooding. With the Operatie Steenbreek campaign, the municipality wants to raise awareness of the use of impermeable surface sealing through TV-shows, leaflets, and the presence on schools and festivals, for example.

The results of chapter 5 show that citizens are mostly aware of the causes and consequences of pluvial flooding, although risk perception is low. The knowledge of climate change is mostly about mitigating measures, not about adaptation measures. Citizens hardly have experience with pluvial flooding, which may have an effect on their awareness.

#### *Willingness and active citizenship*

According to the citizens, the responsibility for taking measures and solving the problem of pluvial flooding mostly lies with the municipality or water boards, not citizens. Furthermore,

the willingness to act is low amongst citizens. This also reflects in the number of active citizens as active citizenship is low amongst the interviewed citizens. If citizens are informed about the problems of pluvial flooding, the measures that can be taken in their private gardens and the costs and benefits of these measures, they might be willing to take appropriate action.

#### *Co-production through Operatie Steenbreek*

The municipality strives to work together with its citizens with a shared responsibility and facilitates citizens initiatives, which is a form of co-production in climate change adaptation. With Operatie Steenbreek, the municipality facilitated the construction of façade gardens. With examples and visible green, like façade gardens, Operatie Steenbreek tries to raise awareness. Although most of these projects are initiated by the municipality, there is an example of a project initiated by a citizen who was inspired by the façade gardens.

## **6.2. Recommendations**

### *Raising awareness*

It becomes clear that in order for the municipality of Groningen and its citizens to come up with and implement measures in private gardens, the most important concepts are willingness and co-production. However, willingness depends on awareness of the risks and benefits of measures (Masued et al., 2015). Citizens need to become aware of the risks climate change and pluvial flooding have for the society. The results of the empirical study show that the citizens of Groningen are aware of climate change, but not aware of the consequences it has for them. The citizens of Groningen also need to become more aware of the measures that can be taken in private gardens, and what their benefits and costs are, as Tobler et al. (2012) have shown. This is also further addressed and carried by the national government of the Netherlands, provided in their Deltaplan Spatial Adaptation (Deltaplan Ruimtelijke Adaptatie, 2018), which states that in urban areas the main problem is short but intense rainfall. The Deltaplan states that the sewage system in cities is not sufficient enough and that water should be temporarily stored on roofs, gardens, streets and parks. Furthermore, the document states that citizens and businesses are responsible for rainwater on their own property.

For awareness, it is important to remember the types of participation proposed by Ekman & Amna (2012), especially social involvement (attention). On the individual level, citizens of the municipality of Groningen should be interested in the issue of pluvial flooding and the use of impermeable surface sealing. On the collective level, a life-style change is needed into a more environmentally friendly and climate adaptable life-style. This is a difficult task to accomplish for the municipality of Groningen. However, as has been shown in chapter 5, there are citizens in Groningen that are aware and willing. The municipality could use a participative management style, where they take an open role for ideas and suggestions and citizens that are aware advise them on how to raise awareness in their policy. For this, the

municipality can set up sounding board groups to understand why and how the citizens are and became aware. The municipality can arrange these sounding board groups in different neighbourhoods of the city of Groningen. Organizing them in local “neighbourhood houses” will make these meeting approachable for the citizens of Groningen. This way, the municipality also collects information on different target audiences. By including gardeners, climate change adaptation specialists and communication professionals in these sounding board groups, the citizens can collect appropriate information to take adaptation measures and share their experiences and knowledge about the subject. The municipality can use this information to reach other individuals and make appropriate, “target audience” specific policy. Furthermore, the municipality of Groningen can raise awareness by informing its citizens, as most citizens do not understand how to act and what to do. Additionally, workshops or brainstorm sessions can be held during these sounding board group meetings to share knowledge and inspire each other.

#### *Raising willingness and co-production*

As Adger et al. (2009) states, information about the specifics of measures also increases willingness to act. This information needs to be specific, so citizens know how ‘bad or good’ their garden is concerning pluvial flooding. The municipality of Groningen already has ideas to address this with the water label, which gives citizens information about their water usage which includes the amount of rainwater that is transported to the sewage system. Additionally, with specific cost-friendly examples, the municipality can raise awareness about possible measures and stimulate citizens to take action. The proposed sample book in chapter four can be made for this. The examples in the sample book should be accessible and understandable for all audiences. A good example for this is Amsteram Rainproof. The website of this campaign contains dozens of good examples and information about rainproof initiatives, also in private gardens and homes. The municipality could work on a website containing information about Operatie Steenbreek, the consequences of pluvial flooding and examples of measures the citizens of Groningen can take in their garden. This will raise knowledge, risk perception and awareness, and can influence the willingness of citizens to take action.

Furthermore, co-production can be used to increase the willingness of citizens. The municipality of Groningen should find ways to engage its citizens appropriately to stimulate co-production amongst the citizens and the municipality, as some citizens in Groningen are open to take measures in their private garden. By taking a role as a partner in collaboration with citizens, the municipality can raise the willingness of citizens to take action. Acting as a partner is important, as the measures to reduce the chance of pluvial flooding should be taken in private gardens. Without the collaboration of citizens, this will and can not happen. Furthermore, working together increases the social involvement on both sides, for the municipality of Groningen and the citizens. The municipality will learn more about what the incentives are for citizens to take action and can deliver customized ideas and measures. On

the other side, citizens' interest in climate change adaptation measures will increase, which might change their life-style.

Furthermore, for citizens that are willing to take adaptation measures, the municipality of Groningen should take a facilitating role, like they already do with Operatie Steenbreek. The citizen is the initiator, as they want to take measures in their private garden. To stimulate this action, the municipality can facilitate the initiator with money, time, expertise or material resources. As the municipality of Groningen already has a lot of expertise, attained by the involvement in Operatie Steenbreek, the municipality can inform the initiator about what measures work best and what the costs of the measures are and how they should be maintained. Furthermore, the municipality can make their material resources available for initiators, such as spades, trailers, or even small digging machines.

The recommendations above are about the implementation of the actual measures. However, it is also important to include citizens in the early processes of policy making. Active citizenship and citizen engagement is not incorporated enough in the policy for green and water in the municipality of Groningen. The municipality can give citizens an advising or a role as a partner in the making of policy. That way, the municipality knows what the citizens want and need, and the citizens become more aware of the issue and possibilities. This gives opportunities to co-produce climate change adaptation measures, such as unsealing private gardens, that can be taken by citizens.

### **6.3. Conclusion**

Concluding the recommendations, and to answer the main question: the municipality takes a lot of initiatives to increase the awareness of its citizens in pluvial flooding and the use of impermeable surface sealing. It uses innovative ideas to raise the knowledge and risk perception of its inhabitants by showing good examples, through leaflets and by facilitating façade gardens. By raising the awareness, and focussing on social limits like risk perception and knowledge, the municipality raises both awareness and willingness. However, the municipality of Groningen can take an open role and interact with its citizens to understand how and why certain individuals are aware of the consequences of pluvial flooding and the use of impermeable surface sealing. The municipality can let citizens advise them and use this information to raise awareness amongst other individuals. By organizing sounding board groups in different neighbourhoods, as described above, the municipality can obtain this information. To raise the willingness of citizens to take adaptation measures in their private gardens and to co-produce adaptation measures with the municipality, the municipality can partner up with its citizens, as the municipality needs to collaborate with citizens in order to activate citizens in taking action in their private gardens. Furthermore, the municipality should continue to facilitate initiators with their expertise and material resources, as they already do now with Operatie Steenbreek. For this participation process, the municipality

should try to understand the who, when, what, how and why questions Sarzynski (2015) proposed:

Who participates: the municipality of Groningen can stimulate citizens with 'grey gardens' to participate by informing them about the problems and solutions. Furthermore, the municipality can collaborate with willing citizens to set an example and stimulate and inspire other citizens to take measures in their private gardens, as the research has shown that citizens are willing to act, but don't know how.

When participation happens: the municipality of Groningen can include citizens in all stages. In the pre-planning phase, to make appropriate policy with its citizens, by understanding what citizens want and need. In the planning phase, in order to know what measures citizens can and want to take. And in the implementation phase, to work together or to facilitate the implementation of the measures in private gardens. This might make citizens more aware of the policy, measures and that they can contact the municipality about the issues of pluvial flooding and impermeable surface sealing.

What happens: the municipality of Groningen can work intensively with its citizens. The citizens can have an influence on policy and the measures taken, as has been stated above. For this, the citizens of Groningen should at least have an advisory role. This will help to make appropriate policy and measures that can be taken.

How much participation: the role that citizens of Groningen take influences how much participation citizens have. The municipality should strive to an equal collaboration, meaning citizens will spend the same amount of time as the municipality.

Why do actors participate: the municipality of Groningen should try to understand why actors, or citizens, participate in order to work together in the right phase, as citizens can participate intrinsically, developmentally or instrumentally. The municipality should take advantage of citizens who participate intrinsically, as they will participate because they have a strong meaning about climate change and pluvial flooding and perhaps have a certain life-style to try to reduce climate change and its consequences. These people can spread the importance of taking action in private gardens. People with experience with pluvial flooding will participate developmentally. They can help the municipality develop measures that will work and that will be easy to implement by citizens. Citizens who participate instrumentally should be partners in the implementation phase. They will have the expertise and resources to actually take action and implement the measures in private gardens.

### *6.3.1. Generalisation of findings*

As this thesis is conducted with a limited scope and a relatively small sample, the findings of this research cannot easily be generalized. The research has only been conducted in one

municipality, so no direct comparison can be drawn with other municipalities. However, the researcher has tried to select a diverse group of citizens for the questionnaires. The participants represent different types of households in neighbourhoods with different characteristics and different gardens. A generalization for the city of Groningen might thus be possible.

Generalizing the findings in the city of Groningen to other cities and villages depends on their characteristics (socioeconomic, population, spatial, etc.). The scope of this research was a city with approximately 200.000 inhabitants. The findings of this research could be generalized for cities with the same characteristics. Extending the results for smaller towns and rural villages might not be possible however, because generally smaller towns and villages have larger lots for housing, and thus larger gardens. The opposite applies to larger towns, such as Amsterdam, which have denser building blocks, with houses with smaller gardens. According to the researchers, smaller gardens tend to be more 'grey' than bigger gardens.

Another important factor for taking measures above the ground is the status of the sewage system. Cities/municipalities with the same problem - a sewage system with insufficient capacity during short but intense rainfall and not ready to be replaced - might look for the same solutions that can be taken above the ground. Younger cities, like Almere, might have more modern sewage systems which can deal with short but intense rainfall.

However, as the theory and the results of this thesis have shown, the knowledge and perception about climate change can be generalized. Awareness of climate change should be near 100 per cent. Awareness of climate change adaptation measures that can be taken in private gardens however, depends (among other things) on the information provided by the municipality. Other municipalities involved with Operatie Steenbreek should have similar programs as the municipality of Groningen and thus the inhabitants of those cities might have the same information level.

The findings presented in this thesis are also a representation of a certain period in time. With different experiences or through campaigns, the awareness of citizens can change in time. Furthermore, the amount of active citizens might change through time as the government relies more and more on the "community".

#### **6.4. Reflection on theory and method**

The theory about pluvial flooding for this research was sufficient. There has been research on the subject in different parts of the world and could be used for this research. It had similarities with the policy the municipality of Groningen uses for its water management. The theory on active citizenship was abundant. Recent decades have seen an enormous growth on the subject. Therefore, concepts connected to active citizenship, such as

limitations, citizen involvement and willingness were also sufficiently described and easy to incorporate into this thesis. However, flood risk governance arrangements, specifically targeting citizen engagement in pluvial flooding and taking measures in private gardens has not been described much. Most of the flood risk governance arrangements focus on other actors, such as the private sector and non-governmental institutes. Flood risk governance arrangements involving or engaging citizens to take action on their private property is a fairly untracked terrain. However, Hegger et. al (2014) describe flood risk management strategies which can be used for arrangements between the municipality of Groningen and its citizens: flood risk mitigation, flood preparation, and flood recovery. Taking measures in private gardens by citizens is a form of flood risk mitigation. Furthermore, by raising awareness, the municipality can work on the flood preparation and flood recovery for and together with its citizens. Community resilience is an arrangement that has been researched which focusses on citizens taking actions in their own environments. However, community resilience focusses on inter-community communication and collective action, not on the interaction between the government and citizens. The theory about co-production, used for this thesis, can be linked to citizens initiatives, allowing to connect the municipality of Groningen and its citizens in taking action against pluvial flooding together.

#### *Contribution to planning theory*

The knowledge obtained by this research contributes to urban planning, the theory and practice through connecting the government arrangements of co-production, active citizenship and private gardens of citizens. There has not been any research on government arrangements specific for policy and the implementation of climate change adaptation measures on private property of citizens before. For municipalities, it is difficult to take measures for pluvial flooding in gardens, as they are privately owned. However, because of the “grey trend” and the relatively large surface of private gardens in cities, it is becoming more and more important to utilize private gardens in order to reduce the impacts of pluvial flooding. Additionally, there has not been any research done before on how to raise the awareness of pluvial flooding and the use of impermeable surface sealing and the willingness of citizens to take action in their private gardens. By understanding what makes citizens aware of pluvial flooding and measures that can be taken in private gardens, and willing to take action, the municipality can implement this knowledge into their policy.

Furthermore, active citizenship usually takes place in the public domain. For example, the realisation of community vegetable gardens, or organizing a neighbourhood spring cleaning day. The theory on active citizenship and climate change adaptation does not include being active in private gardens. This research has tried to connect being active in private gardens with the characteristics of active citizenship in the public domain. The research shows that the characteristics are the same.

### *Further research*

As this research has been limited to twelve interviewed citizens of the city of Groningen and by its conceptual framework, further research should be conducted to understand exactly how citizens should be involved in the process of taking measures in their private gardens and how they should be informed. By conducting interviews with the municipality and citizens, a strategy should be developed on how and when citizens should be involved. By organizing sounding board groups with citizens, the municipality can understand the wishes and meanings of citizens concerning the involvement in the processes. By developing a guideline or a matrix based on the outcome, the municipality can follow certain steps to involve citizens from the beginning of the process to the end. Further research on the incentives, such as costs and benefits of certain measures can help to come up with the best possible/achievable solutions in private gardens. This research could be done by interviewing/questioning experts and suppliers, such as the municipality, landscapers and gardeners. Furthermore, further research should be conducted to understand how certain measures work in different gardens, as the size, elevation, underground, etc. are not the same in every garden. This requires a more technical approach, where the soil should be researched, and groundwater levels should be measured. Another topic that should be researched is how the municipality can facilitate its citizens in taking action in their private gardens appropriately, for this the needs and abilities of citizens should be taken into account. The needs and abilities of citizens can be obtained by using questionnaires.

### **6.5. Reflection on process and outcomes**

The process of writing this thesis has been a difficult process. At the beginning of the process, I found it difficult to limit my topic and research question. At first, the research question was way too broad. This caused that I had difficulties with finding the right literature and to write a clear and understandable introduction for my thesis. Failing to do so and the amount of literature and theories I collected made me lose my motivation and perseverance to write my thesis. This caused a delay. Eventually, with the help of my first supervisor, dr. E.M. Trelle, I managed to limit the research question. The next time I'll do research, I know that it is very important to limit the topic and the scope to keep motivated. The limitation made it easier to collect the right literature and theories and to decide who to interview and how to compile the questions for the interview and the questionnaire.

By framing the theory, the chosen topic became more comprehensible. I could now find the right theory and matching literature more easily. In hindsight, I found that writing about the topic, and trying to understand the literature for me was an easier task than conducting the interviews and interpreting the findings. However, framing them into a conceptual framework to use for my empirical study was again a more difficult process. At first, I again made a framework that was too broad and complicated. I didn't relate the conceptual framework enough to the results I wanted to get through my interviews and questionnaires. Looking back, the next time I should try to see the whole picture at first, and ask myself the

question: what information do I want to retrieve from the interviews to answer my research questions?, and then try to make a conceptual framework based on that.

Conducting the interviews with the municipality was an interesting experience. The representatives of the municipality for Operatie Steenbreek and the water and green policy makers spoke enthusiastically about their work and the topic. Sometimes it was difficult to keep them in the right direction, because they have a lot of interesting stories they want to share. This caused that sometimes the question format was not followed directly. Also, I found it difficult to ask further if the answers were not really satisfying, partly answered in previous answers, or that the interviewees did not have an answer. Reflecting back on this, the next time I would follow my set of questions more, to get more satisfying answers and for easier coding and analysis. Even if this means that questions will be answered twice.

Conducting the questionnaires with the citizens of Groningen was a fun but sometimes difficult and struggling process. Finding people to speak about this topic and interviewing them was sometimes hard. After introducing the topic of the conversation, many were not interested. Others did not have any time. This was frustrating at times. However, at different times, interviewees were really interested and willing to answer the question I proposed. This gave me positive energy. The outcomes of the interviews were satisfying for me, also because of the structure of the questionnaire that was followed.

Analysing the outcomes was a tricky process. Finding the right codes to use for the transcriptions was difficult. At first, again, I chose a set of codes that was too broad, making it difficult to link the outcomes to the conceptual framework. Furthermore, I noticed that a lot of information could not directly be linked to the conceptual framework. Sometimes it was difficult to interpret the answers, especially concerning how active and willing citizens are in taking measure in their private gardens, as the understanding of “being active” and knowledge of measures that can be taken differs. Altogether I am happy with the results of the empirical study, although next time I would like to have a better structure in my interviews.

Finally, I found that discussing the results and linking them to the theory is a difficult process. I found it hard to go back to the theory and detach it from the empirical findings to analyse them and connect them again later. This makes it difficult to discuss the outcomes and write a good recommendation. With the help and suggestions of my supervisor dr. M.A. van den Brink, I think that eventually the thesis has come together.

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