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Bridging flood risk management and climate change adaptation

- Policy and practice in Sweden

Master thesis
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submitted by:
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Abstract

In facing one of the largest environmental challenges in human history, climate change, it has become increasingly obvious that we cannot avoid its consequences, but need to find ways in adapting to them. One predicted change lies in the increased risk of floods. This thesis investigates how adaptation to this particular change is developing in western Sweden. Based on policy documents and interviews with policy-makers on the national, regional and local level, it aims to shine light upon how climate change adaptation is integrated in flood management. The research focus lies on the division of responsibilities and the level of policy integration currently achieved, and it identifies the motivating factors that have induced adaptation in flood protection. The thesis also pays attention to the EU Floods Directive, in particular to how it addresses climate change adaptation, and how it influences Swedish flood management. The results show that the main responsibility for flood protection in Sweden lies with the municipalities, and that national policies on the topic are still weak. Climate change adaptation is high on the agendas of regional authorities, which has contributed to a diverse range of adaptation measures on the local level. Motivation to integration can be ascribed to eye-opening events, an undisputed perception of scientific findings about climate change vulnerabilities, and to the efforts of particularly engaged individuals. The implementation of the EU Floods Directive instigated the Swedish legislation and a new ordinance was adopted, but it does not have any direct influence on the municipalities and has therefore not yet significantly changed flood management practices in Sweden. Overall, the thesis adds to the understanding of how adaptation to climate change of a certain policy area is executed across scales, from the EU to municipal levels, and it shows where there is still room for policy improvement.

Keywords
Climate change adaptation, Flood management, Policy integration, Sweden

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1. Introduction

1.1 Flood risk management and climate change in Sweden

It has become increasingly more visible that the climate change we are currently experiencing worldwide has severe impacts on our livelihoods. One example of this is how the change in temperature and precipitation effects our watersheds in multiple ways, which can lead to excess, or shortage, of water. Floods, defined as "the temporary covering by water of land not normally covered with water" (EC 2007) is a naturally occurring phenomena which has challenged humans throughout our history. It is providing benefits in some cases, as for irrigation or hydropower, but also threatening our valuables when the water levels rise higher or in other places than we expect. The desire to live near watersheds is therefore sometimes resulting in settlements that suddenly face the challenge of rising waters that can endanger buildings, infrastructure, and human lives. When the risks cannot be avoided anymore, we have come to take other measures to protect our values and ourselves. This is generally referred to as flood protection measures, and can be either structural or non-structural. The goal of flood management is to prevent the risk of damage as much as possible, both to people, their values and the environment. As the climate is now changing faster than before, certain areas will face growing threats from floods. Northern Europe is one of the regions expecting this change (EEA 2012a:18), and therefore this thesis will focus on the current situation in Sweden.

Sweden is a country which prides itself with being in the forefront of environmental protection and awareness (Regeringskansliet 2015). There is a consensus on the acuteness of climate change, highlighted by national research institutes such as the Swedish Meteorological and Hydrological Institute (SMHI) and the renowned Stockholm Resilience Institute. As the country is expecting significant changes in precipitation and temperature, one of the main consequences will be an increase in floods (SOU 2007:60). It has already experienced a numerical rise in this kind of natural disasters over the last two decades, and one could therefore expect that there should be efforts undertaken to protect the citizens and both public and private values from them. Since 2009, Sweden has implemented the EU Floods Directive (2007/60/EC) into national law and has recently completed the first cycle. As the directive provides the Member States with the freedom to determine the level of flood protection on their own, Sweden is now up for the challenge of establishing a flood protection

which is sound and sustainable over a long time, considering the changes in the climate which will increase the flood risk on all time frames (Carlsen & Parmhed 2008).

1.2 Problem statement

A relatively new challenge of policy integration is the resulting intersection of climate change adaptation and flood protection. The challenge we are facing is that the predictions of exactly how the climate will change are not uniform and that makes it difficult to determine how to adapt flood protection to climate change. An interpretation of the predictions of climate change has to be made, including precipitation increase combined with other factors such as earlier snowmelt and infiltration rate, to be able to make a decision on what measures to take for flood protection. This interpretation will be made on the basis of available information, but may be influenced by other factors which can be economical, social, political or even cultural in nature. Additionally, this integration of climate change awareness has to take place on different levels of governance; national, regional and local. Some European regions lie on the forefront of preparation, like the federal states of Bavaria and Baden-Württemberg in Germany, which add 15 % to the normal design bases for the flood protection measures (Schuchardt & Wittig 2008), while other areas are less proactive. Another challenge is of course which measures are the most accurate ones, in terms of not just the height of levees but what kind of protection should be implemented. The challenge for countries like Sweden, then, is to realise the need to proactively implement flood protection measures based on the ambiguous predictions of climate change induced floods and choose the right methods for application.

1.3 Purpose and research questions

This thesis will investigate the integration of climate change adaptation into flood risk management in Sweden. Guidelines and policies, including plans, legislation and actual flood protection measures/management, will be examined and compared to display the status of awareness and engagement concerning this issue and how coherent it is throughout the levels of governance. The implementation of these plans and strategies will then be investigated to find how they resonate with the actual measures taken at national, regional and local levels. Firstly, finding to what extent policy integrate concerns for climate change in flood risk management will highlight the latest development of the climate adaptation in Sweden. Second, understanding what factors are particularly important in stimulating the integration of climate change adaptation into flood risk management will help illustrate the motivational

forces that can be triggering to move the application of adaptation practices forward. Moreover, pinpointing discrepancies between the plans and strategies and the actual measures will show current weaknesses of multi-level governance reaching from EU directives down to the implementation of local protection measures.

In order to fulfil this purpose, the thesis will answer the following research questions.

- Responsibilities

  How is the responsibility for flood protection dispersed across levels of government in Sweden, and how are the policies (objectives and measures) coordinated across levels of government?
- Policy integration

  How is climate change adaptation integrated in Swedish flood protection at the various levels (national, regional, local) of governance, in policy documents (plans, programmes, strategies) and in actual implementation of projects, and how coherent are policies across levels?
- Motivation for integration

  Why has climate change adaptation in flood protection policies occurred (or not), and what factors explain how policy makers frame the linkage between flood protection and climate change adaptation (flooding events, new scientific insights, political strategies, values/interests of policy-makers, influence of interest groups and businesses, etc.)?
- Impact of the EU Floods Directive

  How has the Floods Directive changed flood protection policies in Sweden?
  - How has the implementation of the EU Floods Directive in Sweden affected the division of responsibility?
  - Is there any indication of the Floods Directive having affected the integration of climate change adaptation into flood risk management?

1.4 Methodology

The first research question regarding the distribution of responsibilities will to the largest extent be answered with desk research, through the information made available online and elsewhere from the governmental entities on different levels (national, regional/county, and local/municipality) and other stakeholders involved in flood protection. This will form the

first part of the research, and be mostly descriptive in nature. The aim is to give a clear overview to facilitate the understanding of the more dynamical questions following this stage.

The following questions concerning the integration of climate change adaptation and its motivation will be answered to some extent by the initial desk research, but to a larger extent by qualitative interviews conducted with pre-selected key actors in the field. The interviews will also serve as a control of the consistency between the findings of the desk research and the reality, should the interviewees express that there are incoherencies between policies and implementation at the respective levels. In order to limit the study, one of the five water districts in Sweden was selected. The chosen one was Västerhavet, as floods are expected to increase in this area due to climate change (see section 2.1.4 and figure 4). Two county administrative boards within this district were chosen, one small and one large which display different levels of problematic and different urban spreads, striving to capture if there is any difference between them that could be explained by those factors and thus give a better picture of the variance between areas and its causes. For simplification, the county administrative board will be shortened to 'county board' for the remainder of the thesis Thereafter, within these counties and in one other county, three municipalities were chosen based primarily on the fact that they are identified in the flood risk mapping as vulnerable areas within this water district. The three municipalities vary significantly in size and have different histories of floods, which makes them interesting to compare to each other. The county boards will give an insight into the regional governance level, and the municipalities will represent the local level governance.. Finally, the Swedish Civil Contingencies Agency was included to represent the national level of floor risk management. Hence, a total number of six interviews were conducted (see table 1) in September of 2015, five of them in person during visits to their respective offices in Gothenburg, Kungsbacka, Halmstad and Karlstad, and one over Skype due to time limitations of the interviewee. The interviewees agreed not to be anonymised as their particular position is relevant to understand their engagement and role. The interviews averaged on 1 hour in length and were recorded and then transcribed in full length. Follow up questions were asked via email to some of the informants during the analysis and also shortly via phone to clarify a few details. The interview questions were divided into three categories; introductory, regarding responsibilities and regarding policy integration and motivation. The introduction aimed to better understand the background of the interviewee, whereas the responsibility part was aiming to get an overview of how they perceived the organisation of flood protection in terms of engagement from other actors and

their interactions, emphasising the different levels and the links between them. The last section concerning policy integration and motivation brought up the questions of climate change adaptation, influence of science, and the motivating factors for flood protection. The open nature of the questions allowed the interviewees to develop on the topics they found relevant, and shortly answer the questions they found less important. This made all interviews different and tailored to the interviewee, bringing to light their experience and particular concerns regarding certain issues. The full interview guide is displayed in annex 1.

Table 1 List of interviewees

Organisation	Representative	Interview date
Swedish Civil Contingencies Agency (MSB)	Barbro Näslund-Landenmark Expert on natural disasters Unit for protection of critical infrastructure	2015-09-14
County Board Västra Götaland	Lars Westholm Project Manager – Climate Adaptation Community department	2015-09-10
County Board Halland	Catrin Käldman Contingencies administrator, Unit for planning of built environment	2015-09-11 2016-04-19 (phone)
Municipality - Kungsbacka	Charlotta Ljungkull Head of unit, planning of traffic and parks	2015-09-09
Municipality - Gothenburg	Ulf Moback Landscape architect City Planning Administration	2015-09-08
Municipality - Karlstad	Anna Sjödin Flood risk manager Technical services and property management department	2015-09-23 (Skype)

1.5 Presentation of counties and municipalities

Västra Götaland county is the fifth largest in Sweden in terms of area, and rather populous with roughly 1,65 million inhabitants (SCB 2016). Including 49 municipalities makes it the largest county in Sweden in that aspect. As can be seen in figure 1, it is located on the western coast of Sweden, bordering Norway in the north and stretching inland around the southern part of Vänern, the largest lake in Sweden. Its largest city is Gothenburg.

Halland county is small in terms of surface, it only covers 1,3 % of Sweden (County Board Halland 2016). It does however have a significant portion of the Swedish population living within its borders, almost 315 000 people (SCB 2016). Figure 2 shows how the county

stretches along the west coast of Sweden, and it is known for its beaches, fertile agricultural plains and forests. The largest city is Halmstad with almost 97 000 inhabitants.

Figure 1 Västra Götaland (Google Maps 2016)

Figure 2 Halland county (Google Maps 2016)

The city of Gothenburg (see figure 3) is with almost 550 000 inhabitants the largest municipality covered by the study, and the second largest city in Sweden (SCB 2016). It is

located at the mouth of the 93 kilometer long river Göta Älv, that has its origin in the lake Vänern.

Karlstad municipality is located on the northern shore of the lake Vänern (see figure 3), at the delta formed by the river Klarälven. This in the longest river in Sweden, with its origin in in Norway. Karlstad has almost 90 000 inhabitants (SCB 2016) and is located in the county of Värmland.

Kungsbacka is the northernmost municipality in the county of Halland, just 30 kilometres south of Gothenburg. It has almost 80 000 inhabitants (SCB 2016), however the population is rather spread out over the area, making the city centre quite small. The centre is located at the innermost point of a fjord (see figure 3), and is intersected by the river Kungsbackaån. The river has its starting point in the county of Västra Götaland. All three cities are, as previously mentioned, identified in the preliminary flood risk assessment as vulnerable areas.

Figure 3 The municipalities involved in the study (Google Maps 2016)

2. Background

2.1 Climate change and floods

This section aims to give an overview of the natural science behind the challenges discussed in this thesis, by briefly explaining the two phenomena concerned: climate change and floods. It will give a more detailed insight into the Swedish case, as relevant to understand the specificities discussed further on.

2.1.1 Global climate change

It is a commonly accepted fact that the global climate is changing. Most notably, the global surface temperature has increased and continues to rise (IPCC 2007). Yet the consequences will vary with the location in a way that makes it highly relevant to study the change not only on the global but also on a regional and local level, in order to find what specific systems will be altered there and in what way.

A changing system which is fundamental to human subsistence is the water cycle. Altered precipitation patterns is an obvious factor to take into consideration, but the complexity of the climate system also has other effects that change the conditions on which the water cycle is depending. In the temperate climate zone where Sweden is located, temperature increase will turn snowfall into rain, affecting runoff, and earlier thawing of the ground in spring changes the rate of infiltration into the ground. These changes are not only measurable in annual averages, but the temporal distribution and intensity will also be affected (IPCC 2012:7). For example, in some places the annual precipitation may remain unchanged but the rainfall is concentrated to a shorter time period every year, causing intensified rains and possibly a higher runoff. These shifts in water distribution will lead to both short- and long term shortage in some regions, and excess in others. Particularly relevant for the case in this thesis is that in northern Europe, the precipitation increase is estimated to reach as much as 40 % in some parts of the Swedish mountain range over the next 100 years. Other parts of Sweden are expecting less but still a significant increase, as can be seen in Figure 4 (SMHI 2015a). The floods in Sweden are most commonly caused by snowmelt or continuous precipitation and occur along watersheds or lakes (MSB 2012).

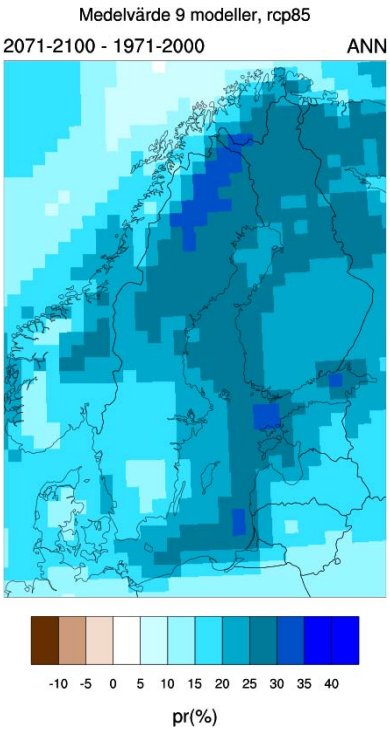

Figure 4 Expected precipitation increase in Sweden for the period 2071-2100 compared to 1971-2000 (SMHI 2015a)

2.1.2 The Swedish climate and its changes

Sweden is a country with a high consensus regarding the anthropogenic induced climate change, which is made evident by important scientific actors. Perhaps most notably, the Swedish Meteorological and Hydrological Institute (SMHI) state that the "warming of the climatic system is beyond doubt" (SMHI 2014a). Correspondingly, the Swedish Defence Research Agency (FOI) refer to the climate change as a fact, which will make Sweden warmer and wetter (Carlsen & Parmhed 2008).

Noteworthy is that both the winter and summer temperatures have been higher during the 1990s than earlier (Carlsen & Parmhed 2008), as can be seen in figure 5. In the south and middle part of the country, the days with snow cover have become fewer. The change is roughly +1°C, with geographical and temporal variance (+2°C change in the north and middle part in the winter).

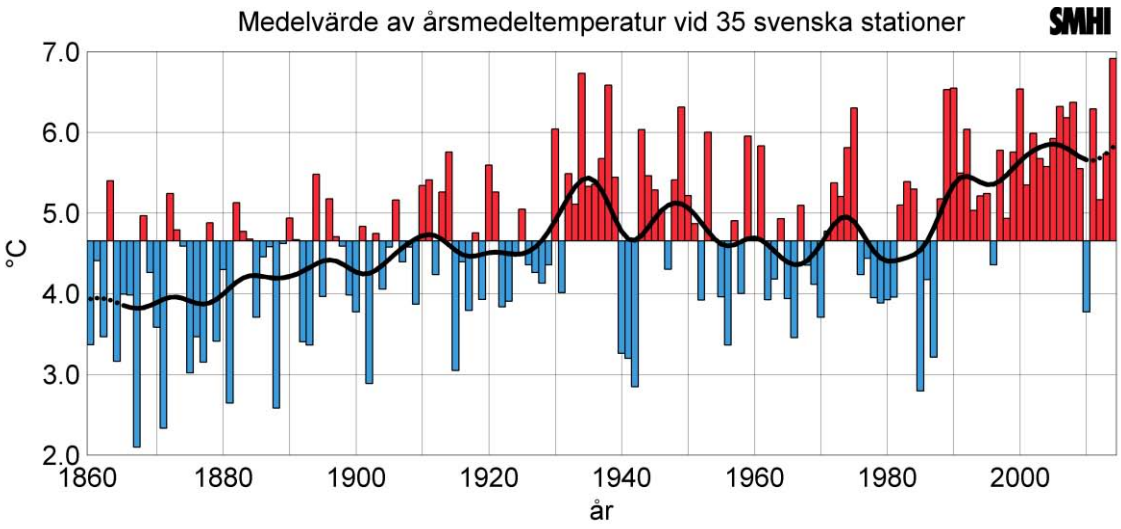

Figure 5 Mean annual temperature at 35 Swedish measurement stations 1860-2013 (SMHI 2015b)

The precipitation is more pronounced in the west, due to the wind patterns. It is spread over the whole year, but with a somewhat higher distribution in summer and autumn. Looking at the annual average precipitation over time (Figure 6), it is evident that the precipitation has increased. This is partly due to normal variance, but the SMHI points out that a 10 % increase as some areas have experienced is significant.

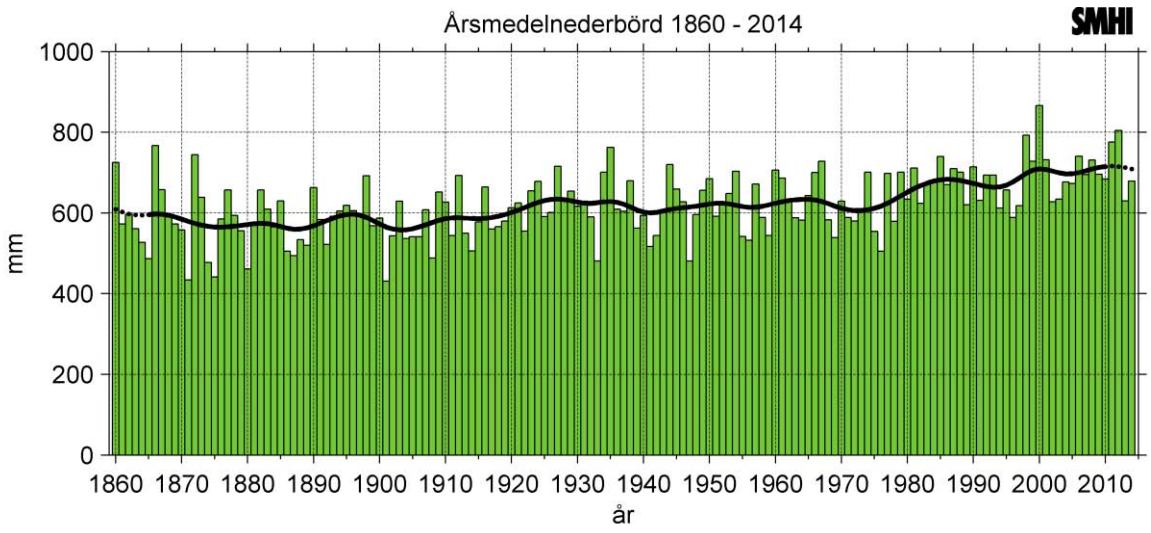

Figure 6 Mean annual precipitation in Sweden 1860-2014 showing a slight increase (SMHI 2015c)

SMHI points out that natural variance makes it hard to distinguish climate change in the local setting (the annual temperature variation during the 1900s was 4°C, while the global temperature increase during the same period was +0.6°C), but that the Swedish values correspond with the global trend. As for floods, SMHI has recorded a remarkable increase

during the last 30 years as a result of increased precipitation and milder winters. Especially the milder winters will be significant in this aspect, as the precipitation will be in the form of rain instead of snow, which has a direct effect on runoff and subsequent floods. However, SMHI also explains that there are many reasons for the weather to be colder, warmer, wetter or dryer without any obvious reason, which makes it difficult to know what would be a representative period for comparison, what is a trend, and what is the cause for any change or variation. Yet, as many researchers have pointed out, variability in itself is an integral part of climate change (Smit et al 2001). Holgersson et al. also point out that the runoff will increase, especially in the western parts of the country. Noteworthy is also that the temperature in Sweden and Scandinavia will increase more than the global average, by 3-5 °C until 2080 compared to the period 1960-1990 (SOU 2007:60).

The Swedish Defence Research Agency (FOI), an authority serving under the Department of Defence, has also conducted research on the expected climate change. Their efforts have been concentrated on the short- to mid-term effects, to serve as guidance for immediate adaptation to climate change. When discussing the reasonable climate scenarios, the authors point out that the "no change" scenario is the least likely, as it is known that even with a 100% emission cut, the climate will change due to lag effects in the atmosphere.

The climate change scenarios which are used in Sweden were developed by the Intergovernmental Panel on Climate Change, IPCC, in 2000 in a report known as the SRES – IPCC Special Report: Emission Scenarios (IPCC 2000). The scenarios are grouped into four families: A1, A2, B1 and B2. The A1 scenario has the highest predicted values and B2 has the lowest. To explain this, each scenario has a describing storyline, which in essence means that;

> A1 describes a rapidly growing economy with a growing world population peaking in mid-century (and the sub-group A1FI represents a fossil fuel intensive situation)
>
> A2 describes a heterogeneous world, with the underlying theme of self-reliance and regional development
>
> B1 describes a convergent world with a population growth as in A1 but a shift to an economy based on services and information, focused on resource efficiency and equity

B2 describes a world centred on local solutions to economic, social and environmental sustainability, with intermediate economic development and continuously rising population

In Sweden, the climate and vulnerability investigation as issued by the Government has chosen to look at A2 and B2 with the justification that those are seen as the more likely ones, reflecting a probable development (SOU 2007:60). However, as the FOI report points out, according to IPCC and others, all scenarios are equally probable. This is necessary to take into consideration as it reflects the attitude and aspirations of the government – if only these scenarios should be considered, that should in theory mean that the government assumes that the Swedish society will develop in the direction of the A2 or B2 scenarios. However, in the SOU (2007:60) the authors explain that the choice was not based on the socioeconomic scenarios, but only to give a "reasonable range". Those scenarios have also been chosen by other national studies on adaptation, as well as by the EU research project PESETA.

FOI dedicate a large share of their report on the future climate of Sweden to outlining the insecurities within and between the scenarios from a critical point of view. However, they come to the conclusion that regardless of which scenario one investigates, the short-term prediction is very much the same for all scenarios. Hence this can be seen as a robust expectation from which short-term climate change adaptation can be planned. However, in the mid-term and long-term range the predictions vary. One example of this can be seen in Table 2, which shows the expected increase in global temperature for three scenarios over short-, mid- and long-term periods. The A1 scenario has sub-categories that describe alternative directions of technological change in the energy system, where A1B stands for 'Balanced' and describes a balance across all sources (McCarthy 2001).The variance between the scenarios is very low for the short-term, but increases significantly for the mid- and long-term, as can be derived from the standard deviation.

Table 2 Predictions for global average surface temperature increase relative to the period 1980-1999 for three different emission scenarios (Meehl et al 2007:763) Standard deviation added by Carlsen & Parmhed (2008)

Period	**A1B**	**A2**	**B1**	**Standard deviation**
2011 - 2030	+0.69°C	+0.64°C	+0.66°C	0.025
2046 - 2065	+1.75°C	+1.65°C	+1.29°C	0.24
2080 - 2099	+2.65°C	+3.13°C	+1.79°C	0.68

2.1.3 Floods and their consequences

A flood is a naturally occurring phenomena, which can be defined as "the temporary covering by water of land not normally covered with water" (EC 2007), and their unpredictability has posed challenges to human settlements for as long as we have records dating back. In modern time, we frequently read about disastrous floods, notably the 2002 and 2013 central European floods (KNMI 2013). In Sweden, records of floods date back to 1596 as described in parish books. Since then hazardous floods have been recorded in practically every part of Sweden, from north to south and on the countryside as well as in densely populated areas (SMHI 2015d).

Floods, together with storms, are the natural disasters that cause the highest economic losses in Europe (EEA 2013). Over the period from 1998 to 2009, 213 events were recorded where in total more than 1100 lives were lost. The recorded economic impacts amounted to EUR 60 billion, even though only 40 % of the recorded events could provide an estimated monetary value for the losses (EEA 2013). However, even if there were data available for all events, the full cost would still remain unknown, as floods have a very large amount of indirect or hidden costs (IPCC 2012:9). These would include for example the loss of production when businesses are temporarily or permanently shut down, or in some cases environmental damage from pollution caused by flooded industries. The recovery may not be complete, and planned investments may be postponed or abandoned (EEA 2013). Noteworthy is also that the costs associated with weather, climate and geophysical events have increased over time, and that economic losses are higher in developed countries. However, the loss expressed as proportion of GDP, as well as lives lost, is higher in developing countries. The key driver behind those losses can be described as societal vulnerability (EEA 2013), and increasing exposure of people and economic assets is the main reason to the increase of losses (IPCC 2012). There is also evidence of the flood related damage to continue to increase (Feyen et al 2012) both in terms of economic losses and people affected. The floods in Sweden have not had the high number of fatalities as other events on the continent, nor been as expensive, but the damage costs are increasing. It has been shown that from 1901 until 2010, 190 floods occurred with negative effects on human health, the cultural heritage, the environment and the economic activity (MSB 2012).

2.1.4 Floods in Sweden

In Sweden, floods are primarily caused by large inputs of water to lakes and water bodies from heavy rains or snowmelt (SMHI 2015e). This is a natural part of the shifting seasons in the northern part, related to the snowmelt, whereas in the south it can occur practically at any time of the year. Currently, if the temperature is high, the snow in the mountain will melt at the same time as the snow in the forest, causing high runoff peaks. This can be further enhanced by the expected increased precipitation (SMHI 2015e). The soil humidity is also highly relevant, as the soil once it becomes saturated cannot store any additional water. Additionally, reduced snow coverage does not insulate the ground and the ground frost will then be more severe which inhibits infiltration. On the other hand, a counteracting effect is that if there is less snow, the runoff due to snowmelt will not be as intense as the water will be more evenly distributed. Hence, the peaks could even decrease if the temperature gets significantly higher as indicated in figure 7.

Swedish historical flood records date back over 400 years. Naturally, more records are available for the 20th century, which include cities and countryside in all parts of Sweden. In the north, the larger rivers have flooded with effects in coastal cities in the east, from the very north all the way down to Uppsala and Stockholm. Central parts such as Dalarna, Värmland, Hälsingland and Östergötland have also experienced costly floods, as have the southern regions and the west coast. Fatalities have occurred, but are few in numbers. Dam failure is a less common cause of floods in Sweden, but has happened in 1973 in Sysslebäck, and in 1985 in Noppikoski. Since 2000, high water levels or floods have been recorded every year, in all parts of Sweden and different times of the year.

Floods in Sweden mainly cause damage to infrastructure such as buildings, roads and railways, but other infrastructure, industry and agriculture can also be affected. In addition, the drinking water supply could be threatened, and long-lasting power cuts could also occur (SOU 2007:60). The increased desire to live on the coastline has caused an increase of residential houses in flood prone areas, and it is estimated that 6 million m^2 of build-up area along watersheds lie within the boundaries of a 100 year return flood (SOU 2007:60), 100-year return flood being the highest flood expected in 100 years. This area is also likely to increase. Another concern is the local heavy rainfalls, which has a strong negative impact on the sewage system. This sometimes causes discharge of sewage water, and basement flooding. This also increases the risks of contagious agents spreading with the water, causing pollution

and subsequent health hazards. Moreover, the runoff in rivers will increase which can cause problems for the 10 000 dam constructions in the country, which may not all be prepared for the increased maximum levels. Hence, dam safety has to be improved as part of climate adaptation (Riksrevisionen 2007:9). In addition to floods, the changed precipitation patterns can also trigger landslides and erosion with devastating consequences. The positive consequence is an increased opportunity for hydropower, estimated to 15-20 % towards the end of the century compared with today's level (Riksrevisionen 2007:9).

Many factors play in when it comes to the effects of climate change on floods, and therefore the picture of future floods in Sweden is not completely uniform. Calculations from SMHI show that flows are actually expected to decrease in parts of northern Sweden, especially inland and on the coast, as well as in parts of central Sweden (SMHI 2015e). This is due to an expected decrease of the spring floods, as explained earlier. However in the north-westernmost part, in the southern fells and in large parts of southern Sweden, the 100 year flows are expected to increase due to the increased precipitation (SMHI 2015e). A rough map of the expected changes is shown below;

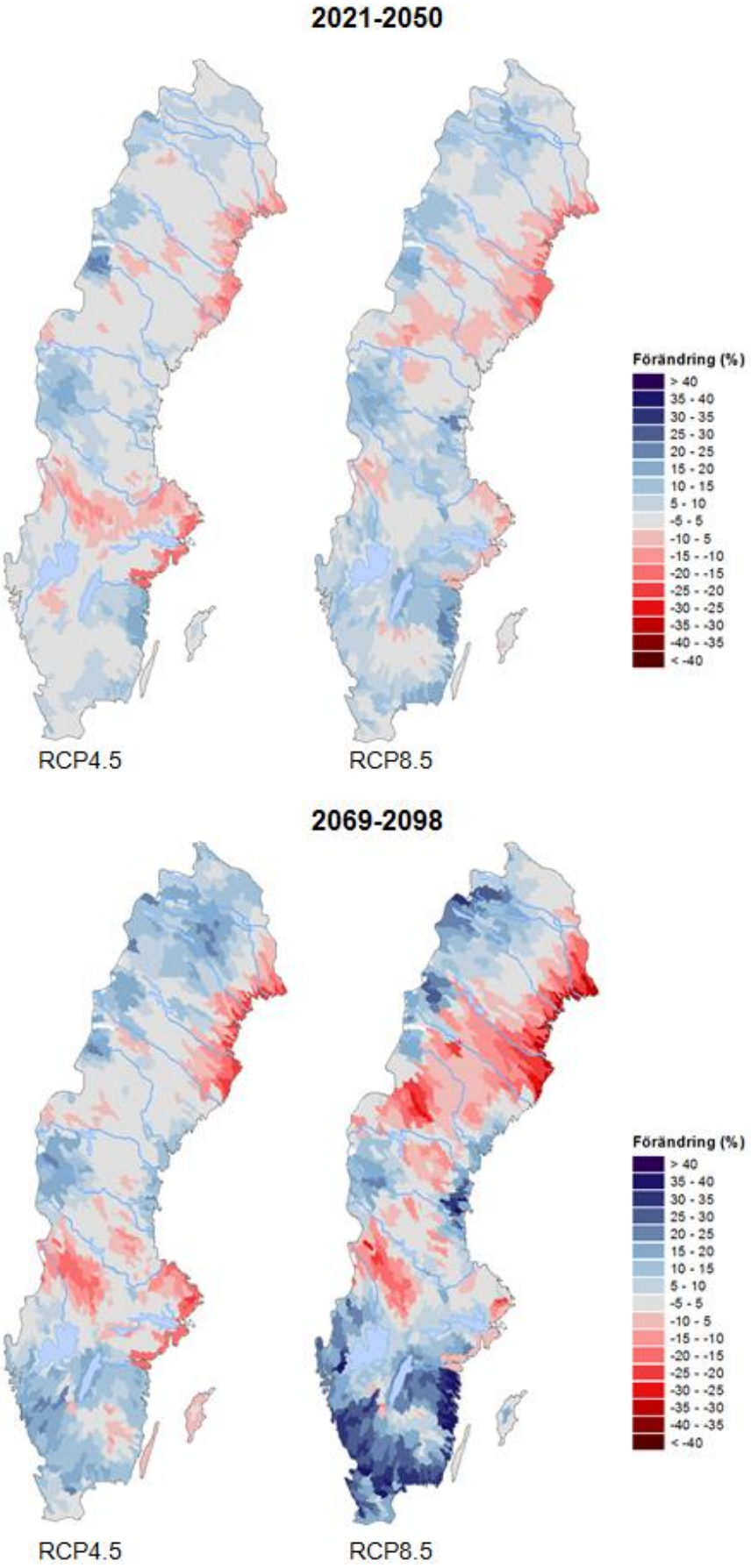

Figure 7 Expected change in 100 year return-flow (SMHI 2015e)

For both time periods the change is displayed in two scenarios, RCP4.5 – limited greenhouse gas emissions and RCP8.5 – continued large emissions. SMHI also point out that floods are affected by anthropogenic behaviour such as water and flood risk management and infrastructure development, which can change faster than the climate, increasing exposure and thus also the risk (SMHI 2015e). Therefore more careful analysis is needed to understand the changes in a specific area.

2.2 Management of floods

This section will give a brief introduction to practical measures and theoretical concepts that help understand flood management in a larger, more general perspective.

2.2.1 Flood protection measures

There are many ways to protect humans and values from floods. The perhaps most well-known ones are referred to as permanent structural flood protection measures, including dams, dykes and levees, and non-permanent structural measures such as temporary walls or sandbags. These are well-known ways to protect our values from increased water levels, and are sometimes seen as 'the old approach' to flood protection. This is because one of the side effects is that it tends to increase the water velocity, and sometimes this causes problems downstream. The 'new approach' to flood protection has a more preventive character, with a focus on providing measures upstream for increased retention and infiltration of the water. Some of those are infrastructure projects, such as basins for retention of water that can be released later during lower flows. It could also be done via more natural methods, such as planting high water retention vegetation types or use forest management techniques to ensure a certain plant cover ratio which helps increase infiltration and decrease runoff. There is essentially a focus on providing space for the natural systems, which could include measures such as reforestation or (re)construction of wetlands. Lastly, non-structural flood protection measures are not constructed, such as early warning systems and flood forecasts. These are extremely important as they give the opportunity to in first hand relocate values, such as items like vehicles and move other possessions (furniture, electronics etc.) upstairs, and of course move humans to safer locations. Often, several of the methods are implanted together and have synergic effects.

Modern approaches have been further developed and conceptualised by innovative scientific stakeholders. The think-tank of the Royal Institute of British Architects, 'Building Futures', has together with the Institution of Civil Engineers developed a think-piece addressing urban

flooding with three different strategies: retreat, defend or attack (Building Futures & ICE 2009). These have been picked up on by the Gothenburg-based research centre Mistra Urban Futures, which produced a visualisation of how these can be applied to Frihamnen in central Gothenburg, an area vulnerable to floods (Mistra Urban Futures 2010). The strategies are defined as follows (Building Futures & ICE 2009:10):

- To retreat is to step back from the problem and avoid a potentially catastrophic blow. It is to move critical infrastructure and housing to safer ground and to allow the water into the city to alleviate flood risk.
- To defend is to ensure the sea water does not enter the existing built environment. This will require built defences to ensure the standard of protection will be met in the distant future as sea-levels rise.
- To attack is to advance and step seaward of the existing coastline. There is massive development potential to be gained for coastal cities by building out onto the water.

The purpose of these strategies is to "begin to challenge the aspirations we have for our threatened towns and cities, pushing forward the horizon of our thinking. The solutions attempt to find opportunities from amongst the threats posed by climate change and sea-level rise." (Building Futures & ICE 2009:26). One can thus see that a way of reframing threats into opportunities is emerging as a pioneering method for stakeholders who want to stay on the forefront of infrastructure development.

2.2.2 Management of flood protection

In most cases, flood protection is a public good provided by the state to its citizens. This is due to two fundamental characteristics: firstly, flood protection is *non-excludable*, meaning that if flood protection is constructed, it will not distinguish between who shall and who shall not be protected. Secondly, there is *no rivalry* in the usage, which implies that the ones protected will not be less safe if one more person is protected. This is also called jointness of consumption (Ostrom & Ostrom 1999), as illustrated with examples in table 3. Albeit the possibility for exceptions, in general terms this arguments holds and will be assumed to be true for the case of flood protection. The opposite would be a private good, defined by excludability and rivalry of consumption, as in the case of goods like food (the consumption by one individual affects that of the others, and other individuals can be excluded from partaking). This discussion becomes relevant when considering who shall provide the good.

In the case of private goods, the suppliers can charge the consumers what they consider accurate for the good, but if the consumers benefit is not related to their purchase, the incentive to pay disappears and thus the suppliers' motive to provide the good diminishes. However, when there is a benefit to all, there is an incentive for the government or another superior authority to intervene and ensure that the desired good is supplied to the community. This is the case for goods such as street light and weather forecasts (Ostrom & Ostrom 1999), and also for protection from natural disasters such as floods. However, to be more precise on who shall carry the responsibility comes down to several other reasons.

Table 3 Jointness of consumption, adapted from Ostrom & Ostrom 1999

Jointness of use or consumption		
	Alternative use	Joint use
Feasible exclusion	Private good: bread, shoes, automobiles, haircuts, books, etc.	Toll good: Theatre, night club, telephone service, toll road, cable TV, electric power
Infeasible exclusion	Common pool resource: water pumped from a ground water basin, fish taken from an ocean, crude oil extracted from an oil field	Public good: peace and security, national defence, mosquito abatement, fire protection, weather forecasts, "public" TV

As floods are naturally correlated with certain local conditions of the environment, there are good reasons for bringing responsibility close to the affected area, resonating with the principle of subsidiarity which is fundamental to Swedish disaster management (MSB 2014c). In Sweden, the responsibility in practice and implementation lies with the municipalities, but recently there was a rearrangement of responsibility, corresponding with the reformation of the Swedish Civil Contingencies Agency (MSB) in 2009, previously called the Swedish Rescue Services Agency (Räddningsverket). This national agency has the overarching responsibility, and the overall flood protection shall be overseen by the 21 county boards. Ultimately, the municipalities are still responsible for implementing the flood protection measures. This structure changed as a consequence of the EU Floods Directive 2007/60/EC which was implemented in the Swedish national legislation in 2009 via the ordinance 2009:956.

It should be kept in mind that there is a quite clear separation between water management and flood management in Sweden. In general, water management falls under environmental law, which at the European level is primarily guided by the Water Framework Directive, and on

the national level by several of the national environmental objectives[1]. Flood management on the other hand is linked to risk management and planning of infrastructure, falling primarily under other laws (see section 3.2.3). This in practice means that flood protection is a task that primarily falls under agencies and bodies working with urban planning and infrastructure, whereas water issues (water quality, biodiversity etc.) fall under environmental agencies. This can be seen also as flood management fall under the overall responsibilities of MSB, which until 2014 was acting under the Ministry of Defence, and only recently reassigned to the Ministry of Justice. As a comparison, in Austria this is the responsibility of the Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW) and in Germany the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety. This means that in Sweden, floods have been primarily been seen as linked to disaster management, and the motivation to defence has been based on the need for civil protection rather than environmental management and protection. This is somewhat in dissonance with the EU perspective where floods are framed as a part of environmental issues, notably so since the Floods Directive is managed by the Directorate General for the environment, whereas MSB and their activities, fall under the responsibilities of the Directorate General for Humanitarian Aid and Civil Protection (DG ECHO).

2.3 Climate change adaptation in flood protection

The impacts of climate change is a topic, which has only recently been paid considerable attention in the political arena, especially in terms of adaptation to the expected changes. Although climate change has been acknowledged by scientists since the 1970s (see for example Sawyer 1972), and has gained significant recognition with the formation of the Intergovernmental Panel on Climate Change (IPCC) since 1988 (IPCC 2016), it has taken governments a long time to adjust to the changes. In the Kyoto Protocol, adaptation was only included in 2001 and then still only concerned developing countries (UNFCCC 2014). Smit et al (2001) defines adaptation to climate change as "adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change". This is different from climate change mitigation, which is the reduction or prevention of greenhouse gas emissions. In a report from OECD published in 2006, it was concluded that most of the

[1] Sweden has 16 National Environmental Objectives; http://www.miljomal.se/sv/Environmental-Objectives-Portal/

developed countries had focused more on mitigation than adaptation. The report could then distinguish between two kinds of climate adaptation measures; 1) general, broader, institutional measures which lay the foundation for adaptation on several sectors and areas of decision, and 2) specific measures on a policy or project level. The small efforts that had then been made were mostly focused on natural hazard management (Gagnon-Lebrun & Agrawala 2006), where there were existing policies, which "might be synergistic with adaptation to climate change" (Gagnon-Lebrun & Agrawala 2006). In 2013 researchers from the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden) published a white paper on climate change adaptation in the region, pointing out that "For many decades, climate policy debates focused on how to curb greenhouse gas emissions" and "the need for adaptation is real and substantial, and in most of the region, the work is only just beginning." (Goodsite et al 2013:4).

2.3.1 Key concepts behind climate change adaptation

It may seem obvious why we should prepare to live with climate change, but like any change of discourse, there are some fundamental ideas that have helped in reaching this conclusion. One key idea is the concept of viewing the human society as an integrated part of nature, that is, to consider the social-ecological system as one instead of society and nature as separate (Adger 2006). It then becomes evident that they are interlinked with one another – that nature provides the boundaries for how our societies can develop, but that we also influence and reshape nature through our societies. Humans have always lived with certain threatening hazards from nature; floods, draughts and plagues just to name a few. However, if these hazards actually pose a risk to a society depend on its vulnerability. That in turn depends on how exposed it is, and if it has the capacity to protect itself. These are concepts which are becoming increasingly more relevant and therefore increasingly studied over the last few decades, with climate change as a major trigger.

The IPCC's widely recognised definition of vulnerability states that "Vulnerability is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity" (McCarthy et al 2001). As a society, then, it is logical to strive for a low level of vulnerability. However, with climate change as an increasing threat, risks that were previously manageable may grow out of hands. It is

therefore desirable to protect the society, but as the risks are dynamic so must the response also be. This has become known as resilience, which can be defined as "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks" (Walker et al 2004). These concepts are spreading from science to policy as can be seen in the common goals from the county boards in Sweden, whose common goal is to "actively meet climatic changes by reducing vulnerabilities and grasp opportunities to develop a long term robust society" (County Board Halland 2014).

2.3.2 International frameworks for natural disasters

In 2005, 168 countries participated in the drafting of the Hyogo Framework for Action (HFA) at the World Conference for Disaster reduction in Kobe, Japan. This was a ten year programme (from 2005-2015) striving to build "the resilience of nations and communities to disasters" (UNISDIR 2005), resulting in "the substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and countries" (UNISDIR 2005). This Conference took place just a few months after the catastrophic tsunami which hit Southeast Asia on the 26th December 2004, with an estimated 283,000 fatalities and enormous economic losses (Lay et al 2005). Later that year, the hurricane Katrina caused tremendous destruction in The USA (over 1500 fatalities and over $100 billion in economic damages) (NASA 2010), which came to serve as a reminder that natural disasters not only take place in developing countries, but also can affect the wealthier nations. Timely, Sweden also experienced its most severe storm in January 2005, named Gudrun, which caused 17 fatalities and damages amounting to €230 million, with further costs in other affected countries (Haanpää et al 2007). In 2015 the HFA was followed up by the Sendai Framework for Disaster Reduction 2015-2030, aiming "to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries over the next 15 years" (UNISDIR 2015a). Thus it is not surprising that Sweden, as one of the countries behind the HFA and now the Sendai Framework, committed to create a national platform for disaster risk reduction to coordinate the work progress towards the established five goals of the original HFA. As a part of this work, Sweden is also partaking in the campaign *Making Cities Resilient* to ensure that the progress also occurs on a local level (se chapter 3.3.3). The responsible national authority is the Swedish Civil Contingencies Agency (MSB). Naturally, the Hyogo Framework for Action and the Sendai Framework are

concerned both with floods and climate change adaptation, which is addressed specifically under the action priority 'Reducing underlying risk'. This priority urges the actors concerned to "Promote the integration of risk reduction associated with existing climate variability and future climate change into strategies for the reduction of disaster risk and adaptation to climate change" (UNISDR 2005:11) and highlight the need to "Implement integrated environmental and natural resource management approaches that incorporate disaster risk reduction […] such as integrated flood management" (UNISDR 2005:10). Sweden is therefore working on this by "continuing to integrate climate change adaptation and disaster risk reduction (DRR) into policy and practices" (MSB 2015a) and allocating significant governmental funds to flood protection (MSB 2015a).

2.3.3 The road to climate change adaptation in the EU

In 2007 the EU published a Green Paper addressing adaptation to climate change. This also to a large extent focuses on natural hazards and disaster management. In doing so, the paper stresses the need for action on multiple levels, both in the public and the private sector. Multilevel governance would in this case mean that "action should be taken at the most appropriate level and be complementary, based on joint partnerships" (EU 2007:23). Four pillars are defined which describe 1) early action in the EU, 2) integrating adaptation into external EU actions, 3) reducing uncertainty through research and 4) involvement of the society, business and the public sector. For the public sector, the paper focuses on hazard prevention and management and spatial planning, whereas the private sector is more broadly addressed with both 'soft and inexpensive action' such as crop rotation and water conservation and 'costly defence and relocation measures'. This paper is to serve as foundation for consultation and is therefore not particularly concrete, nor is it enforcing any direct action. However, it does describe the need for action within several areas, water being one of them. It refers to the need for integration of climate change adaptation in the Water Framework Directive and briefly addresses the Flood Directive, which still had not been published when the Green Paper was issued. The consultation following this paper then lead to the 2009 White Paper and the following EU strategy on adaptation to climate change.

After the Green Paper, the White Paper served as the next stepping stone in the process towards the climate change adaptation strategy. The paper points out that due to the regional variability of climate change, most adaptation action will take place on either national, regional or local levels. However, the EU should play a role in supporting and coordinating

efforts, especially in the transboundary setting. This includes information sharing on best practice strategies between Member States, (MS). Thus, the objective of the EU's Adaptation Framework should be "to improve the EU's resilience to deal with the impact of climate change" (EU 2009). The first phase of this framework spanned from 2009-2012 and included four pillars of action (which to a large extent correspond to the pillars outlined in the Green Paper): to develop a knowledge base, integrate adaptation into EU policies (mainstreaming), employing a combination of policy instruments (market-based instruments, guidelines, public-private partnerships) to ensure effective delivery of adaptation, and stepping up international cooperation on adaptation.

Finally, the EU Adaptation Strategy was adopted in 2013. It focuses on three key objectives: Promoting action by MS, 'Climate-proofing' action at EU level and better informed decision-making (EU 2015). In order to do so, eight overarching actions have been established:

1. Encourage all MS to adopt comprehensive adaptation strategies
2. Provide LIFE funding to support capacity building and step up adaptation action in Europe (2014-2020)
3. Introduce adaptation in the Covenant of Mayors framework (2013/2014)
4. Bridge the knowledge gap
5. Further develop Climate-ADAPT as the 'one-stop-shop' for adaptation information in Europe[2]
6. Facilitate the climate-proofing of the Common Agricultural Policy (CAP), the Cohesion Policy and the Common Fisheries Policy (CFP)
7. Ensuring more resilient infrastructure
8. Promote insurance and other financial products for resilient investment and business decisions

Flooding is mentioned in the background section describing it as a significant risk associated with current and projected climate change in the EU, especially with regards to the costs of floods and the cost-effectiveness of flood protection measures, and it is pointed out that adaptation "measures can be very effective, as for each euro spent on flood protection, we could avoid six euros of damage costs" (EC 2013:4). In more concrete terms of implementation, it is said that "The Commission will promote adaptation particularly in the following vulnerable areas: - cross-border management of floods, fostering collaborative agreements based on the EU Floods Directive" (EC 2013: 10). Making it to the top of the list, flood management is evidently a priority for the EU adaptation strategy. Other areas considered vulnerable are coastal management, urban land use planning and water

[2] The web-based European Climate Adaptation Platform (Climate-ADAPT13) was launched in March 2012.

management, which all to some extent can intersect with flood management. It is also highlighted in the adaptation strategy that there are specific funds available to support adaptation action, giving flood and draught management as an example of what it can be specifically used for.

Moreover, as can be interpreted from this list of actions, it becomes evident that the EU is aiming to provide the first kind of climate adaptation measures as described by the OECD in 2006. Recognising the need for adaptation measures to be more local due to the variability, the EU goals (perhaps with the exception of number 7) strive to accomplish the earlier mentioned 'general, broader, institutional measures which lay the foundation for adaptation on several sectors and areas of decision'. This would then facilitate for the MS and other stakeholders to adopt 'specific measures on a policy or project level'.

2.3.4 The European Floods Directive

As a consequence of the large and devastating floods in Europe in the early 2000s, the EU came to develop the Floods Directive 2007/60/EC. The aim is to "reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity" (EC 2015a). The EC highlights that the directive concerns all kinds of water bodies, inland as well as coastal and therefore also covers all kinds of floods. This directive declares that the MS are obliged to perform both risk assessment and management plans, which should to consider "the likely impacts of climate change on the occurrence of floods" (EU 2007). These plans are performed on a national level, and integrate across borders in the cases of international river basins. There are several steps which are time bound by the EU, giving the MS until 2011 to perform an initial assessment, then risk maps shall be completed by 2013 and by 2015 the risk management plans are to be in place. Those risk management plans are to focus on prevention, protection and preparedness. These assessments, maps and plans are then to be updated continuously on a 6 year interval, which is coordinated with the timetable of the implementation of the Water Framework Directive 2000/60/EC. So far, all MS have complied with the steps of the Floods directive (EC 2015b).

The purpose of the preliminary flood risk assessment is to identify areas prone to significant flood risks. Each MS may define significant flood risk as they please. This assessment shall contain *a*) a map over the water district, *b*) an account for the previous floods that have occurred in the area and their consequences, and *c*) an account for the previous floods that would have severe consequences if they happened again. Many actors contribute to this

process. The identified areas are then further investigated and flood hazard maps and flood risk maps are developed. The hazard maps (HZM) highlight the areas with likelihood of floods, with the established medium return period set to 100 years (low and high return periods are chosen by each MS individually). The risk maps assess the endangered values, showing the "number of inhabitants potentially at risk, the economic activity and the environmental damage potential" (EC 2015c). The last step is the flood risk management plan, which should define measures to reduce the probability of flooding and its consequences. As the MSB points out, the MS are not required to produce any new data, but are instructed to rely on existing data (MSB 2011).

3. Results

This section will present the results of the interviews and the desk research, starting with an outline of the climate change adaptation in Sweden today, as it is perceived both in the country and in an international perspective as well as how it is coordinated on a national level. The following sections present the results in the way that they relate to the first three research questions, and the relation to the EU Floods Directive (the fourth research question) is explained within these sections, with concluding remarks in the last section.

3.1 Climate change adaptation in Sweden

Officially, Sweden currently does not have a national climate adaptation strategy. In an international context, the governmental proposition 'An Integrated Climate and Energy Policy' is counted for as the national strategy, which is the interpretation of the European Environmental Agency (EEA 2016). Noteworthy is that the governmental proposition is centred on mitigation, proposing emission reductions, yet it does include certain adaptation measures delegated to other national and regional authorities. These measures were:

- an improved knowledge base of landslide risks and improved national altitude data performed by the Swedish Geotechnical Institute and the National Land Survey,
- "overarching responsibility" for climate adaptation delegated to the county boards,
- the upcoming improvement of the Swedish Planning and Building Act to take landslides into consideration (which was included in the 2010 revision) (Ministry of the Environment and Ministry of Enterprise, Energy and Communications 2009).

A revision by the OECD in 2014 came to the conclusion that Sweden is lacking an overarching strategy for climate change adaptation (OECD 2014). However, the ministry of

the environment and energy announced in February of 2016 that a national adaptation policy is in the pipeline. The new vision adopted by the Government is to "develop a long-term sustainable and robust society that actively faces climate change through reducing vulnerabilities and seize opportunities" (Regeringskansliet 2016). There is to date no more information available about this policy.

Before the 2009 climate and energy proposition, in 2005, the Swedish government had ordered a report with the purpose to outline the vulnerability of the Swedish society to the global climate changes and the regional and local consequences of said changes, entitled *Sweden Facing Climate Change – Threats and Opportunities*, or SOU (2007:60). This report was finished and published in 2007. To many national actors, this is the most guiding document on national climate adaptation. Not surprisingly, the authors of the report state that it is necessary to initiate climate change adaptation in Sweden, based on the conclusion that the climate change predictions, despite their level of uncertainty, are sufficiently robust to justify this work. They emphasise that the risk of floods, landslides and erosion are increasing in many places, justifying preventive measures, and recommend that a governmental fund should be established to support large scale adaptation (SOU 2007:60). Another issue highlighted is the risk of dam failure, as Sweden has approximately 10,000 dams all across the country. There have to date been very few accidents, but with increased flows, the dams can be pushed to their limits. Therefore, the authors are of the opinion that the dam safety should be improved and developed. Issued permissions for water activity, such as hydropower plants, may have to be reassessed to reduce flood risks. All in all, the report poses 59 suggestions for adaptation activities within various fields. These concern rearrangement of responsibilities, revised missions for authorities, revised legislation and investigation of further revised legislation, governmental financing of investments, Sweden's stance in the EU and internationally, and scientific research and knowledge building. Out of the 59 suggestions, 12 specifically mention flood risk but many others have the potential to affect flood management, such as the governmental fund to prevent landslides and other natural disasters (SOU 2007:60, suggestion 48).

In 2010, a network headed by MSB called 'national platform for disaster risk reduction'[3] composed an overview of the ongoing efforts of climate adaptation in Sweden, aiming to constitute the basis of the continued work on this issue in the country (Rydell et al 2010). The

[3] Swedish: Nationell plattform för arbete med naturolyckor

authors came from MSB, Swedish Geotechnical Institute (SGI), SMHI, and the National Food Agency. The SOU (2007:60) was used as a point of reference, from which key stakeholders were identified and the suggestions proposed there were followed up on. Regarding the 59 suggestions from SOU (2007:60), inventory shows that 14 of those have been fully implemented, 14 have to some extent been integrated in governmental tasks and 22 have not been realised. For the ones previously identified on flooding, one had been fully implemented, five had been partly implemented and six had not been implemented. Some of the propositions were very general which makes it difficult to distinguish the responsibility, and others concern actions on the EU level over which Sweden has limited influence. The sectors of urbanism and urban planning, technical infrastructure and supply and agricultural sciences have experienced the most efforts so far. The link between flood management, urban planning and technical infrastructure is strong, as adaptation in many cases deals with improving resilience against weather extremes such as floods. The authors moreover see an opportunity for improved climate adaptation efforts through further coordination and clarification of roles and responsibilities, both vertically (nationally/regionally/locally) and horizontally (between sectors and actors).

A report from 2015 by SMHI highlight the same need for improvement (Andersson et al 2015). This report was compiled on behalf of the government as part of a follow-up on the SOU (2007:60), and suggests a new road map for climate adaptation. As for responsibilities, the suggestion is that SMHI should be the main head for national and international follow-ups and evaluation of national strategies and action plans, the MSB should contribute to the parts regarding accidents and emergencies, and the Swedish EPA should contribute to the parts concerning climate change related to the national environmental targets. They also enhance that awareness of climate change must be mainstreamed at all levels of decision-making. MSB (2015b) has responded to the report that they agree that there is “a need for a national strategy with clear goals for the work on climate adaptation” and that this should be coordinated with the national strategy for disaster risk reduction as ordinated by the Sendai Framework. They agree that a share of the responsibility should fall on MSB, mainly the coordination of authorities, and stress that already existing networks of authorities, expert groups and other fora should be used instead of establishing new ones (MSB 2015b).

3.2 Division of responsibilities and coordination of flood management across levels of government

This section aims to outline how the responsibility for flood protection is dispersed across levels of government in Sweden. Moreover, it shall be explained how the policies, meaning objectives and measures, are coordinated across levels of government.

3.2.1 National level responsibilities

On the national level, several actors have influential roles that cover flood protection as well as climate adaptation. A highly relevant actor on the national level is the Swedish Civil Contingencies Agency (MSB), which since 2014 act under the Ministry of Justice, but until then served under the Ministry of Defence. This governmental agency is operating on the basis of instructions from a yearly appropriation from the government, and their task is to provide protection against accidents, crisis management and civil defence. As a part of this, MSB is responsible for overseeing the implementation of the EU Floods Directive. The implementation process started in Sweden in 2009, as it was introduced in national legislation in the form a new ordinance on flood risks (Sw: *Översvämningsförordningen* SFS 2009:957) (see section 3.3.1). To fulfil the requirements of the directive, MSB performs the development of the preliminary flood risk assessment and the Hazard Zone Maps (HZM), whereas the further steps are delegated to other actors. Figure 8 shows a visualisation of the share of responsibilities of the implementation of the Floods Directive in Sweden, in a 6-year-cycle (År 1-6 in Figure 8).

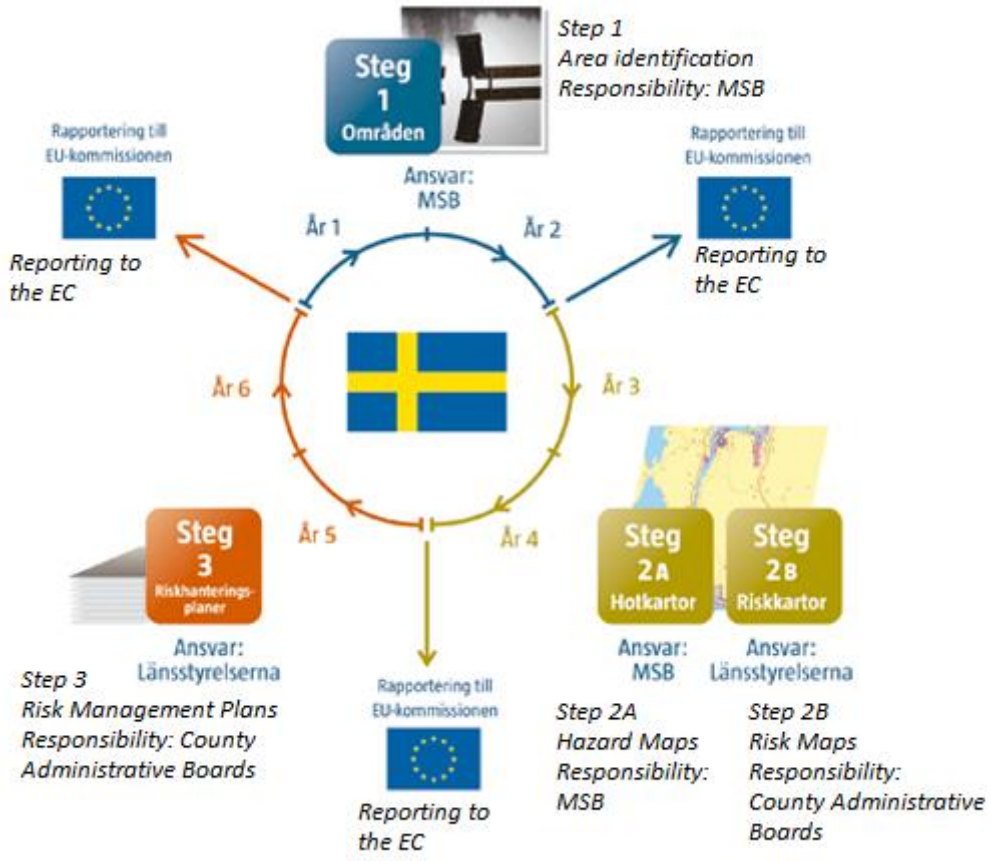

Figure 8 Visualisation of the implementation of the Floods Directive (MSB 2015)

Figure 8 shows that in step 1 (*Steg 1, Områden*) that covers year 1 and 2 (*År 1, År 2*), MSB is responsible for the area identification or preliminary flood risk assessment, which consists of identifying the flood hazard areas in Sweden, based on existing mappings. Step 2a is to produce detailed maps for the flood hazard in the identified areas, also to be performed by MSB, and Step 2b is to produce detailed maps of the flood risks in the identified hazard zones, which is the responsibility of the county boards. Step 2a and 2b take place in year 3 and 4. Step 3 is the development of risk management plans for the identified areas, and is performed in year 5 and 6 by the county boards (further discussed in section 3.2.2). After each step is concluded, the MSB reports back on the results to the European Commission. In the interview with the representative from MSB, this division of responsibility was thoroughly discussed. When asking the interviewee from MSB how she would ideally like to improve the work, she agrees that a law that would reach all the way down to the municipal level would be desirable. However, as she also points out: "In fact we shouldn't need a flood report, since we have the legislation anyway, but now we are in the EU and then this is how it is".

The MSB is also actively working for the civil preparedness for floods, by offering training courses and educational material to actors and the general public. On a reactive level, they possess "resources such as flood containment equipment for supporting large scale national responses" (MSB 2015c), such as expert knowledge but also flood barriers and pumps. During major disasters, these can be used to support municipalities and be made available to other counties in the EU and beyond if needed (MSB 2015c). MSB are also responsible for channelling 43 million SEK annually to municipalities for preventative measures against natural disasters, out of which floods are a significant share (MSB 2015c). Climate change adaptation is specified as one of the reasons to apply for this fund. As explained in the previous section Additionally, MSB has a strong coordinating role as the agency responsible for the National Platform for Work against Natural Disasters (introduced in the previous section), where 19 national authorities and organisations (including SMHI) partake to prevent and handle negative consequences of natural incidents.

The Swedish Metrological and Hydrological Institute, SMHI, also has a key position in this area. The overarching purpose of SMHI is to provide essential information on climate, weather and water, in order to increase safety, good urban planning and a sustainable society. It is a governmental authority serving under the ministry of the environment and energy, with the mission to be an "expert unit on metrology, hydrology, oceanography and climatology" (Sw: *Förordning med instruktion för Sveriges meteorologiska och hydrologiska institut* SFS 2009:974). It is specified that SMHI shall provide warning services, a key part of non-structural flood protection, as well as "produce, compile and disseminate information and knowledge about climate change and climate adaptation" (Sw: *Förordning med instruktion för Sveriges meteorologiska och hydrologiska institut* SFS 2009:974). Furthermore, it is explained that SMHI is obliged to collaborate both with other national agencies (such as MSB and the Swedish International Development Agency, SIDA) and with international organs (such as IPCC and various European initiatives). One significant international involvement is the role as coordinator in the EFAS, the European Flood Awareness System, which monitors and forecasts floods across Europe to provide early warning information. As the fundament for sound and accurate political and policy decisions will be based on data from this source, their accuracy as well as legitimacy is of high importance to reduce the civil vulnerability. Regarding their priorities, the annual report from 2014 states already in the first paragraph of the introduction that "the climate issue is a central and growing part of [its] activity" (SMHI 2014b:4). Further, SMHI has established a national knowledge centre for climate adaptation,

as mentioned in section 3.1 (SMHI 2014b). An important part of the knowledge centre is to manage network for coordination of the national climate adaptation is the Swedish Portal for Climate Change Adaptation. According to its description, it "is intended to support society and citizens preparing for climate change consequences [and] offers comprehensive information and support within a number of areas" (Klimatanpassningsportalen 2016). The portal is managed by SMHI and was established in 2010, but became more active from 2012 (SMHI 2016). Thus, the role of SMHI is multidimensional, including both information collection and sharing as well as coordination of efforts and stakeholders. Important to point out however is that they do not have the mandate to enforce other stakeholders or authorities to take action in any way.

Partaking in both the National Platform for Work against Natural Disasters and the Swedish Portal for Climate Change Adaptation, is the National Board of housing, building and planning (Boverket), which has an important role in flood protection and climate adaptation of constructions and infrastructure. Like all Swedish state authorities, the operation and activities of Boverket are regulated by yearly appropriations issued by the government, reflecting the current national priorities. Their role is to "give advice and disseminate knowledge and experiences to planners and others who work with urban planning or construction" (Boverket 2014). Based on the laws issued by the parliament and the ordinances issued by the government, they produce binding regulations and general recommendations that other state authorities depend and rely on. Moreover, they are responsible for the general oversight of the Swedish Planning and Building Act (Sw: *Plan och Bygglagen* 2010:900) on a national level, whereas the regional supervision is carried out by the county boards which are to collaborate with the municipalities in their planning procedures. Hence, Boverket has a large influence on the municipalities in their spatial planning, and are also of importance to stakeholders ranging from state agencies or companies to individuals, who are constructing buildings or infrastructure. As will be elaborated further on, this is a position that could have an important role in determining how to consider flood risk as well as climate change in urban planning and construction, especially since they have the enforcing mandate from the national level through legislation to set standards on how to account for increased risks in shaping the physical environment.

3.2.2 Regional level responsibility

On a regional level, Sweden is governed by county boards (Länsstyrelser). There are in total 21 county boards, which serve as the link between people and municipalities on the one hand, and the government, parliament and central authorities on the other (County Board of Västra Götaland 2015). They are commonly referred to as the government's extended arm in the regions. The board is governed by the County Governor, appointed by the national government, and the County Administrative Director General who is recruited by the national government. The main role is to implement governmental and parliamentarian decisions in the respective region, financed by governmental assets. These play a very important role in this thesis, as shall become apparent in the following sections.

Since 2004 with the implementation of the EU Water Framework Directive, there are now five water districts in Sweden, one for each water basin (see Figure 9). They each have a water authority, as established by the Environmental code (Sw: *Miljöbalken* SFS 1998:808 chapter 5 §11). Each water authority serves as a part of one of the county boards located within the district, and is governed by 11 expert board members appointed by the government, chosen from the county boards, the municipalities, the business sector and political parties (Vattenmyndigheterna 2015a). When established, the main task of these water authorities was to ensure the implementation of the Water Framework Directive, and in practice this is centred on the assessment and improvement of water quality. However, in 2009 their responsibilities were extended to also include limited work on the EU Floods Directive. Since then, the water authority is responsible for the Risk Zone Mapping (RZM), and together with the concerned county boards responsible for the Risk Management Plan (RMP), i.e. step 2b and 3 in figure 8. This centralises the work effort to a few desks, and aims to create synergies between the Water Framework Directive and the Floods Directive, which was a heavy argument for this constellation. In practice, this carries some complications: according to the interviewee from MSB, the water authorities have no mandate to make decisions in risk issues, but only regarding water quality, as stipulated by the Swedish Environmental code (Sw: *Miljöbalken* SFS 1998:808 chapter 5 §11). The interviewee proceeds to explain that some county boards have expressed discontent over this, and there is an investigation into the reallocation of this task. The interviewee from Halland county board however stated that this had worked out well, and that it had led to the county boards getting to know each other better. Interestingly enough, she also says that Halland provided all the material for the risk

zone mapping, which was then compiled by Västra Götaland, the water authority responsible for the risk area (Kungsbacka) located in Halland.

The division of water districts is as follows:

Table 4 Water districts and corresponding County Board

County Board:	**Responsible for the Water District:**
Norrbotten	Bottenviken
Västernorrland	Bottenhavet
Västmanlands län	Norra Östersjön
Kalmar län	Södra Östersjön
Västra Götalands län	Västerhavet

Figure 9 The five water districts in Sweden (Vattenmyndigheterna 2015)

Subordinate to the water authorities, there are also water councils. These are regional or local cooperation bodies with the purpose to "represent all interests in the runoff area" (Vattenmyndigheterna 2015b), which usually consist of the municipalities and industries or businesses located in the vicinity of the water in question. Taking the water council of the river in Kungsbacka as an example, the members represent four municipalities (Kungsbacka, Mark, Mölndal and Härryda), Swedavia which manages Landvetter Airport, A-Hus AB which is a housing company, the energy company Statkraft Värme AB, AB Gothenburg Fuelling Company and Sand & Grus AB Jehander, a sand and gravel company (Kungsbacka Vattenvårdsförbund 2016). The water councils aim to function as a "local forum and a dialogue party to authorities regarding water issues" (Vattenmyndigheterna 2015b). Within the studied water district Västerhavet there are currently 32 water councils, all of them with a contact person at the county board in which they are located. This brings the water issues

close to the population and thus actively works on public participation, as stipulated by the Water Framework Directive. This is useful in raising awareness regarding opportunities, threats and conflict of interests on the local level, which can be brought to the attention of regional mandates. The water councils currently have no responsibility in flood management, but are still used to disseminate information regarding floods if there is no other network (see following section).

The county boards also foster collaboration through the so called river groups. The purpose of these constellations is to provide a forum for collaboration between and coordination of affected parties within the runoff area of the river in question. This gives increased knowledge about the division of responsibility, functions and capacity of the other parties involved, particularly in relation to flood risk management. Normally, the county board is the coordinator and the other parties include municipalities, hydropower companies, SOS monitoring stations, the Swedish Transport Administration, the police, SMHI, dam owners and other organisations with responsibilities and tasks along the river (MSB 2014a). MSB still has an overarching responsibility for the creation of the river groups and shall support the county boards in the process of sustaining them. In 2014 there were 30 river groups organised (MSB 2014a). These groups were formed after a request in a state official inquiry from the Swedish government (SOU 1995:40). As an example of their work, the river groups of the four rivers running through Halland in south western Sweden meet once or twice annually to discuss the risk of dam failure, the prevention and consequences of floods as well as the management plans to handle those situations (County Board Halland 2015). Hence, the utility of the river groups may be significant, even though the official responsibilities and established obligations are currently few. However, there have been suggestions to increase their responsibilities, for example in a recent official state inquiry from the Swedish government (SOU 2012:46). This suggestion concerned a larger and more enforced share of responsibility for information spreading and dissemination (SOU 2012:46).

The following diagram (figure 10) gives a visual overview of the actors presented in this and the previous section, and illustrate their interdependencies:

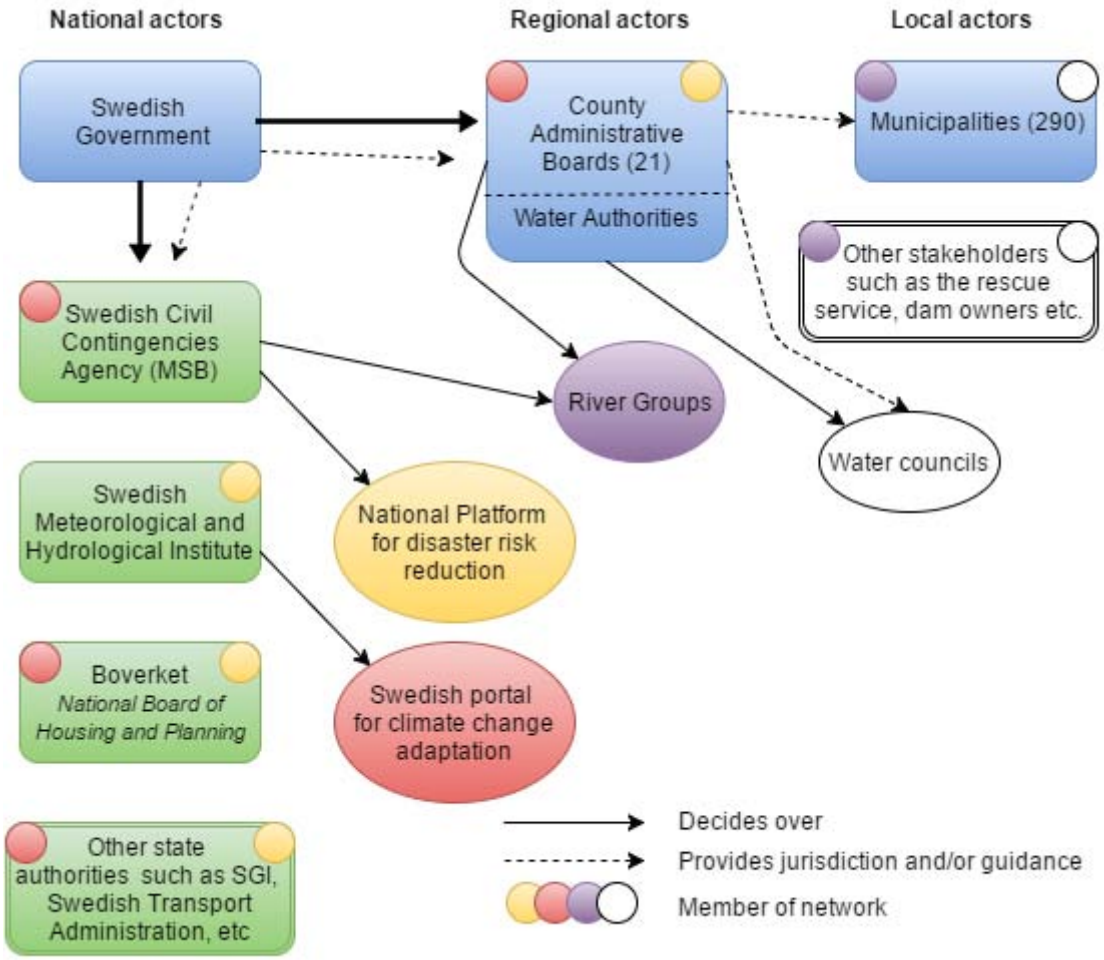

Figure 10 Diagram of actors involved in flood risk management

The blue boxes represent the actors that have a responsibility and mandate over a certain geographic area and the people living there, whereas the green boxes represent actors who have a nationwide responsibility over a certain topic or theme. The white box represent stakeholders that are independent from the state. The round shapes represent the networks and their position indicate the geographical span of their issues, from national at the left to local on the right. The arrows indicate which actor is the main responsible for the network and which actors are subordinate to one another, also indirectly by providing jurisdiction or significant guidance. The coloured dots illustrate the networks of corresponding colour to which the actors and stakeholders are members of.

3.2.3 Local level responsibility

"Sweden is a really strange country – organisationally", the interviewee from Gothenburg Municipality pointed out. He elaborates on this statement and clarifies that municipalities have so much sovereignty and that Sweden is lacking a regional level that has the mandate to

enforce implementation. Comparing it to other countries, he has the impression that a large share of these matters are commonly dealt with on a regional or national level, and not a burden of the individual municipality as in Sweden. Especially since water management does not fit neatly within the municipal borders, he argues that there should be another organisation. The interviewee from MSB sees the situation in a different light and says that "we really have a bottom-up perspective in Sweden", and continues to argue that this is how it should be, as it is in the municipalities where things are actually happening.

On a local level, Sweden is divided into 290 municipalities, which are responsible for the public services within the district. This decentralisation of power provides the municipalities with a large and significant autonomy, where they independently decide over urban planning, public relief work and water supply and sanitation. Certain laws concerning the municipalities are also indirectly related to flood protection. According to the Law on protection against accidents (Sw: *Lagen om skydd mot olyckor* SFS 2003:778), the municipalities must provide satisfactory protection against accidents, which could threaten human lives, health, properties and the environment. Floods are one kind of accident, which could be threatening the inhabitants, especially those caused by dam breakage, and fire outbreaks being another example. According to the Swedish Planning and Building Act (Sw: *Plan och Bygglagen* SFS 2010:900), the municipalities are also responsible for the spatial plans, which detail how a limited area in a municipality should be built and how land and water is to be utilised. The Planning and Building Act states that the risk for accidents, floods and landslides shall be considered when permission to build is granted. However, the county board has the right to intervene and revoke the permission in case this should not be sufficiently addressed. Furthermore, the municipalities are responsible for risk and vulnerability assessments in accordance with the Law on municipalities and regional council's actions in preparation for and during extraordinary events in peacetime and heightened preparedness (Sw: *Lagen om kommuner och landstings åtgärder inför och vid extraordinära händelser i fredstid och höjd beredskap* SFS 2006:544). Concerning the Floods Directive, the municipalities are (perhaps surprisingly) not formally obliged to contribute to the risk management plans which are to be developed by the county board for the municipalities. However, as they will be affected by these plans they will inevitably be involved, as they possess local knowledge about risks and vulnerabilities, technical infrastructure, preparedness capacity and carry responsibility for several areas of law (MSB 2014b). The interviewee from the county board in Halland explains that she has supportive guidelines from MSB in how to develop the risk management

plan that the county board is obliged to compile for the risk area, but that it is challenging to do it together with the municipality as they already are in the process of constructing the flood protection measures and therefore already have a certain mind set on planning, lowest floor level etc. which they want to continue building on. The county board does not officially have to consult the municipality in the development of the risk management plan (although it is encouraged), but interviewee from the county board highlights that she "doesn't want to do it for herself, that wouldn't be a good plan". The municipality and county board are not fully synchronised on this issue as, the interviewee points out, tends to happen when an ordinance is applied from above. This division of responsibility and mandate is due to the fact that the Floods Directive was translated into the Swedish jurisdiction not as a law but as an ordinance, which are per se not binding for municipalities but only for the county boards.

The interviewee from Halland county board also highlights the perhaps most challenging part about the implementation of the Floods Directive – that the county board develops a risk management plan for the municipality, instructing or advising them what to do, without the mandate to enforce the plan since the ordinance does not overrule the municipality's independence to decide over their own matters. The risk management plans were finished and submitted to MSB in December of 2015, and it remains to be seen if they are actually implemented by the municipalities and to what extent.

In the preliminary flood risk assessment, the MSB identified 18 areas (municipalities) with significant flood risk: Edsbyn, Falun, Göteborg, Haparanda, Jönköping, Karlstad, Kristianstad, Kungsbacka, Lidköping, Lindesberg, Malung, Stockholm, Uppsala, Vansbro, Vännäsby, Värnamo, Älvsbyn and Örebro (MSB 2011). This leads to the following division of responsibility for the Risk Zone Mapping:

Table 5 County boards and their responsibility areas (MSB 2011)

County Board:	**Responsible for risk areas:**
Norrbotten	Haparanda, Älvsbyn
Västernorrland	Vansbro, Falun, Malung, Edsbyn
Västerbotten[4]	Vännäsby
Västmanlands län	Lindesberg, Örebro, Uppsala, Stockholm
Kalmar län	Jönköping, Kristianstad
Västra Götalands län	Göteborg, Karlstad, Kungsbacka, Lidköping, Värnamo

The selection procedure in the identification of these areas was based on both risk and

[4] Due to the fact that Västerbotten is located in both Bottenviken and Bottenhavet runoff areas/water districts, the RZM of Vännäsby was delegated to the county board in which it is directly located.

vulnerability, considering both the geographical areas that would be flooded and the values located in the area. Thus, based on the spread of the flood and the threatened values, these 18 areas were considered to have significant flood risk. To identify vulnerability, four focus areas were taken from the Floods Directive: human health, the environment, cultural heritage and economic activities. Three return flow periods were considered: 50 year, 100 year and 'estimated highest flow' that has an approximate return period of 10,000 years or more. 50-year return period means the average probability of occurrence of two events in 100 years (EEA 2012), 100-year return period is the highest flood expected in 100 years, etc. To choose an estimated highest flow as the highest return period is based on the fact that there are many (hydropower) dams in Sweden, and the consequences if they could not withstand the flow would be disastrous. Therefore, this unlikely return flow becomes relevant. In this assessment, coastal floods were not included as the MSB were waiting for the new national altitude database. The old data was not accurate enough to provide any significant results. The intention is to include this in the next round of assessment, in 2017.

3.2.4 Transboundary water management

Sweden borders two other countries; Finland and Norway. Finland and Sweden started collaborating regarding the water shed of Torne River in the mid-1900s. Currently, there is a Finnish-Swedish Transboundary River agreement, which was established in 1971 and renewed in 2010. On the basis of this agreement a cooperation body has been founded; the Finnish-Swedish Transboundary River Commission, which is to perform the functions of the agreement. The Agreement contributes to the efforts to prevent flood and environmental damages, and fulfil the EU directives 2000/60/EC and 2007/60/EC. In Sweden, the city Haparanda is considered one of the 18 risk areas in the country and in Finland, the bordering city Tornio is also considered high risk. Both cities have experienced damaging floods in the past. Considering the proximity of the cities, the cooperation between the Swedish county board and the corresponding Finnish centre for economic development, transport and the environment (ELY Centre) is beneficial. The already existing flood protection measures, two flood forages, protect both cities (Länsstyrelsen Norrbotten 2015) as can be seen in Figure 11. The solid black line in the river indicate the national border.

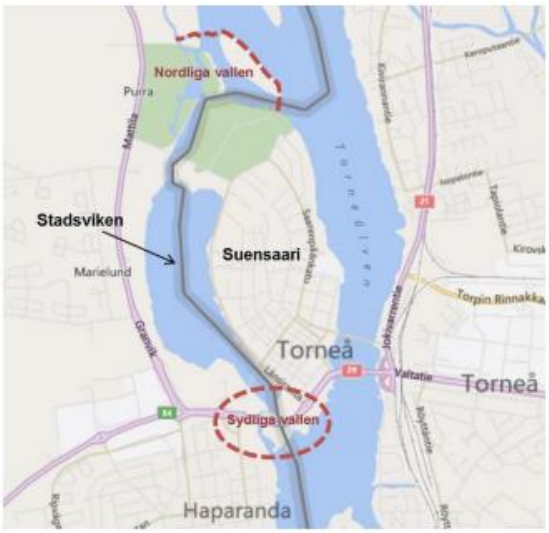

Figure 11 Haparanda and Tornio Flood Forages (Länsstyrelsen Norrbotten 2015)

Norway on the other hand is not a MS of the EU, but is bound by the EEA (European Economic Area) to implement the water management work as outlined by the EU. Additionally, the Norwegian government has allowed for its municipalities and regions to participate in the EU cooperation programs. Thus, they are bound by their own funding and have their own time plan (Vattenmyndigheten Bottenhavet 2015). According to the water authority of Bottenhavet, Sweden shares 24 lakes and 51 rivers with Norway (Vattenmyndigheten Bottenhavet 2015), however, MSB claims that most watercourses from source to the sea, lie within either one or the other country and not both (MSB 2011). Taking the risk factor into consideration, the lakes and rivers mentioned by the water authority may not be of relevance to the MSB from a flood management perspective.

3.3 Integration of climate change adaptation into flood protection policies in Sweden

This section explains how the flood risk management of the different levels of governance (national, regional, local) take climate change into consideration when adopting new legislation and guiding documents. Interviewees were also asked how adaptation is integrated in practice. It will also highlight the level of coherency between policies on the different levels of governance.

3.3.1 National level

Looking specifically at concerns for climate change in the Floods Directive, it is stated that "Based on available or readily derivable information, such as records and studies on long term

developments, in particular impacts of climate change on the occurrence of floods, a preliminary flood risk assessment shall be undertaken to provide an assessment of potential risks", and further that "The elements of flood risk management plans should be periodically reviewed and if necessary updated, taking into account the likely impacts of climate change on the occurrence of floods". The Swedish ordinance states that the preliminary flood risk assessment should take the damaging effects of future floods into consideration, if there are specific needs for it. This includes the effect of climate changes on the occurrence of floods (Sw: *Översvämningsförordningen* SFS 2009:957). This is taken account for, as MSB explains that "In choosing the range of the estimated highest flow for the analysis, it is likely that future negative consequences of climate change have to some extent been taken into consideration" (MSB 2011:8). The reasoning behind this is that the estimated highest return flow, which is approximately equivalent to a 10,000 year flood, would likely include all areas that are exposed to any kind of flood risk, now and in the future. Hench, the bar considered to be set so high that floods, taken climate change into consideration, would not significantly differ from the ones identified in this "worst case" scenario. In the review of this assessment which will be undertaken by MSB every six years (in accordance with the Floods Directive), the likely effects of climate change on flood occurrence shall be continuously considered. Also the risk management plans (to be renewed every six years) shall consider the effects of climate change on flood occurrence. As the Floods Directive was implemented only in 2009, the degree to which this will be considered in the cycles following the current first one cannot yet be determined.

Following the preliminary assessment, new hazard and risk mapping has been conducted for the 18 identified areas. MSB decided that the considered return flows used throughout the different assessments (hazard and risk) should all be adjusted to the expected situation of year 2100. This decision is key, and has often been pointed out in the interviews to show that climate change is considered, as with climate adjusted return flows the protection measures will be adopted to withstand the altered risk that is predicted for the future.

3.3.2 Regional level

In 2009, the Swedish government assigned the county boards the role as regional coordinators of climate adaptation, and in 2013 this responsibility was extended with the task to prepare regional action plans for climate adaptation (County Board Halland 2014). The overarching objective for the county boards' work with climate change adaptation is to create "a society

that is robust to climate change" (County Board Västra Götaland 2014). This plan aims to support the municipalities and other stakeholders in the county with recommendations, guidelines and documentation. This means in practice that the county boards are coordinating the work on climate adaptation in the region, but have little direct mandate to enforce the action plans and these will thus only serve as a strategy from which the municipalities and other regional or local stakeholders can choose to implement the suggestions. The plans do however remind the municipalities of their responsibilities to protect the citizens from danger to which the individual cannot protect itself, and in the light of climate change this may require renewed efforts from the municipality. As will be explained further on, some strategies from the county boards are indeed used extensively by the municipalities and help other counties in developing their strategies. It is clear that the climate adaptation plans coming from the county boards are quite different depending on the size and challenges of the county. Västra Götaland is a large county with 49 municipalities, diverse both in terms of demography as well as geography, ranging from coasts to large forests. Halland on the other hand is small, with only 6 municipalities which display rather similar geographical features. This has led to a climate adaptation plan from Västra Götaland which elaborates on the challenges primarily based on the natural boundaries rather than the administrative. It stresses that a major challenge to the county is the risks of landslides in the Göta älv valley and the flood risks around the lake Vänern. The plan from Halland on the other hand presents the risks ranked in summarising tables, showing what threat each municipality should be concerned with, as shown in figure 12. The table shows an assessment of "unwanted risks of natural disasters in municipal and regional risk and vulnerability analyses", and the level of probability to degree of consequences. The different natural disasters included are floods, heat waves, landslides and storms and the different municipalities are represented in different colours, with the risk to the whole county expressed in black.

Värdering av oönskade naturolycksrisker i kommunala och regionala risk- och sårbarhetsanalyser

Assessment of unwanted risks of natural disasters in municipal and regional risk and vulnerability analyses

Sannolikhet *Probability (ranging from very high to very low)*	Konsekvens *Consequences (ranging from very limited to disastrous)*				
	Mycket begränsade	Begränsade	Allvarliga	Mycket allvarliga	Katastrofala
Mycket hög (>1 gång per år)			Översvämning Halmstad		
Hög 1 gång per 1-10 år		Översvämning länet Värmebölja Halmstad Storm Laholm Värmebölja Laholm	Storm Halmstad		
Medel 1 gång per 10 -100 år		Storm Varberg Översvämning Varberg Översvämning Hylte	Storm Hylte Ras- och skred Halmstad Översvämning Laholm	Storm länet	
Låg 1 gång per 100-1000 år		Värmebölja Varberg Ras- och skred länet Ras- och skred Hylte Värmebölja Hylte	Ras- och skred Varberg		
Mycket låg <1 gång per 1000 år					

Swe-Eng: Översvämning - Flood, Värmebölja - Heat wave, Ras och Skred - Landslides

Figure 12 Table of risks from climate change in Halland (County Board of Halland 2014)

In 2011, the county boards in Västra Götaland and Värmland together published the guiding manual *Stigande Vatten* (Rising waters), which aims to assist the 65 municipalities in the two counties in how to consider flood risk when planning new construction of infrastructure and buildings, as well as reduce the flood risk of current constructions. The main reason behind producing this manual is the perception of climate change as being very likely to increase flood risk and rainfall. This is indicated in the title and becomes evident in the data presented in the manual, which gives an overview of current risks and how they are expected to increase with climate change in the future. Maps and diagrams show how water levels will rise and particular points of interest to which risks may increase (notably the nuclear power plant Ringhals in Varberg). The manual outlines the importance of suitable use of land, i.e. what should be constructed where and what precautions are needed, and has a strong focus on probability reduction, showing concrete examples of measures that would help alleviate the effects of increased flows. There is a plethora of innovative solutions described as inspiring examples in the guide, including infrastructure allowing absorption and infiltration, constructed flow paths and areas for water collection (ponds), retention, technical measures and flood parks, creating green and blue solutions. Many examples are given both from Sweden and abroad (Denmark, Norway, Germany, USA, etc.). The handbook also emphasises the importance of collaboration of all actors and stakeholders concerned, from regional down

to individual level. According to the climate adaptation plan of Västra Götaland, *Stigande Vatten* is used by most of the municipalities in the county to a very large extent in relation to comprehensive plans for flood prone areas.

The mandate of the county board that in practice gives them a certain influence over climate change adaptation is, as mentioned in section 3.2.3, their task to review the spatial plans of the municipality in term of urban planning. Then, on a basis of risk to human health, the county board can overrule a plan that has not sufficiently addressed the flood risks expected in the future climate. The county board in Västra Götaland did this for two plans in Gothenburg in 2014, where they considered the risks of two area developments too high. This resulted in the city having to clarify their strategy, and the plans were passed in 2015. However, as explained by the interviewee from Västra Götaland county board, they cannot repeal a spatial plan that has once been approved, even if there should be new insights or changes in the risk scenario. Thus, very old plans can allow for new construction in flood prone areas. If the county board finds out about this, they can express their opinion that a new plan should be made to design rules that guarantee a risk-free construction. Should the municipality allow construction and a flood causes damage, the municipality will be held liable as it has the legal responsibility to protect its citizens and therefore is the one taking the risk.

3.3.3 Local level

The three municipalities represented through interviews for this study showed significant differences in the integration of climate change concerns into practice. In Kungsbacka, the levee built recently (finished in 2014) for flood protection turned out to be somewhat like a pilot project to understand how climate change should be accounted for in this type of projects. It was constructed to protect already existing buildings, and in the planning there was, according to the interviewee from Kungsbacka municipality, a lot of discussions concerning how the increased risk for climate change should be accounted for. Now, the chosen solution to address the most urgent flood risk area is a 600 meter long wall, protecting the existing building. This is combined with an early warning system developed by SMHI, which is crucial as the wall has several openings (where there are pedestrian paths) that need to be blocked in time to prevent water to flow in behind the wall. The county board had concerns that the planned levee was not high enough to protect against the return flow calculated for the expected climate change in 100 years. However, as the levee itself has a technical lifetime of 50 years, the interviewee from Kungsbacka municipality points out that it

is unreasonable to protect oneself against climate change in 100 years. The compromise reached at the end of the discussion was to add an extra 20 cm to the construction that Kungsbacka had initially proposed and deemed was providing sufficient protection. Although the municipality in theory has the power to decide for themselves, the county board is as can be seen in this case, in practice very much involved as this is part of the detailed planning, and it also has to comply with these vaguely defined standards in order to receive the 60 % subsidy from MSB.

Karlstad municipality has shown quite a different attitude to integrating risks of climate change into flood management. The interviewee from Karlstad municipality has been employed as flood risk manager at the municipality since 2011, working on the implementation of the flood programme that was established the year before. The second chapter of this programme is dedicated to climate change, linking predictions from IPCC via the SOU (2007:70) from the Swedish government to the need for integrated flood risk management measures in the local area. This approach permeates the work of the interviewee, who states that she deals with "risk, vulnerability and adaptation to climate change". She also brings up the campaign *Making Cities Resilient* as influential in her work. The purpose of this United Nations International Strategy for Disaster Risk Reduction (UNISDR) project can be understood through a quote from Ban Ki-Moon (2009) speaking at the Incheon Conference 'Building an Alliance of Local Governments for Disaster Risk Reduction';

> "I call for the need of world leaders to address climate change and reduce the increasing risk of disasters – and world leaders must include mayors, townships and community leaders."

Out of the 18 identified areas with high flood risk in Sweden, five are participating in the *Making Cities Resilient* campaign. These are Gothenburg, Jönköping, Karlstad, Kristianstad and Vansbro. So far a total of 11 Swedish cities are partaking in the initiative, with Vansbro and Värnamo joining in 2015. The project aims to support cities in becoming resilient to disaster, by providing both a network and platform for collaboration as well as practical tools. Karlstad has been a progressive participant, actively framing the flood risk as a threat that will increase by climate change (UNISDR 2015b).

3.4 Motivation for integration of climate change adaptation in flood management

This section will identify various reasons for the awareness of flood risks, and the integration of climate change adaptation in the Swedish flood protection, both in policy formulation and implementation.

3.4.1 Events as triggers to improved flood management and response

Floods are one out of many different kind of natural disasters that have affected the Swedish policy on natural disaster management, and this section will therefore expand the scope to put floods in a larger context, as many of the actors deal with natual disasters in general. Their work however does to a large extent affect the flood management. Going back to 1977, there was a major land slide in Tuve, Gothenburg. This is one of the worst natural disasters in Swedish modern history, causing 9 fatalities and making 436 people homeless (MSB 2016). According to the interviewee from MSB, this was the trigger that led to the formation of Räddningsverket, which in 2009 was transformed into MSB. This new agency was then given the task to produce stability mappings, and in 1998 they were also instructed to develop flood hazard maps. Large events indeed have been shown to trigger a high level response in Sweden as well as elsewhere, which was also the case for the floods in Arvika in 2000 and southern Norrland in 2001, which led to more state funds made available for reconstruction (Näslund Landenmark 2015). In 2014 there was also a major forest fire to which the government had to contribute with €30 million (300 million SEK) to fight the fire. Additionally, the storm named 'Gudrun' in 2005 was brought up by the interviewees from Gothenburg, Västra Götaland and MSB as an eye-opening event on a larger scale. These events have shown how vulnerable the society is to the forces of nature, and therefore is often followed by a raised awareness of the risks and some preparedness for future events. This heightened focus has therefore influenced the management of natural disasters in general, which benefits flood management as well in the cases where more funds become available and the effects of climate change are brought up.

Indeed, most of the interviewees gave examples of incidents that had affected their work. In Kungsbacka, the 2006 flood was a great wake-up call, according to the interviewee from Kungsbacka municipality. This affected the local politicians, it made them more aware of the risk and therefore willing to invest in flood protection. Said interviewee has experienced a unity and a high priority from the political level, which has been positive for her work. The interviewee from the county board in Halland points out that floods in Getinge in 2014 also

affected the political awareness in Halmstad municipality where it is located. At the same time that Kungsbacka experienced their eye-opening flood, there were significant floods also in Mölndal, adjacent to Gothenburg, which interrupted infrastructure, notably the train connection from Gothenburg southwards, and around that time a heavy rainfall caused a land slide which demolished 550 meters of the highway E6 north of Gothenburg (Swedish Accident Investigation Board 2009). When addressing this event, the interviewee from Gothenburg municipality makes the connection from local to national by saying that "we need a damn accident in Stockholm [where the government is located] for something to happen", and refers to the rains in Copenhagen 2011 which caused great economical damage but also triggered a response that extended to a government program entitled 'A Denmark that stands united' by which all municipalities need to produce a climate adaptation plan within two years (Beredsskabsstyrelsen 2012).

The awareness and of the flood risks that the cities are vulnerable to willingness to proactively work to build resilience against them can also be attributed to a longer history of a constant hazard. Karlstad is located in a delta which always have had certain issues with floods, and Gothenburg has both the large river Göta Älv coming from the lake Vänern, and the sea. Given also the high economical costs a flood would cause in a relatively large city like Gothenburg, it would be naïve to stay oblivious to the risks. Kungsbacka on the other hand has no floods recorded in the MSB report from 2012, covering significant floods in Sweden from 1901-2010, except the one in 2006. There is no expert on floods, nor a climate change expert, employed by the municipality, but they are relying on consultants for projects of this kind. This has consequences in the way flood protection is framed, as the interviewee from Kungsbacka Municipality also points out that a low-lying area slightly upstream of the constructed wall that was flooded in 2006 now is being considered for exploitation. The way this risk will be addressed is then to already from the start plan to build a flood protection wall, and integrate this in the detailed development plans.

3.4.2 Framing climate change as a motivation to improve flood management

Both the municipalities in Gothenburg and Karlstad have been working on climate change and adaptation for a relatively long time, Gothenburg since 1999 and Karlstad since 2007. The interviewee from Karlstad municipality points out that the position she currently holds was created then in response to the government's investigation *Sweden Facing Climate Change – Threats and Opportunities* (SOU 2007:60). Regarding the work in Gothenburg, the

interviewee from there refers to a climate report from IPCC which sparked action in the early 2000s. It was picked up on in relation to work on the national environmental objectives, and the discovery of the predicted sea level rise in the report made Gothenburg municipality change its minimum height level for floor level and openings in the construction of new buildings, adding a margin of safety. The interviewee explains how this started a chain reaction, with the municipality investing in investigations on climate change effects and even their own hydrologic and hydraulic model for simulation of water flows in the city.

When directly asked about how they are influenced by science, the interviewees' answers vary. The interviewee from Karlstad municipality says that she absolutely has to consider scientific studies about climate change in her work to understand what it is they need to add height to in practice, and also to understand the consequences that we will have to face regarding other aspects of climate change, such as increased frequency of and more intense heat waves. She also adds that this information is generally not easily accessed, as they do not have access to research networks and databases, and in many cases one has to be lucky to get hold of good research and reports through the personal network, and that this certainly could be improved. Noteworthy is that the interviewee from Karlstad municipality before her current position was working as a high school science teacher[5], and it is therefore likely that she has an understanding of scientific research that is more developed than that of the average municipal employee. The interviewee from Västra Götaland county board presents a slightly contrasting point, stating that "pure research is not something that falls within our responsibility or area of competence" because the result has to be useable. "99 % of us administrators, we don't have use of a new paper. I can read a paper […] but it cannot be applied". There is however a tendency by policy-makers at all levels to refer to some scientific proof as a starting point to justify action. The IPCC is therefore commonly referenced in reports and investigations by Swedish actors upon which the interviewees rely on for more particular guidance, SOU (2007:60) and *Stigande Vatten* being relevant examples. On a national level, the SMHI is virtually the only source of information on climate that actors and other stakeholders rely on.

In the county board in Halland, the interviewee in her role as contingencies administrator has been working closely with the climate adaptation coordinator, with the benefit of being able to raise the issue using both perspectives and creating synergies between the approaches. This

[5] Swedish 'gymnasium', student ages 15-18

according to the interviewee is useful as climate adaptation can be framed as positive, whereas contingency work has a stronger connotation to threats. This may be a particular argument for Halland, where climate change will have positive effects on agriculture and possibly with a temperature increase extend the regionally more lucrative summer season. On the national level, the interviewee from MSB explain that the importance of flood management has been enhanced as it has been framed as "integrated with protection of essential public services, critical infrastructure and climate and vulnerability analyses", and integrated in "the action plans that should be worked on according to the law on protection against accidents and emergency preparedness" (Näslund Landenmark 2015).

3.4.3 Policy entrepreneurs

Another relevant aspect to consider is the importance of highly involved and passionate individuals, what in Swedish is termed 'eldsjälar' and literally translates to 'firesouls'. It is easy to get the impression that some people in Sweden have dedicated themselves fully to this issue, and are willing to go the extra mile to find more information and have more impact in their context. Both the interviewees from Karlstad municipality and Gothenburg municipality show through their actions that their individual engagement is a significant driving force that keep them searching for more opportunities to improve the quality of their policy implementation and take initiatives to think outside the box. The interviewee from Gothenburg explains that sometimes he would take a shortcut in official procedures of bureaucracy and take matters directly to the city council to speed up the process on issues that he perceive as urgent. Both he and the interviewee from Karlstad express that their municipalities have exerted certain pressure upwards on the national government, to which there are some results - the revised Planning and Building Act being one example, according to the interviewee from Karlstad, although the extent of their influence could not be verified for this thesis.

Both of the interviewees also show a strong commitment to international collaborative efforts, such as the voluntary program *Making Cities Resilient*, and other informal networks. Furthermore, the interviewee from Gothenburg initiated an exchange with the city of New Orleans to bring back the lessons learned from hurricane Katrina to Sweden. He also shows great knowledge about the field of natural disasters, floods and climate adaptation in general, saying that he uses "the [inter]net and the network" to stay updated. The interviewee from Karlstad municipality shows a comparable dedication, mentioning that she is one of the

appointed experts of the United Nations International Strategy for Disaster Risk Reduction (UNISDR) Urban Planning Advisory Group, as well as currently working on a bilateral level with Northern Ireland to help them join the *Making Cities Resilient*, which she on behalf of Karlstad municipality is an active member of. The interviewee from MSB is no less present internationally, being the Swedish representative in the EU working group on the Floods Directive, and she was also in the Swedish delegation to the negotiations on the Hyogo Framework and is active in peer reviewing emergency management systems for other EU member states and for the UNISDR Sendai Framework.

3.5 Concluding remarks on the implementation of the EU Floods Directive

The interviewee from MSB who was present at the negotiations for the outlining of the EU Floods Directive explains that Sweden argued for a directive that would only cover the international water bodies, but in the end this was not the final outcome. The reason for this was that most water bodies in Sweden are fully within the national territory, and there is a lot of water in Sweden compared to other countries. Furthermore, Sweden does not have the huge problematic that has been experienced in other European countries, as described in section 2.1.3. Perhaps the most obvious challenge in the implementation of the Floods Directive is, as already described, that the transfer into Swedish legislation came as an ordinance rather than a law, which in practice means that it is only binding for the national and regional authorities, but not to the municipalities that hold key responsibilities in flood risk management (see section 3.2.3). When asked about the Floods Directive, the interviewee from Karlstad municipality responded that it is only steering the national government's work in Sweden. The effects that it has had on her work as flood coordinator is limited to information and some degree of enhanced legitimacy, as pointing out Karlstad as one of the 18 flood risk areas in Sweden shows that there indeed is a need to address this issue. Yet she expressed that they are slightly out of phase with the implementation of the Floods Directive, as for example hazard and risk mapping already had been done independently by Karlstad a long time ago.

Reflecting upon it, the interviewee from MSB expresses that there is actually not a significant difference in how the flood risk management is performed in Sweden now compared to before the Floods Directive. The interviewee from the county board in Västra Götaland is of the same opinion, pointing out that the two areas in Västra Götaland that appeared among the 18 risk areas already had a fairly clear work ongoing regarding this. The interviewee from the county board in Halland highlights that the first 6 year cycle of the Floods Directive will be an

experimental phase, and that complying will probably be easier in the second cycle. Both the interviewees from Karlstad municipalitiy and from the county board in Västra Götaland express that it serves the purpose of knowledge building, especially in the initial phase. The interviewee from Västra Götaland also draws a parallel to the Water Framework Directive, which now is in its second cycle and costs are starting to appear as measures become stricter. Therefore, he believes that the influence of the Floods Directive can also increase over time.

4. Discussion

As it has become apparent over the last decade that climate change is irreversible and that Sweden will be effected, it has slowly started to grow as an important area of concern, again highlighting the document *Sweden Facing Climate Change – Threats and Opportunities* (SOU 2007:60) as a key milestone in the process. Mitigation was the primary climate-related effort that Sweden was engaging in since the emergence of the climate change discourse, and adaptation was then primarily seen as a target for bilateral aid. Change is however ongoing, emphasising the need for adaptation within the national borders, but has so far not followed a very clear structure, as shall be explained in this chapter. The flood management has also gained an increasing interest and over the last decades, and efforts have been stepped up. It is however not a uniform approach, and the reasons for this diversity as well as its outcomes in practice will be elaborated on in the following sections.

4.1 The Climate change adaptation of flood management at the different levels of governance

The following subsections will elaborate on the current state of climate change adaptation within flood management at the different levels of governance in Sweden, comparing the actor's similarities and differences in order to critically assess the policy effectiveness.

4.1.1 Climate change adaptation of flood protection at the national level

The legislation and national strategies regarding climate adaptation in Sweden is very limited, which is naturally leading to a low and unambitious integration of climate adaptation of flood management at this level. Amundsen et al (2010) highlights the weakness of this, being that if the national authorities do not provide clear political guidance through adaptation policies, the implementation will be impeded at the local level. It is important to recognise that particularly for adaptation policies, the purpose of national level policy is to support the local level where the implementation is performed, as the interviewee from MSB pointed out (see chapter

3.3.3). In the Swedish legislation on flood risk management, climate change adaptation is just briefly mentioned in the ordinance on flood risks (Sw. *Översvämningsförordningen* SFS 2009:956). Comparing it to the EU Floods Directive, it can be concluded that the Swedish legislation is following the Floods Directive, word by word, but does not go beyond it in terms of climate change adaptation. It is therefore noteworthy that MSB has decided that the detailed maps for the flood hazard in the areas as well as the detailed maps of the flood risks in the hazard zones (Step 2a and 2b in figure 8) should be performed with return flows adjusted to the climate change expected in year 2100. In doing so, MSB takes a measure that may seem obvious to include climate change concerns into flood risk assessments, but that is not mandated by the legislation at this particular stage. However, it does improve the policy coherence to always use the same return flows, which in this way becomes a rule of thumb. The inconsistencies of the ordinance are somewhat peculiar, as ideally the consideration of climate change should be permeating the work on all levels, and thus also include the flood hazard maps and flood risk maps (step 2a and 2b in figure 8). Fortunately the implementation by MSB covers up for this flaw, and effectively help bridging the gap between the national legislation and local implementation.

In a study by Wejs et al (2014) where climate adaptation in Norway and Denmark is analysed, they explain that:

> "…if [the national] government is clear about what it expects and demands from local government, local practice can be viewed as the implementation of national policy. If government has unclear expectations, as is often the case in climate-change adaptation, the scope for local variation is wider. Local factors, such as values and interpretations, become more important as explanatory factors." (Wejs et al 2014:494)

The governance structures in Norway and Denmark can be considered similar enough to the Swedish structure for this point to be held valid also for this case. The hesitancy by the Swedish government to express clearly what it expects and demands from both regional and local level actors in terms of climate adaptation has resulted in a diverse response, as the following sections will elaborate on.

4.1.2 Climate change adaptation on the regional level

On a regional level, the climate adaptation plans developed by the county boards are the most influential guidance provided. As described in section 3.3.2, they vary significantly in style,

as each county board is addressing a different problematic and a varying number of municipalities. The climate adaptation plan of Halland, with its neat tables, facilitates the use and application for each municipality as they see which threats they should take into consideration. However, this separation of threats and municipalities does not stimulate cross-border collaboration and could in theory make the municipalities rely on the assessment of the county board, not investing in developing a local expertise. In doing so, the municipalities are not building the resilience to stay one step ahead of the local challenges that could arise unexpectedly, but remain dependant on the county board for guidance. In comparison, the plan of Västra Götaland in targeting such a diverse county has produced a more generic plan. Hence, it has the benefit of being more comprehensive, and addressing challenges primarily based on the natural boundaries rather than the administrative. For example, it has one chapter dedicated to the risks of landslides in the Göta älv valley and the flood risks around the lake Vänern. The river Göta älv runs through six municipalities, and Vänern is surrounded by 13 municipalities, of which 8 are located in Västra Götaland. Being so general it requires that each municipality is confident in comprehending their own problematic and see what is relevant to them. Yet, if properly interpreted at the local level the plan has the capacity to lead to a more profound understanding of the more complex challenges in the region and thus foster collaboration across the municipal borders. It is still important that the municipalities possess the local expertise to see where the plan would be applicable, especially in those cases where there is an upstream-downstream problematic, which is pointed out in the plan (county board of Västra Götaland 2014:20).

The climate adaptation plans developed by the county boards in Halland and Västra Götaland both place a strong emphasis on the link to flood protection. The plan for Västra Götaland states that “to find solutions to managing the risks of flood and landslides in Vänern – Göta älv is one of the most important climate adaptation issues in the county of Västra Götaland” (county board of Västra Götaland 2014:27). This is significant in terms of framing, and holds the opportunity to renew the focus on these challenges as the efforts to address adaptation are growing. By approaching floods from a revitalised narrative as an increasing threat due to climate change, one could even see the potential to access financial support from other sources in the future. This could happen if the government allocates more money to climate adaptation, which does not seem unlikely given the increasing focus on this topic. There are also other EU funds available for climate adaptation measures, notably the LIFE and Horizon 2020 funds.

Also bridging flood protection and climate change on the regional level is the guiding document *Stigande vatten*, introduced and described in section 3.3.2. This document indicates a dedication by the county boards of Västra Götaland and Värmland to the role as regional coordinators, as well as an understanding of the challenges that lay ahead. However, the effectiveness of this manual of course lie in the implementation, where the county boards may be very creative yet not have the last word as to what can be done. According to the climate adaptation plan, *Stigande Vatten* is used by most of the municipalities in the county to a very large extent in relation to spatial plans for flood prone areas. This shows a horizontal coherency where the already existing plan is used to establish synergies with the newer one. This will also facilitate the communication with the municipalities, as they can rely on the existing material and not constantly have to relate and adapt to new plans that take a different approach to the same issue.

4.1.3 The local level – diverging approaches in implementing flood protection and climate adaptation

At the local level in Sweden, one can distinguish different approaches to climate change adaptation of flood protection measures. Gustavsson et al (2009:71) found that "The extensive local self-government in Sweden has a strong potential for discretionary action and is a fertile breeding ground for developing climate policies, as well as other policies, based on local resources." As there has been no uniform, top-down guidance, the resources and challenges in each municipality has led to a diversity in flood management as well as spatial planning and construction of protection measures. Revisiting the strategies that were presented by Building Futures & ICE (2009:10) and introduced in section 2.2.1, these showcase how the approaches of the municipalities can be understood. Again, the strategies are: i) Retreat – to step back from the problem and avoid a potentially catastrophic blow, ii) Defend – to ensure that water does not enter the existing built environment, and iii) Attack – to advance and step forward by building out onto the water.

The interviewee from Gothenburg municipality is advocating for the 'attack' approach, which if executed effectively could be a successful way to provide more housing in Gothenburg in a climate-smart way. Kungsbacka evidently preferred the more traditional 'defend' approach for their flood protection measure, whereas the interviewee from Karlstad municipality believes that "technical solutions can always fail … they are expensive, they are complex, and they bring people into a so called false sense of security, that 'now we can build as much as

we want inside here because we have made a flood protection construction'". This illustrates how the flood management of Karlstad municipality is leaning towards a 'retreat' approach.

The explanation for the municipalities' choice can be found in other political priorities and policies, e.g. on urban planning and buildings. In Gothenburg, the key challenge mentioned in section 3.3.3 is the high demand for housing. Therefore, the municipality has to balance the intensely requested and highly lucrative expansion of the attractive area next to the mouth of the Göta älv river, with the threat from rising water levels. Given that Gothenburg municipality has been on the forefront of climate related efforts in Sweden, it is clear that there is a will to take climate change into account, but that the desire to invest challenges the notion of exactly how this should be done. In this case, as the housing market is highly profitable in Sweden, there is room for investment in preventative measures. This could be an exciting and pioneering opportunity to take housing to the next level, if the integration of flood protection measures is well developed.

In Kungsbacka, the flood protection levee was a way to address the flood risk in a way that was in line with the political aspiration to make the river and riverbanks a more attractive recreational area for the citizens, and climate change was as earlier explained (see section 3.3.3) addressed only by raising the height of the levee as a result of discussions with the county board. The integration can therefore not be seen as fully permeating the work flow, and the potential to create multiple benefits was somehow overseen. For example, highlighting flood protection as a need for climate change adaptation could have been used to engage and educate citizens of the topic, if communicated in a strategic manner. Another kind of flood protection, such as a constructed wetland upstream of the endangered area, could have addressed the political vision of creating a recreational area for the citizens in a different way, while creating a habitat for improved biodiversity of species thriving in wetlands. These possibilities could perhaps have been more thoroughly examined if there had been a stronger correlation between the unit working with the environment and health, particularly the nature management section, and the one which was responsible for the flood protection; the unit for technical matters. This shows again and on another level how flood protection in Sweden is not considered an environmental issue, as pointed out in section 2.2.2.

In the case of Karlstad, the reason they do not advocate for the 'attack' principle can be attributed to the fact that they do not have the same need to expand in the centre as Gothenburg, nor would not be financially viable. And as the city is located on a delta, building walls to protect all of the vulnerable spots is not a feasible option either. The

approach that the flood manager described in the interview is instead underpinned by the strive to make the city resilient through an integrated flood risk management, corresponding to 'the new approach' as described in section 2.2.2. The measures involved are thus not as defensive, but focused on creating space for infiltration through green surfaces and avoiding particular weaknesses such as increasing the heights on low bridges etc.

Linking back to the previous section, one can see how the preference of strategy also influences how the municipalities relate to guiding documents from regional and national level. The interviewee from Gothenburg Municipality perceives the measures that are recommended by the county board in *Stigande Vatten* as way too high, although the interviewee from Karlstad municipality point out that it is good that they are strict precisely because "there should be high demands since otherwise it can be very easy for cities to build close to the water, one does not consider [the risks] because the developer is not keen on it". So although there often is an underlying understanding of the implications of climate change, other interests also influence the decision making and then it is crucial to have a control system that can thoroughly assess whether the development plans are sustainable or not, as the county board of Västra Götaland did in the specific case mentioned in section 3.3.2.

4.1.4 Remarks across the levels

The way climate adaptation is structured in Sweden at the moment gives the actors on all levels quite a significant amount of freedom to find efficient ways of addressing the issue of climate adaptation where they find it to be relevant. However, this also provides leeway to postpone or avoid the question, which could happen should it be perceived as too costly, complicated or irrelevant by those who hold the mandate to frame the work. With no enforcing jurisdiction, it is therefore possible for actors to not make any efforts in this direction, or include it in such a vague manner or only in theory, so that it has no effect in practice. It is however still perceived as more desirable to mainstream and strive for a genuine understanding and awareness, than to impose measures through national strategies and laws. The interviewee from MSB emphasises that given the preconditions with the way the legislation is formulated, MSB are trying to create a holistic view where municipalities integrate flood risk management in the law on municipalities and regional council's actions in preparation for and during extraordinary events in peacetime and heightened preparedness (Sw: *Lagen om kommuner och landstings åtgärder inför och vid extraordinära händelser i fredstid och höjd beredskap* SFS 2006:544), and the law on protection against accidents (Sw: *Lagen om skydd mot olyckor* SFS 2003:778). She says that a flood reporting of the kind that

EU requests actually shouldn't be necessary, since these laws cover the topic anyway. And since the Swedish ordinance on flood risks does not have any mandate over the activities of the municipalities, she sees that fostering a holistic understanding of the challenge is the most effective way for MSB to influence the flood management at the local level.

The fact that flood protection is included in these laws resonates with the principle of responsibility which is, together with the principle of subsidiarity as discussed in section 2.2.2, fundamental to Swedish disaster management (MSB 2014c). It states that the one responsible for an operation or activity during normal circumstances, also has a responsibility to ensure that it is functioning during a crisis. Under this responsibility also falls to coordinate with others, ensuring that the aggregated resources of the society can be taken advantage of and be effectively used. Although climate adaptation is not necessarily a crisis response, the key part lies in the fact that the responsibility remains with the same actor. This should be the motivation, be it stick or carrot, to ensure that if there is a flood, the one responsible has ensured that sufficient preparation has been made to avoid damage. Otherwise, that actor will be held liable. As a consequence of these laws, the local actors cannot afford to wait for directives from a national or EU level, as if something happens before that, they are to blame. Bulkeley and Betsill (2013:145) find that "…the increasing complexity and fragmentation of climate governance suggests that there is a growing need to engage more critically with where the authority and capability for addressing climate change as an urban problem lie." Hence, one can see the need to engage both the actors with local responsibility to provide protection as well as the Swedish state authorities with specific responsibilities that somehow overlap with flood management.

4.2 Key motivating factors to flood management and climate adaptation

"There's nothing like a jolly good disaster to get people to start doing something" (Sky News 2014), Prince Charles of Wales said when visiting the flooded areas of Somerset, UK, in early 2014. And indeed, the royalty seem to have hit his head on the nail when it comes to flood management, as more scientifically accredited sources agree that "…before change can be initiated, a signal needs to be recognized as evidence of a novel situation, in response to which existing routines are inappropriate or ineffective" (Wejs et al 2014:495). There is a strong correlation between damaging events and subsequent protection measures being implemented, which is apparent from the events and responses described in section 3.4.1 and should come as no surprise as the event clearly shows exactly where the vulnerabilities lie. It

can of course be argued, as Prince Charles did, that "The tragedy is that nothing happened for so long", however it is not always foreseeable what can happen, especially for a small municipality with scarce resources both in terms of economy and expertise. The interviewee from Gothenburg municipality actually quoted Prince Charles in the interview, linking it to his comment about the 'need' for an accident in Stockholm to happen. As previously mentioned, Stockholm is one of the areas identified as vulnerable to floods in the national flood risk mapping conducted by MSB. The events and responses outlined in section 3.4.1 indicate that the degree of indirect response (long term changes) to the event is related to the size of the event, with local events affecting local politicians and larger events effecting also the national level. However, it is yet to be seen how important the locality of an event is in terms of affecting the national government, if the Swedish government would be as reactive as the Danish government proved to be to the floods in Copenhagen in 2011 (Beredsskabsstyrelsen 2012) or if a local event in Stockholm would have an impact limited to the affected municipalities.

The attention paid to flood risks can also be attributed to a longer history of a constant hazard, as Karlstad is located in a delta which always have had certain issues with floods, and Gothenburg has both the large river Göta Älv coming from the lake Vänern, and the sea to consider. Given also the high economical costs a flood would cause in a relatively large city like Gothenburg, it would be naïve to stay oblivious to the risks. Kungsbacka on the other hand has not experienced this history of threats, except the one flood in 2006. As stated, the municipality has no expert on floods or climate change, which has the consequence that the understanding of the bigger picture is perhaps not as thorough as it could have benefitted from. The choice to build a wall signals a traditional approach to flood risk management, and perhaps the situation in Kungsbacka would have found a better solution, as discussed in section 4.1.3.

As highlighted in section 3.4.3, particularly engaged individuals have shown to have a significant impact on the flood risk management, particularly on the local level. This is not an unusual case, but have been noted also in other Scandinavian studies. Analysing the situation in Norway and Denmark showed "the importance of individuals as institutional entrepreneurs in explaining why two municipalities became front runners, taking proactive and independent measures to promote climate-change adaptation." (Wejs et al 2014:504). An important part of this, as expressed by the interviewees in Gothenburg and Karlstad, is the drive to stay well informed and well connected. Both of them showed a strong commitment to staying up to

date, and maintaining a curiosity of integrated flood risk management as well as state of the art protection solutions. However, in a large municipality like Gothenburg, it is easier to dream big – funding is less of an issue, as there are both more money available in the municipality and from eager investors (particularly for housing, as noted earlier). Yet, perhaps the most valuable resource in Karlstad actually is the person who is committed to integrating flood management across all municipal planning. In accordance with this, another study of climate adaptation in Swedish municipalities found that "…not only political elites but also committed individuals play a significant role in initiating and promoting environmental and climate issues. Thus, individual initiatives and personal enthusiasm have proven to be of importance in both [of the municipalities studies] over the years, both at an early stage of policy formation and in networking with other cities." (Gustavsson et al 2013:71)

Another factor that motivates key individuals with influence over flood management to stay on the forefront of climate adaptation is the opportunity to be present in the international forum for these issues. Taking part in these networks outside of Sweden, such as *Making Cities Resilient* (described in section 3.3.3), appears very stimulating to both the interviewees from Gothenburg and Karlstad municipality, and the interviewee from MSB expresses a similar motivation from her international commitments. The interviewee from MSB is the Swedish representative in the EU working group on the Floods Directive, and was also in the Swedish delegation to the negotiations on the Hyogo Framework and is currently active in peer reviewing emergency management systems for other EU member states and for the UNISDR Sendai Framework. In the aforementioned study of Swedish municipalities, Gustavsson el at (2013) found that "Networks undoubtedly represent important organizations trying to override territorial borders, bridging between different levels and scales of operation. Also, networks have the potential to function as vital channels for the dissemination of information, best practice, and knowledge, and thereby speed up the process of capacity building, not least at the local level" (Gustavsson et al 2013:71). This explains the function of both the international networks that these interviewees partake in, but also the multitude of networks within Sweden as described in section 3.2.1 and 3.2.1 (visual overview presented in figure 10). Particularly beneficial are the dissemination of information and knowledge sharing, as will be elaborated in the next section. This constellation of networks is hence important in providing support to the actors even if they do not have any official responsibilities.

In the light of the networks, it is noteworthy to see what perception this creates among the actors and elsewhere. The interviewee from MSB believes that Sweden has a reputation of being good at collaborating, and that Sweden is used as a good example. The interviewee from Karlstad municipality also points out that the efforts made regarding flood management have given Karlstad a good reputation both nationally and internationally, acknowledging Karlstad as a responsible municipality. In accordance with this perception, Gustavsson et al (2009:63) argue that "cooperation also opens a possibility to put the city's name on the global map, in order to stand out as a pioneer city welcoming innovative ideas". Hence, climate adaptation and flood risk management can be a rewarding investment that gives positive feedback through good publicity, creating further incitements to the municipal as well as higher level political leaders to keep it a priority.

4.3 Demotivating factors?

Amundsen et al (2010) in their study of Norwegian municipalities find that "with a changing climate reactive adaptation processes may be unreliable because floods and other extreme events may change dramatically in the future, as a consequence of climate change" (Amundsen et al 2010:286). The authors argue that since the adaptation is "based on historical events [it] thus do not incorporate new knowledge on climate change", which diverges from the results from this study. The interviewees here were all aware of the possibility of increased flood risk due to climate change, and the triggering event was instead perceived as an instigation to ensure safety for when the next event occurs and the dimensions expected in the future climate, and prepare for that rather than assuming status quo. This can be attributed to the strong networks, and the information and knowledge sharing taking place within them, as the interviewees from Karlstad and Gothenburg municipalities both point out that this is any important information channel to them.

Amundsen et al (2010) identified four key barriers to adaptation at the municipal level: "unfamiliarity with existing data on climate change; lack of concrete data; lack of local expertise for dealing with effects of climate change, and an unclear role for local governments when working with adaptation policies and measures." The first point could not be found in the data collected in this study. All of the interviewees seemed confident in the data presented by SMHI, and trusted its validity as it also resonates with internationally recognised scientific reports as produced by the IPCC. Lack of concrete data was perceived as a challenge particularly to the interviewee from Kungsbacka, who expressed that they did not know what to protect themselves against. This is however not the case for all the others, and one could

therefore speculate that it has to do with the lack of expertise and/or interest for this issue. However, successful climate change adaptation should ideally not be dependent on those policy entrepreneurs, and for small municipalities with limited problems, a way to overcome this should be developed to improve the outcome and not discourage small municipalities from engaging in climate adaptation. This ties in to the third of the identified barrier, the lack of local expertise. The study showed that the degree of expertise is varying, however – one should bear in mind that there is an "increasing significance of climate change in the urban politics of sustainability" (Bulkeley & Betsill 2013:136), and recognise that this is in progress. The lack of expertise can be addressed very rapidly, and that can also be the reason for the diverging results from this thesis and the study by Amundsen et al (2010) from six years ago. However, the fourth identified barrier is indeed also a hindrance in the municipalities covered by this study, as has been discussed in section 4.1.

Lastly, Amundsen et al (2010:277) also point out that "budgetary constraints have been put forward as important considerations in the implementation of adaptive measures". This is a very important consideration, yet was not brought up as an issue by any of the interviewees. The added height to climate adapt the flood levee in Kungsbacka for example did not have a significant impact on the budget (Ljungkull 2015), and in Gothenburg spending 5 million SEK (€500 000) on a hydrological model was not a problem (Moback 2015). This can be attributed to many factors, for example that Kungsbacka is a particularly wealthy municipality, and can certainly be different in other Swedish municipalities. However, this is also something that can be alleviated through national or even European funds, as pointed out in section 3.2.1 – the Swedish governmental fund, and section 3.3.3 – EU funds.

4.4 Missing pieces: Support from the governmental level and specific guidelines

"Sweden is a developing country when it comes to climate change adaptation", the interviewee from Gothenburg Municipality said, and added that there is a need for national guidelines to get on track. Not everyone expresses this high level of dissatisfaction, but it is a recurring point brought up in the interviews, that the division of responsibility for climate adaptation and flood management is not optimal in Sweden.

Many actors, ranging from the national to the local level, have requested more support and guidance from the governmental level. This can be seen in documents such as the SMHI's *Underlag till Kontrollstation 2015 för anpassning till ett förändrat klimat* (Andersson et al 2015), and the interviews also confirmed this request, as outlined in section 3.2.1. The

interviewee from MSB said that perhaps a national climate adaptation strategy would be useful, that could be translated into plans on the regional and local level. The interviewee from Karlstad municipality point out that having one coordinating agency on a national level would be an improvement, and that MSB would be suited for that role. She highlights that the implementation of climate adaptation today has been delegated to the municipalities but that regulations or guidelines coming from the national level would show that the government is engaged and that these are important areas to work with, and would give municipalities the structural support they need. The interviewee from Västra Götaland county board along the same lines also wishes that there would be clearer guidance from above, and that there would be political decisions that the county boards could rely on as an argument in their assessments and decision making process, to create a coherence based on that.

In terms of specifically what guidance is needed, both the interviewee from the county board of Västra Götaland and the interviewee from Kungsbacka municipality bring up the question of how high flood protection should be built as a challenge, and that it would facilitate their work if a standard was set to e.g. 100 or 200 year return flow for construction of new buildings and flood protection measures. According to the interviewee from Gothenburg municipality, the Danish Hydrological Institute has provided planning levels for construction, but as previously explained, SMHI does not have that mandate in Sweden. Instead, this should fall under the responsibility of the National Board of housing, building and planning (Boverket). The interviewee from the county board of Västra Götaland explains on behalf of the county board that "regarding spatial planning in particular, we are a little fragmented. Boverket should be the one providing us with a basis and new ideas but they are not particularly active. There were a number of good reports published a few years ago […] but lately not much has happened. They simply don't have assignments nor means to work with, which is lamentable". This would be an effective and relatively easy point to address which would significantly facilitate the work ongoing on the regional and local level. The fact that it has not yet happened shows the weakness of the Swedish flood management policy where responsibilities are dispersed over many actors and the does not reach the right actor or person, and that the actor has been provided (by the government or directly superior authority) with the means to respond effectively to the need. The interviewee from MSB points out that the corresponding work is centralised to one authority in Norway (DSB, Norwegian Directorate for Civil Protection), which according to her is good at providing guidelines,

whereas the work and associated responsibility is dispersed over several authorities in Sweden.

Evidently, completely centralising the climate adaptation does not resonate well with the Swedish governance structure, and it is therefore unlikely that there can be very specific national targets regarding the climate adaptation of flood management. The exception would be the aforementioned standardised, climate change adjusted return flow to account for in the different situations (e.g. 100 or 200 year for flood protection measures) and perhaps established heights for the construction of flood protection and standardised floor levels in new buildings. It is hence likely and also desirable that the national adaptation plan will be designed to be translated into more specific regional programmes and plans by the county board, as the interviewee from MSB suggests. The county boards would thus maintain a significant portion of the responsibility for climate adaptation that they currently hold, yet coordinate through MSB and could therefore work better across counties and exchange experiences in a more strategic way. Furthermore, funding from the governmental budget would encourage the municipalities to implement the programmes and plans on a local level. In this way the adaptation can be disseminated on all levels without a top-down micro-management, which would be unfit for the varying challenges that the counties are facing.

Adger et al (2005:79) found that "a broad distinction can be drawn between action that often involves creating policies or regulations to build adaptive capacity and action that implements operational adaptation decisions. The latter will often be constrained and influenced by a higher-level adaptation framework as well as the institutions that define all aspects of activity in that society". In this case, the action taken by the EU and the Swedish government falls in the first category, as the output was the creation of the Floods Directive and the Swedish ordinance on flood risks (Sw. *Översvämningsförordningen* SFS 2009:956), whereas the second category only is truly applicable to the municipalities. One could argue that the county board also implements adaptation decisions as they perform the flood risk mapping and create the flood risk management plans for the municipalities, but this cannot qualify as 'operational'. It can therefore be described as a system where there is a regional, intermediate translation of policy and regulation from the national to the local level, yet, as has been pointed out, the legislation is not following through all the way to the end actor carrying out the operational part. It proves the second point of Adger et al (2005:79) not to be solid for this case, as the operational actors did not perceive themselves as influenced by the higher level

adaptation framework (Sjödin 2015, Ljungkull 2015), and the constraint it poses on them is very low.

To conclude this argument, one can see that a national climate adaptation policy would be an improvement to the current governance structure. This is supported by previous research, as Wejs et al (2014) in their study of Norwegian and Danish municipalities' ability to implement climate adaptation came to the conclusion that it would be beneficial to "strengthen[..] the institutional frames and supportive policies of climate-change adaptation in order to galvanise and mainstream collective awareness and preparedness for present and future challenges facing local-level planners." (Wejs et al 2014:506). In Sweden, this input should come from the ministry of the environment and energy, which has announced that it is in the pipeline (Regeringskansliet 2016). How this will turn out is still too early to say, but it would be desirable to see MSB in a coordinating role for the implementation, so that they could use the already existing platforms, networks and information channels to ensure that there are no loop holes or that nothing falls between the stools. By ensuring maximised awareness of the problematic, the response in terms of guidance or even legislation should become faster and perhaps also more appropriate to the specific situations where it is a concern. Also, MSB would in this developed role have the mandate to request other authorities to comply with the policy where they see that there is a need for more action, as the example of Boverket would require.

4.5 Challenges of implementing the EU Floods Directive

Applying a set framework as the EU Floods Directive, which was designed to fit the then 25 MS of the EU, can be challenging to fit with the existing flood management and governance structure in all of the countries. In Sweden, the main complication lie in the implementation of a top-down directive in a bottom-up system, as outlined in section 3.5.1. This is a situation that extends beyond the Floods Directive – choosing to be a MS of the EU, one cannot pick the plums out of the pudding but has to consistently comply with what has been democratically agreed upon.

Some of the actors, in particular the interviewees from Karlstad municipality and Halland county board express that there are difficulties synchronising the ongoing work and existing plans with the implementation cycle of the Floods Directive. The interviewee from Karlstad municipality explains that the flood programme in Karlstad already was well on its way and that the mappings that the new directive requests were already developed, so it would not be

of any use to the municipality. From the perspective of the interviewee from Halland county board, it then becomes difficult to create a flood risk management plan for a municipality like Kungsbacka that already has the operational activities (in terms of flood protection planning and construction) ongoing. This can be seen as cues to that the existing system was functioning and covering the aspects identified as relevant by EU standards, which is positive, yet it can be questioned if the Floods Directive has not imposed an unnecessary administrative burden on the concerned authorities. The interviewee from MSB argues that this is not the case, but rather that the directive gives a direction to the work and helps clarify priorities. It shall also be noted, as the interviewee from the county board in Västra Götaland pointed out, that the first cycle can be seen more as testing the ground and preparing for the real changes that can be intensified in the following cycles, as is happening with the Water Framework Directive. Positive effects in practice are thus likely to increase over time.

Another noteworthy complication is apparent in the division of tasks and responsibilities that was imposed on the actors with the implementation of the Floods Directive. Naturally, the preliminary risk assessment was a task assigned to MSB, as they were already in charge of country-wide flood risk mapping. However, in the following phase of implementation, a somewhat surprising element appears at step 2b, the risk zone mapping. Here it is not the county board in which the hazard is present that should perform the risk zone mapping, but the county board which is the appointed responsible for the water district in which the area is located, i.e. the water authorities. This has the benefit of centralising the work effort to a few desks, which should lead to a more coherent reporting than if each county board concerned would do the mapping. It also makes sense to group them to create synergies between the Water Framework Directive and the Floods Directive, which was a heavy argument for this constellation even though it makes little sense from a practical point of view. However, this has some complications: according to the interviewee from MSB, the water authorities have no mandate to make decisions in risk issues, but only regarding water quality, as stipulated by the Swedish Environmental code. This is also where their expertise lie, which brings back the impact of the distinction between flood management as a matter of civil defence and water as an environmental matter. According to the interviewee from MSB, some county boards have expressed discontent over this, and there was at the time of the interview an investigation ongoing into the reallocation of this task. However, not everyone was outspokenly dissatisfied about this, as the interviewee from the county bard in Halland stated that this had worked out well. She instead saw the benefit in the fact that of the county boards had to get to know each

other better. Interestingly enough, she also says that Halland provided all the material for the risk zone mapping, which was then compiled by Västra Götaland. In this case it appears to have worked out well, but it is easy to imagine that the handing over of information may not always be optimal for the outcome of the risk zone mapping.

As explained earlier, the way that the Swedish legislation is formulated obliges the municipalities to manage flood protection, as a part of the civil defence, whereas the ordinance on flood does not overrule the municipal independence. This means that for the most practical part of the Floods Directive, in transforming the mapping into tangible action, it is essentially toothless, as it does not have any power over the implementing actors. Asking the interviewee from MSB how she would ideally like to improve the work, she agrees that a law that would reach all the way down to the municipal level would be desirable. In that case, the municipality would get more responsibility but also more freedom to develop a risk management plan that could be better integrated in the existing municipal plans and strategies. This structure is supported by Urwin and Jordan (2008) who see the benefits of combining local and national level activity, where the national government identify policy priority areas and local actor(s) are given the right to decide over their own planning and can exercise their expertise in the implementation. One possibly negative consequence could be that this would imply a higher work load for the local actors, however, as has been pointed out by the interviewees, many of the identified municipalities already had flood management ongoing, and as the EC clearly states that there should not be a need for double reporting of the conducted efforts (Näslund Landenmark 2015) it should not be a significant addition to what is already documented. Instead, it could have great benefits in collecting data on ongoing efforts from the actors themselves, and not via their county boards. This could be an opportunity to improve transparency and collaboration between the operational actors. As the interviewee from Kungsbacka municipality pointed out, they have not been in contact with any other municipalities that are amongst the 18 identified as most vulnerable, which is a clear weakness of the current procedures as the lessons learned are not disseminated to the ones that should be most in need of it. It should be noted that the process of social learning is "key to enhancing adaptive capacity" (López-Marrero & Tschakert 2011:230), of which engaging multiple participants and sharing diverse perspectives are core elements.

Another curious point of the Floods Directive is that the link to climate change is very conservatively formulated. This can be interpreted as a way to leave space for the variation both of the different effects of climate change that will be experienced across Europe, but also

to the unpredictability of climate change itself. The whole point of providing different scenarios for the predictions are that no one actually knows to what extent the climate will change, and that is of course part of the core issue – the need to protect ourselves against a change we can only estimate or guess, and not even consistently agree upon. This naturally is a challenge for everyone working on the issue, on all levels. Hence, the vagueness of a directive designed for 25 countries with extremely different predicted climatic changes should be evident, yet it is how each MS and each level of governance manage to communicate its importance that will determine if it will be a meaningful aspect of the directive.

5. Conclusions

This section will summarise the answers to the research questions based on what has been explained and discussed in sections 3 and 4.

The results of the study has given a nuanced answer to how the responsibility for flood protection is dispersed across levels of government in Sweden, and to how the policies are coordinated across levels of government. The municipalities have the largest responsibility for flood protection and climate adaptation. The county boards have been delegated responsibility from the government to coordinate and develop maps and plans, so in practice they should offer support and guidance to the municipalities. In particular, they should consider the threats that cross the municipal borders, which is often the case with climate change and floods. The county board has the mandate to adjust the municipal action plans if the spatial planning turns out to be dangerous in terms of flood risks or not sufficiently addressing climate change, but otherwise the county boards lack power to impose their plans. However, the municipalities often perceive the county boards as helpful and take their advice. The county boards base their efforts on national laws and ordinances or the yearly appropriations from the government. Yet, they are to a large extent depending on other state authorities on the national level to provide the means to fulfil these tasks. Therefore, actors like SMHI have an important role and responsibility to provide information about climate and weather, and Boverket provides recommendations and binding regulations that county boards and municipalities rely on. In flood management, MSB plays a key role to provide protection against accidents, crisis management and civil defence. They manage this on a national level, intervening when the situation grows out of proportion for the municipality to handle on its own, but also in terms of prevention by providing risk assessments. This concerns flood risks as well as other natural disasters, which often happen in relation to and/or enhancing one another. MSB are also

responsible for coordinating the implementation of the EU floods directive and thus serve as a link between EU and the Swedish actors involved. The government has been rather quiet when it comes to climate adaptation and hesitant to take any measures, which has resulted in a climate adaptation based on regional efforts, where county boards coordinate flood management together with climate adaptation. As this is a rather new topic on the agenda, it is still difficult for municipalities to know how to address climate adaptation successfully, and more directions have therefore been requested. Finally, there are many networks ranging from the local/regional level to the national level. Although they have no official responsibilities, they serve an important role in information dissemination and coordination of tasks, ensuring a smoother management of flood risks and climate adaptation.

After having entangled the division of responsibility, the thesis proceeded to explore how climate change adaptation is integrated in Swedish flood protection at the various levels (national, regional, local) of governance, in policy documents (plans, programmes, strategies) and in actual implementation of projects, and how coherent the policies are across levels. In the analysed policy documents, the integration of climate change adaptation in flood protection is most visible at the regional level, as the county boards have a coordinating role in both matters. Collaborative efforts exist both within the county boards as well as between them. By integrating concerns for climate change as a possible threat to human health, the county boards also manage to control that the municipalities' spatial plans are secure in terms of protecting their citizens from the threats that may arise as a consequence of climate changes. The municipalities in the study display different approaches as to how they want to ensure their resilience to climate change and flood risks. The lack of a uniform approach could at least to some extent be a result of the hesitant attitude from the government, which then has left it up to the municipalities themselves to find the most appropriate way to ensure protection. This is however currently addressed, as the upcoming governmental climate adaptation policy will hopefully be another milestone in improving the Swedish climate adaptation efforts, and provide a framework for all actors to rely on.

Integration of climate change adaptation has been assessed focusing on the motivational factors, to find out why climate change adaptation has occurred in flood protection policies, and what factors explain how policy makers frame the linkage between flood protection and climate change adaptation. One of the major reasons for the integration of climate change adaptation in flood protection policies is the consensus of the science that has been communicated from the main information provider SMHI as well as globally recognised

IPCC, showing a high consensus on the conclusion that Scandinavia will be warmer and wetter. This in combination with several recent flood events in Sweden has given indications to regional and local actors of this being a rising threat. The events have created both immediate responses that correspond to the size of the event, as well as in some cases where there has been a long period of threat fostered an understanding of the vulnerability to floods that these cities have to work proactively with. When this understanding is established, the study shows that it has in some of the municipalities led to a strong commitment from key individuals whose hard work for this topic has contributed significantly towards keeping their municipalities on the forefront of a climate-adapted flood management. It should however be pointed out that the flood risks in Sweden are relatively low, so the countermeasures have so far not been overwhelming to the municipalities. It is possible that there is more resistance to come as conflicting interests arise, as seen in the case of Gothenburg.

Lastly, the thesis also aimed to investigate how the implementation of the EU Floods Directive has changed flood protection policies in Sweden, particularly in terms of division of responsibility and if there is any indication that the Floods Directive has affected the integration of climate change adaptation into flood risk management. This links directly to the previous paragraph, as one of the effects that can be seen is the new legislation which helped put flood protection in the spotlight, at least on the national and regional levels, as it demanded certain mapping and plans to be developed. How much they affect the local level remains to be seen. The Floods Directive has not altered the division of responsibility per se, but delegated more tasks to the county boards. However, so far it has not produced any significant additional benefits at the local level, as many of the vulnerable areas already had a flood risk management program or flood protection ongoing. With the new ordinance that affects the national and regional level, it became included in the Swedish legislation that flood management should take climate change into consideration, which is vaguely formulated but still important to recognise as an important step in the process of bridging the topics.

To conclude, one can see that the bridging of flood risk management and adaptation to climate change is well on the way in Sweden. There is still room for improvement and tightening of the knots in terms of more directions from the higher levels of governance and clearer guidelines, particularly in terms of how to account for climate change. Further stimulating the diversity in approaches and enhanced collaboration can keep Sweden up to the task of protecting its citizens and values to the flood risk of today as well as in the future.

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6.2 Swedish laws referred to

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Law on protection against accidents (Sw: *Lagen om skydd mot olyckor* SFS 2003:778)

Ordinance on flood risks (Sw: *Översvämningsförordningen* SFS 2009:956)

Ordinance regarding the management of the quality of the aquatic environment (Sw: *Förordning om förvaltning av kvaliteten på vattenmiljön* SFS 2004:660)

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6.3 Interview respondents

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Ljungkull, Charlotta. Head of unit, planning of traffic and parks, Kungsbacka municipality. 2015-09-09

Moback, Ulf. Landscape architect, City Planning Administration, Gothenburg municipality. 2015-09-08

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Sjödin, Anna. Flood risk manager, Technical services and property management department, Karlstad Municipality. 2015-09-23

Westholm, Lars. Project Manager – Climate Adaptation, Unit for planning of built environment, County Board of Västra Götaland. 2015-09-10

Annex 1. Interview guide

Introductory questions

1. Hur länge har du arbetat med översvämningsskydd och vad exakt är din roll?
   For how long have you been working with flood protection and what exactly is your role?
2. Vilka sorters översvämningsskydd arbetar du med? Tekniska, icke-tekniska, skydd av avrinningsområde, samhällsinformation, stadsplanering/detaljplanering, varningssystem, ?
   Which kinds of flood protection measures do you work with? Technical, non-technical, retention in catchment, public information, spatial planning, early warning systems, ?

Responsibilities

1. Vilka är i din mening de viktigaste beslutsfattarna inom området?
   Which are in your opinion the most important decision/policy makers in flood protection?
2. Hur påverkas ditt arbete och dina beslut av andra aktörer/enheter?
   How are your work and your decisions affected by other stakeholders/entities?
3. Vilka personer och/eller andra enheter har du kontakt med i ditt arbete med översvämningsskydd? Nationellt, internationellt, ↔↕
   Finns det andra involverade som du inte har kontakt med?
   Which people and/or other entities are you in touch with in your work with flood protection? Are there others involved that you are not in touch with?
4. Hur får ni reda på vad andra aktörer arbetar med? Nationellt och internationellt? Vilka "följer" ni och är det någon som "följer" er?
   How do you find out what other stakeholders are working on? Is there anyone you "follow" and anyone "following" you?
5. Hur skulle du beskriva stämningen mellan de involverade aktörerna? (är det hierarkiskt, god samarbetsvilja, öppensinnat, stark vilja att driva igenom protokoll…)
   How would you describe the atmosphere between the involved stakeholders? (is it hierarchical, good will to collaborate, open-minded, strong will to work according to protocols…)
6. Anser du att du har tillräckligt med information för att utföra ditt uppdrag på bästa sätt? Var kommer informationen ifrån? Hur får du tillgång till den?
   Are you of the opinion that you have enough information to perform your mission in the best possible way? Where does the information come from? How do you access it?
7. Anser du att ansvarsfördelningen är adekvat och att du får tillräckligt med stöd från andra aktörer?
   Do you think that the division of responsibilities is adequate and that you get enough support from others?

8. Finns det någon du skulle önska var mer investerad i arbetet?
   Is there someone you would like to see more involved in the work?
   (Vad är älvgruppernas och vattenrådens roll i översvämningsfrågan? Hur är de integrerade med andra enheter?) *(What is the role of the river groups and the water councils in the flood issue? How are they integrated with other stakeholders?)*
9. Hur ser återkopplingen ut? Får du reaktioner/svar på din insats från högre eller lägre instans? Vad får återkoppling förväntar ni er och vad vill ni ha?
   How is the feedback process? Do you get reactions/response on your work from higher or lower instances? Which feedback do you expect and what do you wish for?
10. Hur mycket påverkar utomstående aktörer som intressegrupper och näringslivet ditt arbete och översvämningsskyddet i allmänhet?
    How much do external actors like interest groups and the business sector affect your work and the flood protection in general?

Policy integration and motivation

1. Har du fått riktlinjer för hur du ska jobba med klimatanpassning av översvämningsskydd? Finns det kriterier ni måste leva upp till?
   Have you received instructions/guidance on how to address climate adaptation in flood protection? Are there any criteria you have to fulfil?
2. Är de väl utformade/konkreta? Är de relevanta och anpassade till din befogenhet? Är de lätta att efterfölja?
   Are they well shaped/concrete? Are they relevant and adapted to your authority? Are they easy to follow?
3. Hur kan nationell klimatanpassning förbättras för att underlätta ditt arbete? Bör ansvar/makt skiftas uppåt eller nedåt?
   How could national climate adaptation be improved to facilitate your work? Should responsibility/power be shifted up or down?
4. Är det några politiska strategier som påverkar ditt arbete med översvämningar?
   Från vilket håll och i vilken riktning? På vilken nivå sker detta? Hur användbara är de? Tar de klimatförändringar I beaktning?
   Are there any political strategies influencing your work with flood protection?
   From where do they come? How useful are they? Do they also address climate change?
5. Använder du dig av vetenskapliga studier om klimatförändringar när du arbetar med översvämningsskydd? Om ja, hur viktiga och användbara är de för dig? Om nej, varför inte? Finns det något ni skulle vilja ha mer forskningsunderlag kring?
   Do you use scientific studies on climate change in flood protection? If yes, how important and

useful are they for you? If no, why not? Is there anything you'd like more scientific research about?

6. Är det några specifika händelser som pådrivit arbetet med översvämningar inom ditt område?
   Are there any specific events that have pushed the work on flood protection within your area? If yes, how exactly?
7. Över lag, vad har påverkat och format ditt arbete med översvämningsskydd de senaste åren? Vilka förändringar väntar du dig i framtiden?
   Overall, what has shaped your work on flood protection the most in recent years? What changes do you expect for the near future?

Annex 2. Overview of key actors

Who's who in Swedish flood risk management?

Actor	Swedish name	Responsibility
Swedish Civil Contingencies Agency	MSB – Myndigheten för Samhällsskydd och Beredskap	National level, provide protection against accidents, crisis management and civil defence
Swedish Metrological and Hydrological Institute	SMHI – Sveriges Metrologiska och Hydrologiska Institut	National level, expert unit on metrology, hydrology, oceanography and climatology
National Board of Housing, Building and Planning	Boverket	National level, give advice and disseminate knowledge to planners working with urban planning and construction
County Board	Länsstyrelsen (21 in total)	Regional level, link between people and municipalities, and the government, parliament and central authorities
Water Authority	Vattenmyndighet (5 in total)	Regional level, responsible for the water districts, part of the county board
Water Council	Vattenråd (34 – Västerhavet 13 – Bottenviken 10 – Bottenhavet 9 – Norra Östersjön 41 – Södra Östersjön)	Regional/local level, forum and a dialogue party to authorities regarding water issues
River groups	Älvgrupper (approximately 30 in total)	Regional/local level, forum for collaboration between stakeholders within the runoff area of the river
Municipality	Kommun (290 in total)	Local level, urban administrative division
Finnish-Swedish Transboundary River Commission	Finsk-svenska gränsälvskommissionen	Transboundary level, coordinate Finnish and Swedish authorities to prevent floods and environmental damages
Making Cities Resilient (MCR)	Making Cities Resilient	International level, campaign supporting cities in becoming resilient to disaster, providing a network and platform