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Flood Mitigation alongside the River Thames

Policy transfer from the Belgian Scheldt Estuary for Integrating Alternative Measures

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Subject: Comparative Research and Planning Practice

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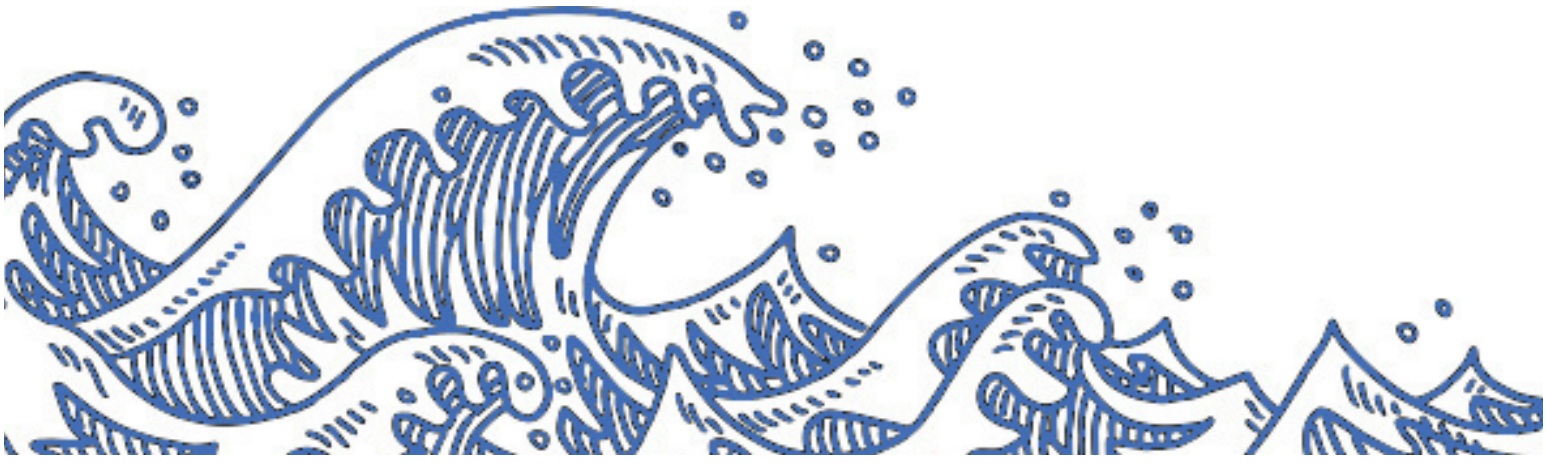

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List of Abbreviations

CIW	Coordination Committee on Integrated Water Policy
DCLG	Department for Communities and Local Government
DIWP	Decree on Integrated Water Policy
EA	(English) Environment Agency
FRMP	Flood Risk Management Plans
FRMS	Flood Risk Management Strategies
GDP	Gross Domestic Product
GLA	Greater London Authority
GVA	Greater Value Added
LA	Local Authority
LLFA	Local Lead Flood Authorities
NPPF	National Planning Policy Framework
PLA	Port of London Authority
RFCC	Regional Flood and Coastal Committee
RSIP	Regional Spatial Implementation Plan
UK	United Kingdom (referring to the English part)

Summary

The aim of this comparative research is to examine alternative methods for mitigating River Thames flood risk, in order to create a comprehensive and sustainable water defence system. Currently, flood protection in the Thames is to a high degree based on hard infrastructure. Much of the infrastructure in place is gradually deteriorating, and will lose its lifetime in the period between 2030 and 2060. Predicted increases in rainfall, sea-level rise, and increased frequency of extreme weather events are expected to put even more pressure on this infrastructure. With the financial and social values of Greater London and its surroundings at risk, improvements to the water defence system are needed. This report first provides an insight on the current situation concerning flood management along the Thames, embedded in the British Planning background. Subsequently, potential donor countries are examined. Belgium's approach to managing flood risk in the Scheldt River - as formulated in the Sigma Plan - was chosen to be the comparative example. The Sigma Plan is one of the longest running flood risk management plans in Europe. An integrated approach of ecosystem-based measures, in combination with the strengthening of existing hard infrastructure, characterise the innovative nature of the Sigma Plan. Emulation was chosen as the appropriate type of policy transfer. The created implementation plan comprises four steps: the nomination of one responsible authority, secured financing, restriction of development in flood prone areas and the creation of wetlands. These steps include fundamental structural changes and are dependent on civil participation, which represents major constraints. However, England is experiencing a shift concerning its flood management, which provides a sound foundation for the proposed implementation plan.

1. Introduction

1.1. The Thames and Its Flood Protection

The Thames is the predominant river in South England (Ackroyd, 2007). The city of London and its metropolitan area are located along the tidal Thames (see Fig.1). The location puts property, infrastructure, cultural heritage, economic value and human life at risk (EA, 2012). The destruction of these commodities is a potential consequence of a flood. An already present consequence is the high costs of flood protection (Alexander et al., 2016). Floods occur due to storm or tidal surges, heavy rainfall in the Upper Thames watershed or failures in drainage systems. Predicted increases in rainfall, sea-level rise, and increased frequency of

extreme weather events exacerbate this threat (Lavery and Donovan, 2005). Additionally, England is tectonically sinking, leading to a perceived higher water level (Mikhailov and Mikhailov, 2012). As the flood risk (the term refers to the risk of a flood to occur) becomes more dire, existing infrastructure is likely to be insufficient and in need of enhancement (EA, 2012). Currently, flood protection is based on hard infrastructure, such as walls or embankments (see Fig.1). A comprehensive and cost effective approach to flood protection that is based on diverse protection measures is needed in London.

Figure 1: Hard infrastructure flood defences in the Thames estuary (EA, 2012).

Retroactive measures are insufficient. Considering the objects at risk, proactive flood protection is a worthy investment for London, especially given the predicted increases of precipitation and sea level. 'Proactivity' is used in terms of embracing the prospect of climate change and acting accordingly in order to be prepared for potential effects. The flood protection strategy for the Thames has been retroactive despite the advantages of proactive defence. (Lavery and Donovan, 2005; Lonsdale et al., 2008). The Thames Gateway regeneration project puts more people, property and economic value in a floodplain (Lavery and Donovan, 2005). A tendency that appears a little risky. The infrastructure that is in place to protect the floodplains needs continuous maintenance and adaptation to changed conditions and all the current infrastructure will lose its lifetime until 2060 (EA, 2012).

Proactive flood measures have seen some advancement. This can be seen in the 'Thames Estuary 2100 Plan' where the Environment Agency (EA) deals with the future flood risk

following an adaptation pathway approach (Klijn et al., 2015). Even though proposing different measurement options, it eventually comes back to maintaining and improving existing hard infrastructure measures, which acquires constant and varied costs (EA, 2012). Furthermore, they are one factor for accelerating the tidal parameters (Mikhailov and Mikhailov, 2012) and are detrimental to the local ecology (Clilverd et al., 2013).

The increasing threat of flood is an exceedingly crucial distress. Extreme financial and immaterial values in London and it surroundings are at risk (e.g. £200 billion of property value and in part London`s economic activity that amounts to £250 billion [EA, 2012])). Reliable proactive protection anticipating extreme impacts of climate change is vital. Therefore, an answer to the following research question is needed:

What are alternative methods for mitigating Thames flood risk in comprehensive and sustainable (in terms of longevity and ecological viability) ways without relying solely on the traditional methods of hard infrastructure?

A river with similar physical characteristics that has a different approach to flood protection and is also established and demonstrated to be successful will be found abroad. Gained knowledge can be used to change the flood management in the Thames (Dolowitz and Marsh, 1996). It will be focused flood protection infrastructure, prevention and mitigation, not on flood response (e.g. social resilience will not be considered). Brexit and consequent legal changes are not taken into account.

Following, the British planning background will be examined before progressing to the donor countries.

1.2. Planning Policies and Responsibilities in England

Flood Risk Management in England is no duty the state is legally bound to, instead all adopted duties are permissive (Hegger et al., 2013).

Current policy trend

Flood risk management and its planning policies have followed different paradigms over the years, from keeping the water out by using hard engineering solutions after the Second World War, to the idea of ‘making space for water’ halfway through the first decade of the current millennium (Johnson and Priest, 2008). Instead of hard engineering solutions, today measures that are taken to improve and maintain water management solutions need to be

environmentally, socially and economically sustainable (Johnson and Priest, 2008) in order to ensure environmental integrity (Defra, 2004), achieve a societal resilience in terms of being resistant to floods and be efficient while using public money (Alexander et al., 2016).

Responsibilities

According to Van den Hurk et al. (2014), local authorities (LAs), such as county councils and district councils, have a range of tasks and responsibilities regarding both planning and flood risk management. The Department for Communities and Local Government (DCLG), which is part of the national government, provides the National Planning Policy Framework (NPPF). Local planning authorities must follow the guidelines provided by the NPPF. However, the framework does not dictate local plans (DCLG, 2015), nor does it provide specific information on how LAs should implement the core planning principles as listed in the NPPF. The framework includes guidelines on how to take flood risk into account while setting up spatial plans (EA, 2013).

The spatial plans are created by the LAs. After finishing a plan, it is examined by the Planning Inspectorate, which is an executive agency on spatial planning for England and Wales (funded by DCLG). The Planning Inspectorate decides on whether the LAs can execute the plans. Furthermore, it can make recommendations and provide advice regarding spatial planning (Planning Inspectorate, 2016). So while the LAs have the power to make plans, they must be approved at the national level.

The EA is tasked with flood risk management in the UK. This is an executive non-departmental body (funded by the Department for Environment, Food & Rural Affairs (EA, 2016a)) that "has a mandate to advise local and regional authorities, as well as actors in the private sector, on the nexus between spatial development and water safety" (Van den Hurk et al., 2014, p.420). Note that the EA has no power to implement specific plans regarding flood risk management. This is in the hands of Lead Local Flood Authorities, which develop, maintain, and apply strategies regarding flood risk management in their areas (EA, 2013). However, the EA, as multi-level actor also representing the national level, has operational responsibilities for the main waterbodies and implements Flood Risk Regulations. LAs have to follow these but have their own powers in creating and implementing plans concerning local waterbodies. Cooperation with the EA exists e.g. in assessing flood risk (Hegger et al., 2013).

2. Inventory of Donor Countries

In this chapter, the criteria used for choosing donor countries will be displayed, followed by a short introduction to the potential donor countries (also see Tab. 1).

2.1. Criteria for Selection

The selection of a donor country is based on their conformance to the following criteria:

- proactive nature of flood risk management
- types of and experience with floods
- organisational structure of water management
- space requirements and longevity of project
- current state of the waterbody
- climatic similarity

In the Thames` flood management plan, it is concluded that a change of measures is not needed until 2070 (EA, 2012). It is thus lacking proactive flood risk management. As Londsdale et al. (2008) put it, nature cannot be managed (defeating it with hard infrastructure) but it needs to be worked with nature, e.g. by giving water space. The donor country should best have an anticipating attitude and not rely on hard infrastructure only.

A donor country that has experience in dealing with similar floods, i.e. tidal storm surges or rain-induced river floods is of advantage because measures need to match the expected impact.

The political and planning system in terms of e.g. the allocation of responsibility or power of implementation concerning water management should not differ to such extent that they could form a barrier. This can happen through path dependencies of precursor policies (Dolowitz and Marsh, 1996).

Ecosystem-based defence structures have greater space requirements than conventional hard structure (Temmerman et al., 2013), therefore, space is vital for the feasibility of defence structures. The success of ecosystem-based defence is difficult to measure. With few examples of contemporary implementation, the longevity of the project is considered as criteria (Temmerman et al., 2013).

The environmental conditions and infrastructural alterations must be regarded. Waterbody characteristics such as infrastructural alteration or environmental factors (i.e. the existence of

floodplains) influence a flood`s development and required protection (Mikhailov and Mikhailov, 2012; Friess et al., 2011). Flood creating climatic conditions such as rain or storm events (Lavery and Donovan, 2005) should be similar.

2.2. The Scheldt River in Belgium

The Scheldt River springs in France, crosses Belgium, and discharges into the North Sea at the Dutch border (Cox et al., 2006). Similar to London, Antwerp is a major city at risk to floods in the Scheldt, moreover the river basin is densely populated (Mees et al., 2016). Climatically, the regions surrounding the Thames and Scheldt are quite equal (Climatedata, 2016a; Climatedata, 2016b) and both have their coastline at the North Sea (see Fig. 1&2).

In 1976, a storm surge ravaged the Scheldt Estuary. In response, the Sigma Plan was created (Mees et al., 2016). The Sigma Plan describes flood defence and mitigation such as floodplains to absorb excess water and weaken storm surges. In 2005, the Sigma Plan was revised, including implications of climate change (Sigmaplan, 2016a). This new plan stipulated more floodplains to give the river room, particularly upstream, to combat the risks of fluvial and pluvial flooding. The scheduled completion of these additions is 2030 (Mees et al., 2016; Sigmaplan, 2016a, Sigmaplan, 2016b). The Sigma Plan is one of the oldest ongoing water management projects in Europe, integrating floodplains as flood protection (Broekx et al., 2010).

In Belgium, the central government regulates flood preparation and flood recovery. Regions are responsible for flood defence, mitigation, and risk prevention. Politically, this is not devolution as in the UK, but a re-centralization at regional level (Mees et al., 2016).

2.3. The United States and the Hudson River Valley

New York City, nestled in the Hudson River's natural harbour, is a useful comparison for London, despite differences in their geography. Both New York and London are found in temperate drowned river estuaries (Perillo, 1995). Both are similar in size and population. However, the city of London is more densely populated (US Census, 2015; Office for National Statistics, 2015; City Mayors, 2015). New York is subject to more than twice the precipitation each year with more extreme temperatures (World Climate, 2012). Despite substantial power of US federal agencies regarding flood protection and national security, New York City has considerable autonomous power in planning. Hurricane Sandy spurred action towards creating a more resilient New York. This planning to prevent future flood

damage serves as a lesson for other major cities to invest in flood protection proactively (Planyc, 2013).

The United States Department of Housing and Urban Development organised a competition for projects to make the greater New York area better defended from floods (Rebuild by Design, 2016). These projects include hard infrastructure to defend low elevation and high density areas, ecosystem-based infrastructure to defend larger areas, and an ecosystem-based breakwater system off the coast to absorb storm surge and revitalize marine wildlife. Construction has not begun but the projects show an interesting approach.

2.4. The Netherlands and the Rhine Delta

The Dutch project Room for the River ('Ruimte voor de Rivier') proactively prepares for floods by creating natural water storage areas along the greater Rhine (Room for the River, 2016a), which is inhabited by 4 million people (Room for the River, 2016b). Planning started in 2007 and the protective infrastructure will last until 2100 (Room for the River, 2016a). On the national level, the governmental agency for infrastructure, Rijkswaterstaat, is responsible for water management and flood risk management (Thaler and Hartmann, 2016). The Room for the River programme Directorate is part of this Rijkswaterstaat. It provides the linkage between the Ministry of Infrastructure and the Environment and Economic Affairs (in charge of Room for the River) and provides a legal framework. Regional authorities are responsible for implementation (Room for the River, 2016c). Predicted increased river flooding from ice melt and more extreme rainfall is thus prepared for (Room for the River 2016b). The Rhine is protected from storm surges by the New Waterway Canal and sluices but remains tidal (Jülich and Lindner, 2006). The areas have similar precipitation (Climatedata, 2016b; Climatedata, 2016c) and are influenced by the North Sea.

3. The Selection of the Donor Country

The three potential donor countries are directly compared according to the previously set up criteria (see Tab. 1). Following, one country will be elected to draw upon for the comparative research. The election follows the 'most similar systems design' of Przeworski and Teune (1970) regarding the conditions such as climate. Proactivity and longevity of the project should be advanced since this aspect should differ from the English situation (Sartori, 1991).

Table 1: Comparison of the three potential donor countries based on the selected criteria (Authors, 2016).

Criteria	**Proactivity**	**Previous floods**	**Organisational structure**	**Space & longevity**	**Waterbody**	**Climate**
England	Present in form of a plan, practical changes not before 2070 (EA, 2012)	Tidal floods, major floods e.g. in 1928, 1953 (EA, 2012), 1998 (Hegger et al., 2016) or 2007 (Alexander et al., 2016b)	Multilevel Environment Agency, much responsibility with LAs	Current hard infrastructure (see Fig. 1) since mid-20th century (EA, 2012)	Large tidal estuary	Oceanic climate, mean precipitation of $63\frac{mm}{month}$ and average high temperature of 14°C (after Climatedata, 2016b)
The Netherlands	Present	Tidal floods, Room for the River focuses more on inland floods as happened in 1993, 1995 (Room for the River, 2016a), 2002 or 2003 (De Wit, 2007)	Independent Water Bodies acting on local level (Thaler and Hartmann, 2016); legal framework provided by the Rijkswaterstaat	Since 2007, several water storage areas distributed along the greater Rhine	Tidal, but sluice replaced original mouth	Oceanic climate, similar both in temperatures and precipitation
United States	Gradual transition to proactivity	Hurricanes and extratropical storm surges, e.g. in 1992 and 1999 (Colle et al., 2008) and 2012 (Planyc, 2013)	Large federal agencies, with complementary initiatives by New York City	Walls in the city (Planyc, 2013), suggested measures from the competition not yet constructed	Large tidal estuary	Humid subtropical climate, higher precipitation and more extreme temperatures
Belgium	Present	Mostly tidal and pluvial, major floods in 1953, 1976 and six large-scale floods between 1995 and 2015, e.g. 2010 (Mees et al., 2016)	Flood risk prevention, defence and mitigation coordinated at regional level, flood preparation and recovery managed by national level	Since 1977, floodplains near the mouth, but also upstream	Large tidal estuary	Oceanic climate, similar temperatures, but less precipitation

The US as potential Donor Country

The Hudson Valley is an attractive donor due to the striking similarities between New York and London. Both cities are similar in size with approximately eight and a half million people each (US Census 2015; Office for National Statistics 2015; City Mayors 2015). Both cities rely on infrastructure systems largely located in underground tunnels making them prone to floods (Aerts et al., 2012), and both cities serve as major international metropoles and centres for international finance, meaning their potential destruction from flood damage puts the economic loss not only on their own citizens but on the global economy (Porter, 1998).

Both rivers comprise a large tidal estuary and have experience in floods. However, the Hudson River is affected by e.g. hurricanes (Colle et al., 2008) whereas the Thames is more prone to storm surges (EA, 2012). The Planyc relies on a combination of hard infrastructure measures, such as seawalls, as well as ecosystem-based infrastructure (Planyc, 2013). It seeks out to enhance the ecological value by revitalizing local ecosystems and enabling recreational possibilities (Planyc, 2013). It would be useful to look at how these measures are placed in an urban area such as New York City. The lack of implementation is a major obstacle, which makes the success of the New York City projects impossible to observe. On the other hand, administrative structure shows similarities, because in both countries flood management responsibilities are within local authorities.

Belgium as potential Donor Country

The Scheldt in Belgium has a large estuary and the river displays embankments (Mees et al., 2016). Its basin is densely populated and home to the city of Antwerp, which is of less economic value than London but hosts Europe's second largest port (Mees et al., 2016).

The Thames and the Scheldt are exposed to the North Sea tidal storm surges and show similar climatic conditions. The Sigma Plan combines hard infrastructure with ecosystem-based infrastructure (Broekx et al., 2010). It has existed since 1977 and, although recent ecosystem-based measures are not completely finished in its construction, it comprises several areas in which historical wetlands have been reclaimed and converted back into potential floodplains (Temmerman et al., 2013), Thus, fluvial and pluvial flood risk is addressed (Mees et al., 2016).

An analysis by Broekx et al. (2010) concludes that the floodplains have become an essential part of the flood defence system. Antwerp, the largest city along the Scheldt River, has not been flooded by storm surges since 1976, (Broekx et al., 2010). In December 2013 the Sigma

Plan proved its suitability as the 'Saint Nicholas'-Storm hit Flanders but neither inundations nor any major damage occurred (Meire et al., 2014).

Flood risk management in Belgium happens at the regional level (Mees et al., 2016), which differs from the UK where responsibility lies with the local level, yet, when dealing with larger waterbody, cooperation between the levels exist (see 1.2.).

The Netherlands as potential Donor Country

The Rhine and the Thames are large estuaries and intensely embanked (Hesselink et al., 2003; EA, 2012). The estuaries are densely populated (Room for the River, 2016a; Lavery and Donovan, 2005), therefore likely dealing with similar space limits and given their geographic proximity unsurprisingly show similar climatic conditions, in that being influenced by the North Sea.

The 'Room for the River'-project directly counteracts the flood risk of fluvial and pluvial flooding by giving space for water in water storage areas, additionally to existing hard infrastructure (Room for the River, 2016a). Dealing with floods and flood protection is an historic experience (de Kraker, 2006).

However, the 'Room for the River'-project aims predominantly to lower the risk of flooding caused by excess rainfall and ice melting coming from inland. Less emphasis is put on lowering the risks of storm surges (Room for the River, 2016b). However, as described in the 'Thames Estuary 2100 Plan', the risk resulting from storm surges is particularly important for the Thames Estuary and London. Yet, the Rhine`s main branch is disconnected from the sea and an intense tide (Jülich and Lindner, 2006). In the Netherlands, a national legal framework is provided which has to be implemented by the regional level (Room for the River, 2016c). This differs from the UK where national guidelines exist but LAs can make plans that then have to be approved and in case of larger waterbodies, cooperation between the levels exists (see 1.2.).

The Choice of Belgium

Belgium with its Sigma Plan (see Fig. 2) appears to be the country most advisable to look at. According to the 'most similar systems design', Belgium exhibits similarities with England and the Thames River regarding climate, waterbody and previous floods. Moreover, the Sigma Plan has the most advanced traits in longevity and provided evidence that it is an effective, proactive measure. Since longevity and proactivity relate to the aspects of the

project, which should differ compared to the recent situation of the Thames, and are necessary to investigate for successful transfer (Sartori, 1991).

However, the organisational structure in Belgium differs from the one in the UK. Yet, regarding flood management, responsibility in the UK is not restricted to this level and thus forms an obstacle to the comparison to Belgium. Belgium is the selected donor country.

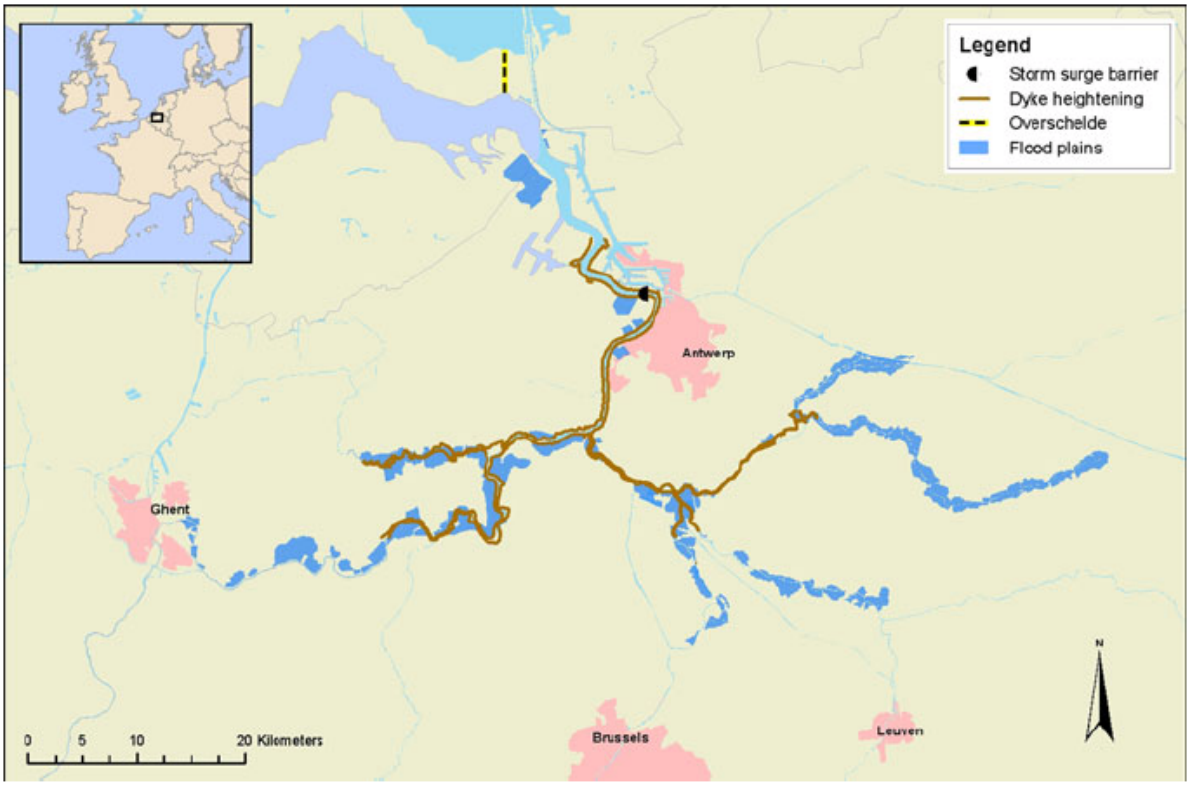

Figure 2: Location of flood protection measures along the Scheldt River by 2030 (Broekx et al., 2010).

In the next chapters, Belgium and the UK will be compared concerning their flood risk management, terminating with an implementation plan.

4. Comparison of the Belgian and English Systems

This section explores the similarities and differences between the Thames water defence system and the Sigma Plan for the Scheldt River. First, an overview will be presented for both the Thames River Valley (throughout Southern England) and the Scheldt River Valley (Sigma Plan project area), according to the DESTEP method (5.1.). Even though DESTEP is more commonly applied in market research, it still provides a useful tool to analyse various factors on a macro level, such as the Thames- and Scheldt River Valley, which is the reason this method was chosen. DESTEP means that demographical, economical, socio-cultural,

technological, environmental and political aspects will be discussed (Eelants, n.d.). Together these aspects provide a contextual framework (see Tab. 2) in which the comparative research will be carried out. Second, the planning system and flood management policies for both the United Kingdom (5.2.) and Belgium (5.3.) will be explained and how these policies are put into practice. Aspects that will be discussed in the second part are the historical background, the structure and the functioning of both planning systems and flood management policies.

4.1. Context

4.1.1. Thames River Valley

The Thames River flows through the region of Southern England, which comprises four political regions: South West England, South East England, Greater London, and Eastern England. At the end of 2014, Southern England's total population was 28.8 million. Of this total population, 8.5 million were citizens of the London metropolitan area (Office for National Statistics, 2015). Southern England has experienced population growth over the past 10 years, as it is shown by figures by the Office for National Statistics (2015). Population growth was highest in the Greater London Area, with an annual population growth rate of 1.4% in the period of 2004 to 2014. The other regions of Southern England had smaller growth rates, ranging from 0.74% to 0.89% annually. The Greater London Area also is the most densely populated region along the Thames River (Office for National Statistics, 2015).
Southern England - more specifically the Greater London Area - is at the centre of the United Kingdom's economy. Greater London's total gross value added (GVA) accounted for 22.9% of the UK's total GVA, with the South East contributing a further 15.1% (GVA is GDP excluding taxes and subsidies on production). Moreover, the Greater London Area saw the highest annual economic growth rates, followed by the South East (Harari, 2016). Together, South East England and Greater London cover most of the Thames River Valley, stressing the economic stakes of a safe and comprehensive water defence system. In 2014, the average GDP per capita for Greater London was €59,700. For South East England the average GDP per capita was €37,800. The other Southern England region's average GDP was around €32,000 (Eurostat, 2016). In august 2016, the Greater London Area had 292,000 unemployed jobseekers (6,1%). Southern England in total had 709,000 jobseekers (4,5%). Since peak unemployment rates in 2011, reaching 10,4% in Greater London, the unemployment rates have steadily been declining (Office for National Statistics, 2016).

Besides being an economic centre within the UK, the city of London has a strong international position as a financial hub. This is demonstrated by the indication that London had the third most sharing economy start-ups in the year of 2015, only trailing behind San Francisco and New York (Bean, 2016). Over the coming years, the economic growth rate of London is expected to accelerate even further (Centre for Cities, Cambridge Econometrics, 2015). It, however, is unsure to what extent Brexit will influence the economic position of Greater London and Southern England more generally.

The catchment area in the upper part of the Thames river is characterized by arable land. Around 80 percent of this area is dedicated to agriculture and grassland. Especially in the headwaters of the Thames agriculture is present, while the lower lying areas are intensively urbanized (Bussi, 2016). Southern England as a whole can be characterized as the center of organic farming within the UK. 63% of the organically managed land within the UK falls within South West- and South East England (including London). This accounts to roughly 190,000 hectares of land used for organic farming within Southern England (Defra, 2016).

Residents of the UK are relatively high educated, compared to other member states of the EU, as 47,7% of the 30-34 year olds have completed and obtained a diploma of higher education. The average to this statistic for the entire EU was 37,9% (Statistics Belgium, 2015).

The Thames flood management is mostly based on traditional hard infrastructure. Much of this infrastructure in place is gradually deteriorating, and will lose its lifetime in the period between 2030 and 2060 (EA, 2012). Flood management is dealt with in the Thames Estuary 2100 Plan. The measures taken in this plan eventually come down to maintaining and improving existing hard infrastructure (see 1.1.). In other parts of the UK, such as the Humber Estuary, alternative methods have been pursued as addition to hard infrastructure, such as ‘managed coastal realignment’, which comes down to converting reclaimed land into marshes for coastal defence (Temmerman et al., 2013). It is estimated that within the urban area of London, 24,000 properties are under significant threat of flooding by the Thames and its tributaries. Parts of Kingston, Barnet and Waltham Forest – which are boroughs within the urban area of London – were most at risk (Hill, 2015).

The UK – and more specifically Southern England – has a temperate oceanic climate (cfb). The average high monthly temperature in London is 14°C. Moreover, the monthly average precipitation in London is 62,9mm (Climatedata, 2016b).

4.1.2. Scheldt River Valley / Sigma Plan Project Area

The project area for the Sigma Plan is located in the Belgian region of Flanders. Flanders is one of the three major Belgium regions, and covers the northern part of Belgium. The region has significant cultural and political autonomy within Belgium, and its own regional government (Toharudin, 2010). In 2009, the region of Flanders had a total population of 6,208,877 (Mees et al., 2016). In 2015, the total population had grown to 6,444,127 (Statistics Belgium, 2015). This suggests that Flanders has experienced continuous population growth over the last years, which is confirmed by Statistics Belgium (2015). Of this population, 1,033 million are citizens of Greater Antwerp (Brinkhoff, 2016). Even though the population is growing, many rural areas of Flanders are experiencing an ageing population and shrinkage. This is being compensated by population growth and relatively young populations in other areas, one of them being the province of Antwerp (Statistics Belgium, 2015).

Flanders is a prosperous region. Its geographic location and regional and international trade relations have contributed to a flourishing economy. This leads to high standard of living for the Flemish citizens. In 2014, the average GDP per capita in Flanders was €36,400. The Province of Antwerp had a slightly higher average; €41,800 (Eurostat, 2016). In August 2016, Flanders had 241,622 unemployed jobseekers, which is 6,402 (2.5%) less than a year before. This decline confirms the continuation of a long-term trend of declining unemployment within Flanders (VDAB, 2016). The urban area of Antwerp – more specifically its harbour – is of great economic importance to Flanders. This is reflected in the GDP figures by Eurostat. Antwerp possesses financial and human resources that most other neighbouring regions do not have (Mees et al., 2016). Unsurprisingly, water safety in the urban area of Antwerp draws significant attention in the Sigma Plan.

Residents of Belgium also are relatively high educated when comparing to other member states of the EU. 43,8% of the 30-34 year olds have completed and obtained a diploma of higher education. However, the UK scored 47,7%, which is higher than Belgium (Statistics Belgium, 2015).

The Sigma Plan is the Flemish region's overarching plan relating to flood management (see 2.2.). It has been praised for its innovative character. Since 2006, agricultural land in the floodplains of the Scheldt River valley has been converted back into wetlands in order to increase natural water storage and reduce flood risk (Temmerman et al., 2013). When the Sigma Plan was first introduced in 2005, the Flemish government was one of the first countries to apply a natural form of water management as addition to strengthening hard

infrastructure, while surrounding countries solely stuck to traditional methods, such as raising the heights of embankments and flood barriers (Waterwegen en Zeekanaal NV, 2013).

Just like the UK, Belgium has a temperate oceanic climate (cfb). The average monthly temperature in West-Flanders is 12,5°C. Moreover, the monthly average precipitation in West-Flanders is 48,3mm (Climatedata, 2016a). These figures indicate that the average temperature and precipitation are higher in the London area, as compared to Flanders.

Table 2: Contextual overview Southern England and Flanders (Authors, 2016).

Level	Southern England	Flanders
Demography	28.8 million inhabitants (2016) / Greater London population 8.5 million / high population density London area	6.44 million inhabitants (2015) / Greater Antwerp population 1,033 million / Slow population grow, but ageing population
Economy	Southern England economic centre within UK / Strong global economic position Greater London / declining unemployment	Strong locality and trade relations / Antwerp of great economic importance to Belgium and surrounding areas / declining unemployment
Socio-cultural	47,7% completed higher education in the UK as of 2014	43.8% completed higher education in Belgium as of 2014
Technology	Thames flood management mostly based on traditional hard infrastructure	Innovative flood management system / ecosystem-based measures as addition to existing hard infrastructure
Environment	Temperate oceanic climate (cfb) / Average high temperature 14°C in London / Average precipitation 62,9mm in London	Temperate oceanic climate (cfb) / Average high temperature 12,5°C in West-Flanders / Average precipitation 48,3mm in West-Flanders
Politics	Flood risk managed nationally, but spatial applications developed locally (further elaborated in section 5.2)	Flood risk prevention, defence and mitigation coordinated at regional level (further elaborated in section 5.3)

4.2. Planning and Flood Risk Management in the United Kingdom

The planning system in the UK distributes responsibilities to the local and the national level: major decision making takes place at both levels. (Van den Hurk et al., 2014). Here, the historical development of flood risk management is displayed, followed by an explanation of the contemporary governmental and organisational structures.

4.2.1. Historical background

The UK water management originally focused on rural protection and land drainage. This didn't change until the 1980s, when flood management became increasingly important. This shift is relatable to the decreasing economic importance of agriculture. Meanwhile, the

manufacturing industry and flood issues in urban areas gained importance. (Hegger et al., 2013). During the 1990s, flood defence (keeping the water away) slowly turned into a more integrated system of flood management (Nye et al., 2011). This included a focus on the environmental and social consequences of flooding (Hegger et al., 2013). During the late 1990s and early 2000s, two large flood events raised national concern. This national concern led to a revision of existing flood management policy (Nye et al., 2011). These events increased concerns about flooding. It was understood that existing flood risk policies were not sustainable enough. Therefore, investments were needed to increase sustainability. Following Hegger et al. (2013), a shift took place towards the idea that communities cannot prevent flooding but must learn to live with water.

A topic of concern is the fragmentation of flood risk management organisations. The first step towards a more general strategy for flood risk management was 'Making Space for Water' in 2004. In practice, the EA gained a "more overarching strategic role for flooding and coastal erosion risks, rather than purely operational responsibilities" (Hegger et al., 2013, p.58). Furthermore, flood risk management became less centrally controlled, while the engagement of local stakeholders on decision making increased. The shift towards a more localized flood management kept going until the late 2000s, when the Flood and Water Management Act (2009) gave LAs more responsibilities regarding flood risk management. Nevertheless, consistency with national strategies remains necessary (Hegger et al., 2013).

4.2.2. System Structure and Functioning

The national ministerial Department for Communities and Local Government (DCLG) provides the National Planning Policy Framework (NPPF). This framework is essentially a set of guidelines and goals for planning authorities on the local and regional level. Note that the guidelines are not meant to dictate local plans (DCLG, 2015). However, on the national level, the Secretary of State is allowed to "call-in" a local planning application, meaning the national government takes "the decision making power on a particular planning application out of the hands of the local planning authority for his own determination" (Smith, 2016, p.3).

An important fact is that the government, in general, has no statutory duty to protect the land and properties from flooding. However, various organisations are responsible for different flooding issues and even types of watercourses (Hegger et al., 2013), which makes it difficult to briefly sum up each organisation's specific responsibilities and powers.

The connection between spatial planning and flood risk management is managed by the non-ministerial organisation EA. This is a multi-level organisation which is mandated to advise local and regional authorities on how to deal with flood risk tasks in spatial planning (Van den Hurk et al., 2014). Since 2010, the EA organises Regional Flood and Coastal Committees (RFCCs) that link the EA, LAs and other stakeholders in order to encourage targeted and efficient measures in flood risk management. The EA must consult the RFCC when working with LAs on flood risk management plans (RFCC, 2016). Regarding the Thames, many different local councils and the Greater London Authority (GLA) are involved. Nevertheless, the EA owns any measure that is implemented along the Thames (EA, 2016c, p.14-327). Apart from the advisory mandate, the EA is the responsible authority for setting up flood risk management plans (FRMPs). Following the 2007 Floods Directive from the European Union, each EU member state is required to produce these plans for each river basin (EA, 2016b). A FRMP summarizes the risks of flooding from rivers, surface water, the sea, groundwater and reservoirs. Furthermore, the EA's advisory role is used again by adding guidelines on how local planning authorities could cooperate and work with communities and the EA on managing flood risk (EA, 2016b). The FRMP for the Thames river basin was finalized late 2015 for a six years' cycle.

Spatial planning applications, including those related to flood management, are developed by LAs (Smith, 2016) by working together with neighbouring LAs if necessary. After the LA's plan is finished, the Planning Inspectorate, an executive agency sponsored by DCLG, examines the plans. The Planning Inspectorate is allowed to make recommendations and advices LAs about their plans, and ultimately decides whether the plans are allowed to be executed (Planning Inspectorate, 2016). So while the LAs have the power to make plans, approval at the national level is necessary.

The highly localized nature of planning along the Thames makes it a unique case in the UK. Since the Thames flows through the greater London area, it reflects spatial plans built by the GLA. The GLA is a regional level governmental body responsible for planning issues in the greater London area. It consists of the mayor of London, 32 boroughs and the Corporation of the City of London. The planning guidelines set up by the GLA are listed in the London Plan, which is "an integrated economic, environmental, transport and social framework for the development of London" (GLA, 2016, p.2). The GLA operates as a cooperation between LAs. Note that the mayor of London, who is at the head of the GLA, just as the national government, has the power to 'call-in' planning applications (Mayor of London, 2016) – in this case applications within the GLA territory. Since the mayor is not member of a political

party (Sweeting, 2003), political influence on the mayor's decisions regarding planning isn't expected. Important to consider is that in the GLA, spatial plans are developed on different governmental levels compared to other UK regions. However, the national government has the final say because, as stated before, they too have the power to accept and/or to call-in a planning application. Figure 3 illustrates the described system functioning in the UK.

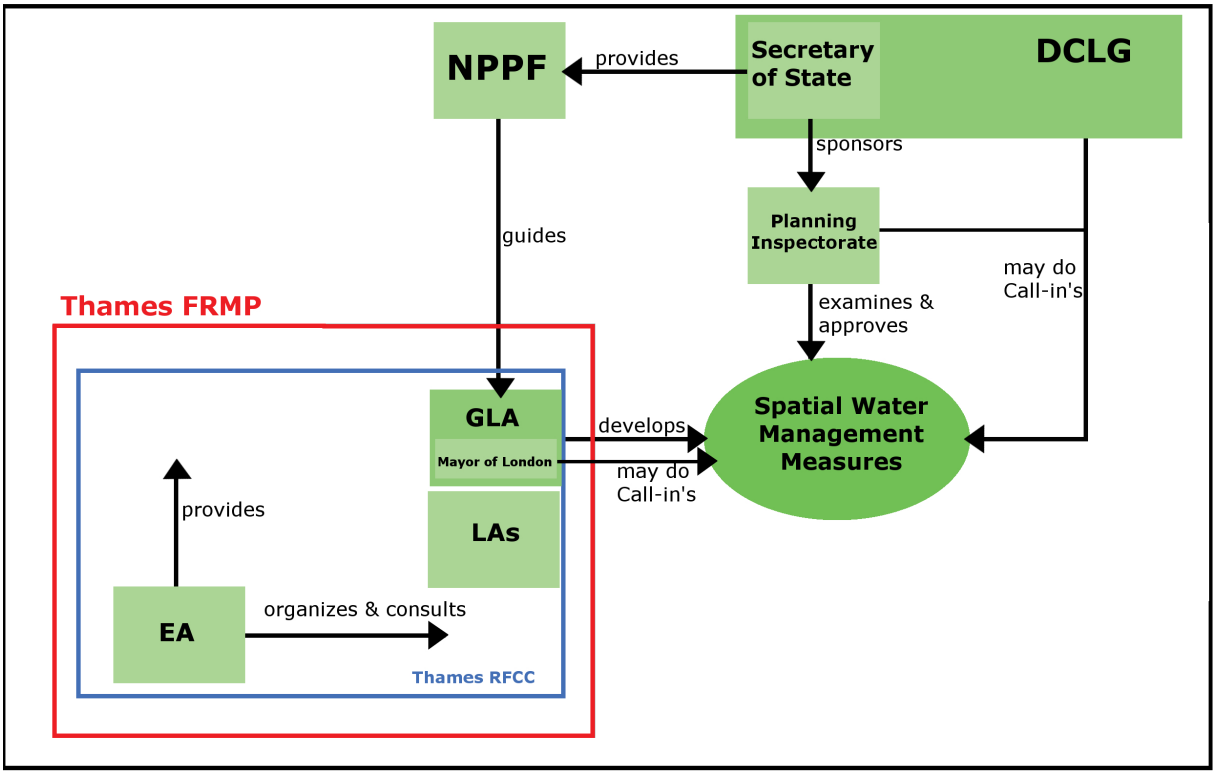

Figure 3: Overview of Spatial Planning Functioning in the UK (Authors, 2016).

4.3. Planning and Flood Risk Management in Belgium

4.3.1 Historical Background

After its independence in 1830, Belgium's industrialization relied heavily on transporting goods and materials for its industrialization. The waterways were split in two categories, 'navigable', such as the Scheldt river, and 'non-navigable', which is still present today. The navigable waterways were supervised by the Ministry of Public Work and the non-navigable ones by the Ministry for Agriculture to serve for drainage and irrigation. Navigable and non-navigable watercourses were governed by separate networks of actors, rules and routines. Over the years, the non-navigable waterbodies got subdivided into three categories and became part of the Ministry of Environment and Nature' (Hegger et al., 2013).

The flooding in January 1976 caused anger in the public perception of the flood management and demanded a better and more reliable one. In reaction, the government decided to overhaul its flood management and developed the Sigma Plan, which entered into force in 1977 (Hegger et al., 2013). Around the same time, the environmental movement gained in attention. Advocates of this movement requested transportation and agriculture be included in water management considerations. They criticized the lack of cooperation between the different actors involved, the absence of stakeholder dialogue, and the usage of outdated policy instruments which were hindering ecological management. Instead, they argued in favour of integrated and more holistic water management (Hegger et al., 2013).

In the 1980's the Belgian state underwent state reform by sequentially transferring power and responsibilities to the regional governments of the three regions Flanders, Wallonia and Brussels-Capital Region. Each of them has full authority in flood prevention, mitigation and defence. As a result, the Sigma Plan became an instrument of the Flemish government. The transfer process was finalized in 1989 as the Ministry for Public Works was integrated into the regional authorities (Hegger et al., 2013).

In the 1990's, the environmental movement gained more momentum and actively started demanding stronger institutionalization of the integrated water policy. Finally, this policy approach entered into force as Decree on Integrated Water Policy (DIWP) in 2003 (Hegger et al., 2013).

In the beginning of the 2000's, there was a shift in public perception towards the embracement of 'creating space for water' instead of rapid water drainage. Thus, in 2004 the concept of 'making space for water' was legally institutionalized in the DIWP. With this decision, the Flemish flood risk governance moved one step further towards a multi-defence water safety and integrated water management (Mees et al., 2016).

4.3.2. System Structure and Functioning

In Belgium, the present flood risk governance comprises five separate Flood Risk Governance Arrangements. Flood prevention, mitigation and defence form the 'Water System Arrangement'. The other two are the 'Flood Preparation Arrangement' and the 'Flood Recovery Arrangement' and are still governed from the national level. The Water System Arrangement is governed by the three regions. As a consequence, each region has slightly different legal frameworks and goals. And even within one region, each region's Water System Arrangements is further divided into four distinct categories (navigable and the three sub-categories of non-navigable) of water courses with each having different water managers.

Thus, the Belgian flood risk governance is not only multi-levelled, but also highly fragmented (Mees et al., 2016).

The overarching legal framework for water and flood risk management on the Flemish regional level builds the DIWP (Mees et al., 2016). In order to increase the coordination at the regional level, the Flemish government introduced the 'Coordination Committee on Integrated Water Policy' (CIW) in 2003. This committee also aims for a better communication with the department for spatial planning, since spatial planning is also executed from the regional level. Therefore, the CIW embodies an institutionalization to establish flood management as a shared issue of water management and spatial planning (Mees et al., 2016). The CIW consists of several representatives from the Flemish regional level, regional and local water managers and water companies (see Tab. 3) (CIW, 2016).

Table 3: Structure of the CIW, showing the three compartments and their subcomponents (after CIW, 2016).

Flemish regional level	Regional & local water managers	Water companies
Policy area 'Environment'	umbrella organisation of Provinces	umbrella organisation of water companies
Policy area 'Transport'	umbrella organisation of Cities and municipalities	
Policy area 'Spatial Planning'	umbrella organisation of Polders and drainage authorities	
Policy area 'Agriculture' and policy area 'Economy' (only with advisory vote)		

The DIWP forms a framework that incorporates the EU Water Framework Directive and the EU Flood Directive as well for the Flemish 'Flood Risk Management Strategies' (FRMS). Table 4 provides an overview how the different FRMS instruments are used in the Flemish Water System Arrangement. All flood risk measures are funded by tax income (Mees et al., 2016).

Table 4: Flood Risk Management Strategies and related instruments in Flanders (modified after Mees et al., 2016)

Level	Prevention	Defence	Mitigation	Preparation	Recovery
National Level				emergency planning & alarm phases; flood warning	Inclusion of flood damage in fire insurance
Flemish Region	water assessment; signal areas; duty to inform; financial instruments	Sigma Plan; dike elevations; watercourse maintenance	Sigma Plan; rainwater regulations; awareness raising on flood resilient building; flood control areas	crisis management	governance of disaster fund

There is the recent trend of both delegating national responsibilities to the regional level as well as upscaling municipal competences to the regions. Thus, there is a regionalization in the Belgian water and flood management. In direct comparison with the UK, the Belgian approach differs since powers in spatial planning and water management are not shifted to the local level, but rather accumulated at the regional level, which does not exist in the UK excepted with the GLA (Mees et al., 2016). Another trend is emphasizing shared responsibilities and improving coordination and cooperation with the Flemish department of spatial planning since there has been increasing recognition that successful flood management relies on interplay between spatial planning and water management. However, coordination needs further improvements (Mees et al., 2016).

Figure 4 illustrates the system functioning in Flanders with focus on the Sigma Plan.

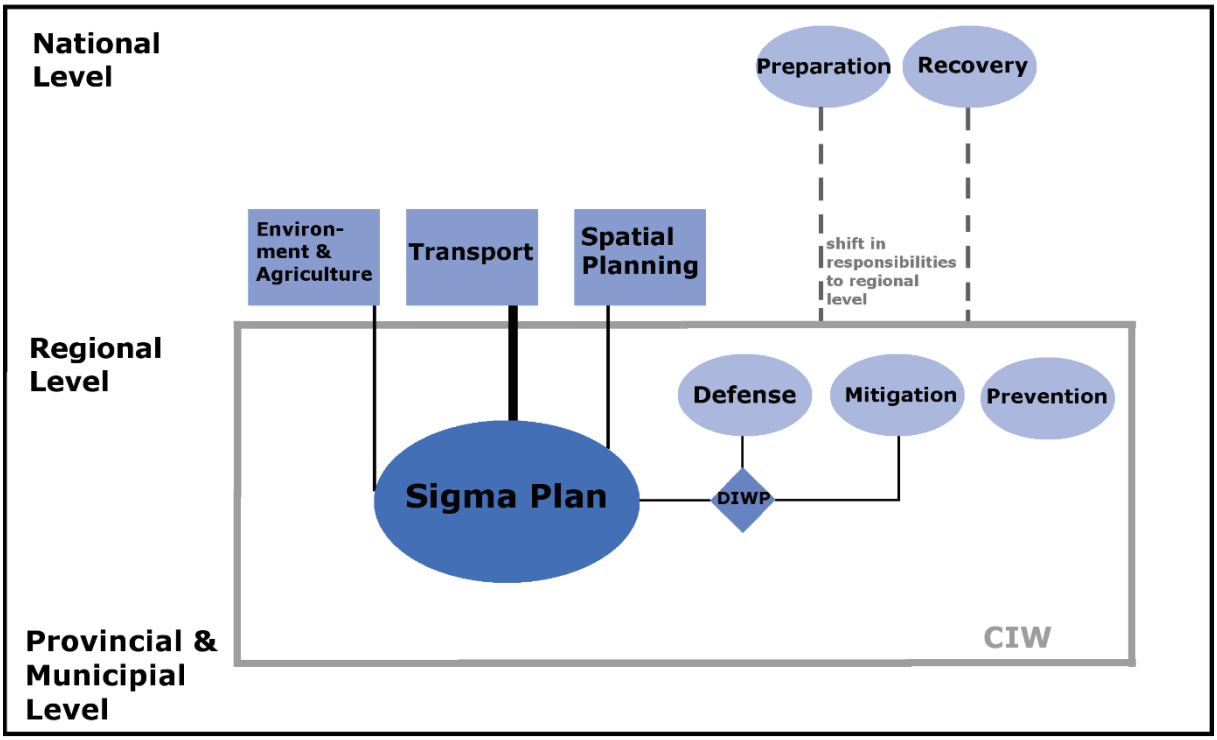

Figure 4: Flood management and planning in the Flemish region (Authors, 2016).

4.3.3. The Sigma Plan

The Sigma Plan is part of the Flemish flood defence and mitigation (see Tab. 3). The Flemish authority of inland waterways 'Waterwegen en Zeenkanal' coordinates the implementation and maintenance of the Sigma Plan. This authority is also responsible for synchronizing the actions of both the CIW and the Flemish department for spatial planning.

Implementation of the Sigma Plan proceeds as follows: Land use plans are developed to determine the exact position of the areas followed by an environmental impact assessment. Afterwards, the flood areas are incorporated into the regional spatial implementation plan (RSIP), which is the spatial plan from the regional level and legally binding for all other plans from the provincial and municipal level. The RSIP replaces existing destination plans for areas that are planned to become floodplains. Nevertheless, the coordinators of the Sigma Plan seek collaboration: people have the possibility to address their concerns or questions to the Flemish Commission for Spatial Planning, which in turn forward these to the officials creating the RSIP and thus have the ability to adapt the RSIP (Sigmaplan, 2016d).

5. Policy Transfer

In this section, the potential for policy transfer of river management by the UK from Belgium and the limitations to that transfer will be discussed by addressing the following questions (James and Lodge, 2003).

1.What aspects of the Belgian policy and Sigma Plan should be considered by the UK?
2.How could the aspects of Belgian policy and plans be implemented in the UK?
3.Which UK parties or organisations would have the best chance of successfully implementing aspects of Belgian policy and plans?
4. What barriers and constraints limit the extent and success of policy transfer from Belgium to England?

Nadin and Stead (2012) show that Belgium and the UK can be allocated to the same typology of planning system. This increases the likelihood of transfer (Spaans and Louw, 2009). However, there are specific differences between intricacies in the planning contexts (see 4.) lessening the likelihood of transfer (Spaans and Louw, 2009). Opportunities of transfer are revealed, at the same time not neglecting constraints that have to be attended, by answering the displayed questions. The questions aim at distinguishing the mechanisms that make the Belgian approach successful in mitigating flood risk and at identifying British conditions that could interfere with a transfer. Thus, an uninformed, incomplete or inappropriate transfer can be avoided (Dolowitz and Marsh, 2000) and the success of transfer can be increased (Bardach, 2004).

The Belgian approach in form of the Sigma Plan is accepted as (one of the) best standard(s) and elements of it are applied to the UK. Therefore, the process is identified as emulation (Evans, 2009). Emulation is a form of policy transfer (Dolowitz and Marsh, 1996). Although not always distinctly separated, policy transfer is broader than lesson drawing and can include e.g. structure or content (James and Lodge, 2003).

5.1. What to Transfer?

The Sigma Plan combines a regional planning directive with local land use plans that have been developed through a collaborative process and approved by regional bodies (Sigmaplan, 2016c). These elements are essential to the success of the plan and should be included in any attempt to replicate the project in the Thames River Valley. Each construction of flood control zones takes into account local contexts as well as technical expertise from the regional level

(Simgaplan, 2016b). This synthesis is vital for a project on a scale as large as an entire river valley.

The flood management policy goals of the UK and Belgium are largely the same. Both states hope to minimize flood risk and potential damage in a sustainable way. It is the methods they pursue that differ. In addition, the institutional framework of Belgium does not directly compare to the UK. The method by which Belgium is able to implement their plan would not be able to be transplanted to the UK as the political and planning structures differ on an inherent level. The Sigma Plan is conducted at the regional level, taking input from the local level but not subject to their authority. The UK planning structure is highly fragmented and responsibility is distributed across the national, regional, and local levels. The UK is undergoing a process of devolution and greater autonomy at the local level, however, the national level still maintains authority and the right to 'call in' decisions and override the local authority (Johnson and Priest, 2008). These differences are important to consider as one evaluates what aspects of the Sigma Plan to introduce into the Thames flood management.

However, at least the essence of the Sigma Plan should be incorporated into flood management along the Thames. In particularly, the creation of flood control zones at ideal locations throughout the river valley, in the attempt at minimizing both fluvial and pluvial flooding, as well as the relocation of residential and commercial zones along the floodplain to areas of lower flood risk, are aspects of the plan that should be emulated. In addition, the proactive nature of the Sigma Plan and comprehensive steps taken to minimize flood risk in reaction to climate change, and the uncertain but inevitable increases in flood risk that are associated with climate change, should be emulated in UK flood preparation. The focus on ecological protection and restoration in infrastructure implementation is also an essential aspect of the Sigma Plan. Initially, the idea was to designate flood areas that could be flooded and then drained when the thread of flood decreased. Now the Sigma Plan aims to create vibrant ecological wetlands that can be used as flood areas. This is done by draining the area more gradually (Sigmaplan, 2016c). When one is developing flood protection infrastructure, it is important to protect or even restore natural ecology for a collection of reasons Natural ecology contributes to flood defence, reduces the maintenance cost of protective infrastructures, and less measurable benefits like carbon sequestration, wildlife diversity, and natural beauty (Temmerman et al., 2013). Examples of the effectiveness and cost-benefit of ecological protection and restoration in flood defence can be seen in the Sigma Plan as well as projects elsewhere in the UK (Sunderland, 2012).

5.2. How to Transfer?

Considerable work can be done within the national, regional, and local plans to disincentivize or restrict development in the Thames floodplain and to incentivize relocation out of at risk areas. In addition to this, particularly flood prone areas or areas impractical to protect by other means can be acquired by authorities under the guise of a creation of public works. The description of floodable green spaces for recreation or wildlife reclamation as public works projects depends on the political climate of the UK which varies with each election. However, flood protection and flood zones can be considered public works, which would allow public UK authorities to acquire the land for their construction.

Flood zones could be created by the UK national, regional, or local levels. However, coordination along the entire river valley would be facilitated by a body that had authority over the entire region. Collaboration between dozens of municipalities is not impossible but would be greatly assisted by the technical expertise and perspective of an organisation outside an individual municipality. A national organisation like the EA could coordinate multiple projects throughout the river valley, and assist local authorities with specific sites and land use plans. In addition, while autonomy in UK planning has been increasing, overarching planning legislation to restrict commercial and residential development in flood prone areas would need to come from a higher authority.

5.3. Who should be involved?

The Thames River flows through Greater London, but also bordering counties on each side. Due to the numerous local authorities, which are responsible for areas along different sections of the Thames, implementation of a comprehensive flood management plan for the Thames would need to be coordinated by the Environmental Agency. While coordination would occur at the national level, considerable planning work would need to be done by local and regional authorities that are affected by the Thames. These would include the Greater London Authority, the Port of London Authority (an organisation responsible for the management of the navigational Thames), Natural England (Governmental advisory body on subjects relating to environmental preservation and green infrastructure), and local planning authorities along the Thames.

A key aspect of the Sigma Plan is the local participation and collaboration, particularly with people who work along or on the river such as fishermen and sailors. The Port of London Authority (PLA) is responsible for over one hundred and fifty kilometres of the Thames River, including maintenance of the river and its navigational and protective infrastructure, as

well and environmental management and conservation (Broodbank, 1921). Similar responsibilities outside the jurisdiction of the PLA are the responsibility of the EA; for example, the Thames Barrier is managed by the EA (Environmental Agency, 2016b). Implementation of a flood protection plan for the Thames River would require the participation of both the Port of London Authority and the Environmental Agency at the very least.

The ecological environment created by flood areas or wetlands would demand the participation of organisations like Natural England, an organisation with experience developing green infrastructure like strategic wetlands in the UK (The National Archives, 2014). The experience with comparable projects and the research and resources they have committed to the advocacy of green infrastructure would make them a useful contributor and a supportive stakeholder. Local citizens should be included in the project through partnerships with local waterboards. Local government should be involved through partnerships with local lead flood authorities (LLFA), and national organizations seasoned with local participatory experience like the Department for Communities and Local Government (DCLG) should be consulted as well. The creation of floodplains as well as any legislative planning changes made to disincentivize development in flood prone areas or the incentivization of migration out of flood prone areas would have substantial impacts on the local social and economic context. This conversation would need to be conducted at the local level and would be reflected in any national spatial planning policy created.

5.4. Barriers and Constraints

A successful policy transfer can be impeded by various factors. In the following, possible constraints, as described by Dolowitz and Marsh (1996), will be discussed concerning the examined policy transfer. The complexity, e.g. complexity of the examined problem or potential side-effects will be considered. Also past policies, current structures and resources (e.g. economic) will be evaluated as potential barriers. Last, subjective perception as proposed by Spaans and Louw (2009) will be regarded.

Complexity as a possible constraint is quite fundamental in flood management. A high degree of complexity makes a transfer more difficult. Flood risk management is very complex problem, made more so by the uncertainty of climate change (Jeuken and Reeder, 2011). The impacts of climate change are uncertain. Therefore, the outcomes of the policy transfer are unpredictable, which hinders the transfer. Adding to the unpredictability of outcome is the amount of value that is at risk: The Thames represents a large region with an immense value,

financially and socially at risk (see 1.1.), which need to be secured over a long timeframe in which the evolvement of the socio-economic sector is uncertain (Klijn et al., 2015).
Furthermore, multiple goals exist: People and infrastructure must be protected, while simultaneously keeping the natural environment intact and the project affordable. However, measures taken sensibly will have a direct influence on flood protection, which as per Dolowitz and Marsh (1996) reduces complexity. It has to be considered that certain measures would take some time before having an effect. It can take several years for an ecosystem to develop in an artificially constructed floodplain (Temmermann et al., 2013).
Furthermore, side-effects of policy transfer can prove impediments. In this case, side-effects would include the loss of space for agricultural purpose or infrastructural land development due to the introduction of flood control areas, which are part of the Belgian Sigma Plan (see 4.3.3.). A further potential side-effect concerns funding. Nowadays, flood defence structures are to some extent funded by private actors that act within a public-private partnership (Alexander et al., 2016). This private funding has to be secured, meaning that private actors have to be convinced by the Belgian approach. Therefore, more effort might have to be put into financial resource pursuing. This would also be the case if the general costs for flood defence increased.
The last point of complexity constraints (as described by Dolowitz and Marsh, 1996) deals with the predictability of outcomes. As already outlined, an immense unpredictability concerning regional impacts of Climate Change exists. Due to the uncertainty of Climate Change it cannot be defined at what time the measures become necessary (Wall et al., 2015) or if they in the end are suitable. However, an increased biodiversity and a healthier environment can be anticipated (Cox, 2006).

Past policies represent another barrier (Dolowitz and Marsh, 1996) in form of path dependencies. In Belgium, politics were held responsible for consequences of flooding and thus altered their management in the 1970s. In addition, the emphasis on hard infrastructure was criticized by environmental groups. During the 1980s, more power was gradually given to the regions and in the 90s, a more holistic water management approach highlighting ecological restoration was introduced. Since 2003 the Decree on Integrated Water Management exists which proves more ambitious in terms ecological restoration than the EU Water Framework Directive (Hegger et al., 2013). Concerning England, it is crucial to keep in mind that flood management is only a permissive duty. Focus used to be on a traditional drainage. Only since 1990s, it had been realized that flood management needed to be more

holistic in terms of taking more than only defence into account. The introduction of the *Making Space for Water* strategy in 2004 represents a policy shift towards holistic management, that takes environmental concerns into account (Hegger et al., 2013). The allocation of responsibilities was rather complex with different components following different laws. Since this century, responsibilities have been shifted more towards the local level (Hegger et al., 2013). This shift towards a more local level however, proves to be problematic in its actual implementation (Johnson et al., 2007). Amongst others, the funding of flood defences is affected which to some extent has to be collected at local level since 2012 (Hegger et al., 2013).

Structural constraints (Dolowitz and Marsh, 1996) are possible since, as already mentioned, flood protection in England is not legally enforced (Hegger et al., 2013). One could assume less effort would therefore be put towards flood protection but considering the creation of the Thames Estuary 2100 plan, this is currently not the case.

England and Belgium are both developed EU-countries (EU, 2016) and therefore have comparably high political, bureaucratic and economic. However, the UK is experiencing recession and in austerity (Meegan et al., 2014) while flood risk management measures are extremely cost-intensive (Alexander et al., 2016) which could hinder the implementation of a new approach despite existing measures. The importance of and therefore priority towards flood risk management needs to be realized. As outlined, despite the British flood risk management structure being nebulous (Hegger et al., 2013), ultimately both countries manage flood risk on the regional level.

Furthermore, the English social model is liberal and not amenable to top-down instructions. Usually plans are proposed and then approved, not the other way around (Nadin and Stead, 2012). Again, the importance of a flood management, which happens at a scale correlating to the scale of the impact has to be realized. This argument accounts as well for the barrier formed by increased planning power of local level (enforced e.g. by the Localism Act 2011), giving politics less influence on planning (Davoudi, 2011).

An obstacle presented by Spaans and Louw (2009) is the subjective perception of a situation. When performing a policy transfer, one has to be aware of the social and political system the borrowed approach is embedded in. In this case, it could be an issue how the wider English public perceives the Belgian approach. Firstly, in a case of flooding, the public will be affected and secondly, they are included in the flood risk management. It should be questioned whether they accept the new measures or prefer the traditional measure. River

restoration as intervention strategy has been present in England for some decades, however focus was put more on channel restoration not so much floodplain restoration (Hegger et al., 2013). However, in other areas of the UK managed coastal realignment, also an alternative to entirely hard infrastructure, has been pursued (Temmerman et al., 2013), meaning that the Belgian approach would not be an absolute novelty to the people.

6. Implementation Plan

In the following, measures to improve flood risk management at the Thames will be displayed and explained step by step.

Step 1 - *Appoint one authority in charge for flood management*

One authority should be defined which resumes the role of the regional management in Belgium. Its function would resemble the Belgian Coordination Committee on Integrated Water Policy, which combines spatial planning with water management. It would be in charge of developing flood management plans and coordinate the implementation with the local authorities. Thereby public participation would be ensured and a collaboration with all stakeholders in order to prevent public antagonism and make use of local knowledge. It could then focus especially on cooperation with organisations such as Natural England, which have experience with green infrastructure. This partnership could thus contribute to the existing knowledge and make flood management more comprehensive. Another important cooperation would be with the Planning Inspectorate, which is experienced in examining and improving plans suggested by the LAs. The Environment Agency, already being a multilevel organisation and collaborating with various stakeholders, is the authority to receive that responsibility. This would avoid the creation of a complete new institutional body. Such step would also help to entangle the existing confusing distribution of responsibilities. This authority would have to be appointed and provided with sufficient financial means by the national government. Since it will provide the basis for all further steps, it needs to be implemented first and as soon as possible. To avoid any legal difficulties, flood management carried out by the Environment Agency should become a statutory responsibility. This is an additional aspect that is likely to take a long time since it contains elemental structural changes. It is however not necessary for the further steps to be implemented.

Step 2 - *Secure funding*

It should be a priority to secure the funding for flood management in order to construct and maintain protection measure. Therefore, it needs to be ensured that local authorities are not dependent on private actors to obtain the financial resources and are provided with sufficient finances to implement measures that have been agreed upon in a regional authority. Too much value, socially and financially, is at stake to risk insufficient financial means. In Belgium, flood risk management is financed by tax income, meaning financial means are provided by the government. This is also the case in the UK but in the course of decentralization financial responsibility was shifted towards the local level that would enter partnerships with private actors. This does not need to be reversed, however, funding through the national government must be arranged in case LAs cannot accomplish required financial means. Since it (still) is mainly public money paying for flood risk management this step is not requiring extreme changes. The responsible regional authority as formed in step 1 should also be in charge of managing and distributing the funds, which is already the responsibility of the EA (Alexander, 2016b), therefore simplifying the process. The step should be taken along with the nomination of the Environment Agency as responsible umbrella authority.

Step 3 - *Establish a system of incentives and disincentives to decrease development in flood prone areas*

An essential aspect of the plan is to decrease the amount of development along the Thames in flood prone areas like naturally occurring floodplains. This can be done through a process of incentives and disincentives to increase the migration out of flood prone areas and decrease new development in those areas. This is important as a spatial planning strategy to give more room for ecological based flood defence along the shorelines and to mitigate the damage of particularly strong flood events. These incentives could come from any level of government but would best be coordinated at the national level. The EA will be the organisation responsible for establishing zones of risk and can collaborate with local authorities on the specifics of both incentives and disincentives in that area. This step should be taken shortly after step one (and two) and the establishment of the EA as the umbrella organisation responsible for the coordination of this plan. This system of voluntary relocation will be most useful outside of the city of London, where the population density is lower, property values are lower, and there is a larger geographic area to defend from the river. The intention of this

system of incentivised voluntary migration is to encourage future development to take place in areas less prone to flood. The intention is not to relocate downtown London but to guide future urban development.

Step 4 - *Creation of Flood Areas and Wetlands*

Ideal locations for the creation of strategic flood areas and ecological wetlands will be determined by the contours of the river valley, local development, and a myriad of geographic factors. These areas will be determined by the EA in order to minimize the influence of private interest and power relations at the local level. These flood areas will be slowly drained to allow the development of ecological wetland habitat which in certain areas can be used for recreation and urban beautification. In addition to the aesthetic and ecological value of the flood areas, they will be used to mitigate the risk of both pluvial and fluvial flooding as well as the impact of storm surges. The areas will be identified by the EA who will take into consideration advice from Natural England, PLA, DCGL, LLFA's, and local planning authorities and waterboards as well as suggestions from the public. The implementation of the projects will be conducted by local authorities. These projects would require the national funding proposed in step two and could begin any time after a budget has been decided.

These steps to some extent require major changes in organisational structure and in the type of flood protection measures. However, processes as the decentralization show that structural changes are possible and approaches such as managed coastal realignment prove that alternative measures can be applied successfully. Funding is a major obstacle and can only be approached by making flood management a priority. Considering the future uncertainty and value that is at stake, this priority should be granted. Then, a success of the implementation plan can be expected. This proposed plan contains the alternative flood management that was asked for in the research question and indicates how it can successfully be implemented.

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Feedback points Group 9 from Group 11

Title Page

- The title page is simple but effective, but could use visual attraction to make it more conspicuous.

Abstract

- The abstract is not a chapter. You better put it before the table of contents.
- The abstract is rather nice. We really have a sense of what to expect in your report and the abstract itself was an understandable story.

Ch. 2 Introduction

- We think it is a convincing story, with properly argued issues of the Thames protection.
- Please make the picture bigger to make it more clear as it is not adding that much when it is not well visible.
- You talk about England sinking due to tectonic movements, but you should make this argument stronger by using numbers. On the other hand you maybe could just leave it out as this is a rather stationary process of the earth and is thus not especially relevant for the England.
- The introduction is a convincing story, with properly argued issues of the Thames protection. We do have a question you could think about: Why has the government not solved this problem themselves yet? You talk about how they implemented retroactive measurements, but if these are insufficient, why would they not come up with answers themselves?
- What we really liked about your 2.2 (about the planning policies in England) is that you put a 1.5 sentence summary of what the paragraph meant for the bigger picture. Gives the reader a focus on what's important when reading.
- The research question needs to be highlighted a little bit more, e.g. with a bullet point or make it *italic* or **bold**. But it is good that you state how your are going to solve the problem.
- 2.2. Check the words "no duty" and "permissive"; they seem a bit unsuitable. Overall we found the parts of the current policy trend and responsibilities well structured.

Ch. 3 Selection of cities

- Why do you only have a figure for the Belgium case? It's unnecessary to show pictures of all countries, but maybe it's better to move the picture a little further down the report and show it once the reader knows what country you picked.
- We feel like you should elaborate on where you want to go with your report at the start of chapter 3. Why are you now suddenly picking donor countries (explain that you

want to learn from other countries), what type of area are you looking for (Thames is on a city, maybe region level, while you state that you want to pick an entire country to learn from). Also, you could elaborate on why you picked these selection criteria: are you looking for the most similar case? And if so, why? Why do donor countries need to have similar climates and why are you looking at space requirements when? Some of the criteria you can kind of guess because they're implicitly mentioned before, but you have to explicitly talk about your reasoning for picking them. One last remark is that you talk about these criteria, but don't mention how donor countries have to relate to them: do they have to excel at these criteria, be similar to the England case, or be very bad on something in order to learn from it? That's crucial information when picking a donor country.

- In 3.4 you probably should use the Dutch translation of the project 'Ruimte voor de rivier' in brackets behind the english translation.

Ch. 4 Picking preferred country

- We like that you picked 3 possible donor countries, as it offers more variety and probably a better preferred choice in the end. We also like the table comparing the criteria in the 3 countries, but it would be a nice addition to put England in the table as well. You have some proper arguments for choosing Belgium, which you made clear quite convincingly.
- Although both countries (Belgium and England) are part of the EU, England/UK isn't following EU directives (especially with Brexit coming).
- An idea for strengthening your choice of preferred donor country: spend a couple of sentences on repeating why you prefer Belgium at the end of chapter 4.

Ch. 5 Comparing context

- Sentence: "province of flanders has slightly higher average: 41.800" does not have a sense. Therefore this could be eliminated. Also use € sign instead of "euro's", or make it euros (instead of euro's). Include the "figure" by Eurostat. Or did you mean the Province of Antwerp (to compare to Flanders as a whole; we couldn't figure that out).
- You mention 'the British system' in the title of chapter 5, but it's the UK or English system, as Great Britain is not the United Kingdom.
- Elaborate more on your DESTEP table. You could just include the table without references in the text.
    - Within the DESTEP, with regard to the environmental characteristics, you could add some numbers of temperature. What is "average temperature" and "precipitation".
    - Within the DESTEP, with regard to the socio-cultural characteristics, you should check the source.
    - Within the DESTEP, with regard to the political characteristics, you refer to 4.2.1 and 4.2.2, but these parts do not exist. We think you're referring to parts 5.2.1 + 5.2.2.

- Within your DESTEP, when you're talking about political characteristics, you're talking about the planning system of both England and Belgium. What we think is meant with politics here however, is about the political context of the country, so e.g. whether there's a dominant right-wing or left-wing government. That's also the reason why the context of DESTEP and planning system were mentioned separately in the assignment description.

Ch. 6 Policy transfers

- The questions that you're going to look into are a nice addition! It gives the reader a sense of what to expect and what to pay attention to. Could use that in other sections as well!
- The chapter is structured very nicely, so well done.
- You chose policy transfer instead of lesson drawing, but you don't explain why. So an explanation would be great.
- You talk about the constraints and limitations for policy transfers quite elaborately. This makes it seem less likely to be able to learn lessons at all, so what you could is talk about how to move around these barriers or how to create opportunities or possibilities (which you don't mention at all).
- You don't explain why you picked emulation and what emulation is, you only quickly mention it in the implementation plan. However this is too late and again not explained. So we suggest you put it at the beginning of the chapter.
- Please explain what a success is or refers to, to make it objective.
- On the second page of chapter 6.4 (p.28) you talk about how past policies form a barrier, this is path dependency, we advise you to refer to this in the text.

Ch. 7 Implementation plan

- In step 3 you mention it should come after 1. Shouldn't it then be step 2?
- Really well structured steps and argumentation of who should do what, when and why.
- The last paragraph is simply there, is it the summary or just a reflection? Please have a look at this.
- We also did not really find an answer to the research question.
- There's a major limitation for your step 3, as England is a liberal market system, which basically means that local governments don't have power over developments by landowners. Knowing that, your step 3 seems slightly too easy and could be made stronger by thinking about how you could give local authorities more power / making it less attractive for landowners to develop next to the Thames in flood prone areas.
- Mention in step 4 why wetlands are so important that you want to create them.

Referencing

- Referencing in text is fine, many different sources and most of the stronger statements use references. Your list is consequent in referring, so well done.

- In some figures (4 for example) you don't refer to a source. If it's your own work, put in ''source: authors'' (and possibly '', based on x and y'').
- Dutch surnames beginning with *van* when you only use the surname it will become *Van* (e.g. Van den Hurk et al., 2014 instead of van den Hurk et al., 2014).
- Referring to multiple sources should be done with a semicolon (;), not the word 'and'.

General

- The overall language looks fine and professional. Some smaller spelling mistakes, although there are very few, so good job on that!. A few examples: ''*a sift*'' > ''*a shift*'', ''*transfered*'' > ''*transferred*'', "euro's > euros". Most of these got picked up by our Word grammar check, so just use that once and you should be fine!
- There is a minor inconsistency: you put the description of tables on top of the table, while the description of figures are below the figures. We suggest you put everything either on top or below of figures/tables for consistency purposes.
- Also, be consequent with use of British and American English. For example: one time characterization is written with a z, the other with an s.
- Sometimes you use the word extreme in front of e.g. financial risk, be consistent in this explain what you mean with extreme. By using an example after the first time you use 'extreme' in text this will be clear.
- Figures and tables were informative and valuable to your report. But do always make sure to refer to a table/figure in text as well (which isn't the case for figure 1 / tables 1 to 3).
- All in all, we find it a very comprehensive and strong report, and it was a joy to read! Good job guys!

CRPP Peer review from group 12 for group 9

Title: Flood Mitigation Alongside The River Thames – Policy Transfer from the Belgian Scheldt Estuary for Integrating Alternative Measures.

Part I

Summary

Abstract: The main elements for a summary are there (aims, introduction to the problem, methods and a solution to the problem), however, none of the information is referenced in the abstract.

Problem definition; causes and consequences of the problem are well defined, also connected to the context of the recipient country, explained why the problem has not been solved so far, convincingly stated relevance and urgency of a comparative analysis**.**

Introduction: The introductory section does a good job in explaining the problem that has been identified in England, which is the point of this section. However, it only states the

build-up of the report in one short paragraph on page 3 without justifying those choices and does not introduce the donor country at all. Even though this might not be in the task description, it will create a better understanding for the reader to have a bit more of an overview on the report and to quickly touch upon the fact that you are using Belgium as a donor country (and for which purposes). We like the fact you pointed out that you will not take the Brexit into account.

Inventory of potential counties for lesson drawing; reasonable and transparent selection criteria, well explained overview of potential countries, convincing assessment per country and explanation of what (configurations) of conditions potentially contribute to the success of the solution / policy / method.

(2) Inventory of Donor Countries & (4) The Scheldt River in Belgium as Donor Countries: In chapter 3 you suddenly propose the selection criteria, without explaining why you are even looking at international donor countries (this should be argued with the mandatory literature on comparative research). The selection criteria are then 'explained' without actually concretely referring to them in the context of England (or the Thames). This does not really convince your reader of the criteria you choose. Then you just start discussing the three potential donor countries (as if that is the inventory) while the inventory should actually be based on the selection criteria that you established. Right now the selection criteria don't have anything to do with the rest of the chapter. In chapter 4 you then start assessing the three potential donor countries based on the selection criteria (which should have been in chapter 3 and where you could then dismiss two out of three countries based on those criteria. **Selection of country for comparative analysis;** well-constructed framework for systematic analysis based on academic literature, properly informed selection.

There is a chapter specifically directed at Belgium as a donor country (4), however it is not in the format as was meant. It does not adequately state a justification for choosing Belgium, but rather just discards the other two countries (which should have been done in the previous chapter). A provisional comparison between England and Belgium lacks, and the criterion on which you eventually select Belgium: *"due to the artificial disconnection of the Rhine to the sea and the longer history of the Sigma Plan, the Scheldt River in Belgium is the favored donor"* (Group 9, p.10) is not the criterion that you tested the country on based on your selection criteria. Also we were surprised of the choice for the Dutch Room for the River programme as one of the potential donors, because of its focus on rivers instead of the estuary region (which is focused on in the Deltaplans).

Also there is no chapter that discusses the academic literature on comparative research that was mandatory to read and include in this section. We think you want chapter 4 to be directed at the justification for Belgium, but right now its rather fulfilling the requirements for the previous section (by comparing Belgium with the other two examples) instead of justifying your decision by comparing it primarily with England based on the selection criteria. It never states that you are now looking at Belgium (except for in the title) and therefore gives no indication as to why you are comparing Belgium with the other two countries (if that is even the task) instead of a comparison with England. The way you have phrased it now indicates that you are going to be comparing all three examples to each other, while you end up comparing only Belgium to the Netherlands, and Belgium to the USA (and not the Netherlands with the USA).

Part II

Comparison between two countries; complete, structured, connected to the criteria in Part I and well-embedded in literature.

(5) Comparison of the Belgian and British Systems: This chapter seems to do its job well structure-wise. The only problem we see in the comparison is that the concepts of Flanders (as a region), Flanders (as the two provinces of East and West Flanders), the Flemish Region, the province of Antwerp, and the city of Antwerp are used interchangeably. While Flanders (as a region; 'het Vlaams Gewest') is actually not the same as the Flemish Region (which includes every part in Belgium where people live that speak Flemish, and thus also includes parts of Brussels and Wallonia). Also, in the literature the concept of Flanders sometimes refers to the two provinces of East and West Flanders (which are two provinces within the Flanders Region or 'het Vlaams Gewest') while you use it as the bigger region, and on provincial level you would actually have to be talking about the province of Antwerp then.

Clearly defined and explained opportunities for lesson drawing/policy transfer; overview of barriers and constrains backed up by literature.

(6) Policy Transfer: There is not a lot of reference to the mandatory literature on policy transfer in the first three sub-sections (6.1, 6.2 and 6.3) in 6.4 there is a little bit of reference to the literature, but not sufficient to justify all of the statements that you make throughout the chapter. Furthermore we think you covered all of the aspects, they just need a theoretical background to justify why you look into those elements.

Implementation plan; concrete, well-defined steps, realistic evaluation of the possibility for success (explanation why the transfer/lesson will work in recipient country).

(7) Implementation Plan: It is clear what you want to do for the Implementation Plan, the only problem we think you need to address a little more is that you are transferring something that in Belgium is done on a regional level and by a regional Decree (which follows a very strong hierarchical structure with regards to the national plans in Belgium) while you use the Environment Agency as the main authority in your Implementation Plan, which at this moment is responsible on a national level, and covers a much bigger area than the Flanders Region. Is this feasible? Also, the EA's responsibility on the national level means that it does not have anyone telling them to take on new responsibilities in the way that Belgium does. To sell your plan to the English planners, you will have to convince your readers of the feasibility of your plan.

General components & advise

Components

Title page Present and complete

Summary Present, see above

Table of contents Present and complete. Thumbs up for the use of word' s tools and the list of figures. Maybe the list of tables can use some extra attention. We also liked the addition of the list of abbreviations, very useful!

Reference list: Present and looks complete

Spelling The report uses American-style English while talking about the UK, which sometimes feels a little weird because of the interchanging of words like 'program and programme' in an English context. Also some typos could be found in the references, but in general a good use of words.

Peer-assessment form Not yet present

Appendices There are no appendices. They are not necessary, but might be useful for adding the peer-assessment form and peer-reviews. Also we think it might look more professional to add the overview maps (figure 1&2) in large to the appendices.

Advise

To summarize we advice you to pay especially attention to:

- The structure and format of part I,
- Strengthening your arguments with the mandatory literature and additional references,
- Look into the different Flanders and solve the interchangeably use of them

Response to Reviewers

General and Structure:

We realized that our report needed a better structure in terms of explaining what we were doing and why. We tried to improve this throughout the report, thereby using methodological literature as back-up. We also indicate the structure of our report more clearly within the abstract. With think this and guiding the reader more throughout the report is sufficient and no extra section on the build-up of the report is needed.

The main obstacle in Part 1 was the selection of a donor country, which was according to the suggestions reorganized. Also consistency, e.g. concerning British or American style of writing was established. Other suggestions as highlighting the research question and making our title page more attractive were applied.

The words 'no duty' and 'permissive' concerning British flood management were questioned. However, these are used in literature and also in the lecture about planning in the UK, therefore we did not change them.

Donor Country:

Concerning the selection criteria we implemented some of the feedback. As already stated, we tried to be more explicit about what we were doing and elaborated on why we were looking abroad and that we were looking for another river(basin) hosting a city in the section of the research question. Yet, we believe to have explained why we chose those criteria sufficiently and also referred to the British context (e.g. by saying that floods should be similar). This becomes more concrete now with the added row in the table representing England. This was definitely missing before! As suggested by our reviewers we included more literature on what methods we base our selection of donor countries on. As mentioned in the structure part, we reorganized our selection of the finally chosen donor country.

Contextual analysis

Most of the feedback about the contextual analysis was rightly given and has been implemented. There were some questions regarding the definition of the region of 'Flanders'. Now a more explicit explanation is being given on the region and what is meant by it. Also, all elements that are in the DESTEP table are now being discussed and explained in the text, which was not the case before. Some parts of the table were indeed referring to non-existent parts, which we changed now. Furthermore, the environmental characteristics are now

supplied with numbers, such as average temperature and average precipitation. All in all, the contextual analysis should now be more complete and more suitable for making comparisons between the countries.

Policy transfer:

As suggested, we included more methodological background in this chapter, though we did not elaborate more on why we chose emulation, because we stated that once and during lecture is was said to only say why we chose the type of transfer but not why we did not choose other types of transfer. We also moved this part to the beginning, thus explaining beforehand what we are doing. It was criticised that there was not enough literature throughout the chapter. This is due to the fact that we stated once in the beginning whose author`s suggestion we are using and then applied it without referring to the author again (e.g. Dolowitz and Marsh`s constraints). Now, we are referring to it more often, since the sections are quite long.

Implementation Plan:

The EA as the one authority to manage flood risk was question, because it was a national organization. However, to our knowledge, it is a multi-level organization which would therefore combine well the need of a larger scale concerning the management and the attention towards the local level. Furthermore, by making FRM a constitutional duty and appointing the EA to carry out this duty, it could very well be told 'from above' what needed to be done (a further point that was criticised). For these reasons, we did not alter step 1 (apart from the supervisor`s feedback) in our implementation plan. The (dis-)incentives are on voluntary basis therefore not crossing with the liberal economy, which was stated to be a limit to step 3. We address wetlands as ecosystem-based measure to reduce flood risk throughout the report, therefore, it is not explained again the implementation plan (as was suggested).

All in all, the feedback was very helpful in realizing what needed to be improved.

Appendix 2: Peer Evaluation form

This evaluation form is to be used at the end of the course for the distribution of group grades. Please fill in the as a group and add it to the final version of your report

Basic Information

Group (name/number) and title of the report:

Please briefly describe the role and task per group member for the group assignment.

Example: Member (name), Role/Task: Devil's advocate/Helped to push other members to think outside of the box, 2) Member (name), Role/Task: Chairperson/Helped to keep discussions in order etc.

Anna Kuhlmann: coordination of group work, organised 'in house' deadlines within group work, initiator, Movie narrator

Malcolm Martin Simpson: critical voice, thinker outside the box, grammer checker, Movie director, lead actor, Chief editor

Joost de Regt: Team worker, Researcher, Camera man

Christian van Uth: Team Worker, worked individually even when being on excursion

Jana Brinkmann: Format editor & reference list supervisor, Movie editor

Evaluation

In order to judge the contribution of each individual in the group the group has to decide on and fill in a score sheet indicating the share of the workload (in % with the overall work being 100%) that was covered by each individual in the group. The group needs to agree on the distribution and all group members need to sign the distribution sheet and hand it in with the final report. In ideal the work-load would be shared equally between all members of the group (20% per individual in the case of a group of 5 or 25% per individual in the case of a group of 4 and so on) and also indicated as such by all group members individually. Unless this is not the case, the grades for each individual member will be calculated using a formula which calculates each individual's grade based on the overall group score/grade and taking into account the distribution in percentages. In the case a group chooses for a differentiation in scores, three rules apply:

1. if a contribution is below / equal to 5%, the student is required to do a replacement assignment (so 10% of input is considered the minimum in groups of 5)
2. a formula is used to calculate the grade; average grade + average grade x (contribution of student in percentage – 1/number of students) > this formula thus gives a student with 15% contribution in a group of five also a 5% lower grade (i.e. with a 7.0 as group grade this would be: 7.0 + (0,15-0,20)*7.0 = 7.0 – 0.35 = 6.65. ; while a student with a 25% contribution in this group will get a: 7.0 + (0,25-0,20)*7.0 = 7.0+0,35 = 7.35
3. no grades higher than a 10

Member 1: Name, Student no., signature :
Dana Kuhlmann, S3219216 A. Kuhlmann

Member 2: Name, Student no., signature :
Malcolm Martin Simpson, S2067495 Malcolm Simpson

Member 3: Name, Student no., signature :
Jeroen de Regt, S2380692

Member 4: Name, Student no., signature :
Christian van Urk, S3035540

Member 5: Name, Student no., signature :
Jens Brinkmann, S3225335 J. Bri

Assign the appropriate percentage to each member.

Please fill this in *after discussions with your group*. The percentage should reflect the contribution of the group member to the assignment. Of course, the percentages will change depending if you are with 4 or 5 members in a group. Please be aware that the total percentage has to amount to 100%.

	0%	5%	10%	15%	20%	25%
Member 1	○	○	○	○	✕	○
Member 2	○	○	○	○	✕	○
Member 3	○	○	○	○	✕	○
Member 4	○	○	○	○	✕	○
Member 5	○	○	○	○	✕	○

By handing in this form you agree on the above distribution of the total group score. This means that you have all agreed as a group to abide by the assigned percentages.