Assessment of impact of storm water overflows from combined waste water collecting systems on water bodies (including the marine environment) in the 28 EU Member States

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Final Report for Task 1.3

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1 AIM AND SCOPE

This study is part of the European Commission (DG Environment) project '*Assessment of impact of storm water overflows from combined and separate waste water collecting systems on water bodies (including the marine environment) in the 28 EU Member States*'.

This is the final report of the deliverable expected under Task 1.3 of the project. This report builds on earlier reports developed in this project, i.e.

- Report on the overview of the EU legal and policy context for storm water overflows and the US framework on storm water overflows (both covered in Task 1.1)
- Member state fact sheets developed under Task 1.2, consisting of the Member State legal and policy framework in addition to technical information on storm water overflows, such as data on the sewer network and overflow structures, the occurrence and monitoring of storm water overflows

While work at these previous stages has provided valuable information for Task 1.3, this information gathering also indicated important gaps in information that limit the extent to which this task can provide outputs across all Member States, such as the total volumes of storm water overflows or the cost of reducing these. The following points summarise the results that this report provides:

- A comparative analysis of the available data on storm water overflows in Europe, based on the Member State fact sheets developed under Task 1.2. The Member State fact sheets contain information on the legal and policy context with respect to storm water overflows, in addition to information on the technical aspects of the management of storm water overflows (such as the existing infrastructure, monitoring and understanding of the occurrence)
- A qualitative assessment of storm water overflows, based on indicators scored on the information contained in the Member State fact sheets
- The analysis of the UK case C-301-10 Commission v United Kingdom (2012)
- A methodology for a first-order calculation of the occurrence of storm water overflows in the EU, including a pilot application for Flanders, Belgium
- A gap analysis of the data that is missing throughout the EU
- Recommendations to further develop the knowledge base
- Proposed further actions to the Commission

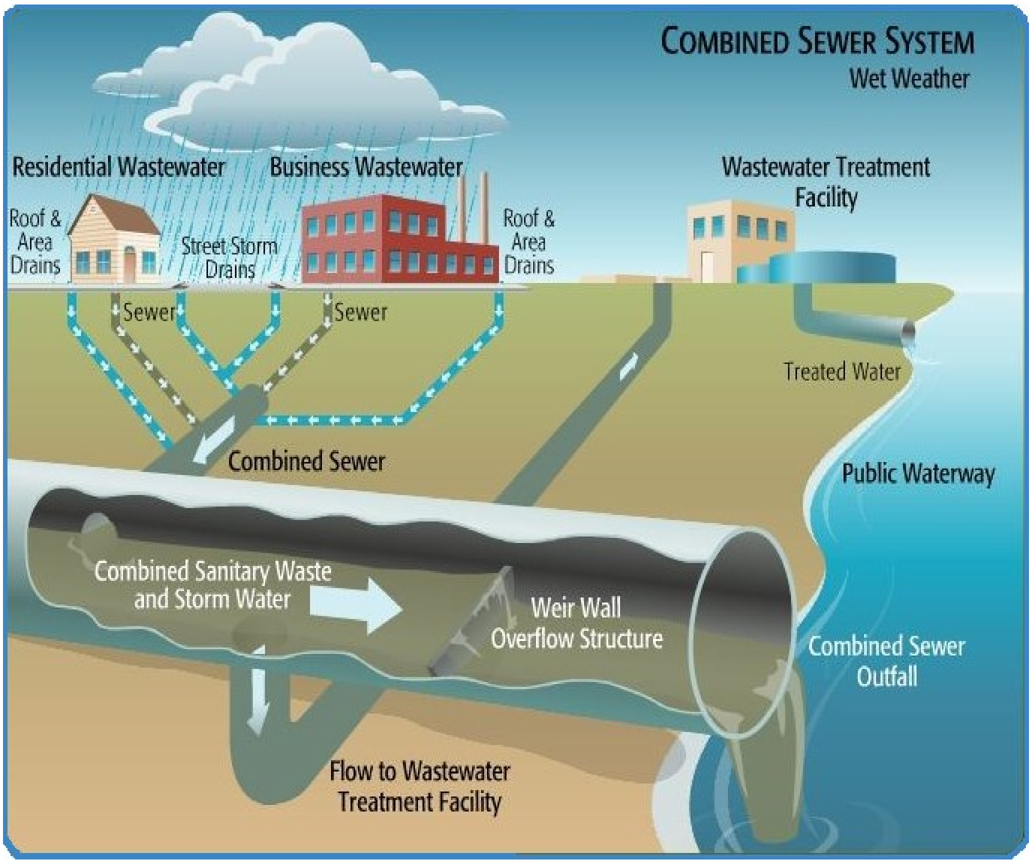
2 INTRODUCTION

2.1 WHAT ARE STORM WATER OVERFLOWS?

During heavy rain events, the capacity of combined sewer systems which collect domestic (residential) waste water, waste water from certain businesses and rain water runoff, may be exceeded. As a result, the system discharges the water excess, aiming to relieve waste water treatment works from the risk of being flooded. The excess water – which is polluted – will be discharged directly and untreated in a receiving water body, such as a river or coastal water. These so-called 'storm water overflows', presented in Figure 1, are typically events of short duration. Synonyms for storm water overflows are combined sewer overflows (CSOs) and sewer outfall.

Storm water overflows contain chemical and microbiological pollution, hazardous substances and plastic litter, which can pose a health risk to humans, animals and the environment. The magnitude of the impacts of polluted storm water overflows depends on the frequency, duration and severity of storm water overflow events, as well as the quality of the excess water that is being discharged. The environmental impact of a storm water overflow event is defined by the conditions of the receiving water body. Water bodies that are most at risk for storm water overflows are water bodies that have one or more of the following characteristics: rivers with good or high ecological status and good or high chemical status, small or seasonal streams and stagnant (or slow moving) waters. In addition, the risk to human health is higher where people are exposed to the polluted water, e.g. through bathing or other water-related leisure.

Figure 1: Scheme explaining the concept of storm water overflows, termed in the figure as combined sewer outfall. Source: Kentucky Water Utility, Henderson, US



2.2 WHAT TRIGGERS A STORM WATER OVERFLOW?

Storm water overflows occur when the capacity of the pipes and / or the waste water treatment plant (WWTP) are exceeded. The processes that trigger a storm water overflow however are complex, highly context-specific and depending of many parameters, including:

- **Rainfall variability**, e.g. the frequency, intensity and duration of rainfall events, including the likelihood of unusual rainfall and seasonal variability. Also important is the recurrence of the unusual rainfall; unusual rainfall shortly after a first rainfall event will likely result in bigger overflows since the storage capacity is still being depleted from the first rainfall event.
- **Area of impervious (sealed) land connected to combined sewer systems**; Rainfall on impervious land will run-off into the sewer system and substantially increase the flow that is to be processed in the system, thereby also diluting the waste water. The building of natural water retention measures can reduce the volume of rain water entering collecting systems. The way a city is urbanised may have an influence on storm water overflows
- **Proportion of combined sewer system:** storm water overflows are associated with combined sewer systems. The proportion of combined sewer systems compared to separate sewers thus provides an important indicator of the extent to storm water overflows will be a concern.
- **Storage capacity in the sewer system:** the storage capacity of the sewer system for water defines how much storm water can be stored in the system, before it is discharged untreated into the receiving water body. The capacity of the sewer system is often designed with a maximum dilution ratio in mind, i.e. by which factor can waste water be diluted with storm water before being discharged as storm overflow; Also, the landscape is a strong determinant in the design of a sewer system, e.g. a lowland country with a high groundwater table is likely to have a substantial number of pumping stations and associated overflow structures.
- **Operational parameters** such as the failure of pumps or not optimal usage of pump capacity increase the occurrence of storm water overflows. Korving et al. (2006) [1] showed for the Dutch cities of Amsterdam and Rotterdam that sewage pumps fail relatively often due to the composition of sewage and the discontinuous operation of the pumps. The operation and maintenance of pumps is hence an important parameter in assessing the risk for storm water overflows.

[1] Korving et al., 2006. Failure of sewage pumps: statistical modelling and impact assessment. Water, Science & Technology 54 (6-7) 119-126

3 METHOD FOR THE QUALITATIVE ASSESSMENT OF STORM WATER OVERFLOWS

Several methods exist to assess the occurrence and impact of storm water overflows. Most methods are typically applied at the level of a sewer system or an individual storm water overflow structure and are data-intensive. The optimal method to assess the occurrence and impact of storm water overflows is the combination of on-site measurements (monitoring) with hydrodynamic modelling. Ideally, parameters such as the technical designs of sewer systems, rainfall variability (including the likelihood of unusual rainfall) and the area of impervious (sealed) land from which storm water is running off into combined sewer systems should also be considered during such assessments. Due to data gaps at Member State level, it was not possible to determine the occurrence of storm water overflows in the European Union in a quantitative and data-intensive way.

Instead, a range of key indicators were scored in a qualitative manner, based on existing publications, data sets and expert judgments. To assess the risk on storm water overflows, firstly indicators have been developed based on the above parameters. Secondly, the indicators have been scored qualitatively (as "-", "+" or "++"). The indicators, together with their information base and an explanation of the scoring system are explained in this section.

3.1 SELECTED INDICATORS

In total, 9 indicators have been developed for the qualitative analysis. The indicators are split up in two categories. The indicator categories are on:

- Storm water pressures (4 indicators)
- Availability of key data on storm water overflows (5 indicators)

The first indicator category is composed of 4 indicators, all relating to the amount of storm water prior to being collected. The indicators in the first category are compiled based on EU-level information. The indicators, together with their information source, are shown in Tables 1-2.

Table 1: Overview of indicators in the category 'Storm water pressures'

Indicators	Information source	Period covered
Number of heavy rain events	European Climate Assessment & Dataset project (ECAD)[2]	1980-2014
Number of major flood events	European Past Floods database EEA[3]	1980-2014
Impervious area	High Resolution Imperviousness data[4]	Imperviousness: 2006
Proportion of combined sewer	MS fact sheets developed in Task 1.2	Current

The number of heavy rain events (indicator 1) has been provided by the European Climate Assessment & Dataset (ECAD). ECAD contains data series of observations from more than 10,000 meteorological stations through Europe. More information on why ECAD has been chosen in this project is explained in section 2.3.1. The data extraction from ECAD is done for illustrative purposes of which data is available. More in-depth statistical analysis would be required to further use this data for the purpose of calculating the occurrence of storm water overflows. ECAD forms the backbone of the climate data node in the Regional Climate Centre of the World Meteorological Organisation (WMO). Three parameters from ECAD are used: the number of wet days (> 1mm of rainfall, parameter 'RR1'), the

[2] ECAD - http://www.ecad.eu/indicesextremes/customquerytimeseriesplots.php
[3] EEA European Past Floods - http://www.eea.europa.eu/data-and-maps/data/european-past-floods
[4] Imperviousness data - http://land.copernicus.eu/pan-european/high-resolution-layers/imperviousness/imperviousness-2012

number of days with heavy rain (>10 mm, parameter 'R10mm') and the number of very heavy rain events (>20 mm, 'R20mm'). Also the ratio of the number of heavy rain days compared to the total number of wet days is used. Further information on the methodology used to describe the extreme rainfall events is published in van den Besselaar et al. (2012)[5]

Indicator 2 is based on the recent dataset of the EEA on 'European past floods'[6]. The database is compiled from floods reported under the Floods Directive and major floods reported to the EM-DAT international disaster database.

The impervious area (indicator 3) is calculated at Member State level from the 2006 High Resolution Imperviousness Data, a product from the Copernicus land monitoring services. A new data layer on imperviousness with 2012 as the reference year is currently being validated.

Indicator 4 shows the percentage of combined sewers relative to the system as a whole.

The category on the available data on storm water overflows is composed of 5 indicators. The indicators refer to the different aspects of storm water overflows, starting from the technical characteristics of the sewer system (indicator 5) and the overflow structures (indicator 6).

The indicator on the occurrence of storm water overflows (indicator 7) assesses both the potential for storm water overflows, based on the technical design of the sewer systems and measurements on actual overflows.

Indicator 8 assesses the extent to which monitoring of overflows takes place and thus partly overlaps with indicator 7. Indicator 8 however focuses on the monitoring network rather than on the measurements (covered in indicator 7).

Finally, indicator 9 assesses whether the data is available at the national or regional level. If data is collected at local level by municipalities or waste water utilities, this indicator also addresses data sharing from the local level to the regional/national level. All indicators under this category are scored on the basis of the Member State fact sheets developed in Task 1.2. In addition, for the indicator on storm water overflow occurrence, also the data on short-term pollution events for bathing waters, as reported by Member States for the 2014 bathing season under the Bathing Water Directive, are used.

Table 2: Overview of indicators in the category 'available data on storm water overflows'

Indicators on the available data	Information source
Sewer system (combined/separate pipes)	MS fact sheets developed in Task 1.2
Overflow structures	MS fact sheets developed in Task 1.2
Storm water overflow occurrence	MS fact sheets developed in Task 1.2 Short-term pollution events reported under the Bathing Water Directive for the bathing season 2014[7]
Monitoring of storm water overflows	MS fact sheets developed in Task 1.2
Data availability at national/regional level and public information	MS fact sheets developed in Task 1.2

3.2 DESCRIPTION OF THE SCORING SYSTEM

The indicators are scored by means of three categories: "-", "+" and "++". The scores have a slightly

[5] E.J.M. van den Besselaar, A.M.G. Klein Tank and T.A. Buishand (2013). Trends in European precipitation extremes over 1951-2010. International Journal of climatology. 33(12):2682-2689. October 2013.
[6] http://www.eea.europa.eu/data-and-maps/data/european-past-floods
[7] MS reports under the BWD - http://www.eea.europa.eu/themes/water/status-and-monitoring/state-of-bathing-water/country-reports-2014-bathing-season

different meaning for each indicator. An overview of the scoring system used is shown in Tables 3-4. For each category, also an overall score is calculated as the average of the scores for the indicators under the category.

Table 3: Scoring system for the indicators on 'storm water pressures'

Indicators on the available data	Scoring system
Number of heavy rain events	Less than 30 percentile scored "-" Between 30th and 70th percentile scored "+" More than 70th percentile scored "++"
Number of major flood events	
Impervious area	
Proportion of combined sewer	

Table 4: Scoring system for the indicators on 'data availability'

Indicators on the available data	Scoring system
Sewer network (combined/separate pipes)	Member States with no data (or no data publically available) were scored "-" Member States with estimates (either from reports or expert opinions) scored "+" Member States with precise data scored "++"
Overflow structures	
Storm water overflow occurrence	
Monitoring of storm water overflows	Member States with no evidence of a national monitoring systems were scored "-" Member States with some evidence of a national monitoring system were scored "+" Member States with substantial evidence of a national monitoring system were scored "++"
Data availability at national/regional level and public information	Member States with no data available were scored "-" Member States likely to have data available at municipal level or held by water utilities but have no central data base scored "+" Member States with a central data base and/or publically available data were scored "++"

3.3 RESULTS OF THE INDICATORS ON STORM WATER PRESSURES

An overview of the indicators under the category 'storm water pressures' is shown in Table 5-6. These indicators have been scored based on available, quantitative EU-level data. The values upon which the indicators are scored are shown as well in Table 4-5 and are referred to as indicator 'values'. As shown in Table 3a, the scores have been defined in function of the percentile distribution: less than the 30th percentile scores "-", between the 30th and 70th percentile scores "+" and above the 70th percentile scores "++". The purpose of indicator scores in Table 5-6 is to qualitatively assess the risk for storm water overflows based on the storm water that may be collected. The assessment is considered to be a first indicative assessment. The indicator values have been calculated based on Member State averages, and may disregard important aspects that have been levelled out in the averaging, for example differences within Member States.

3.3.1 Number of heavy rain events & Rainfall variability

Rainfall variability is different across the EU. One rainfall event leads to a storm water overflow while a similar rainfall event on another system may not lead to an overflow event. The likelihood for exceptional rainfall events is different across the EU. What is exceptional rainfall for one Member State is normal to others. To assess which rainfall is exceptional for a particular agglomeration and thus under which conditions storm water overflow may or may not be accepted, rainfall statistics are required. While this data may be available e.g. at meteorological institutes or universities, it is not readily accessible, or directly useable to assess the occurrence of storm water overflows.

For the calculation of storm water overflow events, a good understanding is needed on rainfall variability. Typically, rainfall variability is described by its intensity, frequency and duration and consequently visualised in so-called “IDF curves”. IDF curves describe rainfall variability for individual meteorological stations. An example of an IDF curve for Bratislava, Slovakia is shown in Figure 1. The numerical form of the IDF-curve is called the IDF-relationship.

An alternative data source to describe rainfall variability was found on the European Climate Assessment & Dataset project (ECAD)[8]. ECAD contains data series of observations from more than 10,000 meteorological stations through Europe. For the purpose of illustrating which information could be extracted from ECAD, data for the Member State capitals have been extracted. Whether the data can be used for the actual calculation of storm water overflows could be the topic of a new project. The publicly available information is vast and would require extensive data analysis.

Considering that the UWWTD only allows storm water overflows under exception circumstances, the analysis of the proportion of heavy rain days (>10 mm) compared to the overall number of wet days (>1 mm) is assessed for the MS’s capitals. The proportion of heavy rain days is largest for Ljubljana, Slovenia (45%) and Zagreb, Croatia (32%). Heavy rain also occurs for about 30% of the time in Brussels (Belgium), Luxembourg and Amsterdam (the Netherlands), in addition to Lisbon (Portugal) and Rome (Italy). All other Member States range between 10-20%, except for Nicosia (Cyprus) where heavy rain events occur only in 8% of the time.

Table 5: Overview of indicator 1 - Number of heavy rain events (1980-2014)

MS (capital city)	Number of wet days (>1mm)	Heavy precipitation days (>10mm)	Very heavy precipitation days (>20 mm)	% of R10mm to RR1	% of R20mm to RR1	Score
	RR1	*R10mm*	*R20mm*			
Vienna (Austria)	97	18	5	19%	5%	+
Uccle (Brussels)	135	24	4	25%	4%	++
Sofia (Bulgaria)	84	18	5	19%	5%	+
Zagreb - Gric (Croatia)	97	31	10	32%	10%	++
Nicosia (Cyprus)	41	8	3	8%	3%	-
Praha (Czech Republic)	92	12	3	12%	3%	-
Copenhagen Meteorological Institute (Denmark)	112	15	3	15%	3%	+
Tallinn (Estonia)	128	17	4	18%	4%	+
Helsinki (Finland)	110	17	4	18%	4%	+
Paris (France)	109	15	3	15%	3%	+
Berlin (Germany)	108	12	3	12%	3%	-
Athens (Greece)	42	13	5	13%	5%	-
Budapest (Hungary)	76	15	4	15%	4%	+
Dublin (Ireland)	130	17	4	18%	4%	+
Rome (Italy)	79	27	11	28%	11%	++
Riga (Latvia)	107	14	3	14%	3%	-

[8] ECAD - http://www.ecad.eu/indicesextremes/customquerytimeseriesplots.php

MS (capital city)	Number of wet days (>1mm)	Heavy precipitation days (>10mm)	Very heavy precipitation days (>20 mm)	% of R10mm to RR1	% of R20mm to RR1	Score
Vilnius (Lithuania)	124	15	4	15%	4%	+
Luxembourg Airport (Luxembourg)	129	27	7	28%	7%	++
Luqa (Malta)	61	17	7	18%	7%	+
Amsterdam (Netherlands)	138	28	6	29%	6%	-
Warsaw (Poland)	98	13	3	13%	3%	+
Lisbon Airport (Portugal)	75	26	10	27%	10%	-
Bucharest (Romania)	75	19	6	20%	6%	-
Bratislava (Slovakia)	88	16	4	16%	4%	+
Ljubliana (Slovenia)	110	44	22	45%	23%	++
Madrid (Spain)	59	13	3	13%	3%	-
Stockholm (Sweden)	103	12	2	12%	2%	-
London Heathrow (UK)	110	14	3	14%	3%	-
Edinburgh (UK)	126	17	4	18%	4%	+

Source: Data from the European Climate Assessment & Dataset project

Member States that are particularly at risk for the consequences of heavy rain are: Belgium, Croatia, Italy, Luxembourg, the Netherlands, Portugal, Romania and Slovenia. The list includes several Mediterranean countries, at risk for heavy rainfall, which may be intense, of short duration, following a dry period and potentially leading to flash floods and storm water overflows. Also in mountainous area, higher number heavy rain events can be expected and is expected to lead, where sewer collection systems are present, to storm water overflows. Based on the observed trends, northwest Europe (Ireland, Finland, Sweden, Estonia, Lithuania, and Latvia) has the lowest risk for heavy rainfall (though not the United Kingdom). A pattern in the number of heavy rain events could not be observed with the current analysis.

3.3.2 Number of major Flood events

The occurrence of floods is related to storm water overflows and gives an indication on the order of magnitude of storm water overflows. From the practical experience that overflows also occur under less extreme conditions (when the area is not flooded), the number of floods likely underestimate the number of storm water overflow events. The 2015 EEA database on past European floods between 1980 and 2014 shows that floods are most common in Greece (617 flood events), Finland (586), the Netherlands (514), Bulgaria (346) and Germany (267). On the other hand, the database shows less than 50 flood events for 15 Member States. While the differences in the number of floods are partly explained by the differences in size of the Member State, other factors may explain the differences, such as a potential underreporting related to a different definition a flood.

Table 6: Overview of the results for the indicator category on storm water pressures

MS	Number of major floods between 1980 and 2014		Imperviousness (ha and %)		
	Value	Score	Value (ha)	%	Score
AT	74	++	1,56E+05	1.86%	+
BE	36	+	2,20E+05	7.19%	++
BG	346	++	2,01E+05	1.81%	+
CY	5	-	2,90E+04	3.14%	++
CZ	11	-	2,51E+05	3.19%	++
DE	267	++	1,77E+06	4.95%	++
DK	35	+	1,50E+05	3.48%	++
EE	7	-	3,82E+04	0.84%	-
ES	64	+	6,58E+05	1.30%	-
FI	586	++	1,89E+05	0.56%	-
FR	5	-	1,49E+06	2.71%	+
GR	617	++	1,68E+05	1.28%	++
HR	69	++	1,18E+05	2.08%	+
HU	13	-	2,86E+05	3.07%	+
IE	28	+	1,09E+05	1.56%	++
IT	45	+	8,66E+05	2.88%	+
LT	65	+	1,27E+05	1.96%	+
LU	8	-	1,24E+04	4.78%	++
LV	3	-	6,88E+04	1.07%	++
MT	5	-	4,20E+03	13.33%	++
NL	514	++	2,97E+05	7.96%	++
PL	26	+	7,43E+05	2.38%	+
PT	53	+	2,43E+05	2.64%	+
RO	20	+	3,64E+05	1.53%	++
SE	8	-	1,98E+05	0.44%	++
SI	109	++	3,60E+04	1.78%	++
SK	26	+	1,17E+05	2.39%	+
UK	109	++	8,10E+05	3.31%	++

With respect to the number of floods, the Danube Member States are mostly struck, in particular Bulgaria, Croatia and Slovenia. Rainfall falling on the Danube catchment runs off and accumulates in the Danube and flows downstream. It is unclear to which extent the flooding of the Danube may lead to increased storm water overflows. Some trends in the major floods are corresponding to the trends in heavy rainfall: the Mediterranean countries are at risk for floods, in particular Spain, Italy and Greece. Exceptions in the Mediterranean where few major floods have been observed are Cyprus and Malta, which is potentially related to the presence of separate sewer systems. Some Member States had a substantial number of heavy rain events, but only a limited number of major floods, for example Belgium. The latter may indicate that the risk for floods in these Member States is well managed. The United Kingdom finally has had a large number of major floods, while the number of heavy rain events is moderate. The low number of major floods in North-west Europe corresponds to the findings on the low number of heavy rain events. The assessment is based on the past trends, which may alter in the future, depending on measures that are taken in the system, or changes in urban land use or climate variability.

3.3.3 Impervious area

The imperviousness gives an indication of the rainfall volumes that may be collected in the sewer system, rather than infiltrate into the soil. The indicator values are expected to be over-estimated since the indicator covers all impervious areas, and not only those that are connected to a combined sewer system. Only the impervious area connected to combined sewer systems is a trigger for storm water overflows. Data on the impervious area that is connected to a combined sewer system is not directly available in the majority of Member States. The impervious area in Europe is 5% or more in 5 Member States: i.e. Malta (13%), the Netherlands (8%), Belgium (7%), Germany (5%) and Luxembourg (5%). The other Member States have impervious areas for around or less than 3% of their territory.

3.4 RESULTS OF THE INDICATORS ON DATA AVAILABILITY ON STORM WATER OVERFLOWS

3.4.1 Overview

These indicators are assessed based on information gathered in Task 1.2. of the study. They present results at Member State level. For three Member States, an assessment at regional level is also done, i.e. Belgium, Germany and the United Kingdom. For Belgium and UK, all regions have been assessed, while for Germany only the two most populated regions have been assessed. The assessed German regions are Bavaria and North Rhine - Westphalia (abbreviated in Table 7 as NRW). In total 34 Member States and regions have been assessed. For simplicity, this text refers to Member States, as the member states and the regions assessed.

An overview of the results of the qualitative assessment on storm water overflows is shown in Table 7.

Table 7: Results of the qualitative assessment for the indicator category on data availability

	sewer system	overflow structures	occurrence	monitoring	data at national / regional level
Austria	++	+	+	-	+
Belgium – Brussels	++	++	++	-	++
Belgium Flanders	++	++	++	++	++
Belgium Walloon	++	+	-	+	-
Bulgaria	+	-	-	-	-
Croatia	++	-	-	-	+
Cyprus	++	-	-	-	-
Czech Republic	+	+	+	-	-
Denmark	++	++	++	+	++
Estonia	-	-	-	-	++

	sewer system	overflow structures	occurrence	monitoring	data at national / regional level
Finland	++	-	+	-	+
France	+	-	+	+	+
Germany: Federal	++	++	-	+	+
Germany: NRW	++	++	++	++	+
Germany: Bavaria	++	++	+	+	+
Greece	-	-	+	-	+
Hungary	++	-	+	-	+
Ireland	+	+	++	++	++
Italy	+	-	-	-	+
Latvia	+	-	-	-	+
Lithuania	-	-	+	-	-
Luxembourg	+	-	-	-	+
Malta	+	+	-	-	-
Netherlands	++	++	+	-	+
Poland	++	++	+	+	+
Portugal	+	++	+	+	-
Romania	+	-	-	-	-
Slovakia	+	+	-	-	+
Slovenia	+	+	+	-	-
Spain	++	+	-	+	-
Sweden	++	+	++	+	++
UK: England & Wales	++	++	+	+	++
UK: Northern Ireland	++	++	-	+	+
UK: Scotland	++	++	-	+	+
TOTAL					
MS and regions scoring ++	19	12	5	3	7
MS and regions scoring +	12	9	14	12	17
MS and regions scoring -	3	13	15	19	10

The results indicate that, across the EU, a diverse set of data is available on storm water overflows. Some Member States have an advanced understanding on storm water overflows (e.g. Flanders (Belgium), Denmark, Ireland, Sweden and England (United Kingdom). The indicator having the most positive scores is the sewer type, followed by the understanding of the overflow structures. Precise quantitative data on the sewer type (++ score) is available for 19 Member States. Estimates were obtained for 12 Member States (+), while no country-wide information (-) could be found for 3 Member States (Estonia, Greece, Lithuania). On the overflow structures, quantitative data is available for 12 Member States, estimates for 9 Member States and no information for 13 Member States. Based on the Member State fact sheets, 5 Member States (Belgium, (Brussels and Flanders), Nordrhein-

Westfalen (Germany), Ireland and Sweden) have a good understanding of the occurrence. In 14 Member States there is some knowledge on the occurrence. A comprehensive overview of storm water overflows at Member States (or regional) level however is not available for 15 Member States.

A regular, country-wide monitoring programme is in operation for 3 Member States out of 5 that have "++" on occurrence: 2 regions (Flanders, Nordrhein-Westfalen) and Ireland. In the majority of Member States, monitoring is organised by municipalities and/or water utilities. While this approach may be valid and effective, insufficient data is publicly available. Also data sharing by municipalities and/or water utilities to the national/regional level is limited. 7 Member States have a central database and/or publicly available data on storm water overflows: i.e. Belgium (Brussels and Flanders), Denmark, Estonia, Ireland, Sweden and England and Wales.

Overall, the majority of Member States have at least an approximate knowledge of their storm water overflow measures. Eight had either a good "+"or excellent "++" score for each indicator for storm water overflow knowledge: i.e. Flanders (Belgium), Denmark, the German regions assessed, Ireland, Sweden and England and Wales. Member States that scored poorly in more than four indicators, include Croatia, Bulgaria, Romania and Estonia. Finland performs low compared to the other Nordic Member States.

Substantial gaps however remain for a substantial number of Member States. In 15 Member States, publicly available information on the occurrence of storm water overflows is not available. In all Member States, monitoring is likely to occur by water utilities. However, a comprehensive country (or region-wide) overview on storm water overflows is often not developed.

Issues:
Deeper analysis of data provided by the Member States reveals two issues to be kept in mind when measuring Member State knowledge of storm water overflow management. The first issue highlights the limitations of imperfect information. This analysis was undertaken after extensive desk research and interviews with national experts. Despite this, there may be data which have been overlooked either due to lack of public accessibility or differences in interpretation regarding interview questions, especially due to the often very technical aspect of the indicators and the sometimes limited available information.

Box 1: Description of Scoring: Greece

There were no national figures for any of the indicators in the case of Greece. However, interviews with Greek authorities in Athens and Thessaloniki indicated that:

In Athens 3% of sewers are combined, supporting 9 overflow infrastructures (thus, 97% of the sewer network is separate). There are also 2-3 incidents over overflow per year, and while there is no formal monitoring system, pumping systems are fitted with ultrasound sensors.
In Thessaloniki around 35% of the pipes are combined. There are also around 80 overflow structures, most of which flow from the combined system into either other combined sewers (70%) or discharge directly into the sea (30%). Approximately 15 overflows occur a year; however, there is no monitoring system for storm water. There is however a project underway to provide real-time control (Real-t-SO system) of overflows in coastal cities.

If these figures represented national figures, Greece would have scored very highly. Not only is the information collected, but it is also available to researchers. However, a national average cannot be estimated, and should a national authority want information, each individual municipality would have to be contacted. Thus Greece only scored one "+" for monitoring on account of the Real-t-SO system which provides real time monitoring to only coastal cities.

The second issue concerns the government level of the authority implementing storm water overflow policy. This study focuses on storm water management at national level including the structures and practices in place at national level. Member States that hold information only at municipal level/water utilities thus would receive a low score. This could mean that some Member States scored poorly in this analysis while in reality may have excellent storm water management. Member States falling into this category include Estonia, Finland, Greece, Latvia, Italy, and the Netherlands. For a detailed example, see Box 1.

When addressing the issue of municipal responsibility, a conscious decision was made not to examine the broad range of local government competencies as this would have required an in-depth analysis of local and national government structures and competencies in each Member State with regards to environmental management, which is far beyond the scope of this project. The Netherlands, for example, has close to 400 municipalities, and while each may undertake storm water management in a comprehensive manner, national authorities may not have an accurate overview of the situation when it comes to establishing national policy or legislation.

3.4.2 Data and knowledge on the Type of Sewer Network

Almost every Member State has information on the sewage networks, and most (31 out of 34 MS and regions) were able to give at least estimates of what proportion of sewers were separate or combined. While many Member States have provided detailed information on the length (in km) of each type of sewer, this information was not available for several other Member States. Instead, estimates of the proportion of combined sewers were made, relative to separate sewers. To facilitate the comparison between Member States, all information has been converted to percentages of each type of sewer system. Table 8 provides an overview of the percentage of each type of sewer found in Member States.

Of the Member States and regions that could provide specific information, just over half (13 out of 22) has mostly separate pipes. A general rule for many Member States was that older systems or those used for smaller populations were combined, while newer systems are separate. For this reason, old city centres often have higher percentages of combined pipes than newer suburbs. Examples would be Finland, where overall only 5% of the pipes are combined, yet in Helsinki, the percentage is 30%, and Hungary, where overall 3% of pipes are combined with 62% in Budapest.

Table 8: Percentage of types of sewage pipes in terms of length

	separate sewers	combined sewers	risk of combined sewer overflows
Austria	71,5%	28,5%	+
Belgium (Walloon)	10%	90%	+++
Belgium (Brussels)	0%	100%	+++
Belgium (Flanders)	13%	87%	+++
Bulgaria	N/A	Majority	+++
Croatia	c.a. 41%	c.a. 50%	++
Cyprus	100%[9]	0%	+
Czech Republic	New structures	66%- 75%	++
Denmark	50%	50%	++
Estonia	New structures		++
Finland	ca. 95%	ca. 5% Helsinki: 30%	+
France	68%	32%	++
Germany	57%	43%	++

[9] Network designed as a separate system but with increased cross connectivity of surface runoff sources with the sewers

	separate sewers	combined sewers	risk of combined sewer overflows
Germany: North Rhine-Westphalia	38%	62%	++
Germany: Bavaria	45%	55%	++
Greece	Attica: 97% Thessaloniki: ca. 65%	Attica: 3% Thessaloniki: 35%	+
Hungary	97% (excluding Budapest) Budapest: 38%	3% (excluding Budapest) Budapest: 62%	++
Ireland	76,3%	15,8%	+
Italy		Majority	+++
Latvia	N/A	20%	+
Lithuania	50%	50%	++
Luxembourg	10%	90%	+++
Malta	100%[10]	0%	+
Netherlands	27,3%	68,2%	+
Poland	8%	73%-90%	+++
Portugal	66%	33%	+
Romania	0%	100%[11]	+++
Slovakia	90%-95%	5%-10%	+
Slovenia	41%	59%	++
Spain	87%	<13%	+
Sweden	88%	12%	+
United Kingdom	30%	70%	+++

These indicators, however, are not without limitations. In their answers to the questions, Cypriot experts point out that although all pipes are separate. Such situation reduces the risk of storm water overflows but not totally as this does not take into account household waste illegally entering pipes specifically separated for rain water and bad connection of rain water into the separate sewer system. It is also worth noting that according to Romanian legislation, all sewers are combined, which, although it may be more accurate than the Cypriot example, does raise the question of the actual networks. Countries with seemingly detailed information on separate sewers may not take into account illegal pollution and while steps could be taken to estimate the likely amount of illegal pollution, an accurate representation of every kilometre of sewer in each of the 28 Member States is simply not possible. Building separate collecting systems means managing properly the risk of bad connections.

3.4.3 Data and knowledge on Overflow structures

Member States were asked if they could provide numbers of storm water overflow infrastructure, with a total 21 out of 34 Member States and regions responding with at least estimates (see an overview in Table 9). Of those that did provide specific information (12), there was also a range of specificity which makes a comparison of different types of overflow infrastructure difficult (see Box 2 for examples). Member States that could not provide information for these indicators often stated that the information would be held at municipal level, or by the private utility company owning the pipes. Others, like Ireland, are currently in the process of collecting data to establish a national figure.

[10] Network designed as a separate system but with increased cross connectivity of surface runoff sources with the sewers
[11] According to legislation

Box 2: Storm Water Infrastructure: examples of specificity

Germany: North Rhine Westphalia
In 2012 North Rhine Westphalia recorded 6.944 overflow structures with a total volume of 11.588.708 m³ in the public storm water treatment system. In addition, 1,781 sewer structures that have no storage volume, operated in combined or separate systems. 71% of the total storage volume is found in the combined system.
Of the total 8,725 22 special structures, 22% are rainwater overflow basins and 17% are storage channels in combined systems. Of the total storage volume 24% is provided by rainwater overflow basins and 13% by storage sewers.
So far, in separate systems, 788 storm water sedimentation tanks with a total storage capacity of 359,191 m³ were recorded for the central storm water treatment.

Spain
According to data from a European survey in 2012, Spain has more than 10,000 storm water overflow infrastructure, but there are no definite statistics because of the different ownership of those devices and the authorities that control them. An inventory of overflow devices is being currently created under regulation of Royal Decree 1290/2012, to be finalised at the end of 2015.

Netherlands
In a 2013 report, a total of 13,700 overflow structures were counted, an average of 0.26 overflow structures per kilometre of combined sewer system. This relatively high number can be explained by the specific conditions in the Netherlands with high groundwater tables in soft and flat soils that need a higher slope (0.5%), leading to short transport distances and smaller systems.

About 100,000 overflow structures are reported from 19 Member States in the EU. Most member States furthermore state the number is underestimated. The large number of overflow structure however does not give indication to the magnitude of overflows. Rather, precise values indicate that an inventory of overflow structures has been made and that it is potentially known which the most problematic ones are.

Table 9: Number of overview infrastructure

Member State	Number of Overflow structures
Austria	10300
Belgium (Walloon)	6000
Belgium (Brussels)	5 major
Belgium (Flanders)	6277 (regional) 1000 (approx. undocumented at regional level) Unknown (municipal level)
Cyprus	100% separate sewers - 2 Sustainable Urban Drainage Systems
Czech Republic	5000
Denmark	Combined: 4370 (33% of which have a basin) Separate: 12675 (17% of which have a basin) No information: 503 Total 17548 (21% of which have a basin)
Germany: North Rhine-Westphalia	Total: 8725 6,944 rainwater basins (total volume of 11,588,708 m³: public storm water treatment system) 1781 rain water overflows with no storage volume (combined or separate systems) 71% of total storage volume is available in the mixed system Of total infrastructure: 22% rainwater overflow basins 17% storage channels - mixed system. 20% storm water overflows.

Member State	Number of Overflow structures
	Of total storage volume: 24% provided by rainwater overflow basins 13% by storage sewers Separate systems: 788 storm water sedimentation tanks with a total storage capacity of 359,191 m³ (9% of rainwater basins with a total share in the total volume of 3%)
Germany: Bavaria	Storm water overflow basins: ca. 6,000 storm water overflows: ca. 3700
Greece	Attica: 9 overflow infrastructures within the 250km of the combined network Thessaloniki: approx. 80 overflow infrastructures exist within the 650 km combined network.
Ireland	1900
Italy	Lombardy: 1639 collection systems, with 1899 lifting facilities, 216 sewage settling tanks and 5699 weir walls.
Malta	100% separate sewers - Ca. 120 wastewater pumping stations each with own overflow to the sea Malta: 3 sewage treatment plants with an overflow incorporated into the design.
Netherlands	13 700 overflow structures, average of 0.26 overflow structures per kilometre combined sewer system.
Poland	Min. 971 storm water overflows infrastructures (combined sewer systems)
Portugal	6432 65 % of total WWTP equipped with overflow infrastructures
Romania	1246 sewer systems (774 are functional) Overflow information not available
Slovakia	Relief structures usually inbuilt to combined sewer systems (larger towns/cities) 100% of total WWTP equipped with overflow infrastructures
Slovenia	Approx. 285 storm water overflows
Spain	Min. 10000 storm water overflow devices
Sweden	approx. 2000 municipal waste water treatment facilities
United Kingdom: England & Wales	15000 combined sewer overflows 17000 major pumping station 37000 quality surface outfalls 57 Combined Sewer Overflows discharging untreated waste into the Thames Tideway
United Kingdom: Northern Ireland	ca. 773 Combined Sewer Overflows 439 Combined Sewer Overflows and Emergency Overflows
United Kingdom: Scotland	ca. 3276 Combined Sewer Overflows (Scotland River Basin District)

It would be plausible to assume that information for both this indicator and that measuring sewer networks would be recorded at least on a local level. However, sewage and overflow infrastructure may not necessarily be accessible to either national governments or the public. In Hungary, for example, around 200 companies manage sewer infrastructure, and while each may have detailed information on their own pipes, there is no mechanism to share this information nationally. A “-” may therefore be set because data were unobtainable rather than non-existent. There is also the issue of what constitutes overflow infrastructure.

3.4.4 Data and knowledge on Overflow Occurrence

In order to assess whether a Member State is aware of storm water management in practice, information on overflow occurrence and monitoring are used as indicators. Overall, however, Member States have far less information available for these two indicators compared to the first two. Although many Member States and regions were able to estimate overflows (19 out of 34, including those giving specific data), only 5 were able to give exact figures.

Denmark was notable in the amount of data available (see Box 3). Interviews with experts in some Member States – including Estonia, Italy, Greece, Latvia, Northern Ireland, and Luxembourg – indicated that information should be available at municipal levels or held by water utility companies, while others simply said no information was available.

Box 3: Danish Storm Water Overflow Data

Denmark regularly publishes data on storm water overflows, including on the number of storm water overflow structures, as in this box, and on the occurrence and pollution load discharged by storm water overflows.

The 2013 Point Source Report published by the Nature Agency in 2015 states that there were 4.370 storm water overflow structures of which 33% were connected to a basin.

Storm Water Overflows Infrastructures in 2013		
Sewer Type	Total	% of storm water overflows structures with a basin
Combined	4.370	33
Separate	12.675	17
No information	503	0
Total	17.548	21

The short-term pollution events reported under the Bathing Water Directive gives an indication of which MS may be facing storm water overflows. These events are reported only if they affect the quality of bathing waters. A number of Member States report that heavy rain is a major cause of the short-term pollution events. It is expected that a number of the short-term pollution events might have a link with storm water overflows. However, evidence is missing to further substantiate this link. Table 10 shows the number of report short-term pollution events for the 2014 bathing season. Some Member States have reported a substantial number of short-term pollution events, such as Belgium (42 events), France (159), Italy (227) and the United Kingdom (59). The number of events in the other Member States can be considered low or inexistent. While the majority of Member States report maximum one event for a bathing water site, the above Member States also report several bathing water sites where more than one even is reported. In particular, Italy, France and the United Kingdom have reported sites where up to 3-4 events have taken place in one bathing season. The presence of short-term pollution events may be an indication that storm water overflows may have an important impact. Considering that Cyprus does not have combined sewer systems, other sources of pollution are causing the short-term pollution events. The Cypriot authorities report illegal waste dump from ships as one main source. Pollution from misconnections in the separate sewer systems or rain water in contact with the pollutants present on the impervious areas may also be a source.

Table 10: Overview of short-term pollution events in bathing waters

	N° of events	No of sites where more than 1 event is reported	Average duration of an event (in days)	Score
AT	2	-	4	+
BE	42	6	5,7	++
BG	1	-	2	+
CY	26	2	9[12]	++
CZ	0	NA	NA	+
DE	0	NA	NA	+
DK	1	-	2	+
EE	0	NA	NA	+
EL	4	-	6,3	+
ES	94	5	2,2	++
FI	0	NA	NA	+
FR	159	20	1,9	++
HR	14	2	2,8	++
HU	4	-	2,0	+
IE	1	-	2,0	+
IT	227	26	2,2	++
LT	0	NA	NA	+
LU	0	NA	NA	+
LV	0	NA	NA	+
MT	0	NA	NA	+
NL	1	-	1	+
PL	5	-	3,2	+
PT	5	-	2,0	+
RO	0	NA	NA	+
SE	4	-	3,0	+
SI	0	NA	NA	+
SK	1	-	3,0	+
UK	59	15	2,0	++
TOTAL	650			

3.4.5 Monitoring of storm water overflows

The indicator representing national monitoring aimed to indicate whether Member States had a comprehensive monitoring process for storm water overflows. The assessment looked in particular for national requirements for overflow monitoring; individual monitoring done by municipalities or water utilities was not considered. This indicator proved difficult to assess, as there are various monitoring systems in place measuring water quality in Member States.
When considering only national monitoring systems, systems specifically monitoring storm water were identified in 15 Member States. Only Ireland and Portugal indicated a comprehensive storm water monitoring system at national level. In three Member States with a Federal system, strong monitoring programmes or projects were identified at regional level: Belgium (Flanders and Walloon), the United Kingdom (all three regions), and Germany (federal and state level).

In England for example the 'surfers against sewage' campaign (Fig. 2) and the bathing water explorer (Fig.3) monitors the occurrence of storm water overflows for coastal bathing waters in England. The

[12] Average for heavy rain events. The majority of short-term pollution events in Cyprus were reported as caused by illegal waste dump from ships. The average for CY considering all events is higher (16,2 days). The higher average is mainly caused by longer events (i.e. one of 28 days and one of 165 days).

bathing water explorer also forecasts a deteriorating water quality of bathing waters as a consequence of heavy rainfall.

Monitoring at a national level can be a major task given the sheer number of overflow structures and kilometres of pipes. Many Member States have delegated this work to local governments, which are often responsible for sewerage and waste water treatment in general. While Member States perhaps have better resources to monitor storm water, some issues became apparent in Member State interviews. The Netherlands carry out extensive monitoring at municipal levels (see Box 4), but have no national monitoring system. In France and Croatia, monitoring is left to local authorities resulting in numerous inconsistencies between authorities. In Germany, on the other hand, baseline requirements are set at national level, leaving specifics and data collection up to federal and local authorities.

Box 4: Different Approaches: Dutch and Estonian Storm Water Monitoring

In the Netherlands, around 91% of municipalities carry out regular measurements at one or more of their overflow structures. Hence, 47% of the overflow structures are being monitored for water height and frequency of flows, and for 7% of the overflow structures, samples of the receiving water bodies are taken as well. The majority of Dutch municipalities measure the functioning of their sewer systems based on the quality of the receiving water bodies (57%) and emissions at the overflow structures (52%)

In Estonia, a different monitoring system is in place. Instead of relying on municipalities to provide data as the Dutch do, the information is gathered via permits for the special use of water. Issued by the Environmental Board, these permits are needed for all activities that may have an impact on water bodies and while there is no special requirement to monitor the occurrence of storm water overflows for the application of a permit, permit holders must show the estimated yearly, quarterly and daily amount of waste- and precipitation water discharge into the receiving waters (m3) and the estimated yearly, quarterly and daily amounts of pollutants from waste- and precipitation water discharged into the receiving waters. Once the permit is obtained, this data has to be reported yearly to the Environmental Board/Environmental Agency. The water utility also has to provide details on the monitoring points and frequency of the monitoring programme. According to Art. 12(5) of the Regulation setting the Requirements for Waste Water Treatment and Management, the frequency of precipitation water testing cannot be less than once per year or more than once per quarter.

Finland takes a different approach again, with national monitoring only carried out in specific cases. This means two urban and two industrial sites are measured four to seven times a year, and even then only measuring general wastewater collection and treatment (thus resulting in a "-"). Finland was not the only country to limit monitoring to water quality of water bodies; Greece, Italy, Latvia, and Estonia all monitor water quality but not specifically storm water overflows.

When comparing the results of national monitoring systems with the previous indicator of storm water overflow occurrences, it becomes obvious that while 19 Member States have at least some information (e.g. estimates) on overflow occurrences at national level, only 15 indicated monitoring activities, and only three scored "++" . One may assume that if a Member State has a monitoring system in place, they would know how many times storm water overflows occurred, thus making the results of these two indicators extremely similar. However, looking at Table 7, this is not the case. These differences could be explained by a number of factors. Firstly, as discussed above, municipalities play a large role in storm water management, and Member States may have access to data on water quality through non-storm water specific monitoring. Both of these categories of Member State would be able to provide estimates of storm water overflows, thus earning the Member State "+". Another factor may simply be a lack of data. Bulgaria, for example, has provisions for monitoring in national legislation, but no evidence was found of it working in practice.

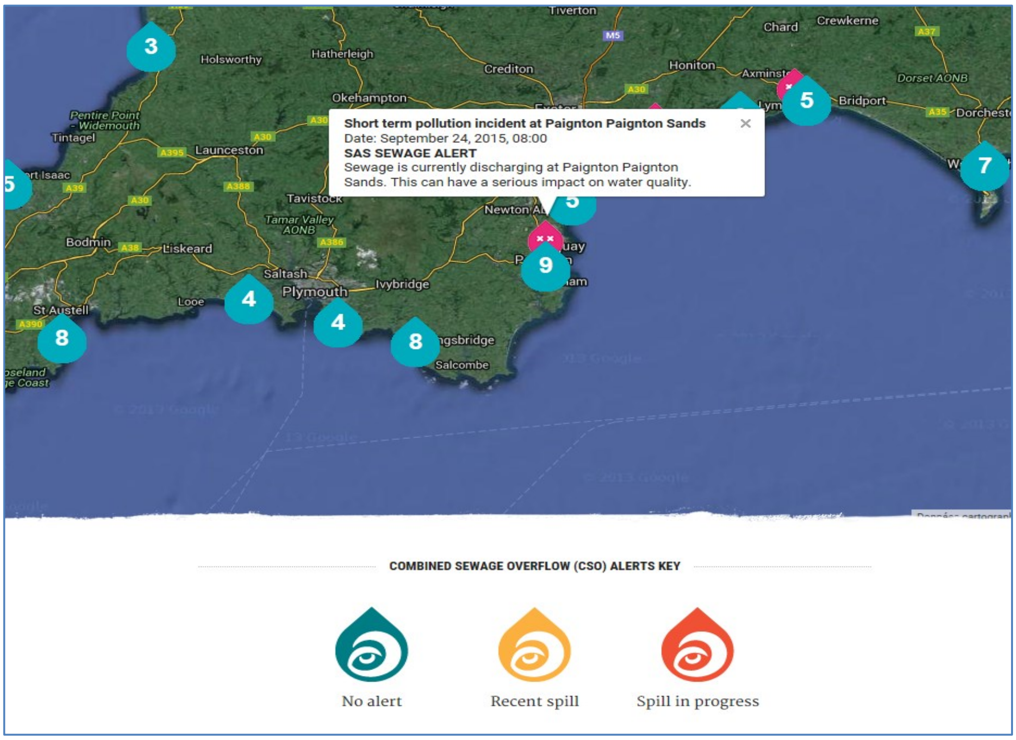
Member States also keep meteorological records, which several Member States use to make overflow estimates on the assumption that if heavy rain is experienced for more than a certain amount of time, overflows will occur. As these assumptions are based on previous experience, they may be relatively accurate, although it does suggest that at least a crude monitoring system must be in place on which to establish this pattern.

3.4.6 Data availability at national/regional level and public information

Examining how Member States share information between different levels of governance was not a core research objective of this study. However, as discussed previously, municipalities and sub-national institutions play large roles in storm water management. The information gathered in Task 2 provides sufficient detail to prepare at least preliminary scores in this regard, as shown in Table 7.

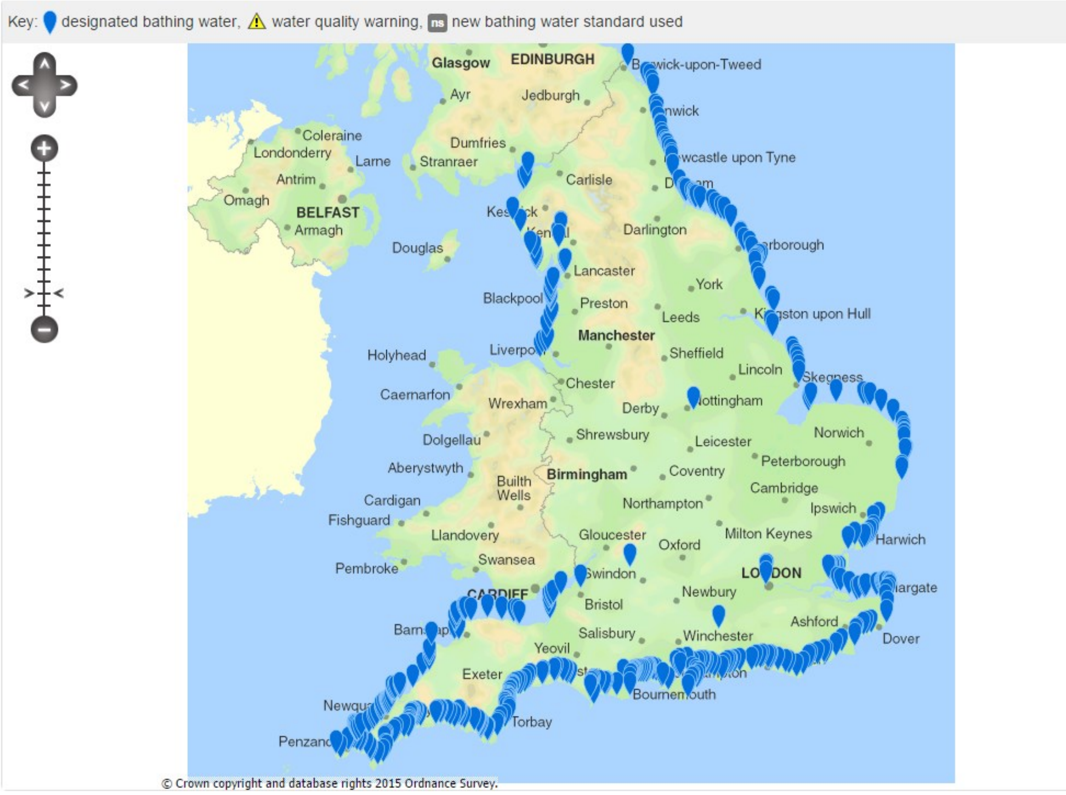
When looking at the scores, almost three quarters of Member States have data sharing occurring on at least a municipal level, although only 7 have visible data sharing on a national level. Of those that do not, it is possible that further research on local government capacities will reveal further examples of data sharing. It is worth noting, however, that several countries have compiled information in online portals available to the public. Countries such as Denmark and Estonia have data in their native languages, although the Danish do have information in English on their website. The United Kingdom provides an excellent example, with an interactive map for England and Wales showing real-time information on water quality at coastal areas, including alerts for sewage overflows. This data is put together by an NGO, which presents data reported by water companies (see Figure 2). In addition, a Bathing Water Quality explorer database is available where the Environment Agency makes a daily prediction of expected water quality at sites in England and Wales where this is possible. These predictions are based on the factors that are known to have an effect on water quality, such as heavy rainfall causing increased runoff from agriculture, urban areas or sewage sources. Predictions are made every day of the bathing water season and warnings issued when conditions that have been shown to affect water quality in the past re-occur (see Figure 3). In Flanders, the regional government provides annual information including an analysis of yearly averages (see Figure 4).

Figure 2: Example of Overflow Monitoring and Data Sharing in England



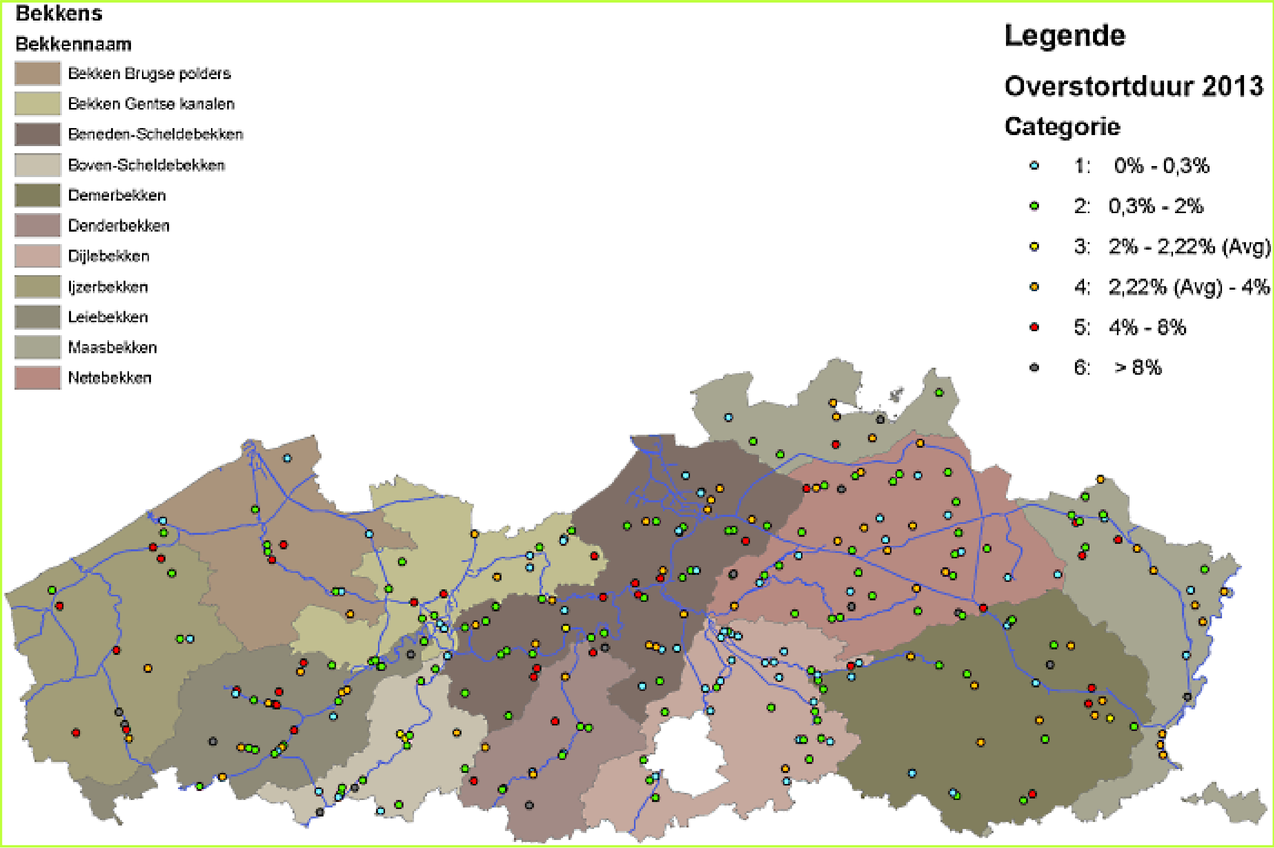
Source: Surfers Against Sewage, http://www.sas.org.uk/map/

Figure 3: Example of Bathing Water Quality Monitoring and Data Sharing in England



Source: Bathing Water Quality database, http://environment.data.gov.uk/bwq/profiles/index.html

Figure 4: Duration of storm water overflows (Overstortduur) for 2013 as a percentage of a full year, Flanders, Belgium



Source: Flanders Environment Agency

4 CONCLUSIONS

Storm water overflows occur when the capacity of combined sewer systems is exceeded and the systems discharge excess water into receiving water bodies. This report presents the results of a first EU-wide assessment on the occurrence of storm water overflows. Assessing the risk of storm water overflows occur is complex and depends of many parameters. Ideally, parameters such as the technical designs of sewer systems, rainfall variability (including the likelihood of unusual rainfall) and the area of impervious (sealed) land from which storm water is running off into combined sewer systems are used to calculate the occurrence of storm water overflows. However, due to data gaps at Member State level, it was not possible to determine the occurrence of storm water overflows in the European Union in a quantitative and data-intensive way.

A range of key indicators were scored in a qualitative manner, based on existing publications, data sets and expert judgements. In total, nine key indicators were identified, which can be categorised as follows:

- Driving factors behind storm water overflows, i.e. the number of heavy rain events and floods, the percentage of combined sewers and the impervious area.
- Available data and knowledge at Member State level on storm water overflows, i.e. data on the sewer system and overflow structures (including the storage capacity of the sewer system), on the occurrence and monitoring of overflows and on data availability at the national/regional level.

Key messages that be concluded from this report are the following:

- A method for the quantitative calculation of the occurrence and impact of storm water overflows at EU or Member State level does currently not exist. Existing methods are typically applied at the local scale, are data-intensive and data is often not aggregated at Member State level.
- Substantial data gaps exist in parameters that could be used to calculate storm water overflows, in particular on the likelihood of rainfall events, on storage capacity of the sewer system and on the impervious area from which storm water is running off into combined sewers.
- The likelihood for exceptional rainfall events is different across the EU. What is exceptional rainfall for one Member State is normal to others. To assess which rainfall is exceptional for a particular agglomeration and thus under which conditions storm water overflow may or may not be accepted, rainfall statistics are required. While this data may be available e.g. at meteorological institutes or universities, it is not readily accessible, or directly useable to assess the occurrence of storm water overflows. A quantitative assessment on the occurrence of storm water overflows would require an in-depth data collection and statistical analysis of rainfall data.. The EU-level data on floods and the number of extreme rainfall events does not provide clear patterns on the risk of storm water overflows and requires further research.
- Country-wide quantitative data on the occurrence of storm water overflows is only available in the following five Member States or regions: Flanders (Belgium), NordRhein-Westfalen (Germany), Ireland, Sweden and Denmark. In addition, England has a good understanding of storm water overflows in coastal bathing waters. Out of these, only three do systematic, region or country-wide monitoring: Flanders (Belgium), NordRhein-Westfalen (Germany) and Ireland
- About 100,000 overflow structures are reported from 19 Member States in the EU. Most member States furthermore state the number is underestimated. The large number of overflow structure however does not give indication to the magnitude of overflows. Rather, precise values indicate that an inventory of overflow structures has been made and that it is potentially known which the most problematic ones are.

ANNEX I – UK CASE ANALYSIS

Introduction

Following an infringement procedure initiated by the European Commission against the UK, the Court of Justice of the European Union ("CJEU") was asked to rule on the scope of Member States' obligation concerning storm water overflows. The findings of the case shed some light on how to interpret the obligation of Member States to take measures to limit the pollution due to storm water overflows. As it will become evident in the analysis below the decision has established some underlying principles on how storm water overflows should be handled by Member States.

Specifically, the European Commission asked the CJEU to declare that the UK had failed to ensure that appropriate collecting systems are in place in Whitburn, and at Beckton and Crossness in London, pursuant to Article 3(1) and (2) of, and Annex I (A) to, the Directive; and that the Member State had failed to ensure that appropriate treatment is provided with regard to waste water treatment plants, in Beckton, Crossness and Mogden treatment plants in London, pursuant to Article 4 (1) and (3) and Article 10 of, and Annex I (B) to, the Directive. The application of the European Commission focused on whether the UK had breached the UWWTD by failing to collect and treat storm water overflows appropriately.

The CJEU ruled against the UK, considering that the frequency and intensity of the storm water overflows were such that they could not be linked to 'exceptional circumstances' and that the costs involved to solve the problem had not been proven to be disproportionate. Accordingly, storm water overflows not falling under the concept of 'exceptional circumstance' are covered by Member States' obligations under the UWWTD. As a result, the CJEU applied a two-steps test examining "whether the discharges from the collecting systems or the treatment plants of the various agglomerations in the United Kingdom are due to circumstances of an exceptional nature, and then, if that is not the case, establish whether the United Kingdom has been able to demonstrate that the conditions for applying the concept of 'best technical knowledge not entailing excessive costs' were met".[13]

The analysis will focus on explaining how the concepts relevant to the obligations of controlling storm water overflows were interpreted and assessed by the CJEU and identifying the principles that were established by the CJEU in regards to the subject-matter.

Arguments

The European Commission argued that a Member State in taking the decision to design and built a collection system and treatment facilities, pursuant to the UWWTD, should collect all urban waste water generated by the agglomeration it serves. The capacity of the collecting system must take into account natural local climatic conditions of the agglomeration, as well as seasonal variations. Moreover, given that the definition of 'urban waste water' provides for the inclusion of 'run-off rain water', if heavy rainfall is a usual occurrence in an agglomeration it would need to be considered as a natural local climatic condition. Therefore failure to collect and treat it would mean that the Member State is in breach of the obligation pursuant to the UWWTD.

In this regard, the European Commission argued that the UWWTD "must be interpreted as providing for an absolute obligation to avoid spills from storm water overflows save for exceptional circumstances".[14] Moreover, the European Commission in order to identify what constitutes exceptional circumstances put forward factors, such as frequency and the volume of the water flows. Therefore, the Commission brought forward the argument that "the more an overflow spills,

[13] Case C- 301-10 Commission v United Kingdom [2012 [para. 73]
[14] Case C- 301-10 Commission v United Kingdom [2012 [para. 27]

particularly during moderate rainfall, the more likely is that the overflow's operation is not in compliance with Directive 91/271/EC"[15].

The UK, on the contrary, considered that the storm water overflows and the subsequent discharges of untreated urban waste water were compliant with the provisions of the UWWTD. Specifically, the Member State argued that based on the provision of footnote 1 of the Annex I (A) and (B) to the UWWTD, the legislator "expressly acknowledges that it will not be possible to avoid discharges in particular circumstances, notably when there is unusually heavy rainfall"[16]. Hence, the UK argued that the provision does not impose an absolute obligation to avoid discharges in other circumstances. It considers that whether discharges are appropriate in other circumstances is to be determined by application of the concept of the 'best technical knowledge not entailing excessive costs' (BTKNEEC) and an assessment of the environmental impact of the discharges on receiving waters. Furthermore, the UK argued that the UWWTD does not lay down requirements regarding the circumstances in which or the frequency with which discharges into receiving waters may occur.

Main analysis

The CJEU decision focused around the interpretation of the three concepts raised by the parties. It was important for the Court to establish how the concepts of 'sufficient performance under all normal local climatic conditions' appearing in Article 10 of UWWTD, the concept of 'unusually heavy rainfall' mentioned in footnote 1 of Annex I to the Directive and BTKNEEC would be interpreted and subsequently assessed.

The CJEU held that these concepts must be interpreted in the light of the objective of the Directive, which is to protect the environment from the adverse effects of urban waste water discharges. However, the objective was identified to have a wider reach than just the protection of aquatic ecosystems. Specifically, as it was held in a previous case and recalled in this case, the CJEU considered that the objective of the Directive seeks to conserve man, fauna, flora, soil, water and air from any significant adverse effect of the accelerated growth of algae and higher forms of plant life that results from discharges of urban waste water.[17] Moreover, the CJEU held that the abovementioned concepts should also be interpreted in the light of Article 191 TFEU, which defines the environmental principles of the Union policies, allowing for a broader interpretation of the concepts.

Initially, the decision of the CJEU established that Member States have an obligation to collect and treat all urban waste water, as defined by the Directive, under normal local climatic conditions, taking in consideration seasonal variations of the load. In its decision, the CJEU interpreted the concept of 'sufficient performance under all normal local climatic conditions' of Article 10 in the light of the objectives of the Directive, discussed above. Given that no numerical target is provided by Article 10, the CJEU has taken the view that, for a Member State to ensure sufficient performance of its collection systems and treatment facilities, pursuant to Article 10, it must collect and treat all urban waste water generated under ordinary circumstances. In essence, this means that failure to treat urban waste water cannot be accepted under usual climatic and seasonal conditions.

Furthermore, the CJEU established that failure to treat urban waste water can only be tolerated where the circumstances are out of the ordinary. The CJEU considered that 'unusually heavy rain' constituted only one example that was included in the footnote only for illustrative purposes. Furthermore, the CJEU interpreted the term 'unusually' to mean situations that are exceptional. Thus, if storm water overflows occurred regularly and there was not sufficient collection and treatment of the urban waste water this would not be considered as an extra-ordinary circumstance.

[15] Case C- 301-10 Commission v United Kingdom [2012] [para. 28]
[16] Case C- 301-10 Commission v United Kingdom [2012 [para. 34]
[17] Case C-280/02 *Commission v France* [2004] ECR I-8573 [para. 16]

The finding of the CJEU has set an important standard for the interpretation of the obligation of Member States pursuant to the UWWTD by connecting compliance of collections systems and treatment plants with the UWWTD on the basis of normal local climatic conditions. Thus, the CJEU seems to go ahead with the European Commission's approach of determining compliance with the UWWTD based on the frequency and intensity of the overflows.

An issue that arises from the above findings is what would constitute an 'extra-ordinary circumstance' that would justify discharges of untreated urban waste water. Such situations were also acknowledged by the European Union legislator. In particular, footnote 1 of Annex I to the Directive provides that failure to collect and treat waste water may be tolerated during 'situations such as unusual heavy rainfall'. Therefore, it is restricted to exceptional situations.

In the case of such an occurrence the provision of footnote 1 of Annex I to the Directive imposes an obligation to take measures to limit pollution from storm water overflows. Thus, the CJEU concluded that, in the absence of any European guideline on the issue and the inability of the Court to define numerically obligations, the concept of any extra ordinary situation, including 'unusually heavy rainfall' should be "assessed in the light of all criteria and conditions prescribed by the Directive, in particular the concept of BTKNEEC".[18]

In regards to the concept of BTKNEEC, because the objectives of the environment are too broad the concept the CJE extended the concept to cover also treatment plants. Therefore, on the basis of this concept discharges of untreated urban waste water could be justified, if the costs for measures would be disproportionate, even under normal climatic conditions. However, it was held by the CJEU that the disproportionate cost can only be invoked by way of exemption.

The concept of BTKNEEC enables compliance with the obligations of the Directive to be achieved without imposing upon the Member States unachievable obligations which they might not be able to fulfil, or only at a disproportionate cost. In this regard, it is the responsibility of the Member State to demonstrate that the conditions for applying the concept of BTKNEEC are met.

The CJEU established that for a Member State to assess whether the costs incurred for the appropriate measures are disproportional to the benefits obtained it must examine the benefits that a more effective water collection or treatment system may provide and weight it against the best technology and the costs envisaged. Only if costs are disproportional to the benefits obtained then a Member State can use the exemption provided under the concept of BTKNEEC.

<u>Conclusion</u>

Following the above analysis, the CJEU has reached to the creation of a two-step test that would allow the CJEU determine whether the Member State is in breach of the Directive.

- Whether the discharges from the collecting systems or the treatment plants of the agglomerations are due to circumstances of an exceptional nature,
- If that is not the case, whether the Member State has been able to demonstrate that the conditions for applying the concept of BTKNEEC were met.

The key for deviating from the absolute obligation that the Directive prescribes in Article 3 and 4 is for a Member State to prove that the discharges from the collecting systems or the treatment plants are due to circumstances of an exceptional nature. To use the example of the UK, the Commission presented the Court with information in regards to the frequency of the discharges and their intensity. The high number of occurrence showed that it was not linked to exceptional circumstances, but rather it was seen as a normal occurrence. In fact, the above was not contested by the UK. In regards to the

[18] Case C- 301-10 Commission v United Kingdom [2012 [para. 61]

second step of the test, the UK, in the first case, did not demonstrate to the “required legal standard that the costs of works to increase the capacity of the collecting system were disproportionate to the improvement in the state of the environment. In the case of the agglomeration of London, taking into consideration that a decision to implement measures to fix the problem was already taken the Court did not regard the costs as disproportional.