



# ADAPTA BLUES

“Adaptation to climate change through management and restoration of European estuarine ecosystems”.

## A4.2: Economic costs derived from flooding in the estuarine areas of study under different scenarios of Climate Change

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#### A4.2: Economic costs derived from flooding in the estuarine areas of study under different scenarios of Climate Change

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#### A4.2: Economic costs derived from flooding in the estuarine areas of study under different scenarios of Climate Change

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## 1 INTRODUCTION

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According to its 5th Report (IPCC, AR5, 2014), the combined effects of changes in hazard associated with extreme events, climate variability and long-term changes, the increase in exposed assets and activities, and the increased vulnerability of human settlements and coastal ecosystems are the main causes of the growth in risk levels.

Furthermore, the need to address decision-making requires more reliable and robust methodologies and analytical tools than ever before to help ensure efficient and equitable use of resources. To establish effective options and measures, it is essential to understand the risks at the scale at which they are managed, and the uncertainty associated with them. The consideration of uncertainty in the framework of analysis therefore plays an essential role, as it allows policy and decision makers to consider the full range of possibilities that could occur in the future.

Estuaries are, by definition, areas with a high exposure to the effects of climate change, especially if we consider the impacts derived from coastal flooding. In addition, estuaries are generally areas with a strong presence of population and socioeconomic activity, so that the impacts of flooding, and the foreseeable effects of climate change, can induce substantial increases in risk on the elements exposed in these areas.

Considering all of the above, it is necessary to develop risk analysis that allows us to assess the current and future risk levels to start taking adaptation actions which should ensure the reduction of these level of risk.

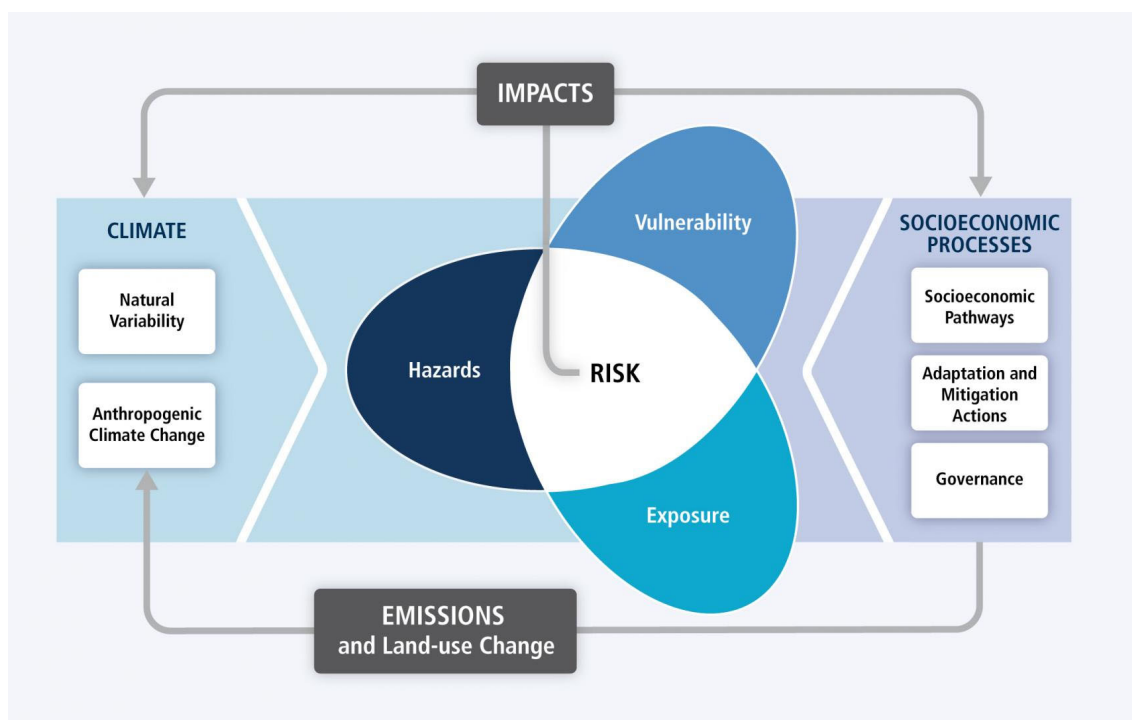
This report presents the assessment of climate change impacts of coastal flooding on the socio-economic system of the estuaries of Mondego (Portugal), Oyambre (Spain), Westerschelde (The Netherlands), the Bay of Santander (Spain) and the Santoña Marhs (Spain), considering the methodology proposed in this same research project (see report “A 4.3: *Risk assessment protocol applicable to estuarine areas considering sea-level rise and potential habitat under different Climate Change scenarios*”).



## 2 RISK FRAMEWORK

For the development of the risk analysis, this report follows the framework developed by the Intergovernmental Panel on Climate Change (IPCC) as a general framework. According to its 5th Report (IPCC, AR5, 2014), the combined effects of changes in hazard associated with extreme events, climate variability and long-term changes, the increase in exposed assets and activities, and the increased vulnerability of human settlements and coastal ecosystems are the main causes of the growth in risk levels.

In this context, the IPCC adopted in 2014 the classical methodology applied to extreme weather risk analysis, resulting in a generalised conceptual framework (Figure 2). This framework establishes that the risk of climate-related impacts derives from the interaction of hazard, represented by the meteo-oceanographic and hydro-meteorological dynamics that generate impacts (e.g. flooding, beach erosion or changes in species distribution), exposure, defined by the sectors and sub-sectors of the socio-economic and natural systems that may be affected by the impacts, and vulnerability, related to the susceptibility of exposed elements to damage. Thus, if any of these factors change, so does the risk.



*Figura 1. Marco general del riesgo definido por el IPCC (IPCC, 2014)*

In this analysis, the general IPCC framework has been applied to the assessment of climate change risks on estuaries of Mondego (Portugal), Oyambre (Spain), Westerschelde (The Netherlands), the Bay of Santander (Spain) and the Santoña Marhs (Spain), considering the impacts of coastal flooding on the socio-economic system.



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The analysis of these impacts has been carried out using process models using historical data and climate change projections of mean sea level, meteorological tide, astronomical tide, waves and sea surface temperature as forcings.

The hazard level of each impact is given by the combination of some of these variables and can be expressed in terms of intensity, e.g. associated with a flood elevation, and probability, corresponding to return periods. Climate change projections, both of climate variables and of the impacts they produce, are always associated with scenarios of greenhouse gas emissions and aerosol concentrations (RCPs), climate models and climate periods (historical period and medium and long-term future periods).

The result of the impact analysis has been combined with exposure data and vulnerability functions. The former has been characterised through geospatial databases of present population and buildings. Regarding the characterisation of vulnerability, damage functions have been defined for the sectors of the socio-economic system.

The consequences integrates the previous components of risk, and have been expressed with various indicators to obtain the level of risk in terms of affected population and buildings for each estuary.





### 3 ECONOMIC COSTS DERIVED FROM FLOODING

This section presents the results of the risk assessment for each of the study sites selected.

The consequences are presented in terms of the following variables:

- Population affected, defined as the residential population located in an analysis unit in which the flood reaches at least 0,01 m height. The variable is measured in people.
- Buildings affected, defined as the value of the buildings located in an analysis unit in which the flood reaches at least 0,01 m height. The variable is measured in euros.
- Building damaged, defined as the value of the damages on the buildings located in an analysis unit when flood exists. This value depends on the height of the flood considering the defined vulnerability function. The variable is measured in euros.

For each variable and estuary, the results are presented for:

- Consequences for five return periods: 5, 10, 25, 50 and 100 years.
- Annual Expected Damage (AED), which expresses the damage observed for different return periods on an annualised basis.

The analysis has considered three temporal horizons (present, 2050 and 2100) and two climate scenarios (RCP4.5 and RCP8.5).

#### 3.1 Mondego estuary (Portugal)

The following tables summarise the flood risk for the Mondego estuary, for population (Table 1) and built capital (Table 2 and Table 3).

POPULATION	Temporal horizon and scenario					
	PRESENT		2050		2100	
			RCP4.5	RCP8.5	RCP4.5	RCP8.5
Return period						
5	696		872	926	874	1.008
10	735		873	942	880	1.061
25	745		885	945	922	1.095
50	743		885	947	930	1.099
100	749		893	965	932	1.107
Annual Expected Damages	208		254	271	257	302

Table 1. Population affected (in person) in the Mondego estuary (Portugal).



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BUILDINGS AFFECTED	Temporal horizon and scenario				
	PRESENT	2050		2100	
		RCP4.5	RCP8.5	RCP4.5	RCP8.5
Return period					
5	21.558.600	27.010.200	28.682.850	27.072.150	31.222.800
10	22.766.625	27.041.175	29.178.450	27.258.000	32.864.475
25	23.076.375	27.412.875	29.271.375	28.558.950	33.917.625
50	23.014.425	27.412.875	29.333.325	28.806.750	34.041.525
100	23.200.275	27.660.675	29.890.875	28.868.700	34.289.325
Annual Expected Damages	6.439.393	7.860.836	8.397.013	7.960.265	9.351.353

Table 2. Buildings affected (in euros) in the Mondego estuary (Portugal).

BUILDINGS DAMAGES	Temporal horizon and scenario				
	PRESENT	2050		2100	
		RCP4.5	RCP8.5	RCP4.5	RCP8.5
Return period					
5	8.593.905	10.804.080	11.473.140	10.828.152	12.489.120
10	9.084.929	10.816.470	11.671.380	10.903.200	13.145.790
25	9.213.954	10.965.150	11.708.550	11.423.580	13.567.050
50	9.195.269	10.965.150	11.733.330	11.522.700	13.616.610
100	9.272.561	11.064.270	11.956.350	11.547.480	13.715.730
Annual Expected Damages	2.568.730	3.144.334	3.358.805	3.184.000	3.740.541

Table 3. Buildings damages (in euros) in the Mondego estuary (Portugal).

In the present scenario the estimated number of population affected varies from 696 for 5-year return period events, to 749 for the case of 100-year return period events. In 2050, these figures will increase, specially for high probability events (low return periods), from 696 to a number between 872 and 926 people affected (depending on the scenario). By the end of the century (year 2100), the population affected will be even higher, reaching more than 1.000 people in the worst scenario (RCP8.5).

Regarding built capital, at present scenario, the value of the buildings affected varies from 21,5 and 23,2 million euros (for 5- and 100-year return period events respectively). Similar to the observed for the population, these figures will increase in the future, and the higher impacts will be observed for higher horizons (2100) and worse scenarios (RCP8.5), reaching more than 30 million euros of impact on the built capital in 2100 even for small return periods. Real damages on the built capital will represent about 40% of the value of the affected buildings.



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In terms of AED, the level of risk will increase for all assets between 22% - 30% for 2050, and between 23% - 45% for 2100 (depending on the scenario, RCP4.5 or RCP8.5).

### 3.2 Santoña Marsh (Spain)

The following tables summarise the flood risk for the Santoña Marsh, for population (Table 4) and built capital (Table 5 and Table 6).

POPULATION	Temporal horizon and scenario				
	PRESENT	2050		2100	
		RCP4.5	RCP8.5	RCP4.5	RCP8.5
Return period					
5	1.379	1.745	1.933	3.024	6.519
10	1.380	2.034	2.080	3.237	9.208
25	1.390	1.965	2.062	3.593	10.779
50	1.408	2.080	2.171	3.679	14.558
100	1.830	2.854	2.980	10.777	15.087
Annual Expected Damages	403	549	586	965	2.439

Table 4. Population affected (in person) in the Santoña Marsh (Spain).

BUILDINGS AFFECTED	Temporal horizon and scenario				
	PRESENT	2050		2100	
		RCP4.5	RCP8.5	RCP4.5	RCP8.5
Return period					
5	369.889.577	397.704.073	425.263.468	671.580.123	1.118.761.068
10	313.968.367	434.875.690	457.334.773	698.986.458	1.394.839.047
25	315.146.027	440.706.856	453.569.674	768.113.213	1.641.549.568
50	326.698.413	457.586.416	467.790.190	798.288.484	2.236.587.498
100	410.374.374	614.427.370	649.841.463	1.650.102.065	2.295.210.630
Annual Expected Damages	100.159.095	122.009.873	128.785.149	207.605.301	390.088.132

Table 5. Buildings affected (in euros) in the Santoña Marsh (Spain).

BUILDINGS DAMAGES	Temporal horizon and scenario				
	PRESENT	2050		2100	
		RCP4.5	RCP8.5	RCP4.5	RCP8.5
Return period					
5	101.260.102	111.971.820	112.786.892	132.656.282	164.914.053
10	91.674.624	114.027.945	117.823.731	136.200.996	195.057.196
25	92.774.973	117.018.716	113.649.766	139.939.092	214.845.880
50	92.559.918	118.178.093	115.807.430	145.349.801	297.960.904



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<b>100</b>	114.602.023		135.376.750	137.870.938		222.979.353	298.405.531
<b>Annual Expected Damages</b>	<b>28.195.393</b>		<b>33.048.312</b>	<b>33.316.389</b>		<b>39.687.229</b>	<b>54.896.960</b>

Table 6. Buildings damages (in euros) in the Santoña Marsh (Spain).

The estimated number of population affected at present scenario reaches 1.379 people for 5-year return period events, and increases till 1.830 people for 100-year return period events. This impact will be higher in 2050, ranging from 1.745 to 2.854 people in the RCP4.5 scenario, and from 1.933 and 2.980 in the RCP8.5 scenario (for 5- and 100-year return period events respectively). In 2100 the impact on the population will be even higher, considering that for high probability events (low return periods) between 3.024 – 6.519 people will be affected (depending on the scenario), and reaching more than 10.000 people for high return period events.

The value of affected buildings varies from 369,8 and 410,3 million euros at present scenario (for 5- and 100-year return period events respectively). Real estimated damages represent about 30% of these estimates. These impacts will increase in future scenarios, varying in 2050 from 397,7 million euros for 5-year return period events in RCP4.5 scenario to 649,8 million euros in 100-year return period events in RCP8.5. In 2100 the impact on built capital will be considerable higher, reaching more than 1.118 million euros even for 5-year return period events in worse scenarios (RCP8.5).

In terms of AED, the level of risk will increase between 36% - 45% for 2050 for population, and between 22% - 28% for the same horizon for built capital (depending on the scenario, RCP4.5 or RCP8.5). By the end of the century (2100), the increase in the level of risk will be more than 500% for the population and more than 285% for the case of built capital, both in the RCP8.5 scenario.

### 3.3 Bay of Santander (Spain)

The following tables summarise the flood risk for the Bay of Santander, for population (Table 7) and built capital (Table 8 and Table 9).

POPULATION	Temporal horizon and scenario						
Return period	PRESENT		2050			2100	
			RCP4.5	RCP8.5		RCP4.5	RCP8.5
5	1.841		1.754	1.795		1.995	1.477
10	1.841		1.794	1.795		2.000	1.477
25	1.841		1.795	1.796		2.019	1.611
50	1.841		1.795	1.804		2.019	1.629



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<b>100</b>	1.931		1.472	1.476		2.200	1.270
<b>Annual Expected Damages</b>	<b>534</b>		<b>513</b>	<b>519</b>		<b>581</b>	<b>435</b>

Table 7. Population affected (in person) in the Bay of Santander (Spain).

<b>BUILDINGS AFFECTED</b>	<b>Temporal horizon and scenario</b>					
<b>Return period</b>	<b>PRESENT</b>	<b>2050</b>		<b>2100</b>		
		RCP4.5	RCP8.5	RCP4.5	RCP8.5	
<b>5</b>	521.109.301	572.965.457	589.675.518	720.961.489	577.105.949	
<b>10</b>	524.645.233	589.640.339	589.705.887	722.965.562	577.363.473	
<b>25</b>	524.645.233	589.705.887	589.912.669	725.699.546	649.127.354	
<b>50</b>	526.020.439	589.705.887	591.242.020	734.145.788	651.734.491	
<b>100</b>	612.683.655	575.329.485	575.683.895	830.077.372	496.554.716	
<b>Annual Expected Damages</b>	<b>152.077.548</b>	<b>168.426.517</b>	<b>170.971.355</b>	<b>210.172.024</b>	<b>170.978.855</b>	

Table 8. Buildings affected (in euros) in the Bay of Santander (Spain).

<b>BUILDINGS DAMAGES</b>	<b>Temporal horizon and scenario</b>					
<b>Return period</b>	<b>PRESENT</b>	<b>2050</b>		<b>2100</b>		
		RCP4.5	RCP8.5	RCP4.5	RCP8.5	
<b>5</b>	185.848.929	209.425.994	216.684.565	260.938.073	207.501.834	
<b>10</b>	186.713.069	216.304.813	217.276.461	262.217.968	208.272.264	
<b>25</b>	186.724.089	217.116.130	217.934.052	263.613.046	225.454.539	
<b>50</b>	186.015.031	217.637.963	218.679.398	264.559.042	226.654.935	
<b>100</b>	224.394.980	205.019.223	206.465.917	301.888.336	189.221.897	
<b>Annual Expected Damages</b>	<b>54.195.549</b>	<b>61.692.595</b>	<b>62.914.684</b>	<b>76.140.498</b>	<b>61.151.171</b>	

Table 9. Buildings damages (in euros) in the Bay of Santander (Spain).

In the present scenario the estimated number of population affected in the Bay of Santander presents low variation among different return period events, and is estimated in 1.841 people for less than 100-year return period events. This figure is maintained almost constant in the future scenarios and horizons.

Considering the impact of flooding on built capital, the value of the buildings affected varies from 521,1 and 612,6 million euros (for 5- and 100-year return period events respectively) at present scenario. These figures are expected to be slightly higher in future scenarios. In 2050



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will vary from 572,9 – 591,2 million euros (depending on the scenario), and from 577,1 and 830,0 million euros in 2100. Estimated damages on built capital will represent about 35% of these figures.

In terms of AED, the level of risk will increase for built capital between 10% - 12% for 2050, and about 38% for 2100 (depending on the scenario, RCP4.5 or RCP8.5). The risk for population, as previously stated, will maintain almost constant.

### 3.4 Oyambre estuary (Spain)

The following tables summarise the flood risk for the Oyambre estuary, for population (Table 10) and built capital (Table 11 and Table 12).

POPULATION	Temporal horizon and scenario					
	PRESENT		2050		2100	
			RCP4.5	RCP8.5	RCP4.5	RCP8.5
Return period						
5	49		50	50	50	52
10	49		50	50	50	52
25	50		50	50	50	52
50	50		50	50	50	52
100	50		50	50	50	52
Annual Expected Damages	14		15	15	15	15

Table 10. Population affected (in person) in the Oyambre estuary (Spain).

BUILDINGS AFFECTED	Temporal horizon and scenario					
	PRESENT		2050		2100	
			RCP4.5	RCP8.5	RCP4.5	RCP8.5
Return period						
5	21.775.764		21.903.441	21.903.441	21.903.441	22.161.959
10	21.775.764		21.903.441	21.903.441	21.903.441	22.161.959
25	21.851.700		21.903.441	21.903.441	21.903.441	22.161.959
50	21.851.700		21.903.441	21.903.441	21.903.441	22.161.959
100	21.851.700		21.903.441	21.903.441	21.903.441	22.161.959
Annual Expected Damages	6.319.528		6.351.998	6.351.998	6.351.998	6.426.968

Table 11. Buildings affected (in euros) in the Oyambre estuary (Spain).



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BUILDINGS DAMAGES	Temporal horizon and scenario						
Return period	PRESENT		2050			2100	
			RCP4.5	RCP8.5		RCP4.5	RCP8.5
5	8.710.306		8.761.376	8.761.376		8.761.376	8.864.783
10	8.710.306		8.761.376	8.761.376		8.761.376	8.864.783
25	8.740.680		8.761.376	8.761.376		8.761.376	8.864.783
50	8.740.680		8.761.376	8.761.376		8.761.376	8.864.783
100	8.740.680		8.761.376	8.761.376		8.761.376	8.864.783
Annual Expected Damages	2.527.811		2.540.799	2.540.799		2.540.799	2.570.787

Table 12. Buildings damages (in euros) in the Oyambre estuary (Spain).

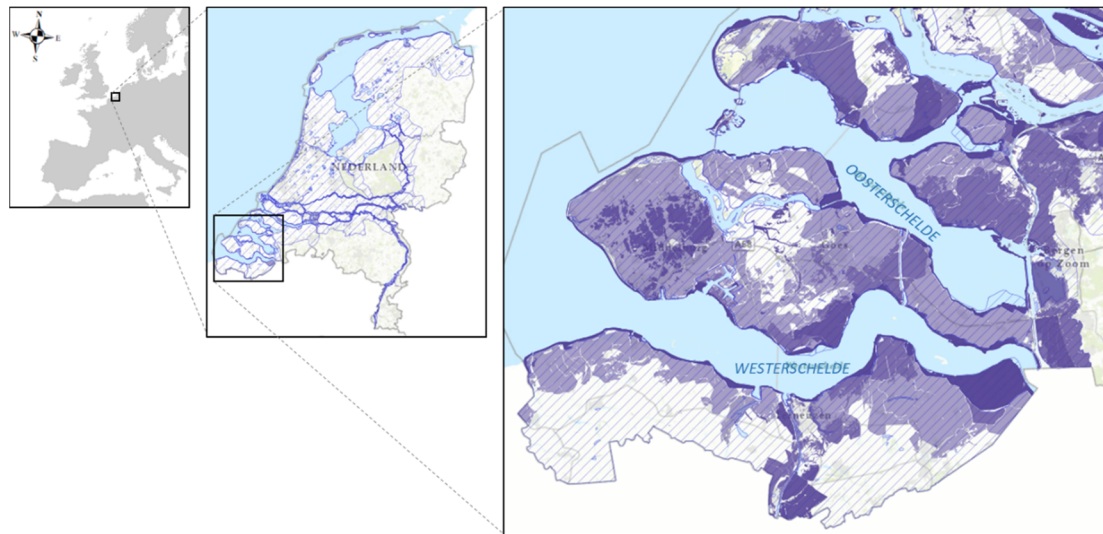
In the case of the Oyambre estuary, the results show that the impacts estimated will maintain constant, with no major variation due to future climate change. Even at present scenario, the impact is also constant no matter the return period considered. This is commonly observed in coastal zones with a low-lying area which is flooded even for very low return periods, followed by a steeped terrain that keeps the rest of the exposed area protected from flooding, even for extreme high return period events.

Considering this singular fact, the risk for population is limited only to 50 people whom are affected, and 21,8 million euros of built capital, resulting on damages of 40% of this value.

### 3.5 Westerschelde estuary (The Netherlands)

The flood risk assessment in the Netherlands has been addressed differently because of the unique context of the Westerschelde estuary compared to the other European estuaries analysed (i.e. Mondego estuary in Portugal, and Santoña Marsh, Bay of Santander and Oyambre estuary in Spain). Around the Westerschelde estuary, and throughout the Netherlands, a large proportion of the territory are below sea level or the high water levels of rivers and lakes. Due to this situation, without the protection of dikes, dunes and hydraulic structures, about 60% of the country is prone to regular flooding at present (Figure 1). Therefore, it is also highly susceptible to both sea level rise and river flooding. Flooding of protected areas around the Westerschelde estuary may occur as a result of the failure or overtopping of dikes. Under these conditions, a relatively large area may be flooded in a short time. Only relatively small, unprotected areas outside these dikes experience the natural dynamics of rising waters due to the tide, storm-surges or river floods.

#### A4.2: Economic costs derived from flooding in the estuarine areas of study under different scenarios of Climate Change



*Figure 1. Flood prone areas (blue striped area) in the Netherlands, and specifically in the Westerschelde and Oosterschelde estuaries. Possible scenarios of flood areas in case of events with a probability of 1:10, 1:100, 1:1.000 and 1:10.000 per year represented with a scale colour from dark to light purple respectively. Source: [www.risicokaart.nl](http://www.risicokaart.nl)<sup>1</sup>.*

Dikes along the coastline (i.e. primary dikes) protect the land against flooding from the North Sea and major rivers, and this flood protection is regulated by law. Since 2017, the Dutch flood protection legislation (*Waterwet*) establishes the safety standards for dike segments that are defined as maximum permissible probability of flooding (Figure 2). Standards were set using a risk-based approach that take into account the costs of dike strengthening and the potential consequences of a flood. These consequences consist of direct and indirect economic damage and mortality, and depend on several factors, such as the maximum water depth of the inundated area, the rate the water rises (i.e. rising sea levels, increasing frequency of heavy rains and storm event due to climate change), the ability to evacuate from a specific area and other relevant features of the area. Overall, the safety standards aim at: a) providing a basic level of protection for the population living behind the dike, b) limiting the total casualties, and c) preventing substantial economic damage<sup>2</sup>. The more serious the consequences of a flood, the lower the target probability of a dike failure (i.e. higher safety standards). By 2050, all dikes must meet these legal requirements. For that, the water boards regularly check the flood defence systems<sup>3</sup> and take the necessary measures.

<sup>1</sup><https://geoweb.gelderland.nl/WebViewer/Index.html?configBase=https://geoweb.gelderland.nl/Geocortex/Essentials/REST/sites/risicokaart/viewers/Mobiliteit/virtualdirectory/Resources/Config/Default>

<sup>2</sup> <https://storymaps.arcgis.com/stories/c948388379ed4180ac7f63489cc4d12f>

<sup>3</sup> <https://waterveiligheidsportaal.nl/#/nss/nss/current>



#### A4.2: Economic costs derived from flooding in the estuarine areas of study under different scenarios of Climate Change

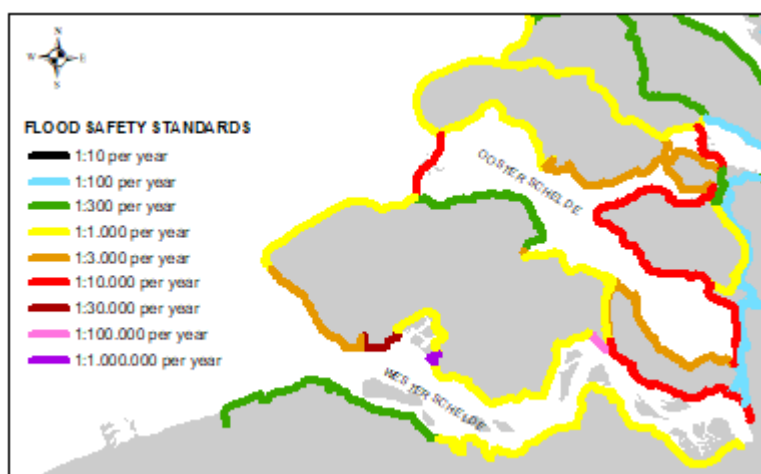


Figure 2. Primary flood defences in the Westerschelde and Oosterschelde estuaries: safety standards defined in 2017 as the maximum permissible probability of failure of flood defences (once in x years). Source: [www.nationaalgeoregister.nl](http://www.nationaalgeoregister.nl)<sup>4</sup>

The safety standards defined in 2017 (Figure 2) were built on a flood risk analysis carried out in “The Flood Risk in the Netherlands” project (VNK2)<sup>5</sup>. This project analysed flood risks for all primary dikes in 2015 at a national level, by calculating and combining both the probabilities of flooding and the associated consequences in terms of economic damage and casualty numbers (Vergouwe, 2016). Three measures of flood risk were considered:

- Economic risk: is the annual expected value of economic losses, expressed in euros per year.
- Individual risk: is the annual probability that an imaginary person at a particular place in the protected area will die because of flooding in the area.
- Societal risk: is the number of deaths as a direct result of a flood expressed as the probability of 1, 10, 100, 1000 and 10.000 fatalities occur.

The flood risk maps generated in such study show that flood risk not only varies between protected areas, but also within them. Differences in the elevation of the land and the compartmentalising effect of secondary flood defences can cause big differences in the maximum water depths, velocity and rise rate of the water. The economic value is not the same throughout a protected area, and the population is often concentrated in towns and villages. Furthermore, the probability of a dike breach varies.

In conclusion, the risk assessment methodology developed in this Task A4 is not applied to the Westerschelde estuary because it is a coastal lowland area strongly influenced by humans, where flooding is currently managed by artificial physical barriers (e.g. dikes) designed to achieve a specific level of risk flood protection in a framework of climate change.

<sup>4</sup> <https://www.nationaalgeoregister.nl/geonetwork/srv/dut/catalog.search#/metadata/9bc22d59-427f-45c9-9f55-7dbe3985a73c>

<sup>5</sup> <https://www.helpdeskwater.nl/onderwerpen/waterveiligheid/programma-projecten/veiligheid-nederland/english/flood-risk-the/>



## 4 CONCLUSIONS

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Estuaries are, by definition, areas with a high exposure to the effects of climate change, especially if we consider the impacts derived from coastal flooding. In addition, estuaries are generally areas with a strong presence of population and socioeconomic activity, so that the impacts of flooding, and the foreseeable effects of climate change, can induce substantial increases in risk on the elements exposed in these areas.

This report presents the assessment of climate change impacts of coastal flooding on the socio-economic system of the estuaries of Mondego (Portugal), Oyambre (Spain), Westerschelde (The Netherlands), the Bay of Santander (Spain) and the Santoña Marshs (Spain), considering the methodology proposed in this same research project (see report “A 4.3: *Risk assessment protocol applicable to estuarine areas considering sea-level rise and potential habitat under different Climate Change scenarios*”).

The results show that, at present, the greatest risk to the population and built capital appears in the Bay of Santander, where about 1.841 people are affected every time a flood event with a return period of less than 100-year takes place. A similar impact is experienced in the Santoña Marsh, where the impact on the population varies between 1.379-1.830 people (for 5- and 100-year return period events respectively).

In the future, the results show that these impacts will increase substantially, especially in the case of the Santoña Marsh, where risk increases of between 36%-45% are expected in the year 2050 (depending on the scenario considered) and over 130% in the year 2100 in the best scenario, and over 500% in the worst scenario.

These consequences translate in this same estuary in the year 2100, in more than 1.100 million euros of affected buildings even for flood events of very high probability (5-year return period). In the case of the Bay of Santander, these numbers for the end of the century remain below 800 million in the worst case (100-year return period event).

In the Mondego estuary the risk is more limited, affecting less than 1.000 people, and with an impact on built assets of less than 35 million euros, in both cases in the worst case scenario at the end of the century.

Of the estuaries studied, the Oyambre estuary has the lowest level of risk, with minimal impact on both the population and the built assets. Similarly, the Westerschelde estuary presents a completely different and non-comparable flood risk structure, due to the strong anthropization of the estuary.



A4.2: Economic costs derived from flooding in the estuarine areas of study under different scenarios of Climate Change

## 5 REFERENCES

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