# Updated Draft Preliminary Flood Risk Assessment

# for

# East Aegean River Basin Management District

## Executive Summary

**March 2021**

This updated draft Preliminary Flood Risk Assessment for the East Aegean River Basin Management District has been prepared with the financial support of the Cohesion Fund of the European Union, through Operational Program "Environment 2014-2020", under a Priority Axis 4 "Flood and Landslides Risk Prevention and Management" procedure for direct grant BG16M1OP002-4.005 "Implementation of studies and assessments in relation to the second FRMP for the period 2022-2027" for the project: BG16M1OP002-4.005-0001 „FRMP – second cycle 2022-2027". Project beneficiary is the Water Management Directorate, in partnership with the four River Basin Directorates. This activity has been carried out by the International Bank for Reconstruction and Development, under an Agreement with the Ministry of Environment and Waters on providing support for the development of RBMPs and RBMPs for Bulgaria.

The current document is an executive summary of the updated Preliminary Flood Risk Assessment (PFRA) for East Aegean River Basin Management District. PFRA is an initial stage of the implementation process of Directive 2007/60/EC (European Floods Directive, FD). As per the requirements of FD Chapter VI, every six years EU Member States shall review and if necessary, update the PFRA.

# 1.Legal Basis, Objectives and Scope

Directive 2007/60 / EC (Floods Directive or FD) has been in force since November 26, 2007. In the legislation of the Republic of Bulgaria it has been transposed with the amendment of the Water Act (WA) in 2010, SG No. 61/2010).

The purpose of the FD is to establish a framework for flood risk assessment and management, aiming to reduce the adverse effects on human health, economic activity, the environment and the cultural heritage associated with floods and thus to have a positive impact on flood risk management at a Member State level as well as in international river basins.

The FD requires Member States to apply a long-term planning approach to flood risk mitigation at national level in three successive stages:

- Preparation of Preliminary Flood Risk Assessment (PFRA) and identification of areas with a significant potential risk of floods (APSFR);
- Development of flood hazard and risk maps for the identified flood risk areas (mapping);
- Development of Flood Risk Management Plans (FRMPs), including Programme of measures to achieve the objectives of flood risk management.

The requirements regarding the content of the PFRA are set out in Section II "Preliminary Flood Risk Assessment" of Chapter Nine of the WA.

## PFRA OBJECTIVES

PFRA aims to provide a quick overview of flood hazard and flood risk across the country, identifying areas where hazard and risk levels are higher based on certain criteria.
Analyzes must be based on available or readily accessible information on both hazard and risk, whereas climate change and its impacts on flood hazard and risk must also be taken into account.

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The ultimate objective of the PFRA is to identify Areas of Potential Significant Flood Risk (APSFRs) where there is:

- Potential significant flood risk;
- Likelihood for potential significant flood risk.

## PFRA SCOPE

- River basin maps indicating topography and land-use;
- Description of past floods with significant adverse effects on human health, the environment, cultural heritage and economic activity;
- Identifying areas with potential flood hazard of 1% exceedance probability;
- Determining potential damages in areas with potential hazard depending on land-use type;
- Assessing possible adverse effects of future floods on human health, the environment, cultural heritage and economic activities;
- Flood risk assessment by applying significance criteria of potential damages and identifying areas with significant flood risk.
- Informing the public.

## 2.Used PFRA Methodology

The Preliminary Flood Risk Assessment shall be performed in line with an approved methodology under WA Art. 187(2), item 6. The current PFRA 2022-2027 has been carried out in accordance with the adopted "2020 Preliminary Flood Risk Assessment Methodology", available at the following link https://www.moew.government.bg/static/media/ups/tiny/filebase/Water/PURN/PURN%202022-2027/Metodika.pdf.

The updated 2020 PFRA Methodology is divided into two main parts and includes methodological guidelines and a work algorithm, which are presented in Figure 1.

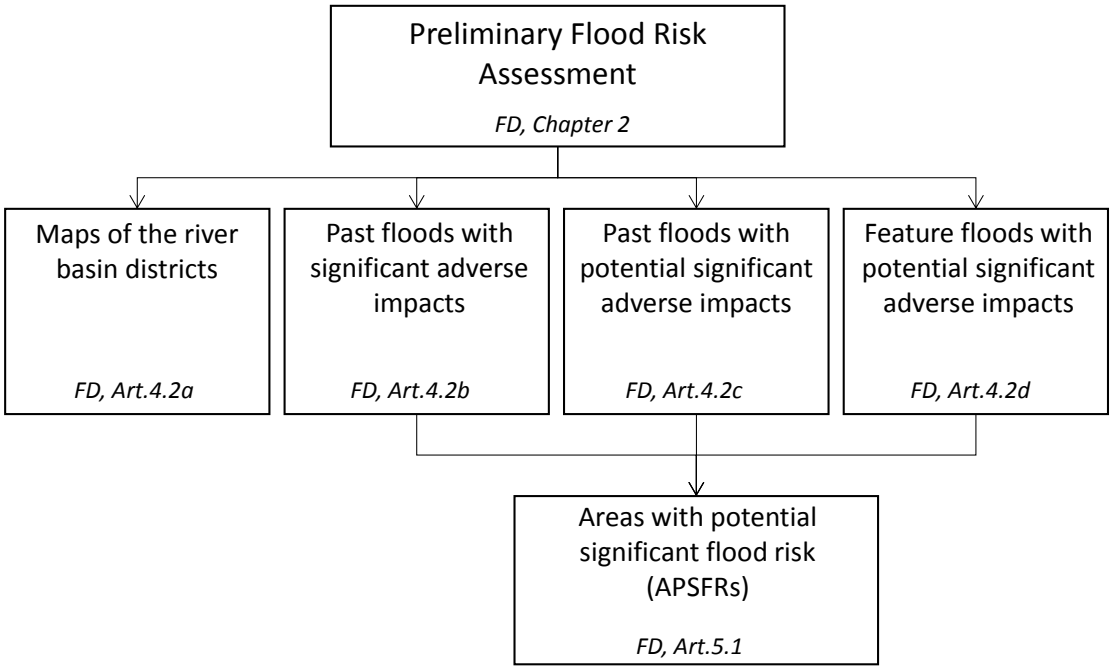



*Figure 1: Diagram of main PFRA elements in line with the FD and the 2020 PFRA Methodology*

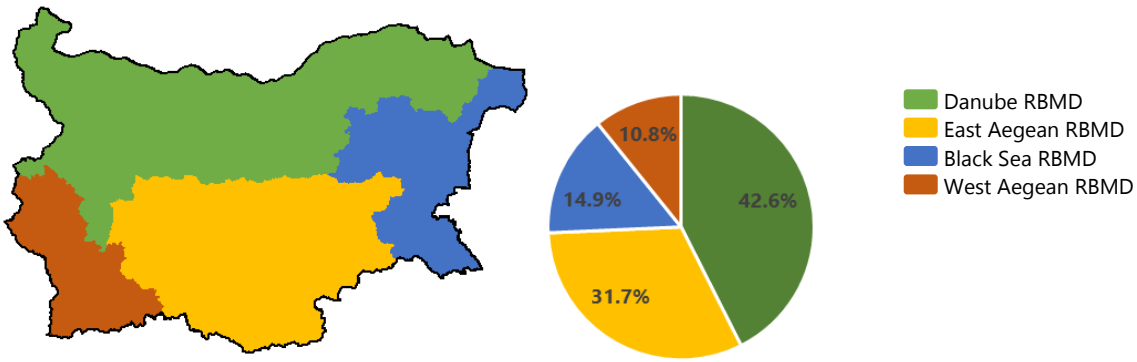
## East Aegean RBMD PFRA Content

This updated Preliminary Flood Risk Assessment (PFRA) draft for the East Aegean River Basin Management District consists of several reports, their respective appendixes, databases and cartographic materials. On the one hand, they provide MOEW and RBD with up-to-date and comprehensive information, and on the other hand, they allow the general public and stakeholders to be better informed about the PFRA results.

The updated PFRA draft is available on the website of the East Aegean River Basin Directorate under https://earbd.bg/indexdetails.php?menu_id=816

# Characteristics of the East Aegean River Basin Management District

The East Aegean River Basin Management District covers the central parts of Bulgaria, south of Stara Planina mountain. It includes all river valleys with direct inflow to the Aegean Sea trough Maritsa river. The district's area is 35,230 sq.km or 31.7% of the country's territory.




To the West, the East Aegean RBMD borders with the Danube (in the northern part) and the West Aegean (in the southern part) RBMDs. To the North, it starts at Zvezdets peak (1654.8 m) of Etropolska mountain, whereas to the South it reaches the state border with Greece along the watershed between Dospat and Vacha rivers. The boundary's length is 273 km.

To the South, the district's boundary coincides with the country's state border with Greece, all the way to Maritsa river at the village of Kapitan Andreevo (Svilengrad Municipality), and thereafter continues along the state border with Turkey, till the eastern end of Derventski heights, village of Strandzha (Bolyarovo Municipality). The boundary's length is 230 km.

To the North, its boundary follows the main watershed of the country. It starts west of Zvezdets peak (1654.8 m) in Etropolska mountain and reaches Karnobatska mountain to the east, east of Iliytsa peak (684.4 m). This boundary's length is 341 km.

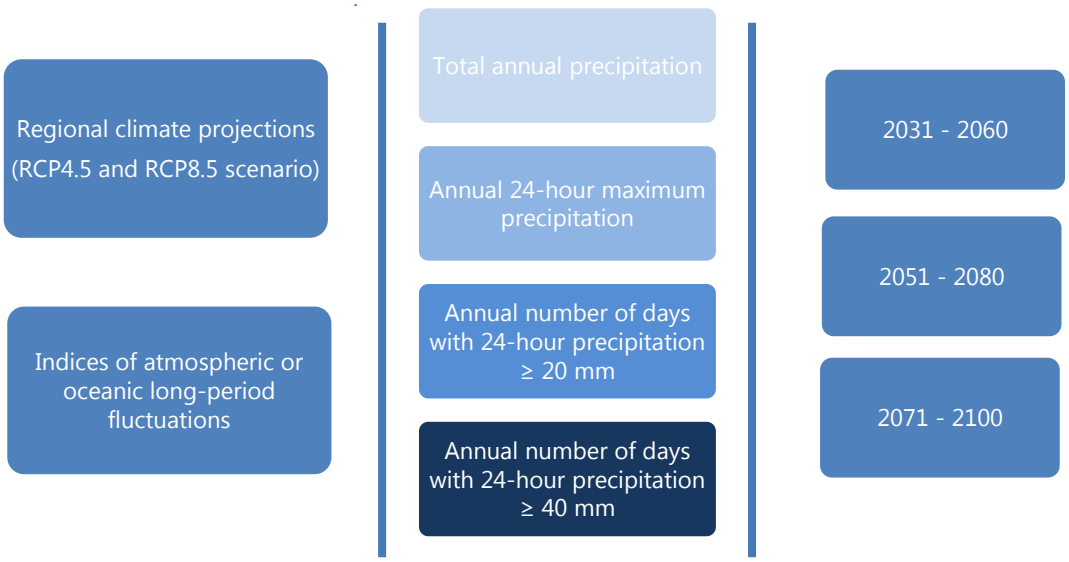
The RBMD's east boundary also coincides completely with the main watershed of the country. To the North, it starts at Iliytsa peak (684.4 m) of Karnobatska mountain, whereas to the South it reaches the state border with Turkey at the village of Strandzha (Bolyarovo Municipality). The boundary's length is 146 km.

The East Aegean RBMD consists of 4 main river valleys - Maritsa, Tundzha, Arda and Byala rivers. Besides them, there are 2 other small catchments, which are separate river valleys within the Republic of Bulgaria; those are the Aterinska and Fishera rivers (Karabashka river).

There are 10 administrative districts, 90 municipalities and 1769 settlements within the RBMD's territorial scope.

## Climate Change Assessment

Climate change has been assessed within the updated PFRA 2022-2027 based on two types of input data for four main flood-related parameters. The respective changes have been assessed for 3 time periods and two Intergovernmental Panel on Climate Change (IPCC) scenarios, as shown in the following diagram:

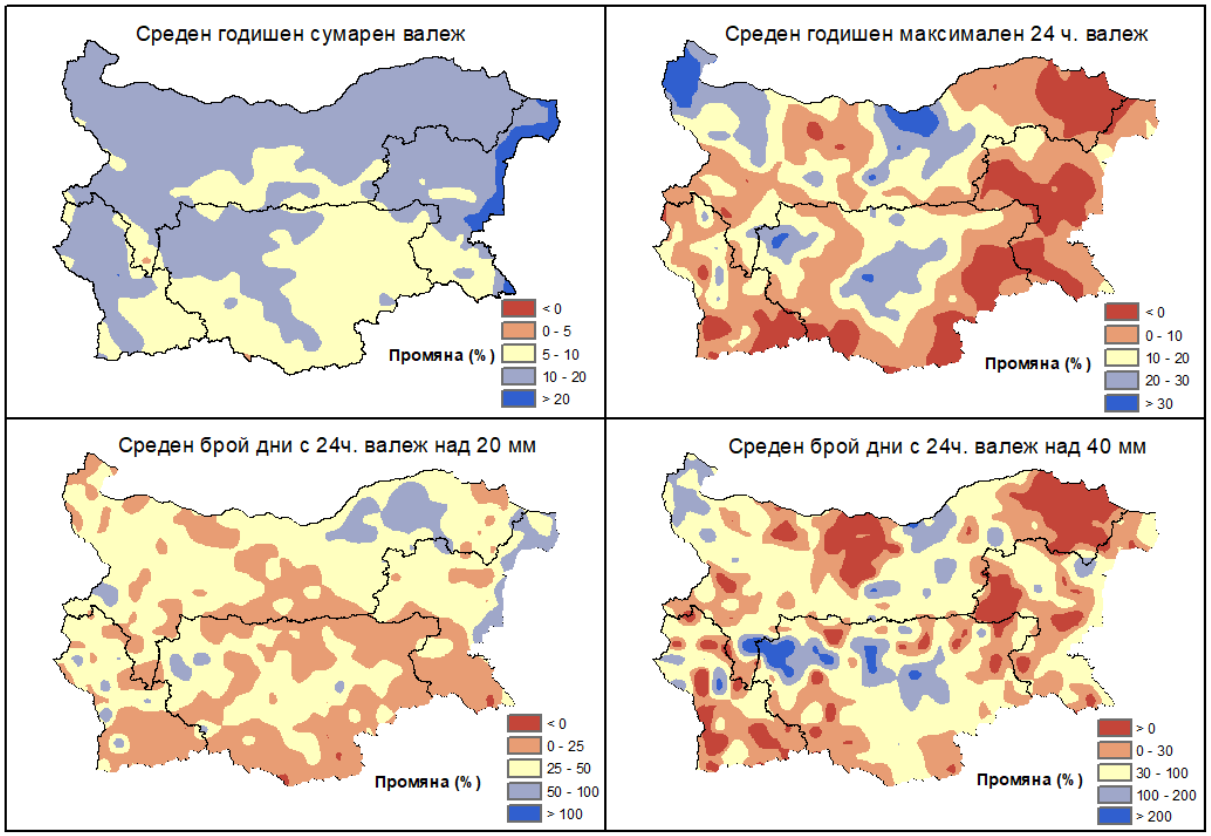



The PFRA has been carried out using data from the CORDEX project (Coordinated Regional Climate Downscaling Experiment) and in particular, its MED-CORDEX subproject - specially developed for the Mediterranean by the National Center for Meteorological Research - France (CNRM, Météo-France).

With regard to atmospheric or oceanic long-period fluctuations, a total of 7 indices of atmospheric or oceanic long-period fluctuations have been considered. Climate data series from ground-based stations of the Bulgarian national meteorological network are limited, both in terms of their quantity and data access, and in some cases there is no metadata on their accuracy. Hence, 24-hour precipitation data from the regional reanalysis MESCAN-SURFEX - a Copernicus Climate Change Service (C3S) product, have been used as historical data.

Schematic maps of the most significant projected changes have been prepared for each of the investigated precipitation indicators for the three periods 2031-2060, 2051-2080 and 2071-2100, as compared to the reference period 1961-2017. These schematic maps present the data under two IPCC

RCP scenarios (RCP4.5 and RCP8.5). Below figure shows a schematic map for the period 2051-2080 under the RCP4.5 scenario.




Climate change analysis results have been used to:

- Determine and investigate areas of future floods;
- Identify APSFRs;
- Create APSFR passports.

## Information Used for the Preparation of PFRA

PFRA requires carrying out a number of analyzes on flood hazard and risk covering the entire East Aegean RBMD territory. On the other hand, the need to compare results between the country's different river basin management districts mandates that the input data used should be readily available and easily accessible at national level, as well as standardized and of the same quality and detail.

The following types of data have been used to perform the PFRA:

**Databases maintained by the East Aegean RBD**

- Information available in the East Aegean RBD collected during the first FD implementation cycle, registers, databases and information arrays generated during the implementation of activities by the East Aegean RBD.

**Administrative-territorial and territorial division**

- Updated data, as of 2020, on the country's administrative spatial planning according to NSI data

**Topographical data**

- Digital Elevation Model from two sources: the Ministry of Agriculture, Food and Forestry (MAFF) and SLED (Shuttle Land Elevation Data)

**Hydrographic and hydro-meteorological data**

- River network, hydrotechnical facilities, monitoring stations, hydrological data;
- Accessible hydro-meteorological data, methodological guidance documents on intensive rainfall, etc..

**Data on past floods**

- Questionnaire survey on past floods (which occurred in the period 2011 - 2019)
- Data from specialized institutions: DG Fire Safety and Civil Protection, NSI, NIMH and others

**Data on risk elements**

- Current information, registers, state institutions and agencies' databases
- Information collected from open data sources

**Data on long-term special development**

- Municipal Master Plans (MPs) for the country, as well as LPIS (for the period 2011-2019).

**Climate change data**

- Climate reanalysis references for the period 1961-2017 (EU Copernicus Program)
- Regional climate models developed under the MED-CORDEX project.

**Data on flood recurrence probability**

- Data on implementation of measures envisaged during the first FD implementation cycle - FRMP 2016-2021.

## Past Floods

***Past floods registered in the period 2011-2019.***

380 floods were registered on the territory of the East Aegean RBMD between 2011 and 2019. They are described per settlements. The distribution of flooding instances per year shows a trend of less occurrences in the period 2011-2013, a clear peak in 2014, followed by a drop and then a gradually increasing trend between 2015-2018. In 2019 there is again a decrease. About 31% of all registered floods during the observed period occurred in 2014. (Figure 2)

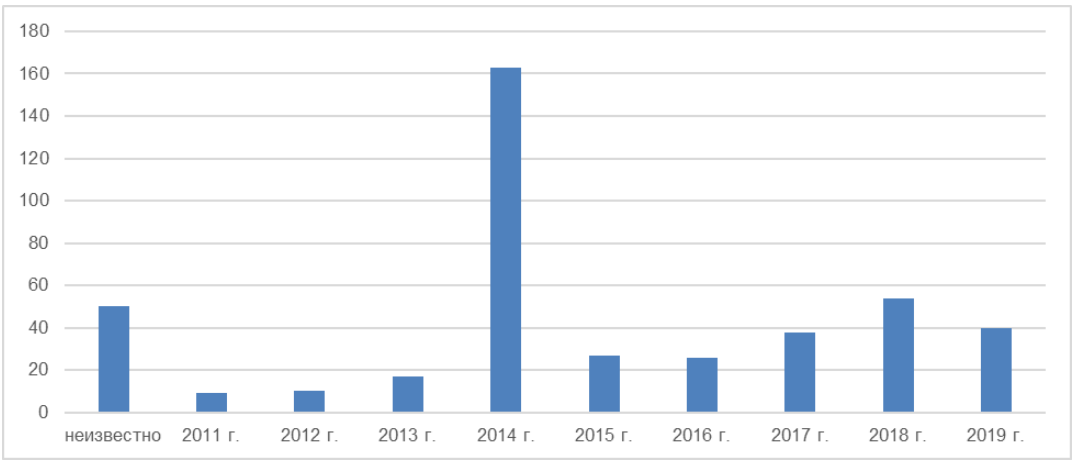
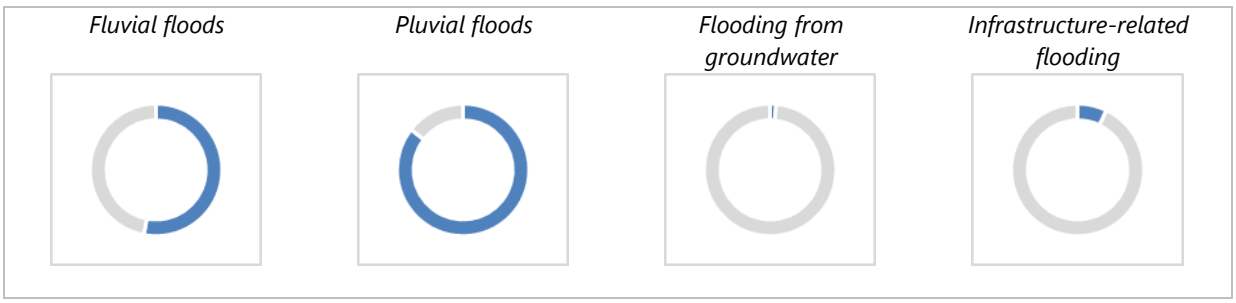



*Figure 2: Distribution of registered past floods in the East Aegean RBMD per settlements and per years*

Pluvial floods have the largest relative share, as well as mixed pluvial-fluvial floods (almost as many as the pluvial). Fluvial floods come second in terms of relative share, whereas infrastructure-related flooding and floods caused by groundwater have the smallest share.



## 2011

The number of registered floods is one of the lowest for the entire reviewed period (2011-2019). Flooding was pluvial or mixed pluvial-fluvial in origin.

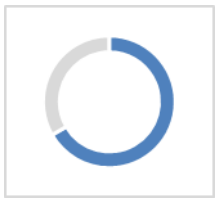
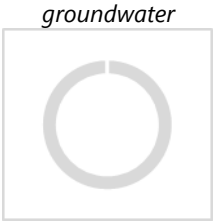
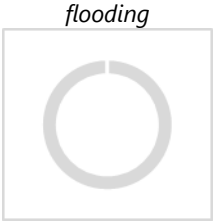
It occurred in Simeonovgrad and the Zlatograd area.

Those floods occurred in mid-March in Simeonovgrad and in mid-May and June in Zlatograd.

Described adverse effects fall only under the category Economic Activity, specifically damages to infrastructure sites.

### Types of floods

Number of floods per type in relation to total number

| *Fluvial floods* | *Pluvial floods* | *Flooding from groundwater* | *Infrastructure-related flooding* |
|---|---|---|---|
|  |  |  |  |

### Adverse effects

Types of described adverse effects per category in relation to total number of floods

| *Human Health* | *Economic Activity* | *Environment* | *Cultural Heritage* |
|---|---|---|---|
|  |  |  |  |

**2012**

There was an increase in the number of registered floods. They were either pluvial, fluvial or mixed pluvial-fluvial.

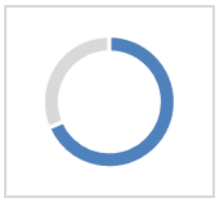
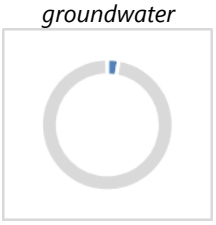
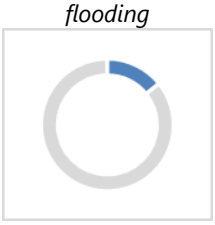
Floods occurred in three main areas: the upper Varbitsa catchment area (right tributary of Arda river) and the lower Maritsa river valley - from the state border to slightly above the inflow of Salziyka river, as well as the lower and middle Harmanliyska river valley and in the Tundzha river valley around the influx of Mochuritsa river.

Flooding occurred several times over the year: at the beginning of January (floods in the catchments of Varbitsa, Tundzha and Mochuritsa rivers); from beginning to mid February the covered territory expanded (upper Varbitsa river valley, lower Byala river valley, lower valleys of Maritsa, Harmanliyska and Sazliyka rivers, the Tundzha river valley where Mochuritsa and Kalnitsa rivers flow into it); the end of November and beginning and mid December (upper valleys of Varbitsa and Cherna rivers, left tributary of Arda river). Floods in February were the most large-scale - 57% of all local floods occurred during that month, and they were pluvial and mixed pluvial-fluvial.

Described adverse effects fall mainly under the category Economic Activity, with the largest relative share being damages on infrastructure sites - 81% of flood occurrences. Impacts on real estate (26%) and primary sector activities (30%) had a smaller share. In terms of the population, adverse effects were mainly related to disruption of public service access (30%) and to a lesser extent, such that affected people's health (12%). The environmental consequences were related only to flooded agricultural lands (29%).

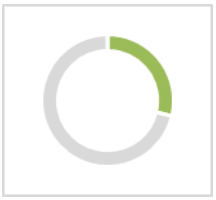
**Types of floods**

Number of floods per type in relation to total number

| *Fluvial floods* | *Pluvial floods* | *Flooding from groundwater* | *Infrastructure-related flooding* |
|---|---|---|---|
|  |  |  |  |

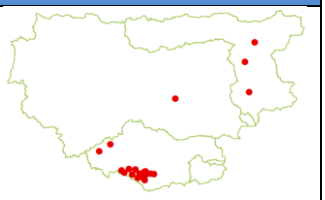
**Adverse effects**

Types of described adverse effects per category in relation to total number of floods

| *Human Health* | *Economic Activity* | *Environment* | *Cultural Heritage* |
|---|---|---|---|
|  |  |  |  |

**2013**

There is a slight drop in the number of registered floods. Flooding was pluvial or mixed pluvial-fluvial in origin.



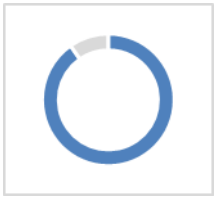
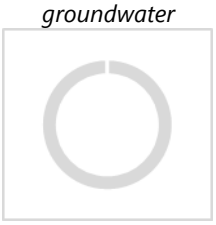
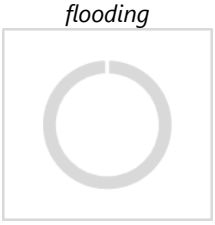
It occurred mainly in the upper Varbitsa river valley, but there were also isolated cases near the town of Dimitrovgrad and in the lower Tundzha river valley.

Flooding occurred mainly during two periods of the year: from mid-January to mid-February and in November.

Described adverse effects fall mainly under the category Economic Activity, whereas in almost all cases there were damages on infrastructure sites (84% of flood occurrences). The share of damages on real estate and primary sector activities was smaller - 19% for each sub-category. In terms of the population, adverse effects were related to people's health (16%). The environmental consequences were related only to flooded agricultural lands (19%).

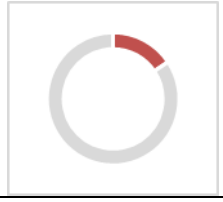
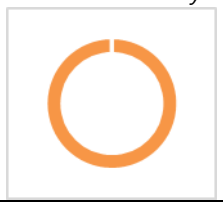
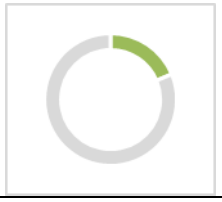
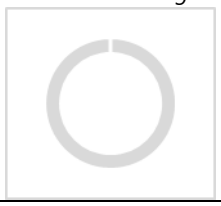
**Types of floods**

Number of floods per type in relation to total number

| *Fluvial floods* | *Pluvial floods* | *Flooding from groundwater* | *Infrastructure-related flooding* |
|---|---|---|---|
|  |  |  |  |

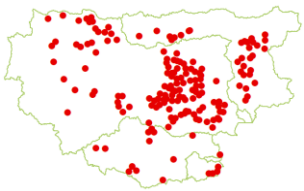
**Adverse effects**

Types of described adverse effects per category in relation to total number of floods

| *Human Health* | *Economic Activity* | *Environment* | *Cultural Heritage* |
|---|---|---|---|
|  |  |  |  |

**2014**

The number of registered floods peaked for the observed period. Flooding was pluvial or mixed pluvial-fluvial in origin.



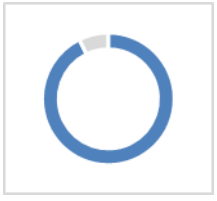
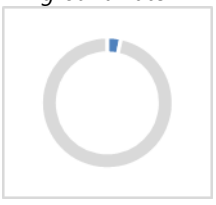
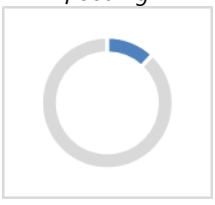
It affected a large part of the RBMD's territory. Two regions were formed in the Maritsa catchment area - its downstream section, incl. the tributaries Sazliyka and Harmanliyska rivers, as well as the upper Stryama river valley. Another two areas in the Tundzha river valley - upstream from the town of Nikolaevo and downstream from the inflow of Mochuritsa river. In the Arda river valley there were small areas in the upper part of the catchment area of Varbitsa and Perperek rivers. The lower Byala river valley.

Flooding occurred throughout the year. One could indicate the beginning of September and beginning of December as the most critical months.

Described adverse effects fall mainly under the category Economic Activity, whereby 80% of occurrences affected infrastructure sites. The extent of damages on real estate (35%), primary sector (23%) and secondary sector activities (5%) was smaller. Adverse effects for the population were related to human health (18%) and disruption of public service access (25%). Ecological consequences were related almost entirely to flooded agricultural land (19%), and in only 3 cases with adverse effects on protected areas.

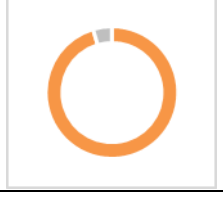
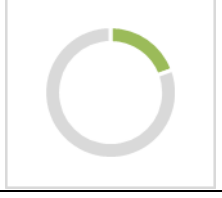
**Types of floods**

Number of floods per type in relation to total number

| *Fluvial floods* | *Pluvial floods* | *Flooding from groundwater* | *Infrastructure-related flooding* |
|---|---|---|---|
|  |  |  |  |

**Adverse effects**

Types of described adverse effects per category in relation to total number of floods

| *Human Health* | *Economic Activity* | *Environment* | *Cultural Heritage* |
|---|---|---|---|
|  |  |  |  |

**2015**

There was a significant drop in the number of registered floods; however, the year ranked second in this indicator for the observed period (2011-2019). Flooding was pluvial or mixed pluvial-fluvial in origin.

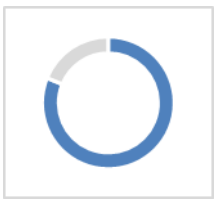
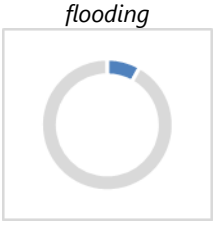
It occurred in several regions: downstream sections of Maritsa, Sazliyka and Harmanliyska rivers; downstream section of Tundzha river, incl. the entire length of Mochuritsa river; the Arda river valley around the upper reaches of Varbitsa, Arda, Cherna and Perperek rivers; the upper Stryama river valley.

Floods occurred several times during the year: end of January - beginning of February; end of February, March and April; mid September; mid October.

Described adverse effects fall mainly under the category Economic Activity and 86% of cases affected infrastructure sites. The extent of damages on primary sector activities (21%), real estate (13%) and secondary sector activities (6%) was smaller. Adverse effects for the population were related mostly to disruption of public service access (26%) and human health (7%). Ecological consequences were related almost entirely to flooded agricultural land (21%), and in only 5% of cases with adverse effects on protected areas.

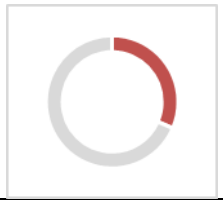
**Types of floods**

Number of floods per type in relation to total number

| *Fluvial floods* | *Pluvial floods* | *Flooding from groundwater* | *Infrastructure-related flooding* |
|---|---|---|---|
|  |  |  |  |

**Adverse effects**

Types of described adverse effects per category in relation to total number of floods

| *Human Health* | *Economic Activity* | *Environment* | *Cultural Heritage* |
|---|---|---|---|
|  |  |  |  |

**2016**

There was a significant drop in the number of registered floods. Flooding was pluvial or mixed pluvial-fluvial in origin.

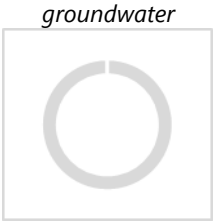
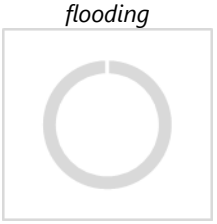
Floods occurred in the upper Arda river valley and along Krumovitsa river, along Maritsa and Harmanliyska rivers, in the downstream section of Tundzha river and upstream section of Stryama river.

They occurred during two time periods - mid-January and June-July.

Described adverse effects fall mainly under the category Economic Activity and 96% of cases affected infrastructure sites. The share of damages on real estate (22%) and primary and secondary sector activities (9% each) was smaller. Adverse effects for the population were related mainly to disruption of public service access (38%) and human health (11%). Ecological consequences were related to flooded agricultural land and adverse effects on protected areas - 9% each.

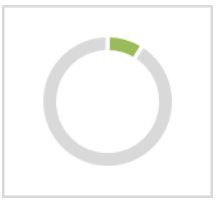
**Types of floods**

Number of floods per type in relation to total number

| *Fluvial floods* | *Pluvial floods* | *Flooding from groundwater* | *Infrastructure-related flooding* |
|---|---|---|---|
|  |  |  |  |

**Adverse effects**

Types of described adverse effects per category in relation to total number of floods

| *Human Health* | *Economic Activity* | *Environment* | *Cultural Heritage* |
|---|---|---|---|
|  |  |  |  |

**2017**

There was a slight increase in the number of registered floods as compared to the previous year. Flooding was pluvial or mixed pluvial-fluvial in origin.

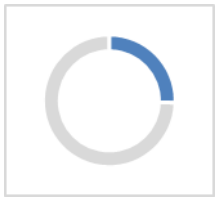
Floods occurred mainly in the upper Arda river valley.

They happen mainly during two periods of time - late May-early June and early December.

Described adverse effects fall mainly under the category Economic Activity and 95% of cases affected infrastructure sites. The share of damages on real estate (7%) and primary and secondary sector activities (4% each) was small. Adverse effects for the population were related to disruption of public service access and to human health, with 4% of cases for each. Ecological consequences were related to flooded agricultural land and adverse effects on protected areas - 4% each.

**Types of floods**

Number of floods per type in relation to total number

| *Fluvial floods* | *Pluvial floods* | *Flooding from groundwater* | *Infrastructure-related flooding* |
|---|---|---|---|
|  |  |  |  |

**Adverse effects**

Types of described adverse effects per category in relation to total number of floods

| *Human Health* | *Economic Activity* | *Environment* | *Cultural Heritage* |
|---|---|---|---|
|  |  |  |  |

**2018**

There is a slight increase in the number of registered floods. In terms of origin, there were pluvial and mixed pluvial-fluvial floods.

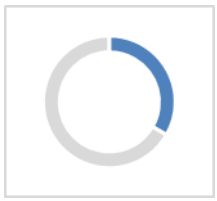
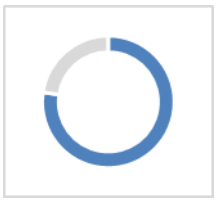
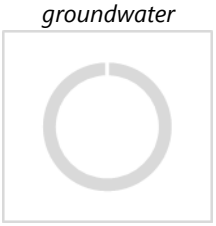
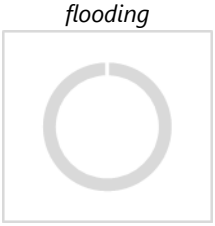
Floods occurred mainly in the upper Arda river valley. In addition, floods were also registered in the Byala river valley, Vacha river, Maritsa river in the Plovdiv area, in the Tundzha river valley at the confluence of Mochuritsa river, in the far northwestern parts of the RBMD within the Topolnitsa river valley and in the area around Stara Zagora.

Floods occurred in the summer season - mainly in June and August.

Described adverse effects fall mainly under the category Economic Activity and 86% of cases affected infrastructure sites. The extent of damages on real estate (19%) and primary sector activities (10%) was smaller. Adverse effects for the population were related mostly to disruption of public service access (18%) and human health (6%). Ecological consequences were related to flooded agricultural land (9%) and adverse effects on protected areas and water body status - 4% each.

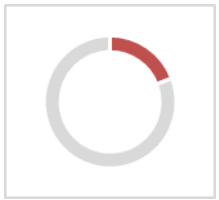
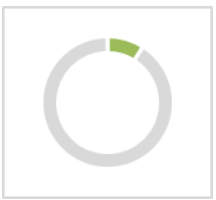
**Types of floods**

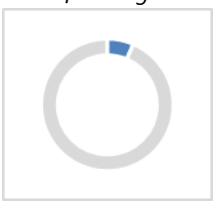
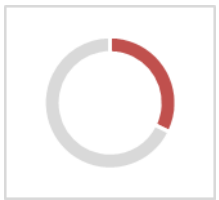
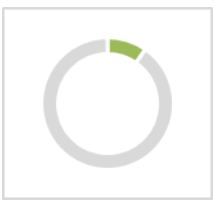
Number of floods per type in relation to total number

| *Fluvial floods* | *Pluvial floods* | *Flooding from groundwater* | *Infrastructure-related flooding* |
|---|---|---|---|
|  |  |  |  |

**Adverse effects**

Types of described adverse effects per category in relation to total number of floods

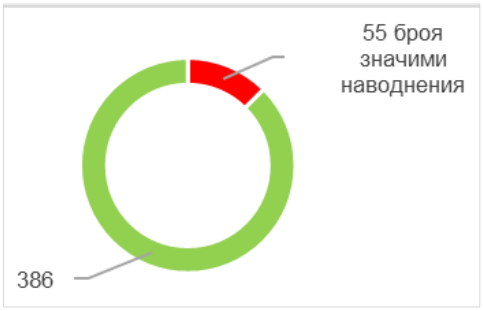
| *Human Health* | *Economic Activity* | *Environment* | *Cultural Heritage* |
|---|---|---|---|
|  |  |  |  |

| 2019 | | | |
|---|---|---|---|
| There was a drop in the number of registered floods. In terms of origin, there were pluvial and mixed pluvial-fluvial floods.<br>Floods occurred in the lower catchment area of Varbitsa river, Maritsa river near the city of Plovdiv, around the town of Kostenets, the upper Stryama river valley.<br>They happened mainly during two periods of time - end of February and June-beginning of July.<br>Described adverse effects fall mainly under the category Economic Activity and 97% of cases affected infrastructure sites. The extent of damages on real estate (32%) and primary sector activities (19%) was smaller. Adverse effects for the population were related to human health and disruption of public service access - 23% each. The environmental consequences were related to flooded agricultural lands (10%). |  | | |
| **Types of floods**<br>Number of floods per type in relation to total number | | | |
| *Fluvial floods* | *Pluvial floods* | *Flooding from groundwater* | *Infrastructure-related flooding* |
|  |  |  |  |
| **Adverse effects**<br>Types of described adverse effects per category in relation to total number of floods | | | |
| *Human Health* | *Economic Activity* | *Environment* | *Cultural Heritage* |
|  |  |  |  |

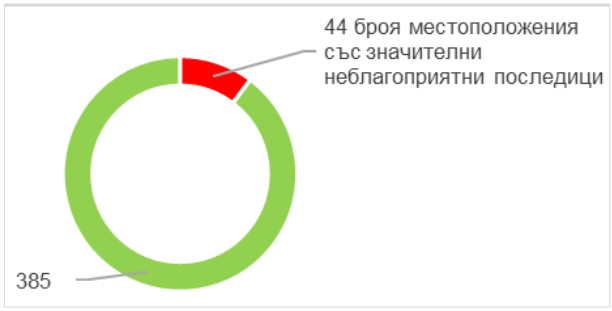
### *Past Floods with Significant Adverse Effects*

All registered past floods are classified according to significant adverse effects criteria, thereby identifying all significant events and locations.

*Total number of past floods, incl. significant ones*



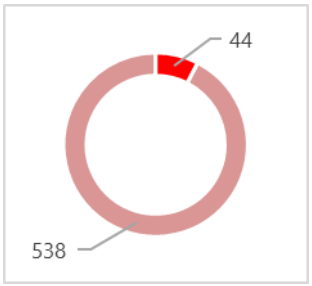

*Total number of locations, incl. such with significant adverse effects*



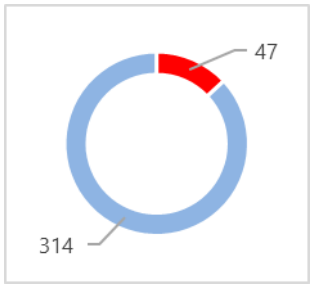

More detailed information on all past floods, and in particular on those with significant adverse effects can be found in the diagrams below. They show the relative share of floods per location in relation to different types of flood sources, mechanisms and characteristics. Complex floods, i.e. with more than one source of origin, are also included in the analysis, whereby different types of floods may have occurred in one location. The total number of locations is therefor greater than the one shown on the previous chart.

According to their **source**, floods are classified into fluvial, pluvial, flooding from groundwater and infrastructure-related flooding. Within the reviewed period (2011-2019), floods were classified predominantly as pluvial or such, where rainfall was one the sources. Fluvial floods come in second, whereas infrastructure-related and groundwater flooding had the smallest relative share. In terms of significant floods, they are split between pluvial and fluvial. Their number is significantly lower in the case of infrastructure and groundwater related occurrences. Below diagram indicates the number of floods in each category, whereby significant floods are marked red.

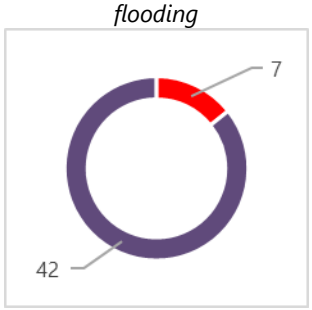
*Pluvial flood*



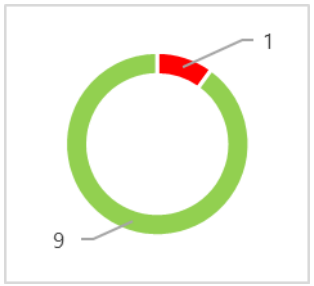

*Fluvial flood*



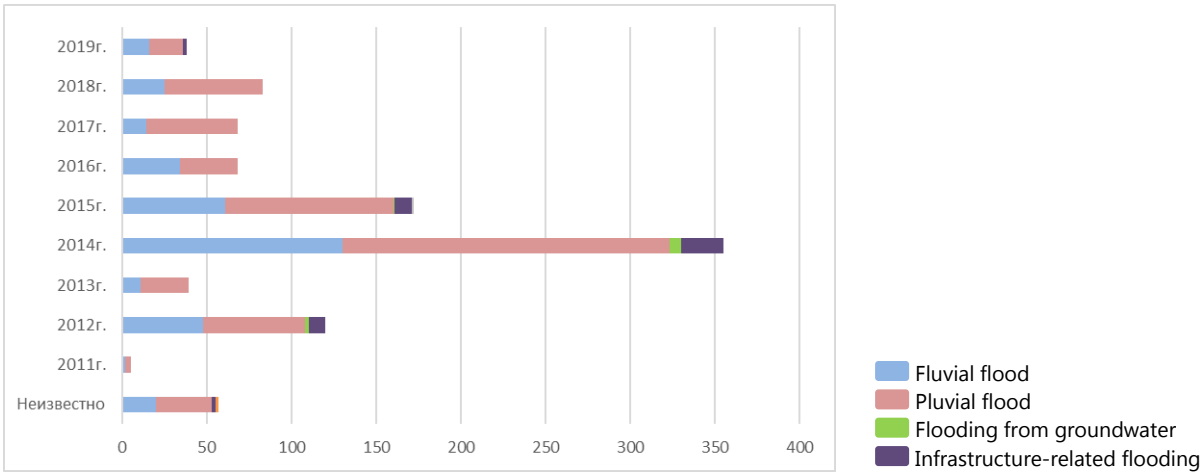

*Infrastructure-related flooding*




*Flooding from groundwater*

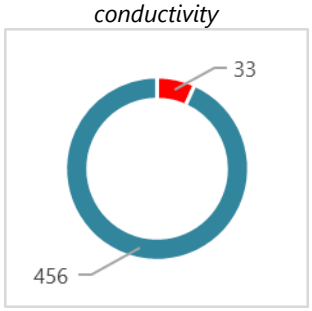



The distribution of past floods depending on their source per year is presented in the diagram below.

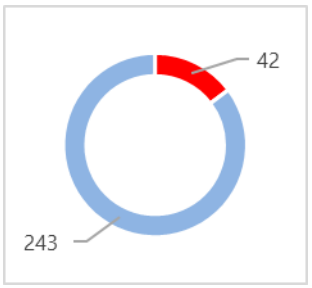



Given their occurrence **mechanism**, there are predominantly floods resulting from backwatering or reduced conductivity, as well as natural river overflow. This trend is also true with regard to significant floods.

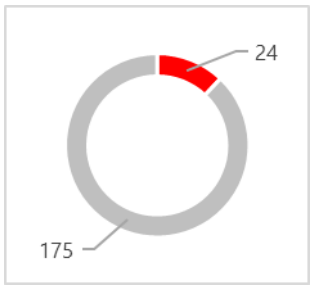
*Backwatering or reduced/disrupted conductivity*



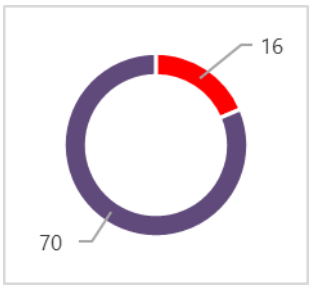

*Natural river overflow*




*Overtopping of protective facilities*

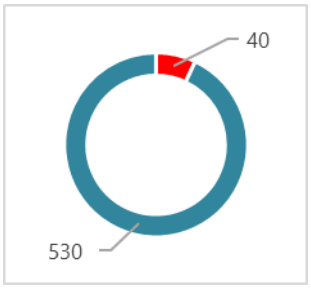



*Protective or infrastructural system failure*

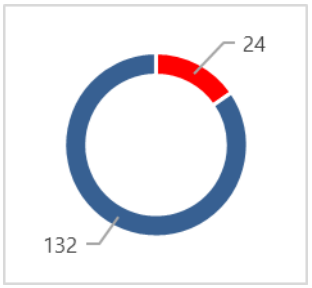



In terms of their **characteristics**, torrential floods have the largest share. Significantly smaller shares are occupied by occurrences described as other flash floods and high flow velocity. The smallest share was attributed to snowmelt and gradual floods. There were no instances characterized as alluvial fan flooding and deep water flooding during the observed period.

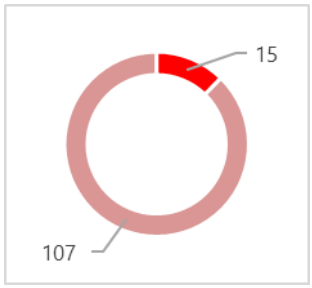
*Torrential flooding*



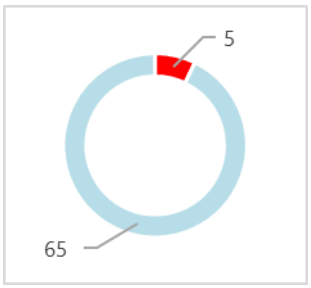

*Other flash flooding*



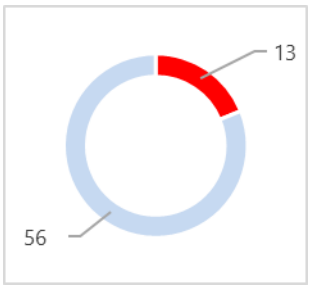

*High flow velocity*




*Snowmelt flooding*




*Gradual flooding*

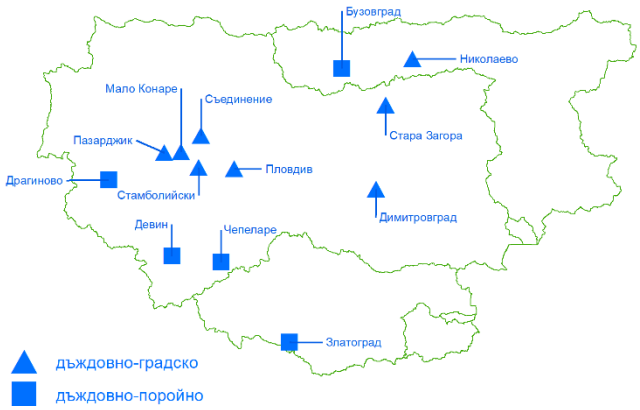



After reviewing past floods and identifying those with significant adverse effects, an analysis of all unclassified occurrences was carried out as to whether they would lead to significant potential consequences, if they were to recur today or in the future (as per FD Art.4.2(c)). 524 floods have been analyzed in accordance with the 2020 PFRA Methodology requirements in terms of their locations. The analysis was facilitated by the database, prepared under the Methodology in MS Excel format with its respective functionalities, where parameters are automatically calculate after entering flood data. These parameters include: specifics of settlements (number of affected settlements and number of inhabitants), flood characteristics (size of flooded area, recurrence and duration). By entering data for each flood within the database, parameters for probability of its recurrence are automatically calculated. In order to calculate risk elements in the floodplain, NSI population data from 2012 to 2019 were used to track changes. Master Plan and Cadaster data on current or planned land-use and infrastructure changes was also taken into account.

The analysis identified only 8 floods in 28 locations with risk indicators exceeding significance thresholds - for number of inhabitants. Detailed follow-up analysis showed that some locations have a population of less than 10 people, whereas in other cases the floodplain is outside the urban area, which is why those floods were assessed as insignificant.

## Future Floods

After performing a comprehensive analysis of the East Aegean RBMD, **13** floods have been identified, for which future pluvial flood hazard and risk shall be mapped in detail during the next FD implementation stage. These include **5** pluvial-torrential locations and **8** pluvial-urban flood, as presented on the schematic map below.

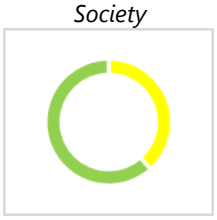



A risk assessment was carried out for each identified location per the main 4 categories: human health, economic activity, environment and cultural heritage and their respective sub-categories. Summarized results for all locations are presented in the following diagrams.

Human Health Category

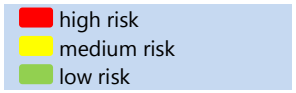
*Human Health*

*Society*



Cultural Heritage Category

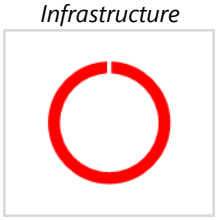
*Cultural property*




Economic Activity Category

*Real estate*

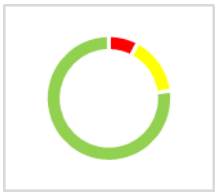
*Infrastructure*



*Primary sector*

*Secondary sector*

Environment Category

| *Water body status* | *Protected areas* | *Pollution with hazardous substances* | *Other adverse effects for the environment* |
|---|---|---|---|
|  |  |  |  |

## Facility Impact Analysis

The current draft PFRA takes into account all available information at the time of assessment on hydrotechnical systems and facilities, facilities for protection against harmful effects of water and sewerage systems.

An analysis was carried out in terms of the condition of complex and significant dams (WA, Appendix №1 under Art. 13(1)), reservoirs that are part of the hydro-melioration system under the stewardship of Irrigation Systems EAD of MAFF, as well as municipally-managed or leased reservoirs.

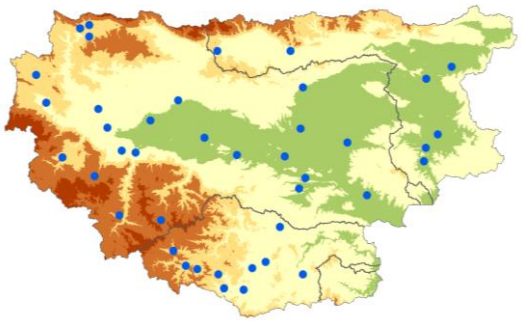
For facilities, where information was received that they are in faulty condition, on-site consultations were conducted and relevant facilities representing a threat have been identified based on received additional information.

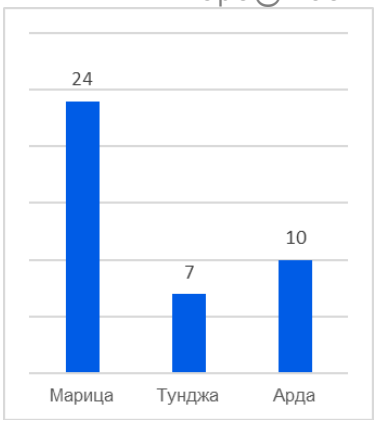
## Identifying APSFRs

Designating APSFRs begins with identifying territories within the river basins, that were subject to floods under FD Art. 4.2(b), (c) or (d) for which potential, significant adverse effects have occurred or were identified. Defining APSFRs is the last stage of the PFRA and its results are used in the next FD implementation steps, namely mapping flood hazard and risk areas and preparing FRMPs.

### *Identified APSFRs*

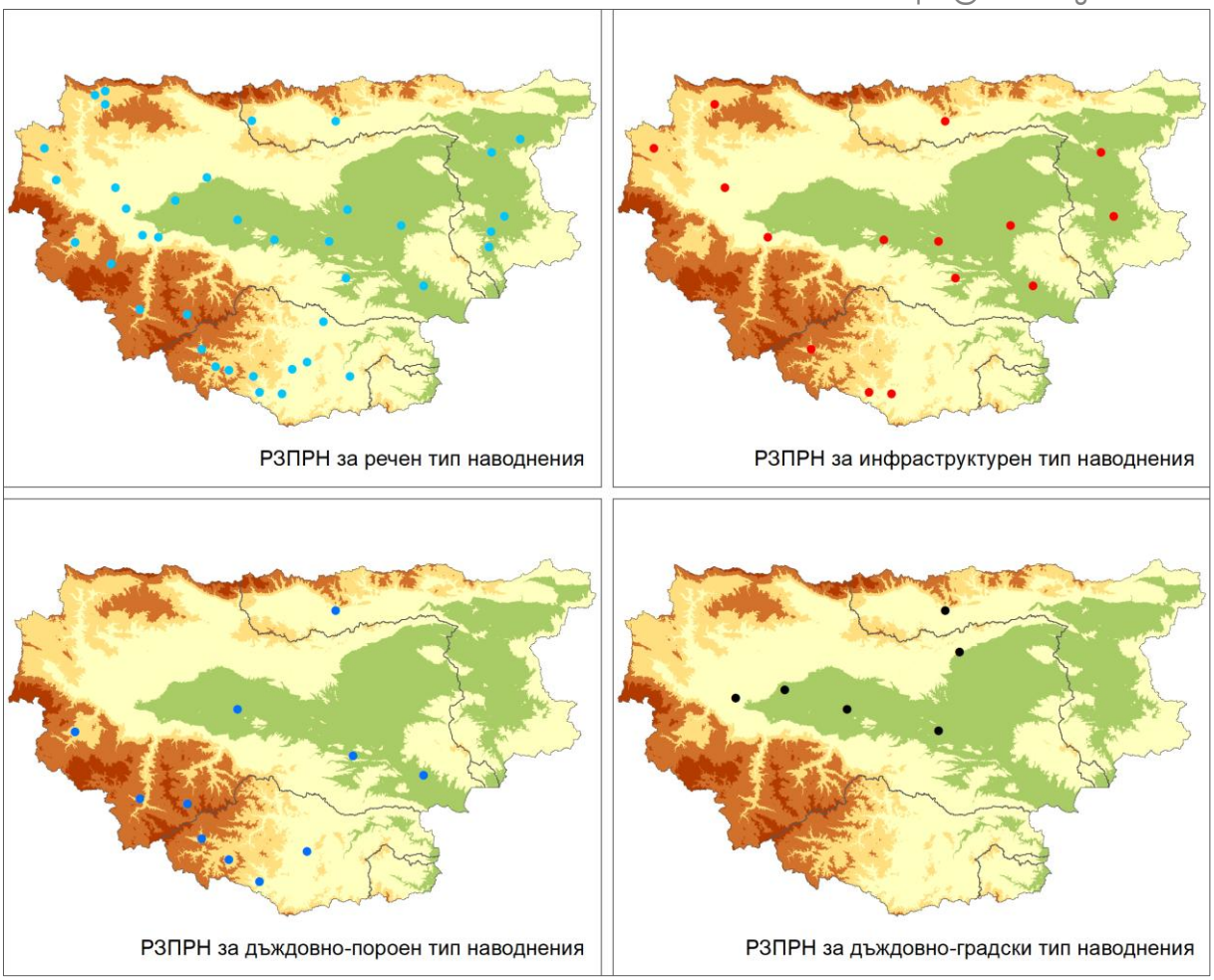
**41 APSFRs** have been identified within the East Aegean RBMD as a result of the PFRA (2022-2027), **6 of which are new**. They are located in three main river valleys. Their location and the number of river valleys are shown on the schematic map below.






In each APSFR one or several different types of floods have been identified, for which flood hazard and risk maps shall be prepared within the next FD stages. There are a total of 4 types of floods: **fluvial, pluvial-torrential, pluvial-urban** and **infrastructure-related.** Infrastructure-related floods examine overtopping or dam failure hazards.

The location of APSFR per types of floods is presented in the schematic map below.


РЗПРН за речен тип наводнения
РЗПРН за инфраструктурен тип наводнения
РЗПРН за дъждовно-пороен тип наводнения
РЗПРН за дъждовно-градски тип наводнения

**LIST OF IDENTIFIED APSFRS IN THE EAST AEGEAN RBMD**

| APSFR code | APSFR name | Type of flood according to source |
|---|---|---|
| **BG3_APSFR_AR_01** | Krumovitsa river - town of Krumovitsa | fluvial |
| **BG3_APSFR_AR_02** | Varbitsa river - village of Benkovski | fluvial<br>infrastructure-related (dam failure of Benkovski reservoir) |
| **BG3_APSFR_AR_03** | Dzhebelska river - town of Dzhebel | fluvial |
| **BG3_APSFR_AR_04** | Nedelinska river - town of Nedelino | fluvial |
| **BG3_APSFR_AR_05** | Varbitsa river - town of Zlatograd | fluvial<br>pluvial-torrential<br>infrastructure-related (overtopping of Zlatograd dam) |
| **BG3_APSFR_AR_06** | Cherna river - town of Smolyan | fluvial<br>pluvial-torrential<br>infrastructure-related (dam failure of Lagera and Kiryanov Gyol reservoirs and a combination of both) |
| **BG3_APSFR_AR_07** | Madanska river - town of Madan | fluvial<br>pluvial-torrential |
| **BG3_APSFR_AR_08** | Arda river - town of Rudozem | fluvial |
| **BG3_APSFR_AR_100** | Varbitsa river - town of Momchilgrad | fluvial<br>pluvial-torrential |
| **BG3_APSFR_AR_101** | Perperek river - from village of Perperek to village of Lyulyakovo | fluvial |
| **BG3_APSFR_MA_01** | Maritsa river - from town of Simeonovgrad to village of Kapitan Andreevo; Biserska river - from village of Slavyanovo to town of Lyubimets | fluvial<br>pluvial-torrential<br>infrastructure-related (overtopping of Dositeevo dam) |
| **BG3_APSFR_MA_03** | Salziyka river - from town of Radnevo to the river mouth | fluvial<br>infrastructure-related (dam failure of Musachevo, Radnevo, Yovina Reka and Aprilovo reservoirs) |
| **BG3_APSFR_MA_04** | Maritsa river - from town of Parvomay to village of Raynovo | fluvial<br>pluvial-urban (Dimitrovgrad)<br>infrastructure-related (dam failure of Dolno Belovo reservoir) |
| **BG3_APSFR_MA_05** | Maritsa river - from village of Orizari to town of Parvomay | fluvial<br>pluvial-torrential<br>pluvial-urban (city of Plovdiv), |
| **BG3_APSFR_MA_06** | Mechka river - from village of Dalbok Izvor to town of Parvomay | fluvial<br>infrastructure-related (dam failure of Zlatovrah (Novi Izvor) reservoir) |
| **BG3_APSFR_MA_08** | Stryama river - from village of Chernozem to village of Razhevo Konare | fluvial |
| **BG3_APSFR_MA_09** | Chepelarska river - town of Chepelare | fluvial<br>pluvial-torrential |
| **BG3_APSFR_MA_10** | Potoka river - from town of Saedinenie to village of Orizari | fluvial<br>pluvial-urban (town of Saedinenie) |
| **BG3_APSFR_MA_100** | Maritsa river - town of Kostenets | fluvial |
| **BG3_APSFR_MA_101** | Maritsa river - from village of Momina Klisura to town of Stamboliyski | fluvial<br>pluvial-urban (towns of Stamboliyski and Pazardzhik, village of Malo Konare) |

| | | |
|---|---|---|
| **BG3_APSFR_MA_102** | Vozdol river - village of Chelopech | fluvial |
| **BG3_APSFR_MA_103** | Kurudere river - town of Zlatitsa | fluvial |
| **BG3_APSFR_MA_104** | Topolnitsa river - from village of Dushantsi to village of Petrich | fluvial<br>infrastructure-related (overtopping of Dushantsi and Zhekov Vir dams) |
| **BG3_APSFR_MA_105** | Harmanliyska river - from village of Vaglarovo to village of Bryagovo | fluvial<br>infrastructure-related (overtopping of Trakiets dam, dam failure of Stamboliyski reservoir) |
| **BG3_APSFR_MA_106** | Uzundzhovska river - village of Uzundzhovo | pluvial-torrential |
| **BG3_APSFR_MA_107** | Erekdere river - from village of Lovets to village of Byal Izvor | fluvial |
| **BG3_APSFR_MA_108** | City of Stara Zagora | pluvial-urban (city of Stara Zagora) |
| **BG3_APSFR_MA_11** | Vacha river - from town of Krichim to village of Kurtovo Konare | fluvial<br>infrastructure-related (overtopping of Krichim dam) |
| **BG3_APSFR_MA_12** | Devinska river - town of Devin | fluvial<br>pluvial-torrential |
| **BG3_APSFR_MA_13** | Stara Reka (Peshterska) river - from town of Peshtera to town of Stamboliyski | fluvial |
| **BG3_APSFR_MA_14** | Stara Reka (Peshterska) river - town of Batak | fluvial |
| **BG3_APSFR_MA_15** | Topolnitsa river - from village of Lesichovo to town of Parzardzhik | fluvial<br>infrastructure-related (overtopping of Topolnitsa dam) |
| **BG3_APSFR_MA_17** | Chepinska river - from town of Velingrad to village of Draginovo | fluvial<br>pluvial-torrential |
| **BG3_APSFR_MA_18** | Mativir river - from village of Verinsko to town of Ihtiman | fluvial<br>infrastructure-related (dam failure of Bakar Dere reservoir) |
| **BG3_APSFR_TU_01** | Tundzha river - town of Elhovo | fluvial<br>infrastructure-related (overtopping of Zhrebchevo dam) |
| **BG3_APSFR_TU_02** | Tundzha river - from village of Samuilovo to village of Tenevo | fluvial<br>overtopping of Zhrebchevo dam (2 scenarios), dam failure of Dvata Chuchura reservoir (2 scenarios - from SE and NE)) |
| **BG3_APSFR_TU_03** | Mochuritsa river - from village of Malenovo to town of Yambol | fluvial |
| **BG3_APSFR_TU_04** | Tundzha river - from Koprinka reservoir to Zhrebchevo reservoir | fluvial<br>pluvial-torrential<br>pluvial-urban (town of Nikolaevo), infrastructure-related (overtopping of Koprinka dam) |
| **BG3_APSFR_TU_05** | Tundzha river - from town of Kalofer to village of Alexandrovo | fluvial |
| **BG3_APSFR_TU_100** | Tundzha river - from village of Ustrem to village of Srem | fluvial |
| **BG3_APSFR_TU_101** | Sinapovska river - village of Sinapovo | fluvial |

***APSFR Documentation***

Detailed documentation has been created for all identified APSFRs. It includes the following enclosures.

**Description of main characteristics**

- The Appendix is in tabular form and indicates the main characteristics of each APSFR, incl. its code, name, length, types of floods, changes compared to previous FD cycle, year of establishment.

**Assessment in terms of risk categories and sub-categories**

- Assessment of each APSFR under the 4 risk categories - human health, economic activity, environment, cultural heritage and their corresponding 12 sub-categories.

**Passports**

- Detailed description for each APSFR in the form of a passport.

**GIS data**

- GIS data presenting each APSFR - location and type of flood in kmz format.

**Maps**

- General map of all APSFRs in the East Aegean RBMD and thematic maps for each APSFR with information on its location, types of floods, past floods registered in the period 2011-2019, based on aerial photography.

## Informing the Public and Consultations

In preparation for the current PFRA, stakeholders were consulted to collect information on past floods that occurred in the country in the period 2011 - 2019. This data is crucial in order to identify floods with significant adverse effects and serious floods, which could lead to significant adverse effects in the future. It is therefor also essential for the identification of APSFRs. These consultations were conducted in two stages:

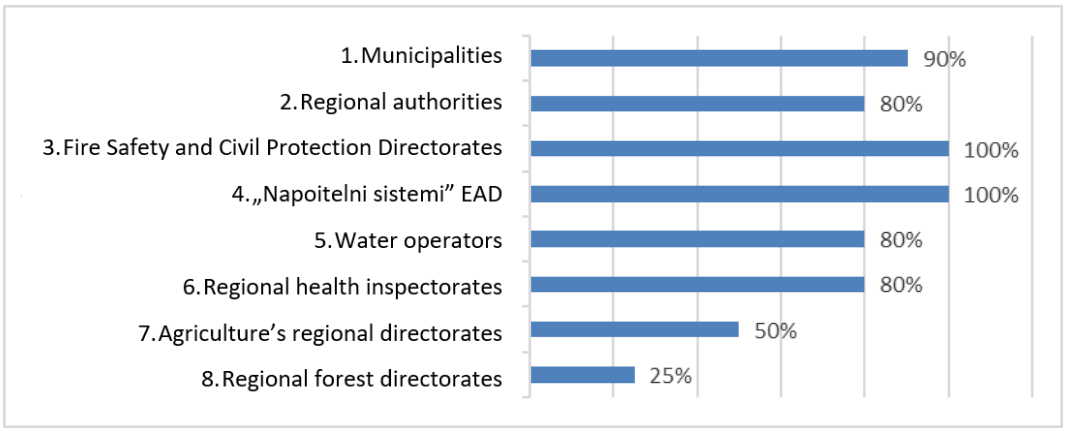
- Questionnaire survey;
- A series of workshops.

The purpose of the survey was to gather detailed information about past floods in the period 2011 - 2019 for the entire RBMD. The survey was carried out via a *Questionnaire on description of past floods*, prepared as part of the 2020 Preliminary Flood Risk Assessment Methodology. In early September 2019, said Questionnaire was sent by representatives of the East Aegean RBD to about 160 administrative structures and organizations, whose functions include activities related to flood prevention, protection, assistance and recovery, incl. local government bodies (district and municipal administrations), specialized state institutions (General Directorate for Fire Safety and Civil Protection and its territorial units, Regional Health Inspectorates, Regional Directorates of Agriculture, Regional Forestry Directorates), as well as others legal entities (incl. W&S operators, Irrigation Systems Company) directly related to and working in this field.

Information from the completed questionnaires was processed, systematized and entered into a common database.

In order to refine and supplement the data, 4 workshops were held in different cities - Plovdiv, Stara Zagora and Kardzhali.

Representatives of 132 institutions and organizations, i.e. 84% of all respondents, participated in the survey and workshops. The diagram shows the number of participating institutions in relation to the total number of respondents.



## Next Steps

PFRA and identifying APSFRs is the first stage of preparing FRMPs under the FD, which was transposed in the Bulgarian WA in 2010 and each stage of its implementation corresponds to the respective legislative provisions therein.

The requirements of the FD (Chapter II) and the WA (Chapter 9, Section II) on the PFRA are set out in the following main articles of the two documents:

- Preparation of a PFRA, FD Art. 4 and WA Art. 146a-146c;
- Identifying APSFRs, FD Art. 5 and WA Art. 146d;

Fulfilling these requirements creates the basis for implementing next steps under the FD, namely:

- Flood hazard and flood risk maps - FD Chapter III, as set out in WA Chapter 9, Section III;
- **Flood Risk Management Plans (FRMPs)** - DF Chapter IV, as foreseen in WA Section IV.