Państwowe
Gospodarstwo Wodne
Wody Polskie

REPORT ON REVIEW AND UPDATE OF PRELIMINARY FLOOD RISK ASSESSMENT IN THE 3rd PLANNING CYCLE

CONTRACTOR:

Institute of Meteorology and Water Management – National Research Institute

Arcadis Sp. z o.o.

Polish Geological Institute – National Research Institute (for groundwater flooding)

DATE: 2025-03-20

VERSION No. 1.00

Fundusze Europejskie na Infrastrukturę, Klimat, Środowisko

Rzeczpospolita Polska

Dofinansowane przez Unię Europejską

Projekt: Przegląd i aktualizacja wstępnej oceny ryzyka powodziowego w 3 cyklu planistycznym
Nr Projektu: FENX.02.04-IW.01-0026/24

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

APSFR	Areas of Potential Significant Flood Risk (Polish abbreviation 'ONNP')
ARiMR	Agency for Restructuring and Modernisation of Agriculture
BDOT	Topographic Objects Database
CBDH	Central Hydrogeological Data Bank
CLC	Corine Land Cover
CSO	Central Statistical Office
DP	Floods Directive, Directive 2007/60/EC of the European Parliament and of the Council of 23 October, 2007 on the assessment and management of flood risks
DTM	Digital Terrain Model
FHA	Flood Hazard Area (Polish abbreviation 'OZP')
FHM	Flood Hazard Maps (Polish abbreviation 'MZP')
FRM	Flood Risk Maps (Polish abbreviation 'MRP')
FRMP	Flood Risk Management Plan (Polish abbreviation 'PZRP')
GDOŚ	General Directorate for Environmental Protection
GIOŚ	Chief Inspectorate of Environmental Protection
GIS	Geographic Information Systems
IMGW-PIB	Institute of Meteorology and Water Management – National Research Institute
IPCC	Intergovernmental Panel on Climate Change
JST	Local Government Unit
EC	European Commission
HF	Historical Floods
KZGW	National Water Management Authority
MhP PPW	Hydrogeological map of Poland. First aquifer
MPHP	Map of Hydrographic Division of Poland

MWP	Groundwater Monitoring
NID	National Heritage Institute
PF	Probable Floods
PFRA	Preliminary Flood Risk Assessment (Polish abbreviation 'WORP')
PFRAS	Preliminary Seawater Flood Risk Assessment (Polish abbreviation 'WORPM')
PGW WP	State Water Holding Polish Waters
PH	significant historical floods with significant adverse consequences; floods as defined in Art. 4.2b of the Floods Directive
PH	significant historical floods without significant adverse consequences; floods as defined in Art. 4.2c of the Floods Directive
PIG-PIB	Polish Geological Institute – National Research Institute
PPd	probable floods with potential adverse consequences; floods as defined in Art. 4.2d of the Floods Directive
PSH	state hydrogeological service (from 01.01.2024 state geological service)
PSHM	national hydrological and meteorological service
PSP	State Fire Service
WFD	Water Framework Directive, Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy
RCP	Representative Concentrations Pathways
RP	Republic of Poland
RZGW	Regional Water Management Authority
SMGP	Detailed Geological Map of Poland
SSP	Shared Socio-economic Pathway
EU	European Union
UW	Voivodeship Offices

DEFINITIONS

Damming structures – structures enabling permanent or periodic damming of surface water above the adjacent land or the natural water table (Water Law Act, Art. 16 point 2).

Flood risk management objectives – reducing the potential adverse consequences of floods on human life and health, the environment, cultural heritage and economic activity (Water Law Act, Art. 16 point 4).

River basin district – a land and sea area, made up of one or more neighbouring river basins together with their associated ground waters, internal marine waters, transitional waters, and coastal waters, being the main spatial unit of water management (Water Law Act, Art. 16 point 31).

Areas of potential significant flood risk (APSFR) – areas where a significant flood risk exists or is likely to occur (Water Law Act, Art. 16 point 33), i.e. areas of significant flood risk.

Areas of potential flood risk – these are areas for which analyses are carried out to identify APSFR; according to the PFRA scheme, they are determined based on the identification and assessment of historical floods and probable floods (considering significant adverse consequences of floods and forecasts of long-term developments) as the sum of areas of historical floods and probable floods (i.e. floods referred to in Art. 4.2 b, Art. 4.2 c, and Art. 4.2 d of the FD).

Special flood hazard areas (Water Law Act, Art. 16 point 34):

a) areas where the probability of flooding is medium (1%),

b) areas where the probability of flooding is high (10%),

c) areas between the shoreline and the flood embankment or a natural high bank with built-in flood embankments, as well as islands and alluvials, as referred to in Art. 224, which constitute cadastral parcels,

d) a technical belt.

Flood – a temporary coverage by water of land not normally covered by water, in particular, caused by water exceedance in natural watercourses, reservoirs, canals, and from the sea, excluding the coverage by water of land caused by water exceedance in sewerage systems (Water Law Act, Art. 16 point 43).

Historical (past) floods – floods that occurred in the past in a given area, including:

- **Floods, as referred to in Art. 4.2b of the Floods Directive** – floods that have occurred in the past and which had **significant adverse consequences** for human health, the

environment, cultural heritage, and economic activity, where similar events are likely to occur in the future;

- **Floods, as referred to in Art. 4.2c of the Floods Directive** – floods that have occurred in the past and have not caused significant adverse consequences at that time but it can be predicted that similar phenomena **will have significant adverse consequences in the future** (considering e.g. land use changes or climate change).

Probable flood – a flood that may occur in a given area in the future and cause **potential adverse consequences** on human life and health, the environment, cultural heritage, and economic activity – **flood referred to in Art. 4.2d of the Floods Directive.**

Water region – a part of the river basin district separated based on hydrographical criteria for the needs of water resources management or a part of an international river basin area situated in the territory of the Republic of Poland (Water Law Act, Art. 16 point 46).

Flood risk – a combination of the probability of flood occurrence and potential adverse consequences of floods on human life and health, the environment, cultural heritage, and economic activity (Water Law Act, Art. 16 point 48).

Alert water level – a conventional water level that corresponds to the filling of the river bed, posing a threat to infrastructure and buildings, as well as to human life and health; usually placed near bank water [source: Thematic dictionary of terms used in hydrological forecasts, IMGW-PIB, 2014].

Significant adverse consequences of floods – negative consequences of floods (on human life and health, the environment, cultural heritage, and economic activity) of a supra-threshold nature (i.e. above certain threshold values resulting from the probability distribution of the values of adverse consequences of historical floods) on a local or regional scale, resulting from a specific flood hazard and the vulnerability of the system affected by that hazard.

Significant historical floods – floods that occurred in the past and had significant adverse consequences (on human life and health, the environment, cultural heritage, and economic activity) or constituted a flood hazard of a supra-threshold nature (i.e. above certain threshold values resulting from the probability distribution of values for historical floods).

Significant flood risk – the flood risk that forms the basis for the designation of APSFR s; it is determined as a result of a flood risk assessment, including an assessment of the adverse consequences of floods and a forecast of long-term developments, carried out for areas of potential significant flood risk.

INTRODUCTION

1. INTRODUCTION

The review and update of the preliminary flood risk assessment was carried out under the project 'Review and update of the preliminary flood risk assessment in the 3rd planning cycle', commissioned by the State Water Holding Polish Waters – National Water Management Authority under agreement no. KZGW/KPP/2023/58 dated 18.09.2023, whose Contractor is the Consortium composed of: the Institute of Meteorology and Water Management – National Research Institute, ARCADIS sp. z o.o. and subcontractor: the National Geological Institute – National Research Institute.

The report on the review and update of the PFRA also covers the PFRA on the seaward side, including internal marine waters, prepared by the minister responsible for maritime affairs (Minister of Infrastructure).

2. LEGAL BASIS

The review and update of the preliminary flood risk assessment (PFRA) is a task of the State Water Holding Polish Waters (PGW WP), resulting from Art. 168 points 1 and 10 of the Act of 20 July 2017 – Water Law (Journal of Laws, 2024 item 1087), hereinafter referred to as the 'Water Law Act' and Art. 14 point 1 of Directive 2007/60/EC of the European Parliament and of the Council of 23 October, 2007 on the assessment and management of flood risks, hereinafter referred to as the 'Floods Directive (DP)'.

According to Art. 315 point 5 of the Act – Water Law the PFRA is a planning document for water management.

The PFRA is reviewed every 6 years and updated as necessary.

The purpose of the PFRA is to estimate the flood risk in the river basin districts and to identify areas where the risk is significant, for which, in further stages, the FHM and FRM should be developed and actions planned in the FRMP.

The scope of the PFRA is defined in Art. 167 of the Water Act:

Art. 167 point 1 A preliminary flood risk assessment shall be prepared for river basin districts on the basis of available or readily derivable information, including the effects of climate change on the occurrence of floods.

2. The preliminary flood risk assessment shall include in particular:

    1) maps of the river basin districts, showing the borders of the river basins, the boundaries of the river basins and the boundaries of the coastal strip, showing the topography of the land and its development;

    2) description of historical floods:

a) which have caused significant adverse consequences on human life and health, the environment, cultural heritage and economic activity, including an assessment of those effects, the extent of the floods and the route of the flood flows,

b) where similar flood events are likely to have significant adverse impacts on human life and health, the environment, cultural heritage and economic activity;

3) an assessment of the potential adverse consequences of future floods on human life and health, the environment, cultural heritage and economic activity, taking into account:

a) the topography of the terrain,

b) the location of watercourses and their general hydrological and geomorphological characteristics, including floodplains as natural retention areas,

c) the effectiveness of existing water reservoirs and other flood control and regulatory structures,

d) the location of inhabited areas,

e) the location of the areas where the economic activity is carried out;

4) where possible, a forecast of long-term developments, in particular the effects of climate change on the occurrence of floods;

5) identification of areas of potential significant flood risk.

The rules for the preparation, opinion, agreement and approval of the PFRA are set out in Art. 168 of the Water Law:

Art. 168. 1. The draft preliminary flood risk assessment shall be prepared by State Water Holding Polish Waters.

2. The draft preliminary seawater flood risk assessment, including internal sea waters, shall be prepared by the minister in charge of maritime economy and submitted to Polish waters not later than six months before the date of preparation of the preliminary flood risk assessment. The draft preliminary seawater flood risk assessment the sea, including internal sea waters, shall be an integral part of the draft preliminary flood risk assessment referred to in paragraph 1.

3. State Water Holding Polish Waters shall submit the draft preliminary flood risk assessment to the voivodes for their opinion and to the minister in charge of inland navigation for agreement as far as inland waterways are concerned.

4. The authorities referred to in paragraph 3 shall give their opinion and agreement within 45 days of receipt of the draft preliminary flood risk assessment. The absence of an opinion within this deadline shall be considered as a positive opinion on the draft.
5. State Water Holding Polish Waters shall agree with the minister in charge of maritime economy on the manner of consideration of opinions to the draft preliminary seawater flood risk assessment, including internal sea waters.
6. State Water Holding Polish Waters shall notify the consulting bodies of the manner in which the opinions have been considered within 45 days of their receipt.
7. The preparation of the preliminary flood risk assessment for river basin districts parts of which are located within the territory of other Member States of the European Union shall be preceded by an exchange of information necessary for the development of this assessment with the competent authorities of those countries. The exchange of information shall take place in the manner and scope laid down in separate legislation.
8. State Water Holding Polish Waters shall submit the draft preliminary flood risk assessment to the minister in charge of water management for approval.
9. The minister responsible for water management shall approve the preliminary flood risk assessment and:
    1) transmits it to the Director of the Government Security Centre;
    2) shall be made public by placing it on the subject page of the Public Information Bulletin of the office supporting the minister responsible for water management.
10. The preliminary flood risk assessment shall be reviewed every 6 years and updated as necessary.
11. The review of the preliminary flood risk assessment also takes into account the possible impact of climate change on the occurrence of floods.
12. Paragraphs 1 to 9 shall apply accordingly to the update of the preliminary flood risk assessment.
13. The minister in charge of water management shall make the reviews and updates of the preliminary flood risk assessment available to the European Commission within 3 months of their completion.

3. UNITS OF MANAGEMENT

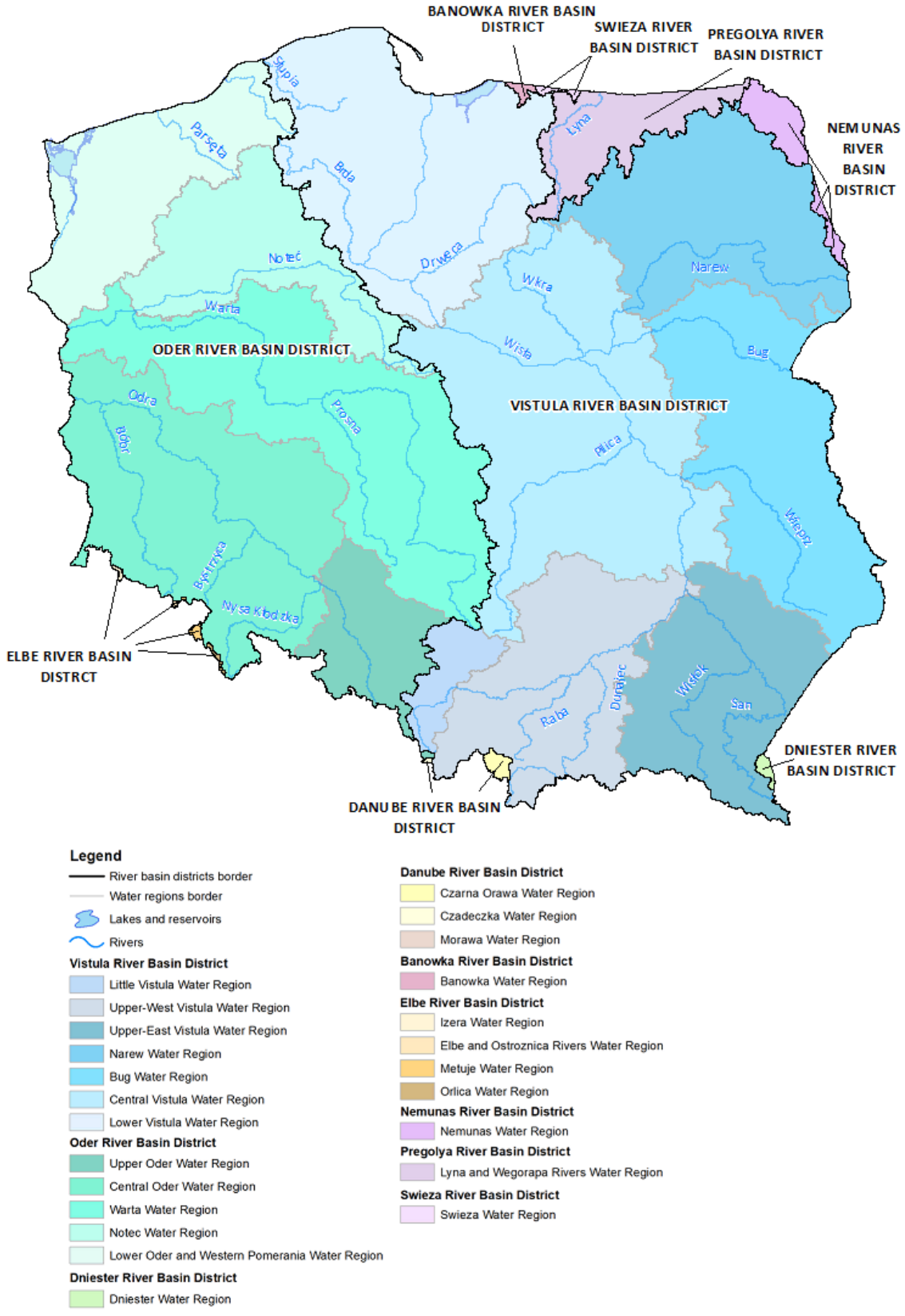
According to Art. 12 of the Water Law Act, water resources management in Poland is carried out taking into account the division of the country into river basin districts, water regions and river basins. **Flood risk management units in Poland within the meaning of the Floods Directive are the river basin districts.** The division of Poland into river basin districts and water regions is presented in Table1 and on Figure1.

Table1 : River basin districts and water regions in Poland

Lp.	River Basin District	Water region
1	**Vistula**	Little Vistula
		Upper West Vistula
		Upper East Vistula
		Narew
		Bug
		Central Vistula
		Lower Vistula
2	**Oder**	Upper Oder
		Central Oder
		Lower Oder and Western Pomerania
		Warta
		Notec
3	**Dniester**	Dniester
4	**Danube**	Czara Orawa
		Czadeczka
		Morawa
5	**Banowka**	Banowka
6	**Elbe**	Izera
		Elbe and Ostroznica (Upa)
		Metuje
		Orlica
7	**Nemunas**	Nemunas
8	**Pregolya**	Lyna and Wegorapa
9	**Swieza**	Swieza

The Vistula river basin area includes, in addition to the Vistula river basin located on Polish territory, the basins of the Slupia, Lupawa, Leba, Reda and other rivers flowing directly into the Baltic Sea east of the Slupia River estuary, as well as those flowing into the Vistula Lagoon.

The Oder river basin district includes, in addition to the Oder river basin located on Polish territory, the river basins of the Rega, Parseta, Wieprza, Ücker and other rivers flowing directly into the Baltic Sea west of the estuary of the Słupia River, as well as those flowing into the Szczecin Lagoon.



Legend

- River basin districts border
- Water regions border
- Lakes and reservoirs
- Rivers

Vistula River Basin District

- Little Vistula Water Region
- Upper-West Vistula Water Region
- Upper-East Vistula Water Region
- Narew Water Region
- Bug Water Region
- Central Vistula Water Region
- Lower Vistula Water Region

Oder River Basin District

- Upper Oder Water Region
- Central Oder Water Region
- Warta Water Region
- Notec Water Region
- Lower Oder and Western Pomerania Water Region

Dniester River Basin District

- Dniester Water Region

Danube River Basin District

- Czarna Orawa Water Region
- Czadeczka Water Region
- Morawa Water Region

Banowka River Basin District

- Banowka Water Region

Elbe River Basin District

- Izera Water Region
- Elbe and Ostroznica Rivers Water Region
- Metuje Water Region
- Orlica Water Region

Nemunas River Basin District

- Nemunas Water Region

Pregolya River Basin District

- Lyna and Wegorapa Rivers Water Region

Swieza River Basin District

- Swieza Water Region

Figure1: River basin districts and water regions in Poland

4. COMPETENT AUTHORITIES

Pursuant to Art. 163 paragraph 1 of the Water Law Act, protection against flooding is the task of the Polish Waters and the bodies of governmental and local administration. Pursuant to Art. 163 point 2, the State Water Holding Polish Waters ensures the protection of the population and property from flooding caused by public waters owned by the State Treasury. In connection with Art. 212 paragraph 1 point 1 of the Water Law Act, the State Water Holding Polish Waters exercises ownership rights over inland flowing waters and groundwater.

With regard to internal sea waters and the territorial sea, on the basis of Art. 42 paragraph 2 point 26a of the Act on Maritime Areas of the Republic of Poland and Maritime Administration, it is up to maritime administration to perform tasks in the field of flood protection in accordance with the provisions of the Water Law Act.

The key role in preventing the negative effects of excess rainwater and its management in the urban area is primarily played by individual local government units, this is directly related to the implementation of a proper urban spatial policy, which is one the own tasks of the municipality. At the same time, according to Art. 6 and Art. 7 paragraph 1 point 1 of the Act on Municipal Self-Government, the municipality's own tasks also include water management matters. In addition, the mayor or town mayor – in accordance with Art. 14 point 1 of the Water Law Act – is also the competent authority in matters of water management.

Competent authorities for flood risk management are those responsible for, or involved in, the planning documents required by the Floods Directive.

The lead authorities are the minister in charge of water management and the President of the State Water Holding Polish Waters and the minister in charge of maritime economy and the directors of the maritime offices.

The different competent authorities are identified below, together with a description of their role in implementing the Floods Directive.

1) **Minister in charge of water management**:

   - approves the preliminary flood risk assessment and makes it available to the public by posting it on the Public Information Bulletin website;
   - approves the flood hazard maps and flood risk maps and make them available to the public by posting them on the Public Information Bulletin website;
   - makes draft flood risk management plans available to the public for comments, ensuring the active participation of all interested parties;
   - takes steps to ensure coordination at the level of international river basin districts;

- adopts, by means of a Regulation, flood risk management plans and their updates;
- specifies, by way of a regulation, in consultation with the minister in charge of digital affairs and the minister in charge of maritime economy, the requirements for the preparation of flood hazard maps and flood risk maps and their scale;
- provides the European Commission with reviews and updates of the preliminary flood risk assessment, the flood hazard maps and flood risk maps and the flood risk management plans;
- monitors the implementation of measures contained in flood risk management plans.

2) **Minister in charge of the maritime economy**:

- prepares a draft preliminary seawater flood risk assessment, including internal sea waters, and submits it to the State Water Holding Polish Waters;
- prepares draft seawater flood risk management plans, including internal sea waters, and submits them to the State Water Holding Polish Waters.

3) **Minister responsible for inland navigation**:

- agrees on a draft preliminary flood risk assessment;
- agrees on draft flood risk management plans as far as inland waterways are concerned.

4) **Minister in charge of transport:**

- agrees draft flood risk management plans for transport infrastructure.

5) **President of the State Water Holding Polish Waters:**

- prepares a draft preliminary flood risk assessment;
- submits the draft preliminary flood risk assessment to the voivodes for their opinion and to the minister in charge of inland navigationin the area of inland waterways for agreement;
- prepares draft flood hazard maps and flood risk maps in agreement with the competent voivodes;
- prepares draft flood risk management plans in consultation with the minister in charge of transport infrastructure regarding transport infrastructure, with the relevant voivodes and after consultion with voivodship marshals;
- agrees the draft flood risk management plans as far as inland waterways are concerned with the minister in charge of inland navigation.

6) **Directors of maritime offices – the Director of the Maritime Office in Gdynia and the Director of the Maritime Office in Szczecin:**

- prepare draft seawater flood hazard maps and seawater flood risk maps, including internal sea waters, and submit them to the State Water Holding Polish Waters.

7) Voivodes:

- give opinions on draft preliminary flood risk assessments;
- agree draft flood hazard maps and flood risk maps;
- agree draft flood risk management plans.

5. CLASSIFICATION OF FLOODS

The basis for determining the **types of floods** considered in the review and update of the PFRA is the classification used in the EU for the implementation of the Floods Directive[1] , which distinguishes floods by: **source**, **mechanism** of their occurrence and **characteristics**. This classification is shown in tables: Table 2, Table 3 and Table 4.

Table 2: Classification of floods by source

Type of flood by source	**Definition**
Fluvial flood [A11 – Fluvial]	Floods associated with exceedance of river waters, streams, mountain streams, canals, and lakes, including snow melting floods
Pluvial flood [A12 – Pluvial]	Floods associated with flooding of land with **waters directly deriving from rainfall** or snow melting; it can include urban storm floods or excess water in non-urban areas
Groundwater flood [A13 – Groundwater]	Floods associated with flooding of land due to the rise of water levels above the ground level; it can include the rise of groundwater and underground water resulting from high surface water levels
Seawater flood [A14 – Sea water]	Floods associated with flooding of land by sea waters, estuaries, and coastal lakes
Flood from artificial water bearing infrastructure [A15 – Artificial Water-Bearing Infrastructure]	Floods associated with flooding of land by waters from the water supply and sewerage infrastructure or resulting from failure of such infrastructure
Flood from another source [A16 – Other]	

Table 3: Classification of floods by mechanism

Type of flood by mechanism	**Definition**
Natural exceedance [A21 – Natural exceedance]	Flooding of land due to rising of water levels
Exceedance of flood defences [A22 – Defence exceedance]	Flooding of land due to overflowing water, e.g. through an embankment crown
Failure of flood defence structures or technical infrastructure [A23 – Defence or infrastructural failure]	Flooding of land due to destruction or damage to natural or artificial flood protection or technical infrastructure, including failure of retention facilities
Blockage flood [A24 – Blockage]	Flooding of land due to natural or artificial blockage of a watercourse

[1] Flood Directive Reporting Guidance, 2019

Type of flood by mechanism	Definition
Other mechanism [A25 – Other]	Flooding of land with water as a result of other mechanisms, e.g. strong wind

Table 4: Classification of floods by characteristics

Type of flood by characteristics	Definition	Application criterion
Flash flood [A31 – Flash Flood]	Rapid flood caused by heavy rainfall in a relatively small area	Heavy rain: > 20 mm/d Rapid course: < 6 hours
Snow melt flood [A32 – Snow Melt Flood]	Flood associated with melting of snow	Occurrence of snow cover, sharp rise in air temperature > 0°C
Other rapid onset flood [A33 – Other rapid onset]	Rapid flood, other than flash flood	Rapid course: < 12 hours
Medium onset flood [A34 – Medium onset flood]	Flood of average course	Course: 1-3 days
Slow onset flood [A35 – Slow onset flood]	Flood of slow course	Course: > 3 days
Debris flood [A36 – Debris Flood]	Flood accompanied by transport of a large amount of debris	Transport of large quantities of debris
High velocity flood [A37 – High Velocity Flow]	High-speed flood	Water flow velocity > 1 m/s
Deep flood [A38 – Deep Flood]	Flood of significant depths	Water depth > 2 m
Other characteristics [A39 – Other characteristics]	Flood with different characteristics or lack of specific characteristics	All other cases of flood

PURPOSE AND SCOPE OF REVIEWING AND UPDATING PFRA

6. PURPOSE AND SCOPE OF REVIEWING AND UPDATING PFRA

The main purpose of reviewing and updating the PFRA in the 3rd planning cycle was to complete the historical flood data and to analyse and assess changes in flood risk since the last PFRA update.

As part of the review and update of the PFRA in the 3rd planning cycle, all types of floods already identified in previous planning cycles were analysed, namely:

1) Fluvial floods (A11) with the following mechanisms and characteristics:
   - natural exceedance (A21),
   - exceedance (A22) or destruction of flood embankments (A23),
   - winter floods with a blockage mechanism (A24),
   - flash flood (A31),
   - snow melt flood (A32);
2) Pluvial floods (A12);
3) Groundwater floods (A13);
4) Seawater floods (A14) with the following mechanisms:
   - natural exceedance (A21),
   - defense exceedance or destruction of flood embankments or storm embankments (A23),
5) Floods resulting from destruction or damage to damming structures (A15).

However, the preliminary flood risk assessment does not include floods from sewerage systems, which is a consequence of Art. 16 point 43 of the Water Law Act, according to which flood is defined as the **temporary covering by water of land that is not normally covered by water**, in particular caused by water exceedance in natural watercourses, reservoirs, canals and from the seawater, with the **exception of the covering by water of land caused by water exceedance in sewerage systems**.

The Preliminary Flood Risk Assessment **for 2nd planning cycle (2018)** identified areas of potential significant flood risk (APSFR) for **three significant flood types**:

1) for fluvial floods (A11) – a total of about 29,000 km of rivers, of which:
   - river sections identified in the 2011 PFRA for which FHMs and FRMs were developed in 1st planning cycle – about 14,500 km,
   - river sections identified in the 2011 PFRA for which FHMs and FRMs were developed in the 2nd planning cycle – about 13,500 km,
   - river sections identified in the 2018 PFRA review and update, for which FHMs and FRMs were developed in 2nd planning cycle – about 1,300 km;
2) for seawater floods, including internal marine waters (A14) – a total of about 1,200 km of rivers and coastal sections, of which:
   - estuarine sections of rivers – about 450 km,
   - lagoons – 269 km,
   - coastal zone – 495 km;
3) for floods from damage or destruction of damming structures (A15) – 26 dam reservoirs with a dam height above 10 m (10 in the Oder river basin and 16 in the Vistula river basin).

Areas of potential significant flood risk in the 2nd planning cycle have been designated in 6 river basin districts: Oder, Elbe, Vistula, Pregolya, Nemunas and Danube (Figure 2). Historical floods were identified in 7 river basin districts: Oder, Elbe, Vistula, Pregolya, Nemunas, Danube and Dniester.

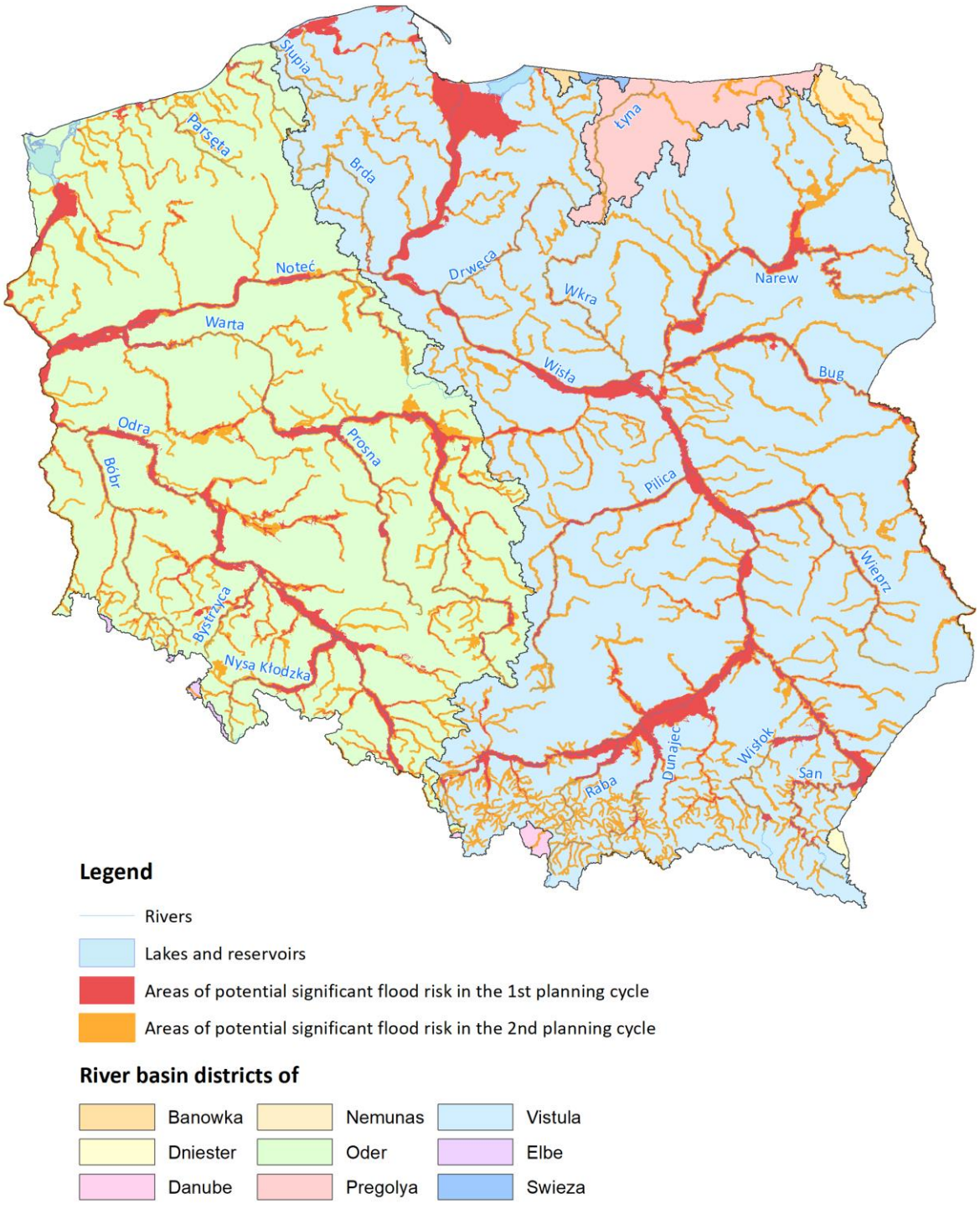


Figure 2: Areas of potential significant fluvial flood risk identified in 1st and 2nd planning cycles

In the 3rd planning cycle, the preliminary flood risk assessment was **reviewed and updated**. As a result of the analyses carried out, it was concluded that **the significant types of floods in Poland** identified in 2nd cycle remain valid and include:

1) **fluvial floods** – in two scenarios:
   - natural exceedance,
   - destruction of flood embankments;
2) **flood from artificial water bearing infrastructure** – associated with flooding of land in the event of damage or destruction of damming structures;
3) **seawater floods** – in two scenarios:
   - natural exceedance,
   - destruction of flood embankments or storm embankments.

A summary of the methodology and the results of the analyses carried out as part of the PFRA review and update for **fluvial floods and floods from damming structures** that have been identified as significant floods and for which APSFRs have been identified are described in **Chapters 7 to 10**.

A summary of the methodology and the results of the analyses carried out as part of the review and update of the PFRA for **seawater floods, including internal marine waters,** which have been identified as significant and for which APSFRs have been identified, are described in **Chapter 11**.

The methodology and results of the analyses carried out as part of the review and update of the PFRA **for pluvial floods and groundwater floods** that have not been identified as significant floods and for which no APSFRs have been designated are described in **Chapter 12** and **Chapter 13** respectively.

A summary of the results of the PFRA review and update, including a description of the PFRA **database and overview maps,** is included in **Chapters 14 to 16**.

FLUVIAL FLOODS
AND
FLOODS FROM DAMMING STRUCTURES

7. SUMMARY OF THE PFRA REVIEW AND UPDATE METHODOLOGY

The detailed method of how to carry out the review and update of the PFRA for fluvial floods and floods from damming structures, as well as the list of source data, is set out in the 'Methodology for the review and update of the preliminary flood risk assessment in the 3rd planning cycle' (hereinafter the Methodology), which is attached as Annex 1 to the Report. In contrast, this chapter provides a summary of the methodology for undertaking the review and update of the PFRA, which covers following.

1) Identification and description of **historical floods**:
    a) Verification and completion of flood data from 1946-2017 (1st and 2nd cycle);
    b) Identification and description of the 2018-2023 floods;
    c) Assessment of significant adverse consequences of floods;
    d) Identification of significant historical floods:
        – with significant adverse consequences as referred to in **Art. 4.2b DP**;
        – without significant adverse consequences as referred to in **Art. 4.2c DP**.
2) Identification and description of **floods that may occur in the future:**
    a) Update data on areas where flooding is likely to occur and data on natural floodplains;
    b) Assessment of potential adverse consequences of flooding;
    c) Determination of probable floods as referred to in **Art. 4.2d DP.**
3) Forecast of long-term developments on the occurrence of flooding, i.e.: impact of climate change and impact of land use change.
4) Designation of areas of potential significant flood risk as referred to in **Art. 5 DP**.

The PFRA procedure was carried out separately for each type of flood.

The scheme for reviewing and updating the PFRA in the 3rd planning cycle is shown at Figure 3.

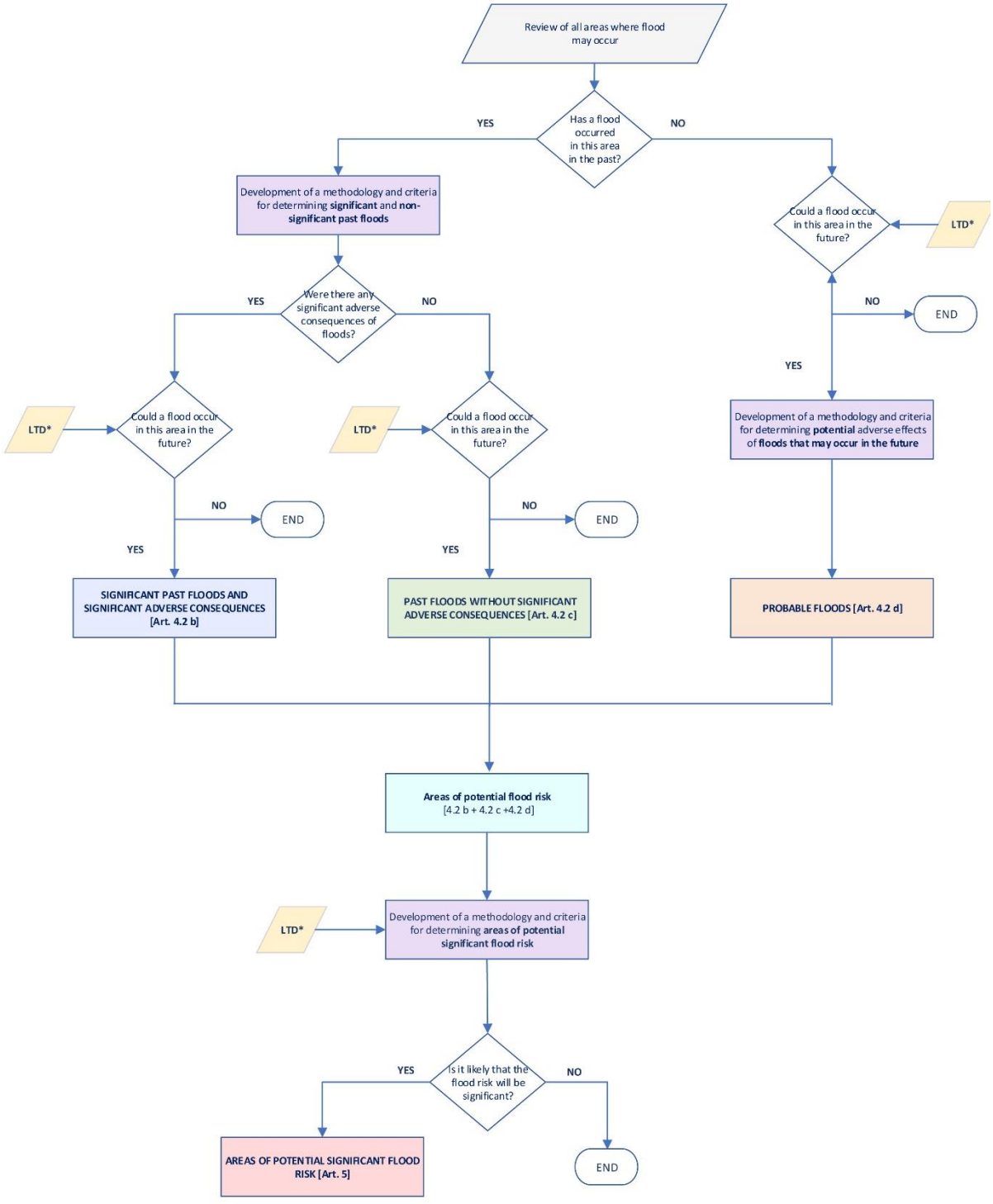


Figure 3: PFRA review and update scheme

** LTD [long-term development] – forecast of long-term developments*

7.1. HISTORICAL FLOODS

The Floods Directive distinguishes between two categories of historical floods:

1) Floods that have occurred in the past and have had significant adverse consequences on human health, the environment, cultural heritage and economic activity and the likelihood of a similar occurrence in the future remains high – referred to in **Art. 4.2b of the Floods Directive** – referred to in the PFRA as: **significant historical floods with significant adverse consequences** (**PHb**).

   In the case of the floods referred to in Art. 4.2b DP – if there is no likelihood of such a flood occurring in the future, this means that it is not a significant flood.

   This may be the case if, after a flood has occurred in an area, safeguards have been implemented which mean that a flood with significant adverse consequences should not occur or the risk of such a flood occurring is residual.

2) Floods that have occurred in the past and did not cause significant adverse consequences at the time, but a similar occurrence in the future can be predicted to have significant adverse impacts, taking into account, for example, changes in land use or climate change – as referred to in **Art. 4.2c of the Floods Directive –** referred to in the PFRA as: **significant historical floods without significant adverse consequences** (**PHc**)**.**

   In the case of the floods referred to in Art. 4.2c DP – this refers to floods that have occurred in the past, but at that time no adverse consequences have been identified or are not known, but there is a likelihood of a future flood that may cause significant adverse consequences.

   This may be the case if, as a result of land use changes or climate change in an area, flood risk (with adverse flood consequences) has increased and become significant. If there is no likelihood of a future flood with significant adverse consequences, this means that it is not a significant flood as referred to in Art. 4.2c DP.

7.1.1. IDENTIFICATION AND DESCRIPTION OF HISTORICAL FLOODS

PERIOD 1946-2017

Due to the difficulties in obtaining complete flood data for 1st and 2nd planning cycles, flood events from the period 1946-2017 were re-analysed and verified in terms of: flood type (by source and mechanism), time and spatial range of flood, frequency and adverse consequences of flood. Additional data sources were used for this purpose, in particular hydrological data from water gauge stations and information from the literature.

Flood data from 1st and 2nd cycle were highly fragmented, making analysis difficult. Therefore, in the 3rd cycle, spatial aggregation of the data was performed in order to obtain comprehensive information on individual floods in river catchments in spatial (polygon) form.

Details on the verification and completion of the flood data up to 2017 are included in section 4.1.2 of the Methodology.

PERIOD 2018-2023

In order to identify and describe the floods that occurred in the period 2018-2023, i.e. since the previous preliminary flood risk assessment was made, data was obtained from the voivodeship offices in terms of submissions made by local government units on flood recovery and reports of events bearing the characteristics of natural disasters. In addition, available hydrological data, satellite data, literature sources, media information, data from PGW WP and other available information on the occurrence of floods (including information from JST) were analysed.

For each identified flood, the type, time and place of occurrence, frequency of occurrence (recurrence period) and the negative effects of the flood on human life and health, economic activity, the environment and cultural heritage were determined.

The time of occurrence of fluvial flood events for the controlled rivers was determined on the basis of hydrological data from the monthly Bulletins of the State Hydrological and Meteorological Service. In order to identify flood events, data on exceedances of alarm levels at individual water gauge stations were analysed. Bearing in mind the definition of exceedances of alarm levels relating to the threat to infrastructure, the identified events were the starting point for selecting significant floods from these events.

The spatial range of the identified flood events was determined based on satellite data and, in the absence of such data, media information and literature as well as hydrological data were used. Where hydrological data was available, it was possible to determine **the approximate range of the** flood event based on the numerical terrain model or the flood hazard areas shown on the flood hazard maps, if the water table ordinate during the flood event was the same as the scenario on the maps.

The flood recurrence period (F) was determined using intervals, corresponding to the scenarios shown on the flood hazard maps:

- F < once every 10 years,
- once every 10 years ≤ F < once every 100 years,
- once every 100 years ≤ F < once every 500 years,
- F ≥ once every 500 years.

Where hydrological data is available for a given flood, a comparison was made between the maximum water table elevation at the culmination of the flood wave at the closest water gauge profile for a given flood reach and the maximum water table elevation, also in a controlled cross-section, determined on the flood hazard maps.

The negative effects of flood were determined on the basis of acquired information on actual flood losses based on archival data, including those obtained from relevant institutions. In addition, due to the lack of complete data on the negative effects of flood, estimates were determined on the basis of spatial analyses carried out on predefined flood extents, taking into account the methodology used in the preparation of flood risk maps and using, among others, BDOT10k.

Details of the negative impact data used and the assumptions for the determination of flood impact categories are included in Section 4.2.7 of the Methodology.

7.1.2. IDENTIFICATION OF SIGNIFICANT HISTORICAL FLOODS

Once all areas with a history of flood had been identified, analyses were carried out, following the PFRA scheme (Figure 3), to delineate significant historical floods in two categories:

1) Significant historical floods with significant adverse consequences – referred to in Art. 4.2b of the Floods Directive;
2) Significant historical floods without significant adverse consequences – referred to in Art. 4.2c of the Floods Directive.

Significant adverse consequences of historical floods were considered to be adverse consequences of flood (to human life and health, the environment, cultural heritage and economic activity) of a suprathreshold nature (i.e. above certain threshold values, resulting from the probability distribution of the values of the negative effects of historical floods), resulting from a specific flood hazard and the vulnerability of the system under the influence of this hazard.

An algorithm consisting of the following steps was used **to identify significant historical floods**:

1) Assessing the adverse consequences of floods:
   - general assessment (for all historical floods);
   - detailed assessment (for the 2018-2023 floods);
2) Hydrological assessment:
   - on a regional scale – taking into account the characteristics of historical floods;
   - on a local scale – taking into account historical flood data for individual water gauges;
3) Consideration of the forecast of long-term developments;
4) Classification of historical floods.

This algorithm assumes that the identification of significant historical floods is based on the flood impact assessment (i.e. hazard assessment), while the hydrological assessment (i.e. hazard assessment) is a supporting factor. An important element in the identification of significant historical floods is the consideration of the forecast of long-term developments .

In the general assessment, based on archival data, the occurrence of adverse consequences of flood was determined in a simplified manner for 4 categories: human health and life, environment, cultural heritage and economic activities (Yes/No).

In addition, additional criteria have been taken into account that relate to the categories: human life and health and economic activities, as determined on the basis of:

1) archive data: number of fatalities and number of injured persons;
2) spatial analyses: the estimated number of inhabitants affected, the area of urbanised areas flooded and the area of industrial areas flooded.

The following limits for the criteria have been adopted to identify significant adverse consequences of flood:

- Number of fatalities ≥ 1,
- Number of injured persons ≥ 100,
- Estimated number of residents affected by flood ≥ 100.

Due to the lack of completeness of the data, an expert assessment of the floods was also a very important criterion for the general assessment, aimed at deciding whether it was reasonable to classify the floods as significant, based on all available information, including from the literature.

In the detailed assessment, on the basis of spatial analyses, the occurrence of adverse flood consequences was determined for 4 categories: human health and life, environment,

cultural heritage and economic activities. The adopted criteria for the detailed assessment are described in chapter 4.3.4 of the Methodology.

In order to determine the significant adverse consequences of the floods that have occurred since 2018, the following limits for the criteria were adopted:

- Number of residential buildings flooded ≥ 20,
- Number of flooded buildings of special social interest ≥ 3.
- Estimated number of residents affected by flooding ≥ 100.

The basis for the **hydrological assessment** was information on the extent and recurrence period of flood, which was related to the 0.2%, 1% and 10% probability floods shown on the FHM. The extent and/or recurrence period F ≥ 10 years was taken as a significant hazard. Information on exceedances of alert levels at water gauges was also taken into account.

The aim of the analysis in terms of **long-term forecasting** was to find out whether floods with significant adverse consequences are likely to occur in the area in the future. For this purpose, information was used

1) on the impact of climate change:
   - on projected changes in high flows (in the case of fluvial flood);
   - about forecast changes in air temperature (in the case of flash floods);
2) on the impact of land-use changes:
   - on projected population changes;
   - on projected land-use changes.

As a result of the analyses carried out, **historical floods** were **classified into:**

1) Historical significant floods with significant adverse consequences (Art. 4.2b DP);
2) Historical significant floods without significant adverse consequences (Art. 4.2c DP);
3) Historically insignificant floods.

Details of the methodology and criteria for determining significant historical floods are included in Section 4.3 of the Methodology.

7.2. PROBABLE FLOODS

In accordance with the Floods Directive, floods that **may occur** in the **future** in a given area and cause **potential adverse consequences** on human life and health, the environment, cultural heritage and economic activity – as referred to in **Art. 4.2d of the Floods Directive** – referred to in the PFRA as: **probable floods** (**PPd**) – are also assessed.

As a result of the analyses carried out within the above areas, areas where **potential adverse consequences of flood** may occur have been designated, i.e. areas referred to in Art. 4.2.d of the Floods Directive.

7.2.1. IDENTIFICATION OF FLOODS THAT MAY OCCUR IN THE FUTURE

In the case of fluvial flood, probable flood areas were used to delineate:

- areas where flood is likely to occur, as determined by hydraulic modelling;
- natural floodplains, defined on the basis of analyses mainly on topography (DTM) and the course of watercourses (MPHP10k).

The main source of data on probable floods was the flood hazard areas (FHAs) for floods with a 1% probability of occurrence, as shown on the current flood hazard maps.

In addition, areas that have also been mapped using hydraulic modelling, but developed as part of other projects, in particular for flood protection programmes implemented by individual Regional Water Management Authorities, were included.

Natural floodplains identified for river basin districts for which no historical floods have been identified and no information on areas flood is likely to occur were also included. This included the river basin areas: Swieza, Banowka and Dniester, for rivers with a catchment area of more than 10 km^2.

For floods from damming structures, the source of the probable flood data was the areas prone to flooding if the 26 damming structures shown on the current flood hazard maps were damaged or destroyed.

Details on the identification of areas where future flood is likely and natural floodplains are included in sections 5.2.and 5.3 of the Methodology.

7.2.2. ASSESSMENT OF POTENTIAL ADVERSE CONSEQUENCES OF FLOOD

An assessment of the potential adverse consequences of flood that could occur in the future was carried out in areas, designated mainly based on hydraulic modelling.

The potential adverse consequences of floods that may occur in the future, taking into account the different categories (human life and health, environment, cultural heritage and

economic activity) were identified in a similar way to the detailed assessment of the adverse consequences of historical floods.

The factors considered, which have a significant impact on the assessment of the potential adverse consequences of flood that may occur in the future, are described below:

1) **Topography of the area**

   Detailed topographic data, including geodetic cross-sections of river channels and a numerical terrain model for valley areas, were used in the delineation of areas with a specific probability of flood as a result of hydraulic modelling.

2) **Location of watercourses and their general hydrological and geomorphological characteristics, including floodplains as natural retention areas**

   The schematisation of the river network and hydrological data were taken into account in the delineation of areas with a certain probability of flood as a result of hydraulic modelling.

   Natural floodplains delineated based on the numerical terrain model and the course of watercourses (MPHP10k) were also used.

3) **Effectiveness of existing flood protection structures**

   The designation of areas with a certain probability of flooding as a result of hydraulic modelling has taken into account existing flood defence structures and the principles of their operation under flood conditions.

4) **Location of inhabited areas**

   The following indicators of the potential adverse consequences of flood were considered: estimated number of residents at risk of flooding, number of residential buildings at risk, number of buildings of special social importance at risk, area of residential development sites (assumptions presented in section 5.4.1 of the Methodology).

5) **Location of the areas where the economic activity is carried out**

   The following indicators of the potential negative effects of flooding were taken into account: the area of land at risk in each use class (residential land, industrial land, transport land, forest land, recreational land, arable land and permanent crops, grassland, other land), the number of industrial plants at risk (assumptions presented in section 5.4.1. of the Methodology).

6) **Forecast of long-term developments**

The following criteria for forecasting long-term developments were taken into account (assumptions presented in Chapter 6 of the Methodology and Chapter 7.3 of the Report):

- The impact of land use development in terms of population change and changes in the area of built-up land;
- The impact of climate change on the occurrence of floods.

Areas of probable flooding with potential adverse flood consequences (PPd) were identified as:

- all areas that in 1st and 2nd planning cycle were identified in the PFRA as areas of potential significant flood risk and for which flood hazard maps are produced;
- other areas, delineated by hydraulic modelling, developed as part of other projects;
- natural floodplains with 10 or more residential buildings or more than 50 people at risk of flooding.

Details of the methodology and criteria for determining the potential adverse consequences of flood are contained in Methodology Section 5.4.

7.3. FORECAST OF LONG-TERM DEVELOPMENTS

The forecast of long-term developments in terms of flood risk addressed the following elements:

1) **IMPACT OF LAND USE CHANGES** including:
   - **Population changes**, based on 2011 and 2021 CSO data;

     Scoring scale: -5÷ 5.
   - **Changes in built-up area** – percentage of areas shown to have an increase/decrease in flood hazard, based on CLC 2012 and 2018.

     Scoring scale: -5÷ 5.
2) **THE IMPACT OF CLIMATE CHANGE ON THE INCIDENCE OF FLOODS** including:
   - **Changes in the percentage of high Q90 flow between 2021** and **2050** for the RCP 4.5 and RCP 8.5 scenarios based on the results of the CHASE-PL project.

     Scoring scale: -5÷ 5.

A forecast of long-term development, based on the above criteria, is included for the analysis of areas where flood is likely to occur in order to identify significant historical floods (DP Art. 4.2b and 4.2c DP) – for the analysis of whether flood is likely to occur in the area in the future; as well as for areas of significant flood risk – for the analysis of whether the projection of long-term developments will influence the designation of areas of significant flood risk (whether flood risk is likely to be significant).

Details of the projections of long-term developments are included in Chapter 6 of the Methodology.

7.4. IDENTIFICATION OF AREAS OF POTENTIAL SIGNIFICANT FLOOD RISK

The identification of areas of potential significant flood risk followed the PFRA review and update scheme (Figure 3) in two stages:

1) **Areas of potential flood risk**, i.e. areas for which analyses were carried out to identify APSFRs.

   These represent the sum of the areas of historical floods and probable floods (i.e. the floods referred to in Art. 4.2b, 4.2c and 4.2d of the DP).

2) **Areas of potential significant flood risk** (areas of significant flood risk) – are areas where a significant flood risk is identified or likely to occur, as referred to in **Art. 5 of the Floods Directive**.

The different stages and criteria of APSFR are shown at Figure 4.

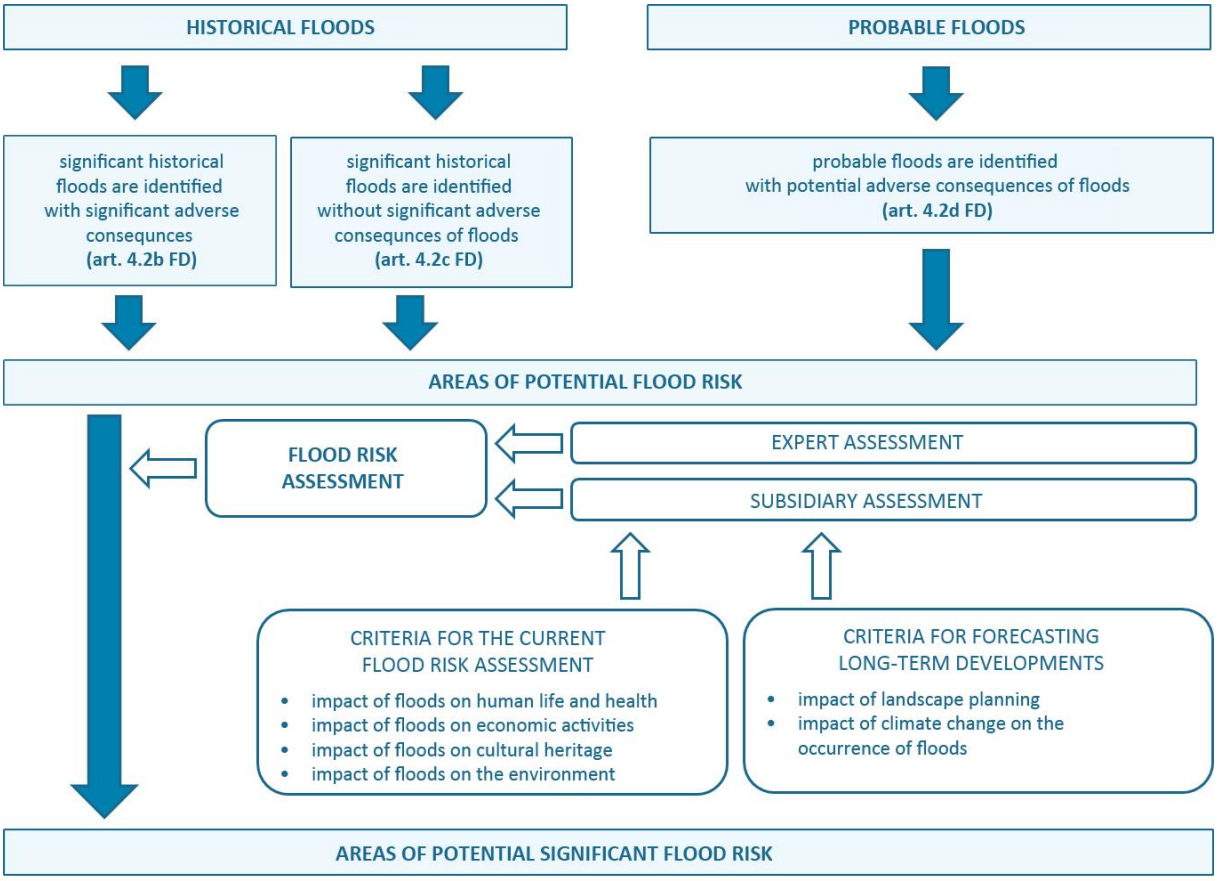


Figure 4: Diagram showing the stages and criteria for identifying APSFRs

A flood risk assessment was carried out for areas of potential flood risk, including:

- **the current state of flood risk** – criteria were used to assess the negative effects of flood;
- **prospective changes in flood risk** – the criteria of the long-term development forecast were applied (described in chapter 7.3);

which forms the basis for the identification of areas of significant flood risk i.e. APSFR.

Criteria for assessing the adverse consequences of flood include:

CRITERION 1. IMPACT OF FLOODS ON HUMAN LIFE AND HEALTH

- Population density [per sq./km^2], based on number of buildings from BDOT10k of 2023.
- Scoring scale: 0÷12.

CRITERION 2. IMPACT OF FLOODS ON ECONOMIC ACTIVITY AREAS

- Percentage of each land cover form class (settled areas, industrial areas, transport infrastructure: roads and railways, agriculture, forests, other) based on 2023 BDOT10k.
- Scoring scale: 0÷5.

CRITERION 3. IMPACT OF FLOODS ON CULTURAL HERITAGE

- Number of historic buildings, based on 2023 NID data.
- Scoring scale: 0÷5.

CRITERION 4. ENVIRONMENTAL IMPACT OF FLOODS

- Percentage of nature conservation forms (including national parks, landscape parks, nature reserves and Natura 2000 sites) based on GDOŚ 2024 data.
- Scoring scale: 0÷5.

For the purposes of the flood risk assessment, the sum of the scores for the assessment of current flood risk and the assessment of prospective changes in flood risk was applied as follows:

$$P = P_{akt} + 0{,}03 \cdot P_{persp} \cdot P_{akt}$$

Where:

P total number of flood risk assessment points;

P_{act} sum of the flood risk assessment points for the current state;

P_{persp} sum of the flood risk assessment points for prospective changes.

The assessment was carried out in a system of units of analysis in the form of hexagons. A total flood risk assessment score was determined for all hexagons included in each potential flood risk area.

The flood risk rating (in the form of a summed score) for each area of potential flood risk was derived from a weighted average of the summed flood risk scores for all hexagons included in the extent of a given area of potential flood risk.

The 3rd planning cycle assumes that all APSFRs designated in 1st and 2nd cycles will remain in place.

Consequently, the flood risk assessment described above is only an ancillary element in the process of identifying areas of significant flood risk (APSFRs). In **contrast, the basis for designating new APSFRs is the expert assessment,** which took into account:

1) the indications of the regional water management authorities (PGW WP);
2) comments made by various stakeholders on the results of the PFRA;
3) the results of the flood risk assessment for individual spatial units, (particularly helpful if not the whole watercourse but only a section of it needs to be assessed).

Detailed information on the methodology and criteria for the selection of APSFRs is included in Chapter 7 of the Methodology.

8. DESCRIPTION OF SIGNIFICANT HISTORICAL FLOODS

As a result of the review and update of the PFRA in the 3rd planning cycle, including the verification and completion of historical flood data for all river basin districts, a total of 1103 floods were identified up to 2023, of which **304 significant historical floods** were identified based on the analysis and assessment of negative flood impacts.

A summary and description of significant historical floods is included in Annex 4.1.

The ranges of significant historic fluvial floods identified between 1946 and 2023 are shown at Figure 5.

The review and update of the PFRA in the 3rd planning cycle, in accordance with the Methodology, covers the period up to 2023. Detailed analyses and descriptions of historic flooding from 2024 onwards will be the subject of the next PFRA review and update in the 4th planning cycle.

However, due to the occurrence of a significant flood in September, 2024 in South West Poland, a description of this flood is included in this report as Annex 7. However, it should be noted that this description is based on data available as at December, 2024 and may not include the overall losses, due to ongoing work in this area.

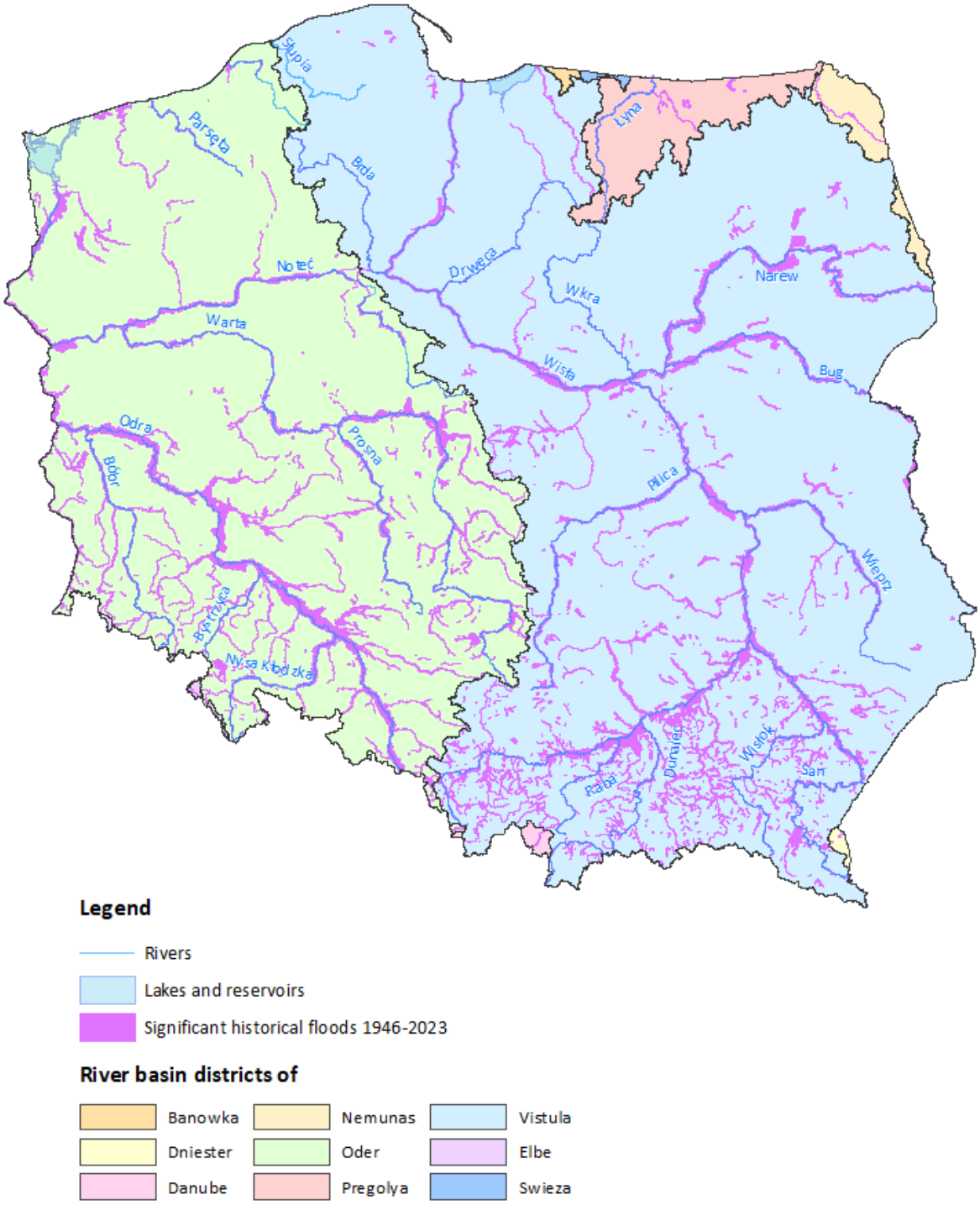


Figure 5: Range of significant historical floods

Table 5 and Figure 6 show the number of significant floods by river basin area and period of occurrence, corresponding to planning cycles.

Table 5: Summary of significant floods by river basin district and period of occurrence

No.	River basin district	1946-2011 (1st cycle)	2012-2017 (2nd cycle)	2018-2023 (3rd cycle)	Total
1	Oder	107	20	8	135
2	Vistula	102	42	14	158
3	Pregolya	5	1	0	6
4	Nemunas	1	0	0	1
5	Dniester	1	0	0	1
6	Danube	0	2	0	2
7	Elbe	1	0	0	1
8	Banowka	0	0	0	0
9	Swieza	0	0	0	0
Total		**217**	**65**	**22**	**304**

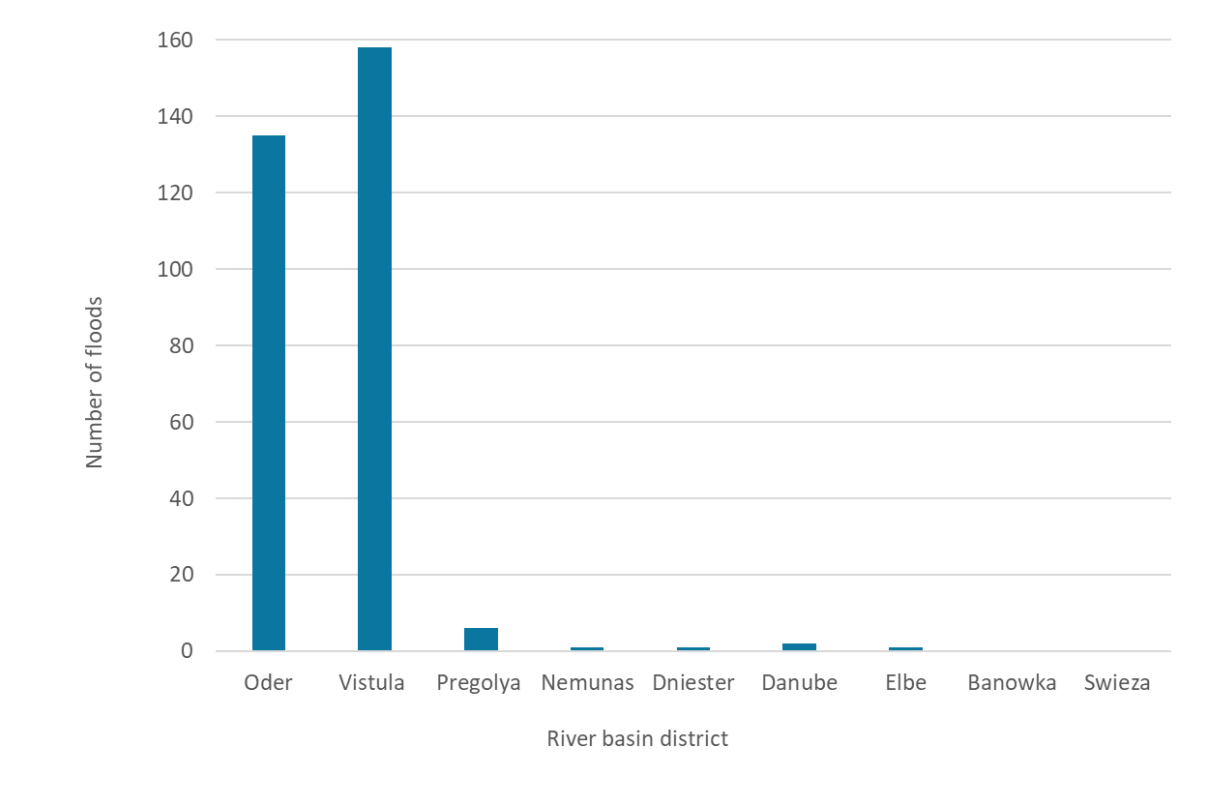


Figure 6: Significant floods by river basin district for the period of 1946-2023

Among the **significant fluvial floods**, the following types of floods were identified by **mechanism and characteristics**:

- Natural exceedance;
- Defence exceedance;
- Defence or infrastructural failure;
- Blockage flood;
- Snow melt flood;
- Medium onset flood;
- Other rapid onset flood.

The number of each type of flood is shown in Table 6.

Table 6: Types of significant fluvial floods (A11) by river basin districts

No.	River Basin District	Flood mechanism	Flood characteristics	Number of floods
1	Oder	A21 – natural exceedance	A40 – no characteristics	104
		A21 – natural exceedance	A32 – snow melt flood	15
		A22 – defence exceedance	A40 – no characteristics	1
		A23 – defence or infrastructural failure	A40 – no characteristics	2
		A23 – defence or infrastructural failure	A32 – snow melt flood	1
		A24 – blockage flood	A40 – no characteristics	3
		A24 – blockage flood	A32 – snow melt flood	2
		A26 – no data available	A40 – no characteristics	7
2	Vistula	A21 – natural exceedance	A32 – snow melt flood	25
		A21 – natural exceedance	A33 – other rapid onset flood	50
		A21 – natural exceedance	A34 – medium onset flood	1
		A21 – natural exceedance	A40 – no characteristics	64
		A22 – defence exceedance	A33 – other rapid onset flood	1
		A22 – defence exceedance	A40 – no characteristics	1
		A23 – defence or infrastructural failure	A32 – snow melt flood	1
		A23 – defence or infrastructural failure	A33 – other rapid onset flood	1

No.	River Basin District	Flood mechanism	Flood characteristics	Number of floods
		A23 – defence or infrastructural failure	A40 – no characteristics	4
		A24 – blockage flood	A32 – snow melt flood	4
		A24 – blockage flood	A40 – no characteristics	2
		A26 – no data available	A40 – no characteristics	4
3	Pregolya	A21 – natural exceedance	A32 – snow melt flood	2
		A21 – natural exceedance	A33 – other rapid onset flood	1
		A21 – natural exceedance	A40 – no characteristics	3
4	Nemunas	A21 – natural exceedance	A40 – no characteristics	1
5	Dniester	A21 – natural exceedance	A40 – no characteristics	1
6	Danube	A21 – natural exceedance	A40 – no characteristics	2
7	Elbe	A21 – natural exceedance	A40 – no characteristics	1
Total				**304**

8.1. HISTORICAL FLOODS IN THE PERIOD OF 1946-2017

A total of 282 significant historical floods were identified for all river basin districts during the period of 1946-2017 (covering the collection of flood data in 1st and 2nd planning cycles), including 144 in the Vistula river basin district and 127 in the Oder river basin district. Between 1 and 6 floods were identified in the other river basin district areas.

In the Oder river basin district area, the highest number of floods was identified in the decade of 2001-2010. In the period of 1991-2000, the number of floods was low, but the catastrophic flood of 1997 made this the decade with the highest number of flooded areas. Flooding was most common on the region's two largest rivers, the Warta and the Oder. The results of the PFRA analysis also indicate that floods were more frequent on the mountainous (left) tributaries of the Oder.

In the Vistula river basin area, the highest number of floods was identified in the period of 2011-2017, while the number of floods was low in the period of 1981-1990. The decade with the highest number of flooded areas was 2001-2010. Floods occurred most frequently on the largest river of the basin area – the Vistula. The results of the PFRA analysis also indicate a more frequent occurrence of floods on the mountainous – Carpathian tributaries of the Vistula, as well as on rivers with their sources in the upland belt.

The ranges of significant historic fluvial floods identified between 1946 and 2017 are shown at Figure 7.

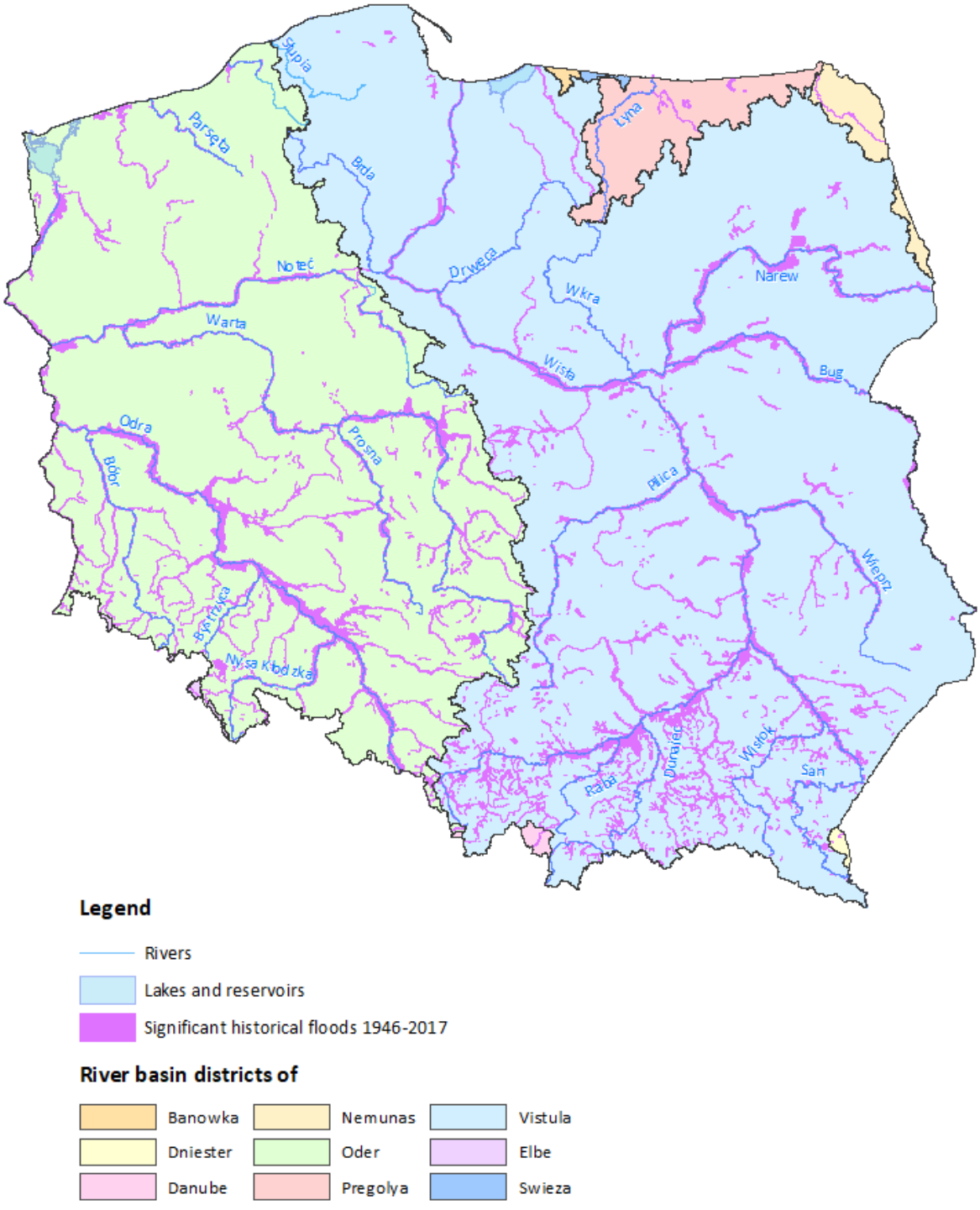


Figure 7: Significant fluvial floods that occurred between 1946 and 2017

Table 7 below summarises information on major historical floods.

Table 7: Types of major fluvial floods (A11) significant in the Oder and Vistula river basin districts

No.	River Basin District	Catastrophic floods	Type of flood
1	Oder	1960 (July)	Fluvial flood – natural exceedance
2		1970 (July	Fluvial flood – natural exceedance
3		1972 (August)	Fluvial flood – defence exceedance
4		1977 (August)	Fluvial flood – natural exceedance
5		1997 (July/August)	Fluvial flood – natural exceedance
6		2010 (May/June)	Fluvial flood – natural exceedance
1	Vistula	1960 (July)	Fluvial flood – natural exceedance
2		1970 (July)	Fluvial flood – natural exceedance
3		1972 (August)	Fluvial flood – defence exceedance
4		1977 (August)	Fluvial flood – natural exceedance
5		1997 (July/August)	Fluvial flood – natural exceedance
6		1979 (March/April)	Fluvial flood – natural exceedance
7		1980 (June-August)	Fluvial flood – natural exceedance
8		1982 (January/February)	Fluvial flood – blockage flood
9		2001 (June/July)	Fluvial flood – natural exceedance
10		2010 (May/June)	Fluvial flood – natural exceedance

8.2. HISTORICAL FLOODS IN THE PERIOD OF 2018-2023

During the 3rd planning cycle, for the period of 2018-2023, a total of 22 significant historical floods were identified for all river basin districts, of which 14 occurred in the Vistula river basin district and 8 in the Oder river basin district. For the other river basin districts, no significant floods were identified. The predominant type of flood by mechanism was natural exceedance, only in one case was it the defence or infrastructural failure. These were mostly floods with an incidence of less than 10%.

For the Oder river basin area, floods in the period of 2018-2023 occurred in both the Upper, Middle and Lower Oder regions, mainly on the Oder River, but also on smaller rivers (Dzierzecinka, Chrzastawa) (Table 15). The winter flood in January 2018 covered the Middle Oder and the rivers Plonia and Ina. At the end of October 2020, flood due to heavy rainfall occurred mainly on the Oder and the estuary sections of its tributaries.

For the Vistula river basin district, 14 summer floods were identified in the period of 2018-2023, which resulted in flooding of areas in the immediate vicinity of rivers (Table 16). Floods occurred mainly in the Upper-Eastern Vistula water region (San, Wislok). The highest total flood losses were recorded after the 2019 flood.

The ranges of significant historical fluvial floods identified between 2018 and 2023 are shown at Figure 8.

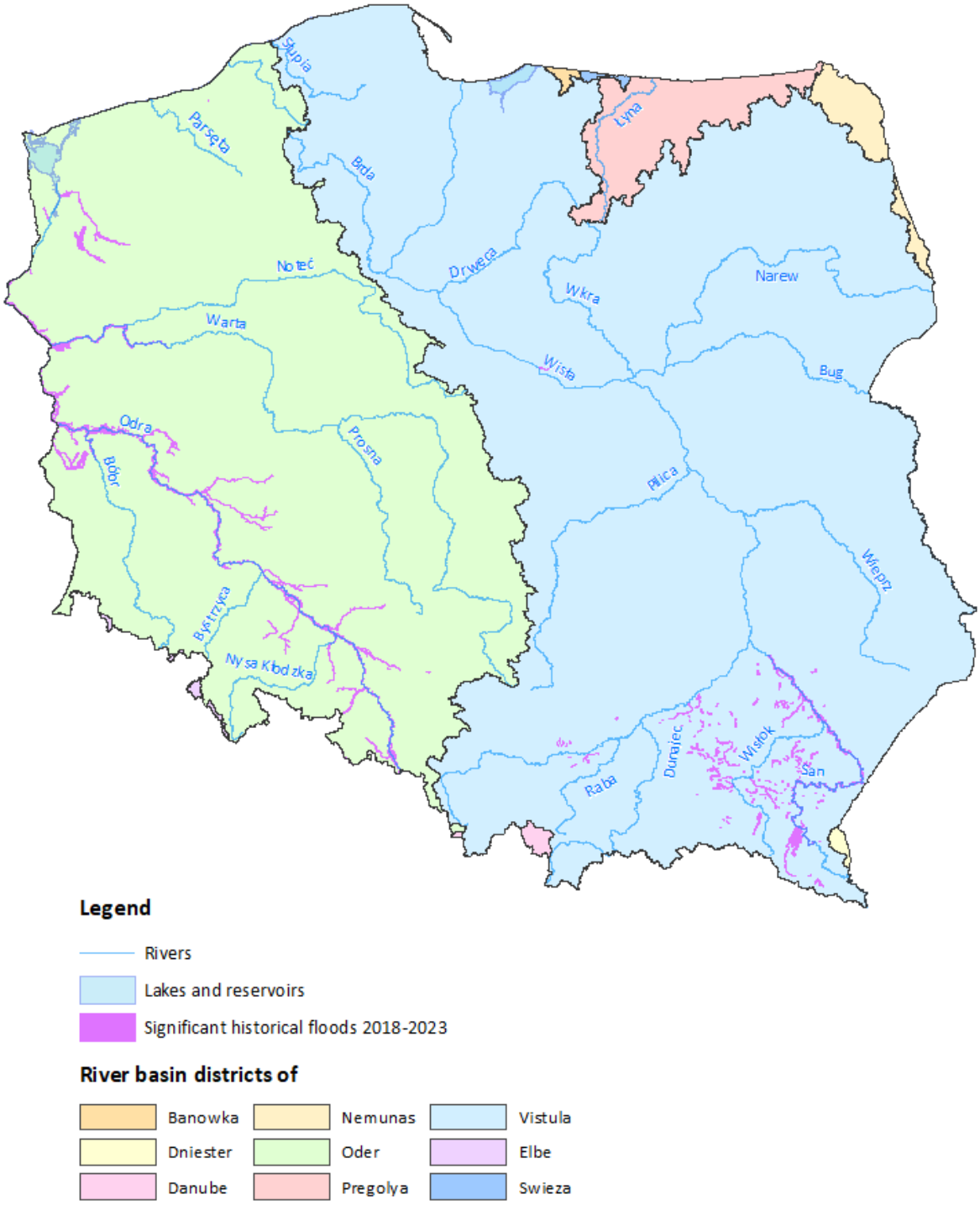


Figure 8: Significant fluvial floods that occurred between 2018 and 2023

The tables below show types of floods, their start dates, the rivers flooded and the flood loss totals, which occurred in the period of 2018-2023 in the Oder and Vistula river basin districts. No significant fluvial floods occurred in the Pregolya, Nemunas, Dniester, Danube and Elbe river basin district during the mentioned period.

Table 8: Significant fluvial floods in the Oder river basin district that occurred between 2018 and 2023.

No.	Date of the beginning of the flood	Type of flood	Rivers subject to the flood	Total damage
1	2018-01-11	Fluvial flood – natural exceedance	Oder, Warta, Obrzyca, Nysa Luzycka, Pliszka, Ilanka, Ina, Strumien, Konotop, Kanal Cybinski, Mysla, Mala Ina, Kanal Rybakow, Plonia	No data available
2	2020-10-16	Fluvial flood – natural exceedance	Oder, Barycz, Bobr, Warta, Opawa, Scinawa Niemodlinska, Stobrawa, Widawa, Kaczawa, Orla, Polski Row, Rudna, Obrzyca, Pliszka, Psina, Osobloga, Chrzastawa, Olawa, Sredzka Woda, Konotop, Rurzyca, Biala, Krynka, Mala Sleza, Slaski Row 2, Kobylec	No data available
3	2021-05-13	Fluvial flood – natural exceedance	Oder	No data available
4	2021-06-30	Fluvial flood – natural exceedance	Bukowa	No data available
5	2021-07-05	Fluvial flood – natural exceedance	Dzierzecinka	No data available
6	2021-09-03	Fluvial flood – natural exceedance	Mala Panew	No data available
7	2022-08-21	Fluvial flood – natural exceedance	Odra, Barycz, Bobr, Polski Row, Krzycki Row, Obrzyca, Nysa Luzycka, Pliszka, Ilanka, Czarna Struga, Strumien, Lubsza, Kanal Cybinski, tributary from Tyrszeliny, Racza, Kurka, Golec	No data available
8	2022-08-21	Fluvial flood – natural exceedance	Chrzastawa, Swornica, Malina	No data available

Table 9: Significant fluvial floods in the Vistula river basin district that occurred between 1918 and 2023.

No.	Date of the beginning of the flood	Type of flood	Rivers subject to the flood	Total damage
1	2018-06-01	Fluvial flood – natural exceedance	Pradnik	No data available
2	2019-05-04	Fluvial flood – natural exceedance	Solinka, Wetlina, Kalnica	PLN 200,000

No.	Date of the beginning of the flood	Type of flood	Rivers subject to the flood	Total damage
3	2019-05-18	Fluvial flood – natural exceedance	San, Baryczka, Stobnica, Zlota, Trzebosnica, Klysz, Rudnia, Kurzynka, Barcowka, Stara Rzeka, Magierka, Lubienka, Lublica, Kopytko, tributary from Orzechowka, Golcowka, Kroscienka, Gwoznica, Malinianka, Zylka, Gleboka, tributary from Letownia, Pijawka, Szklarka, Olszowka, Laskowska Rzeka, Kukulkowy Potok, tributary from Zagorz, Stepinka, Rozanka, Pietrykowka, Rosielna, Bonarowski Potok, Jawornicki Potok, Strug, tributary from Zaborze, tributary from Kamien, tributary from Grabinka mountain, Smierdziaczka, Trapowka, Chmielnicka Rzeka, Rafalowski	PLN 10 442 000
4	2019-05-20	Fluvial flood – natural exceedance	Leg, Przyrwa, Swierczowka, Trzesniowka, tributary from Jamnica	PLN 355,000
5	2019-05-21	Fluvial flood – natural exceedance	Vistula, Kanal Zyblikiewicza, Bren, Kanal Zyblikiewicza II, Zabnica, Upust, Zgorska Rzeka, Bren, Zymanka, Nieczajka, Deba, Los, Jamnica, Jabloniec, Wisnia	PLN 27 050 617
6	2019-05-21	Fluvial flood – natural exceedance	Wisloka, Brzeznica, Iwielka, Olszynka, Biezdziada, Gogolowka, Kamienica, Chotowski Potok, Ostra, Grabinka, Skodzierska, Brzezinka, Niedzwiadka, Zawadka, Kanał Bialoborski, Potok Kiełkowski, Ryj, Niegloszcz, Slony, Kamionka, tributary from Grabowka, Borowa, Malanka, Rzeka, Debrza, tributary from Kamieniec, tributary from Nagawczyn, Gnojnica	PLN 1 328 000
7	2020-06-07	Fluvial flood – natural exceedance	San, Oslawa, Olszanka, Wujski Potok	PLN 412,000
8	2020-06-22	Fluvial flood – natural exceedance	Strug, Baryczka, Golcowka, Strug, tributary from Bielowka, Hermanowka	PLN 2 580 000
9	2020-06-26	Fluvial flood – natural exceedance	San, Oslawa, Kalniczka, Baryczka, Stupnica, Stara Rzeka, Magierka, Drohobyczka, Jawornik, Korzeniecki, Blotnia, Szklarka, Boguszowka, Korzonka, Jasionka, Brzuska	PLN 2 084 000

No.	Date of the beginning of the flood	Type of flood	Rivers subject to the flood	Total damage
10	2020-06-26	Fluvial flood – natural exceedance	Wislok, Mleczka, Sawa, Leg, Husowka, Markowka, Graniczny, Tarnawka, tributary from Pasterniki, Lopuszka, Tatyna, Chmielnicka Rzeka	PLN 17 241 000
11	2020-06-26	Fluvial flood – natural exceedance	Wislok, Morawa, Stobnica, Lublica, Kopytko, Kroscienka, Slaczka, Marcinek, Nieplanka, Gogolowka, Stepinka, Pietrykowka, Rosielna, tributary from Wytrzaska, tributary from Bielowek, tributary from Czarna mountain	PLN 4 557 588
12	2021-07-17	Defence or infrastructural failure	Slupianka	PLN 10,000,000
13	2021-08	Fluvial flood – natural exceedance	Nidzica, Maloszowka	No data available
14	2021-08-06	Fluvial flood – natural exceedance	Vistula, Skawica, Dlubnia, Kleczanka, Garliczka, Bibiczanka, Sudol, Sudol Dominikanski, Podlezanka, Drwinka, Potok Roznowski, Zakrzewianka, Drwinka, Potok Miodowka	No data available

9. ASSESSMENT OF THE POTENTIAL ADVERSE CONSEQUENCES OF FLOODS THAT MAY OCCUR IN THE FUTURE

As part of the review and update of the PFRA in the 3rd planning cycle for all river basin districts, a total of 1336 river areas of probable floods and 26 areas of floods from damming structures were identified (Table 10).

Table 10: Future flood areas with potential adverse consequences (PPd) for each flood type in river basin districts

No.	River Basin District	Fluvial flood	Flood from damming structures
1	Oder	289	10
2	Vistula	1030	16
3	Pregolya	8	0
4	Nemunas	2	0
5	Dniester	3	0
6	Danube	1	0
7	Elbe	1	0
8	Banowka	1	0
9	Swieza	1	0
Total		**1336**	**26**

A summary and description of the potential adverse consequences of flood that may occur in the future are included in Annex 4.2.

Areas of floods that may occur in the future and have potential negative effects are shown in Figure 9 for fluvial flood and Figure 10 for floods from damming structures.

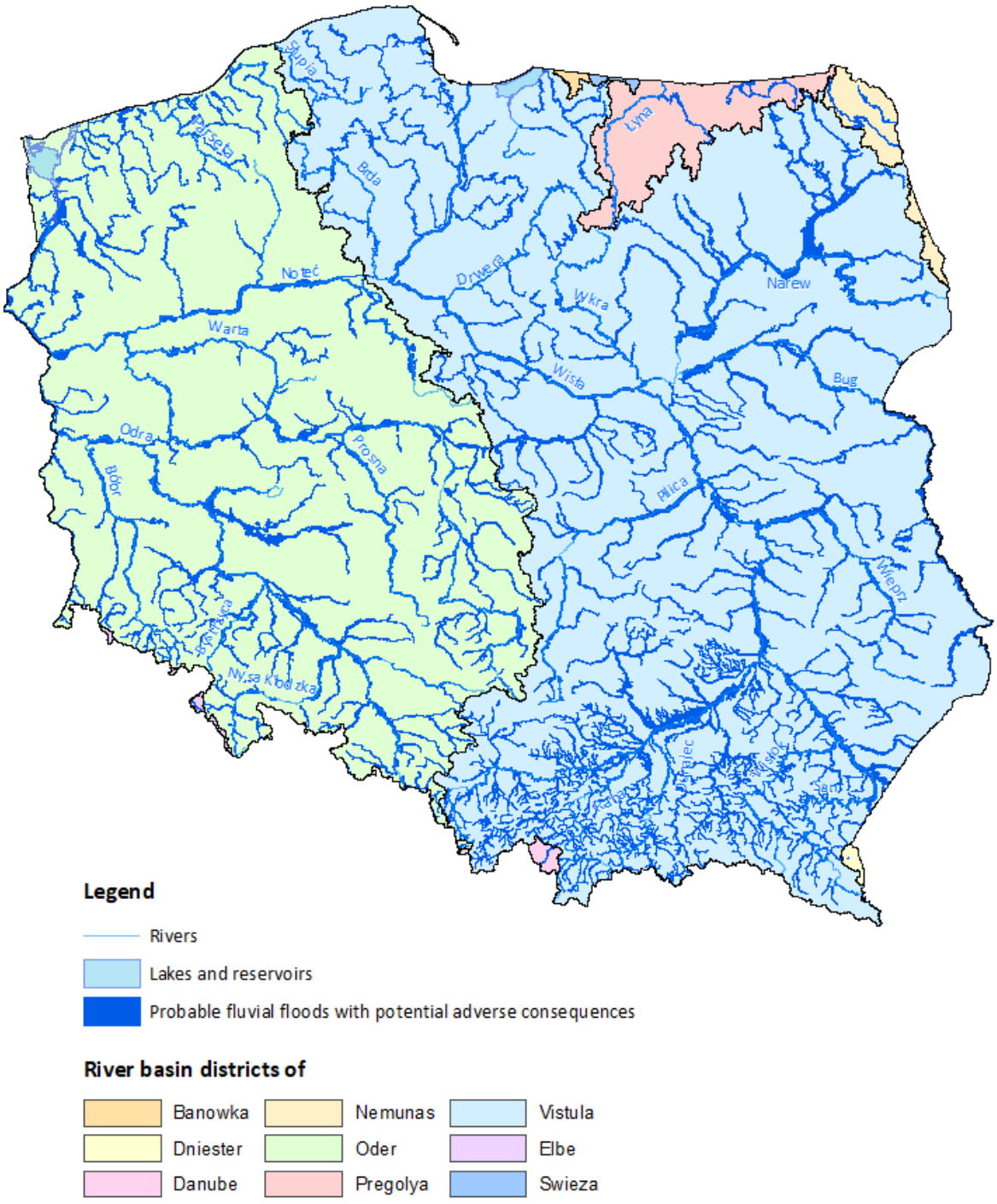


Figure 9: Areas of fluvial floods that may occur in the future and have potential adverse consequences

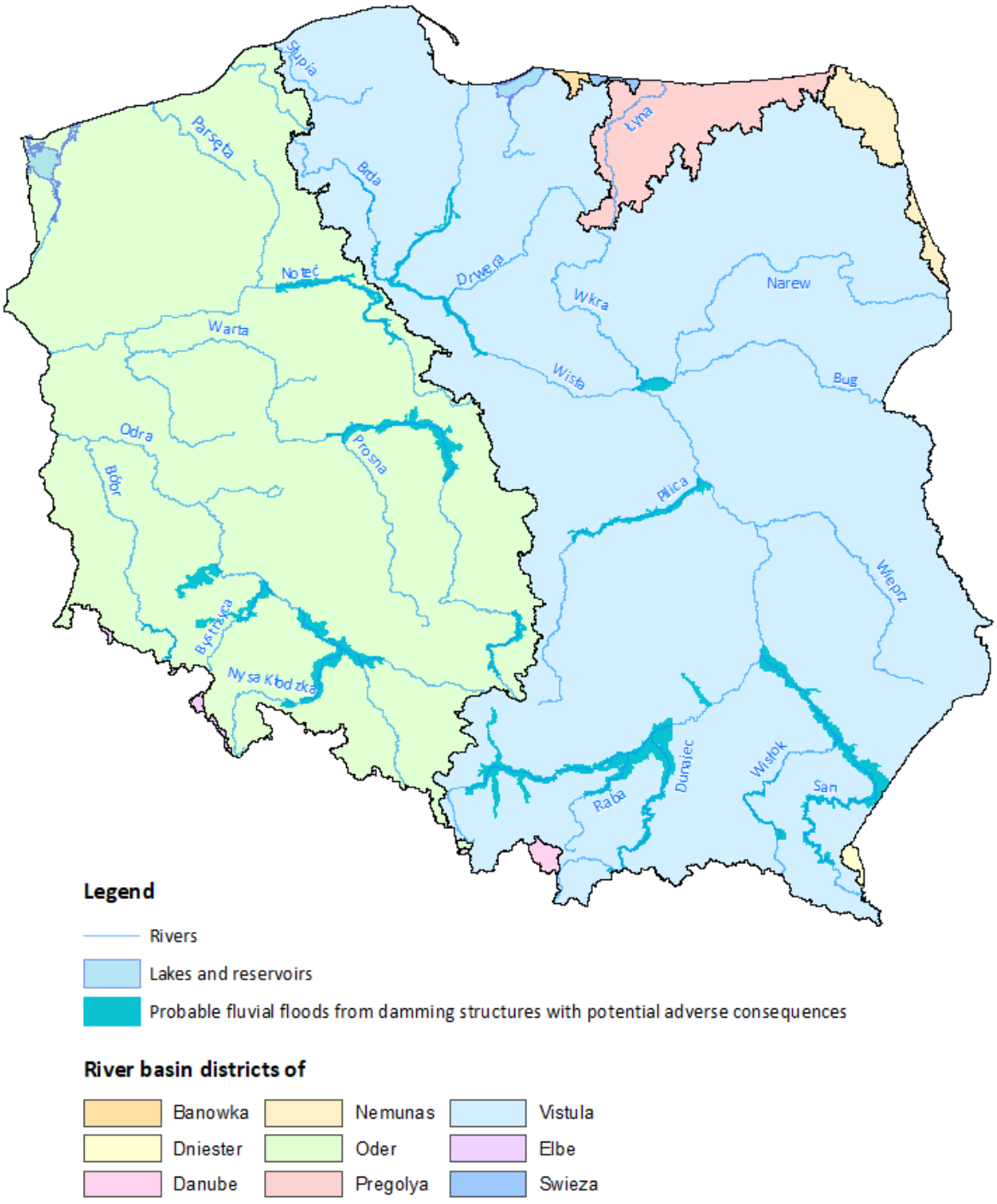


Figure 10: Areas of floods from damming structures that may occur in the future and have potential adverse consequences

10. AREAS OF POTENTIAL SIGNIFICANT FLOOD RISK

10.1. FLUVIAL FLOOD

As a result of the review and update of the Preliminary Flood Risk Assessment in the 3rd planning cycle, **all areas of potential significant flood risk designated in 1st and 2nd planning cycles remain in place**.

In addition, **new river sections were identified as APSFRs** with a total length of about 386 km (Table 11). These include 16 new rivers and for 4 rivers the APSFRs have been expanded.

Table 11: New APSFRs for fluvial floods designated in the 3rd planning cycle

No.	River Basin District	Water region	Name of river	River ID	Initial km APSFR	Final km APSFR	Number of km APSFR
1	Oder	Lower Oder and Western Pomerania	Bukowa	1972	0.0	12.6	12.6
2			Warzymice tributary	19724	0.0	5.0	5.0
3			Gumieniec	19722	0.0	3.5	3.5
4			Stobnica	197212	0.0	1.0	1.0
5		Central Oder	Sasiecznica	144	0.0	21.6	21.6
6	Vistula	Upper East Vistula	Czarna Lada	22862	0.0	18.9	18.9
7			Gleboka	22782	0.0	11.9	11.9
8			Ropa *	2182	57.0	79.1	22.1
9			Warzycki	218492	0.0	5.7	5.7
10			Zawadka	21888	0.0	15.5	15.5
11		Upper West Vistula	Cedron	213568	0.0	30.3	30.3
12			Drwinka	213798	0.0	31.3	31.3
13			Glogoczowka	213566	0.0	20.6	20.6
14			Krolewski Potok	213892	0.0	15.8	15.8
15			Podlezanka	213776	0.0	13.3	13.3
16			Pradnik *	21374	12.1	41.0	28.9
17			Skawinka *	21356	11.8	32.6	20.8
18			Strumien	2176	0.0	44.1	44.1
19			Uszwica *	21396	32.2	68.9	36.7
20			Watok	21488	0.0	26.0	26.0
							385.6

* Rivers for which APSFRs have been expanded.

The total length of all **areas of potential significant fluvial flood risk is about 29,800 km** (Table 12, Figure 11).

A detailed list of rivers for which APSFR s for fluvial flood are defined is included in **Annex 3**.

Table 12: Areas of potential significant flood fluvial risk

No.	River District	Number of km APSFR (1st and 2nd cycle)	Number of km of NEW APSFR (3rd cycle)	Number of km APSFR
1	Oder	10,320.1	43.7	**10,363.8**
2	Vistula	18,362.1	341.9	**18,704.0**
3	Pregolya	455.5	0.0	**455.5**
4	Nemunas	209.6	0.0	**209.6**
5	Danube	26.2	0.0	**26.2**
6	Elbe	13.2	0.0	**13.2**
7	Dniester	0.0	0.0	**0.0**
8	Banowka	0.0	0.0	**0.0**
9	Swieza	0.0	0.0	**0.0**
Total		**29,386.7**	**385.6**	**29,772.3**

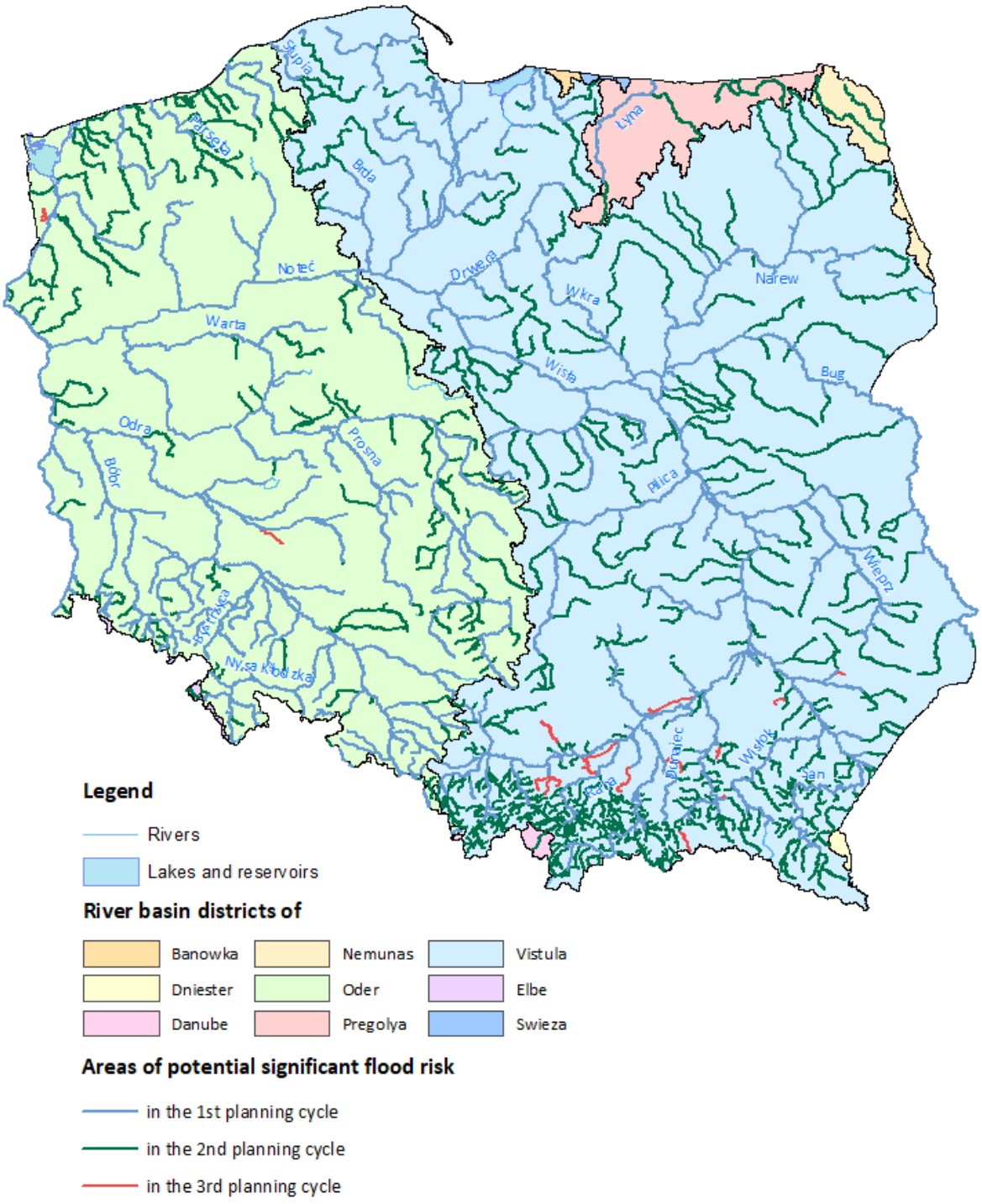


Figure 11: Areas of potential significant fluvial flood risk in the 3rd planning cycle

10.2. FLOODS FROM DAMMING STRUCTURES

For floods from damming structures, no changes were made to the APSFR in the 3rd planning cycle

The 26 APSFRs for floods from damming structures (Table 13, Figure 12) remain in place.

Table 13: Areas of potential significant flood risk from damming structures

No.	River Basin District	Water region	Reservoir name (APSFR)
1	Oder	Warta	Jeziorsko
2			Poraj
3		Notec	Pakosc
4		Central Oder	Nysa
5			Otmuchow
6			Mietkow
7			Dobromierz
8			Slup
9			Bukowka
10		Upper Oder	Turawa
11	Vistula	Lower Vistula	Koronowo
12			Mylof
13			Wloclawek
14		Central Vistula	Sulejow
15			Debe
16		Upper West Vistula	Porabka
17			Tresna
18			Swinna Poreba
19			Dobczyce
20			Roznow
21			Czorsztyn-Niedzica
22			Chancza
23		Upper East Vistula	Solina
24			Besko
25		Little Vistula	Goczalkowice
26			Przeczyce
27	Pregolya		-
28	Nemunas		-
29	Danube		-
30	Elbe		-
31	Dniester		-
32	Banowka		-
33	Swieza		-

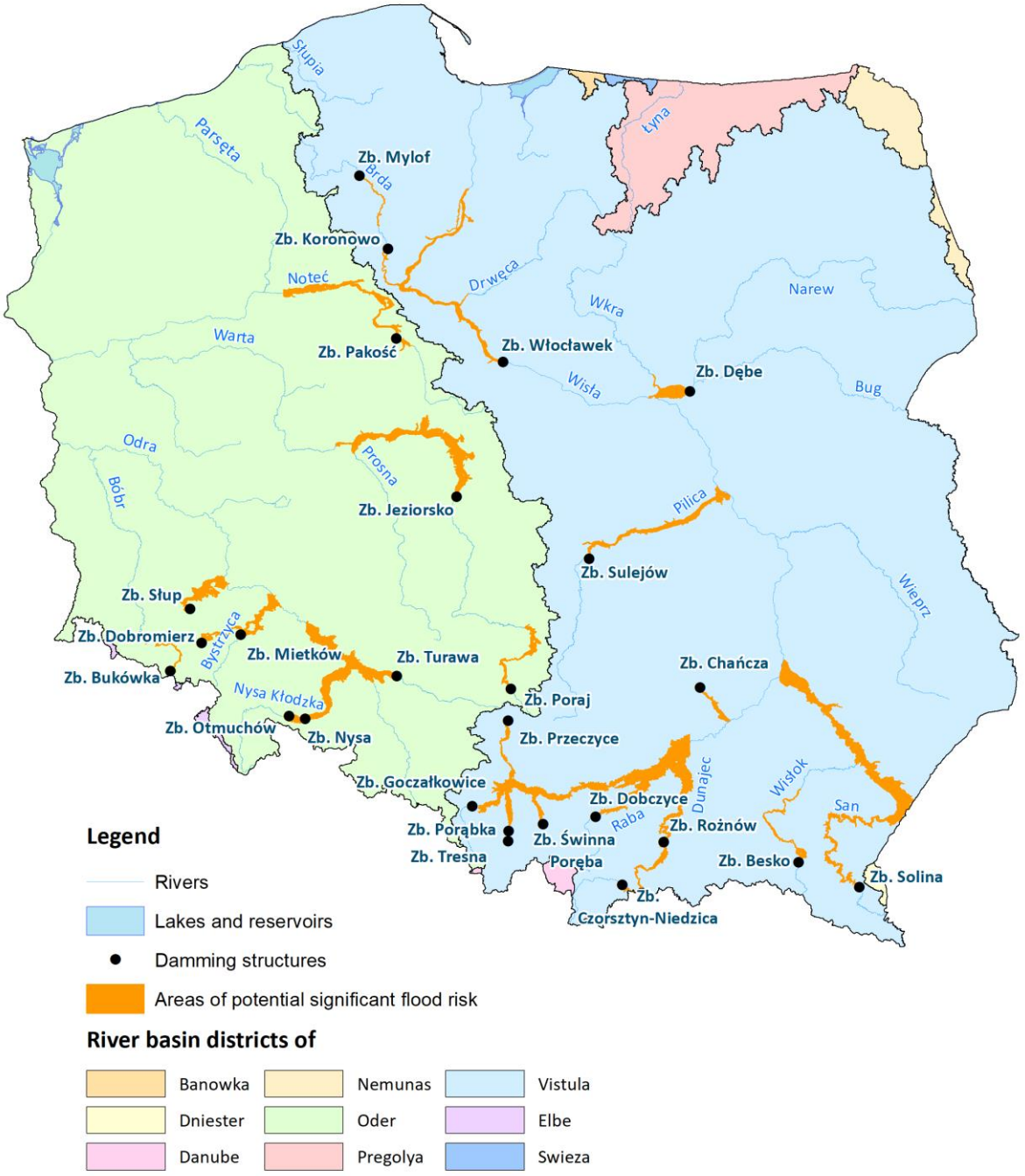


Figure 12: Areas of potential significant flood risk from damming structures

SEAWATER FLOODS, INCLUDING INTERNAL MARINE WATERS

According to Art. 168 paragraph 2 of the Water Law Act, the minister in charge of maritime economy is responsible for drawing up the preliminary seawater flood risk assessment, including internal marine waters.

The sections on reviewing and updating the preliminary seawater flood risk assessment, including internal marine waters, are based on the following documents:

1) Revision and update of the methodology of the preliminary seawater flood risk assessment, including internal marine waters (2024);
2) Report on the review and update of the preliminary seawater flood risk assessment, including internal marine waters (2024);

prepared on behalf of the Minister of Infrastructure.

11. SEAWATER FLOODS, INCLUDING INTERNAL MARINE WATERS

11.1. SUMMARY OF METHODOLOGY FOR REVIEWING AND UPDATING THE PRELIMINARY SEAWATER FLOOD RISK ASSESSMENT

The review and update of the preliminary seawater flood risk assessment, including internal marine waters (PFRAS) in the 3rd planning cycle was carried out in the following stages:

1) Identification and description of floods that have occurred in the past – historical floods:
   a) Organising and completing flood data up to 2017 (1st and 2nd cycle) and developing flood data from 2018 to 2023 (3rd cycle),
   b) analysis of historical floods – assessment of significant adverse consequences of flood,
   c) designation of flood zones as referred to in Art. 4.2b and 4.2c of the Floods Directive.
2) Identification and description of floods that may occur in the future – probable floods:
   a) updating data on areas where flooding is likely to occur,
   b) identifying potential adverse consequences of flood,
   c) analysis of floods that may occur in the future – assessment of potential adverse consequences of flood,
   d) designation of flood areas as referred to in Art. 4.2d of the Floods Directive.
3) Carrying out a forecast of long-term developments, including in particular changes in land use and the impact of climate change on the occurrence of floods.
4) Designation of areas of potential significant seawater flood risk, including internal marine waters.

A detailed description of the methodological assumptions is included in the Methodology for the preliminary assessment of seawater flood risk, including internal marine waters in the 3rd planning cycle, which is attached as Annex 2 to the Report.

11.1.1. HISTORICAL FLOODS

PERIOD UP TO 2017

As part of the review and update of the preliminary seawater flood risk assessment for the 3rd planning cycle, the flood data from 1st and 2nd planning cycles (up to 2017) were cleaned up, completed and spatially aggregated.

Based on the acquired data and available media sources, new extents of the historical flood areas in polygon form were determined for the 36 point objects from the first cycle. The spatial distribution of flooding was determined based on the assumed 1 flooding depth interval (flooding to a depth of 0.5 m) in accordance with the flood hazard mapping methodology.

A total of 97 historical flood areas were analysed.

PERIOD OF 2018-2023

The primary source of information used to identify and describe historical floods in the period of 2018-2023 were the bulletins of the National Hydrological and Meteorological Service of the Institute of Meteorology and Water Management – National Research Institute. Data were obtained on the height (in cm) of exceedances of alarm levels (unit from exceedances of warning levels) for water gauges located in estuary sections of rivers, bays, lagoons or lakes. In addition, other publicly available measurement and observation data (for daily measurements) from hydrological stations were used to interpolate the water table as part of the spatial analyses.

The analyses identified 86 new areas, which together accounted for 12 new historical floods.

IDENTIFICATION OF SIGNIFICANT HISTORICAL FLOODS

The analysis of significant historical floods, analogous to the fluvial floods, was carried out in the following steps:

1) Assessing the adverse consequences of floods:
   - general assessment,
   - detailed assessment;
2) Hydrological assessment:
   - on a regional scale – taking into account the characteristics of historical floods,
   - on a local scale – taking into account historical flood data for individual water gauges;
3) Consideration of the forecast of long-term developments;
4) Classification of historical floods.

The criteria for designating significant historical floods were analogous to those for fluvial floods.

A detailed description of the methodology for the identification and assessment of significant historic seawater floods is contained in Section 6.1 of the Methodology for the Preliminary Assessment of Seawater Flood Risk, including Internal Marine Waters in the 3rd planning cycle, which is attached as Appendix 2 to the Report.

11.1.2. PROBABLE FLOODS

The main source of data on the extent, intensity and frequency of future flood events is the seawater flood hazard maps. Areas with a 1% probability of flooding, as determined by hydraulic modelling, were used to delineate probable sea flood areas.

The designation of areas with potential adverse consequences of flood that may occur in the future was based on a criteria analysis for the identified areas where flood is likely to occur.

The potential adverse consequences of the floods were determined considering 4 categories: human health and life, environment, cultural heritage and economic activity. If at least one criterion in a subcategory had a value greater than 0, it was assumed that the flood in question had a potential negative impact.

The result of the analyses are the areas of probable floods with potential adverse consequences, as stipulated in Art. 4.2d DP. These areas are considered to be all areas that have been identified as areas of potential significant flood risk in the 1st and 2nd PFRA cycle and flood hazard maps have been produced for them for a 1% probability of flooding.

A detailed description of the methodology for delineating areas where potential adverse consequences of flooding may occur in the future is contained in Section 6.2 of the Methodology for the Preliminary Seawater Flood Risk Assessment, including Internal Marine Waters in planning cycle 3, which is attached as Appendix 2 to the Report.

11.1.3. FORECAST OF LONG-TERM DEVELOPMENTS

The long-term forecast of developments in seawater flood risk addressed the impact of climate change on the occurrence of floods, as well as land use and population changes.

THE IMPACT OF CLIMATE CHANGE ON THE OCCURRENCE OF FLOODS

The most up-to-date study on climate change and in particular global sea level change is the latest IPCC report: Sixth Assessment Report (AR6 2021).

The impact of climate change on sea level, among other things, was developed on the basis of scenarios based on the Shared Socio-economic Pathway (SSP). Based on the data

developed, values from the scenario for the ultra-low emissions policy SSP1-1.9 for the years 2050 and 2100 were used to forecast long-term developments.

The determination of the extent of probable floods for the long-term development forecast was based on two parameters:

- median values (H=50%) of the projected increase in Baltic Sea level based on the SSP1-1.9 scenario of the IPCC report (AR6) for 2050 and 2100;
- H-values of the current 1% probability of flooding for individual tide gauge stations.

The selected values of predicted sea level rise were added to the values of probable levels calculated as part of the execution of the review and update of the seawater flood hazard and seawater flood risk maps in 2nd planning cycle. For the selected scenario for the years 2050 and 2100, spatial GIS analyses were performed to identify seawater flood hazard areas due to projected climate change. During the GIS analysis, rasters with water table ordinate information were generated, i.e. numerical water surface models (NMPW) for the entire coast. The prepared rasters were compared with the numerical terrain model to determine the approximate extent of the flood hazard areas. After discarding unconnected fragments, i.e. those not in hydraulic contact with the base raster, the result was reduced to vector form – seaward flood extent polygons, including internal sea waters, were created, reflecting the projected mean sea level rise for the selected scenario for the years 2050 and 2100.

IMPACT OF LAND COVER CHANGES

In order to determine **the impact of land use changes on the occurrence of floods**, the need to identify potential land use changes affecting the level of flood risk was defined.

The impact of land use change was determined by comparing the 2012 and 2018 CLC spatial layers. The main criterion is the relative increase or decrease of sealed land within the analytical units (hexagons). Among the existing land cover classes, the following classes (level two) were considered as sealed areas: 1.1 – Urban development, 1.2 – Industrial, commercial and communication areas, and 1.3 – Mines, pits and construction sites.

In the next stages, the increase or decrease in the area of marked land to that of other CLC classes was used to identify APSFRs.

IMPACT OF POPULATION CHANGES

CSO data was used to identify current and future population changes. Current changes were determined using 2011 and 2021 data in the kilometre grid areas. Future changes were determined based on the study: ‘Resident population projection for Poland for 2023-2060’ in the district areas.

Polygon layers with calculated population increases or decreases were used at the project stage in the APSFR designation process.

A detailed description of the forecast of long-term developments is included in Chapter 6.3 of the Methodology for the Preliminary Seawater Flood Risk Assessment, including Internal Marine Waters in 3rd planning cycle, which is attached as Appendix 2 to the Report.

11.1.4. AREAS OF POTENTIAL SIGNIFICANT FLOOD RISK

The identification of areas of potential significant flood risk took place in two stages:

1) **Areas of potential flood risk–** derived from the identification of historic and probable floods, as the sum of the areas referred to in Art. 4.2b, 4.2c and 4.2d of the DP
2) **Areas of potential significant flood risk–** delineated through a criterion analysis carried out for the previously identified extent of areas potential flood risk as referred to in Art. 4.2b, 4.2c and 4.2d of the DP

As in the case of fluvial flood, analyses were carried out based on the current state of flood risk and projected changes including long-term developments (results of land use changes and climate change).

The delineation of APSFR areas was done on the assumption that in the 3rd planning cycle all APSFR s designated in the 1st and 2nd cycles would remain in place. It was also possible to identify new APSFRs – based on the adopted identification criteria.

A detailed description of the methodology for the delineation of areas of potential significant flood risk is contained in Chapter 6.4 of the Methodology for the preliminary assessment of seawater flood risk, including internal marine waters in the 3rd planning cycle, which is attached as Annex 2 to the Report.

11.2. RESULTS OF THE PRELIMINARY SEAWATER FLOOD RISK ASSESSMENT, INCLUDING INTERNAL MARINE WATERS

A detailed description of the results of the PFRAM is included in the Report on the Review and Update of the Preliminary Assessment of Seawater Flood Risk, including Internal Marine Waters, which is attached as Annex 6 to this Report.

11.2.1. DESCRIPTION OF SIGNIFICANT HISTORICAL FLOODS

A total of 183 areas were identified as a result of the review and update of the seawater PFRA during the 3rd planning cycle, representing 26 significant seawater floods. A summary and description of significant historical floods is included in Appendix 4.3.

11.2.2. AN ASSESSMENT OF THE POTENTIAL ADVERSE CONSEQUENCES OF FLOOD THAT MAY OCCUR IN THE FUTURE

A total of 63 probable floods were identified as part of the review and update of the seawater PFRA during the 3rd planning cycle, 29 in the Lower Oder and Western Pomerania Water Region and 34 in the Lower Vistula Water Region.

A summary and description of the potential adverse consequences of floods that may occur in the future are included in Appendix 4.4.

11.2.3. AREAS OF POTENTIAL SEAWATER FLOOD RISK

As a result of the review and update of the Preliminary Flood Risk Assessment in the 3rd planning cycle, **all areas of potential significant seawater flood risk, including internal marine waters, designated in 1st and 2nd planning cycles remain in place**, but their zoning has been changed.

As a result of the spatial changes made to the existing APSFRs, a total of **118 seawater APSFRs** were identified in the 3rd planning cycle.

A detailed list of areas for which APSFRs are defined for sea water flood is included in Annex 3.

PLUVIAL FLOODS

12. PLUVIAL FLOODS

Pluvial floods are one of the types of floods analysed within the PFRA. These are distinguished by the fact that they are not linked to the hydrographic network – flooding of an area is not a consequence of high water levels on a watercourse, but of intense rainfall. For this reason, pluvial floods are a distinct type of fluvial floods.

Fluvial floods are mainly associated with the exceedance of river waters, streams, mountain streams, canals, lakes, resulting also from the sudden melting of snow.

Pluvial floods, on the other hand, are floods associated with the flooding of land by water directly from rainfall or snow melt, and may include urban storm floods or periodic filling of unlined areas in non-urban areas.

Flash floods are a special case of pluvial floods, i.e. floods that are localised in extent, very fast-moving and of short duration, usually less than 6 hours, caused by high-powered rainfall, often of a thunderstorm nature. Flash floods can occur in any given place, but are most common in mountainous and urban areas.

Because of their genesis, pluvial floods have specific characteristics. Above all, these floods – due to the lack of a link to the hydrographic network – can occur practically anywhere, in any area where there are favourable conditions for this. These mainly include areas without drainage, flat areas with a low gradient (resulting in slow water run-off), areas with steep slopes and sealed areas (resulting in difficult or even no infiltration of rainwater). Especially the latter factor, i.e. the sealing of the terrain, favours intensive rainwater runoff and its accumulation in lower-lying areas.

Land sealing is intrinsically linked to cities and urbanisation, which is why pluvial floods most often occur in urban areas. In this case, an important factor in the occurrence of flood is the capacity and efficiency of the systems for draining rainwater into surface water and also the stormwater drainage systems. If, the capacity of these systems is insufficient or not efficient, then water can accumulate in the streets and flow towards lower situated areas, taking the form of urban flood.

A key factor in the occurrence of pluvial floods, however, is the presence of intense rainfall, often resulting from storm-like phenomena. This rainfall is usually short-lived and occurs over a relatively small area, making pluvial flood similarly localised and short-lived.

As part of the PFRA in the 3rd planning cycle, an analysis of pluvial floods was carried out, particularly with regard to the identification and description of this type of flood. A description of the work carried out and the results of the analyses are presented in the following section.

12.1. HISTORICAL FLOODS

12.1.1. SUMMARY OF METHODOLOGY

In the 2nd planning cycle, pluvial floods were identified on the basis of data on interventions by the state fire service (PSP) from the period 2010-2017 for 39 cities with a population of more than 100,000 inhabitants. A survey of JST was also a source of information on rainfall floods.

As part of the review and update of the PFRA in the 3rd planning cycle, the above data was further supplemented by a point catalogue of sudden local floods and a flood precipitation database developed by IMGW-PIB as part of the KLIMAT project.[2]

The following source materials were analysed to identify pluvial flood events for the period of 2018-2023:

- PSP intervention database for the whole of Poland for the period of 2018-2023;
- Measured precipitation data (daily totals) from the PSHM IMGW-PIB database.

In cycle 3, the form of presentation of rainfall events was changed from point to polygon.

For the area-based presentation of precipitation floods, the ESRI tool 'Model bluespots to map flood risk' was used for the analysis of catchments located in urbanised areas, where intense precipitation can cause periodic flooding of the area.

The operation of the model is based on the analysis of the digital terrain model and the consideration of rainfall above 20 mm, which can cause damage to the area.

The model takes into account the elements of the database of topographic objects, in particular communication networks, buildings, structures and facilities, utility networks.

However, due to the nationwide nature of the analysis, it is not possible to take into account elements such as land use, infiltration of rainwater into the ground and the impact of the operation of rainwater or combined sewer systems. **The areas obtained from the model represent only the approximate extent of flood**.

An example of determining the extent of a pluvial flood using the Bluespot model is shown in Figure 13.

[2] KLIMAT project: 'Environmental, economic and social impacts of climate change (changes, impacts and mitigation, lessons for science, engineering practice and economic planning)'.

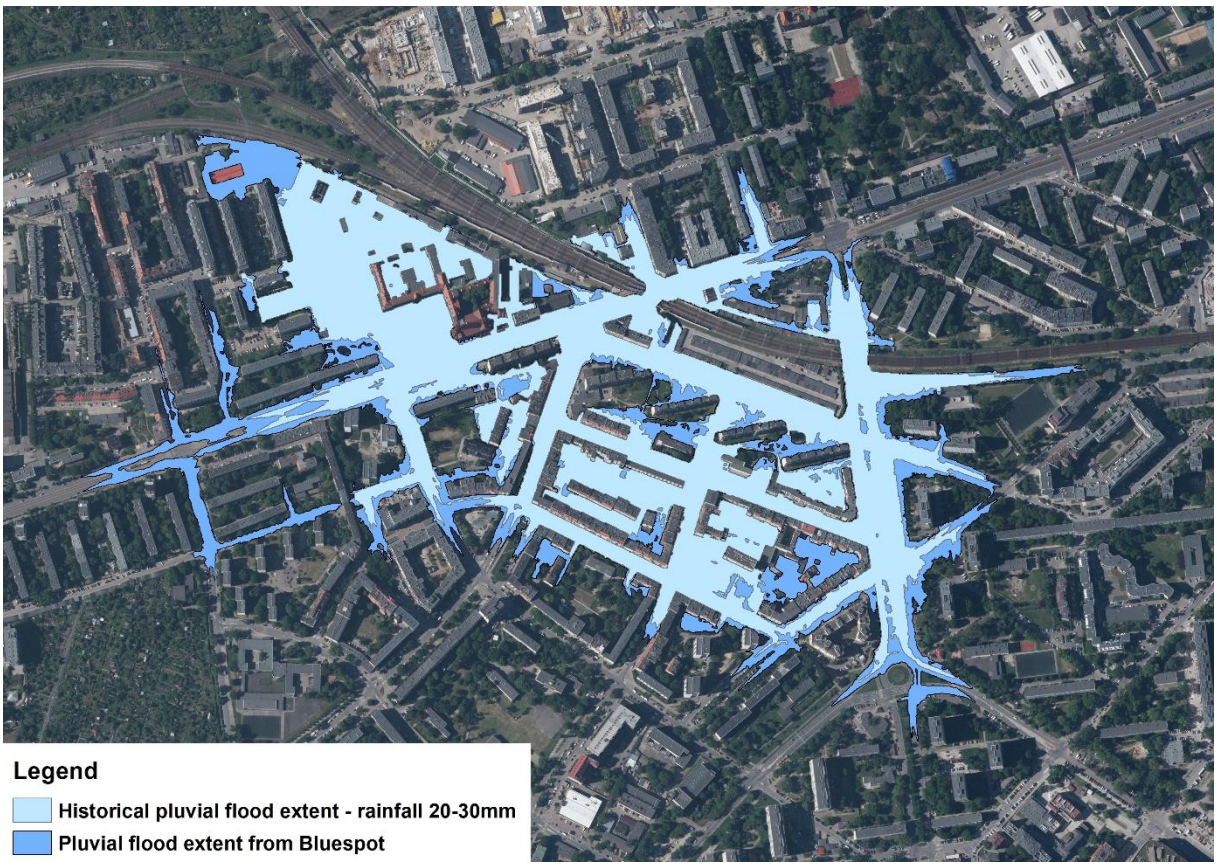


Figure 13: Example of pluvial flood range obtained using the Bluespot model

The results obtained from the model were verified and irrelevant events, such as flooding of individual properties or small depressions in the area, were eliminated. Areas with an area greater than 10,000 m^2 and a depth greater than 30 cm were included in further analyses.

The occurrence of areas obtained from the model was then compared with the PSP intervention points and data from the KLIMAT project. Points that were outside the areas determined from the Bluespot model were excluded from further analyses. Point data for which it was not possible to verify the amount of precipitation due to missing or incomplete date of occurrence were also excluded.

The analyses resulted in a surface layer containing **the approximate extent of areas at risk of flooding (terrain depressions) in the event of a rainfall event of a certain height, corresponding to the events identified in the PSP database**.

A detailed description of the operation of the BLUESPOT model and the assumptions used to develop the extent of pluvial flood areas is included in sections 4.1.3 and 4.2.3 of the Methodology.

12.1.2. RESULTS

The analyses resulted in a total of 2325 rainfall inundated areas, corresponding to rainfall events that occurred in the period 2010-2023, of which 830 i.e. 35.7% fall in the period up to 2017 and 1495 events i.e. 64.3% fall in the period 2018-2023.

The occurrence of pluvial flood areas in Poland is shown in Figure 14**. It should be remembered that these areas are general in nature and represent only an approximate range.**

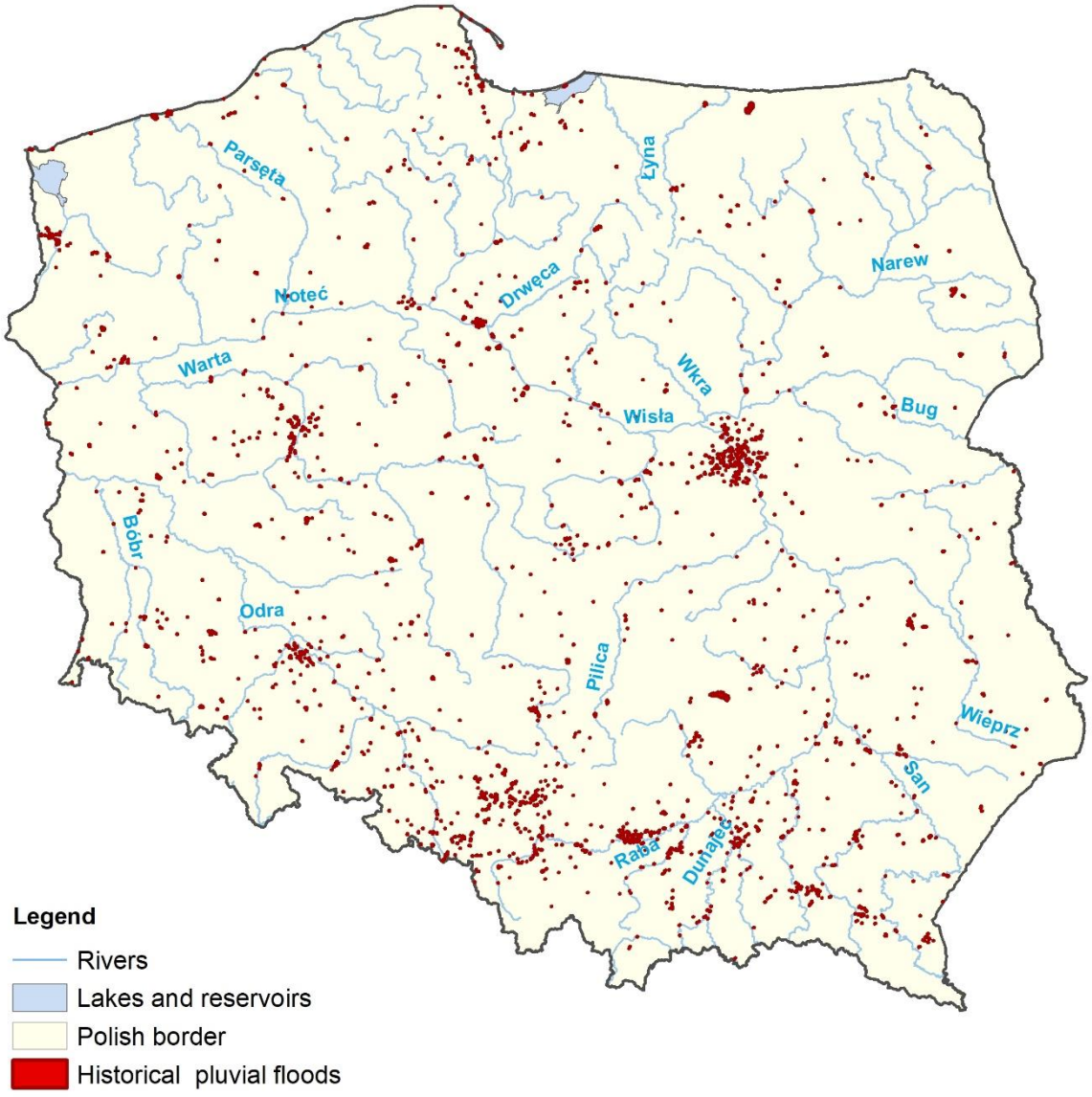


Figure 14: Occurrence of pluvial floods in Poland

The largest number of pluvial flood events was identified in the Vistula river basin district (1480). In the Oder river basin district these events were almost half as many (822). In the other river basin districts that occur within Poland's borders, only a few pluvial flood events were reported.

Analysis of the PSP intervention database and the KLIMAT project database has shown that precipitation is a phenomenon with considerable variability in time and space, which creates difficulties in aggregating this data over a larger area and significantly limits the possibility of determining the area extent of flood hazard.

The analysis of pluvial flood events indicates that they are small in size, with an average flood event area 0.07 km^2 (70,000 $m^{2)}$, bearing in mind the assumptions made earlier related to the elimination of events less than 10,000 m^2, which accounted for about 80% of all designated areas.

Due to the nature of pluvial floods (minor and short-lived in nature) and the lack of relevant data, an assessment of the impact of these events has not been carried out and significant historical floods have not been identified.

12.2. PROBABLE FLOODS

12.2.1. SUMMARY OF METHODOLOGY

As part of the review and update of the PFRA, simplified analyses have been carried out to identify areas where pluvial floods may occur, without specifying the probability of rainfall flooding, as there is no simple quantitative relationship between information on the probability of high intensity rainfall and the probability of flood hazard of a certain extent.

Analogous to the historical floods, results from the ESRI tool 'Model bluespots to map flood risk' were used. Areas were included, as a result of the model, with an area greater than 10,000 m^2, a depth greater than 30 cm and an impervious surface greater than 40%.

The analyses resulted in a surface layer containing **the approximate extent of areas at risk of flooding (field depressions) in the event of a rainfall event of a certain height**.

For the identified areas, the impact of climate change on flood incidence was assessed using the criterion of change in the number of days per year with daily precipitation ≥ 20 mm between 2011 and 2050 for the RCP 4.5 scenario and the RCP 8.5 scenario.

A detailed description of the assumptions used to develop extent of areas where pluvial flood may occur is included in Section 5.2.2 of the Methodology.

12.2.2. RESULTS

The analyses identified 4199 areas where pluvial floods could occur.

The distribution of pluvial floods that may occur in the future in Poland is shown in Figure 15.

It should be borne in mind that the areas of these floods are general in nature and represent an approximate range only.

Figure 15: Areas where pluvial floods may occur in the future in Poland

Probable floods are mainly concentrated in urban centres, while in non-urban areas their distribution is relatively even across Poland. As in the case of historical floods, the largest number of places where pluvial floods are likely to occur is in the Vistula and Oder river basin districts (2587 and 1524 respectively), reflecting the share of these river basin districts in the area of Poland.

Due to the nature of pluvial flood (described in Section 12.3 Summary) and the lack of relevant data, no floods with potential adverse consequences as referred to in Art. 4.2d of the Floods Directive have been designated.

12.3. SUMMARY

Pluvial floods tend to be low-volume and short-lived, variable in time and space. They are mostly triggered by intense rainfall, most often as a result of storm events, and can therefore occur wherever there are favourable conditions for this related to, among other things, slope and land cover. Such conditions are mainly found in cities, where increasing urbanisation and higher surface sealing favour intensive rainwater runoff and its accumulation in lower-lying areas. The capacity and efficiency of surface water drainage systems, as well as stormwater drainage systems, is also an important factor in the occurrence of flooding. The lack of availability of this data nationwide prevents detailed analyses.

An assessment of the impact of climate change on the occurrence of floods, using the criterion of change in the number of days per year with daily precipitation ≥ 20 mm in 2011-2050 for the RCP 4.5 scenario and the RCP 8.5 scenario, showed that the problem of precipitation floods is likely to increase. In both scenarios, the number of days with intense rainfall for most of Poland shows an increasing trend. An increase of more than 10% in the number of such days is predicted in Central Poland and in the Lesser Poland Upland, Western Pomerania or Żuławy Lowlands. **In practically all cases, an increasing trend was observed.**

Due to the nature of pluvial floods, no areas of potential significant flood risk are designated for them.

GROUNDWATER FLOODS

13. GROUNDWATER FLOODS

Groundwater flood is the phenomenon whereby an area is inundated due to the temporary rise of groundwater above the land surface.

Due to their genesis, groundwater floods are characterised by certain specificities. They are local, scattered, relatively short-lived and rare. Compared to other types of floods, this type is characterised by a much less violent course and a much smaller magnitude of adverse consequences on the environment, cultural heritage and economic activity. This type of flood also does not cause loss of life.

Groundwater flood is determined by the coexistence of favourable geological, hydrogeological as well as hydrological and geomorphological conditions in a given area, while its occurrence is also linked to the prevailing meteorological conditions. **Due to natural conditions, the areas most susceptible to groundwater floods are mainly found in the valleys of large watercourses.** During fluvial floods, as a result of rising surface water levels, there can be a change in the pressure gradient in the aquifer adjacent to the river and, consequently, a periodic change in the direction of groundwater flow. This is related to the fact that during high levels, the river may cease to be a drainage base for groundwater and along the river locally groundwater underflow and consequently groundwater flooding may occur.

Groundwater flood can occur in different regions of the country. A key hydrogeological condition for this type of flooding to occur is that the groundwater table is shallow and free – the depth of the groundwater table relative to the surface must be less than or equal to the potential amplitude of its fluctuations. This condition significantly limits the areas where this phenomenon can occur.

In flat or morphologically depressed areas where poorly permeable formations such as clay, silt or mud are present at shallow depths, limiting the infiltration of water into aquifers, this type of flood is often confused with pluvial floods, which are caused by the accumulation of rainwater on the land surface.

13.1. HISTORICAL FLOODS

13.1.1. SUMMARY OF METHODOLOGY

In 2nd planning cycle, groundwater floods were mainly identified as a result of a survey of local authorities. There were then 96 floods identified as groundwater floods in the database.

As part of the review and update of the PFRA in the 3rd planning cycle, flood data from up to 2017 was reviewed and flood information for the period 2018-2023 was completed.

To this end, analyses were carried out:

- geological conditions (in terms of the presence of near-surface permeable formations);
- hydrogeological conditions (for the presence of aquifers with a free water table occurring at depths of up to 2 m a.s.l.);
- geomorphological conditions (in terms of flat or concave morphological forms);
- data on the hydrogeological situation, i.e. persistently high groundwater levels, published in PSH communications and in the PSH Handbook 'Extremely high groundwater levels in Poland in 1981-2015';
- data on the hydrogeological hazard of high groundwater levels on the basis of warnings of hazardous phenomena occurring in groundwater recharge or abstraction zones;
- data in the Groundwater Monitoring Database, which collects measurement results from hydrogeological stations belonging to the PGI-PIB groundwater observation and research network;
- satellite data;
- additional information on the course of the floods directly at the local government offices;
- flood data obtained from, among others, voivodeships offices and regional water management authorities.

Details of how to identify and describe historical groundwater flood are included in sections 4.1.4 and 4.2.4 of the Methodology.

13.1.2. RESULTS

Data on 96 flood events from 2nd planning cycle were analysed in detail, including for the first time an analysis in terms of hydrogeological considerations. For 71 flood events, the analysis showed that their genesis was not groundwater-related or it was not possible to establish basic information about the phenomenon, including the exact dates of flooding.

As a result of the verification, 25 flood events that occurred between February 2010 and December 2017 were left in the database, in addition, one event from 2011 was added to the database. Sixteen such events occurred in the Vistula river basin district and the remaining 10 occurred in the Oder river basin district.

During the period 2018-2023, no phenomena were identified that could be clearly classified as groundwater flood.

The distribution of historical floods from groundwater is shown in Figure 16.

As mentioned in the introduction, the characteristics of groundwater flood differ fundamentally from the other types of floods. Groundwater floods do not cause significant damage compared to other types of floods due to their less violent course, their slight rise in water levels above the ground surface, their occurrence in limited areas and only under certain hydrogeological conditions (shallow, free groundwater table, permeable formations in the aeration zone). At the same time, groundwater floods most often accompany or follow other types of floods, especially fluvial floods.

Due to the described specificity of groundwater floods and the lack of relevant data, an assessment of the impact of these events has not been carried out and significant historical floods have not been identified.

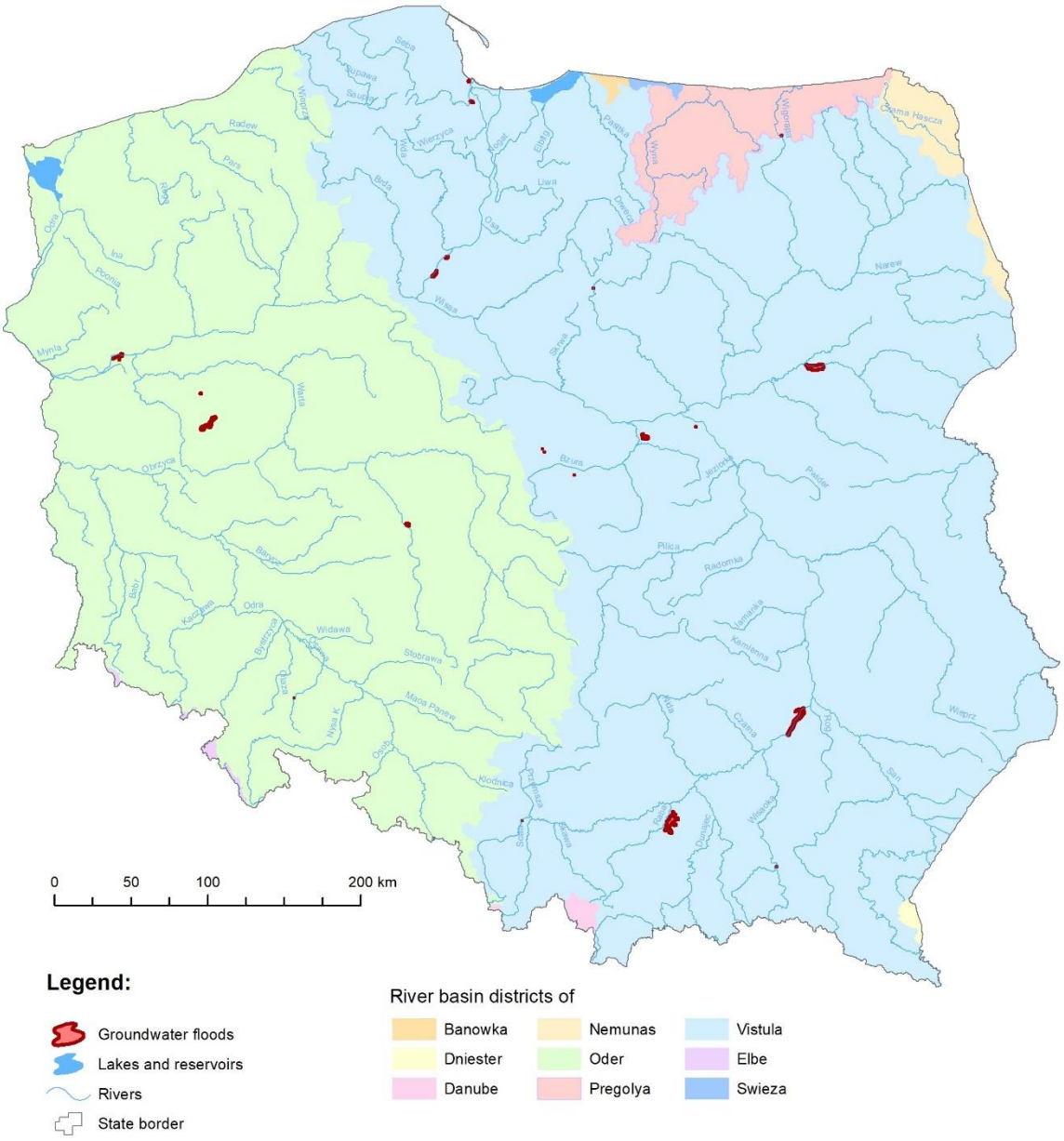


Figure 16: Incidence of groundwater floods in Poland until 2017.

13.2. PROBABLE FLOODS

13.2.1. SUMMARY OF METHODOLOGY

As part of the review and update of the preliminary flood risk assessment in the 3rd planning cycle, analyses were undertaken to identify areas where there is a natural conditioned vulnerability to groundwater floods.

It has been assumed that a prerequisite for an area to be classified as a probable flood area is that the groundwater table is shallow and the water table of the first aquifer is free.

A multi-criteria analysis was carried out on the selected areas to meet the prerequisite, taking into account:

1) Analysis of hydrogeological conditions;
2) Analysis of geological conditions;
3) Occurrence of waterlogging;
4) Proximity to watercourses;
5) Proximity to water bodies;

to classify the probability of groundwater flood based on an area's predisposition to this phenomenon.

Data sources for the analyses were MHP PPW – WH, SMGP, GIS-MOKRADŁA, MPHP, CBDH. Analyses were conducted on a discretisation grid in the form of hexagonal blocks of 0.1 km^2.

For each hexagon, one of five groundwater flood probability classes (very low to very high) has been assigned. A numerical determination of the probability of groundwater flood is not possible.

An example of the application of the adopted groundwater flood probability classification is shown at Figure 17.

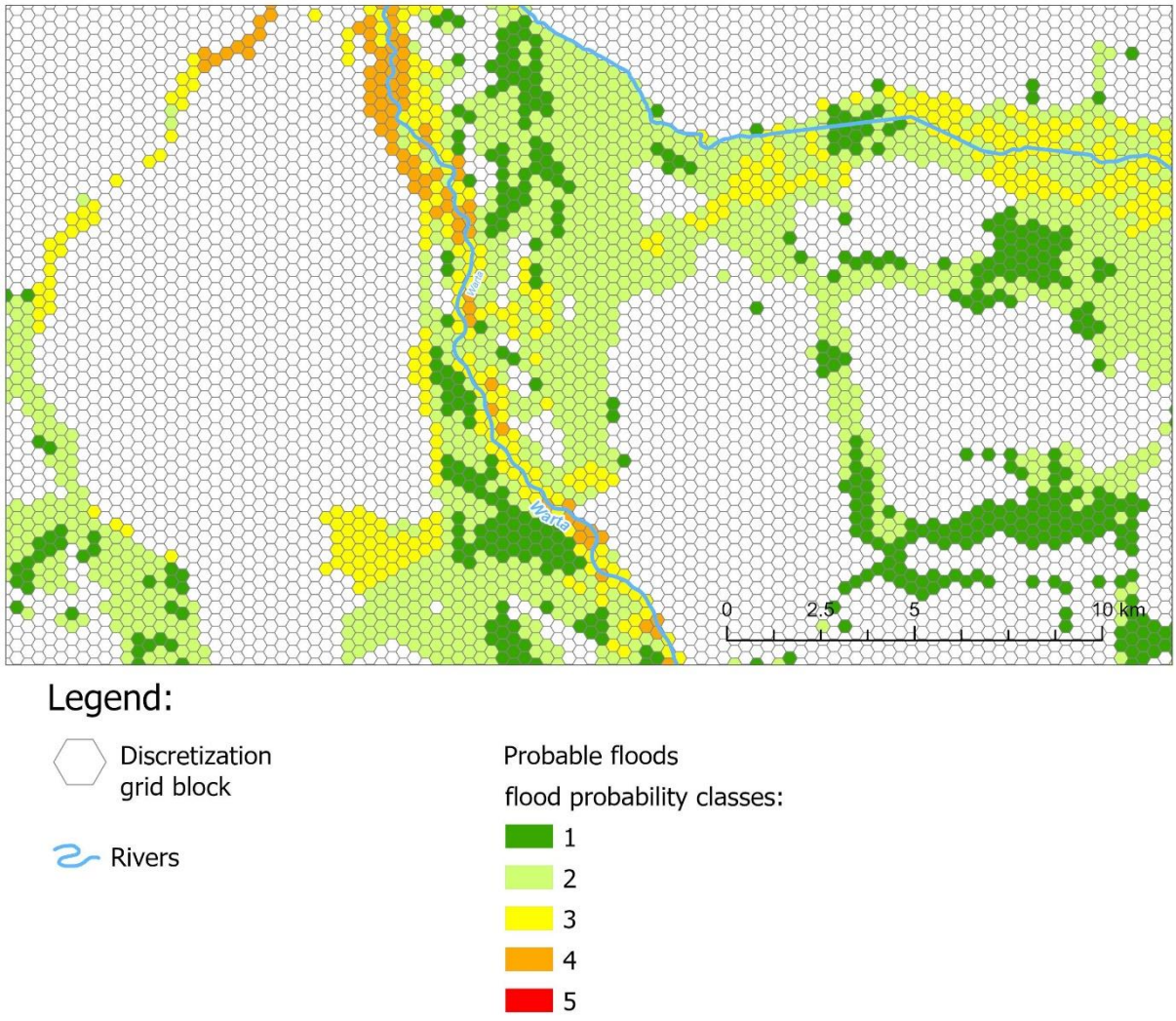


Figure 17: Example of application of groundwater flood probability classification for a given area

Details of how to identify and describe the floods likely from groundwater are included in sections 5.2.3 and 5.4.3 of the Methodology.

13.2.2. RESULTS

As a result of the analyses carried out, areas consisting of hexagons were delimited, for which the assumed necessary condition was met. All hexagons with assigned classes (from 1 to 5) account for about 16% of Poland's area, with class 4 and 5 (high and very high probability of flood) together occupying only 0.002% of Poland's area.

The distribution of class sizes is shown in Table 14 and in Figure 18.

The distribution of probable floods over Poland is shown in Figure 19.

Table 14: Distribution of the abundance of the different classes of probability of groundwater flood

Class of probability of flood	No.	Number of hexagons	% of hexagons	Area in km²
VERY LOW	1	195 444	38%	19,544.4 km²
LOW	2	238 635	47%	23,863.5 km²
AVERAGE	3	66 712	13%	6,671.2 km²
HIGH	4	7 014	1%	701.4 km²
VERY HIGH	5	4	0%	0.4 km²

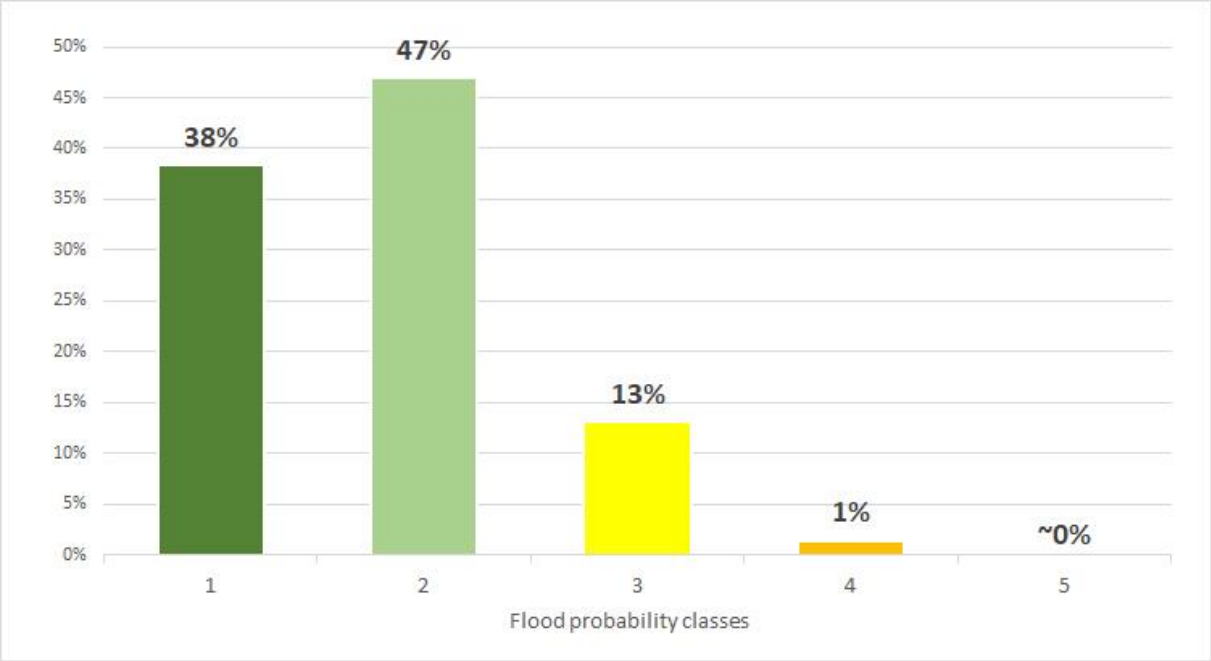


Figure 18: Number of hexagons in designated groundwater flood probability classes

In the river basin system, the largest number of hexagons with an assigned class 4 or 5 were found in the Oder river basin district (3990 hexagons, corresponding to 399 km²), followed by the Vistula river basin district (2981 hexagons, corresponding to 298.1 km²) and a dozen each in the Nemunas (12 hexagons – 1.2 km²) and Danube (15 hexagons – 1.5 km²) river basin districts.

Groundwater flood, including the hexagons with the assigned highest probability of groundwater flood largely overlap with areas at risk of fluvial flood.

Groundwater flooding events are particularly localised in scale, with relatively small amounts of water that can occur above the land surface. The potential adverse consequences of such events are far less than is the case with other types of floods.

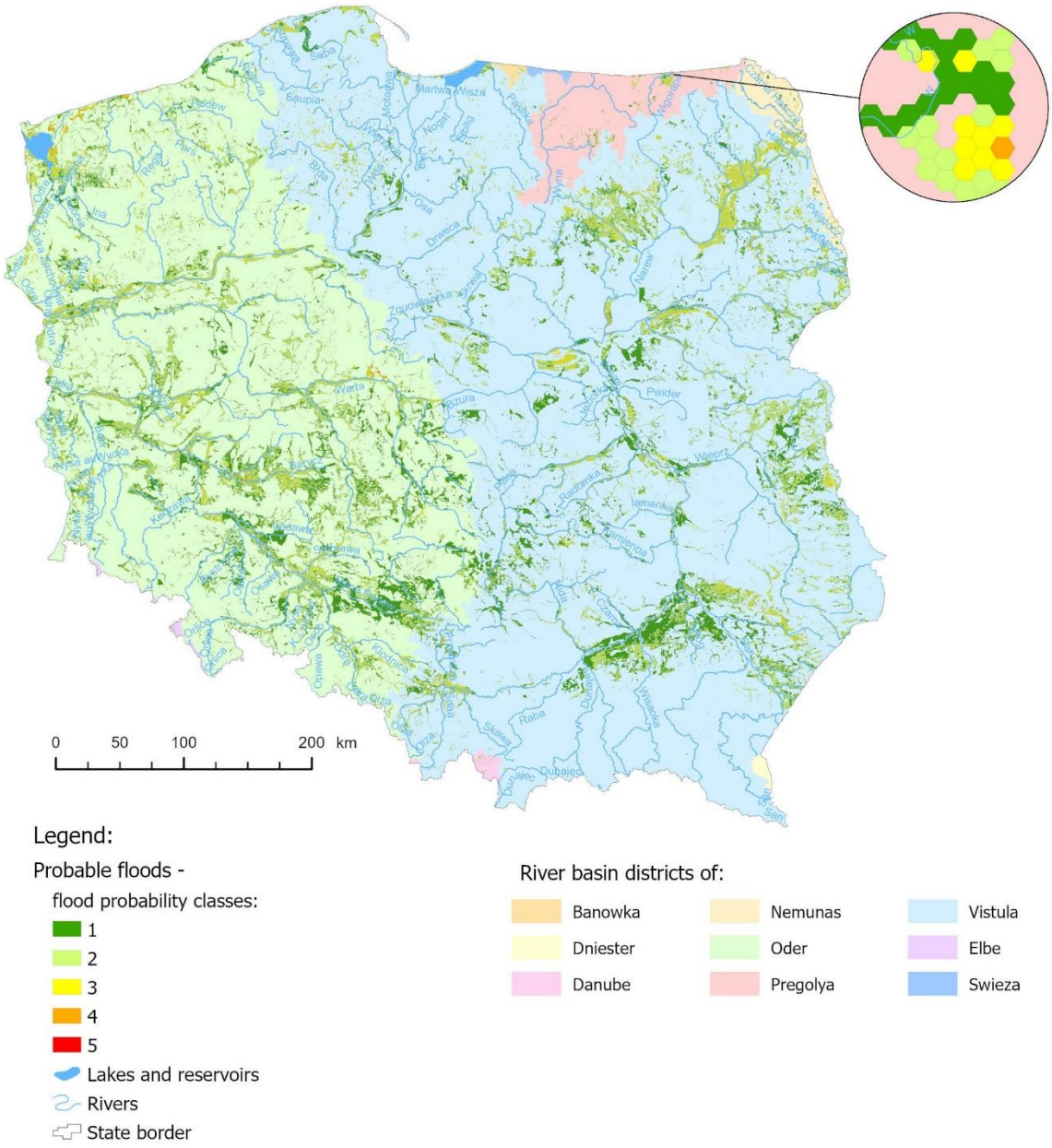


Figure 19: Areas where groundwater floods may occur in Poland

Due to the specific nature of groundwater floods and the lack of relevant data, floods with potential adverse consequences as referred to in Art. 4.2d of the Floods Directive have not been designated.

13.3. SUMMARY

Groundwater floods groundwater are local, diffuse and relatively short-lived and rare phenomena. They depend on specific local conditions. They can occur in many regions of the country, especially where geological, hydrogeological, hydrological and geomorphological conditions are favourable for this phenomenon.

Due to natural conditions, the areas most susceptible to groundwater floods are largely found in river valleys and thus coincide with areas at risk of fluvial flood. During fluvial floods, groundwater flow can be diverted and subducted as a result of rising surface water levels.

In flat or morphologically lowered areas, this type of flood is sometimes confused with pluvial floods, which are caused by the accumulation of rainwater on the surface of the land, where poorly permeable formations such as clays, loams or silts are present at shallow depths, limiting the infiltration of water into aquifers.

Groundwater floods are not significant floods and no areas of potential significant flood risk are designated for them. This is due to the specific characteristics of groundwater floods, such as their less violent course than other floods and the identified lack of significant adverse consequences.

RESULTS AND SUMMARY

14. SPATIAL DATABASE OF PFRA

The results of **the preliminary flood risk assessment were prepared** as a spatial database in file geodatabase (gdb). In addition, a version of the PFRA database in *.shp format was prepared, which covers the same scope of information as the gdb database with necessary modifications due to the specifics of the *.shp format.

The database is drawn up in the PL-1992 rectangular planar coordinate system.

The preliminary flood risk assessment database for the 3rd planning cycle includes the following groups of spatial layers:

1) **Reference layers:**
   a) Administration and management:
      - Regional Water Management Authorities (RZGW) boundaries,
      - Maritime office boundaries,
      - River basin district boundaries,
      - Municipal boundaries,
      - Country border,
      - Coastal belt boundaries,
      - County boundaries,
      - Water regions boundaries,
      - Voivodeship boundaries,
      - Catchment management boundaries.
   b) Hydrography:
      - Rivers,
      - Mileage of rivers,
      - Mileage of coast [entire coast].
2) **Layers of preliminary flood risk assessment:**
   a) Historical floods:
      – Historical floods – rivers,
      – Historical floods – the sea,
   b) Probable floods:
      – Probable floods – rivers,

- Probable floods – reservoirs,
- Probable floods – the sea,

c) Areas of potential significant flood risk:

- Rivers for which APSFR have been designated,
- Areas of potential significant flood risk for rivers,
- Areas of potential significant flood risk from damming structures,
- Areas of potential significant seawater flood, including internal marine waters.

A detailed description of the attribute structure of the PFRA database is provided in Annex 2 of the Methodology.

15. MAPS OF PRELIMINARY FLOOD RISK ASSESSMENT

The results of the preliminary flood risk assessment were also presented in overview maps produced in five thematic sets:

1) Map of river basin districts showing land topography

   (appendices 5.1.1- 5.1.10 to the Report)
2) Map of river basin districts showing land use

   (appendices 5.2.1- 5.2.10 to the Report),
3) Map of significant historical floods

   (appendices 5.3.1- 5.3.3 to the Report),
4) Map of areas where flood is likely to occur

   (appendices 5.4.1- 5.4.3 to the Report),
5) Map of areas of potential significant flood risk

   (attached as Annexes 5.5.1- 5.5.3 to the Report),
6) Maps of seawater floods
   (appendices 5.6.1- 5.6.3 to the Report).

Maps of river basin districts showing land topography and land use (in accordance with Art. 4.2a DP) were produced for the whole of Poland and for individual river basin districts.

Maps of significant historical floods, probable floods and APSFR were made for the whole of Poland, for individual river basin districts, water regions and voivodeships.

A detailed description of the scope of the PFRA maps is included in Chapter 10 of the Methodology, attached as Appendix 1 to the Report.

16. CONSULTATION OF COMPETENT AUTHORITIES AND EXCHANGE OF INFORMATION WITH NEIGHBOURING COUNTRIES

16.1. CONSULTATION OF COMPETENT AUTHORITIES

In accordance with Art. 168 paragraph 3 of the Water Law Act, the State Water Holding Polish Waters submitted the draft preliminary flood risk assessment to the voivodes for their opinion and to the minister in charge of inland navigation for agreement, as far as inland waterways are concerned.

During the opinion process, responses were received from 10 voivodes, with comments on the draft preliminary flood risk assessment from 3 voivodes. No opinion was received from 6 voivodes. According to Art. 168 paragraph 4 of the Water Law Act lack of opinion within the indicated deadline is considered as a positive opinion on the draft.

Table 15 provides a summary table of the opinion process.

Table 15: Summary of the opinion process on the draft PFRA

Voivode	**Submission of opinions**	**Submission of comments**	**Number of comments**
Dolnośląskie Voivode	YES	NO	-
Kujawsko-Pomorskie Voivode	YES	YES	2
Lubelskie Voivode	NO	not applicable	-
Lubuskie Voivode	YES	NO	-
Łódzkie Voivode	NO	not applicable	-
Małopolskie Voivode	YES	NO	-
Mazowieckie Voivode	YES	YES	1
Opolskie Voivode	YES	YES	8
Podkarpackie Voivode	YES	NO	-
Podlaskie Voivode	YES	NO	-
Pomorskie Voivode	NO	not applicable	-
Śląskie Voivode	NO	not applicable	-
Świętokrzyskie Voivode	YES	NO	-
Warmińsko-Mazurskie Voivode	NO	not applicable	-
Wielkopolskie Voivode	NO	not applicable	-
Zachodniopomorskie Voivode	YES	NO	-
Total			**11**

A total of 11 comments were submitted as part of the consultation, of which 6 were taken into account. The comments taken into account related to the content of the report, the maps and figures included in the Methodology and draft PFRA, and the maps of significant historic floods included as Appendix 5 to the draft report.

The minister in charge of inland navigation agreed the draft preliminary flood risk assessment without comment.

16.2. INFORMATION EXCHANGE WITH NEIGHBOURING COUNTRIES

According to Art. 168 paragraph 7 of the Water Act and Art. 4 paragraph 3 of the Floods Directive, Member States shall ensure that the necessary information for the preliminary flood risk assessment is exchanged between the competent authorities concerned.

To ensure the exchange of information, the Ministry of Infrastructure provided information on the review and update of the PFRA in the 3rd planning cycle, separately to each neighbouring country, excluding countries with which cooperation is not carried out due to current geopolitical situation. The information was provided to Germany, the Czech Republic, Slovakia, Ukraine and Lithuania within the framework of bilateral commissions on transboundary waters.

Table 16 shows Poland's neighbouring countries in each river basin district, specifying the form of cooperation.

Table 16. Location of Poland's neighbouring countries in river basin districts

River basin district	Neighbouring country	Form of cooperation
Oder	Germany	International Commission for the Protection of the Oder River against Pollution
		Polish-German Transboundary Water Commission
	Czech Republic	International Commission for the Protection of the Oder River against Pollution
		Polish-Czech Transboundary Water Commission
Vistula	Ukraine	Polish-Ukrainian Transboundary Water Commission
	Slovakia	Polish-Slovak Transboundary Water Commission
	Belarus	-
Danube	Slovakia	Polish-Slovak Transboundary Water Commission
Dniester	Ukraine	Polish-Ukrainian Transboundary Water Commission
Elbe	Czech Republic	Polish-Czech Transboundary Water Commission
		International Commission for the Protection of the Elbe
Nemunas	Lithuania	Polish-Lithuanian Transboundary Water Commission
	Belarus	-

River basin district	Neighbouring country	Form of cooperation
Pregolya	Lithuania	Polish-Lithuanian Transboundary Water Commission
	Russia	-
Banowka	Russia	-
Swieza	Russia	-

The information prepared on the results of the review and update of the PFRAs for neighbouring countries included, inter alia: information on the PFRAs in the 1st and 2nd planning cycles, with an overview map showing the APSFRs and links to the relevant websites; and information on the results of the review and update of the preliminary flood risk assessment in 3rd planning cycle, with information on the identified floods on the boundary rivers between 2018 and 2024 and the new APSFRs designated in the 3rd planning cycle.

As part of the International Commission for the Protection of the Oder River against Pollution, the "Second update of the preliminary flood risk assessment for the International Odra River Basin District was developed. Third planning cycle 2022-2027". The preparation of this document by International Commission for the Protection of the Oder River against Pollution was preceded by the preparation of the Concept for the implementation of Directive 2007/60/EC on the assessment and management of flood risk (Floods Directive) in the International Odra River Basin District. Third cycle – from 2022 to 2027.

17. SUMMARY

As part of the review and update of the preliminary flood risk assessment for the 3rd planning cycle, all types of floods were analysed by source (Table 17).

Table 17: Analysed flood types by source in different river basin districts

No.	River Basin District	Fluvial floods	Pluvial floods	Groundwater floods	Seawater floods	Floods from damming structures
1	Oder	✓	✓	✓	✓	✓
2	Vistula	✓	✓	✓	✓	✓
3	Pregolya	✓	✓	✓	Not applicable	Not applicable
4	Nemunas	✓	✓	✓	Not applicable	Not applicable
5	Danube	✓	✓	✓	Not applicable	Not applicable
6	Elbe	✓	✓	✓	Not applicable	Not applicable
7	Dniester	✓	✓	✓	Not applicable	Not applicable
8	Banowka	✓	✓	✓	Not applicable	Not applicable

No.	River Basin District	Fluvial floods	Pluvial floods	Groundwater floods	Seawater floods	Floods from damming structures
9	Swieza	✓	✓	✓	Not applicable	Not applicable

A total of 1103 floods were identified as a result of the review and update of the PFRA in the 3rd planning cycle, including the verification and completion of historical flood data for all river basin districts, from which **304 significant historical floods** were identified based on the analysis and assessment of adverse flood consequences.

See Table 18 for information on the identification of significant historical floods, probable floods and areas of potential significant flood risk.

Table 18: Identified significant historical floods, probable floods and areas of potential significant flood risk in each river basin district

No.	River Basin District	Historical floods	Probable floods	APSFR
1	Oder	✓	✓	✓
2	Vistula	✓	✓	✓
3	Pregolya	✓	✓	✓
4	Nemunas	✓	✓	✓
5	Danube	✓	✓	✓
6	Elbe	✓	✓	✓
7	Dniester	✓	✓	Not applicable
8	Banowka	Not applicable	✓	Not applicable
9	Swieza	Not applicable	✓	Not applicable

As a result of the review and update of the preliminary flood risk assessment in the 3rd planning cycle, the following **significant flood types in Poland** were identified:

1) **Fluvial floods** (A11) – in two scenarios:
   - natural exceedance (A21),
   - damage to flood embankments (A23);
2) **floods** associated with flooding of land due to damage or destruction of **damming structures** (A15, A23);
3) **Seawater floods** (A14) – in two scenarios:

- natural exceedance (A21),
- destruction of flood or storm embankments (A23).

Areas of potential significant flood risk have been identified for the above types of floods and include:

1) for fluvial floods – a total of about 29,800 km of rivers, of which:
   - river sections identified in 1st and 2nd planning cycles – about 29,400 km,
   - river sections identified in the 3rd planning cycle – about 0.4 thousand km;
2) for floods from damming structures – 26 structures identified in cycle 2;
3) seawater floods, including internal marine waters – a total of about 1200 km of rivers and coastal sections.

For the river basin districts: Banowka, Swieza and Dniester, APSFRs have not been identified to the lack of significant flood risk.

For pluvial and groundwater floods, due to their specificity as described in Chapters 13 and 14, no areas of potential significant flood risk are designated.

See Table 19 for a summary of the number of areas of potential significant flood risk in each river basin district.

Table 20 shows the number of APSFRs in each river basin district distinguishing the type of flood by source and mechanism.

Table 19: Number of areas of potential significant flood risk by river basin district

No.	River Basin District	Fluvial floods		Floods from damming structures	Seawater floods	TOTAL
		Number of km	Number of APSFR	Number of APSFR	Number of APSFR	Number of APSFR
1	Oder	10,363.8	228	10	57	295
2	Vistula	18,704.0	588	16	61	665
3	Pregolya	455.5	8	-	-	8
4	Nemunas	209.6	2	-	-	2
5	Danube	26.2	1	-	-	1
6	Elbe	13.2	1	-	-	1
7	Dniester	-	-	-	-	-
8	Banowka	-	-	-	-	-
9	Swieza	-	-	-	-	-
Total		**29,772.3**	**828**	**26**	**118**	**972**

Table 20: Flood types for areas of potential significant flood risk in different river basin districts

No.	River Basin District	Source of flood	Flood mechanism	Number of APSFR
1	Oder	Fluvial flood	Natural exceedance	228
2		Fluvial flood	Defence or infrastructural failure	101
3		Seawater flood	Natural exceedance	57
4		Seawater flood	Defence or infrastructural failure	32
5		Flood from damming structures	Defence or infrastructural failure	10
6	Vistula	Fluvial flood	Natural exceedance	588
7		Fluvial flood	Defence or infrastructural failure	143
8		Seawater flood	Natural exceedance	61
9		Seawater flood	Defence or infrastructural failure	31
10		Flood from damming structures	Defence or infrastructural failure	16
11	Pregolya	Fluvial flood	Natural exceedance	8
12	Nemunas	Fluvial flood	Natural exceedance	2
13	Danube	Fluvial flood	Natural exceedance	1
14	Elbe	Fluvial flood	Natural flood	1

18. LIST OF ANNEXES

Annex 1: Methodology for review and update of the PFRA in the 3rd cycle including Annexes 1.1 and 1.2

3W-12 Zal1 Metodyka WORP v1.00

3W-12 Zal1.1 Struktura bazy danych WORP v1.00

3W-12 Zal1.2 Opis map WORP v1.00

Annex 2: Methodology for review and update of the seawater PFRA during the 3rd planning cycle [3W-12 Zal2 Metodyka WORPM v1.00].

Annex 3: List of areas of potential significant flood risk

[file: 3W-12 Zal3 Wykaz ONNP v1.00], containing:

3.1 APSFR for fluvial flood [Sheet: 3.1 ONNP rzeki].

3.2 APSFR for damming structures [Sheet: 3.2 ONNP zbiorniki].

3.3 APSFR from the sea [Sheet: 3.3 ONNP morze].

Annex 4: Summary of significant floods

[file: 3W-12 Zal4 Zestawienie powodzi v1.00], containing:

4.1 Significant historical fluvial floods [sheet: PHbc rzeki].

4.2 Probable fluvial floods [sheet: PPd rzeki].

4.3 Significant historical seawater floods [Sheet: PHbc morze].

4.4 Probable seawater floods [Sheet: PPd morze].

Annex 5: Maps of preliminary flood risk assessment

5.1 Maps of river basin districts showing the topography of the area:

5.1.1. Map of river basin districts in Poland showing topography of the area [3W-12 Zal5.1.1. TOPO PL v1.00].

5.1.2. Map of the Oder river basin district showing the topography of the area [3W-12 Zal5.1.2. TOPO OD OD v1.00].

5.1.3. Map of the Vistula river basin district showing the topography of the area [3W-12 Zal5.1.3. TOPO OD W v1.00]

5.1.4. Map of the Pregolya basin district showing the topography of the area [3W-12 Zal5.1.4. TOPO OD PR v1.00]

5.1.5. Map of the Nemunas river basin district showing the topography of the area [3W-12 Zal5.1.5. TOPO OD NI v1.00]

5.1.6. Map of the Dniester river basin district showing the topography of the area [3W-12 Zał5.1.6. TOPO OD DN v1.00]

5.1.7. Map of the Danube river basin district showing the topography of the area [3W-12 Zał5.1.7. TOPO OD DU v1.00]

5.1.8. Map of the Elbe river basin district showing the topography of the area [3W-12 Zał5.1.8. TOPO OD ŁA v1.00]

5.1.9. Map of the Banowka river basin district showing the topography of the area [3W-12 Zał5.1.9. TOPO OD BAN v1.00]

5.1.10. Map of the Swieza river basin district showing the topography of the area [3W-12 Zał5.1.10. TOPO OD ŚW v1.00].

5.2 Maps of river basin districts showing land use:

5.2.1. Map of river basin districts in Poland showing land use [3W-12 Zał5.2.1. UŻYTK PL v1.00].

5.2.2. Map of the Oder river basin district showing land use [3W-12 Zał5.2.2. UŻYTK OD OD v1.00].

5.2.3. Map of the Vistula river basin district showing land use [3W-12 Zał5.2.3. UŻYTK OD W v1.00].

5.2.4. Map of the Pregolya river basin district showing land use [3W-12 Zał5.2.4. UŻYTK OD PR v1.00]

5.2.5. Map of the Nemunas river basin district showing land use [3W-12 Zał5.2.5. UŻYTK OD NI v1.00]

5.2.6. Map of the Dniester river basin district showing land use [3W-12 Zał5.2.6. UŻYTK OD DN v1.00]

5.2.7. Map of the Danube river basin district showing land use [3W-12 Zał5.2.7. UŻYTK OD DU v1.00]

5.2.8. Map of the Elbe river basin district showing land use [3W-12 Zał5.2.8. UŻYTK OD ŁA v1.00]

5.2.9. Map of the Banowka river basin district showing land use [3W-12 Zał5.2.9. UŻYTK OD BAN v1.00]

5.2.10. Map of the Swieza river basin district showing land use [3W-12 Zał5.2.10. UŻYTK OD ŚW v1.00].

5.3 Maps of significant historical floods:

5.3.1 Maps of significant historical floods in river basin districts:

5.3.1.1 Map of significant historical floods – Poland
[3W-12 Zal5.3.1.1. PH PL v1.00].

5.3.1.2 Map of significant historical floods – Oder river basin district
[3W-12 Zal5.3.1.2. PH OD OD v1.00].

5.3.1.3 Map of significant historical floods – Vistula river basin district
[3W-12 Zal5.3.1.3. PH OD W v1.00]

5.3.1.4 Map of significant historical floods – Pregolya river basin district
[3W-12 Zal5.3.1.4. PH OD PR v1.00]

5.3.1.5 Map of significant historical floods – Nemunas river basin district
[3W-12 Zal5.3.1.5. PH OD NI v1.00].

5.3.1.6. Map of significant historical floods – Dniester river basin district
[3W-12 Zal5.3.1.6. PH OD DN v1.00].

5.3.1.7 Map of Significant Historical floods – Danube river basin district
[3W-12 Zal5.3.1.7. PH OD DU v1.00]

5.3.1.8 Map of significant historical floods – Elbe river basin district
[3W-12 Zal5.3.1.8. PH OD ŁA v1.00]

5.3.2 Map of significant historical floods in water regions:

5.3.2.1 Map of significant historical floods – Elbe river basin district, Metuje water region [3W-12 Zal5.3.2.1. PH RW M v1.00].

5.3.2.2 Map of significant historical floods – Dniester river basin district, Dniester water region [3W-12 Zal5.3.2.2. PH RW Dn v1.00].

5.3.2.3 Map of Significant Historical floods – Danube river basin district, Czarna Orawa water region [3W-12 Zal5.3.2.3. PH RW CO v1.00].

5.3.2.4 Map of significant historical floods – Nemunas river basin district, Nemunas water region [3W-12 Zal5.3.2.4. PH RW Ni v1.00].

5.3.2.5 Map of significant historical floods – Oder river basin district, Lower Oder and Pomerania water region
[3W-12 Zal5.3.2.5. PH RW DOiPZ v1.00].

5.3.2.6 Map of significant historical floods – Oder river basin district, Upper Oder water region [3W-12 Zal5.3.2.6. PH RW GO v1.00].

5.3.2.7 Map of significant historical floods – Oder river basin district, Notec water region [3W-12 Zal5.3.2.7. PH RW No v1.00].

5.3.2.8 Map of Significant Historical floods – Oder river basin district, Middle Oder water region [3W-12 Zal5.3.2.8. PH RW SO v1.00].

5.3.2.9 Map of significant historical floods – Oder river basin district, Warta water region [3W-12 Zał5.3.2.9. PH RW W v1.00].

5.3.2.10. Map of significant historical floods – Pregolya river basin district, Lyna and Wegorapa water region [3W-12 Zał5.3.2.10. PH RW ŁiW v1.00].

5.3.2.11. Map of significant historical floods – Vistula river basin district, Bug water region [3W-12 Zał5.3.2.11. PH RW Bu v1.00].

5.3.2.12. Map of significant historical floods – Vistula river basin district, Lower Vistula water region [3W-12 Zał5.3.2.12. PH RW DW v1.00].

5.3.2.13. Map of significant historical floods – Vistula river basin district, Upper East Vistula water region [3W-12 Zał5.3.2.13. PH RW G-WW v1.00].

5.3.2.14. Map of significant historical floods – Vistula river basin district, Upper West Vistula water region [3W-12 Zał5.3.2.14. PH RW G-ZW v1.00].

5.3.2.15. Map of significant historical floods – Vistula river basin district, Little Vistula water region [3W-12 Zał5.3.2.15. PH RW MW v1.00].

5.3.2.16. Map of significant historical floods – Vistula river basin district, Narew water region [3W-12 Zał5.3.2.16. PH RW Na v1.00].

5.3.2.17. Map of significant historical floods – Vistula river basin district, Middle Vistula water region [3W-12 Zał5.3.2.17. PH RW SW v1.00].

5.3.3 Map of significant historical floods in the voivodeships:

5.3.3.1 Map of significant historical floods – Dolnośląskie voivodeship [3W-12 Zał5.3.3.1. PH WOJ DŚ v1.00].

5.3.3.2 Map of significant historical floods – Kujawsko-Pomorskie voivodeship [3W-12 Zał5.3.3.2. PH WOJ KP v1.00]

5.3.3.3 Map of significant historical floods – Lubelskie voivodeship [3W-12 Zał5.3.3.3. PH WOJ LB v1.00]

5.3.3.4 Map of significant historical floods – Lubuskie voivodeship [3W-12 Zał5.3.3.4. PH WOJ LS v1.00]

5.3.3.5 Map of significant historical floods – Łódzkie voivodeship [3W-12 Zał5.3.3.5. PH WOJ ŁD v1.00]

5.3.3.6 Map of significant historical floods – Małopolskie voivodeship [3W-12 Zał5.3.3.6. PH WOJ MP v1.00]

5.3.3.7 Map of significant historical floods – Mazowieckie voivodeship [3W-12 Zał5.3.3.7. PH WOJ MZ v1.00

5.3.3.8 Map of significant historical floods – Opolskie voivodeship [3W-12 Zal5.3.3.8. PH WOJ OP v1.00]

5.3.3.9 Map of significant historical floods – Podkarpackie voivodeship [3W-12 Zal5.3.3.9. PH WOJ PK v1.00]

5.3.3.10 Map of significant historical floods – Podlaskie voivodeship [3W-12 Zal5.3.3.10. PH WOJ PL v1.00]

5.3.3.11 Map of significant historical floods – Pomorskie voivodeship [3W-12 Zal5.3.3.11. PH WOJ PM v1.00].

5.3.3.12 Map of significant historical floods – Śląskie voivodeship [3W-12 Zal5.3.3.12. PH WOJ ŚL v1.00]

5.3.3.13 Map of significant historical floods – Świętokrzyskie voivodeship [3W-12 Zal5.3.3.13. PH WOJ ŚK v1.00]

5.3.3.14 Map of significant historical floods – Warmińsko-Mazurskie voivodeship [3W-12 Zal5.3.3.14. PH WOJ WM v1.00].

5.3.3.15 Map of significant historical floods – Wielkopolskie voivodeship [3W-12 Zal5.3.3.15. PH WOJ WP v1.00]

5.3.3.16 Map of significant historical floods – Zachodniopomorskie voivodeship [3W-12 Zal5.3.3.16. PH WOJ ZP v1.00].

5.4 Maps of areas where flood is likely to occur:

5.4.1 Maps of areas where flood is likely to occur – river basin districts:

5.4.1.1 Map of areas where flood is likely to occur – Poland [3W-12EZal5.4.1.1. PP PL v1.00].

5.4.1.2 Map of areas where flood is likely to occur – Oder river basin district[3W-12 Zal5.4.1.2. PP OD OD v1.00].

5.4.1.3 Map of areas where flood is likely to occur – Vistula river basin district [3W-12 Zal5.4.1.3. PP OD W v1.00].

5.4.1.4 Map of areas where flood is likely to occur – Pregolya river basin district[3W-12 Zal5.4.1.4. PP OD PR v1.00].

5.4.1.5 Map of areas where flood is likely to occur – Nemunas river basin district[3W-12 Zal5.4.1.5. PP OD NI v1.00].

5.4.1.6 Map of areas where flood is likely to occur – Dniester river basin district [3W-12 Zal5.4.1.6 PP OD DN v1.00].

5.4.1.7 Map of areas where flood is likely to occur – Danube river basin district[3W-12 Zał5.4.1.7. PP OD DU v1.00].

5.4.1.8 Map of areas where flood is likely to occur – Elbe river basin district[3W-12 Zał5.4.1.8. PP OD ŁA v1.00].

5.4.1.9 Map of areas where flood is likely to occur – Banowka river basin district[3W-012 Zał5.4.1.9. PP OD BAN v1.00].

5.4.1.10 Map of areas where flood is likely to occur – Swieza river basin district[3W-12 Zał5.4.1.10. PP OD ŚW v1.00].

5.4.2 Maps of areas where flood is likely to occur – water regions:

5.4.2.1 Map of areas where flood is likely to occur – Elbe river basin district, Metuje water region
[3W-12 Zał5.4.2.1. PP RW M v1.00].

5.4.2.2 Map of areas where flood is likely to occur – Dniester river basin district, Dniester water region
[3W-12 Zał5.4.2.2 PP RW Dn v1.00].

5.4.2.3 Map of areas where flood is likely to occur – Danube river basin district, Czarna Orawa water region
[3W-12 Zał5.4.2.3. PP RW CO v1.00].

5.4.2.4 Map of areas where flood is likely to occur – Nemunas river basin district, Nemunas water region
[3W-12 Zał5.4.2.4. PP RW Ni v1.00].

5.4.2.5 Map of areas where flood is likely to occur – Oder river basin district, Lower Oder and Western Pomerania water region
[3W-12 Zał5.4.2.5. PP RW DOiPZ v1.00].

5.4.2.6 Map of areas where flood is likely to occur – Oder river basin district, Upper Oder water region
[3W-12 Zał5.4.2.6. PP RW GO v1.00].

5.4.2.7 Map of areas where flood is likely to occur – Odra river basin district, Notec water region
[3W-12 Zał5.4.2.7. PP RW No v1.00].

5.4.2.8 Map of areas where flood is likely to occur – Oder river basin district, Middle Oder water region
[3W-12 Zał5.4.2.8. PP RW SO v1.00].

5.4.2.9 Map of areas where flood is likely to occur – Oder river basin district, Warta water region

[3W-12 Zal5.4.2.9. PP RW W v1.00].

5.4.2.10 Map of areas where flood is likely to occur – Pregolya river basin district, Lyna and Wegorapa water region
[3W-12 M Zal5.4.2.10. PP RW ŁiW v1.00].

5.4.2.11 Map of areas where flood is likely to occur – Vistula river basin district, Bug water region
[3W-12Zal5.4.2.11. PP RW Bu v1.00].

5.4.2.12 Map of areas where flood is likely to occur – Vistula river basin district, Lower Vistula water region
[3W-12 Zal5.4.2.12. PP RW DW v1.00].

5.4.2.13 Map of areas where flood is likely to occur – Vistula river basin district, Upper Vistula water region
[3W-12 Zal5.4.2.13. PP RW G-WW v1.00].

5.4.2.14 Map of areas where flood is likely to occur – Vistula river basin district, Upper West Vistula water region
[3W-12 Zal5.4.2.14. PP RW G-ZW v1.00].

5.4.2.15 Map of areas where flood is likely to occur – Vistula river basin, Little Vistula water region
[3W-12 Zal5.4.2.15. PP RW MW v1.00].

5.4.2.16 Map of areas where flood is likely to occur – Vistula river basin district, Narew water region
[3W-12 Zal5.4.2.16. PP RW Na v1.00].

5.4.2.17 Map of areas where flood is likely to occur – Vistula river basin district, Middle Vistula water region
[3W-12 Zal5.4.2.17. PP RW SW v1.00].

5.4.2.18 Map of areas where flood is likely to occur – Banowka river basin district, Banowka water region
[3W-12 Zal5.4.2.18. PP RW Ban v1.00].

5.4.2.19 Map of areas where flood is likely to occur – Swieza river basin district, Swieza water region
[3W-12 Zal5.4.2.19. PP RW Św v1.00].

5.4.3 Maps of areas where flooding is likely to occur – voivodeships:

5.4.3.1 Map of areas where flood is likely to occur – Dolnośląskie voivodeship [3W-12 Zal5.4.3.1. PP WOJ DŚ v1.00].

5.4.3.2 Map of areas where flood is likely to occur – Kujawsko-Pomorskie voivodeship [3W-12 Zal5.4.3.2. PP WOJ KP v1.00].

5.4.3.3 Map of areas where flood is likely to occur – Lubelskie voivodeship [3W-12 Zal5.4.3.3. PP WOJ LB v1.00].

5.4.3.4 Map of areas where flood is likely to occur – Lubuskie voivodeship [3W-12 Zal5.4.3.4. PP WOJ LS v1.00].

5.4.3.5 Map of areas where flood is likely to occur – Łódzkie voivodeship [3W-12 Zal5.4.3.5. PP WOJ ŁD v1.00].

5.4.3.6 Map of areas where flood is likely to occur – Małopolskie voivodeship [3W-12 Zal5.4.3.6. PP WOJ MP v1.00].

5.4.3.7 Map of areas where flood is likely to occur – Mazowieckie voivodeship [3W-12 Zal5.4.3.7. PP WOJ MZ v1.00].

5.4.3.8 Map of areas where flood is likely to occur – Opolskie voivodeship [3W-12 Zal5.4.3.8. PP WOJ OP v1.00].

5.4.3.9 Map of areas where flood is likely to occur – Podkarpackie voivodeship [3W-12 Zal5.4.3.9. PP WOJ PK v1.00].

5.4.3.10 Map of areas where flood is likely to occur – Podlaskie voivodeship [3W-12 Zal5.4.3.10. PP WOJ PL v1.00].

5.4.3.11 Map of areas where flood is likely to occur – Pomorskie voivodeship [3W-12 Zal5.4.3.11. PP WOJ PM v1.00].

5.4.3.12 Map of areas where flood is likely to occur – Śląskie voivodeship [3W-12 Zal5.4.3.12. PP WOJ ŚL v1.00].

5.4.3.13 Map of areas where flood is likely to occur – Świętokrzyskie voivodeship [3W-12 Zal5.4.3.13. PP WOJ ŚW v1.00].

5.4.3.14 Map of areas where flood is likely to occur – Warmińsko-Mazurskie voivodeship [3W-12 Zal5.4.3.14. PP WOJ WM v1.00].

5.4.3.15 Map of areas where flood is likely to occur – Wielkopolskie voivodeship [3W-12 Zal5.4.3.15. PP WOJ WP v1.00].

5.4.3.16 Map of areas where flood is likely to occur – Zachodniopomorskie voivodeship [3W-12 Zal5.4.3.16. PP WOJ ZP v1.00].

5.5 Maps of areas of potential significant flood risk:

5.5.1 Maps of areas of potential significant flood risk – river basin districts:

5.5.1.1 Map of areas of potential significant fluvial flood risk

[3W-12 Zal5.5.1.1. ONNP PL R v1.00].

5.5.1.2 Map of areas of potential significant flood risk from damming structures [3W-12 Zal5.5.1.2. ONNP PL BP v1.00].

5.5.1.3 Map of areas of potential significant flood risk – Oder river basin district [3W-12 Zal5.5.1.3. ONNP OD OD v1.00].

5.5.1.4 Map of areas of potential significant flood risk – Vistula river basin district [3W-12 Zal5.5.1.4. ONNP OD W v1.00].

5.5.1.5 Map of areas of potential significant flood risk – Pregolya river basin district [3W-12 Zal5.5.1.5. ONNP OD PR v1.00].

5.5.1.6 Map of areas of potential significant flood risk – Nemunas river basin district [3W-12 Zal5.5.1.6. ONNP OD NI v1.00].

5.5.1.7 Map of areas of potential significant flood risk – Danube river basin district [3W-12 Zal5.5.1.7. ONNP OD DU v1.00].

5.5.1.8 Map of areas of potential significant flood risk – Elbe river basin district [3W-12 Zal5.5.1.8. ONNP OD ŁA v1.00].

5.5.2 Maps of areas of potential significant flood risk – water regions:

5.5.2.1 Map of areas of potential significant flood risk – Elbe river basin district, Metuje water region [3W-12 Zal5.5.2.1. ONNP RW M v1.00].

5.5.2.2 Map of areas of potential significant flood risk – Danube river basin district, Czarna Orawa water region [3W-12 Zal5.5.2.2. ONNP RW CO v1.00].

5.5.2.3 Map of areas of potential significant flood risk – Nemunas river basin district, Nemunas water region [3W-12 Zal5.5.2.3. ONNP RW Ni v1.00].

5.5.2.4 Map of areas of potential significant flood risk – Oder river basin district, Lower Oder and Pomerania water region [3W-12 Zal5.5.2.4. ONNP RW DOiPZ v1.00].

5.5.2.5 Map of areas of potential significant flood risk – Oder river basin district, Upper Oder water region [3W-12 Zal5.5.2.5. ONNP RW GO v1.00].

5.5.2.6 Map of areas of potential significant flood risk – Oder river basin district, Notec water region [3W-12 Zal5.5.2.6. ONNP RW No v1.00].

5.5.2.7 Map of areas of potential significant flood risk – Oder river basin district, Middle Oder water region [3W-12 Zal5.5.2.7. ONNP RW SO v1.00].

5.5.2.8 Map of areas of potential significant flood risk – Oder river basin district, Warta water region [3W-12 Zal5.5.2.8. ONNP RW W v1.00].

5.5.2.9 Map of areas of potential significant flood risk – Pregolya river basin district, Lyna and Wegorapa water region
[3W-12 Zal5.5.2.9. ONNP RW ŁiW v1.00].

5.5.2.10 Map of areas of potential significant flood risk – Vistula river basin district, Bug water region
[3W-12 Zal5.5.2.10. ONNP RW Bu v1.00].

5.5.2.11 Map of areas of potential significant flood risk – Vistula river basin district, Lower Vistula water region
[3W-12 Zal5.5.2.11. ONNP RW DW v1.00].

5.5.2.12 Map of areas of potential significant flood risk – Vistula river basin district, Upper Vistula water region
[3W-12 Zal5.5.2.12. ONNP RW G-WW v1.00].

5.5.2.13 Map of areas of potential significant flood risk – Vistula river basin district, Upper West Vistula water region
[3W-12 Zal5.5.2.13. ONNP RW G-ZW v1.00].

5.5.2.14 Map of areas of potential significant flood risk – Vistula river basin district, Little Vistula water region
[3W-12 Zal5.5.2.14. ONNP RW MW v1.00].

5.5.2.15 Map of areas of potential significant flood risk – Vistula River basin district, Narew water region
[3W-12 Zal5.5.2.15. ONNP RW Na v1.00].

5.5.2.16 Map of areas of potential significant flood risk – Vistula River basin district, Middle Vistula water region
[3W-12 Zal5.5.2.16. ONNP RW SW v1.00].

5.5.3. Maps of areas of potential significant flood risk– voivodeships:

5.5.3.1 Map of areas of potential significant flood risk – Dolnośląskie voivodeship
[3W-12 Zal5.5.3.1. ONNP WOJ DŚ v1.00].

5.5.3.2 Map of areas of potential significant flood risk – Kujawsko-Pomorskie voivodeship [3W-12 Zal5.5.3.2. ONNP WOJ KP v1.001.00].

5.5.3.3 Map of areas of potential significant flood risk – Lubelskie voivodeship [3W-12 Zal5.5.3.3. ONNP WOJ LB v1.00].

5.5.3.4 Map of areas of potential significant flood risk – Lubuskie voivodeship [3W-12 Zal5.5.3.4. ONNP WOJ LS v1.00].

5.5.3.5 Map of areas of potential significant flood risk – Łódzkie voivodeship [3W-12 Zal5.5.3.5. ONNP WOJ ŁD v1.00].

5.5.3.6 Map of areas of potential significant flood risk – Małopolskie voivodeship [3W-12 Zal5.5.3.6. ONNP WOJ MP v1.00].

5.5.3.7 Map of areas of potential significant flood risk – Mazowieckie voivodeship [3W-12 Zal5.5.3.7. ONNP WOJ MZ v1.00].

5.5.3.8 Map of areas of potential significant flood risk – Opolskie voivodeship [3W-12 Zal5.5.3.8. ONNP WOJ OP v1.00].

5.5.3.9 Map of areas of potential significant flood risk – Podkarpackie voivodeship [3W-12 Zal5.5.3.9. ONNP WOJ PK v1.00].

5.5.3.10 Map of areas of potential significant flood risk – Podlaskie voivodeship [3W-12 Zal5.5.3.10. ONNP WOJ PL v1.00].

5.5.3.11 Map of areas of potential significant flood risk – Pomorskie voivodeship [3W-12 Zal5.5.3.11. ONNP WOJ PM v1.00].

5.5.3.12 Map of areas of potential significant flood risk – Śląskie voivodeship [3W-12 Zal5.5.3.12. ONNP WOJ ŚL v1.00].

5.5.3.13 Map of areas of potential significant flood risk – Świętokrzyskie voivodeship [3W-12 Zal5.5.3.13. ONNP WOJ ŚW v1.00].

5.5.3.14 Map of areas of potential significant flood risk – Warmińsko-Mazurskie voivodeship [3W-12 Zal5.5.3.14. ONNP WOJ WM v1.00].

5.5.3.15 Map of areas of potential significant flood risk – Wielkopolskie voivodeship [3W-12 Zal5.5.3.15. ONNP WOJ WP v1.00].

5.5.3.16 Map of areas of potential significant flood risk – Zachodniopomorskie voivodeship [3W-12 Zal5.5.3.16. ONNP WOJ ZP v1.00].

5.6 Maps of seawater floods:

5.6.1. Map of significant historical seawater floods – Poland [3W-12 Zal5.6.1. PH PL M v1.00].

5.6.1.1.1 Map of significant historical seawater floods – Oder river basin district [3W-12 Zal5.6.1.1.1 PH OD OD M v1.00].

5.6.1.1.2 Map of significant historical seawater floods – Vistula river basin district [3W-12 Zal5.6.1.1.2. PH OD W M v1.00].

5.6.1.2.1 Map of significant historical seawater floods – Oder river basin district, Lower Oder and Western Pomerania water region [3W-12 Zal5.6.1.2.1. PH RW DOiPZ M v1.00].

5.6.1.2.2 Map of significant historical seawater floods – Vistula river basin district, Lower Vistula water region [3W-12 Zal5.6.1.2.2. PH RW DW M v1.00].

5.6.1.3.1 Map of significant historical seawater floods – Pomorskie voivodeship [3W-12 Zal5.6.1.3.1. PH WOJ PM M v1.00].

5.6.1.3.2 Map of significant historical seawater floods – Warmińsko-Mazurskie voivodeship [3W-12 Zal5.6.1.3.2. PH WOJ WM M v1.00].

5.6.1.3.3 Map of significant historical seawater floods – Zachodniopomorskie voivodeship [3W-12 Zal5.6.1.3.3. PH WOJ ZP M v1.00].

5.6.2 Map of areas where seawater flood is likely to occur – Poland [3W-12 Zal5.6.2. PP PL M v1.00].

5.6.2.1.1 Map of areas where seawater flood is likely to occur – Oder river basin district [3W-12 Zal5.6.2.1.1. PP OD M v1.00].

5.6.2.1.2 Map of areas where seawater flood is likely to occur – Vistula river basin district
[3W-12 Zal5.6.2.1.2. PP OD W M v1.00]

5.6.2.2.1 Map of areas where seawater flood is likely to occur – Oder river basin district, Lower Oder and Western Pomerania water region [3W-12 Zal5.6.2.2.1. PP RW DOiPZ M v1.00].

5.6.2.2.2 Map of areas where seawater flood is likely to occur – Vistula river basin district, Lower Vistula water region
[3W-12 Zal5.6.2.2.2. PP RW DW M v1.00].

5.6.2.3.1 Map of areas where seawater flood is likely to occur – Pomorskie voivodeship [3W-12 Zal5.6.2.3.1. PP WOJ PM M v1.00].

5.6.2.3.2 Map of areas where seawater flood is likely to occur – Warmińsko-Mazurskie voivodeship
[3W-12 Zal5.6.2.3.2. PP WOJ WM M v1.00]

5.6.2.3.3 Map of areas where seawater flood is likely to occur – Zachodniopomorskie voivodeship
[3W-12 Zal5.6.2.3.3. PP WOJ ZP M v1.00]

5.6.3 Map of areas of potential significant seawater flood risk – Poland [3W-12 Zal5.6.3. ONNP PL M v1.00].

5.6.3.1.1 Map of areas of potential significant seawater flood risk – Oder river basin district [3W-12 Zal5.6.3.1.1. ONNP OD M v1.00].

5.6.3.1.2 Map of areas of potential significant seawater flood risk – Vistula river basin district [3W-12 Zał5.6.3.1.2. ONNP OD W M v1.00].

5.6.3.2.1 Map of areas of potential significant seawater flood risk – Oder river basin, Lower Oder and Western Pomerania water region [3W-12 Zał5.6.3.2.1. ONNP RW DOiPZ M v1.00].

5.6.3.2.2 Map of areas of potential significant seawater flood risk – Vistula river basin district, Lower Vistula water region
[3W-12 Zał5.6.3.2.2. ONNP RW DW M v1.00].

5.6.3.3.1 Map of areas of potential significant seawater flood risk – Pomorskie voivodeship
[3W-12 Zał5.6.3.3.1. ONNP WOJ PM M v1.00].

5.6.3.3.2 Map of areas of potential significant seawater flood risk – Warmińsko-Mazurskie voivodeship
[3W-12 Zał5.6.3.3.2. ONNP WOJ WM M v1.00]

5.6.3.3.3 Map of areas of potential significant seawater flood risk – Zachodniopomorskie voivodeship
[3W-12 Zał5.6.3.3.3. ONNP WOJ ZP M v1.000]

Annex 6: Report on the review and update of the preliminary seawater flood risk assessment, including internal sea waters [3W-12 Zał6 Raport WORPM v1.00].

Annex 7: Flood in September 2024 [3W-12 Zał7 Raport Powódź we wrześniu 2024 v1.00].

19. LIST OF FIGURES

20. LIST OF TABLES

21. BIBLIOGRAPHY

Biuletyn Państwowej Służby Hydrologiczno-Meteorologicznej, Warszawa III 2023 – IV 2017, IMGW-PIB.

Commission Staff Working Document European Overview 2nd Preliminary Flood Risk Assessments accompanying the document Report from the Commission to the European Parliament and the Council on the implementation of the Water Framework Directive (2000/60/EC), the Environmental Quality Standards Directive (2008/105/EC amended by Directive 2013/39/EU) and the Floods Directive (2007/60/EC), Implementation of planned Programmes of Measures, New Priority Substances, Preliminary Flood Risk Assessments and Areas of Potential Significant Flood Risk, COM(2021) 970 final, SWD(2021) 970 final, SWD(2021) 971 final, 15.12.2021.

Directive 2007/60/EC of the European Parliament and of the Council of 23 October, 2007 on the assessment and management of flood risks, OJ L 288/27 6.11.2007.

European Commission, 2013, Guidance for Reporting under the Floods Directive (2007/60/EC), Guidance Document No. 29 A compilation of reporting sheets adopted by Water Directors Common Implementation Strategy for the Water Framework Directive (2000/60/EC), Technical Report-2013-071.

European Commission, JRC, 2015, JRC Science for Policy Report, The benefit of continental flood early warning systems to reduce the impact of flood disasters, An assessment for Europe and an outlook for Africa, JRC97266, 2015.

European Commission, 2021, Assessment of Second Cycle Preliminary Flood Risk Assessments and Identification of Areas of Potential Significant Flood Risk under the Floods Directive Member State: Poland.

Floods Directive Reporting Guidance, 2018, Version no: v.5.0, 08.03.2021.

Methodology for the development of flood hazard maps and flood risk maps in the 2nd planning cycle, 2020.

Nguyen D. T., 2023, Risk-Based Planning and Optimization of Flood Management Measures in Vietnam – A Case Study in the Phan-Calo River Basin, Journal of Ecological Engineering 2023, 24(5).

Report on the review and update of the preliminary flood risk assessment, 2018.

Thematic dictionary of terms used in hydrological forecasting, IMGW-PIB, 2014.

Ordinance of the Minister of Maritime Economy and Inland Navigation of 4 October, 2018 on the development of flood hazard maps and flood risk maps, Dz.U. (Journal of Laws), 2018, item 2031.

Regulation of the Minister of the Environment of 20 April, 2007 on technical conditions to be met by hydrotechnical structures and their location, Dz. U. (Journal of Laws) No. 86, item 579.

Sowiński M. 2008, Szkody powodziowe jako element wyznaczania ryzyka, Infrastruktura i Ekologia Terenów Wiejskich, Nr 7/2008

Act of 20 July, 2017. Water Law, Dz.U. (Journal of Laws) 2024, item 1087 as amended.

Updated methodology for flood risk management plans, 2022.