Państwowe Gospodarstwo Wodne Wody Polskie

Stop Powodzi

Project: Review and update of flood risk management plans
Project number: POIS.02.01.00-00-0001/19

aFRMP_Last version of the FRMP methodology 20211031 v.3.00

UPDATED METHODOLOGY OF THE aFRMP

Contract no SWMB/KPP/2020/047

CONDUCTING A REVIEW AND DRAWING UP OF UPDATED FLOOD RISK MANAGEMENT PLANS (FRMP) AND CONDUCTING INFORMATION AND PROMOTION ACTIONS OF THE PROJECT
TASK 1.1 VERIFICATION AND UPDATE OF THE METHODOLOGY FOR DEVELOPING FRMP

Subtask 1.1.1. Verification and update of the "Methodology for the development of flood risk management plans for river basins and water regions in version 4.0" used in the 1st planning cycle (Appendix 1 to SOPZ), hereinafter referred to as "Methodology of the 1st FRMP"

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History of changes:

Version	Date	Author	Scope of changes
0.01	2020-04-14	Arcadis, Sweco Consulting, DHI Polska	The first version of the FRMP Methodology Update for consultation with the Ordering Party
0.02	2020-04-30	Arcadis, Sweco Consulting, DHI Polska	A version of the FRMP Methodology Update after the Ordering Party's comments
0.03	2020-05-06	Arcadis, Sweco Consulting, DHI Polska	A version of the FRMP Methodology Update after the Ordering Party's comments
1.00	2020-05-11	Arcadis, Sweco Consulting, DHI Polska	A version of the FRMP Methodology Update submitted for acceptance
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1.INTRODUCTION

This study is a methodology for developing updates of flood risk management plans (aFRMP) in the second planning cycle of the implementation of the Floods Directive in Poland and Europe. The updated FRMP methodology is a product of subtask 1.1 Verification and update of the FRMP methodology.

The study was developed by the State Water Holding Polish Waters (SWHPW) as a modification of the study entitled "Methodology for the development of flood risk management plans for river basins and water regions v4.00", briefly adopted as the 1st FRMP Methodology "(12.2015), developed and adopted under the 1st planning cycle.

Some issues have only been updated to include their current legal status, in particular the structure of water management in the country following the reform of the Water Law of 20 July 2017 (the Official Journal of Laws 2021, item 2233, as further amended, hereinafter referred to as the Water Law) and requirements defined at the stage of description of the subject of the project procurement. In the Methodology, there also appeared new issues related to the introduction, as part of the update, of the impact assessment of implementation of the first FRMP in the country and the extensive stakeholder survey carried out under this task.

However, it should be emphasized that the Methodology is in line with the approach implemented in the first planning cycle, especially in the light of the positive assessment of FRMP by the European Commission. More attention was paid to elements which, according to the European Commission, were insufficiently exposed in the first cycle, e.g. prioritization of actions.

Tasks 1 and 2 will be implemented under the Project "Review and update of flood risk management plans", project no: POIS.02.01.00-00-0001/19, financed by the Operational Programmeme Infrastructure and Environment, Priority axis II: Environmental protection in including adaptation to climate change, Measure 2.1 Adaptation to climate change along with protection and increasing resistance to natural disasters, in particular natural disasters and environmental monitoring. The scope of the contract includes the following Tasks included in the Project:

TASK 1 Review and update of flood risk management plans.

TASK 2 Information and promotion actions, including an information campaign, including public consultations on draft updates of flood risk management plans for river basin areas.

TASK 3 Development of environmental impact forecasts and carrying out SEA.

TASK 4 Managing the aFRMP project.

TASK 5 Purchase of specialized software.

Realisation of Tasks 1 and 2 will be conducted in cooperation and coordination with the Contractors of the other Tasks implemented under the Project. Cooperation will also be carried out with contractors of other projects, including updating flood hazard maps (FHM) and flood risk maps (FRM), 2nd aWMP, aFRMP from the sea, including internal sea water

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as well as and "Implementation of instruments supporting the implementation of FRMP actions".

2.ASSUMPTIONS AND OBJECTIVES OF THE METHODOLOGY

2.1. FLOOD RISK MANAGEMENT – BASIC IDEAS

In the last few decades, it has appeared that the prevailing flood protection system used, consisting in the construction of technical security actions, is not effective to the extent resulting from financial outlays. The more investments were made in technical systems, the more the losses of successive floods increased. This was caused by intensive development of protected areas by technical systems. Therefore, it was necessary to break the spiral of ever increasing investment costs and losses. The approach to flood protection has been changed, thus replacing the traditional strategy focusing on technical protection actions aimed at reducing the extent of flood risk areas with a strategy aimed at reducing the negative effects of floods. This change is related to acceptance of the irremovable risk of flooding and the need to reconcile the need for safety with the needs for development. This results in a slightly different approach to the problem of limiting the effects of floods, emphasizing not only protective actions and limiting development in areas at risk, but also, to a greater extent than before, the role of preparing people and objects at risk for a flood.

This new approach was formulated in Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks, the so-called Floods Directive (FD). The directive also introduced the concept of "flood risk", which in many countries around the world forms the basis for actions limiting effects and losses of floods.

The above-mentioned Directive and, as a consequence of the transposition of its provisions into the Polish law, also the Water Law (defines the flood risk (Article 16(48)), as a combination of the probability of a flood occurrence and potential negative consequences for human life and health, the environment related to the flood, of cultural heritage and economic action. The above-mentioned negative effects of floods depend on: the extent of the flood (level of risk), state of development of the area at risk (exposure), vulnerability of development elements to the threat and the ability of local communities to counteract the threat and eliminate consequences of a disaster (the latter elements characterize Flood Vulnerability) We can therefore define flood risk as a function of flood hazard, exposure and vulnerability.

Each of the elements of flood risk can be reduced using appropriate methods, sometimes called flood mitigation strategies, therefore:

The risk can be mitigated by actions increasing retention, both natural and artificial (retention reservoirs) and structures limiting the extent of floods, i.e. embankments and relief channels, and for smaller floods, river channel regulations. That is, mainly by means of technical flood protection facilities as well as increasing and protecting natural retention. This strategy is called "keep the flood away from humans."

The exposure may be reduced by applying actions limiting the development of floodplains, mainly through regulations prohibiting or limiting development (setting special building

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and construction conditions for facilities) and possibly by purchasing and decommissioning facilities most at risk (moving them to a safe place). This strategy is called "keep humans away from the flood."

Vulnerability can be reduced by using various different methods of action: from flood insurance, preparation of buildings for floods, through effective systems of early warning and response to floods, to dissemination of knowledge and education within the scope of flood prevention and management. This strategy is called "learn to live with the flood."

The combination of the above strategy into a harmonious whole, adapted to the specificity of the area in question, is the essence of flood risk management.

2.2. METHODOLOGY OBJECTIVES

The purpose of the methodology is to develop a procedure and prepare basic tools for the development of flood risk management plans. The purpose of the methodology is also to ensure a uniform approach on a national scale to the development of flood risk management plans, and in particular to adopt uniform objectives (main and specific) and preferred methods of achieving these objectives (i.e. actions) for all planning levels.

The departure from sectoral planning towards integrated planning requires coordinating the actions of various institutions and covering all aspects (phases) of flood risk management, from prevention through preparation, responding to floods, to eliminating the effects of floods and drawing conclusions. This raises the need to define the scope of actions that should be the subject of planning and to establish the rules for the participation in the planning process of autonomous units responsible for specific aspects of flood risk management and the society.

This methodology meets these needs by:

- providing catalogue of flood risk management objectives and catalogue of types of actions to meet them, showing possible directions and ways to improve the current flood protection system, which should be taken into account when developing plans,
- defining the course of the planning process, including: the sequence of actions taking into account the relationship between the levels of management - river basin, water region, planning catchment, procedures for setting plan objectives and developing options for solutions, their evaluation and selection of the final solution, with the planned participation of local stakeholders,
- defining the scope and mode of public consultations and informing the public about the process of developing plans and its results, with particular emphasis on the defined target groups of reaching out.

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3.THE BASICS OF THE PLANNING PROCESS

3.1. LEGAL BASICS

In order for flood risk management plans to be implemented, a lot of data and preliminary information must be prepared. Pursuant to the Floods Directive and the Water Law, flood risk management plans must be preceded by the development of:

- Preliminary flood risk assessment (PFRA), the task of which is to identify areas at risk of flooding, for which flood hazard maps and flood risk maps will be developed first
- Flood risk maps (FHM), showing the ranges of areas where the probability of flooding is low and amounts to p=0.2% or where there is a probability of an extreme event, areas of high flood risk and areas including areas exposed to flooding in the event of damage or destruction of a flood protection embankment, anti-storm embankment or a damming structure,
- Flood risk maps (FRM), showing the potential negative effects of a flood in the areas shown on the flood risk maps.

A similar procedure applies to the review and update of the above-mentioned documents.

The legal basis for flood risk management plans, including their review and update, is formed by:

- Act of 20 July 2017 Water Law (the Official Journal of Laws of 2021, item 2233as further amended),
- Directive 2007/60/C of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks (Floods Directive),
- Regulation of the Minister of Maritime Economy and Inland Navigation of 04 October 2018 on the development of flood hazard maps and flood risk maps (the Official Journal of Laws of 2018, item 2031).

Other relevant legal acts for the process of preparing, reviewing and updating FRMP are:

- Act of 03 October 2008 on the provision of information on the environment and its protection, public participation in environmental protection and on environmental impact assessments (the Official Journal of Laws of 2021, item 247, as further amended),
- Directive 2009/147/EC of 30 November 2009 on the conservation of wild birds,
- Directive 92/43/EEC on the protection of natural habitats and wild fauna and flora,
- Act on the infrastructure for spatial information of 04 March 2010 (the Official Journal of Laws of 2020, item 177, as further amended),

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- Directive 2007/2 / EC of the European Parliament and of the Council of 14 March 2007 establishing an infrastructure for spatial information in the European Community (INSPIRE Directive).

This Methodology also takes into account a number of other documents or draft documents, such as the preceding Flood Directive document entitled: *Good practices in the scope of prevention, protection and mitigation of the effects of floods. A complete list of documents can be found in the literature list.*

3.2. REQUIRED CHARACTERISTICS OF PLANS

For the purpose of drawing up the methodology, assumptions were made based on the applicable national and European regulations (the Water Law, the Flood Directive, and related documents). Their formulation was also based on the experiences of other countries as well as previous national diagnoses and experiences.

The Water Law currently in force contains provisions which allow for generalization of several strategic assumptions.

1. The purpose of flood risk management is to reduce the potential negative effects of floods on human life and health, the environment, cultural heritage, and economic action.

> *Whenever the Act mentions: (...) 4) the objectives of flood risk management - it is understood as limiting the potential negative effects of floods on human life and health, the environment, cultural heritage, and economic action (the Water Law, Art. 16)*

2. Flood risk management plans will be drawn up with regard to the division into river basin areas and water regions, taking into account the areas at risk of flooding, designated in the preliminary flood risk assessment, based on the flood hazard and flood risk maps developed for these areas.

1. *For river basin areas, (...) preliminary flood risk assessment is drawn up (the Water Law, Article 167(1)).*
2. *Preliminary flood risk assessment includes in particular: (…) 5) identification of the areas at risk of flooding (the Water Law, Art. 167(2)).*
3. *Flood risk maps shall be developed for the areas exposed to the risk of flooding indicated in the preliminary flood risk assessment. (Water Law, Art. 169(1)).*
4. *For the areas referred to in Art. 169(2), flood risk maps are drawn up. (Water Law, Art. 170(1)).*
5. *On the basis of flood hazard maps and flood risk maps, flood risk management plans are developed, taking into account the division of the country into river basin areas and water regions (the Water Law, Article 172(1)).*

3. Actions to achieve the main objectives of flood risk management include, among others, limiting the risk (flood range), shaping the development of endangered areas as well as preparing for floods.

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Protection against floods is carried out in particular by: 1) shaping the spatial development of river valleys or floodplains, in particular areas of high flood risk, 2) rational water retention and use of flood protection structures, as well as water flow control, 3) dangerous phenomena occurring in the atmosphere and hydrosphere and flood forecasting, 4) preservation, creation, and restoration of water retention systems, 5) construction, reconstruction, and maintenance of flood protection structures, 6) icebreaking operations, 7) information policy within the scope of flood protection and its effects. (Water Law, Art. 165(1)).

4. Flood risk management plans should take into account the long-term perspective and uncertainty about the future related to climate change and changes in the management of flood risk areas.

The update of the flood risk management plans concerns the elements referred to in Art. 172(3), and includes in particular (…) 5) possible impact of climate change on the occurrence of floods. (the Water Law, Article 173(2)1).

5. Flood risk management takes into account the requirements of the Water Framework Directive (WFD) and water management plans for river basin areas in order to ensure the fulfillment of environmental objectives at all stages of flood management and to obtain synergistic effects in the implementation of both directives.

1. When determining actions aimed at achieving the objectives of flood risk management, the following shall be taken into account in particular: (...) 56, art. 57, art. 59 and in art. 61 (the Water Law, Art. 172(5)).

2. The development of flood risk management plans and the drought counteracting plan and their reviews are carried out in a manner coordinated with the reviews of the river basin management plans (the Water Law, Art. 326(4)).

3. Planning should take into account the cost-benefit analysis of the planned actions.

When determining the actions aimed at achieving the objectives of flood risk management, the following shall be taken into account in particular: 1) costs and benefits of actions undertaken to achieve the objectives of flood risk management (...), (the Water Law, Article 172(5)).

6. Flood risk management plans should cover all aspects of crisis management, i.e. prevention, protection, preparation, response and reconstruction phases, and the use of experience.

(…) Flood risk management plans cover all aspects of flood risk management, with particular emphasis on prevention, protection and condition, including flood forecasting and early warning systems, and taking into account the characteristics of the river basin area or sub-basin area. (Directive of the European Parliament and of the Council on the assessment and management of flood risks (2007/60/EC), Chapter IV, Art. 7(3)).

7. The principle of solidarity should be taken into account when selecting actions to reduce flood risk.

The principle of solidarity is of great importance in the context of flood risk management. In this light, Member States should be encouraged to move towards

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an equitable sharing of responsibilities in a situation of jointly deciding on actions that benefit all parties and relate to flood risk management along the entire river course. (preamble point 15 to the Directive of the European Parliament and of the Council on the assessment and management of flood risks (2007/60/EC)).

8. In order to achieve the objectives of the Floods Directive, inter-ministerial and inter-institutional cooperation is essential. Flood risk management plans must be developed in agreement between various institutions responsible for individual areas of action (water management, spatial planning, human safety - crisis response, cultural heritage, protected areas, etc.). Moreover, it is important to ensure that the objectives of flood risk management plans are included in other plans, e.g. within the scope of spatial planning, crisis management.

1. *In order to ensure protection of the population and property against floods: 1) areas of particular flood risk are included in the national spatial development concept, provincial spatial development plan, provincial development strategy, framework study of the conditions and directions of spatial development of a commune, the revitalization programme, the decision to determine the location of a public purpose investment and in the decision on development conditions, 2) the level of flood risk resulting from the designation of areas of high risk of flooding is taken into account in decisions on the location of a public purpose investment and decisions on development conditions for real estate in whole in some of them located in these areas (the Water Law, Art. 166(1)).*
2. *A.6. There is a need for interdisciplinary cooperation of all governmental and local institutions to coordinate sectoral policies regarding environmental protection, facility planning, spatial planning, agriculture, transport and construction development, and to coordinate all phases of risk management: risk assessment, planning mitigation actions and implementation of these actions. B.2. In order to implement the basic principles and methods of operation, it is necessary to cooperate at all levels of government and to coordinate cross-sectoral policies within the scope of prevention, spatial planning, agriculture, transport and construction development. (Best Practices on Flood Prevention, Protection and Mitigation, Water Directors meeting, Athens, 2003).*

9. The condition for effectiveness of actions is the inclusion of stakeholders in the planning process (primarily in the processes of formulating objectives and priorities and defining/accepting solutions).

G.7. (a) Public participation in making decisions on preparation and protection is essential, both to improve the quality of implementation of decisions and to enable communities to express their concerns and enable authorities to take them into account. b) All information and awareness-raising actions are most effective when they involve participation at all levels: from local to national to regional or international. (Best Practices on Flood Prevention, Protection and Mitigation, Water Directors meeting, Athens, 2003).

10. When developing flood risk management plans, avoid unjustified constraints on the national, regional and local economy and social development.

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The suggestion of finding a compromise between the needs of ensuring the safety and development of communities at risk of flooding was formulated on the basis of literature analyzes. It can be found, for example, in Irish planning guides or documents conducted under the aegis of the World Meteorological Organization Associated Programmeme on Flood Management.

3.3. CURRENT INSTITUTIONAL STRUCTURE OF THE FLOOD PROTECTION IN POLAND

A number of state and local government administration institutions at various management levels are involved in flood protection in Poland. The Water Law stipulates that flood protection is the task of the Polish Waters as well as of government and local administration bodies. At the same time, when talking about protection of people and property against flood, it emphasizes, amongst others, the role of spatial development, protection, and restoration of natural and artificial water retention or flood warning systems.

Protection against flooding lies within the competence of numerous institutions, and the scope of responsibility thereof is regulated by a number of legal acts, the most important of which is the Water Law mentioned above, the Act of 26 April 2007 on the crisis management (the Official Journal of Laws 2020, item 1856), the Act of 23 January 2009 on the governor and government administration in the province (the Official Journal of Laws 2019, item 1464), the Act of 05 June 1998 on provincial, district, and municipal self-government (the Official Journal of Laws 2020, item 1668), or the Act of 21 March 1991 on the sea territory of the Republic of Poland and maritime administration (the Official Journal of Laws 2020, item 2135). The role of the main institutions involved in flood protection in the country is described below (legal status as of November 2021).

Council of Ministers

Pursuant to Art. 7 of the Act of 26 April 2007 on the crisis management (the Official Journal of Laws 2020, item 1856), the Council of Ministers performs crisis management in the territory of the Republic of Poland. In urgent cases, crisis management is performed by the minister responsible for internal affairs, who immediately notifies the Prime Minister of actions thereof. Decisions made by the minister are subject to consideration at the consecutive meeting of the Council of Ministers. The Government Centre for Security is under the authority of the Prime Minister.

Minister responsible for water management

Exercises control over the actions of the President of the State Water Holding Polish Waters. Within the scope of flood protection planning, the Minister implements the tasks specified below. The Minister approves, publishes, and makes available to the European Commission the preliminary flood risk assessment and reviews thereof. The Minister's competences also include approval of draft flood hazard maps and flood risk maps. Next, such are transferred in electronic form to the Chief National Surveyor, the competent authority of the

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Environmental Protection Inspection, the director of the Government Centre for Security, Polish Waters, the Commander-in-Chief of the State Fire Service, competent governors, competent province marshals, competent district governors, competent commune heads, mayors or presidents of cities, province and district (municipal) commanders of the State Fire Service, competent directors of inland navigation offices and competent directors of maritime offices, competent railway infrastructure administrators and competent public road administrators. The Minister publishes flood hazard maps and flood risk maps by posting them on the website of the Ministry's Public Information Bulletin. In addition, the Minister responsible for water management, ensuring active participation of all parties interested in achieving objectives of flood risk management, in particular in the development, review, and update of flood risk management plans, makes public, on the terms and in the manner specified in the provisions of the Act of 03 October 2008 on the provision of information on the environment and its protection, public participation in environmental protection and environmental impact assessments, so as to enable submitting comments, draft flood risk management plans at least one year prior to the beginning of the period to which such plans relate. By way of a regulation, the Minister adopts flood risk management plans and updates thereof, taking into account the need to ensure effective flood protection. The Minister makes the flood risk management plans available to the European Commission.

Minister responsible for maritime economy

It is the supreme maritime administration body to which the directors of maritime offices are subordinate as local maritime administration authorities, in accordance with the Act of 21 March 1991 on the maritime areas of the Republic of Poland and maritime administration (the Official Journal of Laws 2019, item 2169, uniform text). According to Art. 173(2) of the Water Law, the minister responsible for maritime economy draws up draft flood risk management plans from the sea, including internal sea water, and submits them to Polish Waters no later than 15 months prior to the date of development of flood risk management plans. Draft flood risk management plans from the sea, including inland sea water, form an integral part of draft flood risk management plans[1]. With regard to draft plans of flood risk management from the sea, including internal sea water, the minister responsible for water management agrees the manner and scope of taking into account the comments with the minister responsible for maritime economy.

Minister responsible for internal affairs

Responsible for crisis management. In urgent cases, the minister exercises crisis management. Supervises the Chief of the National Civil Defense, the Commander-in-Chief

1 Due to the parallelly run project entitled "Review and update of flood risk management plans from the sea, including internal sea water", the minister responsible for maritime economy made available for the purposes of draft flood risk management plans types of actions and action type cards related to flood risk management from the sea, as well as a list of actions planned to be implemented under the aFRMP to reduce the risk from the sea These materials are an integral part of the draft flood risk management plans for the Oder and Vistula river basins.

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of the State Fire Service, the Commander-in-Chief of the Police and the Commander-in-Chief of the Border Guard. Deals with ongoing assessment of threats occurring in the country, including flood hazards. Runs cases of removing effects of natural disasters, including collating information on flood losses.

President of the Polish Waters

This is the central authority in matters of water management, supervised by the minister responsible for water management. According to Art. 163(2) of the Water Law, Polish Waters provides, within the scope of jurisdiction thereof, protection of the population and property against floods caused by public waters owned by the State Treasury, referred to in Art. 212(1)(1) and (3) of the Act. Polish Waters develops the following documents coordinated in the area of cross-border river basins: preliminary flood risk assessment (PFRA), flood hazard maps, flood risk maps and flood risk management plans for river basin areas, as well as periodic reviews and updates of the above-mentioned documents. It also supervises planning and implementation of tasks related to maintenance of waters and other property of the State Treasury related to water management, including levees and the inter-levee area, with the exception of inland waterways of particular transport importance. In addition, Polish Waters carries out defense tasks and tasks within the scope of crisis management delegated by the minister responsible for water management. The President of Polish Waters performs the function of the 2nd degree authority in administrative proceedings pursuant to the Polish Code of Administrative Procedure, including those related to planning in flood risk areas.

Within the framework of the Polish Water Holding Polish Waters there operate: the National Water Management Board, regional water management boards, catchment boards, and water supervision.

Director of the maritime office

Responsible for securing sea shores and protection against onshore floods, in accordance with the Act of 21 March 1991 on the sea areas of the Republic of Poland and maritime administration (the Official Journal of Laws 2020, item 2135), including construction and maintenance of onshore fortifications within the technical belt, supervision over the provision of flood protection from the sea waters, including through the construction, extension, and maintenance of hydrotechnical structures and bank reinforcements in the technical belt, and determining conditions for use of the technical belt (e.g. issuing permits for using the technical belt for purposes other than protection and exemptions from the building prohibition, as well as agreeing on building permits issued by the province governor). In addition, the Director develops onshore flood hazard maps and onshore flood risk maps, including internal sea waters, and hands them over to the Polish Waters.

Province governor

Responsible for actions within the scope of crisis management immediately prior to, during the flood and in the recovery phase, including assessing the state of flood protection in the

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province and announcing and cancelling the emergency and flood alert, also ensures cooperation of all government and and self-government administration bodies operating in the province and manages their actions, among others, within the scope of preventing threats to life, health or property, threats to the environment and prevention of natural disasters. Pursuant to the Act of 23 January 2009 on the governor and government administration in the province (the Official Journal of Laws 2019, item 1464), within the scope of flood protection planning, the governor assesses draft flood risk assessment projects, agrees draft flood hazard maps and flood risk maps and agrees draft flood risk management plans developed by the State Water Holding Polish Waters. The governor also agrees on the programmeme of implementation of tasks related to maintenance of water and other property of the State Treasury related to water management and planned investments in water management. Takes into account the areas of particular flood hazard in decisions on the location of railway lines.

The province marshal

Within the scope of flood protection planning, the province marshal assesses the preliminary flood risk assessment and assesses draft flood risk management plans. Includes in the province's spatial development plan and the province development strategy, the provisions of flood risk management plans and areas of particular flood risk presented on the flood hazard maps and on the flood risk maps.

The district governor

The district governor is responsible for implementation of tasks within the scope of civil planning, including within the scope of implementation of recommendations made to district crisis management plans as well as for managing the monitoring, planning, responding and removing the effects of threats in the district in accordance with the Act of 26 April 2007 on the crisis management (the Official Journal of Laws of 2020, item 1856). The district governor draws up an operational flood protection plan and announces or cancels the flood watch and flood alert in the district or part thereof.

The commune head, mayor

Responsible for development of crisis management plans and operational plans for flood protection as well as for actions within the scope of crisis management immediately prior, during a flood and in the recovery phase. Develops an operational flood protection plan and announces or cancels emergency and flood alert for the commune or town area, or a part thereof. Responsible for taking into account the areas of particular flood hazard in the local spatial development plan, decisions on establishing the location of public purpose investments or decisions on building conditions, as well as municipal revitalization programmemes. In the study of the conditions and directions of spatial development of the commune, the commune head takes into account the provisions of flood risk management plans and areas of particular flood hazard.

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State Hydrological and Meteorological Service (SHMS)

The list of institutional structures is supplemented by the State Hydrological and Meteorological Service. In accordance with Art. 370 of the Water Law, the role is performed by the Institute of Meteorology and Water Management - National Research Institute. The task of the State Hydrological and Meteorological Service is to conduct meteorological and hydrological observations, to develop meteorological and hydrological forecasts, and to warn against extraordinary hydrological and meteorological hazards.

The above-mentioned institutions do not exhaust the list of units involved in flood risk management. An important role is also played by sanitary, medical and uniform services, aid organizations, as well as individuals and entrepreneurs at risk, who are responsible for actions related to flood protection of facilities owned thereby, as well as preparation and response to floods.

3.4. ASSUMPTIONS FOR THE PLANNING PROCESS

Pursuant to the Water Law, flood risk management plans in Poland are developed taking into account division of the country into river basin areas and water regions. The State Water Holding Polish Waters is responsible for their preparation, periodic review and updating. In addition, plans are being made to manage flood risks from the sea, including internal sea water. The Ministry of Maritime Economy and Inland Navigation is responsible for their preparation, periodic review and updating. At the same time, the actions suggested by the law, or rather groups of actions that these plans should contain, lie within the competences of various independent units/institutions. These two features mean that it is necessary to adopt a parametric, and not a directive, impact on units whose competences include reduction of flood risk at various levels.

The methodology adopts several assumptions which define the features of a parametric planning system in flood risk management:

- The basis for influencing independent partners will be instruments (legal, financial and information) encouraging independent entities to implement actions consistent with the adopted objectives.
- All partners who have an impact on the implementation of flood mitigation methods or can support this process will be involved in the decision-making process.

Next to the above-mentioned indirect impacts, it is assumed that restrictions will be imposed to ensure that the planning process takes into account the broadest possible range of actions, covering all aspects of flood risk management. This is done through:

- defining the main objectives and the specific objectives assigned to them applicable to all river basin areas and all water regions,
- assigning to each specific objective appropriate actions that will be selected for planning variants.

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4.THE PLANNING PROCESS MANAGEMENT

4.1. GENERAL ASSUMPTIONS

The following management levels will function in the organizational structure of the Project "Review and update of flood risk management plans":

- Strategic management - implemented by the Project Steering Committee with the participation of Project Supervision,
- Operational management - implemented by the Project Manager on the Ordering Party's side with the participation of the Project Support Office (Task 4 Contractor),
- Supervision over the delivery of the Project's products - carried out by River Basin Planning Groups, Water Regions Working Groups and catchment planning teams,
- Delivery of the Project products - carried out by task teams of the Contractors of Tasks 1, 2 and 3 at the level of river basins and water regions.

For the purposes of supervising the process of delivery by the Contractor of products for review and updating of flood risk management plans outside the Steering Committee as the key decision-making body, the following groups will be appointed within the organizational units of Polish Waters to supervise the planning process at individual planning levels, corresponding on one hand to the levels of the organizational structure of the Polish Waters, and on the other hand, the country is divided into river basins, water regions, and catchments.

A detailed description of the roles and related tasks in the organizational structure of the Project was developed under Task 4 "Project management aFRMP", as part of sub-task 4.1 "Development of project procedures".

4.2. THE STEERING COMMITTEE

The Steering Committee (SC) is the most important decision-making body implementing the strategic management level of the Project. The Steering Committee is responsible for the overall direction and management of the Project. The Steering Committee - as a decision-making body - is responsible for the success of the Project. The SC should also monitor issues external to the Project affecting implementation thereof.

The Steering Committee (SC) of the Project "Review and update of flood risk management plans" will include representatives of each of the stakeholder categories:

- Chairman of the Steering Committee - Deputy President of Polish Waters for protection against flood and drought,
- Main User - representatives of future users of the Project's products, in the composition of the SC represented mainly by the relevant Ministries:

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- Maritime Economy and Inland Navigation,
- Internal Affairs and Administration,
- Environment,
- Climate,
- Infrastructure,
- Development,
- Agriculture and Rural Development,
- Primary Supplier - this role represents the units delivering the Project's products:
- Project Managers on the side of the Contractors of Tasks 1, 2, and 3,
- MI (Department of Maritime Economy),
- Project supervision - covers the interests of all parties participating in the Project - represents the Project stakeholders. In the SC, it is represented by:
- representatives of the State Water Holding Polish Waters, including the Plenipotentiary SWH PW for the Project and the chairmen of the Planning Groups for river basin areas,
- National Fund for Environmental Protection and Water Management,
- Ministry of Maritime Economy and Inland Navigation.

4.3. PLANNING GROUPS FOR RIVER BASINS

The following Planning Groups (PG) for river basin areas will be established at the central level:

- the Vistula river basin (along with the adjacent areas of the Pregolya, Nemunas, and Danube river basins),
- the Oder river basin (including the adjacent Elbe basin).

The groups will be established at the level of the State Water Management Board, working under the leadership of the Director of the Department of Protection against Floods and Drought or other persons designated thereby. The Planning Groups for the river basin areas will include employees of SWMB organizational units responsible for:

- development of flood risk management plans as well as their reviews and updates,
- preparation of a programmeme of planned investments in water management and its updates,
- development of draft water management plans in river basin areas and related documents,

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- participation in works on the assessment of the impact of maintenance and investment actions on the water status, in order to correctly comply with the provisions of Directive 2000/60/EC,
- development and implementation of information and promotion actions related to the actions of Polish Waters.

Additionally, the Planning Groups for the river basin area will include representatives of MGMiŻŚ - currently MI[2] (Department of Water Management and Inland Navigation and Department of Maritime Economy) and the relevant RWMB.

The scope of actions and responsibilities of the River Basin Planning Groups will include:

- Supervision of all works by the Contractor of Task 1 carried out at the level of river basin areas, substantive and formal control (in cooperation with the Contractor of Task 4) and the acceptance of products,
- Coordination of the work of the Working Groups of Water Regions and supervision over the merging of their results to the level of the river basin area,
- Coordination of cooperation with MGMiŻŚ (currently MI), Maritime Offices and the contractor of the aFRMP from the sea and internal sea water,
- Undertaking, together with the Contractor of Task 1, actions to ensure coordination of the implementation of aFRMP in international river basin areas,
- Supervision over the information and promotion actions (Task 2.1) and the acceptance of products,
- Coordination of works as part of public consultations of the project (Task 2.2), supervision over integration of the results of public consultations to the level of the river basin area and carrying out product acceptance,
- Supervision over the development of the Strategic Environmental Impact Assessment for aFRMP in individual river basin areas (Task 3) and the acceptance of products,
- Participation in project management meetings and in working meetings with the Contractor with regard to the Project components performed at the river basin level.

On the part of the Contractors of Tasks 1, 2, and 3, there will be appointed task teams for implementation of aFRMP for individual river basin areas. Contractors will appoint a task team manager for each river basin area, who will be responsible for coordination of cooperation between the Contractor and the Ordering Party at the SWMB level throughout the duration of the project, each river basin area will be assigned a different member of the Contractor's team.

[2] In accordance with the regulation of the Council of Ministers of 10 November 2020 on the transformation of the Ministry of Infrastructure, the water management department has been incorporated into the Ministry of Infrastructure (MI).

4.4. WORKING GROUPS OF WATER REGIONS

Working Groups (WG) for water regions are established at the level of individual RWMB, working under the leadership of RWMB Deputy Directors for protection against floods and drought or other persons designated by them:

- RWMB Lublin Working Group - responsible for supervising the development of aFRMP for the Bug water region,
- RWMB Gdańsk Working Group – the Lower Vistula water region,
- RWMB Kraków Working Group – the Upper-Western Vistula water region and Black Orava water region,
- RWMB Rzeszów Working Group – the Upper-Eastern Vistula water region,
- RWMB Gliwice Working Group - the Little Vistula water region, Upper Oder water region,
- RWMB Białystok Working Group – the Narew water region (excluding the Lower Narew catchment), the Łyna and Węgorapa water regions, the Nemunas water region,
- RWMB Warsaw Working Group – the Central Vistula water region and Narew water region (in the Lower Narew catchment),
- RWMB Szczecin Working Group – the Lower Oder and Western Pomerania water region,
- RWMB Bydgoszcz Working Group - the Noteć water region,
- RWMB Wrocław Working Group – the Central Oder water region and Metuje water region,
- RWMB Poznań Working Group - the Warta water region.

Due to the designated areas of flood risk in connection with the threat from the sea, the Working Groups of RWMB Gdańsk and RWMB Szczecin will be obliged to cooperate with the Ministry of Maritime Economy and Inland Navigation as part of the development of flood risk management plans from the sea, including internal sea water.

The Working Groups for water regions will include employees of RWMB organizational units responsible for:

- cooperation with SWMB in the development of planning documents and implementation of tasks resulting from the directive on flood risk assessment and management
- coordination of investments carried out by the catchment management boards and units implementing projects,
- participation in the development of draft water management plans for river basin areas and related documents,
- agreeing plans for the protection of critical infrastructure,

- preparation and implementation of information and educational campaigns.

Additionally, the Working Groups of RWMB Gdańsk and RWMB Szczecin will include representatives of the relevant Maritime Offices.

The scope of actions and responsibilities of the Working Group of Water Regions will include:

- Supervision over all works of the Contractor for Task 1 carried out at the level of a given water region, control of compliance with the description of the subject of the contract and acceptance of products:

  a. Acquiring and processing data and information,

  b. Review of the diagnosis of flood risk management problems,

  c. Assessment of progress in the implementation of flood risk management actions and objectives at the water region level,

  d. Verification and updating of specific objectives of flood risk management in terms of their relevance in the water region

  e. Verification of the lists of actions as part of the updated flood risk management plans for the Oder, Vistula and Pregolya basin areas and development of lists of actions for the FRMP developed in the second planning cycle

  - at the level of the water region concerned. Obtaining the acceptance of the product by the Contractor at the regional level will be required during its acceptance at the level of the river basin area.
- Participation in the control of compliance with the description of the subject of the contract for products performed at the level of the river basin area,
- Coordination of the works of the catchment planning teams and supervision over merging their results to the level of the water region,
- Participation in information meetings with Project Stakeholders organized by the Contractor of Task 2 at the stage of project development aFRMP,
- Participation in meetings as part of public consultations of the Project (Task 2.2),
- Participation in the Project management meetings at the river basin level (Managers of the Water Regions Working Groups),
- Participation in coordination meetings with managers of the catchment planning teams.

On the part of the Contractor of Tasks 1 and 2, task teams for the implementation of aFRMP will be established in the area of individual water regions. The Contractor will appoint a water task force manager for each region, who will be responsible for coordination of cooperation between the Contractor and the Ordering Party at the

RWMB/water region level throughout the duration of the project, each working group will be assigned a different member of the Contractor's team in this role. In addition, the Group Manager on the Contractor's side for the Warsaw RWMB cooperates with the Contractor's Group Manager for RWMB in Białystok within the scope of studies for the Narew Water Region.

4.5. THE CATCHMENT PLANNING TEAMS

The catchment planning teams (CPT) are established at the RWMB level, working under the leadership of the Directors or Deputy Directors of the Catchment Boards. The catchment planning teams will include employees of the catchment management boards responsible for:

- cooperation in the development or updating of planning documents,
- programmeming, planning water investments on an annual and long-term basis and carrying out investments within the scope of water management,
- development of plans for the protection of critical infrastructure and implementation of tasks related to the regulations on critical infrastructure.

Additionally, the composition of the teams will be supplemented, as needed, by representatives of the Regional Water Management Board. In addition, the planning teams in the catchments where the aFRMP will be developed from the sea and internal sea water will include representatives of the relevant Maritime Offices.

The planning catchment area will be the basic level for identifying flood risks and building of planning variants in the project of review and update of flood risk management plans. Planning catchments will correspond to the areas (or parts of areas) of operation of individual catchment boards (CB) of the State Water Holding Polish Waters, should not cover an area larger than one CB.

The scope of actions and responsibilities of the catchment planning teams will include:

- supervision and cooperation with the Contractor of Task 1 in terms of developing variants of actions for the planning catchment,
- cooperation with the Contractor for Task 1 within the scope of model studies of the effects of actions on reducing flood risk,
- substantive control of the above-mentioned products,
- participation in consultation meetings within the framework of social consultations of the aFRMP of the water region in which the given catchment is located.

The catchment planning teams operating in RWMB Gdańsk and RWMB Szczecin will, by appointing representatives of Maritime Offices to their composition, coordinate the implementation of the aFRMP and aFRMP projects from the sea and internal sea water.

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5.THE COURSE OF THE PLANNING PROCESS IN A WATER REGION AND AREA

5.1. DEFINITION OF TASKS TO BE IMPLEMENTED PRIOR TO PROCEEDING TO THE APPROPRIATE DEVELOPMENT OF FLOOD RISK MANAGEMENT PLANS BY THE SELECTED CONTRACTOR

Works to be performed at the SWMB level before the selected contractor commences actual development of flood risk management plans.

- Establishment of the Project Steering Committee,
- Establishment of River Basin Planning Groups (personnel), appointment of their managers,
- Conducting the public procurement procedure for tasks related to implementation of the Project,
- Publication on the websites of Polish Waters of information about implementation of the Project.

Works to be performed at the RWMB level before the selected contractor commences actual development of flood risk management plans.

- Establishment of Working Groups of Water Regions (personnel), appointment of their managers,
- Development of a list of planning catchment areas (catchment management boards in the area of operation with AEFH designated in the review and update of the preliminary flood risk assessment or smaller areas designated by dividing the areas administered by the catchment management boards),
- Agreeing with MGMiŻŚ (currently MI) on the list of planning catchment areas, in the area of which the review and updating of FRMP from the sea and internal sea water will be developed by MGMiŻŚ (currently MI).
- Appointment of catchment planning teams (personnel, manager).

5.2. FRAMEWORK COURSE OF PLANNING WORKS AT THE RIVER BASIN AREA LEVEL

According to the assumption, the works carried out by task teams of the Contractor of Tasks 1, 2, and 3 under the supervision of planning groups for the river basin areas with the participation of the Contractor of Task 4.

TASK 1 Review and update of flood risk management plans

1. Verification and update of the FRMP development methodology,
2. Acquisition and processing of data and information for the needs of the Project,
3. Review of the diagnosis of flood risk management problems - merging the results of analyzes performed at the level of water regions and conducting an analysis of the possible impact of climate change on the occurrence of floods,
4. Consolidation of the results of the assessment of progress in implementation of actions carried out at the level of water regions and drawing up an assessment of the achievement of the objectives of flood risk management in the river basin areas,
5. Verification and update of specific objectives of flood risk management,
6. Consolidation of the results of verification of previous actions carried out at the level of individual water regions,
7. Preparation of updated lists of actions as part of the updated flood risk management plans (FRMP) for the Vistula, Oder, and Pregolya river basins and developing new lists of actions at the river basin level for FRMP developed in the second planning cycle. On the basis of the works carried out for individual water regions, the development of the final generalized planning variant for the river basin area,
8. Drawing up of draft reviews and updates of flood risk management plans for river basin areas for arrangements, opinions and public consultations - including review and update of FRMP for the seawater and internal sea water,
9. Conducting arrangements and opinions on draft reviews and updates of flood risk management plans for individual river basin areas to the extent specified in Art. 173 of the Water Law,
10. Drawing up of the final version of draft review and update of FRMP for approval by the minister responsible for water management on the basis of results of arrangements, opinions and public consultations,
11. Participation in legislative works aimed at the publication of the review and update of flood risk management plans in river basin areas in the form of a regulation of the minister responsible for water management,
12. Drawing up reports for the European Commission on the review and update of flood risk management plans in river basin areas.

TASK 2 Information and promotion actions, including an information campaign

1. Conducting information and promotion actions of the project and information campaign on a national scale. The information campaign on the development of aFRMP from the sea is conducted by MGMiŻŚ (currently the Ministry of Infrastructure).

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2. Conducting public consultations on draft updates of flood risk management plans for river basin areas, taking into account aFRMP from the sea - consolidation of the results of works carried out at the water region level.

TASK 3 Development of environmental impact forecasts and carrying out SEA

Development of environmental impact forecasts and carrying out SEA for draft flood risk management plans in individual river basin areas.

TASK 4 Managing the aFRMP project

Ongoing project management, including preparation and implementation of project procedures.

Progress of works in the Project, substantive and formal problems encountered during the implementation, risks and changes in the project will be monitored at the level of river basin areas (SWMB) through monthly management meetings of the Project. The contractors of individual tasks will be required to prepare monthly reports on the progress of works and present them at management meetings. The reports will be subject to approval by the Project Manager on the part of the Ordering Party. Identified threats (usually constituting a risk close to materializing or existing issues) for the implementation of the Project will be reported by process participants (SWMB, RWMB, MGMiŻŚ - currently MI, and Contractor) to the Steering Committee.

5.3. FRAMEWORK FOR PLANNING WORK AT WATER REGION LEVEL

According to the assumption, the works carried out by task teams of the Contractor of Tasks 1, 2 and 3 under the supervision of working groups of water regions, with the participation of the Contractor of Task 4.

TASK 1 Review and update of flood risk management plans

1. Acquiring and processing data and information for the Project,
2. Review of the diagnosis of flood risk management problems - carrying out analyzes at the level of water regions,
3. Assessment of progress in achieving the objectives of flood risk management at the level of water regions,
4. Verification and updating of specific objectives of flood risk management in terms of their relevance in the water region
5. Assessment of the progress in the implementation of actions - carrying out analyzes at the level of water regions,
6. Verification of the lists of actions as part of the updated flood risk management plans for the Oder, Vistula, and Pregolya river basin areas and preparation of lists of actions for FRMP developed in the second planning cycle - carrying out analyzes at the level of water regions:

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a. creating an initial list of technical and non-technical actions for the water region,
b. verification of the list of actions in accordance with the provisions of the S.M.A.R.T principle,
c. preparation of variants of actions for individual planning catchments,
d. modeling of technical and non-technical strategic actions to document the effects of reducing flood risk in individual planning catchments,
e. carrying out cost-benefit analyzes for different policy options, including technical and non-technical actions
f. selecting the preferred variant for each planning catchment through multi-criteria analysis,
g. Creating a consolidated list of actions for the water region, after carrying out model studies and variants at the planning catchment level,
h. assessment of compliance of the adopted variants of actions for water regions with legal and environmental requirements, including the requirements of the Water Framework Directive and the Birds and Habitats Directive,

7. Preparation of material for arrangements and opinions on draft reviews and updates of flood risk management plans for individual river basin areas

TASK 2 Information and promotion actions, including an information campaign

Conducting public consultations on draft updates of flood risk management plans in the areas of individual water regions. In the area of RWMB Gdańsk and RWMB Szczecin, consultations also cover the results of aFRMP from the sea and internal sea water.

The progress of works in the Project and substantive problems encountered during its implementation will be monitored at the level of water regions (RWMB) through the Contractor's monthly reports. The reports will be approved by the head of the Water Region Working Group and submitted to the Project Manager on the part of the Ordering Party. Problems (potential risks or issues) arising in the course of project implementation should be reported on an ongoing basis in the manner specified by the project management procedures. Any participant in the planning process (at the level of water regions - RWMB, Contractor) may submit applications to the Project Manager on the Ordering Party's side.

5.4. A FRAMEWORK COURSE OF PLANNING WORKS AT THE PLANNING CATCHMENT LEVEL

In accordance with the assumptions, the works are carried out by task teams of the Contractor of Tasks 1 and 2 under the supervision of the catchment planning teams.

TASK 1 Review and update of flood risk management plans

1. Verification of the lists of actions as part of the updated flood risk management plans for the Oder, Vistula and Pregolya basin areas and development of lists of actions for the FRMP developed in the second planning cycle - carrying out analyzes at the catchment level:
   a. preparation of variants of actions for the catchment area,
   b. modelling actions in the catchment area,
   c. conducting cost-benefit analyzes for individual variants of actions in the catchment area,
   d. selecting the preferred variant for the catchment area through a multi-criteria analysis.

6.A CATALOGUEUE OF FLOOD RISK MANAGEMENT OBJECTIVES

6.1. INTRODUCTION

According to the Floods Directive, the primary objective of flood risk management, resulting directly from the Directive, is to limit potential negative effects of floods on human life and health, the environment, cultural heritage, and economic action.

The Member States establish appropriate flood risk management objectives for areas where they determine the existence of a high flood risk or its occurrence (the Water Law defines these areas as areas exposed to the risk of flooding - AEFH).

In the first FRMP, there were determined three main objectives, the achievement of which was ensured through implementation of specific objectives assigned to each of the main objectives.

In the first planning cycle of FRMP, there were formulated three main objectives of flood risk management in Poland:

1. Stopping the increase in flood risk,
2. Reducing the existing flood risk,
3. Improving the flood risk management system.

The objectives are also maintained for the analyzes carried out during the second planning cycle. Updating FRMP requires verification of specific objectives adopted in the previous planning cycle whilst maintaining the main objectives of flood risk management.

Methodology of verification of specific objectives provides for the assessment of specific objectives and the selection of those which meet the requirements set for them. As a result, a new list of specific objectives was proposed for aFRMP.

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6.2. A METHOD OF ESTABLISHING AND VERIFICATION OF SPECIFIC OBJECTIVES FOR FLOOD RISK MANAGEMENT AND ASSESSING THEIR IMPORTANCE, ADEQUACY AND MEASURABILITY

6.2.1. Introduction

The process of verification and updating of the specific objectives adopted under FRMP in the 1st planning cycle will be carried out in two stages:

- **The first stage - preliminary**, consists in carrying out an assessment of specific objectives due to their measurability, significance for reducing the risk level in a specific area of a water region, significance for achieving the main objective, adequacy to the type of adverse consequences of floods identified in a given area.
- **The second - final stage** will take place after analyzing the results of the assessment of the progress in the implementation of actions and objectives of flood risk management provided for in the previous planning cycle.

These analyzes will make it possible to update the detailed objectives adopted in the previous planning period, while maintaining the main objectives of flood risk management.

The diagram of carrying out both stages of the verification of specific objectives (SO) is shown in Figure no 1 below.

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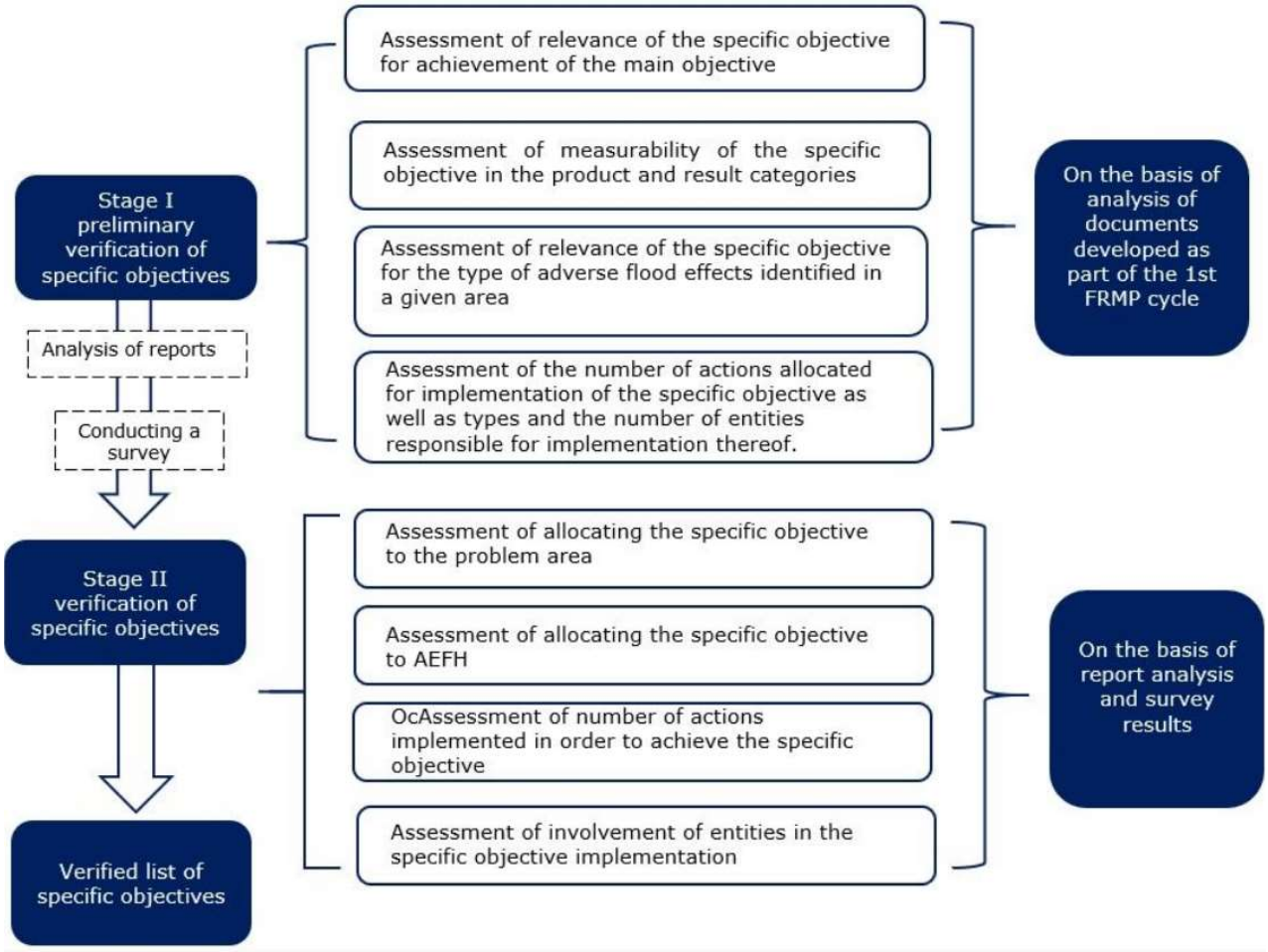

Figure no 1 Diagram of the stages of specific objective verification

6.2.2. The first stage of verification of specific objectives

The basic tools for analyzes carried out as part of the first stage of verification of specific objectives are: a list of features (attributes) of individual specific objectives and a matrix for assessing specific objectives.

The set of features assigned to individual specific objectives includes answers to the following questions from the catalogue (X1 ... ..X15):

- X1 Is the specific objective measurable in the product category? If so, which product indicator (PA) [3] used in the methodology can be used?

[3] PA - product indicator - a action of a set objective, related to a given type of action.

- X2 Is the specific objective measurable in the result category: "reduction of the intensity of the phenomenon"? If so, which result indicator (RA) used in the methodology can be used?
- X3 Is the specific objective measurable in the result category: "reduction of exposure of sensitive objects"? If so, which RA result indicator used in the methodology can be used?
- X4 Is the specific objective measurable in the result category: "reduction of the vulnerability of objects in the flood hazard zone"? If so, which RA result indicator used in the methodology can be used?
- X5 Is the specific objective measurable in the result category: "increasing the efficiency of the system"? If so, which RA result indicator used in the methodology can be used?
- X6 Is the specific objective adequate for the identified adverse consequences of floods in the category: human life and health?
- X7 Is the specific objective adequate for the identified adverse consequences of floods in the category: environment?
- X8 Is the specific objective adequate for the identified adverse consequences of floods in the category of cultural heritage?
- X9 Is the specific objective adequate for the identified adverse consequences of floods in the economic action category?
- X10 Is the specific objective important for the achievement of the main objective?
- X11 Was the specific objective implemented in the 1st planning cycle of FRMP?
- X12 What number of actions were planned under the previous FRMP to achieve the specific objective.
- X13 Which entities, in the previous FRMP, were assigned the responsibility for the implementation of actions assigned to the specific objective?
- X14 Is it possible for the Polish Waters to have an impact on entities implementing actions assigned to the specific objective?
- X15 What type of impact of Polish Waters on entities responsible for the implementation of planned actions[4] can be foreseen?

Answers to the above questions regarding all specific objectives adopted in the previous planning cycle can be summarized in the matrix of characteristics of individual specific

4 The following types of impacts are expected: impacts resulting from direct reporting, impacts resulting from the co-financing of the costs of the action subject to implementation, impacts resulting from granted permits or administrative arrangements, no possibility of impact.

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objectives (Table no 1). This matrix allows for assessment of whether the specific objectives applied in the previous planning cycle can also be used in the updated FRMP or they require modification or replacement with other purposes.

Table no 1 Result matrix for the features of individual specific objectives.

Main objective	Specific objective	X1	X2	X3	X4	X5	X6	X...	X...	X...	X...	XN
1	1.1.											
	1.2.											
	...											
2	2.1											
	2.2											
	...											
3	3.1											
	3.2											
	....											

The following criteria for assessing specific objectives were used:

- measurability in terms of products and results,
- relevance for achieving the main objective for the river basin area,
- adequacy to the type of adverse consequences of floods identified in a given area,
- adequacy of the specific objectives assigned to AEFHs where they have been identified (hot spots[5]) and the objectives assigned to all AEFHs,
- the number of actions planned to achieve individual specific objectives in the river basin area,
- the number and types of entities responsible for the implementation of actions planned to achieve individual specific objectives in the river basin area.

Measurability of the specific objective is determined by the possibility of using the product (PA) and result (RA) indicators from the set of indicators resulting from:

a. Regulation of the Minister of Maritime Economy and Inland Navigation of 14 December 2018 on the scope of information on the implementation of actions included in river basin management plans, flood risk management plans, and sea water protection programmeme (the Official Journal of Laws 2018 item 2390).
b. Regulations on the adoption of flood risk management plans for river basin areas.
c. Methodology of developing FRMP plans for river basins and water regions, Version 4.0, Warsaw 2015.
d. the requirements for reporting aFRMP results to the European Commission (FD Reporting Guidance).

[5] Hot spot is a term used in the 1st planning cycle and refers to an area where a high level of flood risk has been identified that requires urgent actions to mitigate this risk; the definition of hot spot was used in the 1st planning cycle, in the 2nd planning cycle the term "problem area" is used.

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The sets of indicators are presented in the following tables (Table no 2 and Table no 3):

Table no 2 The set of product indicators (PA)

PA designation	Indicator name	Measurement unit
PA0	Number of regulations implemented in the legal system for the FRMP implementation	piece
PA1	Number of expert analyzes performed within the area of flood risk management	piece
PA2	Implementation of an IT system for reporting and estimating flood losses	piece
PA3	Increase in the length of river sections, where their capacity was adjusted to the flow conditions of floodwater, obtained as a result of implementation of the action	km
PA4	Increase in the length of the constructed levees protecting the identified areas of high vulnerability to flood hazard, obtained as a result of implementation of the action	km
PA5	Increase in the number of reconstructed flood protection facilities which have lost their functionality, obtained as a result of implementation of the action	piece
PA6	Increase in the length of the realized bands for protection of the sea shore as a result of the action implementation	km
PA7	Number of multi-functional reservoirs for which the rules of use have been improved in order to increase the flood reserve	piece
PA8	Increase in the length of reinforced and reconstructed levees obtained as a result of the action implementation	km
PA9	Number of flood protection facilities for which technical and economic documentation was drawn up	piece
PA10	Increase in the number of regional and local flood forecasting and alert systems, strengthening the national forecasting and alert system	piece
PA11	Number of trained citizens	number of people
PA12	Number of operational anti-flood plans developed in the reporting period, including plans for the evacuation of the population and inventory	piece
PA13	Increase in the length of river sections for which good conditions for icebreaking and safe ice floe discharge were ensured, obtained as a result of implementation of the action	km
PA14	Increase in the number of educational materials developed with a view to increasing awareness and knowledge about sources of flood hazard and flood risk, available on the website of the SWH WL	piece

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Table no 3 A set of result indicators (RA)

RA designation	Indicator name	Measurement unit
RA1	Increase in the area of land given up to the river as a result of implementation of the action	ha
RA2	Increase in the area of river valleys given up to the river by building polder retention, obtained as a result of t implementation of the action	ha
RA3	Increase in the valley retention capacity obtained as a result of implementation of the action	million m^3
RA4	Increase in the flood reserve capacity obtained as a result of construction of flood protection reservoirs as part of implementation of the action	million m^3
RA5	Relative reduction in the value of average annual AAD flood losses as a result of implementation of the action	[%, PLN]
RA6	Relative reduction in the number of inhabitants in areas of high flood hazard (Q1%) as a result of implementation of the action	[%, person]
RA7	Relative decrease in the number of culturally valuable facilities located in the area of particular flood hazard (Q1%) as a result of implementation of the action	[%, piece]
RA8	Relative decrease in the number of facilities posing a threat to the environment located in the area of particular flood hazard (Q1%), as a result of implementation of the action	[%, piece]
RA9	Relative decrease in the number of water intakes located in areas of particular flood hazard (Q1%), as a result of implementation of the action	[%, piece]
RA10	Relative reduction in the number of facilities of special social importance located in areas of particular flood hazard (Q1%) as a result of implementation of the action	[%, piece]
RA11	Relative reduction of potential flood losses in areas of particular flood hazard (Q1%) as a result of implementation of the action	[%, PLN]
RA12	Relative reduction in the area of sites of high flood hazard (Q1%) as a result of implementation of the action	[%, ha]

Significance of a specific objective for achieving the main FRMP objective in the river basins and water regions was assessed taking into account the specificity of these areas and the specificity of problems related to flood risk management. A three-point scale was used:

- a specific objective is of little importance for achieving the main objective: 1,
- a specific objective is significant for achieving the main objective: 2,
- a specific objective is very important for achieving the main objective: 3.

Assessment of the adequacy of the specific objective to the type of adverse flood consequences identified in the river basin areas and water regions in the following categories: human life and health, environment, cultural heritage, economic action, should be made on the basis of the opinion of experts of the aFRMP contractor. The adequacy of specific objectives is measured using a 0/1 scale (adequate/inadequate).

Assessment of adequacy of specific objectives assigned to AEFHs with identified problem areas and objectives assigned to all AEFHs should be made using the method as for the assessment of adequacy of the specific objective to the type of flood adverse consequences identified in the river basins and water regions, described above.

Assessment of specific objectives in terms of the number of actions, as well as the number and types of entities responsible for implementation of actions planned in the previous planning cycle to achieve the specific objectives in the river basin area, should be made on the basis of the list of actions planned in the previous FRMP and the entities assigned thereto. The assessment will therefore contain information on individual specific objectives, i.e. information on how many actions were planned in the previous planning period to implement a given specific objective and which entities were involved in it, along with assessment of the possibility of the impact of Polish Waters on actions of these entities.

6.2.3. The second stage of verification of specific objectives

The second and final stage of verification of specific objectives will take place after analyzing the results of the assessment of the progress in implementation of flood risk management actions and objectives provided for in the previous planning cycle.

The basic tools for analyzes carried out as part of the second stage of verification of specific objectives are: a list of features (attributes) of individual specific objectives, which is a continuation of the list from the first stage of verification, and a matrix for assessing specific objectives.

The set of features assigned to individual specific objectives in the second stage of verification of specific objectives includes answers to the following questions from the catalogue (X16 ... ..X20):

- X16 Is the specific objective assigned to problem areas (called Hot-spots[6] in the 1st planning period)?
- X17 Is the focus area assigned to AEFHs, for which no Hotspots have been identified?
- X18 How many actions have been carried out in the previous planning cycle to achieve the specific objective?
- X19 What percentage of planned actions were carried out in the previous planning cycle to achieve the specific objective?
- X20 To what extent were the various entities involved in the achievement of the specific objectives assigned thereto?

[6] A hot spot is an area where a high level of flood risk has been identified that requires urgent actions to mitigate this risk, the definition of a hot spot was used in the 1st planning cycle, in the 2nd planning cycle the term "problem area" will apply.

A particularly useful tool for the Contractor to verify the detailed objectives at this stage of their formulation will be the planned survey, the purpose of which is to obtain data and information on the completed, ongoing and planned actions undertaken by entities other than Polish Waters, responsible for individual elements of flood risk management.

The conducted evaluation, including the use of the above-mentioned surveys among relevant stakeholders, in the process of flood risk management, will constitute a source of feedback on the implemented actions. This information will be the basis for assessing and taking into account various changes related to the current action, e.g. procedures for implementing a programmeme of actions to reduce the risk of flooding or changes to assumptions, the way of defining problems and their causes, as well as the adopted objectives (taking into account the current knowledge on the impact of climate change on the way flood risk management).

6.3. A METHOD OF TAKING INTO ACCOUNT THE NECESSITY TO ACIEVE ENVIRONMENTAL OBJECTIVES FOR HOMOGENOUS WATER BODIES WHILST SETTING FLOOD RISK MANAGEMENT OBJECTIVES

The methodology of flood risk management takes into account the requirements of the Water Framework Directive (WFD) and water management plans for river basin areas in order to ensure the fulfillment of environmental objectives at all stages of flood management and to obtain synergistic effects in the implementation of both directives. When determining the actions aimed at achieving the objectives of flood risk management, the environmental objectives referred to in Art. 55-61 (Section III, Chapter 1, the Water Law). It was assumed that the objectives of flood risk management will be negative, positive or neutral in relation to the environmental objectives of water bodies, and so:

- The specific objectives of flood risk management and the types of actions included in them dedicated to the reduction of the intensity of the phenomenon (threat) are assigned the possibility of positive, negative, and neutral impacts in relation to environmental objectives.
- The specific objectives of flood risk management and the types of actions included in them dedicated to reduction of exposure to a hazard are assigned the possibility of positive, negative and neutral impacts in relation to environmental objectives.
- The specific objectives of flood risk management and the types of actions included in them dedicated to reducing the vulnerability of people and objects exposed to threats are assigned the possibility of a neutral impact on environmental objectives.
- The specific objectives of flood risk management and the types of actions included in them dedicated to increasing the effectiveness of the flood protection system are

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assigned the possibility of the occurrence of a neutral impact in relation to environmental objectives.

The assessment of the impact of types of actions and actions assigned to individual specific objectives of flood risk management on the achievement of environmental objectives of WB will be carried out with the use of the matrices presented in Chapter 11.3 of this methodology.

6.4. A CATALOGUEUE OF PRIMARY AND SPECIFIC OBJECTIVES OF FLOOD RISK MANAGEMENT

Specific objectives assigned to individual water regions and river basins are grouped according to the criterion to which the main objective is assigned, taking into account the changing in time and anticipated in the future risk of flooding, resulting from both climate change and changes in the intensity of management of areas exposed to the risk of floods. areas.

Moreover, each specific objective is assigned sets of measurable product (PA) and result (RA) indicators from the set of indicators resulting from the sources indicated in chapter 7.2.2.

The final list of specific objectives assigned to the main objectives will contain only the objectives pursued by groups of actions for which the implementation is sanctioned by the existing legal status and for which entities having a legal obligation to implement them are assigned, or there are entities currently implementing or declaring and confirming the possibility of implementing these actions in the period 2022-2027.

The list of the main objectives and the specific objectives assigned to them is as follows:

1. Stopping the flood risk increase.

1.1. Ensuring conditions limiting the possibility of occurrence of floods.

1.2. Ensuring rational management of flood hazard areas.

2. Reducing the existing flood risk.

2.1. Providing conditions reducing the possibility of occurrence of flooding.

2.2. Reducing the area at risk of flooding and ensuring rational management of flood hazard areas.

2.3. Reducing vulnerability of communities and facilities in the flood hazard area.

3. Improving the flood risk management system.

3.1. Increasing the effectiveness of forecasting and warning about meteorological and hydrological hazards.

3.2. Increasing the effectiveness of response of people, companies and public institutions.

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3.3. Increasing the efficiency of reconstruction and recovery.

3.4. Implementation of the post-flood analyzes and increasing its effectiveness.

3.5. Implementation of legal and financial instruments increasing flood safety.

3.6. Increasing awareness and knowledge of the sources of flood hazard and flood risk.

In the table below, the verified specific objectives of aFRMP are assigned sets of measurable product (PA) and result (RA) indicators, which result from the documents cited in chapter 7.2.2.

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Table no 4 Sets of measurable product (PA) and result (RA) indicators ascribed to individual specific objectives

The main objective	Detailed objectives of aFRMP	Product indicator (PA)	Result indicator (RA)
1. Stopping the flood risk increase	1.1. Providing conditions limiting the possibility of flooding (1)	PA0, PA1, PA3, PA4, PA5, PA7, PA8, PA13	RA1, RA2, RA3, RA4,
	1.2. Ensuring rational management of flood risk areas (2)	PA0, PA1	RA6, RA8, RA9, RA10, RA11
2. Reducing the existing flood risk	2.1. Providing conditions reducing the possibility of flooding (3)	PA0, PA1, PA3, PA5, PA7, PA9, PA13	RA1, RA2, RA3, RA4, RA5, RA6, RA7, RA8, RA9, RA10, RA11, RA12
	2.2. Reducing the area at risk of flooding and ensuring rational management of flood risk areas (4)	PA0, PA1, PA4, PA8, PA9	RA5, RA6, RA7, RA8, RA9, RA10, RA11
	2.3. Reducing the vulnerability of communities and facilities in the flood hazard area (5)	PA0, PA1, PA10, PA11, PA12	RA5, RA11
3. Improving the flood risk management system	3.1. Increasing the effectiveness of forecasting and warning about meteorological and hydrological hazards (6)	PA10	-
	3.2. Increasing the effectiveness of response of people, companies and public institutions (7)	PA0, PA11, PA12	-
	3.3. Increasing the efficiency of reconstruction and recovery to the state from before the flood (8)	PA2	-
	3.4. Implementation of the post-flood analyzes and increasing its effectiveness. (9)	PA2, PA11	-
	3.5. Implementation of legal and financial instruments increasing flood to improving flood safety. (10)	PA0, PA1	-
	3.6. Increasing the awareness and knowledge of the sources of flood hazard and flood risk (11)	PA11, PA14	-

Explanations:

(1) Most of the river basins are subject to more and more intense anthropopressure, causing formation of a flood wave with an increasingly violent course. Therefore, ensuring the conditions limiting the possibility of extreme flood phenomena is the aim of limiting the increase in flood risk by slowing down the runoff of flood water in the river basin, taking into account the predicted climate changes and trends in its management.

(2) Actions related to the reduction of extreme flood phenomena are usually insufficient to effectively reduce the flood risk, which increases year on year, resulting from the increase in the intensity of river basin development and changes in meteorological and hydrological conditions related to climate change, hence the next specific objective is to ensure conditions for rational management flood risk areas. This objective can be achieved through implementation of legal regulations limiting the increase in undesirable management of the catchment area, affecting the increase in flood risk.

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(3) Three specific objectives have been established for problem areas that require urgent actions to reduce the risk of flooding. The first is to ensure conditions reducing the possibility of floods (extreme flood phenomena), i.e. such shaping of the catchment area management to reduce the scale of flood phenomena. In this case, effective actions to achieve this objective are the development of natural and artificial valley retention and slowing down the runoff of rainwater to water courses.

(4) Another specific objective to reduce the flood risk is to reduce the flood hazard area and to ensure rational management of flood hazard areas. This specific objective can be achieved through the use of actions such as reduction of the surface of sensitive flood risk areas, as well as rational management of flood risk areas ensuring reduction of losses in the event of a flood event.

(5) Flood risk reduction can also be achieved by achieving the specific objective of reducing the vulnerability of communities and facilities in the flood risk area. This specific objective can be achieved by applying many different actions, the effect of which is always to reduce the size of the adverse consequences caused by a flood in the areas affected by this phenomenon.

(6) The effectiveness of achieving the main objectives 1 and 2 is influenced by the degree of achievement of the third main objective - improvement of the flood risk management system. This main objective has been assigned six specific objectives. The first is to improve forecasting and warning of meteorological and hydrological hazards. This objective is particularly important because a reliable system for forecasting flood phenomena and an effective warning system can effectively reduce the vulnerability of communities and facilities located in the flood risk area. In order to achieve this objective, it is necessary, on the one hand, to improve the existing national systems, but also to strengthen and develop local systems designed to reduce the flood risk for selected problem areas.

(7) Improving effectiveness of the response of people, companies and public institutions in the event where a flood phenomenon is related to the quality of the functioning of crisis management services, which has a direct impact on the extent of adverse consequences caused by floods.

(8) The competence of local governments is to improve the efficiency of reconstruction and recovery. At the same time, the Ministry of Interior and Administration has established an Office for Disaster Recovery, which provides financial support to local governments that have been affected by the flood. Cooperation of local governments with the Ministry of Interior and Administration has a direct impact on the time and scope of restoring flood-affected areas to full functionality.

(9) The RBMP is responsible for the coordination of flood mitigation actions. Implementing and increasing the effectiveness of post-flood analyzes in the context of the analysis of the effectiveness of the functioning of the flood protection system is a specific objective that improves the effectiveness of the operation of the RBMP within the scope of flood risk management.

(10) Stimulating behaviors that increase flood safety through legal and financial instruments is an important specific objective, the implementation of which is to make it possible to meet headline targets 1 and 2, and to make flood risk management effective.

(11) Increasing the awareness and knowledge about the sources of flood hazard and flood risk are specific objectives, the implementation of which is to influence the attitudes of citizens who are aware of the existing threats and ready to undertake adaptation actions adequate to the identified and anticipated flood hazard.

* Product indicators (PA) as shown in Table no 2

** Result indicators (RA) as shown in Table no 3

7.A CATALOGUEUE OF TYPES OF ACTIONS LIMITING THE RISK OF FLOODS

7.1. GENERAL INFORMATION AND ASSUMPTIONS RELATING TO THE TYPES OF ACTIONS LIMITING THE RISK OF FLOODS

When building a catalogueue of types of actions to reduce flood risk, the types of actions were been divided into two categories: technical actions and non-technical actions. For many years, both of these categories have been used simultaneously, with preference to the use of non-technical methods, often sufficiently effective, and at the same time less invasive to the environment and not requiring significant one-time financial outlays.

In addition, the definition of flood risk resulting from the Water Law and defined as a combination of:

- hazards - determined by the probability of flood occurrence of an intensity resulting in unfavourable consequences,
- exposure - understood as the presence of sensitive objects and the local community in flood hazard areas,
- vulnerability - defined by the scale of adverse consequences caused by the flood, given the natural susceptibility of flood-affected facilities and societies, and the preparation of endangered objects and people for flooding.

For the purposes of the periods useful for flood risk analysis, a fourth active category has been introduced, which is:

- effectiveness of the flood system understood as the ability (organizational, financial, legal) to adapt to the current or anticipated flood risk in order to reduce the negative effects of floods (raise awareness and knowledge of residents) [7].

The methods of flood risk reduction applied in practice should affect all the above-mentioned factors determining the level of flood risk. Technical and non-technical methods of actions limiting flood risk by influencing individual factors determining the level of risk are presented in Figure no 2 below.

7 Deadline according to IPCC, 2012: Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation, where adaptation in human systems is the process of adapting to existing or expected climate change and its effects in order to mitigate damage or use beneficial opportunities, while in natural systems it is the process of adapting to current and expected climate change and its effects, human intervention can facilitate the adaptation of (natural systems) to the expected climate change.

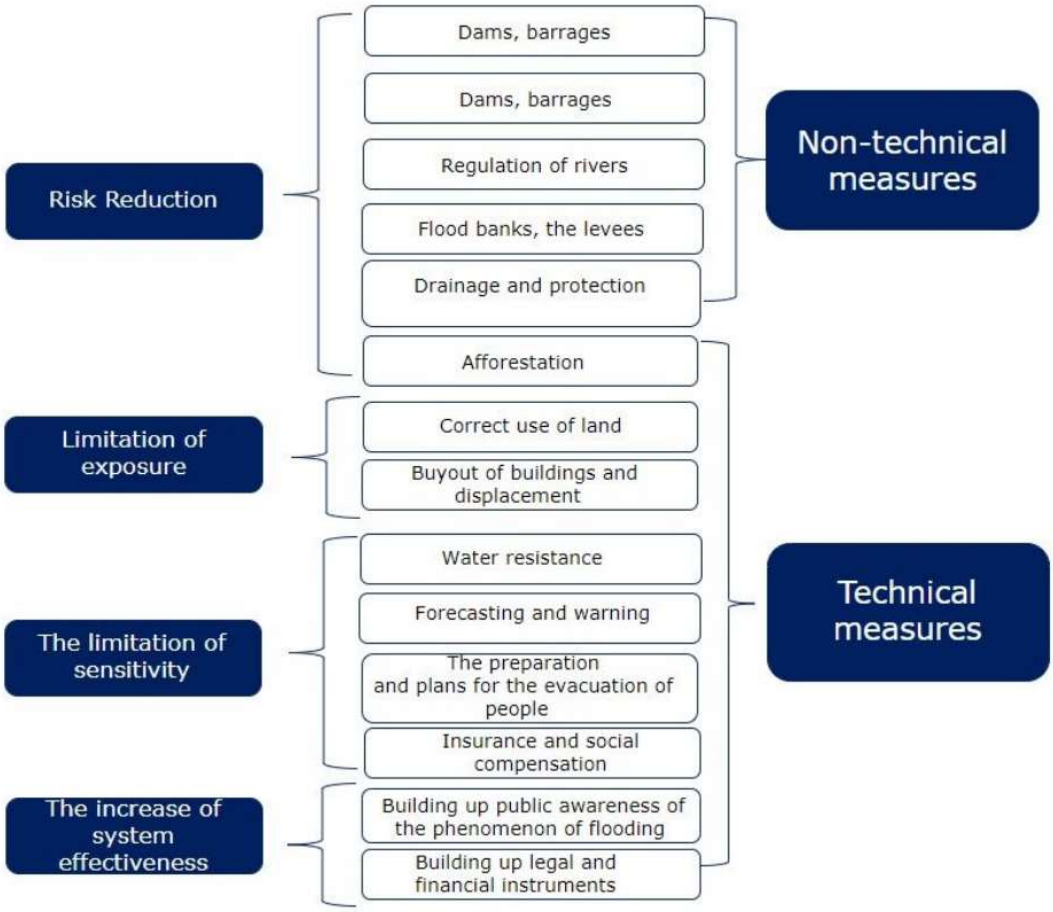

Figure no 2 Technical and non-technical methods of actions limiting flood risk by influencing individual factors which determine the risk level

7.2. A METHOD OF VERIFICATION OF THE CATALOGUEUE OF TYPES OF ACTIONS IN ACCORDANCE WITH THEIR UPDATE, EFFECTIVENESS, AND THE LEGAL AND FINANCIAL POSSIBILITY OF IMPLEMENTATION

7.2.1. Introduction

Verification of the catalogueue of FRMP types of actions[8] formulated for the first planning cycle will be carried out in three stages:

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- **The first stage** – preliminary stage, consists in carrying out an analysis of types of actions indicated in the methodology of the first planning cycle of FRMP in terms of the degree of their adaptation to specific objectives. The criterion is the assessment of whether the product (PA) and result (RA) indicators of individual types of actions are reflected in the product (PA) and result (RA) indicators, specific objectives (in this manner, the requirement that the actions significantly and effectively contributes to for the implementation of specific objectives). It is permissible for the results of actions to contribute to the achievement of many specific objectives. Additionally, for each type of measure, an assessment of the significance of its implementation will be carried out, affecting the implementation of the specific objective.
- The results of the conducted analyzes will be verified in relation to the list of detailed objectives verified and approved by the Ordering Party (in accordance with the assumptions contained in section 6(2)) and in relation to the types of types of actions listed in Art. 165(1) of the Water Law.
- **The second stage** will include an analysis of the data contained in the Information provided by the State Water Holding Polish Waters, governors of provinces, province marshals, commune heads, mayors or presidents of cities and directors of Maritime Offices in annual reports on the implementation of actions contained in Water Management Plans and contained in the Plans Flood Risk Management, prepared in accordance with the Regulation of the Minister of Maritime Economy and Inland Navigation of 14 December 2018 on the scope of information on the implementation of actions contained in river basin management plans, flood risk management plans and sea water protection programme (the Official Journal of Laws 2018, item 2390).
- **The third stage** - the final stage, will consist of carrying out similar analyzes to be carried out under stage two, taking into account the results of the survey of entities responsible for the implementation of actions planned under FRMP, not covered by the reporting obligation.

The work will result in the development of the final catalogueue of types of FRMP actions. The catalogueue will take into account the types of actions, the implementation of which results from the applicable legal conditions and for which entities with a legal obligation to implement them will be specified. The catalogueue will also include types of actions for which entities currently implementing these actions or declaring their willingness to implement them in 2022-2027 and having the ability to confirm the possibility of their implementation have been identified. The catalogueue of types of actions will include actions resulting from the findings of the project "Implementation of instruments supporting the implementation of FRMP actions". The types of actions included in the catalogueue of types of actions will be organized according to the types of actions listed in

[8] The concept of the type of action reducing the flood risk is understood as the idea of an action which has many representatives - actions/tasks consisting in undertaking specific interventions with their location, cost, and time of implementation.

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Art. 165(1) of the Water Law and will be compiled in tabular form with the main objectives and specific objectives of the FRMP.

A diagram of how to verify the types of actions is presented below Figure no 3.

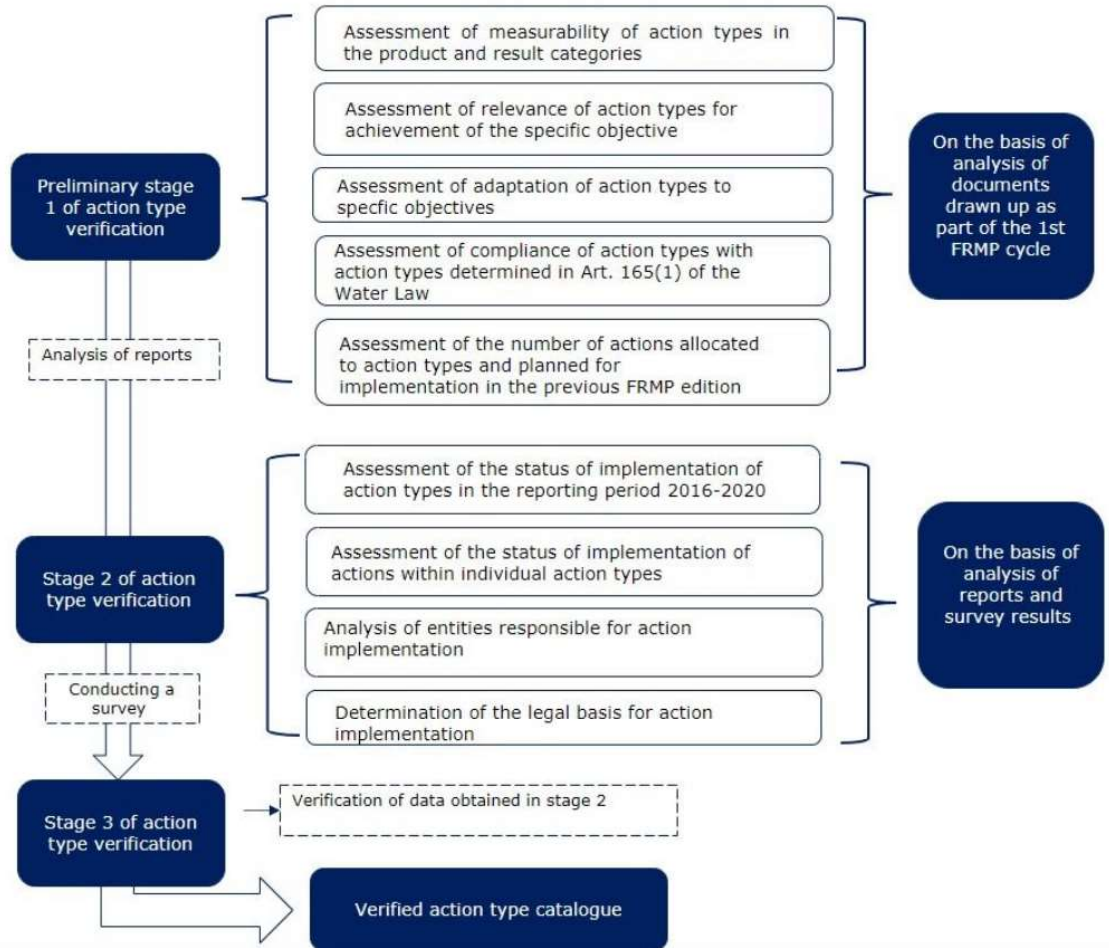

Figure no 3 Scheme of verification of types of actions (TDz)

7.2.2. Stage two of verification of types of actions

The tools for the initial stage of verification of types of actions will be: a checklist of the features (attributes) of individual types of actions and a matrix of assessment of types of actions, taking into account the assessment of the adjustment of types of actions to specific objectives and the compliance of types of actions with the types of actions listed in 165(1) of the Water Law.

The set of characteristics assigned to individual types of actions includes answers to the following questions from the catalogue (Y1 ... ..Y9):

- Y1 Is the type of action measurable in the product category? If so, which product indicator (PA) used in the methodology can be used?
- Y2 Is the type of action measurable in terms of the result: it reduces the intensity of the phenomenon? If so, which result indicator (RA) can be used?
- Y3 Is the type of action measurable in the result category: reduce exposure of sensitive objects? If so, which result indicator (RA) can be used?
- Y4 Is the type of measure measurable in the result category: it reduces the vulnerability of objects in the flood hazard zone? If so, which result indicator (RA) can be used?
- Y5 Is the type of action measurable in terms of the result: increases the efficiency of the system? If so, which result indicator (RA) can be used?
- Y6 Are the product and result indicators of the type of measure consistent with the product (PA) and result (RA) indicators of the specific objective?
- Y7 Is the impact of the analyzed type of action on the achievement of the specific objective significant?
- Y8 For what kind of actions under Art. 165 sec. 1 of the Water Law is this type of action?
- Y9 How many actions are planned in FRMP under the type of measure?

Answers to the above questions regarding the types of actions adopted in the previous planning cycle can be summarized in the matrix of characteristics of individual types of actions. This matrix enables assessment whether the types of actions used in the previous planning cycle can also be used in aFRMP, or whether they require modification or replacement with other types of actions. The matrix proposals are presented in Table no 5 below.

Table no 5 Result matrix for the analysis of types of actions

Specific objective	Action types	Y1	Y2	Y3	Y4	Y5	Y...	Y...	Y9
1.1	Action type 1								
	Action type 2								
	Action type 3								
1.2									
…..									

Action types were assessed using the S.M.A.R.T. approach, taking into account the following characteristics of these types of actions:

- measurability,
- adaptation to specific objectives,
- significance for achieving the overall specific objective,
- compliance with the types of actions specified in Art. 165(1) of the Water Law,
- number of planned actions (investments) in the previous edition of the FRMP.

Measurability of the types of actions is determined by the possibility of using the product (PA) and result (RA) indicators, from the set of indicators presented in chapter 7.2.2.

Adjustment of types of actions to specific objectives is understood as the degree of adequacy of the product (PA) and result (RA) indicators used in assessment of measurability of specific objectives and the types of actions assigned to them. This analysis will be performed using the matrix below.

Table no 6 Assessment matrix for the adjustment of types of actions to specific objectives

Specific objective	Type of Action	Product (PA) and result (RA) indicators allocated to action types					Product (PA) and result (RA) indicators allocated to specific objectives					Assessment of adaptation of product (PA) and result (RA) indicators allocated to action types and specific objectives				
1.1	Type of Action 1															
	Type of Action 2															
	Type of Action 3															
1.2	Type of Action															
	Type of Action															

where columns 1-5 contain answers to the following questions:

- 1 - is the type of action/specific objective measurable in the product category (YES/NO), if YES, indicate which product indicator (PA) can be used?
- 2 - is the type of action/objective measurable in the result category - reduces the intensity of the phenomenon (YES/NO), if YES - indicate which result indicator (RA) can be used?
- 3 - is the type of action/objective measurable in the result category - reduces the exposure of sensitive objects (YES/NO), if YES - indicate which result indicator (RA) can be used?

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- 4 - is the type of action/objective measurable in the result category - reduces the vulnerability of objects in the flood hazard zone (YES/NO), if YES - indicate which result indicator (RA) can be used?
- 5 - is the type of action/objective measurable in the result category - it increases the efficiency of the system (YES/NO), if YES - indicate which result indicator (RA) can be used?

Columns 1'- 5' describe compliance of indicators of individual types of actions with the indicators specified for specific objectives, i.e. the assessment of the adjustment of the product (PA) and result (RA) indicators assigned to the types of actions and specific objectives.The significance of types of actions for achieving the specific objective of FRMP in river basins and water regions should be assessed, similarly to the assessment of the significance of specific objectives (see chapter 6.2.) taking into account the specificity of these areas and specificity of problems related to flood risk management.

In order to assess significance, a three-point scale was used:

- the type of action is not significant for achievement of the specific objective: assessment 1,
- the type of action is relevant for achieving the specific objective: assessment 2,
- the type of action is very relevant for achieving the specific objective: assessment 3.

Assessment of whether a given type of action fits into implementation of individual types of actions listed in Art. 165(1) of the Water Law, that is:

- PW1 - shaping the spatial development of river valleys or floodplains, in particular areas particularly at risk of flooding,
- PW2 - rational water retention and use of anti-flood structures, as well as water flow control,
- PW3 - ensuring functioning of the early warning system against dangerous phenomena occurring in the atmosphere and hydrosphere, and flood forecasting,
- PW4 - preservation, creation, and restoration of the water retention system,
- PW5 - construction, reconstruction, and maintenance of flood protection structures,
- PW6 - icebreaking operation,
- PW7 - conducting an information policy within the scope of flood protection and limiting its effects,

will be executed for all types of actions.

Assessment of the types of actions in terms of the number of specific actions planned in the previous planning cycle should be made on the basis of the list of actions planned in

the previous FRMP. The measure of this assessment will be the number of planned actions belonging to the assessed type of action.

7.2.3. Stage two of verification of types of actions

The second stage of verification of the types of actions will be carried out after the verification of the annual reports on the implementation of actions contained in the Water Management Plans and contained in the Flood Risk Management Plans, developed in accordance with the Regulation of the Minister of Maritime Economy and Inland Navigation of December 14, 2018 on the scope of information on implementation actions included in the plans for 2018 and 2019 and the results of monitoring the implementation of actions for 2017.

The basic tools for analyzes carried out as part of the second stage of verification of types of actions are: the list of characteristics (attributes) of individual actions, which is a continuation of the list from the first stage of verification, and the actions evaluation matrix (Table no 5).

The set of characteristics assigned to individual actions in the second stage of the verification of types of actions includes answers to the following questions from the catalogueue (Y10 ... ..Y17):

Y10 Was the action type implemented in the 2016-2020 reporting period?

Y11 Through how many actions was it carried out?

Y12 How many actions planned under the type of action have not been completed?

Y13 How many actions of the type of action have been taken but not implemented during the planning period?

Y14 Is there a known entity legally required to implement the action?

Y15 Are actions known for the type of action that are implemented by other entities able to finance them?

Y16 Does the action of the action type result from legal instruments?

Y17 Which entities in the plans are identified as responsible for the implementation of actions under the action type?

The basis for answering the above questions will be the annual reports on the implementation of actions contained in the Water Management Plans and those contained in the Flood Risk Management Plans, made as part of the monitoring of the implementation of actions.

As part of the analysis, the assessment of the above-mentioned features of the types of actions will be carried out, extended to establish the legal basis for the implementation of actions.

Based on the analysis of annual reports on the implementation of actions contained in the Water Management Plans and contained in the Flood Risk Management Plans, entities

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whose actions were not included in the above-mentioned reports. These entities will be included in the survey. Details on the survey are described in chapter 8.4.

7.2.4. Stage three of verification of types of actions

Stage 3 of the work involves repeating the actions of stage 2, using the information obtained in stage 2 and the information resulting from the survey.

The tool used to verify the analyzes will be a questionnaire, the purpose of which will be to obtain data and information on planned, implemented, implemented and unrealized actions undertaken by entities other than the Polish Water Holding Polish Waters, responsible for individual elements of flood risk management.

The basic tools for the analyzes carried out under the third stage of verification of types of actions are: the list of characteristics (attributes) of individual types of actions, analogous to the list from the second stage of verification (questions Y10 - Y17), and the matrix of assessment of types of actions (Table no 6).

The conducted stakeholder survey will allow to verify the data obtained in the second stage of works. Its results will constitute a source of feedback on the status of the implementation of actions planned in the 1st planning cycle of FRMP and will form the basis for the assessment and verification of the catalogue of types of FRMP actions.

The final catalogue of types of FRMP actions will be developed, the implementation of which is sanctioned by the existing legal status and for which entities having a legal obligation to implement them are assigned, or there are entities currently implementing or declaring the will to implement them in the years 2022-2027 and able to confirm the possibility of carrying out these actions.

After verifying the catalogue of action types, an action type card will be drawn up for each action type.

7.3. THE ACTION TYPE CATALOGUE

The catalogue of types of actions is addressed to specific detailed purposes. For each of the objectives, types of actions that achieve these objectives are assigned. However, some of the proposed types of actions implement more than one specific objective. The proposed catalogue should be treated as open - it is assumed that it will be verified in subsequent planning cycles as new techniques and technologies develop, experience gained from practice and effectiveness and needs are verified. Below is a table with the types of aFRMP actions and their associated performance indicators (product indicators (PA) and result indicators (RA)), which result from the documents referred to in chapter 6.2.2) and compliance with the types of actions indicated in Art. 165(1) of the Water Law.

In the final catalog, the types of activities will be assigned to activities according to the catalog of types of activities of the European Commission, which are summarized below:

- M21 prevention; avoidance,
- M22 prevention; deletion or transfer,

- M23 prevention; reduction,
- M24 prevention; other methods of prevention,
- M31 security; management of catchment retention and runoff,
- M32 security; water flow regulation,
- M33 security; technical activities in the watercourse bed, in the flood plains and on the coast,
- M35 security; other,
- M41 preparation; flood forecasting and warning,
- M42 preparation; emergency response planning,
- M43 preparation; social awareness and preparation,
- M51 restoration and analysis; reconstruction and recovery from before the flood (society and infrastructure),
- M53 restoration and analysis; other methods of removing damage.

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Table no 7 Catalogue of types of actions in flood risk management plans for river basins and water regions

Main objective	Number and name of a specific objective	Number and name of an action	Product indicators (PA)	Result indicators (RA)	Classification according to the action type as in Water Law	Type of Action acc. EC
1. Stopping the flood risk increase	**1.1.** Ensuring conditions limiting the possibility of occurrence of floods	**1** Protection or increase of catchment retention on wooded and shrubby forest land	PA1	RA1, RA2, RA3	PW1 PW4	M31
		2 Protection or increase of catchment retention on agricultural land	PA1	RA1, RA2, RA3	PW1 PW4	M31
		3 Protection or increase of catchment area retention on built-up and urbanized land	PA1	RA1, RA2, RA3, RA4,	PW1 PW4	M31
		4 Protection or increase of river valley retention	PA1	RA1, RA2, RA3	PW1 PW4	M31
		24 Preserving and improving functionality of the system for securing lower-laying areas	PA1, PA5, PA8, PA9	n/a	PW5	M33
		25 Reconstruction of flood protection infrastructure damaged by floods	PA1, PA5, PA8, PA9	n/a	PW5	M33
		26 Ensuring the functionality of the existing flood protection infrastructure	PA1, PA5, PA8, PA9	n/a	PW5	M33
		27 Providing the ability to conduct icebreaking operations	PA13	n/a	PW6	M35
		28 Construction of mobile flood protection systems	PA1, PA9	RA5, RA6, RA7, RA8, RA9, RA10, RA11	PW2 PW5	M33

Main objective	Number and name of a specific objective	Number and name of an action	Product indicators (PA)	Result indicators (RA)	Classification according to the action type as in Water Law	Type of Action acc. EC
		29 Construction and reconstruction of levees	PA1, PA4, PA8, PA9	RA5, RA6, RA7, RA8, RA9, RA10, RA11, RA12	PW2 PW5	M33
		31 Adjusting capacity of the stream beds or channels for reasonable discharge of flood water on the areas of particular flood risk are characterized by high sensitivity	PA1, PA3	RA5, RA6, RA7, RA8, RA9, RA10, RA11, RA12	PW2 PW5	M33
	1.2. Ensuring reasonable management of flood hazard areas	**5** Development of documents and preparation of grounds for the implementation of the action allowing for specifying the detailed conditions for shaping the spatial development of river valleys or floodplains, in particular areas of high flood risk (Article 165 (1) pt. 1) of the Water Law Act)	PA0, PA1	n/a	PW1 PW4	M21
		9 Development of documents and preparation of grounds for the implementation of the action allowing the purchase of land and buildings in the area of river valleys or floodplains, in particular areas of high flood risk	PA0, PA1	RA5, RA6, RA8, RA9, RA10, RA11	PW1	M22

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Main objective	Number and name of a specific objective	Number and name of an action	Product indicators (PA)	Result indicators (RA)	Classification according to the action type as in Water Law	Type of Action acc. EC
		10 Development of documents and preparation of grounds for the implementation of the action allowing the relocation of objects particularly endangered or hindering the flow of flood waters in the area of river valleys or floodplains, in particular areas of high flood risk	PA0, PA1	RA5, RA6, RA8, RA9, RA10, RA11	PW1	M22
2. Reducing the existing flood risk	**2.1.** Ensuring conditions reducing the possibility of occurrence of floods	**1** Protection or increase of catchment retention on wooded and shrubby forest land	PA0, PA1, PA9	RA1, RA2, RA3, RA5, RA6, RA7, RA8, RA9, RA10, RA11, RA12	PW1 PW4	M31
		2 Protection or increase of catchment retention on agricultural land	PA0, PA1, PA9	RA1, RA2, RA3, RA5, RA6, RA7, RA8, RA9, RA10, RA11, RA12	PW1 PW4	M31
		3 Protection or enlargement of catchment retention on urbanized land	PA0, PA1, PA9	RA1, RA2, RA3, RA4, RA5, RA6,	PW1 PW4	M31

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Main objective	Number and name of a specific objective	Number and name of an action	Product indicators (PA)	Result indicators (RA)	Classification according to the action type as in Water Law	Type of Action acc. EC
				RA7, RA8, RA9, RA10, RA11, RA12		
		4 Protection or increase of river valley retention	PA0, PA1, PA9	RA1, RA2, RA3, RA5, RA6, RA7, RA8, RA9, RA10, RA11, RA12	PW1 PW4	M31
		22 Improvement of rules for control of facilities and technical flood protection devices aimed at reducing the flood wave	PA1, PA7, PA9	RA5, RA11, RA12	PW2	M32
		23 Construction of hydrotechnical water retention facilities	PA1, PA9	RA4, RA5, RA6, RA7, RA8, RA9, RA10, RA11, RA12	PW4 PW5	M32

Main objective	Number and name of a specific objective	Number and name of an action	Product indicators (PA)	Result indicators (RA)	Classification according to the action type as in Water Law	Type of Action acc. EC
		30 Construction of relief channels	PA1, PA3, PA9	RA5, RA6, RA7, RA8, RA9, RA10, RA11, RA12	PW2 PW5	M33
		31 Adjusting capacity of the stream beds or channels for reasonable discharge of flood water on the areas of particular flood risk are characterized by high sensitivity	PA1, PA3	RA5, RA6, RA7, RA8, RA9, RA10, RA11, RA12	PW2 PW5	M33
	2.2. Reduction of the flood hazard areas and ensuring reasonable management of flood hazard areas	**6** Development of documents and preparation of grounds for the implementation of the action allowing to specify the detailed conditions of the use of facilities in flood risk areas	PA0, PA1	RA5, RA11	PW1	M23
		9 Development of documents and preparation of grounds for the implementation of the action allowing the purchase of land and buildings in the area of river valleys or floodplains, in particular areas of high flood risk	PA0, PA1	RA5, RA11	PW1	M22
		10 Development of documents and preparation of grounds for the implementation of the action allowing the relocation of objects particularly endangered or hindering the flow of flood	PA0, PA1	RA5, RA11	PW1	M22

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Main objective	Number and name of a specific objective	Number and name of an action	Product indicators (PA)	Result indicators (RA)	Classification according to the action type as in Water Law	Type of Action acc. EC
		waters in the area of river valleys or floodplains, in particular areas of high flood risk				
		28 Construction of mobile flood protection systems	PA1, PA9	RA5, RA6, RA7, RA8, RA9, RA10, RA11	PW2 PW5	M33
		29 Construction and reconstruction of levees	PA1, PA4, PA8, PA9	RA5, RA6, RA7, RA8, RA9, RA10, RA11, RA12	PW2 PW5	M33
		30 Construction of relief channels	PA1, PA3, PA9	RA5, RA6, RA7, RA8, RA9, RA10, RA11, RA12	PW2 PW5	M33

Main objective	Number and name of a specific objective	Number and name of an action	Product indicators (PA)	Result indicators (RA)	Classification according to the action type as in Water Law	Type of Action acc. EC
		31 Adjusting capacity of the stream beds or channels for reasonable discharge of flood water on the areas of particular flood risk are characterized by high sensitivity	PA1, PA3	RA5, RA6, RA7, RA8, RA9, RA10, RA11, RA12	PW2 PW5	M33
	2.3. Reducing vulnerability of communities and facilities in the flood hazard area	**7** Development of documents and preparation of grounds for the implementation of the action allowing for the development of flood protection instruction for facilities in the flood hazard zone by the facility administrator	PA0, PA1, PA12	RA5, RA11	PW1	M24
		8 Development of documents and preparation of grounds for the implementation of the action allowing the obligation the administrators to undertake actions to reduce vulnerability of facilities in the flood hazard area	PA0, PA1	RA5, RA11	PW1	M23
		10 Development of documents and preparation of grounds for the implementation of the action allowing the relocation of objects particularly endangered or hindering the flow of flood waters in the area of river valleys or floodplains, in particular areas of high flood risk	PA0, PA1	RA5, RA11	PW1	M22

Main objective	Number and name of a specific objective	Number and name of an action	Product indicators (PA)	Result indicators (RA)	Classification according to the action type as in Water Law	Type of Action acc. EC
M233. Improving the flood risk management system powodziowym	**3.1.** Increasing the effectiveness of forecasting and warning about meteorological and hydrological hazards	**13** Development of the national system of forecasts, monitoring, and warnings	PA1, PA10	nd	PW3	M41
		14 Construction and development of local flood warning systems	PA1, PA10	nd	PW3	M41
	3.2. Increasing the effectiveness of response of people, companies and public institutions	**7** Development of documents and preparation of grounds for the implementation of the action allowing for the development of flood protection instruction for facilities in the flood hazard zone by the facility administrator	PA0, PA1, PA12	nd	PW1	M24
		15 Improving crisis management plans (all management levels), including flood hazard maps and flood risk maps	PA1, PA12	nd	BRAK	M42
		21 Initiating research and expert analyzes within the area of flood risk management under uncertainty	PA1	n/a	BRAK	M53
	3.3. Increasing the efficiency of reconstruction and recovery to	**5** Development of documents and preparation of grounds for the implementation of the action allowing for specifying the detailed conditions for shaping the spatial development of river valleys or floodplains, in particular areas of high flood risk (Article 165 (1) pt. 1) of the Water Law Act)	PA0, PA1	n/a	PW1	M21

Main objective	Number and name of a specific objective	Number and name of an action	Product indicators (PA)	Result indicators (RA)	Classification according to the action type as in Water Law	Type of Action acc. EC
	the state from before the flood	**16** Improving the flood recovery "system" for infrastructure	PA0, PA2	n/a	BRAK	M51
		17 Improving material and financial support for victims	PA0, PA2	n/a	BRAK	M51
		18 Improving health (including psychological support) and sanitary assistance for people and veterinary care for animals	PA0, PA1	n/a	BRAK	M51
	3.4. Implementation of the post-flood analyzes and increasing its effectiveness.	**19** Collecting and sharing data and information on damage and flood risk in a standardized form and scope across the country	PA1, PA2	n/a	PW7	M53
		20 Analyzes of effectiveness of the risk management system and recommendations for changes	PA1, PA2	n/a	BRAK	M53
		21 Initiating research and expert analyzes within the area of flood risk management under conditions of uncertainty	PA1	n/a	BRAK	M53
	3.5. Implementation of legal and financial instruments increasing flood safety	**5** Development of documents and preparation of grounds for the implementation of the action allowing for specifying the detailed conditions for shaping the spatial development of river valleys or floodplains, in particular areas of high flood risk (Article 165 (1) pt. 1) of the Water Law Act)	PA0, PA1	n/a	PW1 PW4	M21
		6 Development of documents and preparation of grounds for the implementation of the action allowing to specify the detailed conditions of the use of facilities in flood risk areas	PA0, PA1	n/a	PW1	M23
		7 Development of documents and preparation of grounds for the implementation of the action allowing for the development	PA0, PA1	n/a	PW1	M24

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Main objective	Number and name of a specific objective	Number and name of an action	Product indicators (PA)	Result indicators (RA)	Classification according to the action type as in Water Law	Type of Action acc. EC
		of flood protection instruction for facilities in the flood hazard zone by the facility administrator				
		8 Development of documents and preparation of grounds for the implementation of the action allowing the obligation the administrators to undertake actions to reduce vulnerability of facilities in the flood hazard area	PA0, PA1	n/a	PW1	M23
		9 Development of documents and preparation of grounds for the implementation of the action allowing the purchase of land and buildings in the area of river valleys or floodplains, in particular areas of high flood risk	PA0, PA1	n/a	PW1	M22
		10 Development of documents and preparation of grounds for the implementation of the action allowing the relocation of objects particularly endangered or hindering the flow of flood waters in the area of river valleys or floodplains, in particular areas of high flood risk	PA0, PA1	n/a	PW1	M43
	3.6. Stimulating behaviours increasing flood	**11** Initiating educational programmemes for various recipients, including provision of methodological and educational materials within the area of flood risk management	PA1, PA14	n/a	PW7	M43

Main objective	Number and name of a specific objective	Number and name of an action	Product indicators (PA)	Result indicators (RA)	Classification according to the action type as in Water Law	Type of Action acc. EC
	safety through legal and financial instruments	**12** Implementation of educational and promotional programmemes for various recipients within the area of flood risk management	PA1, PA11	n/a	PW7	M43

Legend:
* Explanations of Product Indicators (PA) are shown in Table no 2
** Explanations of the result indicators (RAs) are shown in Table no 3

7.4. HIERARCHIZING THE TYPES OF ACTIONS AT THE LEVEL OF WATER REGIONS AND ADVANCED AREAS

The following general principle was adopted for assigning priorities to types of actions in aFRMP on the basis of the assessment of: relevance of specific objectives in the implementation of the main objective and significance of types of actions in the implementation of the specific objective.

Table no 8 The principle of hierarchizing types of actions

Relevance of specific objectives in achieving the main objective	Relevance of types of actions in implementation of the specific objective		
1	Low priority	Low priority	Low priority
2	Low priority	Moderate priority	Moderate priority
3	Moderate priority	High priority	High priority

Assessment of the significance of specific objectives in relation to the main objectives and the significance of types of actions in relation to specific objectives (described in the above subchapters) will allow to determine the priority of implementation of individual types of actions. A three-level prioritization scale was adopted:

- high priority (WP) - indicates types of activities that are very significant and essential for the implementation of specific objectives that most effectively implement the main objectives, hence they are types of actions that require urgent implementation/ absolute implementation in the current planning cycle;
- medium priority (CA) - indicates the types of actions which are insignificant for the implementation of specific objectives that most effectively implement the main objectives and activities that, in a very significant and significant way for the implementation of specific objectives, effectively implement the main objectives, hence these are types of activities that should be taken in the current planning cycle and may be continued in the next planning cycle;
- low priority (NP) - indicates the types of other actions that should be initiated in the current planning cycle as resources are available

The prioritization of types of actions will be helpful in assigning the priority to the specific actions, dedicated to reducing the adverse consequences of floods in the AEFH where problem areas have been identified, as well as in other AEFH.

7.5. FORM TEMPLATE/ACTION TYPE CHARTS

Action type cards will be developed for each type of action included in the catalogue of action types, which will be ultimately agreed with the Ordering Party.

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Legal basis[9] will be identified for each type of action. The results of the evaluation will also be transferred, on whether a given type of action fits into implementation of each type of action listed in Art. 165(1) of the Water Law. Institutions responsible for the implementation of the type of action will be listed and it will be specified whether the implementation of the type of action is a legal requirement, whether the type of action is currently being implemented and in the case of other types of action, whether it is possible to implement them in the years 2022-2027.

The card will present a synthetic description of the type of action, along with the definition of the need to which this type is to respond (satisfy), as well as the expected effect of its implementation in the context of reducing flood risk. In addition, it will be specified:

- the impact of implementation of the type of action on achieving the objectives of the Floods Directive, understood as minimizing the flood risk (YES - means that this impact exists, NO - no impact),
- the impact of the implementation of the type of action on the environment and on the achievement of environmental objectives in line with the Water Framework Directive,
- range of impact resulting from its implementation (S - state, R - regional, L - local).

In order to determine whether the effects of the implementation of the types of actions will be measurable, product indicators (PA) and/or result indicators (RA) will be assigned to each type of action, if possible. The result of the implementation of types of actions may be defined in the following categories: reduction of intensity of the flood phenomenon, reduction of exposure of sensitive objects, reduction of vulnerability of objects located in the flood hazard zone and improvement of the effectiveness of the flood protection system in order to limit the scale of consequences of extreme flood events.

Additionally, the action type cards will contain assessment of their flexibility. This is a very important feature of the types of actions, in the context of possible uncertainty of the potential flood risk and changes in its scale resulting, for example, from climate change and possible anthropogenic changes in land use within the catchment area (YES - means that the type of action is potentially more or less flexible, NO - means no or little flexibility, YES/NO - most often it concerns a group of actions within which some actions may be flexible, and some do not have this feature). Flexible types of actions should be understood as types of actions for which it is possible to modify them relatively easily in the event of climate change or land development within the catchment area (adapting the action to the new situation). These are mainly non-technical actions, consisting in increasing the resistance to flood (reducing the vulnerability) of facilities and communities, increasing the natural retention of the catchment, etc. The actions that are inflexible or inelastic (not subject to changes at all without large financial outlays) include mainly hydrotechnical protection against flood.

The action type chart is shown below.

9 the above-mentioned legal provisions are indicative

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Table no 9 Action type chart design

Name of action type			
Main objective			
Specific objective			
Legal basis: Type of action from Art. 165(1) of Water Law			
Responsible units (YES/NO):			
Having a legal obligation to implement the type of action	Currently implementing the type of action	Declaring willingness and possibility of implementing the type of action in the years 2022-2027	
Synthetic description of the type of action:			
Reason for implementing the type of action:			
Expected effect:			
Actions of effectiveness in the implementation of the type of action (YES/NO): YES – indicators (below) NO – a descriptive way of measuring progress			
Product indicators (PA):			
Result indicators (RA) in the field:			
Reduction of the intensity of the phanomenon	Reduction of exposure of sensitive objects	Reduction of the vulnerability of objects	Improving the adaptability of the community
Impact on the implementation of the Floods Directive objectives in the area (YES/NO):			
Human health and life	Cultural heritage	Environment	Economic action
Impact on the environment and on the implementation of the environmental objectives listed in Art. 4 of WFD			
Environment:		Environmental objectives:	
Range of impact (local, regional, state):			
Flexibility (ease of modification) due to (YES/NO):			
Climate changes:	Anthropogenic changes in land development:		

Impact scale: negative (-, -) strong / weak, (0) neutral, positive (+, ++) weak / strong

8. PERFORMANCE OF ANALYZES, DIAGNOSIS OF PROBLEMS

8.1. ANALYSIS OF SPATIAL DISTRIBUTION OF THE FLOOD RISK

8.1.1. Introduction

Methodology of the analysis of the spatial distribution of flood risk is a continuation of the methodological assumptions of flood risk assessments, carried out both under the aPFRA and the FRMP in the first planning cycle.

The aim of analysis is to identify problem areas characterized by the highest level of integrated flood risk - for these areas, at further stages of the development of aFRMP/FRMP, actions related to achieving the assigned objectives of flood risk management will be indicated.

The analysis concerns:

- river floods with a natural flood mechanism (A11),
- river floods resulting from overflow or destruction of flood embankments (A23),
- floods resulting from the destruction or damage to damming structures (A15).

The analysis does not apply to floods from the sea, including internal sea water, for which the aPFRA also indicates the AEFH - the risk for these floods is analyzed in separate flood risk management plans from the sea, including internal sea water.

The analysis concerns both the current state of flood risk and its prospective changes (taking into account the forecast of changes in the conditions affecting the level of flood risk).

The applied flood risk assessment is based directly on the definition of flood risk specified in the Floods Directive (Article 2 (2)) and the Water Law (Article 16 (48)), according to which "*flood risk*" means *a combination of the probability of a flood and the related with a flood of potential negative consequences for human life and health, the environment, cultural heritage and economic action.*

8.1.2. Methodology of analysis for river floods with natural flood mechanism (A11)

The analysis of the spatial distribution of flood risk for river floods with the natural flood mechanism (A11) is carried out primarily on the basis of the FHM and FRM applicable in the second planning cycle, including:

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- FHM from the first cycle, which were not subject to update
- FHM and FRM from the first cycle, which were subject to update
- FHM and FRM developed in the second cycle.

For the parts of the AEFH newly designated in aPFRA in the second planning cycle, for which FHM and FRM have not been developed - a simplified analysis is used, which allows to determine the level of flood risk, synchronized methodically with the main analysis carried out for the AEFH with available information. In the case of incomplete input data, the results of aPFRA are primarily used.

The analysis consists of several stages:

- Preparation of spatial analytical units (SAU).
- Assessment of potential adverse effects of floods.
- Flood risk assessment.
- Assessment of prospective changes in flood risk, including identification of change trends.
- Flood risk assessment taking into account prospective changes.
- Identification of problem areas.

A detailed description of individual stages is presented below, taking into account availability of the input data of the analysis - in the case of having a complete set of data (i.e. available FHM and FRM) and in the case of incomplete data (i.e. no developed FHM or FRM).

8.1.2.1. Methodology of analysis based on a set of input data (available FHM and FRM)

Preparation of spatial analytical units (SAU)

SAU are created in the same manner as the units adopted in aPFRA; they are the result of intersection of flood hazard areas (FHA) for the probability of a flood of 1% (FHM) and elementary catchments (MPHP10k). At the same time, small polygons (<400 m2), resulting from intersection of the above-mentioned FHA and the catchment area, by connecting them to the adjacent catchment area, when they are located within the catchment area of the same homogenous water bodies.

The units are developed in a manner allowing them to be seamlessly aggregated into larger spatial units with a hydrographic structure, including AEFH, planning catchment and HWB, and at the same time correspond to the main objective of the analysis, i.e. identification of problem areas.

Assessment of potential adverse effects of floods

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The assessment of potential adverse effects of floods is based on the calculation of indicators for assessing the potential adverse effects of floods for individual SAUs. The list of the above-mentioned assessment indicators, taking into account the categories of flood effects, are presented in the table below.

Table no 10 Indicators of assessment of potential adverse effects of floods

Indicator number	Flood effects category	An indicator of assessing potential adverse effects of floods	Unit
1	Human Health	Inhabitants	persons/km^2
2		Buildings - social utility facilities social facilities (buildings) accommodating: - children and adolescents (orphanage, student dormitory, boarding school, school, kindergarten, nursery), - people with reduced mobility (hospital, hospice, social care home, social welfare centre, sanatorium), - people with limited decision-making abilities (correctional facility, pre-trial detention centre, foster home, correctional facility)	piece/km^2
3	Environment	Industrial plants facilities posing a potential threat to the environment	For a total of facilities piece/km^2
4		Landfills facilities posing a potential threat to the environment	
5		Sewage treatment plants and pumping stations facilities posing a potential threat to the environment	
6		Cemeteries Facilities posing a potential threat to the environment	
7	Environment	Water intake	piece/km^2
8		Nature protection forms	%
9	Cultural Heritage	Culturally valuable facilities and areas	piece/km^2
10	Business Activity	Average annual damage (AAD)	PLN/km^2

Indicators are calculated for all SAUs. Due to the different area of SAUs, the indicators are normalized, which enables their comparison and hierarchy.

The basis for calculating the indicators are data from flood risk maps (FRM).

In order to be included in the analysis, polygon objects (buildings - social utility facilities, landfills, cemeteries, culturally valuable areas) are transformed into point objects (centroids).

The detailed method of developing individual indicators is presented below.

Indicator No 1: Inhabitants

data source: FRM, BUILDINGS layer (for flood scenario 1%)

calculation method:

- selection of residential buildings for SAU,
- transforming selected polygon objects into point objects,
- summing up the data on the estimated number of inhabitants in the building for SAU,
- reference to the SAU area [person/km^2].

Indicator No 2: Buildings - social utility facilities

data source: FRM, BUILDINGS layer (for flood scenario 1%)

calculation method:

- selection of buildings of social importance for SAU,
- transforming selected polygon objects into point objects,
- reference to the SAU area [pcs/km^2].

Indicator No 3: Industrial plants

data source: FRM, INDUSTRIAL PLANTS layer (for the flood scenario 1%)

calculation method:

- selection of bets for SAU.

Indicator No 4: Landfills

data source: FRM, landfill layer (for flood scenario 1%)

calculation method:

- selection of landfills for SAU,
- transforming selected polygon features into point features.

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Indicator N. 5: Sewage treatment plants and pumping stations

data source: FRM, PUMP CLEANING layer (for the flood scenario 1%)

calculation method:

- selection of sewage treatment plants and pumping stations for SAU.

Indicator No 6: Cemeteries

data source: FRM, CEMETERY layer (for the flood scenario 1%)

calculation method:

- selection of cemeteries for SAU,
- transforming selected polygon features into point features.

NOTE:

In the case of the environment category, objects posing a threat to the environment in a given SAU are summed up, and the importance for industrial plants (as objects posing a high threat to the environment) is increased, in accordance with the formula:

Nsrod = 1,5 · Nzd + Nskl + Nocz + Ncm

where:

Nsrod - number of objects posing a threat to the environment,

Nzd - number of industrial plants,

Nskl - number of waste landfills,

Nocz - number of sewage treatment plants and pumping stations,

Ncm - number of cemeteries.

The sum of objects (Nsrod) refers to the SAU area [pcs/km2].

- Indicator No 7: Water intakes

data source: FRM, WATER JET layer (for the flood scenario 1%)

calculation method:

- selection of water intakes for SAU,
- reference to the SAU area [pcs/km^2].

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Indicator No 8: Forms of nature protection

data source: FRM, FORMS OF NATURE PROTECTION layer (for the flood scenario 1%)

calculation method:

- selection of objects related to forms of nature protection for SAU,
- calculation of the percentage of nature protection forms in the SAU area [%].

Indicator No 9: Culturally valuable facilities and areas

data source: FRM, layers CULTURAL VALUES and CULTURAL VALUES (for the flood scenario 1%)

calculation method:

- selection of culturally valuable facilities and areas for SAU,
- transforming selected polygon objects into point objects,
- reference to the SAU area [pcs/km^2].

Indicator No. 10: Flood loss value (AAD)

data source: FRM, layers USAGE LOSS (for flood scenario 0.2%, 1%, 10%)

calculation method:

- calculation of the value of potential flood losses for SAU for the flood scenario 0.2%, 1%, 10%,
- calculation of the value of potential annual average flood losses for SAU (the so-called AAD method),
- comparison of the value of potential annual average flood losses to the SAU area [pcs/km^2].

Flood risk assessment

Based on the calculated indicators of potential adverse effects of floods, each SAU is assigned a score corresponding to a given indicator (on a scale of 1-5) reflecting the level of flood risk. The assignment of scores is a consequence of the analysis of the distribution of the values of individual assessment indicators for all of the SAU analyzed (i.e. for the entire country) according to the assumptions presented below.

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Table no 11 Assumptions for allocating the number of points

Number of points	Value
1 point	value 0
2 points	percentile: < 25
3 points	percentile: <25, 50)
4 points	percentile: <50, 75)
5 points	percentile: ≥ 75

Based on the assigned scores, the level of flood risk is then determined. A five-level scale of flood risk levels, which is presented below, is assumed.

Table no 12 Scale of risk levels

Risk level	Explanation
level 1	very low flood risk
level 2	low flood risk
level 3	medium flood risk
level 4	high flood risk
level 5	very high flood risk

The level of flood risk is assigned to each SAU separately for individual categories of flood effects, ie human health, environment, cultural heritage and economic action.

For the cultural heritage and economic action category, the number of points assigned corresponds directly to the level of flood risk.

For the human health and environment categories, several indicators describe the situation and a procedure is therefore in place to include all of them.

In the case of the human health category, the level of flood risk is assigned on the basis of the sum of points defined for indicators no 1 inhabitants and no 2 buildings - social facilities, according to the assignment presented below.

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Table no 13 Assignment of the risk level

Total number of points	Flood risk level
2	1: very low flood risk
3 and 4	2: low flood risk
5 and 6	3: medium flood risk
7 and 8	4: high flood risk
9 and 10	5: very high flood risk

In the case of the environment category, the level of flood risk is assigned on the basis of the indicator to objects posing a threat to the environment, while for SAU, for which the score for indicator 7 of water intake ≥ 4, the flood risk level is increased by 1, and then for SAU, for which the score is for indicator 8, forms of nature protection, water intake ≥ 4, the flood risk level is reduced by 1.

Based on the levels of flood risk for individual categories of flood effects, each SAU is assigned a total risk level in the form of an integrated flood risk level, in accordance with the formula:

$RW = a \cdot RZ + b \cdot RS + c \cdot RK + d \cdot RG$

where:

RW - level of integrated flood risk,

RZ - risk level for the flood effects category: human health,

RS - risk level for the flood effects category: environment,

RK - risk level for the flood consequence category: cultural heritage,

RG - risk level for the flood effects category: economic action,

a, b, c, d - weighting factors for individual categories of flood effects determined on the basis of expert judgment, using the method of hierarchical analysis of the AHP problem, the following coefficients were adopted:

a = 0.5 weighting factor relating to the level of flood risk for the flood effect category: human health,

b = 0.145 weight factor relating to the level of flood risk for the flood effects category: environment,

c = 0.155 weighting factor relating to the level of flood risk for the flood effect category: cultural heritage,

d = 0.2 - weighting factor referring to the level of flood risk for the flood effect category: economic activity.

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Above the weighting factors were developed jointly by the Ordering Party and the Contractor. In the first stage of work on the coefficients, the catchment planning teams and the Contractor's teams determined the weighting factors using the method of hierarchical analysis of the AHP problem (Analytical Hierarchy Process, Saaty's method). This method enables a multi-criteria analysis taking into account the preferences (relationships) specified for individual criteria (i.e. the flood effect category) on the basis of the AHP Preference Scale, including integer values from 1 to 9 (Winnicki et al. 2006, Downarowicz et al. 2000) 14.

Table no 14 AHP Preference Scale

The importance of decision-making elements	Descriptive expression of importance of decision elements	Assigned values
Equivalence	X has the same meaning as Y (both contribute equally to achieving the objective)	1
Weak or moderate	X is slightly more important than Y (unconvincing meaning or weak preference of one element over another)	3
Relevant, essential, strong	X is clearly more important than Y (essential or strong importance or strong preference of one element over another)	5
Determined or very strong	X is absolutely more important than Y (decisive importance or very strong preference of one element over another)	7
Absolute	X is absolutely more important than Y (absolute importance or absolute preference of one element over another)	9

When determining the reciprocal of Y to X, the inverse values resulting from the relationship X to Y are assigned.

On the basis of the relationships for individual categories of flood effects specified by the catchment planning teams and the Contractor's teams, accident relationships (Table no 15)

Table no 15 Accident relationships for individual categories of flood effects

	Human health	Environment	Cultural heritage	Economic action
Human health	---	7	7	5
Environment	1/7	---	1	3
Cultural heritage	1/7	1	---	1
Economic action	1/5	1/3	1	---

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The coefficients obtained on the basis of the above-mentioned accident relations have been additionally verified by experts, bearing in mind their importance in the analysis of the spatial flood risk distribution.

Assessment of prospective changes in flood risk, including identification of change trends

The assessment of prospective flood risk changes is based on the calculation of indicators for the assessment of prospective flood risk changes for individual SAUs. The list of the above-mentioned assessment indicators are presented in Table no 16.

Table no 16 Indicators of the assessment of prospective flood risk changes

Indicator number	Indicator of assessment of prospective flood risk changes	Unit
11	Change in population	os.
12	Change in spatial development in terms of changing the surface of built-up areas or sealed areas	%
13	Impact of climate change on the occurrence of floods - the percentage change in high Q90 flow in 2021-2050 (the so-called near future) for the RCP 4.5 scenario	%
14	Impact of climate change on occurrence of floods - the percentage change in high Q90 flow in 2021-2050 (the so-called near future) for the RCP 8.5 scenario	%

Indicators are calculated for all SAUs.

The aPFRA data are the basis for determining the indicators.

The detailed method of developing individual indicators is presented below.

Indicator No 11: Change in population

source of data: GUS data on the population in 2010 and 2016 in communes (aPFRA)

calculation method:

- determination of population change for SAU,
- determination of the score determining the prospective change in flood risk, assuming a score scale of -5 ÷ 5 (according to Table no 17).

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Table no 17 Scoring method for the indicator of prospective changes in flood risk related to population change

Change in the number of population [persons]	Punctation
< -200	-5
<-200, -100)	-4
<-100, -50)	-3
<-50, -5)	-2
<-5, 0)	-1
0	0
(0, 5)	1
<5, 50)	2
<50, 100)	3
<100, 200)	4
≥ 200	5

Indicator No 12: Change in spatial development in terms of changing the surface of built-up areas or sealed areas

data source: Corine Land Cover 2018 (aPFRA update)

Calculation method:

- calculation for SAU of the area of areas for which a decrease in flood risk has been demonstrated (in accordance with the classification presented in Table no 16),
- calculation for SAU of the area of areas for which an increase in flood risk has been demonstrated (in accordance with the classification presented in Table no 16),
- calculation for SAU of the total percentage of the area of areas for which a decrease in flood risk was demonstrated, and areas for which an increase in flood risk was demonstrated [%],
- determination of the score determining the prospective change in flood risk, assuming a score scale of -5 ÷ 5 (according to Table no 17).

Table no 18 Determination of the decrease/increase in flood risk on the basis of changes in land cover forms according to CLC 2018

Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
112-121	112	Loose urban development	121	Industrial or commercial grounds	NC

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Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
112-122	112	Loose urban development	122	Communication areas and areas related to road and rail communication	NC
112-131	112	Loose urban development	131	Opencast mining sites	DECREASE
112-133	112	Loose urban development	133	Construction sites	DECREASE
112-142	112	Loose urban development	142	Sports and leisure areas	DECREASE
121-122	121	Industrial or commercial grounds	122	Communication areas and areas related to road and rail communication	NC
121-131	121	Industrial or commercial grounds	131	Opencast mining sites	DECREASE
121-133	121	Industrial or commercial grounds	133	Construction sites	DECREASE
121-231	121	Industrial or commercial grounds	231	Meadows, pastures	DECREASE
124-112	124	Airports	112	Loose urban development	NC
124-121	124	Airports	121	Industrial or commercial grounds	NC
124-133	124	Airports	133	Construction sites	DECREASE
124-324	124	Airports	324	Forests and shrub vegetation in a state of change	DECREASE
131-112	131	Opencast mining sites	112	Loose urban development	INCREASE
131-121	131	Opencast mining sites	121	Industrial or commercial grounds	INCREASE
131-122	131	Opencast mining sites	122	Communication areas and areas related to road and rail communication	INCREASE
131-211	131	Opencast mining sites	211	Arable land beyond the range of irrigation equipment	NC
131-231	131	Opencast mining sites	231	Meadows, pastures	NC
131-324	131	Opencast mining sites	324	Forests and shrub vegetation in a state of change	NC
131-512	131	Opencast mining sites	512	Water reservoirs	DECREASE
132-122	132	Dumps and heaps	122	Communication areas and areas related to road and rail communication	INCREASE

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Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
132-231	132	Dumps and heaps	231	Meadows, pastures	NC
132-324	132	Dumps and heaps	324	Forests and shrub vegetation in a state of change	NC
133-112	133	Construction sites	112	Loose urban development	INCREASE
133-121	133	Construction sites	121	Industrial or commercial grounds	INCREASE
133-122	133	Construction sites	122	Communication areas and areas related to road and rail communication	INCREASE
133-123	133	Construction sites	123	Ports	INCREASE
133-124	133	Construction sites	124	Airports	INCREASE
133-131	133	Construction sites	131	Opencast mining sites	NC
133-142	133	Construction sites	142	Sports and leisure areas	NC
133-211	133	Construction sites	211	Arable land beyond the range of irrigation equipment	NC
133-231	133	Construction sites	231	Meadows, pastures	NC
133-242	133	Construction sites	242	Complex systems of cultivation and plots	NC
133-512	133	Construction sites	512	Water reservoirs	DECREASE
141-112	141	Green areas	112	Loose urban development	INCREASE
141-121	141	Green areas	121	Industrial or commercial grounds	INCREASE
141-133	141	Green areas	133	Construction sites	NC
142-112	142	Sports and leisure areas	112	Loose urban development	INCREASE
142-121	142	Sports and leisure areas	121	Industrial or commercial grounds	INCREASE
142-122	142	Sports and leisure areas	122	Communication areas and areas related to road and rail communication	INCREASE
142-124	142	Sports and leisure areas	124	Airports	INCREASE
142-132	142	Sports and leisure areas	132	Dumps and heaps	NC
142-133	142	Sports and leisure areas	133	Construction sites	NC

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Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
142-211	142	Sports and leisure areas	211	Arable land beyond the range of irrigation equipment	NC
211-112	211	Arable land beyond the range of irrigation equipment	112	Loose urban development	INCREASE
211-121	211	Arable land beyond the range of irrigation equipment	121	Industrial or commercial grounds	INCREASE
211-122	211	Arable land beyond the range of irrigation equipment	122	Communication areas and areas related to road and rail communication	INCREASE
211-124	211	Arable land beyond the range of irrigation equipment	124	Airports	INCREASE
211-131	211	Arable land beyond the range of irrigation equipment	131	Opencast mining sites	NC
211-132	211	Arable land beyond the range of irrigation equipment	132	Dumps and heaps	NC
211-133	211	Arable land beyond the range of irrigation equipment	133	Construction sites	NC
211-142	211	Arable land beyond the range of irrigation equipment	142	Sports and leisure areas	NC
211-222	211	Arable land beyond the range of irrigation equipment	222	Orchards and plantations	NC

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Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
211-231	211	Arable land beyond the range of irrigation equipment	231	Meadows, pastures	NC
211-242	211	Arable land beyond the range of irrigation equipment	242	Complex systems of cultivation and plots	NC
211-243	211	Arable land beyond the range of irrigation equipment	243	The areas are mainly occupied by agriculture with a large share of natural areas	NC
211-311	211	Arable land beyond the range of irrigation equipment	311	Deciduous forests	NC
211-312	211	Arable land beyond the range of irrigation equipment	312	Coniferous forests	NC
211-313	211	Arable land beyond the range of irrigation equipment	313	Mixed forests	NC
211-324	211	Arable land beyond the range of irrigation equipment	324	Forests and shrub vegetation in a state of change	NC
211-512	211	Arable land beyond the range of irrigation equipment	512	Water reservoirs	DECREASE
222-112	222	Orchards and plantations	112	Loose urban development	INCREASE
222-121	222	Orchards and plantations	121	Industrial or commercial grounds	INCREASE
222-122	222	Orchards and plantations	122	Communication areas and areas related to road and rail communication	INCREASE

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Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
222-133	222	Orchards and plantations	133	Construction sites	NC
222-211	222	Orchards and plantations	211	Arable land beyond the range of irrigation equipment	NC
222-231	222	Orchards and plantations	231	Meadows, pastures	NC
222-324	222	Orchards and plantations	324	Forests and shrub vegetation in a state of change	NC
222-512	222	Orchards and plantations	512	Water reservoirs	DECREASE
231-112	231	Meadows, pastures	112	Loose urban development	INCREASE
231-121	231	Meadows, pastures	121	Industrial or commercial grounds	INCREASE
231-122	231	Meadows, pastures	122	Communication areas and areas related to road and rail communication	INCREASE
231-124	231	Meadows, pastures	124	Airports	INCREASE
231-131	231	Meadows, pastures	131	Opencast mining sites	NC
231-132	231	Meadows, pastures	132	Dumps and heaps	NC
231-133	231	Meadows, pastures	133	Construction sites	NC
231-142	231	Meadows, pastures	142	Sports and leisure areas	NC
231-211	231	Meadows, pastures	211	Arable land beyond the range of irrigation equipment	NC
231-222	231	Meadows, pastures	222	Orchards and plantations	NC
231-242	231	Meadows, pastures	242	Complex systems of cultivation and plots	NC
231-243	231	Meadows, pastures	243	The areas are mainly occupied by agriculture with a large share of natural areas	NC
231-311	231	Meadows, pastures	311	Deciduous forests	NC
231-312	231	Meadows, pastures	312	Coniferous forests	NC
231-313	231	Meadows, pastures	313	Mixed forests	NC
231-324	231	Meadows, pastures	324	Forests and shrub vegetation in a state of change	NC
231-512	231	Meadows, pastures	512	Water reservoirs	DECREASE

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Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
242-112	242	Complex systems of cultivation and plots	112	Loose urban development	INCREASE
242-121	242	Complex systems of cultivation and plots	121	Industrial or commercial grounds	INCREASE
242-122	242	Complex systems of cultivation and plots	122	Communication areas and areas related to road and rail communication	INCREASE
242-124	242	Complex systems of cultivation and plots	124	Airports	INCREASE
242-131	242	Complex systems of cultivation and plots	131	Opencast mining sites	NC
242-132	242	Complex systems of cultivation and plots	132	Dumps and heaps	NC
242-133	242	Complex systems of cultivation and plots	133	Construction sites	NC
242-211	242	Complex systems of cultivation and plots	211	Arable land beyond the range of irrigation equipment	NC
242-324	242	Complex systems of cultivation and plots	324	Forests and shrub vegetation in a state of change	NC
242-512	242	Complex systems of cultivation and plots	512	Water reservoirs	DECREASE
243-112	243	The areas are mainly occupied by agriculture with a large share of natural areas	112	Loose urban development	INCREASE

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Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
243-121	243	The areas are mainly occupied by agriculture with a large share of natural areas	121	Industrial or commercial grounds	INCREASE
243-122	243	The areas are mainly occupied by agriculture with a large share of natural areas	122	Communication areas and areas related to road and rail communication	INCREASE
243-124	243	The areas are mainly occupied by agriculture with a large share of natural areas	124	Airports	INCREASE
243-131	243	The areas are mainly occupied by agriculture with a large share of natural areas	131	Opencast mining sites	NC
243-132	243	The areas are mainly occupied by agriculture with a large share of natural areas	132	Dumps and heaps	NC
243-133	243	The areas are mainly occupied by agriculture with a large share of natural areas	133	Construction sites	NC
243-211	243	The areas are mainly occupied by agriculture with a large share of natural areas	211	Arable land beyond the range of irrigation equipment	NC
243-242	243	The areas are mainly occupied by agriculture with a large share of natural areas	242	Complex systems of cultivation and plots	NC

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Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
243-311	243	The areas are mainly occupied by agriculture with a large share of natural areas	311	Deciduous forests	NC
243-312	243	The areas are mainly occupied by agriculture with a large share of natural areas	312	Coniferous forests	NC
243-313	243	The areas are mainly occupied by agriculture with a large share of natural areas	313	Mixed forests	NC
243-324	243	The areas are mainly occupied by agriculture with a large share of natural areas	324	Forests and shrub vegetation in a state of change	NC
243-512	243	The areas are mainly occupied by agriculture with a large share of natural areas	512	Water reservoirs	DECREASE
311-112	311	Deciduous forests	112	Loose urban development	INCREASE
311-121	311	Deciduous forests	121	Industrial or commercial grounds	INCREASE
311-122	311	Deciduous forests	122	Communication areas and areas related to road and rail communication	INCREASE
311-124	311	Deciduous forests	124	Airports	INCREASE
311-131	311	Deciduous forests	131	Opencast mining sites	NC
311-132	311	Deciduous forests	132	Dumps and heaps	NC
311-133	311	Deciduous forests	133	Construction sites	NC
311-211	311	Deciduous forests	211	Arable land beyond the range of irrigation equipment	NC

Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
311-231	311	Deciduous forests	231	Meadows, pastures	NC
311-324	311	Deciduous forests	324	Forests and shrub vegetation in a state of change	NC
311-412	311	Deciduous forests	412	Peatlands	NC
311-512	311	Deciduous forests	512	Water reservoirs	DECREASE
312-112	312	Coniferous forests	112	Loose urban development	INCREASE
312-121	312	Coniferous forests	121	Industrial or commercial grounds	INCREASE
312-122	312	Coniferous forests	122	Communication areas and areas related to road and rail communication	INCREASE
312-124	312	Coniferous forests	124	Airports	INCREASE
312-131	312	Coniferous forests	131	Opencast mining sites	NC
312-132	312	Coniferous forests	132	Dumps and heaps	NC
312-133	312	Coniferous forests	133	Construction sites	NC
312-142	312	Coniferous forests	142	Sports and leisure areas	NC
312-211	312	Coniferous forests	211	Arable land beyond the range of irrigation equipment	NC
312-231	312	Coniferous forests	231	Meadows, pastures	NC
312-313	312	Coniferous forests	313	Mixed forests	NC
312-321	312	Coniferous forests	321	Grasslands and natural pastures	NC
312-324	312	Coniferous forests	324	Forests and shrub vegetation in a state of change	NC
312-411	312	Coniferous forests	411	Inland marshes	DECREASE
312-512	312	Coniferous forests	512	Water reservoirs	DECREASE
313-112	313	Mixed forests	112	Loose urban development	INCREASE
313-121	313	Mixed forests	121	Industrial or commercial grounds	INCREASE
313-122	313	Mixed forests	122	Communication areas and areas related to road and rail communication	INCREASE

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Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
313-124	313	Mixed forests	124	Airports	INCREASE
313-131	313	Mixed forests	131	Opencast mining sites	NC
313-133	313	Mixed forests	133	Construction sites	NC
313-142	313	Mixed forests	142	Sports and leisure areas	NC
313-211	313	Mixed forests	211	Arable land beyond the range of irrigation equipment	NC
313-311	313	Mixed forests	311	Deciduous forests	NC
313-312	313	Mixed forests	312	Coniferous forests	NC
313-321	313	Mixed forests	321	Grasslands and natural pastures	NC
313-324	313	Mixed forests	324	Forests and shrub vegetation in a state of change	NC
313-512	313	Mixed forests	512	Water reservoirs	DECREASE
321-112	321	Grasslands and natural pastures	112	Loose urban development	INCREASE
321-231	321	Grasslands and natural pastures	231	Meadows, pastures	NC
321-324	321	Grasslands and natural pastures	324	Forests and shrub vegetation in a state of change	NC
321-333	321	Grasslands and natural pastures	333	Scattered vegetation	NC
321-512	321	Grasslands and natural pastures	512	Water reservoirs	DECREASE
322-324	322	Moors and bushes	324	Forests and shrub vegetation in a state of change	NC
324-112	324	Forests and shrub vegetation in a state of change	112	Loose urban development	INCREASE
324-121	324	Forests and shrub vegetation in a state of change	121	Industrial or commercial grounds	INCREASE
324-122	324	Forests and shrub vegetation in a state of change	122	Communication areas and areas related to road and rail communication	INCREASE
324-123	324	Forests and shrub	123	Ports	INCREASE

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Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
		vegetation in a state of change			
324-124	324	Forests and shrub vegetation in a state of change	124	Airports	INCREASE
324-131	324	Forests and shrub vegetation in a state of change	131	Opencast mining sites	NC
324-132	324	Forests and shrub vegetation in a state of change	132	Dumps and heaps	NC
324-133	324	Forests and shrub vegetation in a state of change	133	Construction sites	NC
324-211	324	Forests and shrub vegetation in a state of change	211	Arable land beyond the range of irrigation equipment	NC
324-231	324	Forests and shrub vegetation in a state of change	231	Meadows, pastures	NC
324-242	324	Forests and shrub vegetation in a state of change	242	Complex systems of cultivation and plots	NC
324-311	324	Forests and shrub vegetation in a state of change	311	Deciduous forests	NC
324-312	324	Forests and shrub vegetation in a state of change	312	Coniferous forests	NC
324-313	324	Forests and shrub vegetation in a state of change	313	Mixed forests	NC
324-512	324	Forests and shrub vegetation in a state of change	512	Water reservoirs	DECREASE

Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
333-321	333	Scattered vegetation	321	Grasslands and natural pastures	NC
333-322	333	Scattered vegetation	322	Moors and bushes	NC
333-324	333	Scattered vegetation	324	Forests and shrub vegetation in a state of change	NC
333-512	333	Scattered vegetation	512	Water reservoirs	DECREASE
411-131	411	Inland marshes	131	Opencast mining sites	INCREASE
411-133	411	Inland marshes	133	Construction sites	INCREASE
411-512	411	Inland marshes	512	Water reservoirs	NC
511-122	511	Watercourses	122	Communication areas and areas related to road and rail communication	INCREASE
511-512	511	Watercourses	512	Water reservoirs	NC
512-122	512	Water reservoirs	122	Communication areas and areas related to road and rail communication	INCREASE
512-131	512	Water reservoirs	131	Opencast mining sites	INCREASE
512-324	512	Water reservoirs	324	Forests and shrub vegetation in a state of change	INCREASE
512-411	512	Water reservoirs	411	Inland marshes	NC
523-123	523	Morza i oceany	123	Ports	INCREASE
112-231	112	Loose urban development	231	Meadows, pastures	DECREASE
231-141	231	Meadows, pastures	141	Green areas	NC
121-112	121	Industrial or commercial grounds	112	Loose urban development	NC
121-211	121	Industrial or commercial grounds	211	Arable land beyond the range of irrigation equipment	DECREASE
121-243	121	Industrial or commercial grounds	243	The areas are mainly occupied by agriculture with a high proportion of natural vegetation	DECREASE
131-132	131	Opencast mining sites	132	Dumps and heaps	NC
131-142	131	Opencast mining sites	142	Sports and leisure areas	NC

Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
131-243	131	Opencast mining sites	243	The areas are mainly occupied by agriculture with a high proportion of natural vegetation	NC
132-512	132	Dumps and heaps	512	Water reservoirs	DECREASE
133-132	133	Construction sites	132	Dumps and heaps	NC
133-324	133	Construction sites	324	Forests and shrub vegetation in a state of change	NC
141-142	141	Green areas	142	Sports and leisure areas	NC
211-111	211	Arable land beyond the range of irrigation equipment	111	Dense urban development	INCREASE
411-324	411	Inland marshes	324	Forests and shrub vegetation in a state of change	INCREASE
222-242	222	Orchards and plantations	242	Complex systems of cultivation and plots	NC
231-123	231	Meadows, pastures	123	Ports	INCREASE
243-142	243	The areas are mainly occupied by agriculture with a high proportion of natural vegetation	142	Sports and leisure areas	NC
243-231	243	The areas are mainly occupied by agriculture with a high proportion of natural vegetation	231	Meadows, pastures	NC
311-321	311	Deciduous forests	321	Grasslands and natural pastures	NC
312-242	312	Coniferous forests	242	Complex systems of cultivation and plots	NC
312-243	312	Coniferous forests	243	The areas are mainly occupied by agriculture with a high proportion of natural vegetation	NC
312-322	312	Coniferous forests	322	Moors and bushes	NC

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Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
312-334	312	Coniferous forests	334	Site of fire	NC
324-321	324	Forests and shrub vegetation in a state of change	321	Grasslands and natural pastures	NC
313-123	313	Mixed forests	123	Ports	INCREASE
313-231	313	Mixed forests	231	Meadows, pastures	NC
313-412	313	Mixed forests	412	Peatlands	NC
321-133	321	Grasslands and natural pastures	133	Construction sites	NC
324-142	324	Forests and shrub vegetation in a state of change	142	Sports and leisure areas	NC
324-243	324	Forests and shrub vegetation in a state of change	243	The areas are mainly occupied by agriculture with a high proportion of natural vegetation	NC
324-322	324	Forests and shrub vegetation in a state of change	322	Moors and bushes	NC
331-321	331	Beaches, dunes, sands	321	Grasslands and natural pastures	INCREASE
511-133	511	Watercourses	133	Construction sites	INCREASE
512-132	512	Water reservoirs	132	Dumps and heaps	INCREASE
512-133	512	Water reservoirs	133	Construction sites	INCREASE
512-211	512	Water reservoirs	211	Arable land beyond the range of irrigation equipment	INCREASE
512-231	512	Water reservoirs	231	Meadows, pastures	INCREASE
521-331	521	Laguny przybrzeżne	331	Beaches, dunes, sands	NC
523-331	523	Morze i ocean	331	Beaches, dunes, sands	NC
132-142	132	Dumps and heaps	142	Sports and leisure areas	NC
142-131	142	Sports and leisure areas	131	Opencast mining sites	NC
142-511	142	Sports and leisure areas	511	Watercourses	DECREASE

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Change	CLC 2012	CLC 2012	CLC 2018	CLC 2018	Change type
211-511	211	Arable land beyond the range of irrigation equipment	511	Watercourses	DECREASE
222-131	222	Orchards and plantations	131	Opencast mining sites	NC
231-411	231	Meadows, pastures	411	Inland marshes	DECREASE
242-142	242	Complex systems of cultivation and plots	142	Sports and leisure areas	NC
242-312	242	Complex systems of cultivation and plots	312	Coniferous forests	NC
311-313	311	Deciduous forests	313	Mixed forests	NC
312-331	312	Coniferous forests	331	Beaches, dunes, sands	NC
313-141	313	Mixed forests	141	Green areas	NC
321-313	321	Grasslands and natural pastures	313	Mixed forests	NC
324-141	324	Forests and shrub vegetation in a state of change	141	Green areas	NC
324-222	324	Forests and shrub vegetation in a state of change	222	Orchards and plantations	NC
324-331	324	Forests and shrub vegetation in a state of change	331	Beaches, dunes, sands	DECREASE
333-331	333	Scattered vegetation	331	Beaches, dunes, sands	DECREASE
411-222	411	Inland marshes	222	Orchards and plantations	INCREASE
512-511	512	Water reservoirs	511	Watercourses	NC

Explanations:
INCREASE - increase in flood risk
DECREASE - decrease in flood risk
NC - no changes in flood risk

Table no 19 The scoring method for the indicator of assessment of prospective changes in the flood risk related to the change in land use in terms of changes in the surface of built-up areas or sealed areas

Change of the surface of sealed areas [%]	Punctation
< -40	-5
<-40, -30)	-4
<-30, -20)	-3
<-20, -10)	-2
<-10, 0)	-1
0	0
(0, 10)	1
<10, 20)	2
<20, 30)	3
<30, 40)	4
≥ 40	5

Indicator No 12: The impact of climate change on the occurrence of floods - the percentage change in high Q90 flow in 2021-2050 (the so-called Near Future) for the RCP 4.5 scenario

Source of data: data of the CHASE-PL project. Assessment of the consequences of climate change for selected sectors in Poland, Norwegian Financial Mechanism 2009-2014, no. Near future) for the RCP 4.5 scenario (i.e. the moderate greenhouse gas emission scenario), in the case of the coastal rivers, the values resulting from the trend analysis of the maximum annual flows (aPFRA)

Calculation method:

1. assigning for SAU the percentage change in high Q90 flow in the years 2021-2050 (the so-called Near Future) for the RCP 4.5 scenario, in the case of the Pomeranian rivers the value resulting from the trend analysis of the maximum annual flows,
2. determination of the score determining the prospective change in flood risk, assuming a score scale of -5 ÷ 5 (Table no 17).

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Table no 20 Scoring method for the indicator of prospective changes in flood risk assessment regarding the impact of climate change on the occurrence of floods

Projected flow change [%]	Punctation
< -40	-5
<-40, -30)	-4
<-30, -20)	-3
<-20, -10)	-2
<-10, 0)	-1
0	0
(0, 10)	1
<10, 20)	2
<20, 30)	3
<30, 40)	4
≥ 40	5

Indicator No 13: The impact of climate change on the occurrence of floods - percentage change of high Q90 flow in 2021-2050 (the so-called Near Future) for the RCP 8.5 scenario

data source: CHASE-PL project data. Assessment of the consequences of climate change for selected sectors in Poland, Norwegian Financial Mechanism 2009-2014, no. POL-NOR / 200799/90/2014, concerning the percentage change in high Q90 flow in 2021-2050 (the so-called Near future) for the RCP 8.5 scenario (i.e. high greenhouse gas emissions scenario), in the case of the rivers of the Sea, the values resulting from the trend analysis of the maximum annual flow (aPFRA).

calculation method:

1. assigning for SAU the percentage change in high Q90 flow in the years 2021-2050 (the so-called Near Future) for the RCP 8.5 scenario, in the case of the Pomeranian rivers the value resulting from the trend analysis of the maximum annual flows,
2. determination of the score determining the prospective change in flood risk, assuming a score scale of -5 ÷ 5 (according to Table no 17).

The trend of changes in flood risk for SAU is determined on the basis of a score assigned to individual indicators of the assessment of prospective flood risk changes, which determines the prospective change in flood risk (analogous to the aPFRA). The sum of the scores is in the range of ⟨-20.20⟩ and determines the trend of changes in the flood risk in a given SAU.

Assumed are the following:

- a tendency of flood risk decrease - when the sum of points for indicators of the assessment of prospective flood risk changes is in the range of ⟨-20, -8⟩ ,

- a tendency of flood risk increase - when the sum of points for indicators for the assessment of prospective flood risk changes is in the range of 〈8.20〉,
- no clear trend of flood risk changes - when the sum of points for indicators for assessing prospective flood risk changes is in the range (-8.8).

Flood risk assessment taking into account prospective changes

Flood risk assessment taking into account prospective changes takes into account both the flood risk assessment (based on the assessment of potential adverse effects of floods) and the assessment of prospective changes in flood risk, including the change trend. The following assumptions apply:

- in the case of a decrease in flood risk, the level of integrated flood risk is reduced by 1,
- in the case of a trend of increasing flood risk, the level of integrated flood risk increases by 1,
- in the absence of a clear trend of changes in flood risk, the level of integrated flood risk does not change.

Identification of problem areas

The basis for determination of problem areas characterized by the highest flood risk level, for which, in the following stages of aFRMP/FRMP development, there will be determined actions aimed at achieving the assigned objectives of flood risk management, are the results of analysis of spatial distribution of the integrated floor risk level and the resultant tendency of flood risk change for individual SAU.

In addition, the problem areas are confronted with the results of the analysis carried out in the FRMP in the first planning cycle, and the reasons for changes in the level of flood risk in relation to the first planning cycle are indicated.

When identifying problem areas, particular attention is paid to the consultation of the results of the analysis of the spatial distribution of the flood risk and the proposed problem areas selected on its basis with the Planning Catchment Association (ZPZ). Such verification allows taking into account local conditions, the specificity of a given area - also in relation to elements that were not included in the analysis (e.g. the presence of floods in the past, depressive areas, intensification of development, etc.).

The results of the flood risk spatial distribution analysis are presented graphically using the following colour scale:

Colour	Explanation
	1: very low flood risk
	2: low flood risk

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	3: medium flood risk
	4: high flood risk
	5: very high flood risk

The results of the analysis of the spatial distribution of the flood risk are presented graphically for aggregation units, ie ONNP, planning catchment and SWB.

8.1.2.2. Methodology of analysis based on incomplete input data (lack of FHM and FRM)

Preparation of SAU

For AFAs, for which FHM and FRM are not developed, spatial units used in aPFRA are used, resulting from the intersection of areas potentially at risk of flooding with elementary catchments (MPHP10k).

Spatial units are selected in such a way that they cover the entire AEFH, for which FHM and FRM are not developed, and at the same time the surface of these units is not changed (which will allow to directly derive the data assigned to them).

Assessment of potential adverse effects of floods

The assessment of the potential adverse effects of floods uses the results of aPFRA, namely four assessment criteria. The list of the above-mentioned the assessment criteria, taking into account the categories of flood effects, are presented in Table no 21.

Data on the above-mentioned criteria are entered into for selected spatial units directly from the aPFRA.

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Table no 21 Criteria for assessing the potential adverse effects of floods in the situation of incomplete input data

Criterion No	Flood effects category	Criterion for assessing potential adverse effects of floods	Unit
1	Human health	The direct impact of floods on people's lives and health - population density	person/km^2
2	Environment	The impact of floods on the environment - percentage of forms of nature protection (including national parks, landscape parks, nature reserves and Natura 2000 sites)	%
3	Cultural heritage	The impact of floods on cultural heritage - the density of historic buildings	piece/km^2
4	Economic action	The impact of floods on the areas of economic action along with infrastructure - percentage share of individual classes of land cover forms: inhabited areas, industrial areas, communication infrastructure (roads, railways), agriculture, forests, other	%

Flood risk assessment

The assessment of potential adverse effects of floods uses the results of aPFRA, namely the number of points assigned to individual criteria for assessing the potential adverse effects of floods.

Data on the above-mentioned scoring is drawn for selected spatial units directly from the aPFRA.

For the categories of environment, cultural heritage and economic action, the aPFRA uses a scoring scale of 1-5, which can be changed to a five-point scale of flood risk levels (level 1 - very low flood risk, level 5 - very high flood risk).

For the human health category, the aPFRA uses a scoring scale of 1 ÷ 12, which is changed to a five-point scale of flood risk levels, as shown in Table no 22.

Table no 22 Change in the score assigned in aPFRA for the criterion of the direct impact of floods on human life and health on the level of flood risk

No	Punctation in aPFRA	Flood risk level
1	1÷3	1
2	4÷5	2
3	6÷7	3
4	8÷9	4
5	10÷12	5

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Based on the levels of flood risk for individual categories of flood effects, each selected spatial unit is assigned a total risk level in the form of an integrated flood risk level, in accordance with the formula:

RW = a·RZ + b·RS + c·RK + d·RG

where:

RW - level of integrated flood risk,

RZ - risk level for the flood effects category: human health

RS - risk level for the flood effects category: environment,

RK - risk level for the flood consequence category: cultural heritage,

RG - risk level for the flood effects category: economic action,

a, b, c, d - weighting factors for individual categories of flood effects determined on the basis of expert judgment, respectively, a - human health, b- environment, c- cultural heritage, d - economic action:

a = 0.54

b = 0.07

c = 0.07

d = 0.32

Assessment of prospective changes in flood risk, including identification of change trends

The assessment of prospective flood risk changes in the case of incomplete input data of the analysis is carried out in the same way as in the case of having a complete set of input data (i.e. when FHM and FRM are available), where:

- indicator no.10: Change in population number - these are the aPFRA results for criterion 5, i.e. the impact of spatial development in terms of population changes with the assigned score,
- indicator no 12: Change in spatial development in terms of changing the surface of built-up areas or sealed areas - calculated for selected spatial units in the same way as in the case of having a complete set of data,
- indicator no 13: The impact of climate change on the occurrence of floods - the percentage change of high Q90 flow in the years 2021-2050 (the so-called Near Future) for the RCP 4.5 scenario - these are the aPFRA results for criterion 7, i.e. the impact of climate change on the occurrence of floods together with assigned scores for the RCP 4.5 scenario,
- indicator no.14: The impact of climate change on the occurrence of floods - the percentage change of high Q90 flow in the years 2021-2050 (the so-called Near Future) for the RCP 8.5 scenario - these are the aPFRA results for criterion 7, i.e.

the impact of climate change on the occurrence of floods together with assigned scores for the RCP 8.5 scenario.

The trend of changes in flood risk for selected spatial units is determined in the same way as in the case of having a complete set of input data (i.e. when FHM and FRM are available).

Flood risk assessment taking into account prospective changes

Flood risk assessment taking into account perspective changes is carried out for selected spatial units in the same way as in the case of having a complete set of input data (i.e. when FHM and FRM are available).

Identification of problem areas

Identification of problem areas is carried out for selected spatial units in the same way as in the case of having a complete set of input data (i.e. when FHM and FRM are available).

8.1.3. Methodology of analysis for river floods caused by overflow or destruction of flood embankments (A23)

8.1.3.1. Methodology of analysis based on a set of input data (available FHM and FRM)

The analysis of the spatial distribution of flood risk for river floods caused by overflow or destruction of flood embankments (A23) is carried out in the same way as for river floods with a natural flood mechanism (A11).

The only exception is the factor for assessing the potential adverse effects of floods related to the value of flood losses (AAD) - due to the fact that for river floods caused by overflow or destruction of flood embankments, the FHM and FRM have only one probability of flood occurrence (i.e. 1%) this indicator is not calculated.

8.1.3.2. Methodology of analysis based on incomplete input data (lack of FHM and FRM)

The analysis of the spatial distribution of the flood risk for river floods resulting from the overflow or destruction of flood embankments (A23) is carried out in the same way as for river floods with a natural flood mechanism (A11).

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8.1.4. Methodology of analysis for floods caused by the destruction or damage of damming structures (A15)

8.1.4.1. Methodology of analysis based on a set of input data (available FRM and FRM)

The analysis of the spatial distribution of flood risk for floods caused by the destruction or damage to damming structures (A15) is carried out in the same way as for river floods with a natural flood mechanism (A11).

An exception is the factor for assessing potential adverse effects of floods related to the value of flood losses (AAD) - due to the fact that for floods resulting from the destruction or damage of damming structures, the developed review of the FHM and FRM include only one probability of flood occurrence, this indicator is not calculated.

8.1.4.2. Methodology of analysis based on incomplete input data (lack of FHM and FRM)

The analysis of the spatial distribution of flood risk for floods caused by the destruction or damage to damming structures (A15) is carried out in the same way as for river floods with a natural flood mechanism (A11).

8.2. DIAGNOSIS OF PROBLEMS

The diagnosis of flood risk management problems concerns obtaining knowledge about the formation of flood risk in a given area (including river basin areas) in relation to both the current state and prospective changes, with particular emphasis on problem areas characterized by the highest level of flood risk, for which in further stages of the development of aFRMP/FRMP, actions related to achieving the assigned objectives of flood risk management will be indicated.

The basis for the diagnosis of flood risk management problems are the results of the analysis of the spatial distribution of flood risk, taking into account:

- assessment of potential adverse effects of floods,
- flood risk assessment,
- assessment of prospective changes in flood risk (including determination of change trends),
- flood risk assessment taking into account prospective changes,
- identifying problem areas.

Confronting the results of the analysis of the spatial distribution of flood risk with the results of similar analyzes carried out during the development of FRMP in the first planning cycle

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allows for the determination of risk changes, and in the case of significant changes - for determination of the causes of such situation (taking into account, among others, methodological changes for both aFHM and FRM and aFRMP, factors influencing the level of flood risk, the effect of implemented actions).

In addition, information on the trend of flood risk changes allows to identify areas where in the near future a potential increase in flood risk can be expected due to the forecasts of climate change or the impact of anthropogenic pressure.

Both determining the causes of changes in flood risk and information on the trend of changes in flood risk are important for determining actions related to achieving the assigned objectives of flood risk management.

8.3. DESCRIPTION OF THE EVALUATION OF THE IMPLEMENTATION OF THE ACTIONS FROM THE 1ST CYCLE

The monitoring system for implementation of actions adopted in the first edition of FRMP is aimed at assessing the achievement of the adopted flood risk management objectives within the prescribed period and at identifying possible causes of delay in the implementation of actions, and thus identifying the risk of failure to achieve the objectives and planning remedial actions. This system is described in the study "Flood risk management plans for river basins and water regions. Report on the methods and manner of carrying out monitoring ”(hereinafter referred to as the Report), contains a list of product (PA) and result indicators (RA) for the monitoring process.

Ultimately, the process of monitoring the progress of FRMP implementation in river basin areas is carried out in the manner provided for by the Regulation of the Minister of Maritime Economy and Inland Navigation of 14 December 2018 on the scope of information on the implementation of actions contained in water management plans in river basin areas, flood risk management plans and the sea water protection programme (the Official Journal of Laws 2018 item 2390). The current Regulation is therefore a guideline for assessing the progress of the implementation of the actions of the 1st FRMP cycle using the materials provided to the minister competent for water management as part of the annual reports for 2018 and 2019 and summary reports on monitoring the implementation of actions in 2018-2019 and the results of monitoring the implementation of actions for 2017.

In addition, the assessment of progress in implementation of actions will be based on the results of the survey carried out as part of the FRMP update, covering the entities responsible for implementation of actions related to flood risk management, which are listed in the FRMP and not covered by the above Regulation.

The result of the monitoring will be an action matrix, including the following data:

- action name,
- responsible institutions,

- action status: not started, under design, under implementation, completed,
- the stage of advancement of planned actions expressed by product indicators (PA),
- effectiveness in achieving the objectives of flood risk management as expressed by result indicators (RAs).

8.3.1. Analysis and evaluation of progress in the implementation of the actions of the 1st FRMP cycle

The analysis of the assessment of progress in the implementation of the actions of the first cycle will include:

- calculating the percentage value of the indicators of the implementation of actions which in the reports of MGMiŻŚ (currently the Ministry of Infrastructure) contain only absolute values in kilometers or pieces
- calculation of the product indicators (PA) listed in the regulation[10],
- calculating the values of product indicators (PA) listed in the FRMP and not covered by the Regulation
- assessment and description of progress in the implementation of actions based on the calculated indicators,
- description and explanation of the reasons for failure to implement individual actions.

The analysis will be carried out with a breakdown into implemented and ongoing actions.

The table below summarizes the product indicators used to monitor the progress in the implementation of the actions of the 1st FRMP cycle along with information on the target values of the indicators. According to the "Report on the methods and manner of carrying out monitoring", the table below does not include the PA1 indicator, ie the number of analyzes performed under the instruments for rational management of flood risk areas, which indicator is used as one of the criteria for the assessment of specific objectives.

A tool helpful in presenting the results of the conducted analyzes is the matrix below which is going to show the comparison of the target value of the indicator specified in the Report for each of the river basins with the values calculated on the basis of the reports received and the conducted survey.

10 Regulation of the Minister of Maritime Economy and Inland Navigation of 14 December 2018 on the scope of information on the implementation of actions contained in river basin management plans, flood risk management plans and sea water protection programmeme.

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Table no 23 Product indicators for monitoring the progress of FRMP implementation along with the total value for the Oder, Vistula and Pregolya River basin area

Index of monitoring the implementation of the 1st planning cycle FRMP (with the unit)	Product indicator target		Value of the indicator from monitoring
	Relative	Absolute	
PA2. Implementation of an IT system for reporting and estimating flood losses [pcs.][11]	100	1	
PA3. Increase in the length of river sections, where their capacity was adjusted to the flow conditions of flood waters [%, km][12]	100	217,7	
PA4. Increase in the length of the constructed flood embankments protecting the identified areas of high vulnerability to flood risk [%, km][13]	100	1 109,0	
PA5. Increase in the number of reconstructed flood protection facilities which have lost their functionality [%, pcs][14]	100	318	
PA6. Increase in the length of the realized bands for protection of the sea shore [%, km][15]	100	8,1	
PA7. Number of multi-functional reservoirs for which the rules of use have been improved in order to increase the flood reserve [pcs][16]	100	7	
PA8. Increase in the length of reinforced and reconstructed levees [%, km][17]	100	6,5	

11 The indicator means that an IT system for reporting and estimating flood losses has been implemented

12 The rules for determining this index are analogous to the rules for determining the index of relative increase in the area of land given to the river. The length of river sections requiring the correction of their capacity is the sum of the lengths of those river sections for which the hydraulic calculations showed the necessity to increase or decrease the flow velocity of flood waters due to the desired level of flood waters. For the river basin areas of the Vistula, Oder and Pregolya rivers, the absolute value of the indicator is 217.7 km.

13 The rules for determining this index are analogous to the rules for determining the index of the relative increase in the area of land given to the river

14 The rules for determining this index are analogous to the rules for determining the index of relative increase in the area of land given to the river. The objects that have lost their functionality and require reconstruction include those included in the flood protection system, qualified for reconstruction, reconstruction or expansion due to their poor technical condition. For the basin districts of the Vistula, Oder and Pregolya rivers, the absolute value of the indicator is 318 pcs.

15 The rules for determining this index are analogous to the rules for determining the index of the relative increase in the area of land given to the river

16 The indicator determines the number of multi-functional reservoirs for which the rules of use were improved to increase the flood reserve. The target value of 7 defines the number of reservoirs for which this action is planned in the first planning period of the FRMP.

17 The rules for determining this index are analogous to the rules for determining the index of relative increase in the area of land given to the river. The length of the reinforced and reconstructed flood embankments is the total length of the existing embankments, the technical condition of which required intervention, and the analysis of the effectiveness of individual sections of the embankment indicates the need for their reconstruction. For the river basin areas of the Vistula, Oder and Pregolya rivers, the absolute value of the indicator is 6.5 km

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Index of monitoring the implementation of the 1st planning cycle FRMP (with the unit)	Product indicator target		Value of the indicator from monitoring
	Relative	Absolute	
PA9. Number of flood protection facilities for which technical and economic documentation was drawn up [%, pcs][18]	100	53	
PA13. Increase in the length of river sections for which good conditions for ice-breaking operations and safe ice floe discharge are provided [%, km][19]	100	516,4	
PA14. Percentage share of areas of high flood risk (p1%) covered by local spatial development plans [20]	100	844 074	
PA10. Increase in the number of regional and local flood forecasting and alert systems [%, pcs][21]	100	29	
PA11. Number of trained citizens [number of people][22]	100	74 639	
PA12. Number of operational anti-flood plans developed in the reporting period, including plans for the evacuation of the population and inventory [pcs.][23]	100	1 136	

8.3.2. Analysis and evaluation of progress in achieving objectives

The analysis of the assessment of progress in achieving the objectives of the first cycle will include:

18 The indicator determines the number of flood protection facilities for which technical and economic documentation has been prepared. The target value of 53 defines the number of flood protection structures for which technical and economic documentation was prepared in the 1st Planning Cycle.

19 The rules for determining this index are analogous to the rules for determining the index of relative increase in the area of land given up to the river. The section of the river where good conditions for icebreaking operations and safe ice floe removal are ensured is a section of the river where icebreakers can be operated in winter. For the river basins of the Vistula, Oder and Pregolya rivers, the absolute value of the indicator is 516.4 km

20 The quotient of the area of the areas of special flood risk covered by the approved local spatial development plans to the total area of the areas of high risk of flooding, which for the basin areas of the Vistula, Oder and Pregolya rivers is 844,074 ha.

21 The indicator determines the number of regional and local flood forecasting and warning systems. The target value of 29 defines the number of regional and local flood forecasting and warning systems for which this action was planned in the first planning period of FRMP

22 The indicator determines the number of trained citizens, for which the target value was adopted at the level of 20% of the number of all inhabitants in the area of particular flood risk in the basin areas of the Vistula, Oder and Pregolya rivers

23 The target value of 1136 is based on the assumption that one operational flood plan will be created in each commune at risk of flooding

- calculating the percentage value of indicators of the achievement of objectives, which in the reports of MGMiŻŚ (currently the Ministry of Infrastructure) contain only absolute values
- calculation of the result indicators (RA) listed in the regulation[24],
- calculation of the result indicators (RA) listed in the FRMP and not covered by the scope of the Regulation,
- assessment and description of progress in achieving objectives on the basis of calculated indicators,
- assessment of the effectiveness of the objectives pursued,
- description and explanation of the reasons for failure to achieve specific objectives.

The table below summarizes the result indicators (RAs) used to monitor the progress towards the objectives of the 1st FRMP cycle.

The following matrix will be a helpful *tool in presenting the results of the conducted analyzes, showing a comparison of the target value of the indicator specified in the Report for each of the river basins with the values calculated on the basis of the reports received and the survey conducted.*

Table no 24 Result indicators for monitoring the progress of FRMP implementation together with the total value for the Oder, Vistula and Pregolya River basin area

Indicator of monitoring the implementation of the 1st planning cycle of FRMP	Result indicator target value		The value of the indicator obtained from monitoring
	Relative	Absolute	
RA1. Increase in the area of land given to the river as a result of the measure implementation [%, ha][25]	100	207,0	
RA2. Increase in the area of river valleys given to the river by	100	10 171,0	

24 Regulation of the Minister of Maritime Economy and Inland Navigation of December 14, 2018 on the scope of information on the implementation of actions contained in river basin management plans, flood risk management plans and sea water protection programme.

25 The principles of determining this indicator are analogous to the principles of determining the indicator of a relative reduction in the number of inhabitants in areas of particular flood risk, determined on the basis of flood risk maps taking into account the already implemented actions, however, the areas of land given to the river are obtained from the database of strategic investments implemented under the FRMP in the period 2016 - 2021 containing information on their status, product and result indicators as well as data on the environmental impact of the investment. The area of land given up to the river is: 1) the area obtained as a result of the liquidation of the embankment, the area of which is equal to the area of the potential flood hazard zone for water 1%, designated for the section of the embankment being liquidated, 2) the area obtained as a result of moving the embankment away from the river, the size of which means an increase the area of the inter-embankment zone obtained as a result of the action, 3) the area obtained as a result of the revitalization of the river section is an increase in the area of the special risk zone resulting from the new morphology of the revitalized river section. For the river basins of the Vistula, Oder and Pregolya rivers, the absolute value of the indicator is 207 ha.

Indicator of monitoring the implementation of the 1st planning cycle of FRMP	Result indicator target value		The value of the indicator obtained from monitoring
	Relative	Absolute	
building polder retention, obtained as a result of the implementation of the action [%, ha][26]			
RA3. The increase in the valley retention capacity obtained as a result of the implementation of the action [%, mln m³][27]	100	53,1	
RA4. Increase in the capacity of the flood reserve obtained as a result of the construction of flood protection reservoirs as part of the measure [w mln m³][28]	100	530,6	
RA5 Relative reduction in the value of average annual AAD flood losses as a result of the implementation of actions [29]	100	563 571 377	
RA6 Relative reduction in the number of inhabitants in areas of high flood	100	120 800	

26 The rules for determining this index are analogous to the rules for determining the index of relative increase in the area of land given to the river. The area of river valleys given to the river through the construction of polder retention is the area of the constructed controlled and uncontrolled polders, located on the bank of the existing flood embankments. For the river basins of the Vistula, Oder and Pregolya rivers, the absolute value of the indicator is 10 171.0 ha.

27 The rules for determining this index are analogous to the rules for determining the index of relative increase in the area of land given to the river. The capacity of the obtained valley retention is the usable capacity of the constructed controlled and uncontrolled polders located on the bank of the existing flood embankments. For the river basins of the Vistula, Oder and Pregolya rivers, the absolute value of the indicator is 53.1 million m³.

28 The rules for determining this index are analogous to the rules for determining the index of relative increase in the area of land given to the river. The capacity of the obtained flood reserve is the sum of the capacity of the constructed dry flood protection reservoirs and the flood reserve of the constructed multifunctional reservoirs. For the river basin areas of the Vistula, Oder and Pregolya rivers, the absolute value of the indicator is 530.6 million m³.

29 The principle of determining the average value of the annual AAD flood losses is described in the "Problem analysis and diagnosis" report (WBS 1.2.5.2). The value of the average annual flood losses, taking into account the actions already implemented in the analyzed period AAD (X), is determined on the basis of flood risk maps for Q0.2%, Q1% and Q10% taking into account the effect of flood risk reduction as a result of implemented investments. The reduction in the value of the mean annual flood losses ΔAAD (X) in the analyzed period is the difference between the value of the mean annual flood losses identified as the state before the intervention AAD (W0) and the determined value of AAD (X). On the other hand, the relative reduction of the AAD value in the analyzed period is determined by the quotient of the reduction of the average annual flood losses obtained in the analyzed period ΔAAD (X) to the reduction of average annual flood losses assumed in the planning period, taking into account all planned actions, which for the Vistula, Oder and Pregolya river basins amounts to PLN 563,571,377.

Indicator of monitoring the implementation of the 1st planning cycle of FRMP	Result indicator target value		The value of the indicator obtained from monitoring
	Relative	Absolute	
risk (Q1%) as a result of the implementation of actions [30]			
RA7 Relative decrease in the number of culturally valuable objects located in the area of particular flood risk (Q1%) as a result [31]	100	100	
RA8 Relative decrease in the number of objects posing a threat to the environment located in the area of particular flood risk (Q1%), as a result of the implementation of actions [32]	100	817	
RA9 Relative decrease in the number of water intakes located in areas of particular flood risk (Q1%), as a result of the implementation of actions [33]	100	233	
RA10 Relative reduction in the number of objects of special social importance located in	100	1633	

30 The principle of determining the number of inhabitants in flood risk areas is regulated by the Regulation on the development of flood hazard maps and flood risk maps. For the analyzed period, the number of inhabitants in the areas of high flood risk LMQ1% (X) is determined on the basis of flood risk maps for Q1% taking into account the effect of flood risk reduction as a result of implemented investments. Reduction in the number of inhabitants in areas of high flood risk in the analyzed period ΔLMQ1% (X) is the difference in the number of inhabitants in areas of high flood risk LMQ1% (W0) identified as the state before the LMQ intervention 1% (W0) and the determined LMQ1 value % (X). On the other hand, the relative reduction of the LMQ1% value in the analyzed period is determined by the quotient of ΔLMQ1% (X) to the reduction in the number of inhabitants in the areas of particular flood risk assumed in the planning period, taking into account all planned actions, which for the basins of the Vistula, Oder and Pregolya rivers is 120 800 people.

31 The rules for determining this indicator are analogous to the rules for determining the indicator of a relative reduction in the number of inhabitants in areas of particular flood risk, determined on the basis of flood risk maps that take into account already implemented actions.

32 The rules for determining this indicator are analogous to the rules for determining the indicator of a relative reduction in the number of inhabitants in areas of particular flood risk, determined on the basis of flood risk maps that take into account already implemented actions.

33 The rules for determining this indicator are analogous to the rules for determining the indicator of a relative reduction in the number of inhabitants in areas of particular flood risk, determined on the basis of flood risk maps that take into account already implemented actions.

Indicator of monitoring the implementation of the 1st planning cycle of FRMP	Result indicator target value		The value of the indicator obtained from monitoring
	Relative	Absolute	
areas of particular flood risk (Q1%) as a result of the implementation of actions [34]			
RA11 Relative reduction of potential flood losses in areas of particular flood risk (Q1%) as a result of the implementation of actions [35]	100	5 722 749 993	
RA12 Relative reduction in the area of areas of high flood risk (Q1%) as a result of the implementation of actions [36]	100	82 528	

8.3.3. Monitoring of environmental parameters

The methods and indicators for monitoring the environmental effects of the FRMP implementation are adopted in accordance with the methods indicated in the environmental impact prognosis of the draft flood risk management plan. They are dedicated to specific environmental objectives.

There are eight strategic environmental protection objectives related to the actions of the FRMP. Those are:

1. Protection of human health and safety.
2. Protection of biodiversity.
3. Supporting the achievement of environmental objectives for water bodies surface and underground.

34 The rules for determining this indicator are analogous to the rules for determining the indicator of a relative reduction in the number of inhabitants in areas of particular flood risk, determined on the basis of flood risk maps that take into account already implemented actions.

35 The rules for determining this indicator are analogous to the rules for determining the indicator of a relative reduction in the number of inhabitants in areas of particular flood risk, determined on the basis of flood risk maps that take into account already implemented actions.

36 The rules for determining this indicator are analogous to the rules for determining the indicator of a relative reduction in the number of inhabitants in areas of particular flood risk, determined on the basis of flood risk maps that take into account already implemented actions.

4. Decreasing vulnerability and preparing for climate change.
5. Protection of the earth's surface, including soil.
6. Protection and, if possible, improvement of landscape values.
7. Protection of cultural heritage.
8. Economic objectives and protection of material goods of great value.

To monitor the achievement of the above-mentioned environmental protection objectives, it is proposed to use:

- Selected product indicators (PA) [37] and result indicators (RA), proposed to monitor progress in achieving the objectives of flood risk management,
- the results of monitoring conducted by the Chief Inspector of Environmental Protection (CIEP) as part of the State Environmental Monitoring (SEM),
- data on the occurrence and effects of flash floods,
- checklists.

- The scope of monitoring for each of the above-mentioned environmental objectives.

Monitoring of the achievement of the objective "Protection of human health and safety":

Product (PA) and result (RA) indicators:

- RA6 - relative reduction in the number of inhabitants in areas with high flood risk (Q1%) as a result of the implementation of actions,
- RA8 - relative decrease in the number of objects posing a threat to the environment located in the area of **particular flood risk (Q1%) as a result of the implementation of actions,**
- RA9 - relative decrease in the number of water intakes located in areas of particular flood risk (Q1%) as a result of the implementation of actions,
- RA10 - relative reduction in the number of objects of special social importance located in areas of high flood risk (Q1%) as a result of the implementation of actions,
- RA11 - relative reduction of potential flood losses in areas of particular flood risk (Q1%) as a result of the implementation of actions,
- RA12 - relative reduction in the area of areas of high flood risk (Q1%) as a result of the implementation of actions,

37 We use output indicators for actions, when we cannot use result indicators to action their result.

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- PA10 - relative increase in the number of regional and local flood forecasting and warning systems,
- PA11 - number of trained citizens,
- PA12 - number of operational anti-flood plans prepared in the reporting period (including plans for the evacuation of people and inventory),
- PA2 - implementation of an IT system for reporting and estimating flood losses.

Monitoring of the achievement of the "Protection of biodiversity" objective:

Indicators:

RA1 - relative increase in the area of land given to the river,

RA2 - Increase in the area of river valleys given to the river by building polder retention obtained as a result of the implementation of the action,

RA3 - Relative increase in the capacity of the obtained valley retention

and information from the Chief Inspector of Environmental Protection in the environmental monitoring documents[38]:

Results of monitoring of natural habitats and water-dependent species occurring in wetlands within which technical and non-technical actions of the FRMP are implemented.

The results of the above-mentioned monitoring in connection with the location of projects implemented as part of the implementation of the first FRMP **should be included in the current planning cycle as information about the impact of flood protection investments on the condition of protected species and natural habitats.**

Monitoring of the achievement of the objective of "Supporting environmental objectives for water bodies":

Information included in the environmental monitoring documents: State Environmental Monitoring (CIEP):

Results from the surface water quality monitoring subsystem - inland waters, transitional and coastal waters, including:

1. research and assessment of the condition of rivers, including dam reservoirs,
2. testing and assessing the condition of lakes,
3. testing and assessing the quality of bottom sediments in rivers and lakes,
4. survey and assessment of the status of transitional and coastal waters,

38 The "State Environmental Monitoring Programme for 2016-2020" developed by the Chief Inspectorate of Environmental Protection fulfills the provisions of Art. 23 sec. 3 point 1 of the Act of 20 July 1991 on the Inspection of Environmental Protection (Journal of Laws of 2013, item 686 as further amended

5. testing of hydromorphological elements for the purposes of assessing the ecological status of surface waters,
6. implementation of the requirements of the Water Framework Directive on environmental quality standards within the scope of water policy.

The results of this monitoring in connection with the location of projects implemented under the previous edition of the FRMP should be taken into account in actual planning cycle as information about the impact of flood protection investments on the condition of water.

Monitoring the achievement of the objective of "Reducing vulnerability to climate change and other future challenges" (within the scope of flood risk management)

Data on the occurrence and effects of flash floods

- Results collected in the framework of the system of reporting and estimating flood losses (caused by flash floods)
- Flood data collected as part of the development of the PFRA update

Monitoring of the achievement of the objective "Protection of the earth's surface, including soil"

Result indicators:

- RA1 - Relative increase in the area of land given to the river,
- RA2 - Relative increase in the area of river valleys given to the river by building polder retention,
- RA3 - Relative increase in the capacity of the obtained valley retention.

Monitoring of the achievement of the objective of "Protection and, if possible, improvement of landscape conditions"

Product indicators:

1. Implementation of the guidelines for spatial development in flood risk areas into the legal system

Monitoring of the achievement of the objective "Protection of cultural heritage"

Result indicator:

- RA7 - a relative decrease in the number of culturally valuable objects located in the area of particular flood risk (Q1%) as a result of the implementation of actions

Monitoring the achievement of the objective "Economic objectives and protection of material goods of great value"

Result indicator:

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- RA5 - Relative reduction in the value of average annual flood losses determined on the basis of flood risk maps taking into account already implemented actions (AAD)

In addition to monitoring on the basis of the above-mentioned product and result indicators, additional information should be obtained on the projects implemented under the previous FRMP planning cycle. For this purpose, the following list of checking questions will be used:

1. Has a decision on environmental conditions been issued for the investment?

2. Has the decision on environmental conditions been issued after conducting an environmental impact assessment?

3. Has the procedure been carried out for the project pursuant to Art. 96 of the Act of 3 October 2008 on the provision of information on the environment and its protection, public participation in environmental protection and on environmental impact assessments - if the decision on environmental conditions has not been issued?

4. Has a notification been made for the project pursuant to Art. 118 of the Act of April 16, 2004 on nature protection?

5. Has a permit for the removal of a tree or a bush been issued for the project pursuant to Art. 83a of the Act of April 16, 2004 on nature protection?

6. Have derogations been issued in connection with the implementation of the project pursuant to Art. 56 of the Act of April 16, 2004 on nature protection?

7. Was there a need to notify under Art. 58 sec. 3 of the Act of April 16, 2004 on nature protection?

8. Area of natural habitats directly occupied for the needs of the investment (km).

9. Number of Natura 2000 sites for which derogations were obtained pursuant to Art. 34 of the Act of 16 April 2004 on nature protection.

10. The area of protected areas referred to in Art. 6 sec. 1 points 1-9 of the Act of 16 April 2004 on nature protection, directly occupied for the purposes of the project (km).

11. Number of water bodies within which the project is implemented,

12. Number of water bodies for which derogations were obtained pursuant to Art. 66 of the Water Law.

13. Have any special requirements for landscape protection been defined in connection with the project implementation?

14. Number of monuments endangered as a result of the project implementation.

15. Number of people who had to change their place of residence as a result of the project.

The results of monitoring the implementation of environmental objectives together with the results of the features implemented in the first edition of FRMP will be summarized in the matrix, the formula of which is presented below.

Table no 25 Template of a matrix presenting the results of monitoring the implementation of environmental objectives of actions implemented in the previous planning cycle of FRMP

No	Obtained data/Water regions/River basin areas	Water region	River basin area
1	Relative increase in the number of regional and local flood forecasting and warning systems (PA10)		
2	Number of citizens trained (PA11)		
3	Number of operational anti-flood plans prepared in the reporting period (including plans for the evacuation of people and livestock) (PA12)		
4	Relative increase in the area of land given to the river (RA1)		
5	Increase in the area of river valleys given to the river by building polder retention (RA2)		
6	Relative increase in the capacity of the obtained valley retention (RA3).		
7	Implementation into the legal order of guidelines for spatial development in flood risk areas,		
8	Number of actions implemented		
9	Number of actions with the Environmental Decision		
10	Number of actions notified pursuant to Art. 118 of the Nature Conservation Act		
11	Number of actions with a decision for logging		
12	Number of actions with a derogation decision		
13	Number of notifications based on Article 58 of the Nature Conservation Act		
14	The area of natural habitats directly occupied for the needs of the investment		
15	Number of N2000 areas for which derogations under Art. 34 of the Nature Conservation Act		
16	The area of protected areas directly occupied for the purposes of implementing projects		
17	Number of HWB within which the project is implemented		
18	Number of HWB for which derogations were obtained pursuant to Art. 38j of the Water Law		
19	Number of endangered monuments		
20	Number of people who had to change their place of residence		

The results of the assessment of progress in the implementation of planned actions in the verification of specific objectives and verification of types of actions adopted for the first planning cycle of FRMP in order to improve the preparation of aFRMP.

8.4. CONDUCTING A SURVEY OF ENTITIES IN CHARGE FOR IMPLEMENTATION OF ACTIONS RELATED TO FLOOD RISK MANAGEMENT

8.4.1. Review of selected survey methodologies carried out as part of the implementation of tasks on a similar topic

Updating of the preliminary flood risk assessment

Survey as part of the project entitled The "review and update of the preliminary flood risk assessment" was carried out on three levels, through: a dedicated survey portal (geo-questionnaire), by e-mail and traditional mail. 3,639 entities were surveyed, including: local government units, water supply and sewage systems, drainage and water facility managements, the Fire Brigade at the provincial level, the State Fire Service Headquarters and district crisis management centers.

The progress of the survey was monitored on an ongoing basis. Reminders e-mail and paper questionnaires were sent to units that did not complete the online geo-questionnaire within the given time period. The contractor has been monitoring communes with an increased risk of flooding and cities with more than 100,000 inhabitants. During the survey, there was used a dedicated telephone line and mailbox. Through these communication channels, respondents could obtain help when needed. Such approach enabled obtaining a very satisfactory scope of the survey and obtain information covering 86% of the country's area.

Drought Effects Counteracting Plan

The survey process as part of the development of the drought counteracting plan covered nearly 3,500 entities. Stakeholders were divided into 5 groups: ministries, specialized government administration units, local government and government administration units, water users and other institutions. The survey was conducted via a geo questionnaire with a geoportal function. At the same time, the questionnaires were distributed via standard distribution channels, allowing for analog responses.

8.4.2. Purpose of the survey and indication of respondents

As part of the project entitled "Review and update of flood risk management plans", a survey of entities responsible for the implementation of actions related to flood risk management will be conducted. Conducting a survey among relevant stakeholders in the flood risk management process is a source of feedback on the quality of the actions implemented and their effects at each stage of the planning and implementation cycle of public intervention. On the basis of the results of the survey concerning the implemented,

implemented and planned actions undertaken by entities other than Polish Waters, responsible for individual elements of flood risk management (sub-task 1.4.2), a list of actions will be created (the so-called "D" list). It will be one of the components of the analyzes used to create the initial list of actions (the resultant of 4 worklists: A, B, C, D) and then the base list of actions.

The subject of the survey will be to obtain information on:

- Actions taken or carried out during the validity period of the FRMP developed in the 1st planning cycle, indicated in the flood risk management plans,
- Actions taken or carried out during the validity period of the FRMP, developed in the 1st planning cycle, not included in the flood risk management plans and implementing the FRMP objectives,
- Actions that are planned to be taken during the period of validity of the FRMP review and update in the second planning cycle (2022-2027),
- Identification of the reasons for not taking action or not carrying out an action in the planned time frame, including information whether the implementation/continuation of the action is planned. The survey process is also intended to supplement the information on the actions monitoring indicators included in the Flood Risk Management Plans, the reporting obligation of which results from the Water Act.

Two draft surveys were drawn up, adequate for the relevant stakeholders. Draft surveys are attached to the Methodology.

For the needs of the survey, a list of respondents/stakeholders responsible for the implementation of actions related to flood risk management was prepared. The basis for determining the list of stakeholders were:

- Flood risk management plans for river basins and water regions developed in the first planning cycle (action cards),
- National Crisis Management Plan,
- Entities responsible for carrying out actions that contribute to minimizing the risk of flooding, in accordance with applicable law,
- Local government units implementing the so-called Non-technical actions (eg Urban Adaptation Plans, expert opinions, projects).

The list of survey recipients was prepared in tabular form in a manner adapted to the type of surveyed units. The full list of recipients is attached to the Methodology.The survey will cover representatives of the following stakeholder groups:

- Province Governors
- Province Marshals

- Commune heads
- Village heads
- Mayors
- City Presidents
- District and province Crisis Management Centres
- General Directorate of State Forests
- Polish Geological Institute
- Entities responsible for implementing the actions included in the National Crisis Management Plan:
- Chief Sanitary Inspectorate
- Department of Military Health Service
- National Institute of Public Health - National Institute of Hygiene
- Chancellery of the Prime Minister
- Government Security Centre

Ministries:

- Ministry of Digital Affairs
- Ministry of Education
- Ministry of State Assets
- Ministry of Development
- Ministry of Finance
- Ministry of Maritime Economy and Inland Navigation
- Ministry of Infrastructure
- The Ministry of Culture and National Heritage
- Ministry of Science and Higher Education
- Ministry of National Defence
- Ministry of Family, Labour and Social Policy
- The Ministry of Agriculture and Rural Development
- Ministry of Sport

- The Ministry of Internal Affairs and Administration
- Ministry of Justice
- Ministry of Climate
- Ministry of the Environment
- Ministry of Health.

In order to standardize the paper version of the survey and the electronic version (posted on the portal), the layout and form of the questions will remain the same.

8.4.3. Distribution of surveys

In order to carry out the survey process efficiently, the questionnaires will be distributed electronically via a dedicated portal created for the project. In addition, cities with more than 100,000 Residents will be contacted using the ePUAP platform. Paper surveys will be sent by Poczta Polska only at the express request of the respondent. The aim of the survey is to thoroughly examine all stakeholders and obtain the maximum amount of materials in electronic form.

The basic scope of functionality of the portal developed for the survey will include:

- The ability to edit the responses by the respondent,
- The ability to add attachments by the respondent,
- The respondent can draw objects on an interactive map,
- The administrator can monitor the course of the survey process.

The survey process will be constantly monitored, and in the event of a low level of survey return, the procedures described below will be implemented to obtain answers from as many respondents as possible. The action of stakeholders in the following areas will be monitored:

- Log in to the portal through a personalized login and password,
- Complete the survey fully or partially.

Stakeholders who do not show the above-mentioned actions will be sent messages reminding about the survey within 3 weeks from the start of the survey process. The next steps will be taken depending on the progress in completing the questionnaires. Regions/catchments with identified flood risk will be subject to special supervision.

During the survey, a dedicated mailbox and a telephone line for respondents will be launched, where from 8:00 to 16:00, from Monday to Friday, stakeholders will be able to contact a specialist who will help in completing the questionnaire.

As part of the information meetings, participants will be informed about the planned survey process and initially implemented in the survey procedure itself.

8.4.4. Survey results

The data obtained in the survey process will be processed into a uniform, resulting form. The scope of data processing will include:

- Digitization of all materials received in paper form and saving in the project documents repository in an ordered structure of folders and files
- Unifying the obtained spatial data into the shapefile format and saving them in an online spatial data database,
- Summary of the survey process in the form of a tabular summary containing a list of all entities:
- for which they answered / did not answer the survey questions,
    - undertake tasks related to flood risk management,
    - undertake tasks related to flood risk management,
    - they intend to undertake tasks related to flood risk management.
- Statistical analysis of the obtained data.

9.SELECTION OF ACTIONS LIMITING THE RISK OF FLOODS

9.1. GENERAL ASSUMPTIONS FOR THE LIST OF POTENTIAL ACTIONS

The general rules for drawing up a checklist are as follows:

- The list will include actions covering all phases of flood risk management and relating to all components of flood risk (threats, exposure, and vulnerability).
- The list will include technical and non-technical actions from all catalogue groups assigned to specific flood risk management objectives (product of sub-task 1.5).
- If possible, the list will include synergies with actions resulting from other planning documents ("win-win" actions).
- All actions, the implementation of which will reduce the level of flood risk in the AEFH areas indicated under the aPFRA, and especially in problem areas identified and selected under subtask 1.3, will be taken into account. It is also assumed to take into account the actions implemented outside the AEFH area - provided that the action reduces the level of flood risk in the area of the defined AEFH.
- The condition for including an action on the list will be the definition of a minimum set of parameters, i.e. action name, location, cost, source of financing, completion date, description/characteristics of the action. For this purpose, it is planned to perform the S.M.A.R.T. analysis, described in the next chapter.
- The scope of analytical works is carried out for areas selected as part of the analysis of the spatial distribution of flood risk caused by floods from the rivers, failure of embankments and failure of damming structures. Analyzes (including the construction of planning variants and prioritization of actions) for the areas of flood risk caused by flooding from the sea or failure of the technical lane are carried out as part of flood risk management plans from the sea, including internal sea water.

In addition to the general assumptions, below we present the procedure for determining the actions in aFRMP aimed at achieving the objectives of flood risk management, taking into account the critical infrastructure.

Planned actions to reduce the flood risk must take into account the protection of the critical infrastructure at risk of flooding, and limiting the negative impact of flooding on the functioning of critical infrastructure facilities can be implemented through the implementation of two groups of actions. The first group of actions is aimed at eliminating or significantly reducing the flood risk for these facilities. The second group of actions will

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consist in reducing the vulnerability of critical infrastructure objects to the effects of flooding with flood waters.

Planning of actions belonging to the first group belongs to the aFRMP contractor, while planning and undertaking actions belonging to the second group is the responsibility of the operators of individual critical infrastructure facilities, who can, on the basis of flood hazard and flood risk maps, assess the scale of threats to these facilities, which should be taken into account when updating the Plans Critical Infrastructure Protection

Planned actions of aFRMP resulting in the reduction of flood risk of critical infrastructure facilities are aimed at achieving two basic specific objectives of flood risk management: ensuring conditions limiting the possibility of flooding and reducing the area at risk of flooding, and are subject to agreement with province governors using the following procedure:

- The aFRMP Contractor presents to the province governors the spatial distribution of problem areas requiring urgent intervention related to the reduction of flood risk in order to agree their location in the context of the location of critical infrastructure sensitive to flood risk.
- The aFFRM contractor presents to the province governor for final approval the aFRMP project containing a list of planned actions to reduce flood risk, taking into account the earlier stage of arrangements.

On the other hand, in the next planning cycle, it is recommended to expand the aFRMP agreement process with the introduction of an additional document (of a classified nature) containing a list of critical infrastructure facilities located in areas of particular flood risk, with information to what extent the planned actions in aFRMP will reduce their flood risk and whether the operator has taken any action in order to reduce the vulnerability of the critical infrastructure facility to flood.

9.2. RULES FOR CREATING A CATALOG OF MEASURES TO REDUCE FLOOD RISK

Creating a catalog of measures to reduce the flood risk in the area of the river basin / water region / planning catchment area, hereinafter referred to as the final list of measures of the AAPMP, will consist in the selection of measures implementing all three main objectives with the use of the algorithm presented in the figure - Figure 4.

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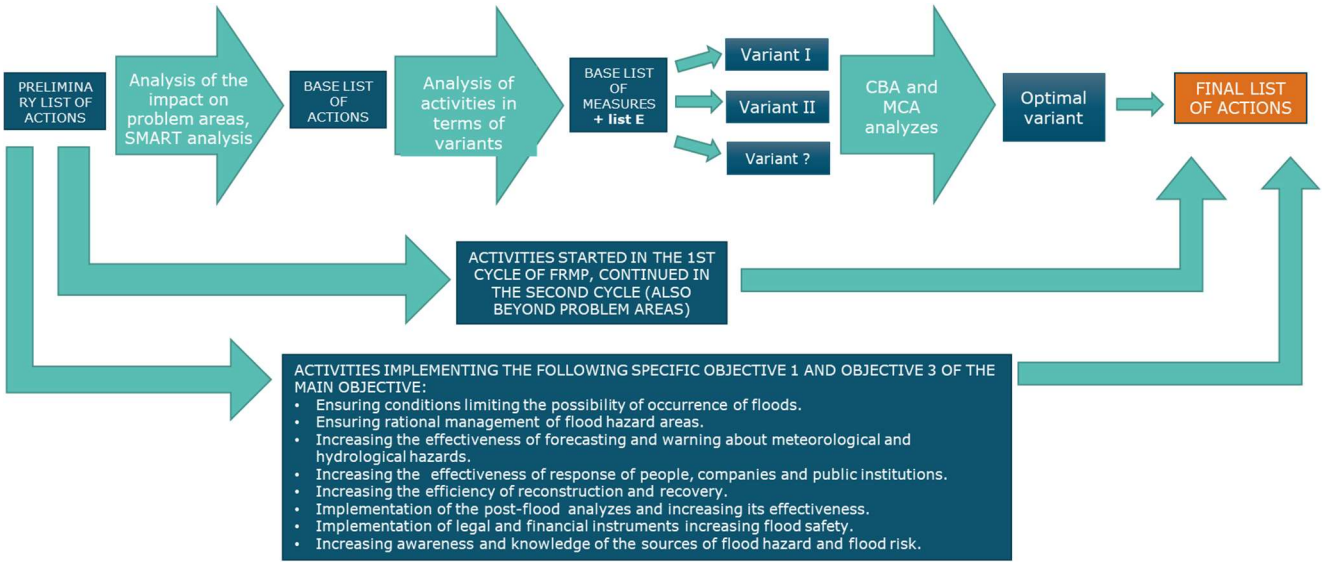

Figure no 4 Algorithm for creating the final list of aFRMP actions

The Flood Risk Management Plan pursues three main objectives:

1. Stopping the increase in flood risk;
2. Reduction of the existing flood risk;
3. Improving the flood risk management system.

The first step in creating the final list of flood risk reduction measures will be to formulate a preliminary list of measures, including a large number of identified measures that may, to a varying degree, contribute to the reduction of flood risk. This list will include both non-technical and technical measures belonging to different types of measures and pursuing different flood risk management objectives. Rational management of flood risk will require selection of these measures in order to create the final list of measures effectively and rationally pursuing the objectives of flood risk management, which will be included in the FRMP.

In the case of measures implementing Objective 1, which are designed to prevent an increase in flood risk, and in the case of measures implementing Objective 3, which are to improve the flood risk management system, it is agreed that these measures will add to the final list of measures without the need to conduct CBA and MCA analyzes.

Actions implementing Objective 1 are aimed at interventions related to the restoration of the functionality of the existing flood protection system lost as a result of the destruction of its element. In such situations, actions are aimed at rebuilding such an element of the flood protection system that protects the inhabitants and their property, which has been

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part of the functioning of the ecosystem for many years. Hence, Objective 1 measures in many cases represent an overriding public interest. Among the activities implementing Objective 1, there are also activities planned in the PPSS, which may also serve to limit the increase in flood risk resulting from climate change.

In the case of measures implementing Objective 3, these will mostly be non-technical measures strengthening the flood risk management system, the implementation of which has no impact on the natural environment.

Activities planned in the 1st cycle of FRMP and commenced but not completed during the period of the 1st planning cycle, which do not contribute to the reduction of flood risk in designated problem areas, also contribute to the final list of activities without the need to conduct CBA and MCA analyzes. This is due to the need to maintain the continuity of the planning process.

The activities planned and started in the 1st planning cycle, which reduce the flood risk in problem areas, will be included in the analyzes. These activities will be included in the planning variant W0 bis. Thus, the result of activities related to the creation of the base list of measures will be the creation of a list of measures implementing Objective 2, which, without conducting analyzes, will be added to the final list of FRMP measures, as well as the list of measures implementing Objective 1 and Objective 3 of FRMP, which will also be added to the final list of measures.

In addition, the analysis of effectiveness and efficiency will only cover the measures implementing Objective 2 qualified to the base list of measures, i.e. measures aimed at reducing flood risk in identified problem areas. The activities included in the base list of activities will be used to create planning variants subject to the CBA and MCA assessment, and the results of the environmental assessment carried out under the aFRMP will be an element of a multi-criteria analysis, including planning variants that will be proposed for designated problem areas.

The selection of the initial list of activities to distinguish activities qualified for the base list of activities will consist in selecting those activities that may significantly affect the reduction of flood risk in problem areas and at the same time will positively pass the S.M.A.R.T. analysis.

If the actions on the initial list of actions are not indicated or actions from the initial list of actions turn out to be insufficient to effectively reduce the flood risk in problem areas, the Contractor's group of experts will propose and agree with the Employer additional actions to reduce the flood risk (list E). The scheme for selecting measures to reduce the flood risk in problem areas / locations recommended for implementation under aFRMP is shown in Figure 5.

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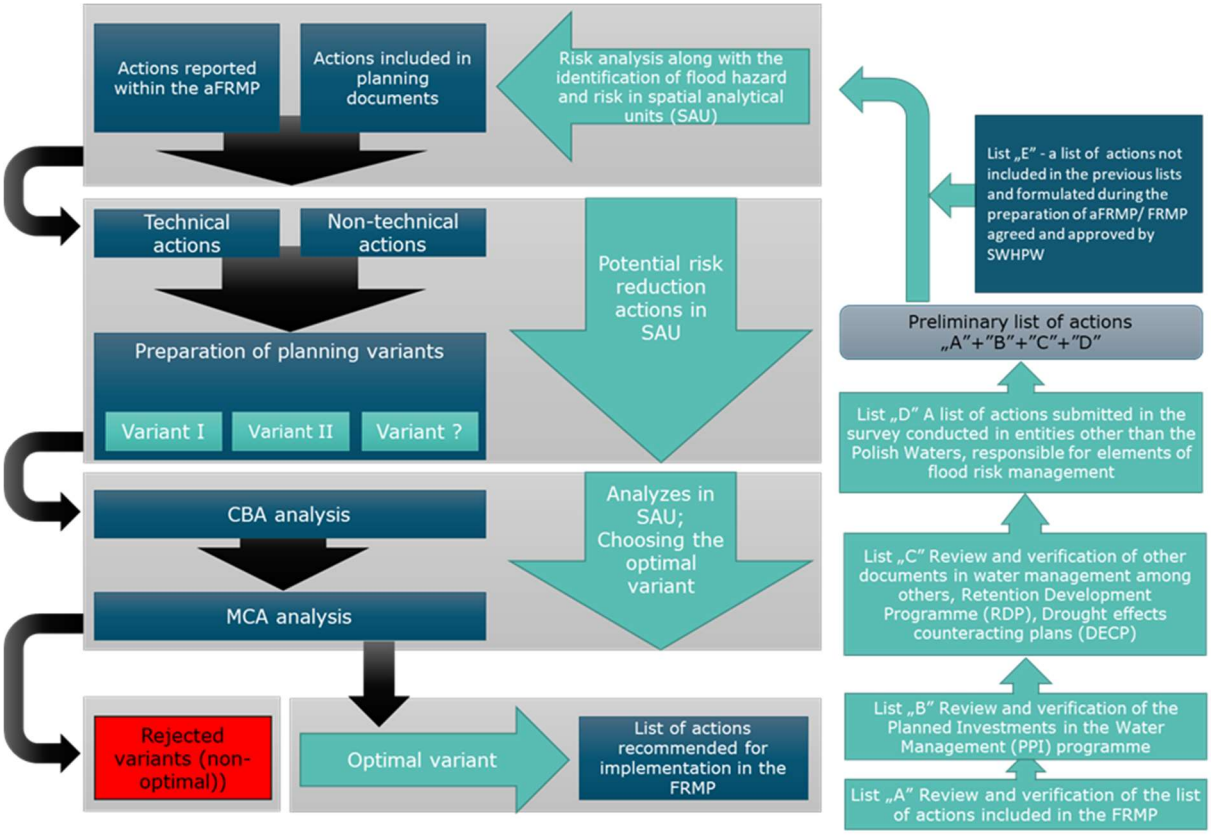

Figure no 5 Scheme of selecting measures to reduce flood risk in problem areas / locations recommended for implementation in FRMP

9.3. PREPARING AN INITIAL ACTION LIST

Not all actions that can help to solve the identified problems and, consequently, meet the objectives of flood risk management, can be implemented. Experience shows that many of the planned actions arouse resistance in the local community, others do not have documentation prepared so that they can be implemented quickly, and still others have not been analyzed in terms of the effects that they may bring or do not meet the requirements of the Water Framework Directive and other environmental directives. As a result, some of the actions initially considered cannot be implemented and should be removed as soon as possible at the stage of FRMP development.

The process of creating a draft list of actions is as follows:

Review and verification of the list of actions included in the FRMP from the 1st planning cycle.

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For this purpose, it is planned to use, among others the review of the diagnosis of flood risk management problems carried out as part of sub-task 1.3 and the assessment of the progress of the implementation of actions included in the FRMP lists from the 1st planning cycle, carried out as part of sub-task 1.4. As part of the verification, a preliminary selection will be carried out and the list will only include actions with a significant impact on reducing the flood risk, having financing, technically and economically feasible in the near financial perspective (2021-2027). The list of these tasks will be the "A" list.

Review of the Programme of Planned Investments in Water Management of SWH PW (PPI). The PPI plan is updated annually by SWH PW on the basis of data from investment departments of individual organizational units of SWH PW, so in the first place it is planned to link the actions included in the PPI with the list of tasks not completed from the 1st cycle of FRMP (list "A" after modifications). An action selected from the PPI, but not yet included in the "A" list, will form the "B" list.

Analysis and review of other actions (technical and non-technical) planned in water management that affect the achievement of flood risk management objectives. In this case, the planned actions will be analyzed, including included in planning documents regarding water management, eg the Plan for Counteracting the Effects of Drought - this mainly concerns actions related to the creation of various types of retention and verification of water management rules for multi-purpose reservoirs, as well as other strategies and programmes within the scope of navigation, energy and the environment. The list of these tasks will be the "C" list.

On the basis of the results of the survey concerning the implemented, implemented and planned actions undertaken by entities other than Polish Waters, responsible for individual elements of flood risk management (sub-task 1.4.2), a list "D" will be created.

The **initial list of actions** will be the sum of the tasks from lists A, B, C and D. The diagram of the process of developing the initial list of actions is presented in Figure no 6.

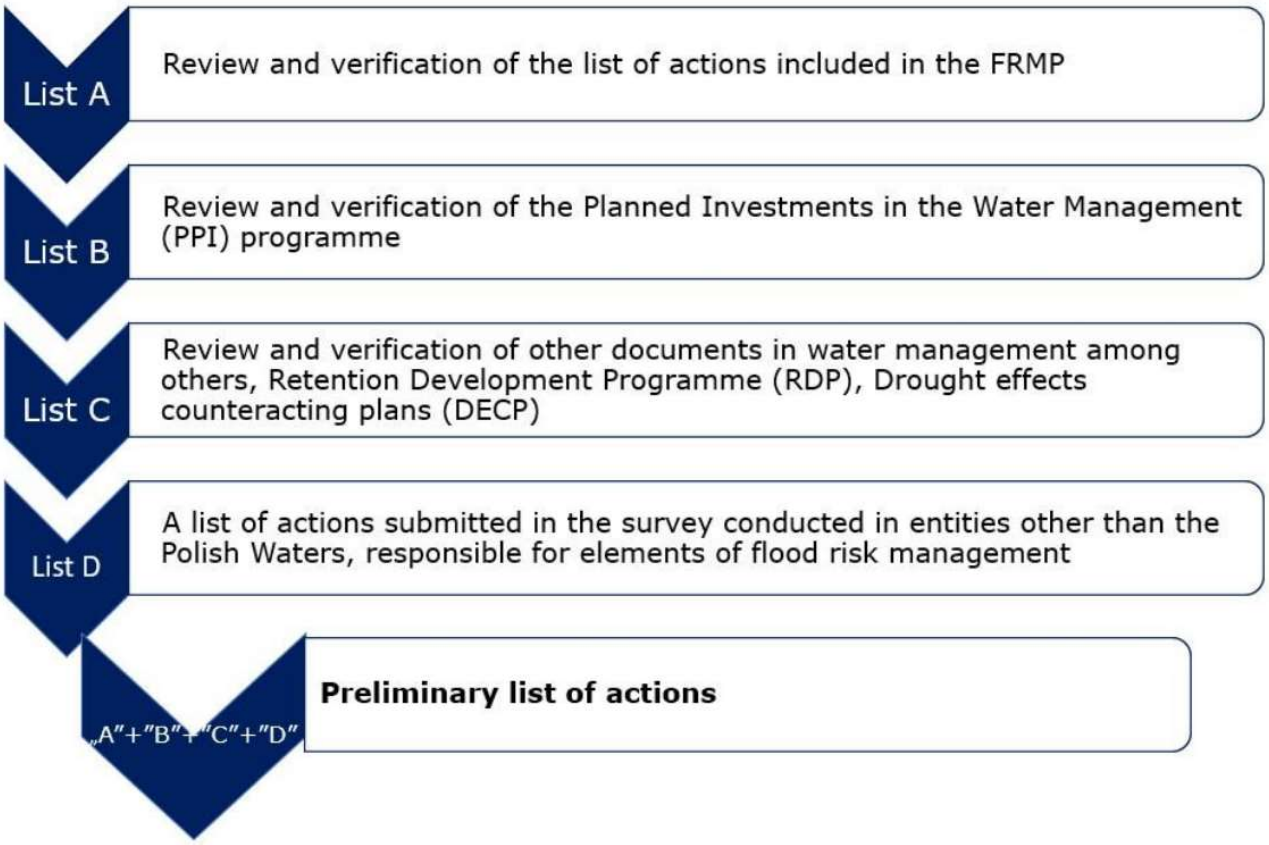

Figure no 6 Diagram of the preparation of an initial list of actions

9.4. CREATING A BASE LIST OF ACTIONS

The performed assessment of the legitimacy of individual actions for the purpose of creating an initial list of actions will enable the introduction of data to create a spatial database, with the use of attributes, allowing for the verification of actions in the next step in accordance with the provisions of the S.M.A.R.T. rule.

The final list of FRMP tasks will be compiled in accordance with the provisions of the S.M.A.R.T. rule. To this end, the values of all evaluation criteria for each task must be precisely determined. The indicated action will receive a positive result of the verification only as a result of a positive evaluation by all criteria.

To perform the S.M.A.R.T. rule it will be obligatory to consider the following factors in the course of the analysis:

Within the scope of the "**Specific**" criterion, the task should contain, for example, the answer to the questions: what is it to be achieved and where, what is the reason for the action, who will do it and what limitations and problems may be. In other words, it is necessary to recognize and clearly establish:

1. Entities responsible for the performance of actions, but general expressions such as local government units, state administration, etc. are not allowed.
2. Method of coordinating the implementation of an action if the obligation to implement it concerns more than one entity, and all entities should be clearly defined.
3. Confirmation of the intention to implement them by the entities indicated for the implementation of actions in the survey process 4. Location where the action will be implemented,

In terms of the "**Measurable**" criterion, the task should be assigned the effects that its implementation will bring and the actions of control of achieving these effects, that is

- The need to ensure the possibility of monitoring the effects of the action by means of a measure related to the objective of flood risk management,

In terms of the "**Achievable**" criterion, the task will be assessed in terms of checking whether there are adequate resources and forces that allow for their achievement, and the social environment allows for their implementation. In other words, confirm that:

1. The implementation of actions is possible in the currently applicable legal system,
2. The entities indicated for the implementation of actions are legally obliged or authorized to do so,
3. Actions have established funding sources or a planned method of obtaining funding,

In terms of the "**Relevant**" criterion, it will be confirmed whether the action is adequate and important for the achievement of the objective that was assumed to be achieved, in particular:

1. Perform essentially the function of reducing the flood risk, especially for actions within the scope of shaping the retention and construction of water facilities,
2. The significance of actions in terms of flood protection should result from the review of the diagnosis of flood risk management problems and the results of the review and update of PFRA, FHM and FRM,

Within the scope of the "**Time-bound**" criterion, the time frame of the task will be verified, as the action must have a certain implementation schedule and, consequently, achieve the objective for which it was developed. The time condition is as follows:

1. The implementation of selected tasks (or at least the development of technical documentation) should be realistic in the next financial perspective (2021-2027).

Applying the S.M.A.R.T. rule is to ensure that the actions included in the plans are well thought out, prepared, fit for purpose and possible to implement. Simplifying the above provisions, it can be said that the key requirements for potential actions are that they should be well-defined and realistic, which is understood as follows:

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1. An action is **'well-defined'** when it is known:
   a. what needs to be done (an action has a specific location and parameters)
   b. who is to do it (the entity or units potentially responsible for the implementation is known)
   c. what problem is solved by the action (to what purpose it relates)
   d. what effects will the implementation of the measure bring, i.e. what will be the impact of the measure on reducing the flood risk, quantified if possible, so as to enable the measure to be assessed.
2. An action is "**realistic**" if:
   a. adequate forces and resources are provided for its implementation (or the probability of obtaining them is high)
   b. there is public consent for its implementation (potentially conflicting actions were consulted with stakeholders)

In addition, the proposed actions should take into account the applicable legal requirements, and therefore require, in particular:

- performing an analysis whether the action may result in failure to achieve good water status or deterioration of good water status,
- checking whether the actions that are in conflict with the environmental objectives set for the waters concerned by the action are adequately justified, in accordance with the requirements of the Water Framework Directive, taking into account the Principles of verification of the premises under Art. 4(7) of the WFD in relation to anti-flood actions
- Checking whether the actions influencing the habitat areas or other forms of nature protection have the proposed compensatory actions (eg in accordance with the Habitats Directive, the Birds Directive).

The base list of actions will be a set of actions that meet the above requirements of the S.M.A.R.T.

The baseline list of actions for the water region will be developed in the form of a spatial database with filled in attributes for the results of the S.M.A.R.T. along with assigning tasks to problem areas for individual planning catchments, and then merged for the river basin areas.

The diagram of the process of developing the baseline list of actions is presented in Figure no 7.

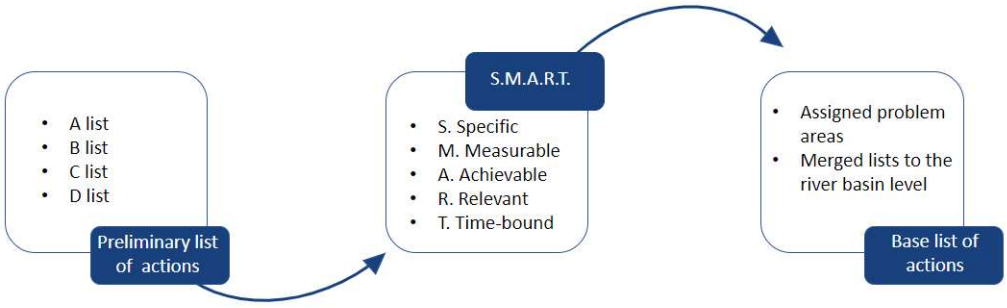

Figure no 7 Diagram of the preparation of the initial and base list of actions

Actions selected from the base list will be used to build planning variants.

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10. PREPARATION OF PLANNING VARIANTS

10.1. ASSUMPTIONS FOR BUILDING VARIANTS

The planning variant is a set of independent or related actions leading to the achievement of the indicated objectives.

It is assumed that planning variants will consist of various technical and non-technical actions. Preparation of proposed alternative solutions for the selection of actions is preceded by the implementation of the spatial distribution of flood risk and the definition of problem areas - actions described in chapter 8.1. Then, for the designated problem areas, the Contractor in the next step will prepare and evaluate individual planning variants.

Verification of the adopted variants, their assessment, comparison and selection of the optimal variant, and determination of the type of instruments necessary for implementation will take place already at the level of the defined area of ntervention.

The process of selecting actions in the form of a set of a given planning variant is a complicated process due to obtaining, on the one hand, the lowest possible degree of negative impacts on the environment, society and economy, and on the other hand, the greatest possible reduction of flood risk. Therefore, particular attention should be paid to the process of identifying problems and selecting actions at local level. Considering the state of flood risk in our country, as well as the fact that threats often occur in river valleys, which are the natural habitat of the natural world, when developing variant proposals, the following should be considered:

- actions reflecting the "spirit" of the Floods Directive, i.e. non-technical actions,
- assessment of technical options through the prism of their impact on the environment and the achievement of environmental objectives adopted in water management plans

Formulating planning variants from the baseline list of actions may be ineffective, as it may happen that the list of actions is insufficient to define a planning variant, the implementation of which would guarantee the achievement of the assumed flood risk management objectives. In such a situation, additional actions should be indicated, which were not indicated in the previous lists of actions (additional actions will be included in the form of the "E" list). Actions indicated in this way will be submitted to the Ordering Party for verification and approval at the water region level. Only then, when formulating planning variants, taking into account additional actions, will the rules of S.M.A.R.T. This will allow:

- achieve the adequacy of the proposed solutions to the diagnosed problems,
- define the expected effects of the proposed solution,
- ensure its feasibility, including social acceptability,

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- define the time frame for the implementation of individual actions that make up the proposed solution.

The planning variants should be aimed at:

- as far as possible, they were different from each other, e.g. variants opposed to or extended with further actions compared to the previous variant
- they were not limited to the competences of one unit or sector, in particular to the competences of institutions related to water management and river maintenance, i.e. the State Water Holding Polish Waters,
- comply with the applicable law or would clearly result from the developed legal instruments supporting the implementation of the PZPR (the source of information will be the study entitled "Implementation of instruments supporting the implementation of FRMP actions"),
- in the case of actions having a negative impact on the environment, they should take into account actions to compensate or mitigate this impact.
- ensure their functionality in terms of the requirements resulting from changing climatic conditions and changes in flood vulnerability of protected areas.

In the process of formulating planning variants, variants should be developed that represent different approaches to reducing flood risk. The process of selecting the best variant will be an iterative process, during which it will be necessary to redefine or supplement the variants or even formulate new ones in order to achieve success in the form of the final (mixed) variant, meeting all the assumed objectives of flood risk management in a given water region.

Planning variants should be formulated for each identified problem area independently for each planning catchment basing on actions from the base list and possibly additional actions in agreement with the Ordering Party (**list "E").**

It is expected to define planning variants in the following scope:

a) **The "zero" variant**, covering the hydrotechnical condition of construction sites existing at the end of 2019 (according to the results of the review and update of flood hazard maps and flood risk maps), assuming the ongoing implementation of maintenance actions in accordance with the Water Maintenance Plan,

b) **Mixed variant** (non-technical and technical actions) "soft", including the implementation of actions that do not adversely affect hydromorphological conditions or improve hydromorphological conditions (such as reconstruction of existing embankments, increasing the spacing of embankments, construction of relief channels, construction of polders and dry retention reservoirs),

c) **Mixed variant** (non-technical and technical actions) "hard", including also technical actions that may have a negative impact on hydromorphological conditions (such

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as the construction of multi-purpose retention reservoirs, barrages and new sections of embankments).

It is allowed to introduce a greater number of variants or introduce additional variants, e.g. for the "soft" type, if the "hard" variant cannot be implemented, reconstruction of the existing embankments, increasing the spacing of embankments, construction of relief channels, construction of polders and dry retention reservoirs.

The lists of planning variants will be developed in the form of database tables with a structure enabling connection with spatial data on actions and planning catchments. **In the structure of the tables, the attributes should be distinguished** that allow to save the results of analyzes leading to the selection of the optimal variant, which will be carried out at the next stage of development.

The lists of planning variants **should be developed separately** for the identified problem areas in each planning catchment. Then, for each planning variant in individual planning catchments, **it is planned to carry out a cost-benefit analysis (CBA analysis)**, as a result of which, inter alia, economic efficiency index values. Variants with a positive result will be assessed in the next step in the form of a multi-criteria analysis. The positive result of the cost-benefit analysis is understood as follows:

- Benefits / costs ratio higher than 1,
- Economic net present value (ENPV) greater than 0,
- Economic rate of return (ERR) greater than the discount rate.

Then, using a number of CBA analysis criteria, the optimal planning variant for implementation will be indicated.

In the absence of a positive result of the cost-benefit analysis for all analyzed planning variants in the problem area, only the non-technical variant in this problem area will be recommended, as the lack of a positive result of the cost-benefit analysis means that it is not economically effective to implement technical variants to protect property located in the problem area.

A detailed description of the cost-benefit analysis and multi-criteria analysis is presented in chapter 11.2 and 11.4.

10.2. THE FINAL LIST OF ACTIONS AND PRIORITIES

Having a list of actions of optimal planning variants for problem areas in individual catchments, these lists will then be aggregated to the lists of actions at the levels of water regions and river basins. In this manner, a list of actions to reduce the risk of flooding in individual river basins will be created.

In addition, the final list of measures will be supplemented by measures recommended for implementation in the previous FRMP planning cycle and requiring continuation in the current FRMP cycle as well as measures implementing FRMP main objectives I and III (in

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accordance with the algorithm for creating the final list of measures described in Chapter 9.2).

Moreover, the final list of actions will be supplemented by actions taken during public consultations of the FRMP and actions from public consultations as part of the strategic environmental impact assessment of this document.

For all technical actions consisting in the construction of water devices that will be included in the final list of actions, the size of the measurable and control flows, determined in accordance with the requirements of the Regulation of the Minister of the Environment of 20 April 2007 on technical conditions to be met by hydrotechnical structures and their location. The amounts of flows should be determined based on the parameters of the probability distributions of the maximum flows with a certain probability specified in the framework of review of the FHM and FRM/ aFHM and FRM. The mere lists of actions, the legitimacy of which will be proven, will not indicate the hierarchy of their implementation. In line with the Water Framework Directive and the Water Law, it is necessary to prioritize actions aimed at achieving the objectives of flood risk management and monitoring the progress of the plan implementation.

Determining the method of selecting the categories of actions to reduce the flood risk, and then specific actions assigned to the designated problem areas requires establishing criteria that will allow limited resources to be directed to actions that may be the most effective and serving also the objectives of other strategic documents relating to broadly understood water management and security countries.

Therefore, an important tool indicating the necessity to implement an action in the first place over the others is the definition of priorities for actions.

In order to prioritize actions, it is planned to perform a multi-level assessment and determine their importance, and to define a hierarchy on several levels, starting from the base level, i.e. the problem area, then the planning catchment level, and finally indicating the sequence of actions at the water region level and for the river basin. When assessing the importance of individual tasks, the Contractor intends to use the findings and indicators from previous analyzes.

As in the case of multi-criteria analyzes, the participation of the Contracting Authority's representatives in identifying the criteria and assigning weights to the criteria is also expected in prioritization. **The criteria adopted for prioritization will be agreed with the Ordering Party to take into account the Ordering Party's preferences and local specificity.**

10.3. SET PRIORITIES FOR ACTIONS AT THE PROBLEM AREA LEVEL

All actions included in the list of planned actions were assigned the final priorities for their implementation using a 5-point scale, consistent with the recommendations of the European Commission, indicating actions with:

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- low priority (low),
- moderate priority,
- high priority (high),
- very high priority,
- immediate priority (critical).

Actions commenced in the first planning cycle and passed to aFRMP and actions for which construction supervision orders are issued, because their condition endangers safety, has been assigned an immediate priority (5) resulting from the necessity to implement these actions, regardless of what main objective of aFRMP such actions implement.

Horizontal non-technical actions, i.e. not relating to a specific problem area, as well as technical actions (excluding technical actions implementing Objective 2) were assigned priorities (on a scale of 1 - 5), taking into account that a given measure belongs to the type of measure (which had previously been assigned the priority low, medium or high) and the assessment of individual characteristics of the prioritized action, i.e. the following evaluation criteria were used:

Criterion 1. Action progress, weight 30%:

a. Action in the idea phase (for technical actions - no documentation - evaluation: 1

b. Action in the preparatory phase (for technical actions - there is a technical concept - evaluation: 2

c. For technical actions - there is an environmental decision - assessment: 3

d. Action ready for implementation (for technical actions - there is a building permit - assessment: 4

Criterion 2. Provision of financing, weighing 30%:

a. Has confirmed financing - assessment: 2

b. It is planned to obtain financing - evaluation: 1

Criterion 3. Affiliation of the assessed action to the type of action with a given priority, with a weight of 40%:

a. Actions of the high priority type - assessment: 3

b. Actions of the medium priority type - assessment: 2

c. Actions of the low priority type - assessment: 1

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Non-technical actions relating to a specific problem area were assigned priorities (on a scale of 1 - 5), based on the value of the average annual AAD flood losses in the problem area to which a given measure relates.

New technical actions provided for in the aFRMP implementing Objective 2 have been assigned priorities (on a scale of 1 - 5) at the water region (or river basin) level as a resultant of the pre-set priority at the level of the type of measure, as well as the priority of reducing flood risk in the problem area to which it is dedicated this action.

10.4. DETERMINING PRIORITIES FOR ACTIONS AT THE PLANNING CATCHMENT LEVEL

When analyzing the distribution of problem areas in a given planning catchment, the "catchment approach" should be applied in accordance with the assumptions of the Framework Flood Directive when indicating the sequence of implementation of the recommended actions. Priorities at the planning catchment level will be established not for individual actions, but for packages of actions forming the planning variant, previously selected in the multi-criteria MCA analysis, for each problem area as an optimal variant, recommended for implementation.

When prioritizing the reduction of flood risk in problem areas located in the planning catchment, water region (or river basin), the "catchment approach" was used, which shows that the first priority should be to reduce flood risk in problem areas closer to the source of watercourses to exclude risk transfer in downstream problem areas. One should also be guided by the significance level of a given problem area in shaping the flood risk reduction policy in a water region (or river basin). In this case, it is necessary to try to solve the most serious problems in the first place, that is to try to reduce the unfavorable consequences of floods in problem areas, where these consequences are the most serious.

In the case of the Narew Water Region, when moving from the level of the problem area to the level of the catchment area, a situation may theoretically arise in which it will be necessary to prioritize between the problem areas of the Narew catchment and the water region, one of which will be within the administrative reach of RWMB Warszawa, and the other the problem area will be within the administrative reach of RWMB Białystok. It is recommended to approach such a hypothetical situation as follows: it will be necessary to cooperate between the Manager of the Middle Vistula Water Region on the Contractor's side for RWMB Warszawa and the Manager of the Narew Water Region on the Contractor's side for RWMB in Białystok in terms of prioritization at the level of the Narew catchment and the water region if problem areas with high flood risk are identified in this catchment and it will be necessary to prioritize at the catchment level, and then the water region level, and the problem areas will be within the administrative reach of RWMB Warszawa and RWMB Białystok.

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10.5. ESTABLISHING PRIORITIES FOR ACTIONS AT THE WATER REGION AREA LEVEL AND AT THE APPLICATION AREA LEVEL

Due to the fact that the level of the water region covers individual planning catchments, the indication of the sequence of actions, aggregated to planning variants, is to be applied based on the same prioritization principles as for the planning catchment. It is also recommended to apply an analogous approach to prioritizing planning variants for the river basin area.

Actions included in the lists should then be grouped on a 5-point scale, in line with the recommendations of the European Commission[39] indicating:

a. low priority,
b. moderate priority,
c. high priority,
d. very high priority,
e. critical priority.

The scale ranges of individual priorities will be defined on the basis of the results of the ranking of recommended investments in the river basin scale.

39 COMMISSION STAFF WORKING DOCUMENT European Overview - Flood Risk Management Plans 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) and the Floods Directive (2007/60/EC) Second River Basin Management Plans First Flood Risk Management Plans SWD/2019/31 final
https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1576069425296&uri=CELEX:52019SC0031

11. ANALYSIS AND EVALUATION OF PLANNING VARIANTS

11.1. HYDRAULIC AND HYDROLOGICAL ANALYSIS

11.1.1. General assumptions

Planning variants formulated under the aFRMP will be assessed for effectiveness and efficiency with the use of hydraulic and hydrological models. For each of the planning variants, the modeling will determine flood hazard areas with a specific probability of occurrence:

- Areas where the probability of flooding is low and amounts to 0.2% (i.e. once every 500 years),
- Areas where the probability of flooding is average and amounts to 1% (i.e. once every 100 years),
- Areas where the probability of flooding is high at 10% (i.e. once every 10 years).

The existing, most up-to-date models, which are the products of the flood hazard maps and flood risk maps review and update project, will be used for hydraulic modeling. These models can be broadly divided into four groups:

1. hydraulic models for rivers or river sections indicated in the PFRA (2011) for the 2nd planning cycle - made in accordance with the Methodology of developing flood hazard maps and flood risk maps in the 2nd planning cycle,
2. hydraulic models for rivers or river sections indicated in the APFRA for the 2nd planning cycle - made in accordance with the Methodology of developing flood hazard maps and flood risk maps in the 2nd planning cycle,
3. hydraulic models for rivers or river sections for which the flood hazard maps developed in the 1st planning cycle have been updated - depending on the significance of the review criteria, fully or partially performed in accordance with the Methodology of developing flood hazard maps and flood risk maps in the 2nd planning cycle,
4. hydraulic models for rivers or river sections for which the flood hazard maps developed in the 1st planning cycle have not been updated - made in accordance with the methodology of developing flood hazard maps and flood risk maps adopted in the 1st planning cycle.

In the case of rivers or river sections for which the flood hazard maps developed in the 1st planning cycle have not been updated, it is possible to use hydraulic models developed in the FRMP in the 1st cycle, provided that the proposed variants of actions for a given river or river section have not changed significantly.

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For areas not covered by review and update of FHM and FRM, it is acceptable to use other models if they meet the methodological requirements for the models used in the review and update of FHM and FRM study.

Methodological compliance with updating flood hazard maps (FHM) and flood risk maps (FRM) mainly includes:

- Use of MIKE 11, MIKE 21 or MIKE FLOOD software by DHI,
- The use of geodetic measurements not older than 8 years,
- The use of the digital terrain model referred to in art. 4 sec. 1a point 11 of the Act of 17 May 1989 - Geodetic and Cartographic Law, with a grid interval of 1 m and height accuracy of not less than 0.2 m, made by air laser scanning,
- The use of hydrological data developed in accordance with the Update of the methodology for calculating maximum flows and precipitation with a specified exceedance probability for controlled and uncontrolled catchments and identifying models for the transformation of precipitation into runoff [Stowarzyszenie Hydrologów Polskich, 2017] or in accordance with the exceptions adopted in the updating flood hazard
- maps (FHM) and flood risk maps (FRM) project regarding the development of hydrological data.

The aFRMP does not assume updating of the existing models within the scope of topographic data (geodetic measurements, numerical terrain model), hydraulic and hydrological data.

One-dimensional (1D), two-dimensional (2D) or hybrid (1D / 2D) models will be used for hydraulic calculations. 1D modeling will be performed in MIKE 11 or MIKE HYDRO River software. The MIKE 21 software will be used for 2D modeling, and MIKE FLOOD for 1D / 2D modeling.

1D models are commonly used for water flow analysis in open channels. They can be used wherever the assumption of one-dimensionality of the phenomenon is met - river beds and well-defined river valleys. 2D modeling is used in cases where there is a need to obtain a spatial distribution of the position of the water table, flow rate, as well as velocity and flow directions. 2D calculations are performed on a computational grid that continuously defines the terrain topography and riverbed bathymetry. 1D / 2D models combine 1D and 2D models dynamically - information is exchanged between these models during calculations and calculations in one affect the calculations in the other model. There are many possibilities to combine 1D and 2D models. However, the most commonly used approach is in which the river bed is modeled 1D, and the flow in the flood plains is calculated in a 2D model.

Most of the hydraulic models developed by the updating flood hazard maps (FHM) and flood risk maps (FRM) project are one-dimensional. 2D or 1D / 2D models have been developed for provincial cities and cities with district rights and other cities with a

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population exceeding 100,000 people (in accordance with the Regulation of the Minister of Maritime Economy and Inland Navigation of 04 October 2018 on the development of flood hazard maps and flood risk maps.

Additionally, in special cases, 2D or 1D/2D models have been developed for other areas:

- estuary stretches of rivers to the sea,
- depression areas such as: Żuławy Wiślane, the area of coastal lakes and the vicinity of the Szczecin Lagoon and the Vistula Lagoon,
- sections of rivers where the scheme of the river network in the 1D model was too complicated and laborious, and the results of one-dimensional modeling would be burdened with a large error (based on a detailed analysis of the river and valley geometry, the layout of the main river network and tributaries, location and layout of hydrotechnical and communication structures in relation to the river beds or sections of rivers where, due to the width of the floodplain, the assumptions of one-dimensional traffic are not met,
- areas under the influence of mining subsidence (mining damage).

The results of hydraulic modeling will be the basic element determining the inclusion of specific tasks from the so-called "Base list" for a specific planning variant and, consequently, decide on the choice of the recommended variant for each planning catchment. Modeling will also be a decisive element in rejecting the actions indicated in the 1st cycle of FRMP, which are unjustified due to, for example, a reduction in the range of flood zones in updating flood hazard maps (aFHM) in relation to the 1st cycle of FHM.

The planning variants will take into account both technical actions, consisting in the construction (construction, reconstruction, demolition) of water devices, and non-technical ones, consisting among all in shaping the retention (natural and artificial). Depending on the type of actions, modeling will include changes to the hydraulic models or additionally hydrological analyzes, using the existing rainfall-runoff models.

11.1.2. Modelling of technical actions

For the proposed technical actions, a preliminary analysis of the impact on the change of flood risk areas will be performed. For hydraulic modeling, actions will include:

- construction of new bridges, hydrotechnical structures, flood embankments or other facilities used for flood protection purposes,
- a significant change in the parameters of bridge structures, hydrotechnical structures and flood embankments (investment parameters may have a significant impact on the change of data for hydraulic modelling),
- a significant change in the river bed cross-sections,

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- a significant change in the terrain in the valley.

Actions classified as significant, for which the parameters necessary for their correct mapping will be available, will be entered directly into the hydraulic models.

Depending on the nature of the technical actions, modifications to the hydraulic models will include:

- for actions involving regulation works in the riverbed, construction/reconstruction of flood embankments - changes in the parameters of cross-sections and/or changes in the course of river network elements, in the case of 2D or 1D/2D models - changes in the calculation grid,
- for actions involving the construction of new hydrotechnical or bridge facilities - introduction of additional model elements.

The MIKE11 programmeme enables the introduction of various types of objects to the hydraulic model, such as water reservoirs, weirs, thresholds, barrages, culverts, bridges, pumping stations, and also allows to reproduce the operation of controlled objects.

Uncontrolled hydrotechnical objects (weirs, sills, steps) should be mapped in the model by means of an overflow. In the Mike11 DHI software, a dedicated tool for this purpose is the "structures - weirs" module contained in the NWK11 river network file.

The weirs module allows to enter, depending on the selected method, data from the Q/h curve, relating to the relationship between the flow and the position of the water surface, or building parameters, which can be entered by drawing it in a cross-section or setting height and width parameters in the programmeme.

For bridges, in Mike11, there are two methods of entering the object into the hydraulic model:

- by means of two interconnected hydraulic elements describing the water flow over the bridge (overflow, the 'structures - weirs module in the NWK11 river network file) and inside its structure (culvert,' structures - culverts module).
- using a dedicated module for bridges, by selecting a method appropriate to the existing conditions (Energy Equation, Federal Highway Administration Water Surface Profile FHWA WSPRO and United States Bureau of Public Roads USBPR).

Reservoirs and polders will be introduced into the model in accordance with the Methodology of developing flood hazard maps and flood risk maps in the second planning cycle.

If the reservoir capacity curve is available, it will be mapped to the model. The work of the proposed tanks and polders will be introduced to the model in accordance with the available design documentation, by defining overflow-relief devices and/or introducing control rules. In the case of multi-purpose objects (retention reservoirs and barrages), the modeling will be carried out with the assumption of water management oriented at mitigating flood waves.

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The recommended method of implementing the rules of controlling the outflow from a water reservoir in a hydraulic model is their mapping by means of a system of logical conditions and tables linking individual variables with each other. The module enabling this approach in the Mike11 DHI software is the module "control structures" contained in the file of the river network NWK11.

11.1.3. Modelling non-technical actions

Effectiveness of non-technical actions, consisting in changing the management of the catchment area, will be checked first in hydrological models, while taking into account the actions that can be modeled - increasing retention in forest, agricultural and urban areas, slowing down surface runoff. The parameters of the hydrological models (land use change, runoff delay time) will be changed to take into account the introduction of non-technical actions. The results of the hydrological models will then be used to create the boundary conditions for hydraulic models. As a result, it will be possible to evaluate the effectiveness of non-technical actions in the context of reducing flood risk in problem areas.

The existing rainfall-runoff models developed under the flood hazard maps review and update project and flood risk maps will be used for hydrological analyzes. These are models made in the HEC-HMS software, using the SCS-CN method, which links the amount of effective rainfall (directly shaping the runoff hydrograph) with the type of soil, the way of managing the catchment area, the nature of the vegetation cover, hydrological conditions, and soil moisture during the period preceding the occurrence of the analyzed rainfall episode.

In line with the approach adopted in the updating flood hazard maps (FHM) and flood risk maps (FRM) project to develop hydrological data, hydrological models were made for rivers with rainfall types in water regions:

- Upper-West Vistula,
- Upper-Eastern Vistula (excluding some rivers in the San catchment area),
- Upper Oder,
- Central Oder.

For the remaining water regions, in the area of northern and central Poland, where the maximum flows are associated with thaw or mixed floods (thaw floods are more frequent here and their culminations are greater than rainfall floods), hydrological models were performed mainly in the case of small urbanized catchments.

For the catchment area, where there are no hydrological models available, and such non-technical actions will be proposed, the methodology adopted in the 1st planning cycle will be used. On the basis of the literature review and hydrological modeling performed for the lowland and mountain test catchments, in the 1st planning cycle, a matrix of flow reduction in natural catchments was developed for certain degrees of increase in afforestation and the index of forest cover, which illustrates the distribution of forested areas in the

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catchment. Based on the hydrological modeling carried out in the second planning cycle, this matrix will be verified and possibly corrected.

If there are hydrological models developed under other projects (e.g. models in the Pilica and Wkra catchments) for which similar analyzes have been conducted, they will be analyzed in detail in terms of the possibility of using the results of calculations or conclusions to assess the effectiveness of the implementation of non-technical actions in the catchment.

11.1.3.1. Analysis of the possibility of increasing forest retention in the catchment

Increasing the forest cover of the catchment area and proper management of forest areas have a positive effect on shaping the hydrological regime of watercourses through, among others:

Limiting the flood wave in areas with large slopes and covered with little permeable soils,

- Delay and limitation of surface runoff from precipitation and snow melting,
- Limiting soil erosion and fulfilling a water-protective function by limiting the inflow of pollutants to groundwater.

The analysis of the possibility of increasing the retention capacity of forest areas under the AFRMP assumes introducing changes in the management of the catchment area, consisting in increasing the level of forest cover at the expense of, first of all, grassy vegetation, and secondly, arable land cultivation.

Potential afforestation areas in individual catchments, indicated on the basis of spatial analyzes, will be the basis for calculating the amount of surface runoff reduction from the catchment area.

The detailed methodology for approaching these analyzes is presented below in the next few steps.

STEP 1 Preparation of input layers

First, the spatial layers should be prepared based on the classes of land cover objects from the Topographic Object Database for two variants:

- current land cover according to the BDOT10k database,
- variant with a change of forested area.

STEP 2 Calculating the CN parameter

In the next step, the values of the CN parameter should be calculated for the SCS-CN model, based on the specific form of land cover and the soil group.

In order to define the soil group, the European Soil Data Center (ESDAC) database was used. On its basis, the division of soils and mineral deposits into groups and granulometric

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subgroups according to the percentage of sand, silt and clay fractions by weight was created - the grading classification of soils and mineral deposits was used according to the Polish Soil Science Society (according to the PTG 2008 Classification).

Then, approximate equivalents of granulometric groups from the BN-78 / 9180-11 standard were used in order to correctly assign the soil species to the corresponding soil group: A, B, C and D according to Ignar [Ignar, 1988]:

A - Soils with little possibility of surface runoff. They are characterized by good permeability, high filtration coefficients (k> 7.6 mm / h). This group includes deep sands, sands with a small admixture of clay, gravel, deep loess,

B - Soils with above average permeability, average filtration coefficient (3.8 <k ≤7.6 mm / h). This group includes medium-deep sandy soils, shallow loess and sandy loams,

C - Soils with less than average permeability (1.3 <k ≤ 3.8 mm / h). These include stratified soils with poorly permeable inserts as well as clay loam, shallow sandy loams, soils with a low organic content, loams with a high clay content,

D - Soils with a high possibility of surface runoff, very low permeability and very low filtration coefficient (k ≤ 1.3 mm / h). This group includes clay soils, silt loam, saline loam, and stratified soils with impermeable layers.

The values of the CN parameter for individual land cover classes and soil groups for average humidity conditions in the catchment are presented in the table below.

Table no 26 CN parameter values for individual land cover classes and soil groups for average humidity conditions in the catchment area

Land cover	Hydrological conditions	BDOT class PT	CN values for soil groups			
			A	B	C	D
Open areas: lawns, parks, cemeteries, etc.	Bad (grass <50% area)	PTRK01	68	79	86	89
	Medium (50-75% coverage)	PTUT01	49	49	79	84
	Good (coverage> 75%)	PTWZ01, PTUT02, PTUT03, PTUT04, PTUT05	39	61	74	80
Impermeable areas: paved parking lots, roofs, roadways	-	BUBD, PTPL01	98	98	98	98
Streets and roads	Impermeable with roadsides and open ditches	PTKM01, PTKM03, PTKM04	83	89	92	93
	Grit	PTKM02	76	85	89	91
	Ground	PTGN03	72	82	87	89

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Land cover	Hydrological conditions	BDOT class PT	CN values for soil groups			
			A	B	C	D
Commercial and industrial areas	Approx. 85% of the area impermeable	PTNZ01, PTZB04, PTZB05	89	92	94	95
	About 72% of the area impermeable	PTNZ02, PTSO01, PTSO02	81	88	91	93
Residential areas - with an average plot area:	< 500 m^2 or 65% of the area impermeable	PTZB01, PTZB03	77	85	90	82
	> 500 m^2	-	54	70	80	85
	Homesteads	PTZB02	59	74	82	86
Fallow lands	-	PTRK02, PTGN04, PTGN02, PTWZ02, PTGN01	77	86	91	94
Arable land	Average conditions	PTTR02	62	73	81	85
Meadows and pastures	Average conditions	PTTR01	49	69	78	84
Forests	Medium dense	PTLZ01	36	60	73	79
Forest and wooded area	-	PTLZ02, PTLZ03	45	66	77	83

In catchments different in terms of soil type and use, the CN parameter for the whole catchment area should be calculated as a weighted average according to the formula:

$$CN = \frac{1}{A}\sum_{i=1}^{n} A_i \cdot CN_i$$

where:

A - total area of the catchment area [km2],

Ai - surface area of a homogeneous area in terms of the CN coefficient [km2],

Cni - CN coefficient values for homogeneous areas Ai [-],

n - number of homogeneous areas.

STEP 3 Rainfall-runoff modeling in HEC-HMS software

The values of the CN parameter for partial catchments determined for the current condition of the catchment should be compared with the values included in the existing rainfall-runoff model for the analyzed catchment. Due to the possibility of using other land cover data (in

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the updating flood hazard maps (FHM) and flood risk maps (FRM) project it was mainly the Corine Land Cover database) and the adoption of different initial humidity conditions in the catchment depending on the modeled flood scenario, these values may differ. Based on the difference of the CN parameter for the current state, adopted in the existing rainfall-runoff model and determined in the analyzes, the mean values of the CN parameter for the variant with a change in afforested area should be corrected for partial catchments. On the basis of the CN values determined in this way, calculations should be made, as a result of which the amount of reduction of surface runoff from the catchment area will be determined. The calculated hydrographs of the runoff from partial catchments should be introduced as boundary conditions into the hydrodynamic model in a further step.

11.1.3.2. Analysis of the possibility of increasing retention in agricultural areas

In agricultural areas, water relations can be regulated by increasing soil retention. As part of good agricultural practices, aimed at limiting soil erosion and runoff of agricultural pollutants into water, it is recommended to use agrotechnical actions such as plowing, molehling, loosening, as well as proper fertilization and liming of land. These treatments improve soil structure and physical properties, increase humus content and reduce erosion. Treatments improving the conditions of plant rooting bring a beneficial effect in terms of improving retention. The expanding root system increases the effectiveness of soil retention.

Agrotechnical treatments along with the appropriate shaping of slopes (including slope blocking, forming furrows), using protective vegetation (planting trees, shrubs and herbaceous plants, cultivation of catch crops) or leaving buffer zones in the vicinity of watercourses, reservoirs and ditches, delay the runoff of rainwater and snowmelt, securing the soil against erosion and increasing surface retention and soil retention.

In agricultural areas, the hydrological conditions are significantly influenced by the limitation of excessive surface runoff of rainwater and the infiltration of biogenic pollutants into both watercourses and water reservoirs. In order to implement these assumptions, it is necessary to analyze the impact of planting mid-field trees and shrubs, creating riverside protection strips and buffer zones around water reservoirs and water intakes, and shaping an appropriate arrangement of arable fields and grasslands.

Increasing retention in agricultural areas has a positive effect on the water cycle in the catchment area, biodiversity, local soil and water conditions and the microclimate. By implementing natural actions for small retention in agricultural areas, it is possible to increase the water retention capacity in the catchment area during periods of its excess and ensure its longer leaving in the soil or on the surface during drought, however, it is not possible to control individual processes on an ongoing basis.

The quantitative assessment of non-technical actions in agricultural areas is difficult and the limitations of numerical modeling are mainly due to:

a. dynamics of changes in the use of agricultural land (crop rotation, type of agrotechnics, etc.),
b. difficulties in parameterization of treatments aimed at increasing the retention capacity of agricultural areas, including landscape, soil, surface and underground retention (e.g. arable field system, anti-erosion, phytomelioration and agro-improvement treatments, etc.).

The local scope of the impact of small retention actions in agricultural areas is significantly simplified when constructing rainfall-runoff models at the level of regional catchments, which may ambiguously define the results of numerical modeling. Considering the above and the tools adopted for the analyzes, no further hydrological and hydraulic analyzes within the scope of retention in agricultural areas are planned.

11.1.3.3. Analysis of the possibility of increasing retention in urban areas

Increasing the retention capacity of urban areas consists primarily in increasing the biologically active areas in cities. The main purpose of such actions is to reduce the degree of sealing of the catchment area, which is reflected in the speed and amount of surface runoff. The increase in the sealing of the catchment area in urbanized catchments increases the maximum values of water outflow from the catchment area, directly affects the dynamics of water flow changes in the river bed and the increased risk of flooding. It is visible mainly in small watercourses where the influence of the catchment area on the qualitative and quantitative parameters of the riverbed water is clear. Limited infiltration of water into the ground contributes to the discharge of more rainwater through sewage systems.

The use of good practices in shaping public space, and most of all, proper planting and maintenance of urban green areas can increase evaporation and naturally retain water. As a result, the runoff of rainwater may be limited and slowed down, which reduces the risk of local flooding and inundation.

The possibilities of numerical modeling of increasing retention in urban areas, however, are somewhat limited and result mainly from:

- lack or incompleteness of data related to the forms of small retention in urbanized areas,
- the impossibility to parameterize empirical information regarding the current state and planned land use (e.g. changes to the surface of roads, parking lots),
- dynamics and the local scope of such changes, which prevent their correct assessment.

Actions for small retention in urbanized areas belong to the so-called "uncontrollable retention" and their active control is limited. Sites with retention potential are being developed, but there may be a multitude of local scenarios where this potential will be more or less exploited. This makes it difficult to reflect these actions in the numerical model.

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The local scope of the impact of actions for small retention of urbanized areas is largely generalized when constructing rainfall-runoff models at the level of regional catchments. This may ambiguously define the results of numerical modeling.

Among the non-technical actions leading to an increase in retention in urban areas, hydrological analyzes using rainfall-runoff modeling will take into account changes in land development, possible to be spatially determined on the basis of BDOT10k land cover classes. The analyzes will be performed in the same way as in the case of increasing forest retention in the catchment area.

11.2. COST-BENEFIT ANALYSIS

Economic analyzes will be carried out according to the following logic of conduct:

A. Assessment of planning options using cost-benefit analysis

the first stage: cost-benefit analysis - in each of the problem areas

EFFECT OF THE STAGE A:

List of planning variants with assigned attributes (including economic efficiency indicators) in the form of database tables - with an indication of the variants recommended for further analyzes and the variants recommended to be rejected as ineffective at this stage

A. Choosing the optimal planning variant by means of multi-criteria analysis

second stage: multi-criteria analyzes in order to select variants recommended for implementation at the planning catchment level

EFFECT OF THE STAGE B:

Variants recommended for implementation in planning catchments

11.2.1. Assumption for the cost and benefit analysis

This methodology assumes an approach to economic analyzes that is a continuation and development of the approach implemented in the preparation of FRMP in the first planning cycle. Cost-benefit analyzes, as well as multi-criteria analyzes that will be performed as part of the FRMP update in the second planning cycle, are aimed at generating the final list of actions (Updating and creating final lists of actions). The actions included in the FRMP in the 1st planning cycle will be analyzed, as well as the proposed actions not included in the FRMP in the 1st planning cycle, but included in other planning documents (including those related to the problem of water shortage) and proposed new actions. Planning variants will be analyzed, consisting of actions included in the initial list of actions, consisting of the sum of tasks from lists A, B, C and, D. The sum of actions/tasks of these lists may be extended by the tasks indicated by the Contractor agreed with the Ordering Party and necessary to reduce the identified excessive flood risk in identified problem areas

in planning catchments on tne list E. This will ensure a coherent and synergistic approach in water management planning between planning documents.

The purpose of the cost-benefit analysis is to evaluate the planning options in terms of the effectiveness criterion. The purpose of the economic analysis in the form of an assessment of the expected impact of planning variants on the socio-economic area they will affect during the investment implementation period and after completion, is the basis for checking whether the investment is justified from the point of view of the entire community. Contrary to the methods used in the classical analysis of the financial effectiveness of investment projects, the analysis of social costs and benefits is carried out from the point of view of the entire society, and not of an individual investor who intends to find out the possible profit from the planned project.

The formulated planning variants should be assessed for effectiveness and efficiency with the use of hydraulic models. The effect of hydrodynamic modeling will be the flood zones in the zero variant and investment variants, presenting the areas at risk of flooding with a specific probability of occurrence:

I. Areas where the probability of flooding is low and amounts to 0.2% (i.e. once every 500 years)
II. Areas where the probability of flooding is average and amounts to 1% (i.e. once every 100 years)
III. Areas where the probability of flooding is high at 10% (i.e. once every 10 years)

For the areas covered by lagoon zones, the following elements are important:

- estimated number of people living in the endangered area,
- residential buildings and facilities of special social importance (i.e. hospitals, schools, kindergartens, hotels, shopping centres, and other),
- areas for which the water depth is: 1 - <= 0.5m, 2 - 0.5-2m, 3 - 2-4m, 4 -> 4m (the limit value of the water depth was adopted in relation to the adopted water depth ranges and their impact on the degree of danger to the population and buildings),
- historic areas and objects,
- protected areas, i.e. water intakes, protection zones for water intakes, bathing areas, nature protection areas,
- potential water pollution outbreaks, in the event of a flood, i.e. industrial plants, sewage treatment plants, sewage pumping stations, landfills, cemeteries,
- the value of potential losses for individual land use classes, i.e. residential areas, industrial areas, communication areas, forests, recreation and leisure areas, agricultural land, water.

The measure of social, economic and natural effects generated by a given planning variant is the increase in social income. It includes an estimate of the benefits that society will receive from improving the safety and condition of the flood protection system. The

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increase in social income will be forecast and will be equal to the economic value of the net present value, ENPV[40], which will be calculated for each planning option formulated. The category of the net economic present value of the planning variant reflects the added value for the whole society, which is the difference between the discounted social benefits resulting from the implementation of a given planning variant and the discounted social costs.

The analyzes plan to assume a time horizon of 50 years. For analyzes in constant prices, a social discount rate of 5% is planned. The analysis will be carried out in Polish zlotys. The period of analyzes and the discount rate were proposed in accordance with Jaspers' recommendations (presented during the assessment of applications for flood protection projects submitted for co-financing from the Cohesion Fund). It was assumed that actions aimed only at restoring flood protection structures to their previous functionality and thus do not affect the product parameters of the hydraulic model, are not included in planning variants and are not subject to analyzes carried out under the FRMP. These types of actions are only maintenance actions and must be carried out pursuant to the applicable legal regulations, therefore they do not require justification and evaluation of benefits and should be implemented independently of the FRMP.

11.2.2. Stages of analysis

The basis for the economic analysis are cash flows determined at the stage of the analysis of investment and operating costs. They require specific adjustments in the scope of:

- Fiscal effects,
- External effects,
- Effects caused by the distortion of market prices.

Fiscal corrections consist of:

- Deduction of indirect taxes from the prices of inputs and products (VAT),
- Eliminate transfers (e.g. social security payments, if any).

Adjustment for externalities is aimed at determining additional, other than those resulting from financial analyzes, negative and positive effects of a given planning option (external costs and benefits, respectively).

In order to make an economic assessment of planning variants, the following economic efficiency indicators should be calculated:

- Economic Net Present Value (ENPV),
- Economic rate of return (ERR),

40 ENPV - Economic net present value, i.e. the sum of discounted future cash flows resulting from the analyzed investments, from individual years of the analysis (discounted = taking into account the loss in value of money over time)

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- Benefit cost ratio (B / C).

11.2.3. Methodology of estimating costs and benefits

Effectiveness of the analyzed variant will be assessed on the basis of the calculated difference between the forecasted average annual flood losses in the zero variant and the average annual flood losses in the case of implementing the planning variant. In the zero variant, additional annual increase in flood losses will be estimated, resulting from the increasing flood risk caused by climate change. In this way, progressive climate changes will be included in the analysis. In addition, there will be social benefits in the case of implementation of planning variants, the structures of which will ensure the possibility of adapting to changing threats over time.

Social benefits are represented by avoided social costs, which the society will not have to bear due to the implementation of the analyzed planning variants, or if, as a result of preventive actions, it is possible to prevent the occurrence of costs that would accompany the implementation of planning variants.

The analysis period covers the years 2020 - 2069.

An economic discount rate of 5% was adopted. The analysis is performed at constant prices.

The benefits will include the following categories:

- material losses avoided,
- avoided intangible losses,
- fiscal corrections regarding VAT on investment and replacement costs. transfer of money, therefore, in the calculation of economic efficiency indicators, it is included on the benefit side to balance its inclusion in the investment costs, which are introduced in the analysis in gross amounts. It was assumed that after the completion of the works, flood protection actions would be used for actions not subject to VAT, i.e. for statutory actions, resulting from the Water Law, which are not economic actions. Therefore, the investor will not be entitled to deduct input VAT within the meaning of Art. 86 sec. 1 of the Act on Value Added Tax, paid on the purchase of construction services related to the implementation of flood protection actions, therefore the capital expenditure should be entered in gross value and then a fiscal adjustment for VAT is made, including the tax amounts as benefits, as indirect taxes are a transfer and in order to calculate economic efficiency indicators, net investment outlays should be calculated.

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The social costs include the increase in vehicle operation costs while incurring investment costs due to the slowdown in vehicle traffic in the vicinity of the construction site.

The full benefits of the avoided flood losses and operating costs appear in the analysis from the first year after the end of incurring capital expenditure.

The basic and most important quantifiable social benefits (which can be valued in monetary units) are the avoided flood losses as a result of the implementation of planning variants. Reduction of flood losses will be calculated as the difference between the amount of losses in the variant of abandoning the implementation of planning variants and after its completion.

Avoided material damage

The method of assessing material flood losses, proposed in this methodology, is based on the calculation of annual average damage (AAD), which can be defined as a sequence of damages for floods ranked by decreasing frequency of occurrence. The area under the flood loss probability curve can be expressed as the integral, which in turn corresponds to the distribution of standard normal density. Using the standardization principle, the calculation of the value of the area under the normal curve above any section can be reduced to the calculation of the appropriate cumulative values.

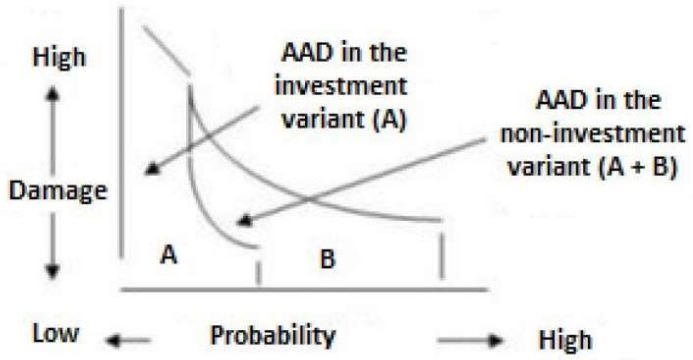

Figure no 8 Calculating the AAD value

In the figure presented above, the amount of average annual losses that are avoided thanks to the implementation of the investment is equal to area B.

When calculating the value of losses in a given flood risk area, it is planned to take into account the degree of property impairment depending on the depth of flooding in the case of 3 land use classes: residential areas, industrial areas, and communication routes. For the remaining land use classes, constant values of losses are assumed, regardless of the water depth, due to the small influence of water depth on the degree of property impairment. It is planned to use the unit property values for each land use class that were used in the FRM update project, they will, however, be indexed for 2016-2019 - for the

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purpose of calculating the AAD when preparing the risk distribution analysis and for the cost-benefit analysis.

The next important step in the analyzes will be to determine the extent of the flood waters. Total flood losses will be calculated on the basis of the size of the flooded area from the digital terrain model, using the results of hydrodynamic modeling.

In the next step of the analysis, the average annual loss (AAD) will be calculated using the probability of flood occurrence for various flow rates.

Avoided non-pecuniary damage

Non-pecuniary damage can make a significant contribution to the total amount of flood losses. The results of studies carried out in the past indicate large discrepancies in the estimated level of non-pecuniary damage in relation to material damage caused by the same flood. Some researchers of the social benefits and costs of flooding believe that non-pecuniary damage in some cases is even higher than material damage [Green and Penning-Rowsell, 1989]. Individual floods may, for example, involve minor material losses and result in the death of several people at the same time, or mean long-term interruptions in industrial or agricultural production.

Particularly noteworthy are the results of the research described by Stępień, 2005. The research was carried out about 60–63 months after the 1997 flood in victims' homes by one researcher (a psychiatrist) in 4 villages in the Nysa Kłodzka catchment. Post Traumatic Stress Disorder was diagnosed in 31% of respondents, which is a result of the durability of damage and daily exposure to exposure symbolizing a flood (loss of all or part of the house, unfinished flood repairs, high humidity, the need to live in substitute housing estates, were supposed to be only a temporary state). Few people were insured, and usually the insurance did not cover the effects of natural disasters.

The valuation of the social costs of floods can be carried out, for example, using the Defensive expenditures method. The results obtained using this method constitute the lower limit of costs, because they do not take into account the categories of costs against which potential preventive actions do not protect. In addition, the cost of preventive actions is low due to the often laid-back attitude of people at risk of flooding to the likelihood of flooding their homes and overestimating the ability to deal with possible flooding (Tunstall, Tapsell, & Fordham, 1994). Possible preventive actions are, for example, relocating farm buildings with livestock (Boddington, 1993), lifting fuses and electrical generators / devices to a safe height, or building houses on stilts.

Another method for the valuation of intangible losses in the cost-benefit analysis in the assessment of planning options is based on past surveys to determine the economic value of the health effects of floods. There are numerous research results available in the literature, e.g. in Great Britain the survey was conducted by DEFRA (Department of Environment, Food and Rural Affairs). The study found that the estimated value for avoiding the health and stress effects of floods is around £200 per household per year. This value can be used as the starting point for the valuation of intangible damages. In order to ensure the adequacy in Polish conditions, the propensity of the British to bear the costs of avoiding the effects of floods is proposed to be adjusted by the percentage share

of GDP per capita for Poland in GDP per capita for Great Britain (source Eurostat data), thus obtaining an estimate for Poland to avoid the effects of floods per household. The obtained value should be indexed by the inflation index. On the basis of the number of people covered by flood protection, intangible damage can be estimated in terms of value.

American researchers (Hallegatte, 2007) estimate the so-called DEAR-Disaster Economic Amplification Ratio, i.e. an indicator increasing economic losses due to natural disasters, amounting to more than 1 for major disasters (i.e. over 100% of material losses), to take into account the entire range of losses, not only referred to in the literature as intangible losses (i.e. difficult to quantify in monetary terms, e.g. impact on health, natural environment), but also referred to in the literature as indirect losses (Mechler, 2014), such as higher public debt, falling house prices, contributing to a decline in consumption, exacerbating social inequalities.

On the other hand, the Dutch estimates made when determining the standards for flood embankments, including analyzes of over 600 variants of flood protection (Kind, 2013), include the valuation of flood-induced stress and nuisance at the level of EUR 2.5 million/person, the valuation of bodily injuries at the level of 100,000 EUR/person, and the valuation of human life at the level of EUR 7 million/person. The Dutch guidelines (Kind, 2011) also used the loss estimate in percentage terms, with indirect losses at 50% of direct losses, in addition, the Dutch cost-benefit analyzes use a loss-increasing ratio every year (total, both direct and indirect) corresponding to the forecast gross domestic product (Kind, 2011).

The value of non-pecuniary damage recommended in this methodology is approximately 20–40% of the value of material damage. On the basis of the conducted research, it can be assumed that on average approx. 5% are the costs of stress and trauma, approx. 15% are the costs of a rescue operation, and approx. 20% are other losses (e.g. communication disruptions, disruptions in the functioning of hospitals, clinics, hospices, orphanages and nursing homes for the elderly, breaks in educational actions, breaks in the work of offices and public institutions, an increase in the cost of living in areas affected by the flood). This is a conservative estimate that does not take into account potential non-material losses such as the death or injuries of flood victims, nor the socio-economic indirect losses experienced by society in the long term.

In addition, the costs of population resettlement should be assessed, as well as compensation for the owners of land that will be recognized as land intended for actions aimed at increasing retention under the FRMP.

Depending on the specificity of the problem area, additional social benefits can also be assessed, for example:

- avoided costs of lost time of persons travelling by vehicles during and after the flood,
- a benefit for tourists visiting the order implementation area due to the reduction of flood risk,
- a benefit for the owners of tourist facilities due to the reduction of flood risk,

- avoidance of interruptions in the actions of enterprises without water and electricity during a flood,
- avoided purchases of bottled water by residents during a flood.

Induced economic benefits

In addition to the material and non-material damage avoided due to the implementation of the planning variants, there will certainly also be other benefits for the region, such as economic development, intensification of construction and infrastructure investments, increased attractiveness of the region for potential investors, and increased tourist attractiveness. This, in turn, translates into the creation of new jobs and social benefits from the reduction of social pathologies caused by unemployment. The aforementioned categories of social benefits will undoubtedly occur, but their valuation is a controversial issue and is not proposed in this methodology.

However, it is proposed to additionally calculate the benefit related to indirect economic effects (multiplier effect of the investment), understood as profits for entrepreneurs from the investment environment. It is about entrepreneurs who will be suppliers of all services, materials, equipment and fittings for the immediate and further environment of the investment. It should be remembered that this whole range of suppliers is related to subsequent companies, etc. The quantification of the effect can be based on the income multiplier (the Keynes theory). According to the multiplier effect theory, an investment brings with it direct and indirect income effects of an increase in investment outlays.

For the purposes of the analysis, it is planned to assume a multiplier of investment purchases at the level of 2.5. Such value of the multiplier for developed countries is recommended by American researchers from the National Bureau of Economic Research, who analyzed the effects of government investments in 44 countries (i.e. in 20 developed countries and 24 developing countries).

In order to calculate the benefits of additional profits for enterprises in connection with the implementation of the investment, the global indirect economic effects (multiplier) will be calculated first, equal to the product of investment outlays and the multiplier of 2.5, and then corrected according to the net profitability index published by the Central Statistical Office.

Cost valuation

Difficulties related to the conduct of construction works include noise, increased vehicle traffic, as well as possible negative impacts on fauna and flora and habitats. The contractor will be obliged to ensure that actions are taken to reduce noise emissions, for people and the environment to store and manage materials and waste, and to take appropriate actions to protect sensitive species of fauna and flora and habitats.

The basic assumption in social cost-benefit analysis is to strive for a conservative cost valuation, as the purpose of cost-benefit analyzes is to identify the lower limit of social costs. Some of the social costs should be considered intangible and not be quantified due to the difficulty of quantifying them in monetary terms. Costs considered to be tangible may be calculated at a minimum value to avoid the possible allegation that the amount of

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social costs is overestimated. No detailed studies have been carried out that would enable a precise calculation of individual social costs, therefore it is advisable to apply simplifications aimed at showing the order of magnitude of the identified costs. However, more detailed calculations are not necessary to illustrate the far-reaching effects of the analyzed investment.

INCREASE OF LOSSES IN THE ZERO VARIANT DUE TO THE GROWTH OF LAND CONSTRUCTION AND INCREASE OF LOSSES DUE TO CLIMATE CHANGE

The increase in losses in the zero variant, used to calculate the avoided losses due to the implementation of planned actions, consists of two components:

- increase in the intensity of land development,
- increase in losses due to climate change.

The amount of loss increment is the product of the amount of losses from the base period multiplied by the above-mentioned growth factors, thus in the analysis period there is an increasing value of losses from year to year. As a result, the total increase in losses at the end of the analysis period results from both of the above-mentioned growth factors.

The indicator of the annual increase in losses in the zero variant due to the increase in land development was estimated based on the indicator of the increase in fixed assets published by the Central Statistical Office in 2016-2018, which amounted to approx. 5% per year.

With regard to the increase in losses due to climate change, it is recommended to use the approach to the increase in flood damage, consistent with the approach used in the reports of the European Commission. Based on the EC Report of 2020: Dottori F, Mentaschi L, Bianchi A, Alfieri L and Feyen L, Adapting to rising river flood risk in the EU under climate change, EUR 29955 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-12946-2, doi: 10.2760/14505, the increase in AAD (Average Annual Damage) was determined according to the EC Report based on the PESETA IV project - scenario 2 degrees Celsius, which means an increase annual at 4.2%.

ASSUMPTIONS FOR THE CALCULATION OF THE PROJECT RENEWABLE AND OPERATING COSTS

The assumptions for calculating the project's replacement and service costs were adopted at the same level as in the 1st planning cycle of the FRMP.

The indexes of replacement and operating costs, expressed as a percentage of investment costs, are presented in the table below.

Table 27 Indicators of replacement and operating costs expressed as a percentage of investment costs

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1.08% 0.75%

1.21% 1.00%

1.25% 1.00%

1.72% 2.00%

1.00% 0.75%

Tabela 1 Wskaźniki kosztów odtworzeniowych i eksploatacyjnych wyrażone jako procent kosztów inwestycyjnych

Cost index	Average annual replacement costs	Average annual operating costs
Flood embankments and boulevards	1,08%	0,75%
Front dam of the flood control reservoir	1,21%	1,00%
Reservoirs and polders	1,25%	1,00%
Weirs, locks J	1,72%	2,00%
Other capital expenditure	1,00%	0,75%

INDEXATION OF THE VALUES OF THE ASSETS CONTAINED IN THE "METHODOLOGY FOR THE DEVELOPMENT OF FLOOD RISK MAPS AND FLOOD RISK MAPS IN THE SECOND PLANNING CYCLE"

In the second planning cycle, the approach to estimating the value of property in areas exposed to flooding and potential flood losses was specified in two documents:

- Regulation of the Minister of Maritime Economy and Inland Navigation of 04 October 2018 on the development of flood hazard maps and flood risk maps (the Official Journal of Laws of 2018, item 2031),
- Methodology of the development of flood hazard maps and flood risk maps in the 2nd planning cycle (FHM and FRM 2019 Methodology) IMGW-PIB, ARCADIS Sp. z o.o., June 2019 (v. 6.00).

The regulation specifies in paragraph 16 that the value of potential flood losses is determined for land use classes, without specifying the method of their calculation. The detailed loss calculation mechanism is included in the FHM and FRM Methodology.

The preliminary version of the review and update of flood hazard maps (FHM) and flood risk maps (FRM) Methodology was created in 2017, therefore the indicators included in it are based on the values (and prices) available at that time, namely based on data from 2016.

For this reason, calculations performed for the purposes of risk maps and flood risk management plans require indexation of the developed property value ratios - updating their values from the 2016 price level to the current prices. The year 2019 was assumed as the level of current prices.

The the review and update of flood hazard maps (FHM) and flood risk maps (FRM) methodology presents property value ratios for 7 land use classes:

- residential development areas,
- industrial areas,
- communication areas,
- forests,
- recreational and leisure areas,
- arable land and permanent crops,
- grassland.

The need to verify the indicators included in the review and update of flood hazard maps (FHM) and flood risk maps (FRM) methodology also results from the following premises:

- property value ratios in residential areas do not include the value of home furnishings,
- the value of assets in residential areas includes the value of fixed assets used for running a business, but the value of this property is only a part of the fixed assets of the economy, a significant part of the property was not included in the indicators, additionally current assets (inventories) were not included, which for many industries the economy is even the main asset - e.g. in trade, construction,
- industrial property value indicators do not include the value of current assets (inventories).

Residential building areas

In the the review and update of flood hazard maps (FHM) and flood risk maps (FRM) Methodology, the value of property in residential areas was determined on the basis of data on the wealth of households - the value of tangible property of households according to the NBP Report - Narodowy Bank Polski /The National Bank of Poland/, 2017 *Wealth of households in Poland. 2016 survey report.*

The calculations were based on the median value of tangible assets of households - value of PLN 293,000.00. Assets included real estate that is the main place of residence, vehicles, valuables and assets resulting from running one's own business. The value of the main place of residence and assets from running a business did not include home/business/farm equipment - furniture, home electronics and household appliances, clothes, agricultural machinery, crops, and livestock.

According to the above-mentioned In the NBP report, assets resulting from running one's own business account for approx. 12.8% of the total assets. The property of natural persons conducting business activity is included, but the companies run in a different legal form are not included. 12.8% of the value of assets means that the ratios include the value of real estate in the total of PLN 535,833 million. Fixed assets in Poland amount to PLN 4,029,717 million (according to CSO data "Fixed assets in the national economy in 2018"). Assets in industrial areas include fixed assets worth PLN 1,281,158 million from 4 sectors of the national economy, classified according to the Polish Classification of Business Activity PKD 2007 as sections B, C, D and, E (B Mining and mining, C Industrial processing, D Manufacturing and electricity, gas, steam and hot water supply, E Water supply, sewage and waste management, remediation). Hence, it can be assumed that in non-industrial areas, i.e. residential areas, there are fixed assets of other - non-industrial - sectors of the economy with a total value of PLN 2,748,558 million. This value is more than 5 times higher than the property of households used for running a business included in the indicators.

In order to verify the indicators for residential areas, the following approach was used:

1. deduction from the indicators from the review and update of flood hazard maps (FHM) and flood risk maps (FRM) Methodology **of the value of household assets used for running a business (approx. 12.8% of the value of assets) - determination of the value of household property without property for economic action;**
2. **taking into account the value of home furnishings, according to the USACE 2006 literature "*Depth-damage relationships for structures, contents, and vehicles and content-to-structure value ratios in support of the Donaldsonville to the Gulf, Louisiana, feasibility study*", the value of home furnishings is at the level of 43-71% of the value of buildings. The loss in value of the equipment depending on the depth of the flood (loss functions) is higher than the losses in the building. As at the current stage (risk mapping completed) the loss function for equipment cannot be introduced, and therefore equipment losses will be calculated based on the loss function for residential areas, it is possible to safely (without the risk of overestimation) assume the value of equipment at 50% buildings' value;**
3. updating the prices from 2016 to the level of 2019 - according to CSO data, the price of 1 m2 of **usable floor space of a residential building commissioned in 2016-2019 increased from PLN 4,000 to PLN 4,597, the growth rate was therefore 14.9%;**
4. estimation of the fixed and current assets (stocks) of business entities operating in residential areas.

Ultimately, the calculations lead to the determination of the value of household assets (flats with equipment) and the property of companies operating in residential areas (fixed assets and inventories).

Determining the value of household property consists in 3 adjustments of the indicators set in 2016: subtracting property for business activities (reduction by 12.8%), taking into

account price changes in the housing market (increase by 14.9%) and adding the value of housing equipment (increase by 50%).

Determining the value of property of economic entities operating in residential areas consists in determining the value of fixed assets and inventories in individual sectors of the national economy.

Based on the data from the Central Statistical Office on the value of fixed assets in individual sectors of the economy, broken down by provinces, the value of fixed assets was estimated in the following sections:"Construction", "Wholesale and retail trade; repair of motor vehicles","Accommodation and food service activities","Information and communication","Financial and insurance activities","Real estate activities","Professional, scientific and technical activities","Activity within the scope of administration services and supporting activities","Public administration and defense; compulsory social security","Education","Healthcare and social assistance","Activities related to culture, entertainment and recreation", in the case of the section" Transport and warehouse management" 80% of fixed assets are included, the remaining 20% are fixed assets in the sub-sectorn "Transport", which are included in the indicators of the value of assets in communication areas. Assuming that these assets are evenly distributed over residential areas, the value ratio per 1 m^2 can be determined. In order to determine the indices in 2019 prices, the same calculations were made for the data from 2016 and 2017 and the average annual changes for individual provinces were determined (average from the dynamics of 2017/2016 and 2018/2017). The average annual changes were used to convert the indicator from 2018 to 2019.

Apart from fixed assets, economic entities have current assets, among which inventories (materials, goods, work in progress and finished products) are exposed to flooding. To determine the value of inventories of economic entities in individual provinces, the Central Statistical Office data on the financial results of economic entities from the last three years: 2016, 2017 and 2018 were used. On their basis, average indicators were estimated - the ratio of the value of inventories to the value of fixed assets. These indices were used to estimate the value of stocks in individual sectors by province, and then the stocks / fixed assets ratio was calculated.

Due to the advancement of works in the second planning cycle - preparation of flood risk maps - the designated indicators can no longer be used to estimate potential flood losses and the benefits of reducing them. The maps were prepared on the basis of the indicators from 2016, in order to index the information contained therein, a uniform indicator was established that enables the conversion of losses determined into 2019 prices and additional consideration of all the above analyzes (taking into account home furnishings, fixed assets and inventories of economic entities operating on residential areas). In this final step of the analysis, the average index for all provinces was calculated, converting the indicators from the 2016 (FHM and FRM) Methodology to the level of indicators from 2019.

The calculations of the ratio were made with the following assumptions:

- risk maps for residential development areas were prepared using two indirect loss indicators: for loose housing areas, indirect losses are 40% of direct losses, and for dense built-up areas it is 80% of direct losses, because at the stage of preparing the FRMP it is currently impossible to distinguish the type of development (loose or dense), the data was re-aggregated, it was assumed that the average indirect loss ratio was 60% of direct losses;
- the analysis of the literature on the subject shows that the adoption of indirect losses at the level of 60% is burdened with a significant underestimation of losses, in this CBA methodology it was assumed that indirect losses would be determined as 100% of direct losses;
- for individual provinces the relation of the loss rate was determined according to the (review and update of FHM and FRM) 2016 Methodology and the indicators determined according to the approach presented above;
- the average indexation index for all provinces was determined.

In the methodology of calculating all indirect losses, it was assumed that the multiplier for residential areas would be much smaller and amount to 100%.

- losses resulting from production interruption and loss of profits,
- costs of cleaning and land reclamation.

Industrial areas

In the methodology of aFHM and aFRM, the value of assets in industrial areas was determined on the basis of data on the value of fixed assets in industry, the value of inventories was not taken into account. This methodology proposes to update the value of fixed assets from the level of 2016 to the current values (2019) and to take into account the value of inventories.

The indicators from the review and update of FHM and FRM Methodology were calculated on the basis of data for individual provinces with the value of fixed assets in industry (sectors of the economy according to PKD2007: B Mining and mining, C Industrial processing, D Electricity, gas, steam and hot water production and supply, E Water supply, sewage and waste management, reclamation) and the area of industrial sites according to CSO data from 2016.

In order to determine the current values of fixed assets, ratios were calculated based on the latest data from 2018 published in the Local Data Bank of the BDL CSO. Then, the indices were converted to 2019 prices on the basis of the calculated average annual changes in the value of indices for individual provinces (average from 3 years 2016-2018). According to the publication of the Central Statistical Office entitled "Balance sheet financial results of economic entities in 2018", inventories constitute approx. 29% of the value of fixed assets in the industry sector (sections B, C, D and E according to PKD2007). The

stock level in a given year may be random, therefore, for the purposes of the analysis, the average value (28%) was determined from the data from the last 3 years 2016-18 (2016: 26% of the value of fixed assets, 2017 27%, 2018 29%). The average value of the inventory index was then used to derive the final industrial property value index for fixed assets and inventories.

The determined indicators may no longer be used to estimate potential flood losses and the benefits of reducing them. Therefore, the average indicator for all provinces was calculated, converting the indicators from the 2016 review and update of FHM and FRM Methodology to the level of indicators from 2019.

The calculations of the ratio were made with the following assumptions:

- risk maps for industrial sites were made using an indirect loss index of 80% of direct losses;
- for individual provinces the relation of the loss rate was determined according to the review and update of FHM and FRM 2016 Methodology and the indicators determined according to the approach presented above;
- the average indexation index for all provinces was determined.

In the case of other land use classes (communication areas, forests, recreational and recreational areas, arable land and grassland), the value indexation was based on the growth rate of fixed assets in 2016-2018, which amounted to 10.1%.

AVOIDED LIMITATION ON THE PROVISION OF PUBLIC SERVICES BY COMMUNES, VALUED BASED ON THE DECREASE IN THE COMMUNE'S BUDGETARY RECEIPTS FROM INCOME TAXES

Benefits from savings for avoiding a decrease in income from PIT income tax by municipal governments

Data on the amount of income from PIT to the commune budget is prepared on the basis of the indicators of the Local Data Bank of the Central Statistical Office. The amount of savings was estimated by analyzing data from the indicated source for the years 2008-2011 (the period of fluctuations in the impacts resulting from the economic crisis and the water crisis in 2009) in a rural and urban commune, as well as a city with district rights. The reports of regional statistical offices concerning fluctuations in revenues from PIT income taxes to municipal budgets were also taken into account.

The following were taken into account:

- The value of the impact from PIT tax in rural communes in terms of dynamics - analysis of deviations.
- The value of the impact from PIT tax in communes in dynamic terms - analysis of deviations.

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- The value of the income from PIT tax in cities with district rights in dynamic terms - analysis of deviations.

A variant formula was adopted:

- 10% means no losses in PIT revenues,
- 1% means 2% lower PIT (30-day consequences),
- 0.2% means 4% lower PIT (60-day consequences).

Benefits from savings for avoiding a decrease in income from CIT income tax by municipal governments

Data on the amount of CIT revenues to the commune's budget is prepared on the basis of the indicators of the Local Data Bank of the Central Statistical Office. The amount of savings was estimated by analyzing data from the indicated source for the years 2008-2011 (the period of fluctuations in the impacts resulting from the economic crisis and the water crisis in 2009) in a rural and urban commune, as well as a city with district rights. The reports of regional statistical offices concerning fluctuations in revenues from CIT income taxes to municipal budgets were also taken into account. Data based on the Local Bank of the Central Statistical Office of Poland and reports on fluctuations in revenues from CIT income taxes to municipal budgets (including in 2009-2011 and 2020.

The following were taken into account:

- The value of the impact from CIT in rural communes in dynamic terms - analysis of deviations.
- The value of the impact of CIT in communes in dynamic terms - analysis of deviations.
- The value of the impact from CIT in cities with district rights in dynamic terms - analysis of deviations.

A variant formula was adopted:

1. 10% means no losses in CIT revenues.
2. 1% means 4% lower CIT (30 day consequences).
3. 0.2% means 8% lower CIT (60 day consequences).

AVOIDED WORKING TIME COSTS OF VOLUNTEERS

Volunteering

To estimate the value of the volunteer's working hour, not the average value of the volunteer's working hour was adopted, but the value of work under a civil law contract. It was assumed that volunteers will be representatives of the local community who will act to mitigate the effects of the water crisis, instead of taking up paid work. Value of the

minimum gross remuneration under the contract of mandate (e.g. according to gov.legalis.pl) (PLN 17 gross) x 40 hours of work during a 5-day flood.

A variant formula was adopted:

1. In the 1% variant, on average, 20 volunteers work per shift, ie 60 a day.
2. In the 0.2% variant, on average, 40 volunteers work per shift, ie 120 a day.

AVOIDED WATER COSTS

The evaluation of the sense of safety of residents, resulting from the certainty of water supply, can be valued using the Preventive Expenditure and Willingness to pay methods known in the literature on the subject. It was assumed that thanks to the implementation of flood protection actions, residents will not have to purchase bottled drinking water, which is a measure of the benefits from flood protection.

The table below presents the assumptions made to calculate the benefits of avoiding the purchase of bottled water.

Summing up, the estimated cost of purchasing bottled drinking water is added to the losses with a flood probability of 1% and 0.2% in the AAD calculation formulas in the zero variant.

AVOIDED COSTS OF LOST TIME TRAVELING IN VEHICLES

Flood protection actions will affect the transport accessibility of towns located near roads affected by floods. It was assumed that as a result of the project implementation the slowdown in traffic and detours will be avoided, thanks to which there will be time savings in the case of a single flood event - it was assumed that significant traffic restrictions take place with a probability of at least 1% of a flood occurrence. First, the time spent in vehicles per day was estimated, and then the costs of extending this time, depending on the period since the flood occurred.

In order to estimate the benefits, one should use the results of the study of the traffic volume measurement in the area of localities situated by the roads subject to flood floods.

11.3. CONDUCTING ANALYSIS AND ASSESSING COMPLIANCE OF THE ADOPTED FINAL OPTIONS FOR ACTIONS WITH LEGAL AND ENVIRONMENTAL REQUIREMENTS, INCLUDING IN PARTICULAR WITH THE REQUIREMENTS OF THE FRAMEWORK WATER DIRECTIVE AND THE HABITAT DIRECTIVE AND BIRDS DIRECTIVE

The process of assessing the compliance with the law of the planned variants in the aFRMP will concern, in particular, the examination of their compliance with the following acts of national and Community law:

- Act of 20 July 2017 Water Law (the Official Journal of Laws of 2021 item 2233, as further amended),
- the Act of 16 April 2004 on nature protection (the Official Journal of Laws of 2021, items 1098, as further amended),
- the Act of 27 April 2001, Environmental Protection Law (the Official Journal of Laws of 2020, item 1219, as further amended),
- the Act of 03 October 2008 on the provision of information on the environment and its protection, public participation in environmental protection and on environmental impact assessments (the Official Journal of Laws of 2021, item 247, uniform text, as further amended),
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action within the scope of water policy (Water Framework Directive - WFD),
- Council Directive 92/43/EEC of 21 May 1992 on the protection of natural habitats and wild fauna and flora - the Habitats Directive,
- Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds - the Birds Directive.

As part of the aFRMP analyzes, consistency with the assumptions of the 2nd aWMP will be ensured by including in the environmental analyzes information from the documents prepared for the needs of the 2nd aWMP regarding, in particular:

- update of homogenous water bodies (HWB),
- analysis of significant anthropogenic impacts and assessment of their impact on the condition of surface and groundwater (pressure analysis),
- updating environmental objectives for homogenous water bodies and protected areas,

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- review and verification of methodologies for the determination of heavily modified and artificial surface water bodies, together with the initial and final designation.

In addition, the analyzes of aFRMP included a change - in relation to the previous planning cycle - of the methodology for the development of the 2nd aWMP, in terms of verification of the premises under Art. 4.(7)-(9) WFD. In the present 2nd aWMP, a different approach was assumed with regard to determining the basis for derogation by transferring these analyzes from the strategic level (aFRMP) to the level of administrative procedures (in relation to individual projects (EIA)).

For individual actions, included in the planning variants, an environmental acceptability assessment will be developed on the basis of standardized assessment matrices.

The assessment matrices will assess the investment taking into account:

- the impact of actions on the hydromorphological and biological parameters of watercourses and the morphological permeability of watercourses (for the assessment of the possibility of affecting the achievement of water protection objectives within the meaning of the Water Framework Directive),
- the impact of actions on the objects and objectives of the protection of area forms of nature protection (the following area forms of nature protection were analyzed: national parks, landscape parks, nature reserves, Natura 2000 areas, ecological lands, protected landscape areas, nature and landscape complexes),
- impact of actions on the functionality of national and international ecological corridors.

The assessment of environmental acceptability will allow assigning degrees of environmental acceptability to individual actions on a three-point scale:

K	-	environmentally beneficial effect
U	-	moderately environmentally beneficial effect
N	-	environmentally unfavorable effect

The degree of environmental acceptability **N (environmentally unfavorable)** has been assigned to actions that:

- pose a threat to the achievement of water protection objectives within the meaning of the Water Framework Directive and/or
- may significantly affect the objects and objectives of protection of area forms of nature protection (in particular Natura 2000 areas designated under the Birds and Habitats Directive) and/or
- may significantly limit the functionality of ecological corridors.

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The degree of environmental acceptability **U (moderately beneficial for the environment)** and **K (favorable for the environment)** was assigned to the actions, the impact of which on the individual elements of the assessment is not significant, can be effectively minimized or no possibility of impact was found. These investment actions, in the assessment, do not pose a threat to the achievement of the objectives of water protection within the meaning of the Water Framework Directive and do not have a significant negative impact on Natura 2000 areas (and other area-based forms of nature protection included in the assessment) and the functioning of ecological corridors.

Standardized matrices include action assessment tables:

- Assessment of the impact on the hydromophrological parameters of the assessment of water status/potential
- Assessment of the impact on the biological parameters of water status/potential assessment
- Assessment of the impact on the patency of watercourses for aquatic organisms
- Assessment of the impact on area forms of nature protection
- Assessment of the impact on the permeability of terrestrial ecological corridors.

The following chapters describe how each assessment is carried out.

In the case of activities that do not reduce the flood risk in problem areas, but implement the flood risk reduction objective formulated in the intermediate planning cycle and were started but not completed in the previous cycle, environmental assessments are not carried out. Pursuant to the Regulation of the Council of Ministers of 10 September 2019 on projects that may have a significant impact on the environment (Journal of Laws 2019, item 1839), in most cases these activities are classified as projects that may potentially or significantly affect the environment. For this reason, the activities, before commencing their implementation, had to obtain appropriate approvals and decisions, including a decision on environmental conditions.

11.3.1. Assessment of the impact on the hydromorphological parameters of the water status/ potential assessment

The assessment of the impact of individual actions on the hydromorphological state will be based on the assessment of changes in the value of the Hydromorphological River Index (HIRk) calculated on the basis of the indoor method. This method is used in the State Environmental Monitoring to assess the condition of hydromorphological elements of unmonitored HWB. The indoor method of HIR assessment consists in the assessment of the hydromorphological elements of the entire unit of HWB based on spatial databases and

orthophotos. The assessment is made by filling in the individual sections of the HIR camera protocol, on the basis of which the HIRk index is then calculated. As part of the work on aFRMP, it was decided to slightly modify the assessment - all of them are described in chapter 11.3.1.1.

The impact of the actions will be assessed by determining the changes in the index components: Hydromorphology Transformation Parameters (PPH) and Hydromorphological Diversity Parameters (PRH) caused by these actions. For this purpose, the PPH and PRH indicators will be assigned to the group of flood protection actions with the same characteristics, the values of which may change as a result of typical and most probable impacts occurring during the implementation of these actions. Moreover, if the analysis of the characteristics of individual actions (regardless of the group of these actions listed in *Table no 27 List of HIR components, the values of which may change as a result of the implementation of actions*Table no 27) shows that they may also affect other PPH and PRH indicators (apart from those indicated for the group of actions), the analysis of changes in the value of other indicators will also be performed - the analysis however, this will be done individually for each action on the basis of the description of its characteristics.

Table no 27 List of HIR components, the values of which may change as a result of the implementation of actions

Action	HIR component
1. construction of retention reservoirs classified as "water reservoirs",	PPH2, PPH3, PRH5, PRH6, PRH7
2. construction of dry flood control reservoirs,	PPH2, PRH4, PRH5
3. reconstruction of flood embankments and related infrastructure (pump stations, locks and embankment culverts) and construction of polders,	PPH1, PPH2, PPH6, PRH1, PRH5
4. boulevards and retaining walls with accompanying infrastructure (e.g. locks),	PPH4, PRH5
5. regulation of rivers and streams,	PPH1, PRH1, PRH5
6. cleaning and maintenance of river beds,	PRH2, PRH3, PRH5
7. cleaning and maintenance of the embankment area,	PRH4, PRH5
8. relief channels,	PPH4
9. drainage network and drainage with related infrastructure (e.g. sluices, pumping stations),	PPH4
10. restoration and revitalization of wetland ecosystems,	PRH6, PRH7
11. afforestation,	PRH4

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Action	HIR component
12. maintenance works on the seashore,	
13. storm gates and flood gates,	PPH4
14. facilities that increase retention in urbanized areas,	PRH6, PPH3
15. technical infrastructure crossing watercourses.	PPH5

The assessment of changes in the hydromorphological state will be made on the basis of:

- the results of the project of designating heavily modified and artificial water bodies defining the current state of hydromorphological elements of aHWB (or hydromorphological state according to the HIR methodology), with a division into the main river (of the lowest order tested in accordance with the HIR methodology in the State Environmental Monitoring system) and other rivers (additionally assessed - taking into account designation of heavily modified water bodies (HMWB) under the project). The components of the HIR_k indicator come from the database generated from the file "Ocena_JCWP_rzecz" (further in this methodology, references to "Ocena_JCWP_rzecz" are described as "HMWB database"). The columns of the file "Ocena_JCWP_rzecz " contain the values of successive HIR_k components (PPH and PRH), summing up and substituting to the formula to calculate the condition assessment index on the basis of indoor tests;
- assessment of the hydromorphological status (changes in the values of PPH and PRH and the HIR_k index) performed as part of the works on aFRMP simulating changes in the values of indicators under the influence of flood protection actions. The assessments will be made in accordance with the methodology of the Hydromorphological River Index with changes resulting from some differences in the HIRk hydromorphological assessment methodology implemented in the project to determine the sludge, and which changes will be introduced to the update of the HIR methodology (most likely in 2021). The method of calculating the values of the HIR_k index components is presented in point 11.3.1.1 and 11.3.1.2.

When assessing the impact of actions on the values of individual hydromorphological indicators, sections of rivers that are under the influence of the planned flood protection actions and which may affect changes in HIR_k values will be analyzed and determined. A hydromorphological assessment will be performed for all aHWB with such impact.

Prior to carrying out the hydromorphological status assessment, additional verfication will be run to check whether the action is located on the lowest-order river in aHWB (assessed according to the HIR methodology) or on tributaries (higher-order rivers included in the

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aHWB layer). In the first case, used for the assessments from the HMWB database there will be fields with 'rg' in the indicator name, e.g. PPH2_rg (which stands for the PPH2 value for main rivers – the lowest order). In the second one, there will be used fields with 'rp' in names, e.g. PPH2_rp (which stands for the PPH2 value for other rivers remaining in the aHWB – of the higher order). In both cases, an assessment of the hydromorphological status will be made after implementation of the action, assessing the impact on the main river of the lowest order or remaining rivers according to the following scheme:

When assessing the impact of the action on the main and other rivers, they will be assessed separately:

- if an impact on a major (lowest order) river is identified, only the major river will be assessed and changes in PPH and PRH components and HIR_k values for the major river only will be indicated;
- if an impact only on the remaining rivers in aHWB is identified, then only the remaining rivers will be assessed and changes in the PPH and PRH components and the HIR_k values for other rivers only will be indicated;
- If impacts on the main (lowest order) river and the remaining rivers are identified, both the main and non-main rivers will be assessed and changes in the PPH and PRH components and the HIR_k values for the main and non-main rivers will be indicated.

11.3.1.1. Hydromorphology Transformation (PPH) Parameters

PPH1 - no indicator in the heavily modified water bodies database. The index value is contained in the cumulative PRH1 value in the database, which was calculated and aggregated on the basis of PRH1 and PPH1. The valuesin the database are the result of the calculations made in the heavily modified water bodies calculation project and are close to the actual values (in the heavily modified water bodies calculation project, approximate calculations were used without separate calculation of PPH1 and PRH1 due to the need to assess all aHWB in Poland, which would not be possible using a more accurate method). For this reason, in aFRMP, the indicator should be assessed according to the current status and after implementation of actions. The assessment is made in part A3 of the indoor form. Section A3 concerns the longitudinal profile of the watercourse (watercourse route) and informs about how winding the analyzed river section is. Curvature is assessed in 5 categories, of which, for each category of the longitudinal profile (watercourse route), the percentage share of the river length in the assessed aHWB is marked. This analysis will be performed visually on the basis of the orthophotomap (it is also the assessment used in PRH). On this basis, the values of PPH1 are assigned - straightening of the watercourse route - the percentage of the river length in the assessed aHWB, the route of which is straight or broken, points are assigned to each of the two mentioned routes and then

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summed up; this parameter is not assessed in mountain aHWB (located> 800 m above sea level).

Table no 28 Longitudinal profile of the watercourse route

% of the river lenght in HWB	none	≤25%	25-50%	50-75%	>75%
Straight (k<1,05)	❑	❑	❑	❑	❑
Winding (k=1,05-1,3) 	❑	❑	❑	❑	❑
Meandering (k>1,3) 	❑	❑	❑	❑	❑
Broken 	❑	❑	❑	❑	❑
Multi-channel/delta 	❑	❑	❑	❑	❑

Table no 29 Punctation range for PPH1

Straightening the watercourse	% of the river lenght in HWB	none	0
		≤25	1
		25-50	3
		50-75	5
		>75	7

PPH2 - damming structures (dams, thresholds and barrages, weirs). One of the categories of hydrotechnical structures assessed in the indoor form in section A5. Points are awarded for damming structures per kilometer of river of the lowest order in the assessed aHWB; each damming structure with a strong environmental impact = 1 point, medium impact = 0.5 point and weakly influencing = 0.25 points. The value of the PPH2 index is included in the "heavily modified water bodies database". In addition, the " heavily modified water bodies database " provides information on the number of points awarded for damming structures (as above) per km of river (PKT_BP) - this is the exact value on the basis of which the PPH2 value will be assigned.

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Table no 30 Division of damming structures

Structure category/impact	Strong	Medium	Weak	None
Damming structures				❑
Damming structures	damming height ≥0,7 m and no working fish pass	damming height 0.3-0.7 m and a current working fish pass	damming height ≤ 0.3 m or 0.3- 0.7 m and current working fish pass	

Table no 31 Punctation range of the PPH2 parameter

Damming structures	points/km of the river lenght in HWB	none	0
		≤0,2	3
		0,2-0,5	5
		>0,5	7

PPH3 - Water reservoirs (Water reservoirs, fish ponds) - the percentage of the length of the lowest-order river in the assessed aHWB along which there are water management facilities. Category of hydrotechnical structures assessed in the indoor form in section A5. The PPH3 value is included in the "heavily modified water bodies database". In addition, there is information about the share of river sections along which there are water management facilities (UDZ_SZT_ZB) - i.e. the exact value on the basis of which the PPH3 value will be assigned.

Table no 32 Division of water management facilities

Structure category/impact	Strong	Medium	Weak	None
Water management facilities	≥33% of river lenght in HWB	5-33% of river lenght in HWB	≤5% of river lenght in HWB	❑

Table no 33 PPH3 Punctation range

PPH4 - regulatory structures (flood protection gates, embankment sluices, siphons, eiver bank bands and groynes, navigable canals and sluices, relief channels, quays) - percentage of the river length of the lowest order in the assessed aHWB, along which there are regulatory structures. Category of hydrotechnical structures assessed in the indoor form in section A5. The value of the PPH4 index is included in the "heavily modified water bodies

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database". In addition, the "heavily modified water bodies database" contains information on the share of river sections along which heavy (UM_C) and light (UM_L) regulatory structures occur, as well as the number of points for regulatory structures (PKT_UM), on the basis of which the value of PPH3 will be assigned. PKT_UM will be computed as UDZ_UM_C + (UDZ_UM_L / 2). The approach is not exactly the same as the original HIR methodology. However, it is proposed to retain this approach so that it is possible to demonstrate a lower impact of regulatory actions taking into account light type regulations.

Table no 34 Division of regulatory structures

Regulatory structures	≥33% of the river length in aHWB	5-33% of the river length in HWB	≤5% of the river length in HWB	q
UM_C	≥33% of the river length in aHWB	5-33% of the river length in HWB	≤5% of the river length in HWB	q
UM_L	≥33% of the river length in aHWB	5-33% of the river length in HWB	≤5% of the river length in HWB	q

Table no 35 Punctation range of the PPH4 parameter

Regulatory structures	% of the river lenght (UM_C+UM_L/2) in HWB	≤0,1	0
		0,1-5	1
		5-25	2
		25-50	3
		50-75	4
		>75	5

PPH5 - Bridge structures and crossings (bridges, flyovers, footbridges, culverts, crossings) - the number of objects per kilometer of the river of the lowest order in the assessed aHWB. Category of hydrotechnical structures assessed in the indoor form in section A5. The PPH5 value can be found in the "heavily modified water bodies database". In addition, the "heavily modified water bodies database" contains information on the number of bridges and crossings per kilometer of rivers (L_MOST_KM) - this is the exact value on the basis of which the PPH3 value will be assigned.

Table no 36 Breakdown of bridge structures

Structure category/impact	Strong	Medium	Weak	None
Bridge structures (total number)	number of objects			☐

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Table no 37 Punctation range of the PPH5 parameter

Bridge structures, crossings	indv/km of the river length in aHWB	≤0,2	0
		0,2-0,5	1
		0,5-1,0	2
		>1,0	3

PPH6 - Embankments - the percentage of the lowest-order river length in the assessed AHWB along which embankments are present. The parameter was assessed differently in rivers with a riverbed width of ≤30 m and> 30 m, due to the different detail recording of this element in indoor protocols. In the first case, we add up the points for the presence of embankments and the dominant embankment, additionally in the case of the dominance of two-sided embankments, the sum is multiplied by 2. On the other hand, in rivers with a bed width> 30 m, we determine the highest value recorded for the left and right bank and sum these values. Item assessed in section A8. The value of the PPH6 index is included in the "heavily modified water bodies database". In addition, the "heavily modified water bodies database" contains information about the width of the inter-embankment (MIEDZYWALE), the share of bilateral embankments (UDZ_OBW_DWU) and the share of

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one-sided embankments (UDZ_OBW_JED) - on this basis, the value of PPH6 will be assigned. ≤

Table no 38 Distribution of the embankments for rivers with a bed width of less than 30 m

Embankments in rivers with a bed width ≤30 m	none	≤25%	25-50%	50-75%	>75%
Presence of an embenkment (% of the river lenght in HWB):	❑ none	❑ ≤25%	❑ 25-50%	❑ 50-75%	❑ >75%
Dominant type of inter-embankment:	❑ without inter-embankment	❑ with inter-embankment <2 of the width of the bed		❑ with inter-embankment >2 of the width of the bed	
Dominant type of embenkments:	❑ one-sided		❑ two-sided		

Table no 39 Division of the embankments for rivers with a bed width of more than 30 m

Embankment in rivers with a bed width ≤30m						
% of the river lenght in HWB		none	≤25%	25-50%	50-75%	>75%
Embankments of the left bank	without embankments	❑	❑	❑	❑	❑
	without inter-embankments	❑	❑	❑	❑	❑
	inter-embankment <2 of width of the bed	❑	❑	❑	❑	❑
	inter-embankment >2 of width of the bed	❑	❑	❑	❑	❑
Embankments of the right bank	without embankments	❑	❑	❑	❑	❑
	without inter-embankments	❑	❑	❑	❑	❑
	inter-embankment <2 of width of the bed	❑	❑	❑	❑	❑
	inter-embankment >2 of width of the bed	❑	❑	❑	❑	❑

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Table no 40 Punctation range of the PPH6 parameter

PPH6	Embankments in rivers with a bed width of ≤30 meters (we sum up the points for the presence of embankments and the dominant one between the embankments; additionally, when embankments dominate on both sides, the sum is multiplied	occurrence of embankments (% of the river's length in HWB)		none	0
				≤25	0,5
				25-50	1
				50-75	1,5
				>75	2
				> 2 the width of the river bed	0,5
		the dominant type of inter-embankment		≤2 the width of the river bed	1
				no inter-embankment	1,5
PPH6	Embankment in rivers with the width of the channel >30 m (determine the highest value noted for the left and right edges and sum)	the percentage length of the river in HWB	without inter-embankment	none	0
				≤25	2
				25-50	2,5
				50-75	3
				>75	3,5
			embankments ≤2 channel widths	none	0
				≤25	1
				25-50	1,5
				50-75	2
				>75	2,5
			embankments >2 channel widths	none	0
				≤25	0,5
				25-50	1
				50-75	1,5
				>75	2

11.3.1.2. Hydromorphological Diversity (PRH) parameters

PRH1 - the value of the PRH1 indicator, which is included in the "heavily modified water bodies database", is not consistent with the values resulting from the assessment carried out in accordance with the HIR methodology. The value of the indicator is the result of calculations made in the SEW project and is close to the actual values (rough calculations were used in the SEWS project due to the need to assess all aHWB in Poland, which would not be possible with a more accurate method). For this reason, in aFRMP, the value of the indicator should be calculated according to the current status and after the implementation of actions. The assessment is made in part A3 of the indoor form. Section A3 deals with the longitudinal profile of the watercourse and shows how the analyzed river section is winding. Torsion is assessed in 5 categories, where for each category the percentage share of the river length in the assessed aHWB is marked. This analysis will be performed visually on the basis of the orthophotomap (it is also the assessment for PPH1). On this basis, the value of PRH1 will be assigned - straightening of the watercourse route - the percentage

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of the river length in the assessed aHWB, the route of which is straight or broken, points are assigned to each of the two mentioned routes and then added up; this parameter is not assessed in mountain aHWB (located> 800 m above sea level).

Table no 41 Longitudinal profile of the watercourse route

% of the river lenght in HWB	none	≤25%	25-50%	50-75%	>75%
Straight (k<1,05)	❑	❑	❑	❑	❑
Winding (k=1,05-1,3) 	❑	❑	❑	❑	❑
Meandering (k>1,3) 	❑	❑	❑	❑	❑
Broken 	❑	❑	❑	❑	❑
Multi-channel/delta 	❑	❑	❑	❑	❑

Table no 42 PRH1 parameter Punctation range

Natural route of the watercourse	% of the river length in HWB	none	0
		≤25	1
		25-50	3
		50-75	5
		>75	7

PRH2 - inland drains and islands - the percentage of the length of the river along which inland drains and islands occur; this parameter is not assessed in rivers with a riverbed width of ≤30 m, as it is not sufficiently visible on orthophotomaps in this category of watercourses. The parameter is assessed in section A4. The value of the PRH2 index can be found in the "sewage database". In addition, in the "sewage database" there is information about the share of inland water discharge and islands in aHWB (UDZ_ODS_SR), on the basis of which PRH2 values will be assigned.

Table no 43 Division of in-channel and island dumps

% of river lenght in HWB	none	≤10%	10-30%	30-50%	>50%
Inland drains and islands	❑	❑	❑	❑	❑

Table no 44 Punctation range of the PRH2 parameter

Inland drains and islands	% of the river length in HWB	none	0
		≤10	1
		10-30	2
		30-50	3
		>50	5

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PRH3 - Bank and meander dumps - the percentage of the length of the river along which there are bank dumps; this parameter is not assessed in rivers with a riverbed width of ≤30, as it is not sufficiently visible on orthophotos in this category of watercourses. The parameter is assessed in section A4. The value of the PRH3 index can be found in the "heavily modified water bodies database". In addition, there is information in the "heavily modified water bodies database" regarding the coastal and island share in aHWB (UDZ_ODS_BRZ), on the basis of which PRH3 values will be assigned.

Table no 45 Division of bank discharge

% of river lenght in HWB	none	≤10%	10-30%	30-50%	>50%
Bank dumps	❑	❑	❑	❑	❑

Table no 46 PRH3 parameter Punctation range

Bank and meander dumps	% of the river length in HWB	none	0
		≤10	1
		10-30	2
		30-50	3
		>50	5

PRH4 - use of the river valley area - the average number of points weighted by the share in the coverage of 3 categories of land use (urbanized, agricultural and semi-natural areas) in a 100 m buffer (for rivers with a river bed width of ≤30 m) or 1000 m (for rivers with a river bed width> 30 m). The parameter is assessed in section A6. The value of the PRH4 index is included in the "heavily modified water bodies database". In addition, in the "heavily modified water bodies database" there is information on the share of urbanized areas (Sum_ZURB), agricultural land without grassland (Sum_ROLN), grassland (Sum_UZ_ZIEL) and seminary areas (Sum_SEMI), on the basis of which PRH4 values will be assigned. The approach is not exactly the same as the original HIR methodology. When determining heavily modified water bodies, agricultural land was divided into grassland and land without grassland, differentiating the values of the indicator for both categories, which is not referenced in the original HIR method. However, it is proposed to leave such an approach so that it is possible to demonstrate more precisely the impact of changes in use, e.g. when changing arable land to grassland in the construction of dry reservoirs.

Table no 47 Breakdown by types of river valley land use

Urbanized areas	Agricultural land without grassland	Grassland	Seminary areas
%	%	%	%

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Table no 48 Scoring range for the PRH4 parameter

Land use of the river valley	Point average weighted by the share of four land use categories in the river valley (buffer)	Urbanized area	1
		Agricultural land without grassland	4
		Grassland	6
		Seminary grounds	10

PRH5 - tree cover - percentage of the river length along which there are trees in the coastal zone (for rivers with a river bed width of 30 m) or in a 50 m strip (for rivers with a river bed width> 30 m). The parameter is assessed in section A7. The value of the PRH5 index is included in the "heavily modified water bodies database". Moreover, in the "heavily modified water bodies database" there is information on the share of forested river sections (UDZ_ZADRZ), on the basis of which PRH5 will be assigned. The project to designate heavily modified water bodies used a revised assessment scale, but the aFRMP proposes to stick to the original methodology (below).

Table no 49 Division of coastal trees

Forested river sections (% length HWB¹)	❑ none	❑ ≤25%	❑ 25-50%	❑ 50-75%	❑ >75%

Table no 50 Scoring range for the PRH5 parameter

Forested area	% of the river length in HWB	none	0
		≤25	1
		25-50	2
		50-75	3
		>75	5

PRH6 - oxbow lakes - percentage of the length of the lowest-order river in the assessed AHWB along which there are oxbow lakes. The parameter is assessed in section A8. The value of the PRH6 index is included in the "heavily modified water bodies database". In addition, the "heavily modified water bodies database" contains information on the percentage of oxbow lakes and other small reservoirs in the river valley (buffer) (UDZ_STAR), on the basis of which PRH6 values will be assigned. The project of designating heavily modified water bodies uses a modified assessment method consisting in the assessment of the oxbow lake area in the buffer, and not the% of the river length in the

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aHWB with oxbow lakes. In the evaluation of actions, it is proposed to stick to the original methodology (below).

Table no 51 Division of oxbow lakes

Oxbow lakes (% of the river lenght in HWB)	☐ none	☐ ≤10%	☐ 10-30%	☐ 30-50%	☐ >50%

Table no 52 Scoring range for the PRH6 parameter

Oxbow lakes	% of the river length in HWB	none	0
		≤10	1
		10-30	2
		30-50	3
		>50	5

PRH7 - Wetlands - the percentage of the length of the lowest-order river in the assessed aHWB along which the wetlands occur. The parameter is assessed in section A8. The value of the PRH7 index can be found in the "heavily modified water bodies database". In addition, the "heavily modified water bodies database" contains information on the percentage of wetlands area in the river valley (buffer) (UDZ_MOKR), on the basis of which PRH7 will be assigned. However, it is proposed to leave this approach aside so that the impact of actions on wetlands can be more accurately assessed.

Table no 53 Distribution of wetlands

Wetland - % of wetland in the river valley (buffer)	☐ none	☐ ≤10%	☐ 10-30%	☐ 30-50%	☐ >50%

Table no 54 Scoring range for the PRH7 parameter

		Wetlands	
Wetlands	**% of wetland area in the river valley (buffer)**	≤10	0
		10-25	1
		25-40	2
		40-60	3
		60-80	4
		>80	5

Based on changes in the values of PPH and PRH parameters under the influence of actions, the HIRk index values will be calculated in accordance with the following formula:

$$HIR_k = \frac{\left(\frac{WRH_k - WPH_k}{10}\right) + 1{,}2}{3}$$

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where:

HIR_k - correction factor for the hydromorphological state class based on the indoor assessment,

WRHt - Hydromorphological Diversity Index based on indoor assessment,

WPHt - Hydromorphology Transformation Index based on the indoor assessment.

On its basis, the HIRk value will be determined according to the table below. The methodology of the Hydromorphological River Index in the indoor part takes into account a three-class assessment of the state, which corrects the result of the field assessment when assessing the entire HWB. In this approach, the limit values are as follows: 0.4 - the conventional limit between the poor and at most moderate status (values ≤0.4 lower the grade), and 0.6 - the conventional limit between the moderate and at least good status (values> 0 , 6 increase the grade). Values in the range of 0.4-0.6 correspond to a moderate state. In the assessment of the impact of actions included in aFRMP, it was decided to refine this classification. A similar approach was used in the National Surface Water Restoration Programmeme. The analysis introduces a division into five classes by dividing the class with values> 0.6 into two ranges: 0.6-0.8, which corresponds to a good condition, and> 0.8, which corresponds to a very good condition. Similarly, the class with values <0.4 was divided into two ranges: 0.2-0.4, which corresponds to the poor condition, and <0.2, which corresponds to the bad condition.

Table no 55 Classification of the hydromorphological state

Hydromorphological state on the basis of chamber studies	HIRk value
Very good	>0,8
Good	0,6-0,8
Moderate	0,4-0,6
Weak	0,2-0,4
Bad	<0,2

After determining the hydromorphological state class, the HIR_k after the implementation of flood protection actions will be compared with the current class determined on the basis of the results of the project to determine the sludge. Based on the change of the hydromorphological state class after the implementation of the action, an assessment of the impact on the hydromorphological state of aHWB will be carried out according to the following scheme:

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- no reduction of the HIR_k class (possible reduction of the HIR_k value, but no change of the class) - no impact - environmentally beneficial option,
- lowering the HIR_k class by one class with the possibility of implementing actions to minimize the impact on the indicators for assessing hydromorphological parameters according to the Manual of Good Practices for Surface Water Restoration developed under the project, which will result in the eventual lack of class reduction; mitigation actions were assigned to each of the flood control actions on the basis of changes in the values of PPH and PRH parameters according to Appendix 2 and the table below which is a short version of this Appendix - moderate impact insignificant - moderately unfavorable environment option,
- lowering the HIR_k class by two or more classes - potentially significant impact - an environmentally unfavorable option.

Table no 56 List of potential actions to minimize the impact on Hydromorphology Transformation Parameters (PPH) and Hydromorphological Diversity Parameters (PRH)

Symbol for a parameter that has deteriorated by operation	**Parameter name**	**Symbol of action from the *Manual of Good Practice for Surface Water Restoration* to be implemented within the AHWB minimizing or compensating the impact ***
PPH1	Straightening the watercourse route	D4, D5, D6, T1, T2, T12
PPH2	Damming structures	D7, T15, T16
PPH3	Water management facilities	
PPH4	Regulatory structures	T7, T9, T10
PPH5	Bridge structures, crossings	T17
PPH6	Embankment in rivers	T13
PRH1	Natural route of the watercourse	D4, D5, D6, T1, T2
PRH2	Mid-riverbed bars and islands	T12
PRH3	Shore and meander bars	T12
PRH4	Utilization of the river valley area	D1, D2, T13
PRH5	Tree plantings	D1, D2
PRH6	Oxbow lakes	T4, T5
PRH7	Wetlands	T13, T14, Z1

Symbol for a parameter that has deteriorated by operation	Parameter name	Symbol of action from the *Manual of Good Practice for Surface Water Restoration* to be implemented within the AHWB minimizing or compensating the impact *
* D - Complementary actions under normal water management; T - technical actions; Z - actions in the catchment area); D1 - Planting trees and shrubs in the coastal zone; D2 - Shaping of vegetation in the flood zone and on the banks of water; D4 - Introduction of key elements for habitat diversity in the riverbed; D5 - Introduction of gravel-stone piles imitating rapids and dephs systems or directing the flow; D6 - Introduction of natural deflectors; D7 - Modifications to water management to eliminate anthropogenic flow distortions; T1 - Initiation of side channel erosion; T2 - Formation of a new or reconstruction of the old bed in an ecologically optimal form; T4 - Restoration of oxbow lakes; T5 - Creation of quasi-oxbow lakes; T7 - Removal of bank reinforcements; T9 - Rebuilding of shore fortifications to make them more natural; T10 - Unnatural edge profile; T12 - Structures or structures that direct the current to initiate channel restoration processes; T13 - Removal or "retraction" of flood embankments and restoration of flood plains; T14 - Removal or digging of bank or meander embankments T15 - Removal or reconstruction of the seabed construction sites; T16 - Removal or clearing of transverse partitions T17 - Reconstruction of culverts; Z1 - Renaturation of wetlands in the catchment area		

11.3.2. Assessment of the impact on biological parameters. Assessment of water status / potential

Assessment of the impact of the action on biological parameters will be performed for the individual aHWBs that make up a given waterline under the action. It should be assumed that the impact assessment is proportional to the percentage of the length of the aHWB covered by the work. The following biological elements are assessed: phytobenthos, macrophytes, macrophytes and fish. Assessments of biological elements were performed for the individual aHWB on which the action is found.

Phytobenthos are characterized by low vulnerability to hydromorphological changes, but it may be affected by water damming and changes in the bottom substrate as a result of stopping sediment transport.

As part of the phytobenthos assessment, the retention time of water in dam reservoirs and the presence of devices enabling the migration of rubble will be taken into account.

Macrophytes are characterized by moderate susceptibility to hydromorphological changes in the influence of damming up water in the reservoir and to actions related to heavy longitudinal development of the banks and straightening of the riverbed.

As part of the macrophyte assessment, the retention time of water in dam reservoirs and the presence of devices enabling the migration of rubble will be analyzed. The type of

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longitudinal elements of buildnig development (technical, biological) as well as the occurrence of straightening of the watercourse bed or its curvature will also be assessed.

Macrobinvertebrates are susceptible to hydromorphological transformations related to the damming of water in reservoirs, longitudinal development of banks and bottoms with technical elements and disruption of sediment transport (changes in substrate granulation) and permeability for the migration of organisms closely related to water.

As part of the assessment of macroinvertebrates, the water retention time in dam reservoirs and the presence of devices enabling the migration of debris will be taken into account. Barrages and thresholds will also be analyzed, along with information on the presence of devices enabling the migration of organisms and debris.

The type of longitudinal elements of construction sites (technical, biological) as well as the occurrence of straightening of the watercourse bed or its curvature will be assessed.

Fish and lampreys are particularly sensitive to hydromorphological transformations: damming of water in reservoirs, longitudinal development of banks and bottoms with technical elements and interruption of sediment transport (changes in substrate granulation - loss of spawning grounds). It is very important to interrupt the permeability for the migration of post-modromous species (migrating in river systems), especially - bi-environmental species (the possibility of migration between the sea and freshwater determines the maintenance of the population). Therefore, the information about the importance of a given aHWB for bi-environmental species and protected post-modromic species in the assessment of river patency serves as an auxiliary criterion in the assessment of the impact of transverse structures (dams, weirs, barrages, thresholds).

As part of the assessment for fish and lampreys, the following information should be used: water retention time in dam reservoirs and the presence of devices enabling the migration of ichthyofauna and debris. The type of longitudinal elements of construction sites (technical, biological) as well as the occurrence of straightening of the watercourse bed or its curvature will be assessed. In addition, the impact of transverse structures will also be assessed, along with information on the presence of devices that enable the migration of organisms.

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Table no 57 Elements of the assessment of the impact on the biological parameters of the assessment of water status / potential

No	Assessment component	Actions (tasks)
1	Fitobentos	Dam reservoirs with a retention time of more than 10 days without devices enabling the migration of **3D** rubble Dam reservoirs with a retention time of less than 10 days without devices enabling the migration of **2D** rubble Dam reservoirs with a retention time of more than 10 days with devices enabling the migration of **2D** rubble Dam reservoirs with a retention time of less than 10 days with devices enabling the migration of **1D** rubble
2	Macrophytes	Dam reservoirs as in item 1 Longitudinal construction with technical elements, **2D** riverbed straightening Longitudinal development with biological elements, straightening of the channel **1D** Longitudinal development with technical elements, maintaining the **1D** channel curvature
3	Macrobial invertebrates	Dam reservoirs as in item 1 Barrages and thresholds without devices enabling the migration of organisms and **2D** debris Barrages and thresholds without devices enabling the migration of organisms and debris **1D** Barrages and thresholds with devices enabling the migration of organisms and debris **1D** Longitudinal construction with technical elements, **3D** riverbed straightening Longitudinal development with biological elements, **2D** riverbed straightening Longitudinal construction with technical elements, preservation of the **2D** channel curvature Longitudinal development with biological elements, maintaining the **2D-1D** channel curvature

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No	Assessment component	Actions (tasks)
4	Fish	Dam reservoirs with a retention time of more than 10 days without devices enabling the migration of ichthyofauna and **3D** debris Dam reservoirs with a retention time of less than 10 days without devices enabling the migration of ichthyofauna and **3D** debris Dam reservoirs with a retention time of more than 10 days with devices enabling the migration of ichthyofauna and **2D** rubble Dam reservoirs with a retention time of less than 10 days with devices enabling the migration of ichthyofauna and debris **1D** Longitudinal construction with technical elements, **3D** riverbed straightening Longitudinal development with biological elements, **2D** riverbed straightening Longitudinal construction with technical elements, preservation of the **2D** channel curvature Longitudinal development with biological elements, keeping the **2D-1D** channel curvature Transverse construction - thresholds, Barrages, without devices enabling the migration of **3D** organisms Transverse construction - thresholds, Barrages, with devices enabling the migration of **2D-1D** organisms
1 - weak impact - environmentally beneficial option 2 - significant impacts - option with moderate environmental benefit 3 - very significant strong impacts - environmentally unfavorable option K - short-term impacts D - long-term impact		

Source: own study based on: Babiasz R., Engel J. Jelonek M., Kokoszka R., Król W., Makomaska-Juchniewicz M., Wawręty R., Mazurkiewicz-Boroń G., 2010: Wytyczne do uwarunkowań rozwoju hydroenergetyki na obszarze działania RWMB w Krakowie. IOP PAN, Kraków, Grela J., Jelonek M., Sądag T., 2009: Zrównoważone użytkowanie oraz ochrona ekosystemów wodnych w świetle wymagań prawa europejskiego i polskiego. Architektura. Czasopismo Techniczne 2009/10., Chylarecki P., Engel J., Kindler J., Nieznański P., Okruszko T., Rutkowski M., Wiśniewska M.M., 2005: Zasady gospodarowania na obszarach NATURA 2000 w dolinach rzek. Warszawa, WWF Polska, GWP Polska, DVWK, 2002: Fish passes. Design, dimension and monitoring. FAO, Rome.

11.3.3. Assessment of the effect on the permeability of watercourses for aquatic organisms

The impact of the action on maintaining the patency of water courses for aquatic organisms within the meaning of the WFD will be assessed. The assessment of the ecological status / potential of biological water quality elements is carried out on a "one out - all out" basis. This means that the element with the lowest class decides about the classification of the state/potential of biological elements. Each of these elements reflects a different type of pressure acting on aHWB (phytoplankton, phytobenthos and macrophytes react primarily to water fertility, benthic macrobenthic invertebrates to physicochemical conditions (mainly indicators characterizing oxygen conditions) and changes in the morphology of rivers and sediment transport, and finally the most responsive fish. on morphological transformations of the riverbed). Due to the greatest mobility and the use in the life cycle of various sections

of rivers (potamodromous species) or marine and fresh waters (migratory - diadromous species) for the purposes of considering the impact of river patency on the ecological state/potential of water, the most appropriate indicator reflecting this impact is the classification of ichthyofauna. Due to the particular vulnerability of fish to partitioning and development of rivers, especially diadromous species, the permeability for the freedom of migration of ichthyofauna is one of the basic hydromorphological criteria taken into account in the assessment of the state or ecological potential of rivers. Determining ecologically objective needs and priorities for fish migration, therefore, becomes an indispensable condition for taking actions to restore or maintain the morphological continuity of natural watercourses in the river basin areas. It conditions both the success of species restitution and biodiversity protection, as well as the possibility of achieving good ecological status or potential of waters.

As part of the environmental assessment, it will be determined whether a given measure may adversely affect the morphological continuity, taking into account the results of the study: "Establishing environmental objectives for water bodies with the development of a register of lists of protected areas" (2019) and "Assessment of the needs and priorities of improving the morphological continuity of rivers in the context of achieving good status and potential of water bodies in Poland "(2010). Only actions related to transverse investments will be assessed.

The assessment will be performed for the individual ACUs that make up the action.

As part of the assessment, it will be determined whether a given investment is located on a river section (aHWB) particularly important for morphological continuity, on a river section (aHWB) important for maintaining morphological continuity. For aHWB, which in the work "Establishing environmental objectives for water bodies and developing a register of protected lists", an environmental objective was also assigned to achieve the value of 0.5 for the bi-environmental fish index D (if they were included in the monitoring of ichthyofauna and the D index was calculated), it would be advisable also consider maintaining patency for bi-environmental species. However, due to the fact that the assessments from the State Environmental Monitoring (SEM) for the state/ecological potential are made by HWB, and the currently conducted analyzes include the division into aHWB, only data for within the quoted project "Setting environmental objectives ...". Information on the results of monitoring from 2015-2018 is available in these data only for 1804 out of 3116 designated aHWB rivers, while the monitoring of ichthyofauna was carried out only in part of the assessed aHWB. Therefore, due to the fragmentation and randomness of the available data, the use of the D indicator as a criterion to indicate the environmental objective of rivers' permeability for bi-environmental species was abandoned. It should be mentioned here that the rivers for which the D indicator is calculated under the SEM include all sections indicated as particularly important and important for bi-environmental fish, going beyond them when there are data on the historical occurrence of this group of fish also above the designated sections. In subsequent studies, when more complete results of ichthyofauna monitoring are available, taking into account the division into aHWB - the criterion of the environmental target based on the value of indicator D should be applied. If the action is located outside the above-mentioned

sections of watercourses, it will be checked whether the location of the action has defined environmental objectives resulting from the requirements for natural areas.

The assessment will take into account:

- The migration route of two-environmental fish from the sea to the area protecting their spawning grounds,
- Tracking according to asp or barb requirements (no obstacles> 0.30m), distance of 50 km,
- Passage according to lamprey requirements (no obstacles> 0.15m), section 20 km,
- Clearance according to requirements: Kessler's gudgeon, white-finned gudgeon, European bullhead, spined loach, Sabanejewia aurata, weatherfish, or bitterling (no obstacles> 0.1m), 10 km distance.

In the event that an action occurs in several aHWB - one aHWB eligible for the above-mentioned groups is enough to take account of this result in the assessment of the impact of the action on biological components.

Table no 58 Elements of the assessment of the impact on the permeability of water courses for aquatic organisms.

River permeability for ichthyofauna		
Action name:		
ID:		
Watercourse name:		
An investment affecting the patency of the watercourse		YES/NO
		AHWB code (1):
		AHWB status (1):
Conditions for the requirements of morphological continuity necessary to achieve good ecological status or potential		
River section (aHWB) particularly important for maintaining morphological continuity		
River section (aHWB) important for maintaining morphological continuity		
Environmental objectives resulting from the requirements for natural areas	The migration route of two-environmental fish from the sea to the area protecting their spawning grounds	
	Tracking according to asp or barb requirements (no obstacles> 0.30m), distance 50 km	
	Passage according to lamprey requirements (no obstacles> 0.15m), section 20 km	
	Clearance according to requirements: Kessler's gudgeon, white-finned gudgeon, European bullhead, spined loach, Sabanejewia aurata, weatherfish, or bitterling (no obstacles> 0.1m), 10 km distance	
River section (HWB) not included in the above / no flow requirements		
Determining whether the investment has an impact on maintaining the river's permeability (aHWB) for ichthyofauna		

11.3.4. Assessment of the impact on area forms of nature protection

In the course of analyzes aimed at determining the environmental acceptability of actions to reduce the risk of flooding, the main determinants will be:

- spatial relationship of projects to protected areas,
- the impact of a specific action on the functions and features of the area

At the level of analyzes performed under the aFRMP, the following forms of nature protection will be taken into account:

- National parks,
- nature reserves,
- Natura 2000 areas,
- landscape parks,
- ecological lands,
- protected landscape areas,
- nature and landscape complexes,
- and the buffer zones of national parks, landscape parks and nature reserves.

The basic condition that will be taken into account is the location of the planned action in relation to the boundaries of the protected area. After determining the spatial relationship of the planned action, it is necessary to proceed in parallel with obtaining knowledge about two key aspects for the correct determination of environmental acceptability of investments:

- define and define the most important natural resources of the area (define the protection objectives of the area and the objects of protection of the protected area in the case of Natura 2000 sites in accordance with the current 2nd aWMP versions) and for the purposes of indicative assessment, present them in the form of categorized environmental objectives (specified in the study "Analysis of significant impacts with an assessment of their impact on the status of water and the risk of not achieving environmental objectives"),
- determine the impact factors appropriate for the action with the use of the results of the analyzes described above in terms of the impact on the hydromorphological parameters of watercourses and morphological patency of watercourses.

Within each aHWB on which the action is located, the percentage share of the aHWB catchment in the area of the protected area will be determined. For each aHWB affected by the action, an index assessment of the significance of the impact on the protected area conservation objects and site conservation objectives will be performed.

The assessment will be carried out with the use of categorized environmental objectives specified in the study "Analysis of significant anthropogenic impacts together with the assessment of their impact on the state of water and the risk of failure to achieve environmental objectives":

- Maintaining a high level of groundwater,
- Maintenance of periodic floods,

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- Maintaining water management in fish ponds,
- Maintaining / restoring the patency of the watercourse,
- Maintaining the natural character of the bed / lake,
- No influx of pollutants.

The following will be adopted as the impact factors:

- Assessment of wetlands and actions to restore melioration systems,
- Assessment of the pressure of embankments and retention reservoirs - assessment made for a given measure under the aFRMP implementation from the sheet "parametry_hydromorfologiczne",
- Assessment of water management facilities (fish ponds),
- Assessment of the pressure of damming structures - assessment made for a given measure under the aFRMP implementation from the sheet "drożność_rzeki",
- Assessment of pressure on the watercourse route, regulatory structures - assessment made for a given measure under the aFRMP implementation from the sheet "parametry_hydromorfologiczne",
- Assessment of waste water discharge pressure.

With regard to the categorized environmental objectives, on the basis of the collected data for each aHWB, a total assessment of significance for a fragment of the protected area in a given catchment area will be developed, the impact on the connectivity of the area with other areas and the impact on the functionality of the ecological corridor, and an assessment of the impact on the integrity of the entire protected area will be carried out.

As part of impact assessments, the following assessment scale is assumed:

- Potentially significant - PZ,
- Moderate, insignificant - UN,
- None - B.

The assessment will be carried out by experts on the basis of the index assessment of the significance of the impact on the protected area protection objects and the site protection objectives.

The analysis should give an image of the value of a given catchment area of the aHWB in the natural context and allow to determine the expected conflicts between the implementation of the planned projects to reduce the risk of flooding or the use of specific methods of their implementation, and the protection objectives of individual areas. Correct completion of the Assessment Sheet of the impact of the planned actions on the condition,

features and protection objectives of the protected area will enable an analysis of the environmental acceptability of the project or the proposed methods at the catchment level.

With regard to the forms of nature protection, the following valorization of protected areas is assumed:

- national park: high rank,
- Natura 2000 area: high rank,
- nature reserve: high rank,
- landscape park: medium rank,
- ecological land: medium rank,
- national park buffer zone: average rank,
- protected landscape areas: low rank,
- nature and landscape complexes: low rank,
- landscape park buffer zone: low rank,
- nature reserve buffer zone: low rank.

High-level areas: in connection with the implementation of the measure, there is no risk of potentially significant impact, (PZ) possible moderate, insignificant impact (UN) that can be minimized or no impact at all;

Medium and low-rank areas: in connection with the implementation of the measure, there is no risk of potentially significant impact on the areas, (PZ), possible occurrence of moderate/insignificant impacts (UN), that can be minimized or no impacts at all, (B).

The worksheet for assessing the impact of projects, actions on the condition, features and conservation objectives of the protected area in a given aHWB is presented below.

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Table no 59 Assessment elements for area-based forms of nature protection

Protected areas (1)	
Action name:	
ID:	
A form of nature protection	
Protected area name:	
Objects of protection of the protected area (in the case of Natura 2000 sites)	

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Protected areas (1)								
Site conservation objectives								
AHWB code (1):		**Assessment (1):**		**Comments (1):**			**The share of aHWB catchment in the area of the protected area [%]:**	
Impact significance assessment, impact factors:	***INDICATIVE ASSESSMENT OF THE IMPACT ON THE PROTECTED AREA PROTECTION OBJECTS / SITE PROTECTION OBJECTIVES (based on the categorized environmental objectives specified in the study entitled: Analysis of pressures together with the assessment of their impact on the condition of surface waters and risk assessment of failure to achieve environmental objectives) Categories of environmental objectives***					***Total assessment of significance for a fragment***	**Impact on connectivity of the site with other areas / impact on the**	**Impact on the integrity of the entire**

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Protected areas (1)									
	Maintaining a high level of groundwater	**Maintaining periodic floods**	**Maintaining water management in fish ponds**	**Maintaining / restoring the patency of the watercourse**	**Maintaining the natural character of the riverbed / lake**	**No influx of pollutants**	***of the protected area in a given catchment aHWB (potentially significant - PZ, moderate, insignificant - UN, none - B)***	**functionality of the ecological corridor**	**protected area**
Assessment of wetlands and actions to restore drainage systems									
Assessment of the pressure of embankments and retention reservoirs - assessment from the "hydromorphological parameters" tab									
Assessment of water management facilities (fish ponds)									

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Protected areas (1)									
Assessment of the pressure of damming structures - assessment from the "river permeability" tab									
Assessment of pressure on the watercourse route, regulatory structures - final assessment from the "hydromorphological parameters" tab									
Assessment of waste water discharge pressure									

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11.3.5. Assessment of the impact on the permeability of terrestrial ecological corridors

The national network of ecological corridors (Jędrzejewski 2005) was designed mainly to ensure appropriate migration conditions for large predatory mammals (the impact of projects on the permeability of watercourses for aquatic organisms was analyzed separately).

In 2011, another map of ecological corridors important for the population of large forest mammals and the coherence of forest and wetland habitats on a national and continental scale was developed.

The impact on ecological corridors will be analyzed in two aspects:

1. impact on the conditions of free migration of terrestrial mammals - it is proposed to adopt the otter *Lutra lutra* and beaver *Castor fiber* as indicator species (all transverse partitions in the watercourse can have a negative impact, but with appropriate minimization actions it is effectively limited),
2. impact on the migration conditions of large mammals, with particular emphasis on large predatory mammals (lynx *Lynx lynx*, wolf *Canis lapus*). In this case, the impact on the conditions of migration in the greater part of the river valley will be significant (e.g. construction of a reservoir, barrage and infrastructure of a large part of the forested part of the river valley).

Table no 60 Elements of the assessment of the permeability of terrestrial ecological corridors

No	Assessment component	Significance assessment (potentially significant - PZ, moderately insignificant - UN, none - B)	Description
1	Impact on the conditions of free migration of terrestrial mammals - it is proposed to adopt the otter *Lutra lutra* and beaver *Castor fiber* as indicator species (all transverse partitions in the watercourse can have a negative impact, but with appropriate minimization actions it is effectively limited).		
2	Influence on the migration conditions of large mammals, with particular emphasis on large predatory mammals (lynx *Lynx lynx*, wolf *Canis lapus*). In this case, the impact on the conditions of migration in the greater part of the river valley will be significant (e.g. construction of a reservoir, barrage and infrastructure of a large part of the forested part of the river valley).		

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As part of impact assessments, the following assessment scale is assumed:

- Potentially significant - PZ
- Moderate, insignificant - UN,
- None - B.

The assessment will be performed by experts on the basis of data on the location of the measure in the area of ecological corridors and the size of the impact of the measure on the corridors.

11.3.6. Assessment for multi-criteria analysis (MCA)

Based on the analyzes described in point 11.3.1. - 11.3.5., In terms of:

- assessment of the impact on the hydromophrological parameters of the assessment of water status/potential
- assessment of the impact on biological parameters of the assessment of water status/potential,
- assessment of the impact on the permeability of watercourses for aquatic organisms,
- assessment of the impact on area forms of nature protection,
- assessment of the impact on the permeability of terrestrial ecological corridors,

scoring of actions and planning options for the MCA analysis will be made. The main aim of the assessment will be to capture the difference between planning variants in individual problem areas and express it in the point scale adopted in the MCA analysis.

According to the MCA methodology, the scoring will apply to 2 environmental criteria:

- Criterion I. Impact on protected areas within the meaning of the Nature Conservation Act and ecological corridors.
- Criterion II. Impact on the purposes of water protection within the meaning of the Water Framework Directive.

Scoring will be made for the actions included in the planning variants covered by the MCA analysis. In the first step, individual actions will be assessed for the individual ACUs affected by the action. Initially, the following evaluation criteria (points 1 to 9) will be applied.

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Table no 61 MCA result table

Criterion I. IMPACT ON PROTECTED AREAS WITHIN THE MEANING OF THE NATURE CONSERVATION ACT (national parks, nature reserves, landscape parks, Natura 2000 areas, protected landscape areas, ecological lands, nature and landscape complexes, documentation stations) AND ON NATIONAL AND REGIONAL ECOLOGICAL CORRIDORS	
9	the project is located outside the spatial form of protection (or lagging zone) and outside the ecological corridor; due to the nature and scale of the project, it is expected that there will be no possibility of influencing the site's conservation objectives and no possibility of influencing the functionality of the corridor
8	the project is located within the ecological corridor and outside the area-based form of protection (or lagging zone); due to the nature and scale of the project, there is no possibility of influencing the corridor functionality and site protection objectives
7	the project is located within the spatial form of protection (or lagging zone) and outside the ecological corridor; due to the nature and scale of the project, it is expected that there will be no possibility of influencing the site's conservation objectives and the functionality of the corridor
6	the project located outside the area-based form of protection (lagging zone) and outside the ecological corridor; due to the nature and scale of the project, the possibility of a negative impact on the conservation objectives is expected to a degree justifying the probability of obtaining consent for the project implementation, and it is possible to impair the functionality of the corridor, however, it is possible to apply for effective measures to minimize or compensate
5	the project is located within the ecological corridor and outside the area-based form of protection (or lagging zone); due to the nature and scale of the project, it is expected that the functionality of the corridor may be impaired, however, it is possible to apply effective measures to minimize or compensate for the impairment, and it is possible to have a negative impact on the conservation objectives to a degree justifying the probability of obtaining consent for the project implementation
4	the project is located within the limits of the area form of protection (or lagging zone) and outside line ecological corridor; due to the nature and scale od the project, it is envisaged that there will be a negative impact on the conservation objectives is expected to a degree justifying the probability of obtaining consent for the implementation of the project and impairment of the corridor functionality, however, it is possible to apply effective measures to minimize or compensate for the impairment
3	the project is located within the ecological corridor and outside the area-based form of protection (or lagging zone); due to the nature and scale of the project, it is expected that the functionality of the corridor may be impaired, while the possibility of applying effective measures to minimize or compensate for the impairment is questionable, while the possibility of a negative impact on the protection objectives is expected to the extent that the probability of obtaining consent for the project implementation
2	the project is located within the spatial form of protection (or its buffer zone) and outside the ecological corridor; due to the nature and scale of the project, the possibility of a negative impact on the conservation objectives is expected to the extent that would justify the potential difficulties in obtaining consent for the project implementation, while in the case of impairment of the corridor functionality, it is possible to apply effective measures to minimize or compensate for the impairment

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1	the project is located within the spatial form of protection (or its buffer zone) and within the ecological corridor; due to the nature and scale of the project, the possibility of a negative impact on the conservation objectives is expected to the extent that would justify the potential difficulties in obtaining consent for the project implementation and the possibility of impairment of the corridor functionality is envisaged, while the possibility of applying effective measures to minimize or compensate for the impairment is questionable
	sum:
Criterion II. IMPACT ON WATER PROTECTION PURPOSE WITHIN THE MEANING OF THE FLOODS DIRECTIVE	
9	natural aHWB , strongly changed and artificial; due to the nature and scale of the project, no impact on water protection objectives is expected
8	strongly changed and artificial aHWB ; due to the status of the aHWB and the nature and scale of the project, no impact on the objectives of water protection is expected, provided that appropriate measures are implemented to minimize the impact
7	natural aHWB ; due to the status of the aHWB and the nature and scale of the project, no impact on the objectives of water protection is expected, provided that appropriate measures are implemented to minimize the impact
6	strongly altered and artificial aHWB ; whereas, in view of the status of the aHWB and the nature and scale of the project, it is envisaged that the objectives of water protection for biological and hydromorphological elements may be endangered, the fulfilment of the conditions of Article 4.7. of WFD
5	strongly altered and artificial aHWB ; in view of the status of the aHWB and the nature and scale of the project, the possibility of a risk in achieving the objectives of water protection in terms of both biological, hydromorphological and patency elements is foreseen, while the fulfilment of the conditions of Article 4.7. of WFD
4	natural aHWB; due to the status of aHWB and the nature and scale of the project, there is possibility of a threat to the implementation of the water protection objectives, in terms of biological and hydromorphological elements, while fulfillment the conditions of Art.. 4.7. of WFD can be duly substantiated
3	natural aHWB; due to the status of aHWB and a nature and scale of the project, there is possibility of a threat to the implementation of the water protection objectives, both in terms of biological and hydromorphological elements and the patency of the watercourse, while fulfillment the conditions of Art.. 4.7. of WFD can be duly substantiated
2	natural, heavily altered and artificial aHWB;due to nature and scale of the project, there is possibility of a threat to the implementation of the water protection objectives, in terms of biological and hydromorphological elements, while the proper substantiation of fulfillment the conditions of Art. 4.7. of WFD is questionable
1	natural, heavily altered and artificial aHWB; due to the nature and scale of the project, there is a possibility of a treat to the implementation of the water protection objectives, both in terms of biological and hydromorphological elements and the patency of the watercourse, while the proper substantiation of fulfillment of the conditions of Art.. 4.7. of WFD is questionable

In the absence of a given combination of the location of the action in relation to protected areas and ecological corridors and the severity of the impact, the expert will be assigned a score in the manner best suited to the characteristics of the action. When assigning grades, the valorization of protected areas, referred to in item 11.3.4, will also be taken into account.

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Then the assessment will be aggregated for that action. In the next stage, based on assessments of individual actions building planning variants, an aggregation of assessments for planning variants in individual problem areas will be performed. Aggregation of assessments (transfer of scores from 1-9 to the level of the entire measure, and then the entire variant) will be performed by experts in order to indicate, as objectively as possible, differences in the environmental impact of actions and variants within individual problem areas. Ultimately, each planning variant will receive a score (from 1 to 9) in both criteria described above.

11.4. MULTI-CRITERIA ANALYSIS

11.4.1. Assumptions in conducting multi-criteria analysis

Economic efficiency indicators, calculated for each planning variant as part of the cost-benefit analysis, will be implemented into the multi-criteria analysis as one of the variant evaluation criteria. The multi-criteria analysis will be used to select the optimal variant.

The results of the cost-benefit analysis will be used as part of multi-criteria analyzes as one of the criteria for assessing planning variants, which is a very advantageous solution, as it allows taking into account economic efficiency in the process of selecting the optimal variant.

Multi-criteria analysis is used when out of a given number of variants (in this case variants formulated for each of the problem areas) - it is necessary to choose the optimal one in terms of specific non-uniform criteria. The heterogeneity of the criteria means that reducing the criteria to a common denominator is difficult, i.e. direct comparison of variants is not possible. The criteria may be defined, for example, by the cost in PLN, number of pieces, area, kilometers, time units, etc., or even in the form of an assessment assigned by experts, determining the degree of achievement of the objective by a given variant in terms of a given criterion.

Reducing the criteria to the set of assessments allows additionally to evaluate complex problems with the use of IT tools. The analysis should make it possible to make the optimal decision, i.e. to choose the variant that will bring the best expected results for the decision-maker. It is assumed that the criteria are selected in such a way that the largest possible part of the criteria are objective criteria based on actual values, and not only on expert judgment. Thanks to this, the element of discretion is eliminated, which will be important in social consultations.

An important aspect is the selection of criteria. There should be as few of them as possible, so that the description of the problem and its analysis are simple, and the influence of the indicator on the implementation of the objective function can be described. As a result, the decision-making process is transparent and easy to present, e.g. in public consultations. At the same time, the description of the problem with the help of indicators must be complete, i.e. they cannot omit the aspect of reality that is important from the point of

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view of the decision-maker. At the same time, one should avoid focusing and optimizing non-essential criteria, as well as Redundancy, i.e. repeating the same information by various criteria, which results in increasing/lowering the rating. To avoid this, a situation where different criteria describe the same phenomenon should be excluded, artificially improving or worsening the assessment of a given variant.

In the first planning cycle of the FRMP, the AHP (the Analytic Hierarchy Process) method was used for multi-criteria analyzes. It is assumed that multi-criteria analyzes will be performed in aFRMP under this methodology at the level of problem areas, also taking into account this method.

The AHP method was developed by its creator Saaty in the 1970s. It is a pairwise comparative assessment method. The great advantage of the method is its focus on defining the criteria for evaluating variants and assigning them the appropriate rank. It is their selection and the mutual relations between the criteria that determine the result to the greatest extent. Thanks to the AHP method, we have a chance to take into account the specificity of criteria evaluation processes by evaluating experts, combining with the elimination of those assessments that differ significantly from the others.

The assessment of flood protection variants is a complex decision-making problem, which, thanks to the essence of the AHP method, can be reflected in a hierarchical model that allows to assess the degree of fulfillment by the adopted implementation variants of the overarching objective by means of the degree of fulfillment of partial factors. The adoption of multi-criteria analysis as a method supporting the selection is based on the breakdown of the objective into criteria, which is a significant simplification of reality. However, it allows for an effective solution to the problem taking into account its most important features. The criteria are, in a way, partial objectives, the optimization of which allows the best possible achievement of the main objective.

11.4.2. Methodology of multi-criteria analysis

The analysis itself is performed in stages:

STAGE 1 CREATE A HIERARCHICAL STRUCTURE

First, the number of levels of the hierarchical structure for which the analysis will be performed should be determined.

In the case of FRMP in the 1st planning cycle, 3 levels were used in a hierarchical structure:

- groups of criteria,
- criteria within a given group of criteria,
- variants that solve the problem in the problem area.

In the FRMP in the second planning cycle, 2 levels are proposed in a hierarchical structure:

- criteria,
- variants that solve the problem in the problem area.

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This change is dictated by the desire to limit the number of criteria in the analysis in order to omit redundant criteria, i.e. those whose scope partially overlaps. Moreover, it results from the necessity to take into account in the strategic document, which is FRMP, the need to counteract the climate change intensified in recent years, by including in the multi-criteria analysis the criterion of importance for the strategy of adaptation to climate change. It is a separate category with one "climatic criterion".

It is not appropriate to create a level of criteria groups in a hierarchical structure if there is only one criterion within a given group of criteria, therefore this methodology deviates from the level of criteria groups.

Pairwise comparative analysis is performed separately for each level, i.e. the individual criteria are compared in pairs, and in the next step the variants of solving the problem in the problem area are compared in pairs in the light of each of the criteria separately.

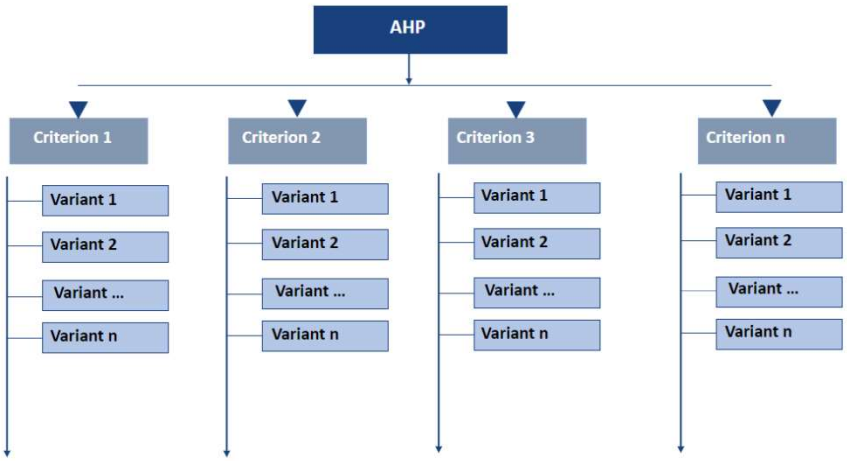

Figure no 9 Creating a hierarchical structure

STAGE 2 COMPARATIVE PAIRWISE ASSESSMENT

The second stage is the assessment of characteristics and objects in a hierarchical structure.

The options are foreseen to be assessed in the light of comparative criteria covering at least:

- Effectiveness of achieving the objectives of flood risk management, with particular emphasis on problem areas - determined as a result of hydraulic modeling (hydrological criterion), as well as the protection of critical infrastructure facilities,
- Financial feasibility of actions - from national funds or the required support, e.g. from EU funds (criterion of funding sources),
- The results of the cost-benefit analysis (economic criterion),
- Impact (negative and positive) on the achievement of environmental objectives for water bodies (WFD compliance criterion),
- Scope and degree of negative environmental impact, including impact on Natura 2000 areas (environmental criterion),
- Importance for the implementation of the strategy of adaptation to climate change (climate criterion),
- Possible social conflicts related to the implementation of actions, in particular related to the necessity of expropriation (social criterion),
- Impact (negative and positive) on the achievement of the PPSS objectives, the national surface water restoration programme, as well as the objectives of other strategies and programmes in the field of navigation, energy and the environment (action synergy criterion).

It is possible to formulate possible additional criteria, apart from the above-mentioned ones, such as the criterion of increasing the retention potential in the catchment area.

According to the methodology developed by the creator of the AHP method - Saaty - the scores in the comparison in pairs range from 1 to 9, i.e. from the equivalence of the criteria to the absolute advantage of one of them over the compared. Criteria are assigned weights determining the importance of a given characteristic in achieving the main objective, and the importance of particular criteria is assigned by comparing them in pairs, using the Saaty table. This means that each criterion should be assigned a weight that determines the significance of a criterion against other criteria, resulting from the comparison of pairs of criteria and thus determining how much more important a given criterion is than another compared criterion.

It is planned to involve the Ordering Party in the weighting process in order to objectify the weighting to the criteria, if possible. The sheet for assigning weights to the criteria will

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be sent to the group of people proposing weights from the Ordering Party and to the staff of the aFRMP Contractor, representing hydrotechnical, environmental, and socio-economic teams, and then the proposed weights of the criteria will be averaged and the resulting set of averaged weights will be used in multi-criteria analysis.

STAGE 3 APPLICATION OF THE AHP METHOD FOR PAIRWISE COMPARATIVE ASSESSMENT

The assumption of the method is to adopt criteria for which numerical quantities are the measure of the pairwise comparison. For qualitative actions, a graded scale system will be used by assigning scores on a 1-9 scale, and therefore expert judgment is only necessary for criteria that cannot be quantified. If it is possible, the comparative assessment results from the degree of meeting a given criterion expressed in natural units, e.g. in pieces, m2 or PLN.

It should be emphasized that the availability and quality of data describing the variants will be of key importance for the evaluation. The source of information will include analyzes performed under FRMP in the 1st planning cycle, flood risk maps, GIS databases (including the BDOT database), modeling results for technical variants and cost estimates of the analyzed technical variants. Moreover, local and large-scale studies are a source of valuable data for multi-criteria analysis. Compliance assessments with the WFD and the Habitats and Birds Directives, as well as the GDEP databases will provide information for the environmental criteria. In conducting analyzes aimed at evaluation and selection of the optimal variant, it will be important to use consistent data between the cost-benefit analysis and the multi-criteria analysis.

Based on the degree of fulfillment of each criterion by the variants, the results of the analysis will be calculated, enabling the ranking of variants from the most to the least meeting the criteria. The degree of fulfillment of the criterion, depending on the specificity of a given criterion and the possibility of its quantification in order to compare variants, will be expressed either in natural units or in the form of scoring, resulting from the adopted evaluation ranges. The result of such a multi-criteria analysis will be the indication of the optimal variant in each of the problem areas, i.e. the one that will meet the analyzed criteria to the greatest extent.

STAGE 4 VERIFICATION OF THE INCONSISTENCY COEFFICIENT

After each pair of criteria has been evaluated, the transitivity of the preferences is checked using the inconsistency factor. If its value exceeds 10%, it is necessary to return to the evaluation, as it means that consistency was not followed in the comparative evaluation.

The assessments should be consistent - e.g. if we assess that variant A meets the analyzed criterion more than variant B, and variant B more than variant C, as a consequence, variant A must meet the criterion more than variant C. The inconsistency coefficient informs about a possible inconsistency in expert assessments. Thanks to it, it is possible to return to the grades and correct them so that the value of the inconsistency coefficient does not exceed 10%.

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STAGE 5 CALCULATION OF THE TOTAL GRADES AND SUMMARY OF THE ANALYSIS RESULTS

The last stage of the analysis is the calculation of the sum of scores for individual levels in the hierarchical structure, and then multiplication of the scores obtained in this way from each level of the structure, e.g. evaluation of a given variant x weight of a given criterion.

The result of these calculations is a ranking of variants, created on the basis of the sum of the products of scores from individual levels of the hierarchical structure - the variant with the highest sum is recommended for implementation as the one that best meets the assumed evaluation criteria.

11.5. AREAS UNCLASSIFIED AS AREAS EXPOSED TO THE FLOOD HAZARD

If it is necessary to analyze the effectiveness of actions located outside the area scope of the available hydraulic model, it is expected to assess their impact on reducing the level of flood risk in a simplified manner, so as not to create new sections of hydraulic models. Two ways of assessing such actions should be distinguished.

- "**Quantitative assessment**" - this is the type of assessment for which it is possible to directly transfer the effects of a given action to a hydraulic model. The quantitative assessment is planned to be performed by modifying the hydrological conditions, which constitute the boundary conditions for the target hydraulic model, the area of which will potentially be affected by a specific action.
- "Qualitative assessment" - it is a type of expert assessment, in which it is not possible to define the scope of the impact in a quantitative form and thus transfer the measurable effects to the hydraulic model. The assessment in this case will be performed subjectively by experts within the scope of hydraulic engineering and hydrology.

The following actions are distinguished, for which it will be possible to quantify their impact on AEFH areas not located on the watercourses modeled in review and update of FHM and FRM:

1. changing the management of the catchment area, e.g. through afforestation, micro-retention, delaying runoff from the catchment area, etc.,
2. construction of reservoirs or polders against floods,
3. construction of flood embankments.

The above actions are related to the technical and non-technical possibilities of shaping the retention in the catchment area, which will result in limiting the value of maximum flows, reducing the volume of waves and their duration. The effectiveness of the proposed solutions will be checked first in the hydrological models of the rainfall-runoff type, which link the amount of runoff from the catchment area with the type and type of soil and the form of land use. The results of the hydrological model will be used to create the boundary

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conditions in the modified hydraulic models. As a result of this treatment, it will be possible to directly assess their effectiveness in the context of reducing flood risk in problem areas.

If actions subject to quantitative assessment are identified, the available hydrological models are to be updated, and in their absence, new models will be developed along with the transfer of the value of reduced flows at the point of contact with the available hydraulic model. New hydrological models will be made in accordance with the methodology for the development of review and update of FHM and FRM.

Qualitative assessment will be used when it is not possible to apply quantitative assessment. For the purposes of analyzing the effectiveness of such actions, it is planned to use the available results of the review and update of the preliminary flood risk assessment, flood protection studies, as well as other available analyzes based on hydraulic modeling, the structures of which are not compatible with the currently available models. Using the knowledge of a wide group of experts, an irrational evaluation of the potential impact of a given action on the problem area will be carried out.

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12. PUBLIC PARTICIPATION IN THE DEVELOPMENT OF FLOOD RISK MANAGEMENT PLANS

12.1. INTRODUCTION

Flood risk management plans are a strategic document of the state within the scope of planning and implementation of actions aimed at minimizing flood risk. Proper understanding of the FRMP assumptions, analyzes and conclusions obtained, including the final specific technical and non-technical solutions, is crucial for the process of document processing in the course of consultations and ministerial arrangements. A properly conducted information campaign, along with the process of public consultation, constitute a key element of the process of developing plans. Involving stakeholders in the creation of flood risk management plans will increase the acceptance of the document and the transparency of decisions made in it.

The consultation process of flood risk management plans is governed by the provisions shaping the principles of public participation in environmental decision-making. Therefore, when considering public participation in the context of minimizing flood risk in Poland, the Contractor will be guided by the regulations primarily:

- at European level: Directive 2007/60/EC on the assessment and management of flood risks of 23 October 2007 (Floods Directive), Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for the Community actions within the scope of water policy (Water Framework Directive), Directive on the assessment of the effects of certain plans and programmes on the environment (2001/42/EC), Directive on environmental impact assessment (85/337/EEC), Directive on public access to environmental information (2003/4/EC) and the Aarhus Convention,
- at the national level: the Act of 03 October 2008 on the provision of information about the environment and its protection, public participation in environmental protection and environmental impact assessments (the Official Journal of Laws 2021, item 247, as further amended) and the Act of 20 July 2017 Water Law (the Official Journal of Laws of 2021, item 2233, as further amended).

It should be remembered that the preparation of the aFRMP public consultation process and the accompanying information and promotion actions has taken place in Poland for the second time. This means that there has already been some increase in public awareness of the causes of floods, their effects, methods of prevention, the available flood risk maps and flood risk maps, and as a result of the flood risk management plans themselves. All actions carried out in this area were presented on an ongoing basis on the website powodz.gov.pl, which is still maintained by SWH PW. An important element in the first FRMP consultations and their updating will certainly be the coordination of the consultation

process between the FRMP and the water management plans. Thus, while proceeding to continue these actions, the Contractor will take into account the conclusions formulated in this respect in the draft FRMP to maintain the continuity of the message as possible and raise public awareness of the risk of flooding.

The process of conducting public consultations in Poland concerning aFRMP has been positively assessed by the European Commission. The forms of contact with stakeholders adopted in the previous planning cycle have produced a good effect, and the numbers of interested parties have been impressive. The future planning cycle will include an additional several thousand rivers (aPFRA, review and update of FHM and FRM), so the number of informed stakeholders will certainly increase. In striving to achieve even better results of information and consultation actions, it is also worth using the evaluation of projects implemented in other EU countries and reviewing them in the context of the effectiveness of the public consultation process.

Approach to social consultations of aFRMP in other EU countries

Similarly to Poland, in each of the analyzed documents summarizing the consultation process and social campaigns regarding flood risk management plans, it was emphasized that when choosing a communication method and a method of collecting information, it must be adapted to the studied group. The most frequently chosen form of collecting information in the EU countries was survey.

This form was chosen by, among others Germany. One of the documents describing the research process presents an exemplary questionnaire divided into three parts. The first part was a general metric, the second was a general public questionnaire requiring no specialist knowledge, while the third was a professional questionnaire with more detailed and technical questions. The survey was published on an open website.

Ireland was another country that chose the survey approach. However, people who are directly or to a significant extent involved in the implementation of the Floods Directive in Ireland were invited to complete. The first contact was made by means of a short questionnaire sent by e-mail to obtain information on key issues. The survey contained only three questions - about issues of concern about the DP, the involvement of the administration in the FRMP and the level of compliance of Irish law with EU law. Social media also played an important role.

Also in Italy, questionnaires were prepared under the national project. Here, too, a group of respondents was selected - the selection was made on the basis of living at the floodplain. The survey results were used to conduct a series of meetings with the public.

The United Kingdom presented a slightly different approach to conducting actions within the framework of consultations on anti-flood actions. The country is active in raising public awareness in the context of flood risk by organizing groups of volunteers who provide people at risk with maps and inform about flood threaylevel. A special hotline has also been created for people living in the floodplain.

In Switzerland, on the other hand, it is the communes' responsibility to draw up hazard maps and to inform the public about them. In this case, after the end of the information

campaign, it was found that this was a one-way campaign, and letters informing about protection actions had a very limited effect.

The analyzed documents repeatedly emphasize that the society involved in the process of, for example, surveying, does not necessarily have to live in an area at risk of flooding. An important element of the campaign should also be increasing public awareness of general environmental problems. Best practice is shown to involve the public as widely as possible from the earliest stages of planning. It was emphasized that it is worth informing what form of public participation the stakeholders are dealing with and what role they play in the process of creating plans, and after completing the process, e.g. surveying, provide feedback on the results.

The above-mentioned topic was also raised many times in Brussels. The European Commission has repeatedly emphasized the importance of the mass media, especially the use of the Internet. Online research allows to reach not only various social groups, but also to disseminate information faster and easily catalogue the results. The summary and examples are presented in the document entitled: "Factual summary report on the public consultation for the fitness check of the water framework directive and associated directives and the flood", and the conclusions were presented after public consultation in the part "Have your say". The consultations were conducted as part of the campaign in cooperation with WWF and other NGOs. Almost 400,000 people participated in the study. Respondents representing various social groups.

The issues presented above - the experiences of other EU countries and EC guidelines - will support the planning of the information campaign and will allow for the effective conduct of the aFRMP public consultation process in Poland.

12.2. STRATEGIC AND OPERATIONAL OBJECTIVES OF CONDUCTING AFRMP PUBLIC CONSULTATIONS AND INFORMATION AND PROMOTIONAL ACTIONS

Defining the objectives of the information campaign of the flood risk management plan update project implemented by the Polish Water Holding is one of the key success factors in carrying out information and promotion actions. Setting the directions in the campaign (strategic objectives) and defining the operational objectives of the project measurably influences the organization of actions during the project implementation. It also allows everyone involved in the project to understand the priorities of the campaign, plan actions carefully - create a coherent and agreed schedule and carry out individual tasks in accordance with the campaign idea. The objectives of the campaign will be implemented through specific tasks, and the selection of specific solutions and proposals of the Contractor will clearly emphasize reaching the appropriate target groups with properly prepared information about the project. It should be emphasized that the tasks and actions described by the Ordering Party will interpenetrate and complement each other during the project implementation.

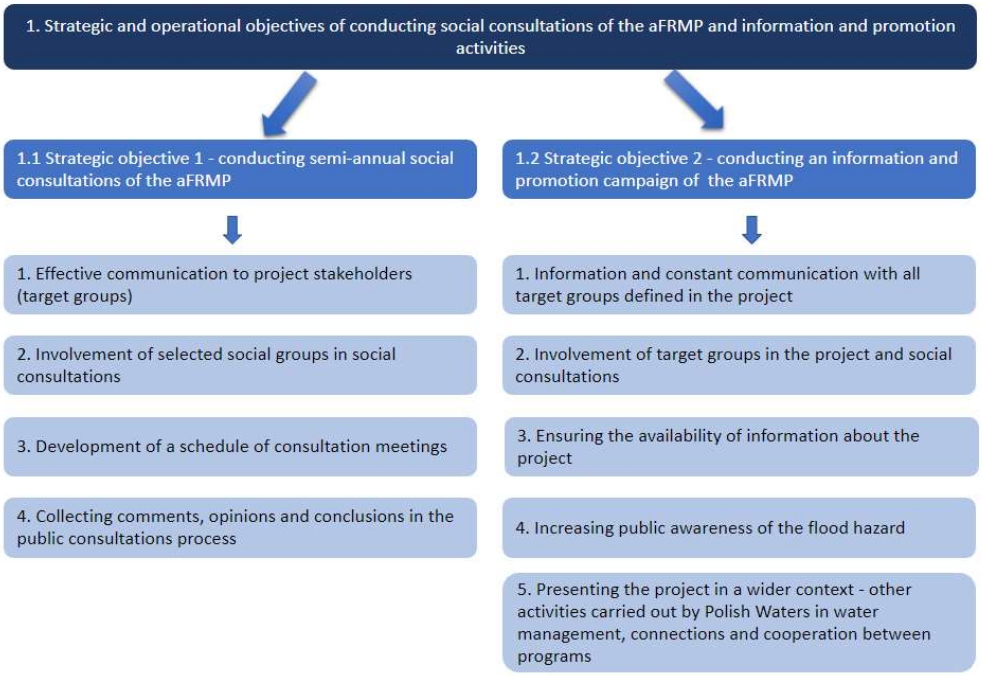

Figure no 10 Strategic and operational objectives of Task 2

12.2.1. Strategic objective 1 - conducting six-monthly public consultations on the project

Conducting public consultations of draft plans and collecting comments, conclusions and opinions is the first strategic objective of the social campaign (information and promotion actions). The consultation process will be planned and consistent with the legal requirements and the scope of the contract. The strategic objective will be implemented through the operational objectives set out below, but will also be supported by the information and promotion campaign of the project. The key operational objective of the project is to collect comments, opinions and conclusions for aFRMP projects (6-month period). The public therefore has a real participation and influence on the document, as it will be involved in the consultation process of the draft plan documents.

12.2.1.1. Effective communication to project stakeholders (target groups)

Effective communication is understood primarily as information that has reached the appropriate social group in a timely manner. Therefore, implementation of the campaign's tasks must be planned in time and in a thoughtful manner - appropriate channels to reach

the appropriate target groups of the project, and the planned actions must be carried out according to the schedule. Doing so will be the key to success.

12.2.1.2. Involvement of selected social groups in social consultations

At the beginning of the project, it should be specified which social groups should be informed about updating the plans (see point 3 of this methodology). The tasks undertaken during the implementation and the materials prepared will be made available in an accessible and legible form to all stakeholders. Due to the variety of tasks in the project, there are many possibilities of information profiling in such a way that, as a result, wide social groups can become familiar with the project. It is possible to create project marketing documents and materials that will be developed for experts, but also for the general public. Such a diversified approach makes it possible to involve many social groups in the campaign and in the consultation process. And the right choice of communication tools guarantees reaching these groups (mailings - invitations to conferences and consultations (updated database), updated website, social media (FB profile), distribution of posters to local government units and others).

12.2.1.3. Developing a schedule of consultation meetings

Planning 30 consultation meetings during the six-month public consultation on draft plans, from 22 December 2020 to 21 June 2021, gives the opportunity to involve a large number of people in the consultation process. Time and locations, i.e. planning meetings at the right time and place, is an important point of an effective campaign and enables the best reaching of defined stakeholders throughout Poland. It is also important to inform the target groups about the planned meetings well in advance. It is also possible to organize consultation meetings online.

12.2.1.4. Preparation of a scenario/meeting plan

Developing a framework scenario for each meeting not only organizes the order of speeches and sets priorities for each of them, but above all reduces the possibility of a crisis situation. Informing the participants about the agenda of the meeting will to some extent avoid difficult situations during the meeting. Additionally, planning time for discussion gives the opportunity to exchange views and comments on the proposed solutions and to start discussions.

12.2.1.5. Collecting comments, opinions and conclusions in the process of public consultations

Realization of all the above operational objectives of conducting the public consultation process will facilitate reaching and collecting comments, opinions and conclusions from project stakeholders. Preparation of consultation meetings in an appropriate manner, but

also the development of draft plan documents (non-specialist versions), instructions on how to comment on plans, and other project marketing materials will affect the number and quality of comments submitted. Various forms of submitting comments and applications to draft plans, i.e. online forms and redirecting to them from various places (project website, Ordering Party's website and MGMiŻŚ website - currently MI), an active PDF form or a word file to be filled in available on the project website and printed forms available at the headquarters of Polish Waters, in MGMiŻŚ (currently MI) and at consultation meetings, will be developed in such a way that everyone interested has the opportunity to comment on the draft plans.

12.2.2. Strategic objective 2 - conducting an information and promotion campaign for the project

The second strategic objective of the project is to successfully conduct an information campaign. Conducting a social campaign should cover the entire duration of the project and achieve the operational objectives set out below. These objectives clearly define the tasks to be performed. The following part explains how the operational objectives can be achieved.

12.2.2.1. Information and constant communication with all target groups defined in the project

Profiling information, developing appropriate marketing materials for target groups specified in the project is an important element of planning actions in the project. In addition, an important aspect in strategic planning is time, i.e. the distribution of actions in such a way that information about the project is available throughout the entire period of its implementation. It is obvious that both of these elements should be included in the schedule of the information campaign. The contractor will prepare information on the scope of the review and update of the aFRMP and on the obtained funding, as well as on the six-month consultation process of aFRMP documents. This information is aimed at disseminating knowledge about the risk of flooding and increasing public awareness of actions for flood protection. In addition, the information campaign is also intended to contribute to rational decision-making in spatial planning.

12.2.2.2. Involvement of target groups in the project and social consultations

This action extends the Operational Objective 12.2.1.2 about the involvement of the public (stakeholders) in the consultation process. In this case, the contractor has a broader vision of communicating the project, the aim of which is to engage the entire society and inform about the implemented project, actions undertaken by Polish Waters (e.g. about hydrotechnical investments), signaling and explaining the concepts of flood hazard or risk. On the occasion of this project, it is possible to implement a social campaign aimed at

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informing the public about the actions taken by the Ordering Party and MGMiŻŚ (currently MI) for flood protection in endangered areas.

12.2.2.3. Ensuring the availability of information about the project

The widespread availability of information about the project will increase public awareness of the aFRMP developed within the project, but also of the risk and risk of flooding. The variety of actions in the project makes it possible to reach very diverse groups with information, e.g. a popular film and its broadcast on TV will ensure a wide reach with the main message of the project, and an expert film to groups directly related to water management.

12.2.2.4. Increasing public awareness of the risk of flooding

Similarly to informing, the aim of increasing awareness will be broken down into specific target groups. As part of this objective, educational actions are planned (both for the youngest and adult stakeholders). It is extremely important to increase people's awareness in the face of implemented and planned actions in order to counteract floods, their positive and sometimes negative consequences, but always aimed at minimizing the risk.

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12.2.2.5. Presenting the project in a broader context - other actions carried out by WMP Waters Polskie in water management, connection and cooperation between programmes

Development of a concept for presenting the project in the context of other tasks and projects carried out by SWH PW and the entire department (water management) together with the Ordering Party may contribute to increasing the rank of the project and presenting it as a project taking into account various actions in water management and promotion of tasks carried out by SWH PW, including planned anti-flood investments, actions related to natural retention or the need to include actions in parallel water management plans (their second update). Such approach will be very important due to the integration and image coherence of projects carried out simultaneously by SWH PW.

12.3. PROJECT TARGET GROUPS

Stakeholders of the entire project, or target groups, are a wide audience, ranging from experts, through administration employees, to children and adolescents. The diversity of this group allows for divisions and systematization of its members into subgroups. The main division can be made according to the level of involvement in the project implementation. Thus, we distinguish two basic target groups: those directly interested in the project and the general public.

12.3.1. The group with a direct interest in the project

These are people related to water management or working in administrative bodies, working in the industry, experts. An exemplary typology of potential stakeholders is as follows:

- **Specialists** - they may include public and private sector organizations, professional non-governmental groups (social, economic and environmental), there will also be business, insurance and academic groups.
- **Authorities** - elected representatives of the departments of government bodies and local authorities related to flood protection and responsible for them, as well as local authorities.
- **Local groups** - unorganized entities operating at the local level, e.g. associations and local councils.
- **Other social groups interested in FRMP** - groups of farmers, developers, inhabitants of flood risk areas, etc.

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The group of people directly interested in the project includes inhabitants of areas at risk of flooding or in the past affected by floods, for whom increasing awareness of the planned planning documents and their real consequences (building prohibitions/restrictions) is extremely important.

The above-mentioned target groups can independently search for information about the project, be interested in issues related to it, broadly understood water management or topics related to the flood or investments. Reaching this group does not seem to be a difficult task, but the substantive materials (information about aFRMP, public consultations, brochures, surveys) and marketing materials must be developed in an appropriate manner, in non-technical language, accessible to the recipient and must be widely available.

12.3.2. The society

Another group is the broadly understood society to which information and promotion actions will be directed. It is a group that should be informed about the project, its objectives and tasks. As already emphasized in the introduction, this is an element on which the European Commission focused a lot of attention after reading the conclusions from the first FRMP in the EU countries. On the other hand, selected tasks from the information and promotion campaign (e.g. educational actions) will be targeted at specific social groups, such as children and adolescents or students.

Figure no 11 Target groups of the information and promotion campaign

In line with the recommendation of the European Commission, in the assessment of the first FRMP, the final version of the aFRMP (i.e. after public consultations) should clearly indicate specific stakeholders and interested parties along with their sectors of action, which were actively involved in the process.

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12.4. A CONCEPT OF RUNNING PUBLIC CONSULTATIONS

On the basis of previously identified strategic objectives, and after determining the target groups - selecting potential stakeholders, six-monthly public consultations on aFRMP projects will begin no later than 22 December 2020. An important role in this process is played by simultaneous information and promotion actions under the project aimed at the general public.

Active and actual involvement of the public in the decision-making process will take place at this stage of the project. Public consultations under the aFRMP will take a very wide form of public debate through, inter alia, organizing consultation meetings, discussions or the possibility of submitting opinions to documents in the broadest possible way.

It should also be remembered that consulting administrative decisions means expressing the openness of the authorities to opinions, proposals or positions of citizens and should not take the form of "negotiation" or public resolution of disputes. The Ordering Party will

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decide on the impact of public consultations on the aFRMP documents on the basis of the project Contractor's analyzes.

Using the guidelines of the European Commission, which were developed almost 15 years ago, when conducting the public consultation process, one should follow a set of minimum standards, the diagram below shows the most important of them.

Figure no 12 Standards of public consultations in accordance with the EC

In Poland, work has also been undertaken to adopt general standards defining the principles of public consultations. Many government documents have been prepared on this matter, such as the "Better Regulation 2015" programmeme adopted by the resolution of the Council of Ministers on 22 January 2013. Some solutions are enshrined in various legal acts, others are codified in the form of good practices or recommendations[41].

It is clear that both techniques and processes used in public consultation will differ and the language used is a key aspect. Some of the parties will need clear and simple messages, while others will want to engage in substantive discussion and require specialized language (non-specialized versions of aFRMP).

41 Social consultations as a tool of public participation, BADiK, Senate Chancellery, 2019.

It is worth emphasizing that the materials created for the needs of public consultations based on the experience of the FRMP project should highlight the issues that arouse the greatest interest among consultants - such as: flood hazard maps and flood risk maps, changes in spatial development and planned flood protection investments. These three elements (the first of which is a product of the currently ongoing project) are still of interest to many residents, users or local governments, and most of them are not yet able to distinguish between the stages of implementation and updating of plans prepared on the basis of the provisions of the Floods Directive. The above is also evidenced by the fact that during the FRMP consultations, comments were made: "... difficulties in understanding some of the information contained in the FRMP, especially those formulated in a specialized language, by persons not related to water management"[42]. Therefore, an important role will also be played by presenting the content of aFRMP in a way that is understandable to the general public, which is to be used, inter alia, by non-specialized versions of documents. It should be taken into account that FHM and FRM were many times an element or the basis for the comments submitted to the first FRMP. Also in this planning cycle, this problem will certainly occur, because the publication of the updated FHM and FRM is scheduled for September 2020, therefore, about 3 months before the start of public consultations of aFRMP, which will open up opportunities for stakeholders to express their dissatisfaction with the risk areas. That is why it will be so important to include key stakeholders in the course of the meetings and the process of informing the methodological assumptions of FHM and FRM and the results obtained.

12.4.1. Developing an action schedule of public consultations

In accordance with the requirements of the contract, the schedule of actions for conducting public consultations of aFRMP will be combined with a parallel information and promotion campaign for the project, as well as public consultations of the second update of water management plans in the river basin areas. Three months before the start of the 6-month consultations, an appropriate schedule (dates, meeting places) will be developed, taking into account the locations where the RWMB headquarters are located and the catchment management boards (for locations with a high level of flood risk).

12.4.1.1. Preparation of non-specialized versions of aFRMP projects for river basin areas

The preparation of non-specialized aFRMP projects will be an action supporting the proper transmission of the consulted documents. These documents will be prepared for each of the river basin areas and written in simple, non-technical language (planned circulation - 1000) for distribution, among others, during consultation meetings.

In order to strengthen the message - to make the target groups interested in the consulted documents, dedicated infographics will be developed for non-specialized versions of aFRMP

42 Report on public consultations on draft Flood Risk Management Plans, SWMB, 2015.

projects, an appropriate graphic design consistent with the project identification, which will immediately make the recipient aware that he is dealing with actions carried out within the same project. Such an effect is undoubtedly difficult to achieve due to the multitude of information actions related to water management, conducted by SWH PW or MGMiŻŚ (currently MI).

All documents will be posted on the project website (www.stoppowodzi.pl) or made available for other parties (SWH PW home page, RWMB websites) for download in pdf versions.

12.4.2. Development and broadcasting of an information film on the public consultation process of the aFRMP project

In accordance with OPZ, a short film will be prepared to encourage participation in public consultations of aFRMP, which can be played during consultation meetings during the conference and available on the project website (including websites indicated by SWH PW). The film will be educational in nature, therefore it will require an appropriate scenario tailored to the identified function. The film will be made in an animated form - no longer than 3 minutes. The animated film will also contain a fragment illustrating the method and forms of conducting public consultations of aFRMP in a transparent, attractive and understandable form.

When developing the script and making the film, one should strive to obtain a positive impression from a wide audience, which, when combined with a specific sender of this message - SWH PW - will allow for the appropriate shaping of the image expected by the Ordering Party and the reception of the document itself.

12.4.3. Development of instructions for submitting comments to the aFRMP draft during public consultations

The effectiveness of the public consultation process can also be increased by proper and clear preparation of instructions for submitting comments to the draft aFRMP documents during the six-month public consultation. The manual should contain at least the following elements:

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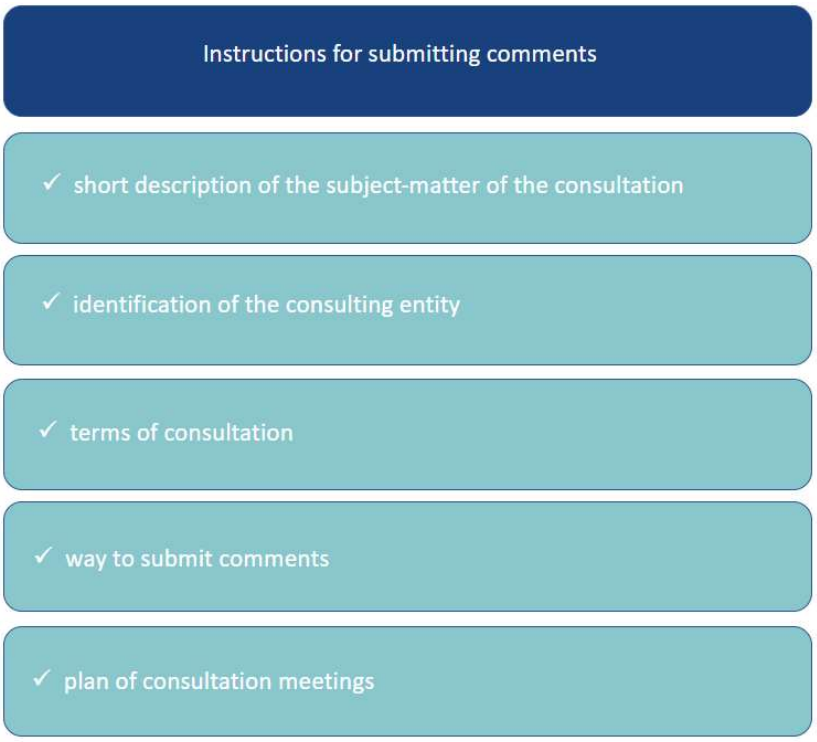

Figure no 13 Sample instruction

Due to the specific nature of the consulted documents and due to the fact that the manual will be developed only in digital form, "interchangeability" of elements relating to a given region will be used - placing a map of the entire country (place of consultation meetings) will be appropriate for SWH PW, however, in water regions highlighting actions within the region seems a more appropriate option.

For the purposes of public consultations (submitting comments by stakeholders), an appropriate e-mail address will be created, for example: aFRMP@konsultacjepowodz.pl, Konsultacje@stoppowodzi.pl.

INSTRUCTION FOR SUBMISSION OF COMMENTS AND APPLICATIONS
TO THE DROUGHT EFFECTS COUNTERACTING PLANS (DECP)

Figure no 14 Sample instruction "How to submit comments to the draft plan"

12.4.4. Preparation and conducting of a survey as part of public consultations

A survey as a method of research consisting in filling in a previously prepared questionnaire by the respondent is the most frequently chosen form of collecting feedback during consultations of flood risk management plans in EU countries.

Two methods of collecting information through a survey will be developed:

- the traditional (paper) questionnaire, which will be provided to participants of consultation meetings, will also be permanently available at the premises of SWH PW (SWMB, RWMB) and MGMiŻŚ (currently MI),
- on-line questionnaire widely available on the dedicated website www.stoppowodzi.pl and via the redirecting link from the project website (the questionnaire will also be available for download in the word version on the project website).

An on-line survey (which will also be prompted by a paper survey) will allow, among others for spatial marking of actions planned in the commune and identification of problem areas. Thanks to both, the answers will be exported to the database and provided to the Ordering Party.

It should be borne in mind that some of the information, which may not be justified in the consultations with aFRMP, may be a valuable source of information in the next planning cycle (e.g. information on flooding on watercourses not covered by aPFRA, which will be analyzed in the next cycle). Therefore, the database will contain a set of collected information, which will finally be sent to the Ordering Party not only in the traditional version (document), but also in the form of a database.

During the first consultations of the FRMP, the on-line form turned out to be the most popular method of submitting comments on documents, therefore its form should be clear and intuitive.

The contracting authority will have access to the database of survey results with a weekly refresh, which will allow for up-to-date monitoring of the comments submitted as part of the consultation and ongoing decision-making regarding their inclusion in the content of aFRMP. Such proceedings will also have a positive impact on the actions carried out under Task 1. However, it should be borne in mind that the comments submitted may be divergent/contradictory (e.g. comments of hydrotechnicians with comments from environmental NGOs), they may be submitted at different times, therefore necessary together with the Ordering Party and MGMiŻŚ (currently MI) (which is the final instance in the way of considering comments), the procedure to be followed in various cases, e.g. technical comments, important comments, etc.

By combining both elements, i.e. the instruction for submitting comments and the survey, a short animation will be made - an instructional video explaining both actions, and thus encouraging active participation in the process.

12.4.5. Organization and carrying out of consultation meetings in individual water regions

As mentioned in the introduction, the measure of the quality of public consultations will be both the scale of stakeholder participation and the opinions expressed. One of the most effective tools to ensure public participation in the entire process is the organization of consultation meetings in specific locations relevant to the project. 30 consultation meetings will be held for a group of up to 100 participants during the six-month social consultations of aFRMP in terms and forms agreed and approved by the Ordering Party.

In order to plan and implement this objective smoothly, the Contractor will prepare a plan of consultation meetings for approval by the Ordering Party. This plan will then be communicated to stakeholders, including through the project website as well as media and other marketing tools (e.g. poster, leaflet).

Based on the experience of the FRMP project, an important factor will be the proper selection of the place and dates of consultation meetings and a high level of substantive preparation of the speakers, as well as allowing adequate time for discussion, which is crucial for the satisfaction of meeting participants, but also for a better understanding of the problems presented. Elements of the consultation plan will therefore include suggestions for specific consultation locations. Also, as part of the schedule of consultation

meetings, a list of stakeholders to whom invitations to participate in consultations will be sent will be prepared. In addition, an application form for potential consultation participants will be available on the website. Subsequently, applications will be collected and the final list of participants in the consultation meeting will be established. The consultation plan will also include a proposed detailed scope of meetings.

The meetings will take into account the possibility for the stakeholders to express themselves freely. During the consultations, recording of the consultation meetings will be ensured by means of two independent recording devices. Meetings will be conducted by a moderator.

In order to efficiently conduct consultations, a consultant will be appointed by the Contractor, who will be responsible, inter alia, during the six-month consultations. for contacting the Ordering Party in all matters related to the consultation process.

As part of the meetings, participants will receive promotional materials containing at least:

- a non-specialized version of aFRMP projects,
- instructions on how to submit comments to aFRMP projects,
- a paper questionnaire,
- plan of consultation meetings,
- notebook with a pen,
- folder for meeting materials.
- All of the above materials will be marked in accordance with the requirements of OPZ.

During the semi-annual public consultations, the Contractor shall submit to the Ordering Party a summary of the course of the meeting within 3 business days following the date of the consultation meeting, including:

- attendance list (number of participants),
- the number of information materials distributed,
- the number of completed questionnaires,
- a list of submitted comments along with their authors,
- photographic documentation.

As press conferences/briefings are to accompany the consultation meetings, they will be organized on the day of the consultation meeting before its commencement. However, it is proposed that press briefings should start at least 1.5 hours. Before the consultation opens, e.g. a briefing at 9:00 a.m., and a consultation meeting between 10: 30-15: 00 or after - at 4:00 p.m. This will allow the Contractor to conduct a meeting with journalists in an efficient and calm manner and gives time to record the so-called Hundred. Additionally, with this approach, representatives of the Ordering Party and MGMiŻŚ (currently MI) will

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be able to participate in both events, and the participants of the consultation meeting will not interfere with the course of the press conference.

12.5. PLANNING AND CONDUCTING INFORMATION AND PROMOTION ACTIONS

Carrying out the information and promotion actions of the aFRMP project, also known as the social campaign, is a task that should be carried out in accordance with the detailed schedule planned at the beginning of the project implementation. In order for the social campaign along with information about the project to reach a wide audience, an appropriate message should be prepared. The adoption of a new communication name for the project Stop the flood (spelling to be agreed), understandable for all social groups, easily remembered and associated directly with the project will significantly affect the reception of the project and reaching a wide audience. This name will be communicated in parallel with the aFRMP name so that it is only associated with these actions. It is a short and legible term, clear in the message - the objective is to stop a flood, prevent it from occurring in a place where we do not want it to occur, and inform the public about the threat and risk of flooding. Communication of the project will be conducted in a way that focuses the essence of the programme (flood risk minimization, in line with the Flood Directive objective), but the short name Stop the Flood will greatly facilitate reaching people who have not yet encountered the project (aFRMP). In addition to the name of the programme, one should also focus on building communication in a clear and transparent manner, so that not only the group of experts, but the general public, understand the actions undertaken by state bodies for the benefit of the community. Separating communication to experts with communication directed to the general public may affect the wider reach and understanding of the project by people not previously related to water management. Additional support will be conducting educational actions aimed at children, youth and students.

Creating a visual identity of the project, including a new logotype, is, apart from the name, a very important communication element that affects the main message and reaching target groups. The most important value of coherent visual communication is that all communication materials (marketing and PR) will have a uniform design and will be associated with the project and actions. Consistency at the stage of project implementation in this regard will affect the association of the information provided with Stop the Flood, and will affect the consistency of the message. When developing a creative concept, it is necessary to develop a basic color palette and select fonts. In addition, the existing projects implemented by the Ordering Party should be taken into account so that the Stop the Flood proposal is consistent with the image of the State Water Holding Polish Waters.

The visual identification developed for the project should apply not only to the graphic team preparing graphic designs, but also to all persons involved in the project. All tasks performed under the project should also apply:

- Word documents, PowerPoint presentations,
- marking of supporting materials,

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- educational materials,
- marking of conferences and consultation meetings,
- designing and implementing a website.

Project website

The new website for the aFRMP project is a very important communication tool. It is directed to all target groups, therefore creating a clear structure is a must. The division of content, as flat a structure as possible and the ease of finding the information one is looking for are key elements that should be taken into account when designing a website. The website should contain at least: information about the project, milestones in the project (presented, for example, in a graphic form on the slider on the home page), information and dates of public consultations and consultation meetings themselves, as well as nationwide conferences, registration for these events, tab "Education" and downloadable documents, news and contact.

As previously mentioned, the graphic design should be developed in accordance with the selected creatine line and the project website should be launched in the domain www.stoppowodzi.pl. All graphic elements published on the website should be consistent with the identification, the content prepared for its needs should be profiled according to the target group.

The website will also contain all information related to the organization of consultation meetings, starting from the schedule (date and place), through the meeting plan and the registration process. The banner should be highlighted (planned in a visible place) and directed directly to the questionnaire collecting comments and proposals for draft flood risk management plans. Involving the largest possible group of stakeholders is a key objective of public consultations.

One, consistent website, and not running two websites simultaneously (FRMP and aFRMP), is also important in conducting consistent communication. Therefore, the fastest possible transfer of content to one should be as soon as possible.

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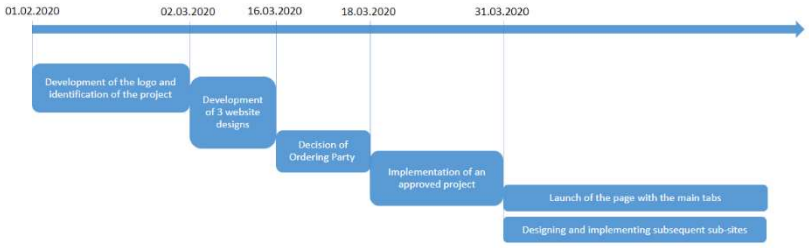

Figure no 15 Preliminary work schedule on the stoppowodzi.pl website

Graphic project

Stop the Flood identification means consistent graphic designs at every stage of work. Developing clear, modern and legible works is important for receiving and reaching. You should not limit oneself to the points listed by the Ordering Party in OPZ, but look at the project as a whole and work on all elements of communication (e.g. invitations to public consultations and to national conferences and conferences or press briefings, graphics and infographics on Facebook and Instagram profiles and others. , e.g. press announcements and banners for websites).

Interesting, creative ideas prepared for the project are another element of communication that should be paid attention to. Presenting properly prepared content in a non-standard form is important, affects the reception and may or may not interest the recipient. Therefore, the right form seems to be important.

Campaign with the project ambassador

We can call the function of the Ambassador of the Stop the flood project the most representative element of the project's communication. Therefore, the choice of the person who will work with Stop the flood is very important in terms of the image of the entire project. The ambassador should represent values in line with the values of the public institution, which is SWH PW. The extent of the ambassador's involvement will depend on his profile. The ambassador must arouse positive emotions and not cause controversy. An additional advantage will be the ambassador's involvement in environmental or social matters.

Apart from the above-mentioned aspects, the ambassador's recognition is also important from the point of view of project communication and project image. The person who represents the project should be known and positively associated. It is not possible to propose a person known to everyone (the whole society), but it is worth considering candidates who are more recognizable and have experience in working with the media. With this approach, there is a greater chance of involving a person more widely in the project and thus gives more opportunities to communicate the project. Therefore, when

considering the proposals, the Contractor took the above-mentioned aspects to consider. With this approach, it is possible to offer the Ordering Party to prepare interesting video content with the participation of the ambassador during the project. The topics discussed by the ambassador include informing about the flood phenomenon and its consequences, developing flood hazard maps and flood risk maps and their availability - informing the public where these maps are available and what to check on them, providing information on public consultations aFRMP, informing about the proposed types of non-technical and technical, including retention promotion actions. **To implement this idea, the Contractor envisages the involvement of not only the project ambassador, but also substantive experts and representatives of the Ordering Party.**

The ambassador's participation in national conferences and the accompanying press conferences is considered each time.

The organization of four nationwide substantive conferences (on the FRMP methodology, aFRMP objectives and actions, a summary of aFRMP actions before the commencement of public consultations and a summary **of the consultation process) is an opportunity to discuss project issues among experts. Additional communication actions, which will strengthen the message and arouse the interest of event participants, and will be the setting for each meeting, are other actions influencing the positive reception and range of the campaign.** Concrete ideas and proposals should be agreed with the Ordering Party prior to the organization of the meetings, so as to fit the message as much as possible. Each nationwide conference will be accompanied by a press conference, which should be prepared by the Contractor. Inviting journalists and follow up, preparing a press release and being available for journalists' questions is important for the project. Through positive contact with the media, we positively create (not invent) and provide information about the course of the project. Such contact also means preventing the emergence of crisis situations. It should be mentioned here that the cooperation of the department implementing information and promotion actions with experts on the side of the Contractor, but also on the side of the Ordering Party and MGMiŻŚ (currently MI) is very important. Feeding with specific content, cooperation in choosing topics for communication and agreeing on how we communicate seem to be crucial.

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PR actions

The organization of press conferences is part of the "Conducting PR actions" task, which is provided for in the project. The scope of these actions is described in detail in the OPZ, they cover all the necessary actions that should be taken on such a large project.

Figure no 16 Sample photo from the press conference accompanying the nationwide conference of the project

Ideas for additional actions, which are required by the provisions of the OPZ, were proposed by the Contractor at the stage of the offer, but may be changed depending on the circumstances. Therefore, a flexible approach on the part of the Contractor and the Ordering Party seems to be the best solution. This allows to adjust the solution to the current situation. At the time of preparing the offer, the contractor may present very general ideas that can be refined or even changed at the stage of project implementation.

Proposals of non-standard PR actions proposed by the Contractor:

1. Representatives of various social groups support the project's information and promotion actions, video content development or participation in selected consultation meetings, moreover, the materials will be posted on the social media of these people, on the project profiles and on the website.

   Examples of people to choose from:

   a. a family who survived the flood and moved to a new place (resettlement) - talks about the new infrastructure, about a different quality of life (based on the procedure carried out during the Construction sites of the Racibórz reservoir),

b. an ecologist blogger who, from the environmental point of view, will be able to defend the ideas, needs or planned actions included in the project,
c. expert or eco organization - discussing more complicated aspects of the project in a simple and understandable way..

Involvement of the "mini ambassadors" additionally strengthens and credible the message of the campaign.

2. Questions to the expert: - the project expert answers the questions on FB (the answers are also posted on the project website) or presents short curiosities (texts, graphics, videos). Creating video content by the Contractor or short texts, e.g. question - answer.

For points 1 and 2, the Contractor provides for permanent cooperation during the project implementation, intensification of actions in the periods specified together with the Ordering Party, e.g. public consultations.

1. Radio broadcast with experts on floods in the context of climate change (flood / drought).
2. Preschoolers about floods - short statements of children about what a flood is and how to protect against it. We check the knowledge of the youngest. The contractor assembles the statements and publishes them on FB and on the project website.
3. Publication of an advertorial in the women's press, eg "Woman and Life" (the most-bought women's magazine) - advice on the flood (eg where not to buy a plot or a house) or a report (new life after a flood).

Publication of sponsored articles about the project in the media should be carried out regularly throughout the duration of the project. Of course, the moment when the number of publications can be increased is the time just before the start of public consultations of aFRMP and during their duration. Certainly, it is also worth considering a few publications at the end of the project - materials summarizing the work on the plan, conclusions from consultations or the most important changes that the plans will bring. The content of articles should be profiled according to the target groups of the journals and planned. The contractor should prepare a publication schedule for the Ordering Party, containing trade magazines dealing with environmental issues, investments and general information reaching a wider audience. Media planning should be carried out in cooperation with the Ordering Party (as in the case of the content of the articles) in order to find optimal solutions.

Popular film (including its shortened version) and expert film

Preparing a film about the project that will be interesting, surprising, short and meaningful in its message is another communication task, important from the point of view of the message. In order for the message of the film to be effective, it should not be too long. Therefore, it is proposed that the length of this video should not exceed 3 minutes. This is the time to keep the viewer. The longer version is risky to keep the audience's attention. Interesting creation - the idea for the script of the film and its realization are the basis of its success. Therefore, focusing on finding an interesting idea for a message is the most important task. The choice of media will only be a consequence of the decision. At the offer stage, it was very difficult to present a specific idea, because the preparation of a solution

for this task requires consultation with the Ordering Party. The objective that should be set before starting the work on the idea and the script is to agree on what film should have the message, what should be the most effective and to whom it should be directed (target groups). Only after these arrangements are made, the Contractor's team can start working on the concept.

The expert film, in turn, should aim at presenting selected aspects of the project to professionals related to water management, as opposed to the "popular" film, it is to be a short description of the "Review and update of flood risk management plans". An expert film, apart from the experts' statements, could contain infographics or mini-names illustrating the issues discussed. Adding other elements to the interviews will make the message more attractive and contribute to its understanding.

However, a short advertising film (sub-task 2.1.13) should be a shortened version of the "popular" film. This will allow to achieve consistency in the project, strengthen the message by increasing the number of broadcasts of the film in the media. The contractor proposes to broadcast the movie / spot in accordance with the media plan proposed in sub-task 2.1.15.

Campaign in the media

The contractor will develop a media plan for the entire Stop the Flood campaign. Its aim will be to reach stakeholders (target groups) as broadly as possible with the key message related to informing about works on flood risk management plans, basic definitions of FRMP and methods of reducing this risk through many tools implemented at the national and local level. In addition, the Contractor will also inform about the six-month social consultations of aFRMP. The planned campaign will be carried out in national and regional media to ensure the best possible reach to target groups. Promotional actions will include announcements and articles in the national and regional press. The media plan will include the publication of sponsored articles, broadcasting the spot on TV and the Internet. The contractor offers 20 broadcasts of spots on TVP in blocks related to nature (Sunday morning) or, for example, programmes for farmers, but also the broadcast of 3-5 spots in front of Panorama, Teleexpress or News. The combination of these two points - planning of advertorials, television, Internet and radio is, according to the Contractor, important for the holistic view of the Stop the Flood campaign.

Educational campaign

The educational campaign will accompany the information and promotion actions.

In principle, it will be developed at two educational levels:

- basic (scenario of a 45-minute lesson for primary school students),
- secondary and tertiary (lecture scenario for pupils and students studying to be specialists within the scope of water management).

Both packages will be prepared by the Contractor, taking into account the actions already carried out in this area within the FRMP, in order to exclude the repeatability of elements. An interesting solution for primary schools may be "building" river valleys by students from cardboard templates previously developed by the Contractor.

In addition, as part of this task, an on-line game will be developed, which will cover issues related to flood safety, responding to threats, evacuation plan, the possibility of verifying the actions taken by the platform users and their effects (e.g. it will enable the development of a river valley, simulating flood wave and reaction to the infrastructure created by the user with indication of appropriate and inappropriate solutions).

Ambient campaign

The Contractor's first proposal is to create a mural along with a mini-competition for the project. The place for the mural would be selected together with the Ordering Party. This could be the place with the greatest flood risk or the most controversial investment. The contractor would prepare a mini-competition for design and implementation (all in one), organize a painting and a video to be posted on social media and on the project website. The mural would be completed before the public consultation on the project begins and it would exist until the end of its duration.

Another idea are inflatables - larger advertising displays, made to order according to the identification - it can be an inflatable screen or a balloon with a printout, set up e.g. in the five most important cities from the point of view of the project + a person distributing leaflets on consultations and/or educational actions of the project.

Figure no 17 Sample photo of a mural and an inflatable rocket

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12.6. SUMMARY

Communication of the aFRMP project will be diverse and multi-threaded. This is due to the complexity of the project itself, the large number of topics to communicate and the broad and diverse target group. Therefore, when constructing, for example, media plans, particular attention should be paid to the selection of the most appropriate channels of reaching (titles, place and time). And so, the selection of appropriate times of broadcasting a TV spot will depend on the target groups to which the information should reach, this should be agreed in detail with the Ordering Party during the project implementation, the titles of magazines and the publication time of the avertoriali as well. It should also be noted that proper preparation, so that it meets the expectations of the Ordering Party and meets the requirements of the title, is a point that cannot be omitted in communication. These are just examples of the proposed solutions. All the proposals presented to the Ordering Party should have their justification and should be presented in advance, so that the Ordering Party has time to analyze ideas and solutions.

The implementation of some tasks should also start much earlier than proposed in OPZ. This applies to deadline for the proposal to present film scripts. The film-making process is longer, and more time is required to prepare the production. It certainly depends directly on the scenario, but a longer period of preparation will allow both parties to work out the best possible solutions. This approach should also apply to other tasks, all proposals for changing the dates should be included in the proposed schedule.

In order to achieve the objectives of the campaign, the Ordering Party should be offered modern solutions that are currently used in communication campaigns. Extensive experience in the communication actions of the entity carrying out the task may significantly affect the quality of the proposed proposals.

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13. COORDINATION OF FLOOD RISK MANAGEMENT PLANS

13.1. COORDINATION OF FLOOD RISK MANAGEMENT PLANS IN INTERNATIONAL ADVANCED AREAS

The exchange of information and cooperation with the neighboring countries within the scope of water management on border waters are regulated by bilateral or tripartite (Oder) international agreements.

The Oder river basin area

The exchange of information for the Oder river basin takes place within the framework of the International Commission for the Protection of the Oder River against Pollution, the Polish-German Commission for Border Waters, the Polish-Czech Commission for Border Waters ,and the Polish-Czech Intergovernmental Commission for Cross-Border Cooperation in Border Waters.

The Vistula river basin area

The information exchange with Slovakia takes place within the framework of the Polish-Slovak Commission for Border Waters under the international agreement on water management in border waters.

Cooperation with Ukraine on the borderland Bug within the scope of flood protection, regulation and drainage takes place within the framework of the Polish-Ukrainian Commission for Border Waters.

Cooperation between Poland and Belarus on the Bug is regulated by the agreement between the Government of the Republic of Belarus and the Government of the Republic of Poland on cooperation within the scope of preventing catastrophes, natural disasters, other serious accidents and removing their consequences, which entered into force on 27 January 2017. Moreover, on 07 February 2020 in Białowieża, the Polish-Belarusian Agreement on cooperation within the scope of protection and rational use of transboundary waters was signed. The agreement aims to protect and rationally use transboundary waters, improve their quality, preserve and, if necessary, restore ecosystems. The government of Poland and Belarus, in accordance with the terms of the agreement, undertook to strive, improve and maintain the quality of transboundary waters at a high level. States will also collaborate in the development of transboundary water management plans, including international river basin management plans, flood risk management plans and drought-counteraction plans, and other plans. In order to implement the provisions of the agreement, the Polish-Belarusian Commission for Cooperation in Transborder Waters was established.

The Danube river basin rea (the Black Orava water region)

The International Commission for the Protection of the Danube River, established on the basis of the Danube Protection Convention of 29 June 1994, operates in the Danube basin.

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Information exchange with Slovakia takes place within the framework of the Polish-Slovak Commission on Border Waters and the Polish-Czech Commission on Border Waters under international agreements on water management in border waters.

The Pregolya river basin area

Formally, cooperation with the Russian Federation within the scope of water management is based on the Agreement between the Government of the Polish People's Republic and the Government of the Union of Soviet Socialist Republics on water management in frontier waters, drawn up in Warsaw on 17 July 1964. This agreement is valid on the basis of succession and is subject to automatic extension by another five-year periods, while the Russian side shows no practical interest in its implementation.

The Elbe river basin area

Information exchange for the Elbe river basin takes place within the framework of the International Commission for the Protection of the Elbe River, the Polish-Czech Commission for Border Waters and the Polish-Czech Intergovernmental Commission for Cross-Border Cooperation in Border Waters.

The Nemunas river basin area

In 2011, meetings of the Polish-Lithuanian working group for cooperation in border waters began. Information was exchanged on identified historical and probable flood areas and flood hazard areas in the Nemunas basin. Information exchange with Lithuania also takes place within the framework of the Polish-Lithuanian Commission for Border Waters under an international agreement on cooperation within the scope of use and protection of border waters.

The Dniester river basin area

In the Dniester river basin, information is exchanged within the Polish-Ukrainian Commission for Cooperation in Border Waters.

Pursuant to the Water Law in force, the minister responsible for water management is responsible for international cooperation in border waters. This cooperation is carried out together with SWH PW, who delegate representatives of SWMB or RWMB to the work of working groups and committees. Participants of the meetings on the Polish side should bring to the deliberations of all bilateral committees and the International Commission for the Protection of the Oder River against Pollution, the issue of developing and agreeing flood risk management plans in international river basin areas. Introducing this subject to the discussion should take place during the annual negotiations of these committees.

In addition, it should be emphasized that it is Polish Waters that prepare the following coordinated in the area of cross-border river basins: preliminary flood risk assessment (PFRA), flood risk maps, flood risk maps and flood risk management plans for river basin areas, as well as periodic reviews and updates of the above-mentioned documents.

13.2. COORDINATION WITH THE FRAMEWORK WATER DIRECTIVE

13.2.1. Introduction

In accordance with Art. 326(4) of the Water Law, development of flood risk management plans and the drought prevention plan and reviews thereof are carried out in a manner coordinated with reviews of the water management plans in the river basin area. Coordination of FRMP with WMP also results from the provisions of both directives (the Flood Directive and the WFD), therefore, it is an important element assessed by the European Commission in the case of both documents.

The basic document regulating water management at the EU level is the Water Framework Directive, which establishes a framework for Community action within the scope of water policy. This directive obliges the Member States to develop WMP in the river basin areas and to create an action programmeme, the role of which is to ensure achievement or maintenance of good status of surface and groundwater bodies.

In accordance with Art. 315 of the Water Law, river basin management plans are one of the planning documents in water management. These documents constitute the basis for making decisions shaping the condition of water resources and principles of their future management. Currently, in force are the WMP updates for river basins adopted in the form of ordinances of the Council of Ministers of 18 November 2016. At the moment, the SWH PW is simultaneously working on documents on the development of the 2nd update of water management plans.

Other planning documents in water management include flood risk management plans, drought counteracting plans, water maintenance plans, as well as documents related to the protection of marine waters (preliminary assessment of the state of the marine environment, environmental objectives, monitoring programmeme, and sea water protection programmeme).

Pursuant to the Water Law, protection against floods is carried out in a manner ensuring coordination with actions aimed at achieving environmental objectives and water protection, therefore, for the purposes of FRMP, there is carried out an environmental analysis of projects and variants of actions which has a direct impact on the process of planning and coordinating the development of updates water management plans.

As part of the 2nd update of the water management plans, the following planning tasks have been planned to be performed as a contribution to aWMP:

- characteristics of water bodies (HWB) - completed,
- identification of significant anthropogenic impacts and assessment of their impact on the condition of surface water and groundwater – completed, awaiting approval of the competent ministry,
- establishing environmental objectives for the units and conservation sites - completed,

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- developing a register of lists of conservation sites - completed,
- developing a list of HWB, indicating heavily changed and artificial water bodies and homogenous water bodies at risk of failing to achieve environmental objectives - completed,
- economic analyzes related to water use - completed.

The water management plan contains arrangements for planning units (water bodies), however, as part of the work of the aFRMP in terms of ensuring coordination and coherence, the main focus will fall on aspects related to:

- achievement of environmental objectives,
- indication of departures from the achievement of environmental objectives,
- indication of selected planning units making up the list of conservation sites, including the list of: areas intended for the protection of habitats or species referred to in the provisions of the Act of 16 April 2004 on nature protection, for which the maintenance or improvement of water status is an important factor in protection thereof, homogenous water bodies intended for abstraction of water for the purpose of supplying the population with water intended for human consumption, homogenous water bodies intended for leisure purposes, including bathing,
- a set of actions, taking into account the methods of achieving the established environmental objectives.

As part of ensuring coordination and coherence between development of the review and the first update of the flood risk management plans and the second update of water management plans, it is proposed to coordinate actions at different levels and of different nature envisaged in both projects. Those are:

- organizational and management actions,
- information and promotion actions,
- actions in relation to the substantive content of project products.

13.2.2. Organization and management actions

The key to good cooperation and discussion at the stage of agreeing the content of plans and joint public consultations is to define a team of people responsible for coordinating both projects on the part of the contractors and the Ordering Party, who through cooperation will achieve consistency of documents and meet possibilities/expectations of both parties.

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In terms of organizational and management actions, the Contractor of the aFRMP proposes:

- appointing a person responsible for coordination of cooperation on the part of the Contractor of aFRMP and the Contractor of 2nd aWMP. In the organizational structure of the project, the Contractor of the aFRMP provides for the position of the Plenipotentiary for the coordination of aFRMP with other projects, whose main task will be to coordinate the work with the 2nd aFRMP. On the side of the aFRMP Contractor, the person responsible for coordinating cooperation with the aWMP will report directly to the Project Manager and indirectly to managers of individual regions, which guarantees a quick exchange of information on the arrangements made in the Contractor's team,
- obtaining information about the persons responsible for coordination of the studies related to the 2nd update of water management plans on the part of the Ordering Party (a contact list for the implementation of individual projects),
- obtaining a detailed schedule for implementation of the 2nd aWMP and planning on its basis a detailed schedule of joint actions,
- building a model of the aFRMP/aWMP information exchange in agreement with the 2nd aWMP Contractor (e.g. access to the project's SharePoint platform, regular meetings, exchange of information and methodologies within the scope of environmental assessment of planned variants),
- coordination of the bodies responsible for the implementation of the WFD and DP (SWH PW and MGMiŻŚ - currently MI) - it is important that the works are carried out and coordinated by the same institution (SWH PW), with the participation of stakeholders who often participate in the work of working groups both for plans flood risk management and water management plans,
- optional participation in the works of the aFRMP working group of experts dealing with other strategic documents (e.g. DECP, Water Shortage Programme, National Surface Water Restoration Programme), in order to exchange experiences and expert support due to other objectives and project priorities.

13.2.3. Information and promotion actions

Joint implementation of both projects will include six-monthly public consultations of draft plans (aFRMP, 2nd aWMP), as well as simultaneous information and promotion campaigns for both projects.

In terms of information and promotion actions, the Contractor of aFRMP proposes:

- a coherent schedule of public consultations - the added value of coordination of the aFRMP and 2nd aWMP documents could be a coherent schedule of public consultations; during drawing up the schedule of public consultations for aFRMP, contact with the

contractor of public consultations 2nd aWMP is envisaged in order to find possible common elements (e.g. selected consultation meetings),

- promoting organized promotional and consultation actions on the websites dedicated to the 2nd aWMP and aFRMP,
- agreeing on common elements of the survey for both projects,
- inclusion in educational actions within the framework of aFRMP of issues within the scope of broadly understood water management, including water protection and its retention, and not focusing exclusively on flood issues,
- possibility of organizing a two-day conference (National Water Forum) on aFRMP and 2nd aWMP during the six-month public consultation period.

13.2.4. Actions in relation to the substantive content of project products

A key element in the coordination of the implementation of both directives is to maintain methodological and substantive consistency in the development of environmental analyzes of aFRMP, and the approach adopted in the 2nd aWMP. In the first planning cycle, the results of the analyzes, including the grounds for derogation, were transferred from the FRMP directly to the findings of the aWMP. On the other hand, in 2nd aWMP, it was assumed that the investments planned for implementation under the aFRMP, for which no decision on environmental conditions / water law assessments had yet been issued, will be included in the 2nd aWMP in the so-called a list of directional investments. With regard to these investments, I will not analyze or include in the HWBp charter derogations from art. 4.7. WFD, including the rationale for their establishment. At this point, it is important to pay attention to the guidelines of the European Commission and those submitted in the assessment of the European Commission to the FRMP and the AWMP in terms of coordinating the implementation of directives in Poland.

In terms of the substantive content of project products, the aFRMP Contractor proposes:

- harmonization of the content concerning the descriptions of river basins and water regions - implementation of the task possible through access to the repositories of both projects for designated representatives of Contractors,
- use of common input data, including spatial databases, the aFRMP Contractor will use the databases prepared under the projects preceding the 2nd update of the RBMP.

These will be the following bases:

- base of anthropogenic pressures - base of intake and discharge as well as other anthropogenic pressures (sewage treatment plants, industrial plants, waste management facilities),

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- base of hydromorphological pressures (including anti-flood infrastructure, hydrotechnical facilities),
- database of lists of heavily modified and artificial water bodies,
- information on the ecological condition / potential of the HWBP for the HWBP system, which will be applied under the 2nd aWMP,
- review and update of FHM and FRM of database (access to which will also be available to contractor 2nd aWMP),
- MPHP database (map of the hydrographic division of Poland),
- aHWB database, with a list of protected areas and their environmental objectives[43].

Moreover:

- inclusion in 2nd aWMP of actions to minimize flood risk (technical and non-technical), which affect the quality of water, along with the environmental assessment,
- unified approach in both projects to the environmental assessment of investments and comprehensive, multi-tasking actions serving both the objectives of the Floods Directive and the WFD. Environmental assessment of actions in aFRMP will consist in the analysis of the compliance of the proposed options with legal and environmental requirements (multi-criteria and cost-benefit analysis):
- • cooperation and exchange of experiences of economic analysis teams of aFRMP and 2nd aWMP Contractors. With the aim of a consistent approach to assessing the legitimacy of the implementation and effectiveness of flood protection actions, it is necessary to exchange information on the assumptions of methodological cost-benefit analyzes and multi-criteria analyzes carried out within individual strategic documents. It is planned to establish cooperation consisting in periodic communication between economic analysis teams and at working meetings regarding assumptions for analyzes and interpretation of the results of analyzes,
- common emphasis on actions conducive to increasing retention - these are often pro-environmental actions, counteract the effects of drought and fulfill the function of supporting actions in flood protection. These actions are described in the next subchapter, they are consistent for several completed, implemented and planned planning documents, they require coordination with aFRMP,
- verification whether the investment is included in the list of investments referred to in Art. 323 of the Water Law, and cooperation in the preparation of a list of directional investments in water management or related to waters, which will be created during the development of the 2nd aWMP,

[43] Updated as part of works on the 2nd aWMP

- analysis of the National Surface Water Restoration Programme in terms of the possibility of using the conclusions included in the programme.

ENVIRONMENTAL ASSESSMENT

In order to ensure the consistency of environmental assessments, aFRMP and 2nd aWMP proposes he environmental analysis of the impact of investments and actions (comprehensive, multi-task) for the purposes of water protection within the meaning of the Water Framework Directive should be performed in terms of verifying the compliance of the actions with the law and environmental objectives specified in the parallel updated river basin management plans (2nd aWMP).

Taking the above into account, it will be necessary to implement the environmental objectives set out in the 2nd aWMP and the actions aimed at achieving or maintaining the environmental objectives for individual units. Taking into account the actions proposed in 2nd aWMP guarantees an integrated approach to water management in the river basin area. This will ensure a balanced approach to both flood safety and other actions that

The analysis will be performed as follows:

- identification of aHWB, based on the updated list for the purposes of 2nd aWMP, within which investments and actions are "located" and those on which they may have an impact,
- identification of the aHWB category and its environmental objective, taking into account the objectives for protected areas (in the context of the WFD requirements),
- identification of the factors influencing the investment and actions on the hydromorphological (including patency) and biological parameters of aHWB,
- determining the impact of actions on the hydromorphological (including patency) and biological parameters of aHWB,
- identification of the factors of the impact of investments and actions on objects and objectives of protection of area forms of nature protection (the following area forms of nature protection were analyzed: national parks, landscape parks, nature reserves, Natura 2000 areas, ecological lands, protected landscape areas, nature and landscape complexes) in relation to to aHWB,
- determining the impact of actions on objects and objectives of protection of area forms of nature protection (the following area forms of nature protection were analyzed: national parks, landscape parks, nature reserves, Natura 2000 areas, ecological lands, protected landscape areas, nature and landscape complexes) in relation to the AHWB,
- assessing whether the implementation of investments and actions will affect the achievement of the environmental objectives set for aHWB.

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The process of proceeding with the analysis of compliance with the WFD is presented in the diagram below.

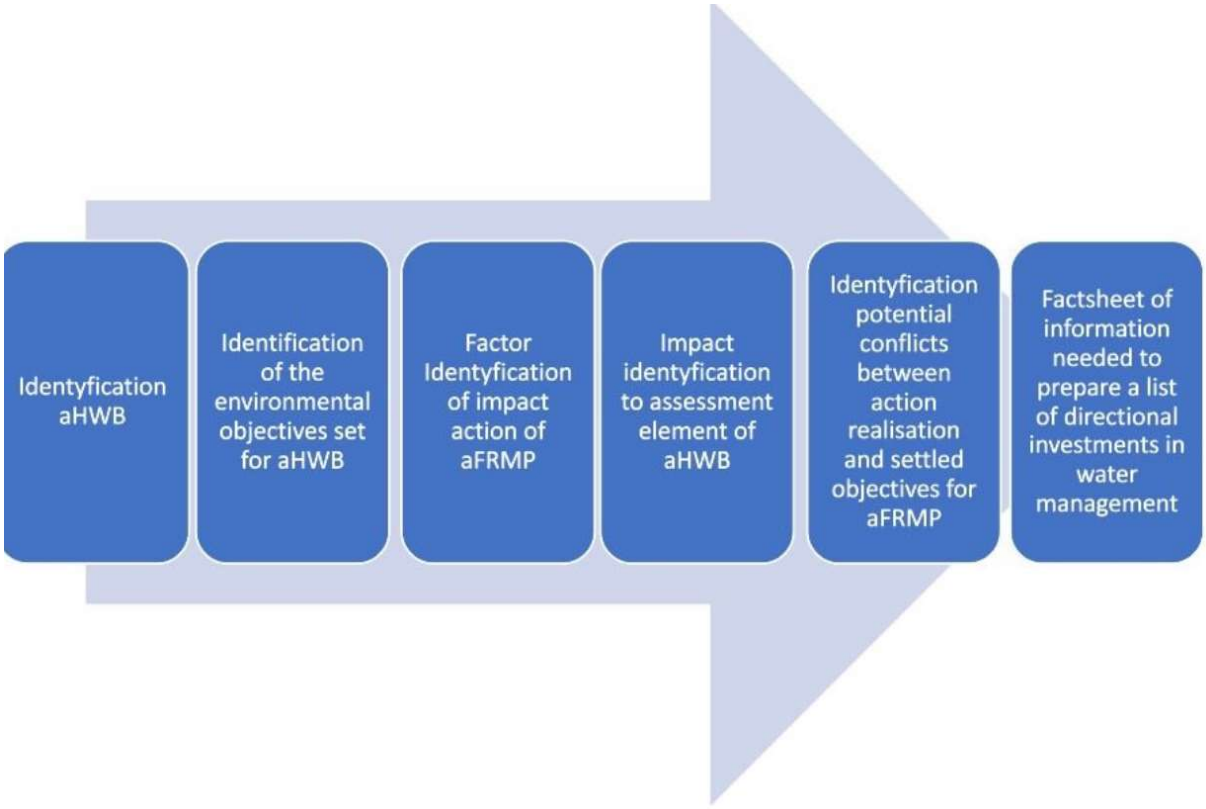

Figure no 18 Summary of the WFD compliance analysis. Source: own study

As a result of the WFD compliance analysis carried out in the AFRMP, the information needed to prepare a list of targeted investments in water management was compiled.

It is important that as part of the preparation of documents for the needs of the new planning cycle, the findings of aFRMP are not transferred to the 2nd aWMP for investments for which no decision on environmental conditions/water law assessments has been issued. This is due to the fact that in 2nd aWMP, it was assumed that the investments planned for implementation under the aFRMP, for which no decision on environmental conditions/water law assessments has yet been issued, will be included in the 2nd aWMP in the so-called list of directional investments. In view of these investments, I will not analyze or include in the HWBp charter derogations from Art. 4(7) WFD, including the rationale for their establishment.

13.2.5. Coordination with other planning documents

Currently, the following documents in water management are being developed or will be implemented, which should also be taken into account during works on updating flood risk management plans. Belong to them:

- Plans to counteract the effects of drought.
- Programme for counteracting water scarcity (Retention Development Programme).
- Implementation of instruments supporting the implementation of FRMP actions.
- National programme of surface water restoration.
- A programme of non-technical and retention actions which is an element of flood risk management in the Lesser Vistula and Upper Vistula water regions (catchment area above Kraków), including flood protection for the city of Kraków.
- Master Plan for the Bóbr river catchment area - Concept of FRMP implementation in the Bóbr river catchment area in terms of identifying investment priorities in the middle Oder water region.

Plans to counteract the effects of drought

The development of plans to counteract the effects of drought in the river basin areas is intended, inter alia, to increase the available resources of surface waters.

Many of the actions to counteract the effects of drought simultaneously may have a greater or lesser impact on reducing the risk of flooding.

For actions implementing both of the above-mentioned objectives include the construction of storage reservoirs and the use of lake retention.

A similar role can be played by actions consisting in the protection and restoration of water retention capacity in valleys and river beds, as well as in natural water reservoirs through their renaturation and restoration of natural floodplains. River valley retention can also be regulated through the use of damming devices, actions including the polderization of river valleys, and the restoration of natural habitats within river valleys with water retention capacity.

Other actions to counteract the effects of drought and, at the same time, reduce the risk of flooding include actions to increase water retention within wetlands and peatlands, actions to increase forest cover within the catchment area, as well as the development of drainage systems in agricultural areas.

The documents made available as part of public consultations show that a number of planned and proposed non-technical actions will certainly be consistent for DECP and aFRMP. In the case of the list of actions attached to the DECP document, some are significant hydrotechnical investments (including flood protection), while some are small investments, not related to flood protection. At the stage of analyzes, the contractor will

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verify and consider the proposed lists of investments in terms of the possibility and legitimacy of including them in aFRMP projects.

Programme for counteracting water scarcity (Retention Development Programme)

The Retention Development Programme aims to counteract the observed water deficit and the phenomenon of drought, resulting from both climate change and increasing anthropopressure.

Urbanization and the associated increase in land sealing contribute to the reduction of the catchment area. At the same time, the occurrence of drought contributes to the formation of water deficits, especially in the agricultural sector, as well as the occurrence of low flows on rivers. The effects of these unfavorable phenomena can be mitigated by increasing the retention capacity of the river basin.

Taking action within the scope of water retention will contribute to reducing or slowing down the outflow of water from the catchment area, being at the same time one of the methods of preventing floods or limiting the scale of their effects.

It will be important to take actions to change the way the land is used, including afforestation and afforestation. These actions contribute to increasing the infiltration of soil water, and also slow down and reduce the volume of surface runoff - these are actions included in the landscape retention.

An important role in reducing water shortages is played by surface water retention, implemented through the construction of large retention reservoirs (with a capacity of more than 5 million m3), the so-called small retention including the construction of storage reservoirs with a smaller capacity, including breeding ponds, as well as microretention involving the construction of water reservoirs with a capacity of less than 0.1 million m3 and a capacity of less than 1 ha, including ponds and watercourse back-ups. Actions within the scope of rainwater retention, carried out in places where precipitation occurs, including areas used by private persons, are also of significant importance.

The above-described retention actions will allow to achieve various effects. Large retention reservoirs primarily contribute to the flood protection of areas, while being a source of water supply. The main role of actions within the scope of small retention, micro retention, as well as soil and landscape retention is the retention of water within the catchment area and slowing its outflow, at the same time increasing the catchment's resistance to flooding.

The development of the Retention Development Programme will contribute to the improvement of the functioning of water management in the country, simultaneously contributing to the reduction of flood risk and mitigation of the effects of climate change related to the occurrence of drought and water shortages.

The effects of the Programme implementation will be, among others, increasing the volume of water retained within the catchment area, increasing the capacity of small retention reservoirs, increasing the area of hydrogenic habitats, increasing the role of ecosystems related to water retention systems, increasing the number of actions related to water retention, as well as reducing the risk of flooding, including resulting from flash floods in highly urbanized areas.

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The status of the document at the moment is as follows - the government adopted in the form of a resolution the assumptions for the Retention Development Programme and an Advisory Team for the development of a retention development programme was established at the Ministry. However, no details on the implementation of the programme are available so far. The document has slightly changed its name, as it now refers to the "Assumptions for the Programme for Counteracting Water Scarcity for 2021-2027 with a perspective until 2030". The document is not planned to be adopted until the fourth quarter of 2020 - the first quarter of 2021, therefore, during public consultations with the aFRMP. However, an appendix to the adopted assumptions of the programme has already been indicated, which is a list of 94 investments that will be implemented by 2027, aimed at improving retention in Poland (the same list accompanies the Plans for counteracting the effects of drought in the river basin areas). Therefore, the aFRMP Contractor's approach is analogous to that of DECP - these investments will be analyzed at the stage of works on aFRMP projects.

Implementation of instruments supporting the implementation of FRMP actions

The implementation of instruments supporting the implementation of FRMP actions is aimed at ensuring a high level of safety for the population and technical infrastructure, and thus limiting the size of losses resulting from the occurrence of a flood.

Those instruments are provisions in the Polish legal system and in local law, allowing i.e. for actions aimed at reducing the flood risk, including by eliminating or avoiding an increase in development within areas of particular flood risk, as well as limiting the existing development. They result from the findings of the project "Implementation of instruments supporting the implementation of FRMP measures" received by the Polish Waters in August 2020.

An important course of action is implementation of legal provisions enabling and supporting actions aimed at protecting the areas of natural retention, restoring natural retention, natural flow conditions and hydromorphology of water coursesallowing for the implementation of flood protection infrastructure by developing an assessment of the completeness of the set of anti-flood facilities with accompanying facilities to be implemented, as well as enabling the acquisition of rights to the real estate on which these facilities are to be built.

mplementation of the instruments is a complementary set of measures for the planned other measures of aPPLN and must be realistically implemented as part of flood management, because without this element it is not possible to improve and improve the situation, both in the context of non-technical measures (spatial planning, insurance, fees) and technical (e.g. streamlining the investment process as part of flood protection investments).

National programme of surface water restoration

Development of the Programme is one of the actions included in the update of the water management plans (aWMP). The implementation of the Programme will allow for the assessment of the possibility of restoring watercourses and the identification of necessary actions to achieve this objective.

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Surface water restoration aims to increase the natural retention of watercourses by restoring or maintaining natural ecosystems.

As part of the renaturation of surface waters, actions will be taken to normalize the water conditions within the catchment area, improve valley and channel retention, renaturise fens and wetlands, as well as restore continuity and increase the hydromorphological diversity of surface waters.

The effects of the actions taken will not only create places attractive to the public, reduce the costs of maintenance works, but also reduce the risk of flooding. The limitation of the flood risk will be achieved as a result of an increase in the natural retention of watercourses, which will result in a reduction of possible water levels.

The aFRMP contractor will get acquainted with the results of the project, analyze the proposed sites in terms of problem areas in terms of flood risk and include in aFRMP, in justified cases, the guidelines presented in this project.

Programme of non-technical and retention actions as an element of flood risk management in the water regions of the Little Vistula and Upper Vistula (catchment area above Kraków), taking into account flood protection of the city of Kraków

As part of the work on aFRMP, project results will be analyzed and incorporated into the **aFRMP where possible, in consultation with the relevant RWMB.**

Master Plan for the Bóbr river catchment area - Concept of FRMP implementation in the Bóbr river catchment area in terms of identifying investment priorities in the middle Oder water region

As part of the work on aFRMP, project results will be analyzed and incorporated into the aFRMP where possible, in consultation with the relevant RWMB.

To sum up, as part of the work on aFRMP, the provisions of the above-mentioned documents in terms of:

- defining the objectives of flood risk management,
- analysis of the list of technical and non-technical actions for flood protection, which have been included in the documents on counteracting the effects of drought, surface water restoration or retention,
- the possibility of proposing organizational actions related to the implementation of legal instruments,
- defining a complete list of stakeholders who should be involved at the stage of public consultations on aFRMP projects,
- obtaining data on water regions and river basins.

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14. TAKING CLIMATE CHANGES INTO CONSIDERATION

The analyzes and forecasts carried out as part of Polish and European projects dedicated to this subject [the Climate Project, 2011], [PESETA Project, 2009] show that climate changes in Poland will be moderate, both in the short and long term. These changes will apply to all elements significant from the point of view of flood risk, i.e. both the amount of rainfall and maximum flows, and the frequency of extreme events. Mean and maximum sea levels are also projected to rise.

In the second planning cycle, the source of information for including climate change in the analyzes will be the data of the CHASE-PL project. Assessment of the consequences of climate change for selected sectors in Poland, the Norwegian Financial Mechanism 2009-2014, no POL-NOR/200799/90/2014, also used in the works on the update of the Preliminary Flood Risk Assessment (2018).

As part of implementation of individual stages of works under the project, it is expected to include predictable effects of climate change in aFRMP. Details of the approach are presented in individual analytical chapters; below is a synthetic summary of the approach to climate change as part of the analyzes.

Table no 62 A synthetic summary of the approach to the issue of climate change as part of the analyzes

Principles of taking into account changes in flood risk resulting from anticipated climate changes		
Spatial distribution of flood risk in the basin/catchment	Assessment of prospective flood risk changes based on information determining the impact of climate change on the occurrence of floods (percentage change of high Q90 flow in 2021-2050 - CHASE-PL project data. Assessment of the consequences of climate change for selected sectors in Poland, values resulting from the analysis of the trend of the maximum annual volumes flows) - determining the trend of changes in flood risk in terms of area (apart from climate change, also perspective changes resulting from anthropopressure, i.e. changes in the population number and changes in the area of built-up areas / sealed areas).	The assessment of prospective flood risk changes was included in the analysis of the spatial distribution of the flood risk, the results of which constitute the basis for the identification of problem areas.
Evaluation and selection of technical actions to reduce flood risk	Preferred technical solutions enabling adjustment of their construction parameters to increased flood flows - description in the methodology of evaluation of planned actions (e.g. 1) flood embankments - change of the principles of construction of embankments enabling their superstructure or installation of mobile partitions, 2) reservoirs or polders - change of the structure enabling the increase of wave reduction while maintaining a constant outflow from the reservoir - guaranteeing safety below the dam, increasing the retention capacity in the catchment area)	The estimated benefits of the applied solution take into account the increase in the avoided potential flood losses in individual decades of the analyzed period - description in the CBA methodology

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Principles of taking into account changes in flood risk resulting from anticipated climate changes		
Selection and evaluation of non-technical actions to reduce flood risk	Actions must take into account: 1.monitoring of changes in hydrological parameters on river sections that pose a flood risk, 2.education within the scope of changing climatic conditions and related consequences, 3. Conducting research looking for new actions to reduce flood risk	The estimated benefits of the applied non-technical measure take into account the increase in the avoided potential flood losses in individual decades of the analyzed period - description in the CBA methodology
Collaboration with teams preparing aWMP, DECP and other strategic documents	Analysis of all documents in terms of the expected effects of climate change included in individual documents	Harmonization of planned actions in river basins and sub-basins, whose task is to counteract the effects of climate change

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15. DESCRIPTION OF THE METHOD OF MONITORING PROGRESS IN IMPLEMENTING THE UPDATED PLAN AND ASSESSING IMPLEMENTATION OF ACTIONS AND OBJECTIVES

Monitoring of the progress of implementation of the flood risk management plan will be carried out in accordance with the guidelines included in the document "Guidance for Reporting under the Floods Directive (2007/60/EC)" and the Regulation of the Minister of Maritime Economy and Inland Navigation of 14 December 2018 on the scope of information on implementation of actions included in river basin management plans, flood risk management plans ,and the sea water protection programmeme. Reporting to the EC should be carried out with the use of a specially prepared electronic reporting system, available on the website of the European Topic Centre on Inland, Coastal and Marine waters (http://icm.eionet.europa.eu/schemas/dir200760ec/resources) .

According to the guidelines, the report on progress of the aFRMP implementation will include the following elements:

- information on any changes or updates made since publication of the previous version of FRMP, including a summary of reviews carried out in accordance with Article 14 of the FD,
- assessment of the progress made in achieving the assumed objectives, as referred to in Article 7(2) FD (description and explanation of all actions provided for in the previous version of FRMP, which had been planned for implementation but were not implemented,
- description of any additional actions taken since the entry into force of the assessed aFRMP.

In the FRMP implementation reports, the Member States are expected to include the issues envisaged in the first plans, but also focus on progress and changes, as defined in the directive. After the first plan implementation period, the reporting sheet had been modified on the basis of the conclusions of the first plan implementation period.

Due to the need to coordinate and synchronize plans with the second cycle of water management plans (WMP) and in order to avoid double reporting, the reporting sheets will be coordinated. The structure of data required in reporting is related to the relevant WMP report form included in guidance document no 21. This applies in particular to reporting under Article 5 of the WFD and actions to be included in the action programmeme that forms part of valid WMP.

Reports on implementation of flood risk management plans will allow the European Commission to:

- Check compliance of Member States' FRMP with the requirements of the directive, with particular emphasis on completeness, consistency with other provisions set out in the directive and coordination of works in the river basin / region, taking into account the following criteria:
    - whether the flood risk management objectives have been established and how they relate to reducing the potential negative consequences of floods on human health, the environment, cultural heritage and economic action and to non-technical actions or to reducing the likelihood of floods (Art 7(2) FD),
    - whether FRMP includes actions to achieve the objectives established in accordance with Art. 7(2) and Part A of the Appendix (Art 7(3) FD),
    - whether all the relevant aspects mentioned in article 7 of the DP have been taken into account,
    - whether coordination (as referred to in Article 7(4)) has been ensured - with neighbouring water regions and neighbouring countries - whether the potential significant increase in flood risk in other countries has been clearly communicated and agreed by stakeholders;
    - whether the coordination of work on the plans with the work on WMP has been ensured, and whether the possible benefits have been taken into account, taking into account the objectives of the WFD, have been taken into account coordination actions between the Member States in the case of an international river basin area, have there been public consultations with interested parties Article 14 of the WFD,
- Compare methods and use of information between Member States and river basin and regional water management authorities, especially for international river basins;
- Conduct an assessment of compliance of the application of Article 13(3) with the requirements of Articles 7, 8, 9 (compliance of the FRMP performed before 22.12.2010 with the requirements of the FD),
- Prepare digital data on the objectives of flood risk management, planned actions and other relevant information at the level of river basins and water regions,
- Assess the consideration of climate change that is required in the analysis of plans.
- The guidelines for reporting documents resulting from the Floods Directive (2007/60/EC) indicate which data should be entered into the electronic spreadsheet. Those are:
- summary of FRMP,

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- other information (links to more detailed documents, hyperlinks to relevant data),
- Action status categories ("not completed", "in progress", "completed").

The product and result indicators adopted in detail in the implementation of objectives and actions in the second planning cycle are presented in chapters 7 and 8. Revision of the indicators will take place after the implementation of the task concerning Assessing the implementation progress of the first FRMP. The methodology in this regard will be updated.

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16. A TABLE OF CONTENTS FOR THE OVERVIEW AND THE FLOOD RISK MANAGEMENT PLAN

The proposed structure and content of flood risk management plans was developed based on, inter alia:

- provisions of the Water Law and the Floods Directive,
- analysis of the content of methodological works and pilot flood risk management plans developed in EU countries,
- analysis of the content of the preliminary flood risk assessment and the provisions of the methodologies for the development of flood hazard maps and flood risk maps,
- EU requirements for reporting flood risk management plans.

However, bearing in mind the need to adopt the final versions of the plans in the form of a regulation, thus passing the legislative verification of, inter alia, The Government Legislation Center, the proposed table of contents for the plan, is a faithful reflection of the requirements of the Water Law Act, as the Act is the direct reference point for introducing the regulation on the Flood Risk Management Plan.

Because for:

- the Odra river basin area,
- the area of the Vistula river basin,
- the Pregoła river basin area,

flood risk management plans are being developed for the second time, for these river basin districts a document of the Review on the implementation of the 1st planning cycle of FRMP will be prepared.

The proposed table of contents of the Review for these river basins is uniform. It is presented below:1. Introduction

2.Characteristics of the river basin district

2.1. Morphological, hydrographic, environmental and economic characteristics

2.1.1. Terrain morphology

2.1.2. Geological construction

2.1.3 Underground waters

2.1.4 Hydrography

2.1.5. Land use

2.1.6. Protected areas

2.1.7 Population

2.1.8. Infrastructure and economy

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For this reason, the tables of contents of a FRMP for the Vistula, Odra and Pregoła basin districts will differ from the FRMP for the Danube, Laba and Niemen basin districts for which the Plan document is being prepared for the first time. , Pregoły is uniform. The table of contents is presented below:

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11.6. The way of taking into account the comments and conclusions reported in the strategic environmental impact assessment in the flood risk management plans

11.7. A proposal on the methods and frequency of monitoring the effects of implementing the provisions of the document

12. List of authorities competent in matters of flood risk management

12.1. Authorities competent to implement the Floods Directive

12.2. The role and relationship of authorities responsible for the implementation of the Floods Directive

12.3. Authorities responsible for the implementation of activities resulting from flood risk management plans

13. Description of international cooperation in the field of flood risk management

14. Coordination of works on updating flood risk management plans with other planning documents in the field of water management

14.1. Coordination with the 2nd update of water management plans

14.2. Coordination with the plan of counteracting the effects of drought

14.3. Coordination with other planning documents

15. Integrating climate change into the development of updates to flood risk management plans

15.1. Climate change in Poland and its impact on flood risk

15.2. Planning methods used in flood risk management taking into account climate change

The proposed FRMP table of contents for the river basin districts of the Danube, Elbe and Niemen is uniform. The table of contents is presented below:

1. Introduction

2. Characteristics of the river basin

2.1. Morphological, hydrological, environmental and economic characteristics

2.1.1. Terrain morphology

2.1.2. Geological structure

2.1.3. Groundwater

2.1.4. Hydrography

2.1.5. Land use

2.1.6. Protected areas

2.1.7. Population

2.1.8. Infrastructure and economy

x

17. A LIST OF ABBREVIATIONS AND ACRONYMS

A11	Designation of river floods with the natural swelling mechanism
A15	Designation of the type of floods resulting from destruction or damage to damming structures
A23	Designation of the type of river floods caused by overflow or destruction of flood embankments
AAD	Average Annual Damage
AHP	Analytic Hierarchy Process
aFHM and FRM	Project: Review and update of flood hazard maps and flood risk maps
aWMP	Update of Water Management Plans
API	Analyzes of investment programmes, prepared as part of the Flood Protection Programme in the Upper Vistula River basin
APSFR	Areas of Potentially Significant Flood Risk
aPWŚK	Update of the country's water and environmental programme
aFRMP	Updated Flood Risk Management Plans
aPFRA	Updated Preliminary Flood Risk Assessment
B	No negative impacts in the context of assessing the significance of the impact of actions
BDOT	Database of topographic objects
B / C	Benefits / costs indicator
BMŚ	Environmental Monitoring Library
NC	No change
CBA	Cost-benefit analysis
CN	Curve number according to SCS model
CLC	Corine Land Cover
SO	Specific objective
DEAR	Disaster Economic Amplification Ratio
DEFRA	Department of Environment, Food and Rural Affairs
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
ENPV	Economic net present value
ePUAP	Electronic Platform of Public Administration Services
ERR	Economic rate of return
ESDAC	European Soil Data Centre
EEC	Europejska Wspólnota Gospodarcza
FB	Facebook
FEMA	Federal Emergency Management Agency Department of Homeland Security
FHWA WSPRO	Federal Highway Administration Water Surface Profile
FTP	File Transfer Protocol
GDEP	General Directorate for Environmental Protection (GDOŚ)
GEZ	Communal Register of Monuments
GIOŚ	Chief Inspectorate of Environmental Protection
GIS	*Geographic Information System*
GP	Planning Group
GR	Working Group

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GUGiK	Main Office of Geodesy and Cartography
CSO	Central Statistical Office, Główny Urząd Statystyczny (GUS)
HEC-HMS	Hydrologic Modeling System
HIR	Hydromorphological River Index
HIRk	results of the in-door assessment of the Hydromorphological River Index
Hot-Spot	An area where a high level of flood risk has been identified that requires urgent actions to reduce this risk, the definition used in the 1st planning cycle, in the 2nd planning cycle the term "problem area" will apply
ICPDR	International Commission for the Protection of the Danube River
ID	Identification number
2nd aWMP	Second update of water management plans
3rd aWMP	Third update of water management plans
IMWM - NRI	Institute of Meteorology and Water Management, National Research Institute, Instytut Meteorologii i Gospodarki Wodnej Państwowy Instytut Badawczy (IMGW PIB)
INSPIRE	*Infrastructure for Spatial Information in the European Community*)
ISOK	Project "IT system for protecting the country against extraordinary threats"
HWB	Homogenous water bodies
HSWB	Homogenous surface water bodies
HGB	Homogenous groundwater bodies
LSGU	Local self-government unit
k	Permeability coefficient
K	Environmentally beneficial in terms of the degree of environmental suitability
EC	European Commission
CAP	Code of Administrative Procedure
SC	Steering Committee
SWMB	State Water Management Board, Krajowy Zarząd Gospodarki Wodnej (SWMB)
L	Local, in terms of the range of impact
LP	Polish Forests
MCA	Multi-criteria analysis
MGMiŻŚ	Ministry of Maritime Economy and Inland Navigation
MI	Ministry of Infrastructure
MKOOpZ	International Commission for the Protection of the Oder River against Pollution
FRM	Flood risk maps
FHM	Flood hazard maps
n/a	Not applicable
uns	Unsatisfactory - assessment of the technical condition of hydrotechnical structures
N2000	Natura 2000 areas
Ncm	Number of cemeteries
Nocz	Number of sewage treatment plants
Nskl	Number of landfills
Nsrod	Number of objects hazardous to the environment
Nzd	Number of industrial plants
NFEPWM	National Fund for Environmental Protection and Water Management, Narodowy Fundusz Ochrony Środowiska i Gospodarki Wodnej (NFOŚiGW)
NGO	Non-Government Institutions
NID	National Heritage Institute

NKW11	River network file tagging in hydraulic modeling software
NMT	Numerical Terrain Model
AEFH	Areas exposed to flood hazard
OOŚ	Environmental Impact Assessment
OPZ	Order description
OSO	Special bird protection area
OZP	Flood Hazard Areas
PA1 ... PA13	Product indicators
PFRA	Preliminary Flood Risk Assessment
WMP	Water Management Plans
SWH PW	State Water Holding Polish Waters, Państwowe Gospodarstwo Wodne Wody Polskie (SWH PW)
PIG-PIB	Polish Geological Institute - National Research Institute
SAU	Spatial analytical unit
GDP	Gross domestic product
PMŚ	State Environmental Monitoring
POPDOW	Flood Protection Project of the Oder and Vistula Basins
PPH1 ... PPH7	Hydromorphology Transformation Parameters
PPI	Programme of Planned Investments in Water Management of SWH PW
DECP	Drought effects counteracting plans
PR	Public relations
PRH1 ... PRH7	Hydromorphology Transformation Parameters
SHMS	State Hydrological and Meteorological Service, Państwowa Służba Hydrologiczno – Meteorologiczna (PSHM)
SFS	State Fire Service, Państwowa Straż Pożarna (PSP)
PTG	Polish Soil Science Society
PUW	Water maintenance plan
PW1 ...PW7	Designation of the type of action determined in accordance with Art. 165(1) of the Water Law
PZGiK	State geodetic and cartographic resource
PZ	Potentially significant in terms of assessing the significance of the impact of actions
PZO	Protection task plans
FRMP	Flood risk management plans
R	Regional, in terms of the range of impact
RA0 .... RA12	Designation of result indicator
RCP 4,5 RCP 8,5	Representative concentration pathways
RDLP	Regional Directorate of State Forests
RDOŚ	Regional Directorate for Environmental Protection
WFD	Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action within the scope of water policy, the so-called Water Framework Directive
RG	Risk level for the flood effect category: economic action
RK	Risk level for the flood consequence category: cultural heritage
RODO	Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of individuals with regard to the processing of personal data Regulation on the protection of personal data
ROOŚ	Project's environmental impact report

RP	The Republic of Poland
RS	Risk level for the flood effects category: environment
RW	Integrated flood risk level
RZ	Risk level for the flood effect category: human health
RWMB	Regional Water Management Authority The National Water Holding Polish Waters
SCS	Soil Conservation Service
S.M.A.R.T.	Specific, Measurable, Achievable, Relevant, Time-bound
SOO	Special area of habitat protection
SOOŚ	Strategic Environmental Impact Assessment
SOPZ	Detailed description of the subject of the contract
TDz	Action types
U	Moderately beneficial for the environment, in terms of the degree of environmental suitability
UOOŚ	Act of 3 October 2008 on the provision of information on the environment and its protection, public participation in environmental protection and on environmental impact assessments
EU	European Union
UN	Moderately insignificant for assessing the significance of the impact of actions
USBPR	United States Bureau of Public Roads)
VAT	value-added tax
EC	European Community
WIOŚ	Regional Inspectorate for Environmental Protection
PFRA	Preliminary flood risk assessment
WPHk	Hydromorphology Transformation Index
WRHk	Hydromorphological Diversity Index
WWF	World Wildlife Fund, World Wide Fund for Nature
PC	Planning Catchment, Zlewnia Planistyczna (ZP)
ZPZ	Planning Catchment Association
CB	Catchment Board

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Appendices:

Appendix no 1 – A draft of the project's document repository
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