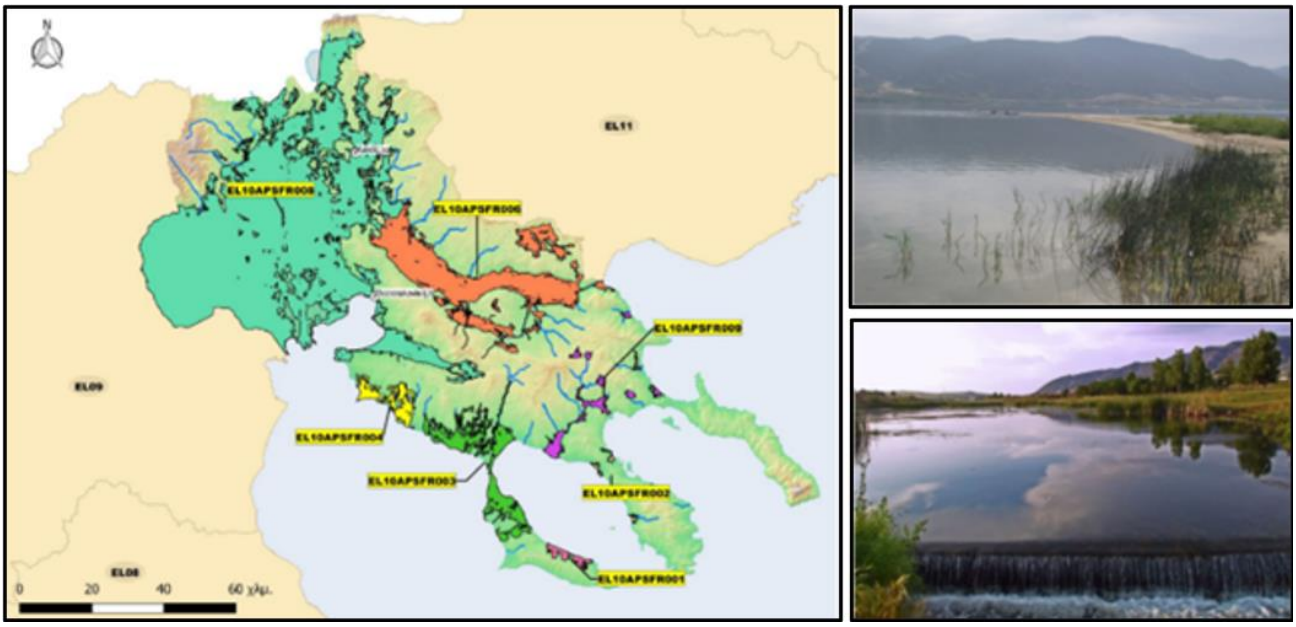
HELLENIC REPUBLIC

MINISTRY OF ENVIRONMENT & ENERGY

GENERAL SECRETARIAT FOR NATURAL ENVIRONMENT AND WATER
GENERAL DIRECTORATE FOR WATER



1st REVIEW OF THE FLOOD RISK MANAGEMENT PLAN

of the River Basins of the Central Macedonia River Basin District (EL10)

PHASE 2

DELIVERABLE 19:
ENGLISH TRANSLATION OF THE DELIVERABLES' SUMMARY METHODOLOGIES AND STUDY RESULTS

Co-funded by the European Union

ΕΣΠΑ 2021-2027
Βιώσιμη Ανάπτυξη για Όλους

HELLENIC REPUBLIC
MINISTRY OF ENVIRONMENT AND ENERGY
GENERAL DIRECTORATE FOR WATER

PROJECT: 1ST REVIEW OF THE FLOOD RISK MANAGEMENT PLAN OF THE RIVER BASINS OF THE CENTRAL AND WESTERN MACEDONIA RIVER BASIN DISTRICTS

JOINT VENTURE OF THE 1ST REVIEW OF THE FLOOD RISK MANAGEMENT PLANS OF THE CENTRAL & WESTERN MACEDONIA RIVER BASIN DISTRICTS

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PREPARATION OF THE 1ST REVIEW OF THE FLOOD RISK MANAGEMENT PLAN OF THE RIVER BASINS OF THE CENTRAL MACEDONIA RIVER BASIN DISTRICT

PHASE 2

DELIVERABLE 19: ENGLISH TRANSLATION OF THE DELIVERABLES' SUMMARY METHODOLOGIES AND STUDY RESULTS

Revisions:

Version	Date	Remarks
Ver. 1	28/08/2024	First Version
Ver. 2	12/12/2024	Second Version
Ver. 3	30/05/2025	Third Version

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1 Directive 2007/60/EC in Greece

In October 2007 the European Union enacted Directive 2007/60/EC[1]. The purpose of the Directive is to establish a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity. The Directive has been incorporated into National Law by Joint Ministerial Decision ΗΠ 31822/1542/E103/2010 (Government Gazette B'1108/21.07.2010), as amended and in force by Joint Ministerial Decision 177772/924 (Government Gazette B' 2140/22.06.2017).

According to Joint Ministerial Decision ΗΠ 31822/1542/E103/2010 (Government Gazette B' 1108/21.07.2010) as amended and in force, the geographical unit considered for application of the Directive 2007/60/EC on the assessment and management of flood risks is the River Basin District, namely the same geographical unit as that of the Directive 2000/60/EC on Water.

The key requirements of the European Directive are implemented in three (3) phases:

Phase 1: Preliminary flood risk assessment in river basins and respective coastal zones and identification of areas with potential severe flood risks or where flooding is likely to occur (Areas of Potentially Significant Flood Risk), (Articles 4 & 5).

Phase 2: Preparation of Flood Hazard Maps and Flood Risk Maps for the Areas of Potentially Significant Flood Risk (article 6).

Phase 3: Establishment of Flood Risk Management Plans (article 7). These plans shall include measures to forecast floods and reduce the likelihood of flooding and its consequences, and must also include ways of protecting such areas as well as preparing the population in the event of flooding.

Flood risk management under the Directive is an iterative process implemented over six-year cycles.

The following legislative provisions are considered in the implementation of Directive 2007/60/EC:

- Joint Ministerial Decision 177772/924 (Government Gazette B '2140/22.06.2017), on the Amendment of Joint Ministerial Decision No. 31822/1542/2010 (Government Gazette B'1108/21.07.2010).
- The Water Framework Directive 2000/60/EC, which sets the legislative framework for the proper management and protection of water resources.
- Law 3199/2003 (Government Gazette A'280/09.12.2003) "Water protection and management - Harmonization with Directive 2000/60/EC of the European Parliament and of the Council of 23rd October 2000", whereby and by the delegated regulatory acts of which, national law is harmonized with the provisions of the Water Framework Directive.
- The approved Flood Risk Management Plans for the River Basins of the country's 14 River Basin Districts and the River Basin of Evros river, as well as all the deliverables of the studies which formed the basis of the FRMPs (https://floods.ypeka.gr/index.php).
- The approved River Basin Management Plans (2nd Review) of the country's 14 River Basin Districts (http://wfdver.ypeka.gr/el/home-gr/).

[1] Directive 2007/60/ EC of the European Parliament and of the Council of 23rd October 2007 on the assessment and management of flood risks.

- The 1st Review of the Preliminary Flood Risk Assessment under Article 14 of the Directive (Ministry of Environment and Climate Change – General Directorate for Water, 2019), and the identification of the Areas of Potentially Significant Flood Risk.
- The Guidance Documents for implementation of the Floods Directive 2007/60/EC, issued by the European Union.
- Information from other relevant studies or projects, which are being prepared or have been prepared, at national or regional level, by the involved Services, Bodies and Educational Institutions in Greece, as well as the available data from national platforms and databases.
- The results of the EU assessment of the approved Flood Risk Management Plans, including the respective assessments of the Preliminary Flood Risk Assessment and the Flood Hazard and Flood Risk Maps, as well as any EU recommendations for the preparation of 1st Review of the Flood Risk Management Plans.
- Implementation practices by other EU Member States in relation to the implementation of Directive 2007/60/EC.

Competent Authorities

The **Ministry of Environment and Energy (MoEE)** sets the policy for water protection and management and oversees its implementation. In particular, in accordance with Article 3(1.1) of Joint Ministerial Decision ΗΠ 31822/1542/E103/2010, as in force, the General Secretariat for Natural Environment & Water (GSNEW) /**General Directorate for Water** (GDW), in cooperation with the General Secretariat for Civil Protection of the Ministry of Climate Crisis and Civil Protection and possibly with other jointly competent Ministries, shall establish the national flood risk management programme. In addition, GDW monitors, assesses and controls the implementation of the national flood risk management programme. For this purpose, it prepares annual reports on the implementation, assessment and control of the previous period's national flood risk management programme, based on the annual reports of the individual Regions' Water Directorates, and submits them to the Minister of Environment and Energy (Article 3(1.5) of Joint Ministerial Decision ΗΠ 31822/1542/E103/2010, as in force).

The **Water Directorates of the Decentralized Administration** perform the responsibilities of the Decentralized Administration on water protection and management, including the flood risk. The Macedonia – Thrace Decentralized Administration, which is responsible for the river basins of the Central Macedonia RBD - EL10, includes the **Central Macedonia Water Directorate** and the Eastern Macedonia – Thrace Water Directorate. Each Water Directorate is responsible for water protection and management and for assessing and managing flood risk in the respective Region (Central Macedonia and Eastern Macedonia and Thrace respectively) and performs the responsibilities assigned to the Decentralized Administration pursuant to the applicable legislation. The performance of their responsibilities is further qualified by decision of the Secretary of the Decentralized Administration. **As regards the water basins of the Central Macedonia River Basin District, the responsibilities of the Decentralized Administration are performed by the Central Macedonia Water Directorate.**

2 The Central Macedonia River Basin District - EL10

The **Central Macedonia River Basin District (EL10)** consists of the four (4) river basins, **Axios** (EL1003), **Gallikos** (EL1004), **Chalkidiki** (EL1005) and **Athos** (EL1043), as distinguished by virtue of decision no. 706/16.7.2010 (Government Gazette 1383B/2-9-2010 & Government Gazette 1572B/28-9-2010)[2]. The Axios river basin (EL1003), covering an area of 3,326.47 km^2 is administratively attached to the Region of Central Macedonia, and mainly consists of the water catchment areas of the **Axios** and **Loudias** rivers. The Gallikos river basin (EL1004), covering an area of 1,049.62 km^2 is administratively attached to the Region of Central Macedonia, and includes the catchment area of the **Gallikos** river. The Chalkidiki river basin (EL1005), covering an area of 5,541.93 km^2 is administratively attached to the Region of Central Macedonia, is the largest basin of RBD EL10, consists of the basins of lake **Volvi** and lake **Lagada (Koronia)**, the artificial lake **Mavrouda**, **Anthemountas** and **Chavrias** rivers, the catchment areas of the Thessaloniki Agglomeration and surrounding areas, as well as other smaller sub-basins of the Regional Unit of Chalkidiki. The Mount Athos river basin (EL1043), covering an area of 239.26 km^2 , is the smallest in area of the river basins of RBD EL10 and occupies the northeastern part of the homonymous peninsula, the easternmost of the three peninsulas of Chalkidiki.

In the Central Macedonia River Basin District, the predominant use is that of agricultural land. This is followed by forests – woodlands and transitional woodland – shrub areas. Urban areas - industrial uses and pastures account for smaller percentages. In 2020, RBD EL10 contributed to the country's GDP by 11.86%.

In the 2nd Review of the RBMP there has been no change as regards the one hundred and twenty-four (124) surface water bodies for the Central Macedonia RBD (EL10) identified in the 1st Review. Thirty-three (33) areas included in the Natura 2000 network are found in RBD EL10. Moreover, the Central Macedonia RBD includes one (1) site covered by International Treaties, specifically Mount Athos, four (4) Controlled Hunting Areas, fifty-one (51) Wildlife Refuges, as well as other protected areas.

[2] *Decision no. οικ. ΥΠΕΝ/ΔΔΥΠ/28011/316 (Government Gazette 1246/B/13-03-2025) replaced decision οικ. 706/2010 of the National Water Commission (Β' 1383) and established forty-seven (47) River Basins, belonging to fifteen (15) River Basin Areas (River Basin Districts) and will form the basis for preparing the 2nd Review of the FRMPs and the 3rd Review of the RBMPs.*

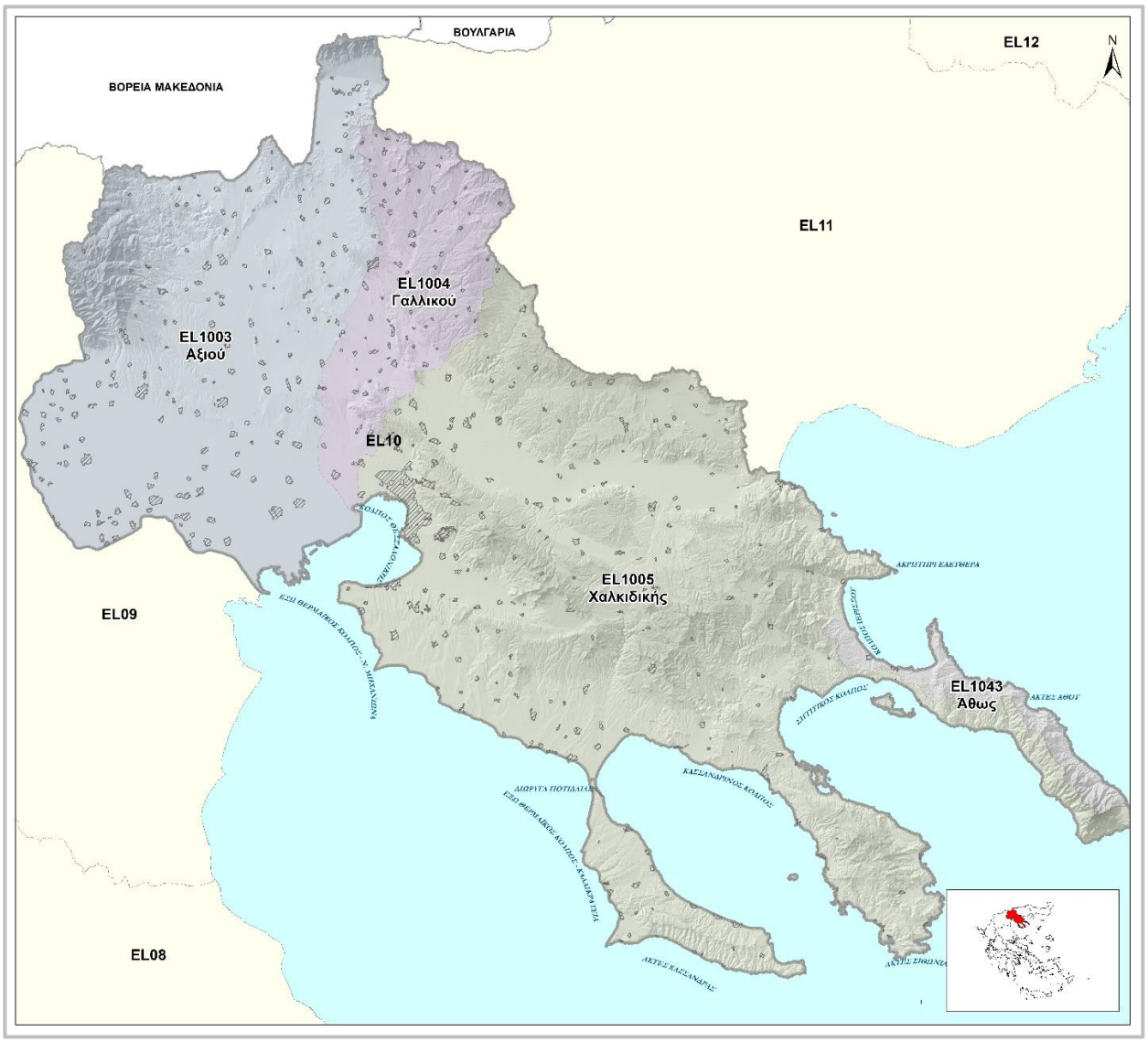


Image 2-1: River Basins of the Central Macedonia River Basin District EL10.

3 The 1st Review of the Preliminary Flood Risk Assessment

The 1st Review of the Preliminary Flood Risk Assessment (PFRA) reviews and updates the following: the Preliminary Flood Risk Assessment for all the River Basin Districts of the country, the list of Historical Floods and Significant Historical Floods as well as the Areas of Potentially Significant Flood Risk (APSFR).

Between the PFRA and the 1st Review of the PFRA, i.e. from 2012 to 2018, **39 flood events** were recorded in RBD EL10, resulting in **208 flood incidents** in as many locations. After processing historical incidents, the areas where significant floods have occurred in the past are the **plain of Thessaloniki**, the riverside areas in the **lower part of Gallikos** river, the residential area of the **Thessaloniki Agglomeration**, the lakeside areas of **Koronia-Volvi** lakes and the **Anthemountas and Chavrias** streams, as well as the coastal areas of Moudania and **Kassandra peninsula**.

In RBD EL10, the APSFRs appearing in the 1st Review of the PFRA have been modified in relation to the APSFRs of the PFRA as follows:

- EL10APSFR001: not modified
- EL10APSFR002, EL10APSFR003, EL10APSFR009: Extended based on the results of the first FRMP for T1000, incorporating new low areas.
- EL10APSFR004, EL10APSFR006: They resulted from APSFR consolidations and/or modifications of the First FRMP. Specifically, T1000 floods were consolidated and GR10RAK0004 was consolidated with GR10RAK0005 in the new EL10APSFR004 APSFR. Moreover, GR10RAK0006, GR10RAK0007 and part of GR10RAK0008 which, in the first FRMP where sited in the basin of Koronia and Volvi Lakes, were consolidated in APSFR EL10APSFR006.
- EL10APSFR008: The low zone of the basin of Koronia-Volvi lakes was removed and transferred to APSFR EL10APSFR006. In the other areas, the limit was broadened according to the results of the First FRMP for T1000 and small low zones were incorporated.

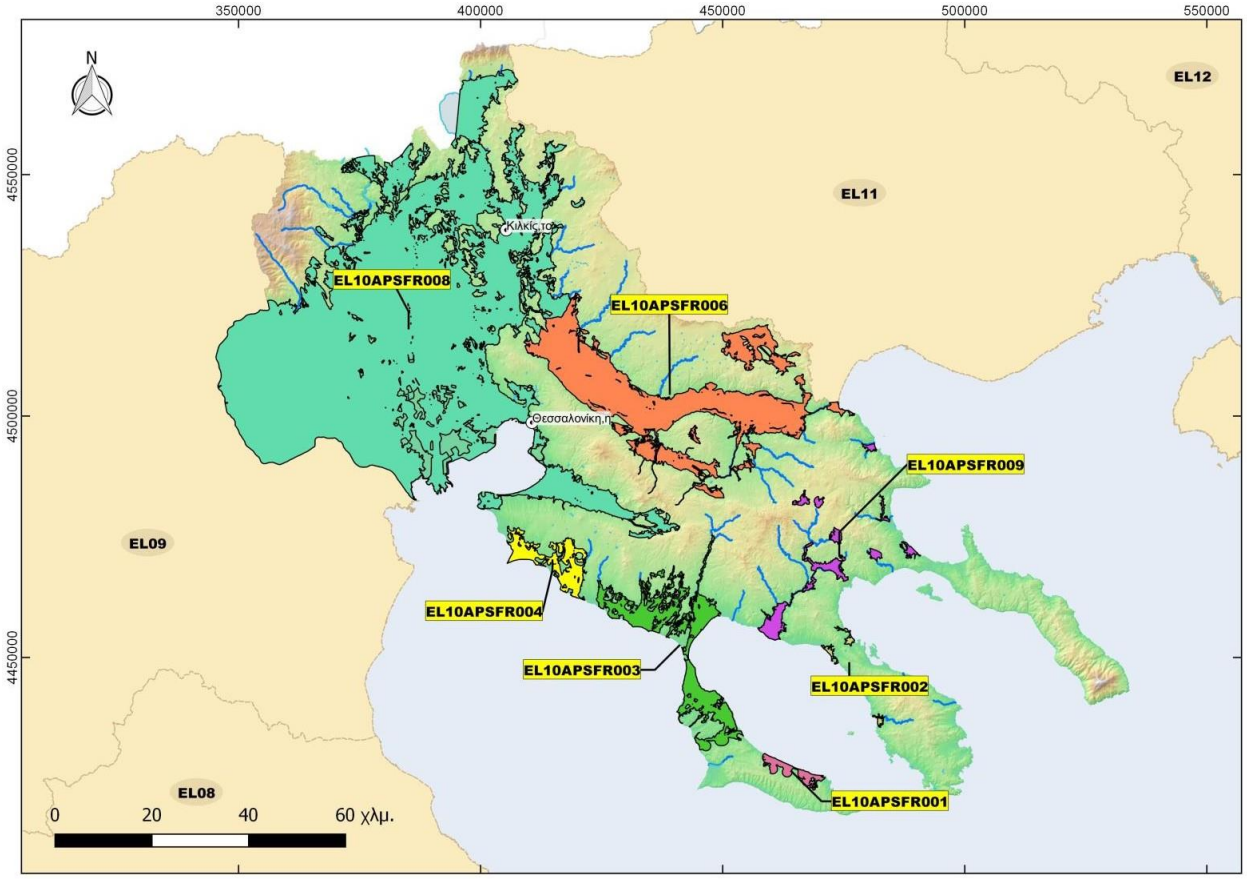


Image 3-1: Revised APSFR in the Central Macedonia River Basin District (EL10).

Table 3-1: Revised APSFR in the Central Macedonia River Basin District (EL10).

Name of APSFR	Reference	Area (km²)
Coastal zone of the areas of Hanioti - Polydroso in the southern part of the Kassandria peninsula	EL10APSFR001	24.37
Coastal zone of Ag. Nikolaos and other low areas of the Municipality of Sithonia	EL10APSFR002	8.60
Low zone of the stream basins of N.Moudania, Ag. Mamas and the northern part of the Kassandria peninsula in Chalkidiki	EL10APSFR003	221.32
Low zone of the stream basin of N. Iraklia - N. Kallikratia and the Coastal Zone of Epanomi	EL10APSFR004	79.21
Low areas of the Koronia – Volvi and Rihios river basin	EL10APSFR006	646.97
Low zone of the T66 peripheral trench, Loudias river, Axios river basins, including the area of the former Lake Arjan, and Gallikos river basin, lakeside areas of Lake Doirani, low zones of the Thessaloniki Agglomeration and the Anthemountas stream	EL10APSFR008	3099.38

Name of APSFR	Reference	Area (km²)
Low zones of the Chavrias basin and the basin of streams in the Municipality of Aristotelis	EL10APSFR009	86.15[3]
	TOTAL	**4,166**
	Difference compared to PFRA 2012	**+11.5%**
	Percentage over the entire RBD* **	**41%**

* The area of RBD EL10 is 10,157 km²

[3] While studying the map data of the original PFRA, an overlap was discovered in the polygons of the new EL10APSFR008 and EL10APSFR009 APSFRs. Specifically, the polygons of the EL10APSFR009 APSFR consist of four (4) polygons with a total area of 16.57 km², located to the north of the River Basin District, and the same polygons have already been included in the EL10APSFR008 APSFR. The area of these polygons had been considered in the 1st revision of the PFRA in both APSFRs. In this FRMP, this area has been removed from APSFR EL10APSFR009 and is deemed to be included only in zone EL10APSFR008, to which it belongs spatially. Therefore, the area of EL10APSFR009 is 69.58 km² in total.

4 Central Macedonia River Basin District (EL10) Hydrology

The technical requirements of the 2nd implementation cycle of Directive 2007/60/EC and the relevant Joint Ministerial Decision ΗΠ 31822/1542/E103/21.07.2010 incorporating it into National Law, require the preparation of hydrographs corresponding to average, favourable and unfavourable conditions for the following scenarios regarding rivers, streams and torrents of the River Basin District:

- Floods with **return period T = 50 years**, high exceedance probability.
- Floods with **return period T = 100 years**, medium exceedance probability.
- Floods with **return period T = 1000 years**, low exceedance probability.

In the context of the 1st Review of the FRMP, the intensity-duration-frequency (idf) curves, or rainfall curves for the whole country were revised. Rainfall curves are a parametric relationship linking the intensity of rainfall to the rainfall return period for each rainfall duration. In relation to the rainfall curves of the First FRMP and the average rainfall amount in RBD EL10:

- For return period T = 50 years, the average surface rainfall amount rises in 58% of the basins and, for the remaining 42%, drops by up to 50%.
- For return period T = 100 years, the average surface rainfall amount rises in 76% of the basins and, for the remaining 24%, drops by up to 50%.
- For return period T = 1000 years, the average surface rainfall amount rises in 82% of the basins and, for the remaining 18%, drops by up to 50%.

The hydrological simulation considered a new Digital Terrain Model (DTM), which was based on the most recent DTM used in the Cadastre with a 2m x 2m resolution, and the morphometric - geometric characteristics of basins and sub-basins were extracted: area, maximum, mean and outlet elevations, as well as the flow length. Hyetographs (rainfall graphs) were prepared for design storms with return periods T = 50, 100, and 1000 years and rainfall duration equal to D times the basin concentration time, based on the revised rainfall curves and the morphometric - geometric characteristics of each catchment. Point rainfall was extrapolated to surface rainfall using a surface runoff coefficient. Hyetographs were prepared as follows:

- Using the alternating block method for medium and high exceedance probability floods, i.e. with return periods of 100 and 50 years, respectively.
- Using the worst profile method in preparing the design hyetograph for low exceedance probability floods, i.e. with return periods of 1000 years.

The active rainfall depth was estimated separately for each sub-basin, using the curve number (**CN**). The calculation was made for three types of soil moisture conditions. In addition, recent fires were considered to increase the curve number in sub-basins with burnt areas. To convert the hyetograph (rainfall) into runoff (rate of flow), the flood hydrograph of each rainfall event is prepared considering the concentration time, the rainfall duration and the Unit Hydrograph of each basin / sub-basin. The **Muskingum method** was used for the **hydrologic channel routing** of the flood wave within each respective section of a watercourse. Flood hydrographs were generated using the open source software HEC-HMS 4.10 (Hydrologic Engineering Center – Hydrologic Modeling System), which was created by the US Army Corps of Engineers (USACE). The HEC-HMS can model all the hydrological processes (calculation of hydrological losses, transformation of active rainfall into direct runoff, hydrologic channel routing, etc.) that occur during the transformation of rainfall into runoff in dendritic basins.

The following table presents the results of the hydrologic flood routing for the River Basin District's 25 basins for which a hydrological analysis was carried out, and the three return periods considered, for average humidity conditions:

Table 4-1: Summary results of the hydrological model of the basins in EL10, with average humidity conditions.

no.	Basin ref.	Description	Area (km²)	Q (m³/s) T=50	Q (m³/s) T=100	Q (m³/s) T=1000	Rainfall Duration (hrs)
1	EL1003FLNM43	DOIRANI	268.53	142*	207*	603*	24
2	EL1003FR0001	ANATOLIKO	43.4	25	32	72	48
3	EL1003FR0003	GALLIKOS SMALLER CHANNEL	24.4	22	29	66	48
4	EL1003FR0006	LOUDIAS	1275.97	568	767	2088	48
5	EL1003FR0008	GALLIKOS SMALLER CHANNEL	91.38	89	120	304	48
6	EL1003FRNM04	AXIOS	1761	1775	2312	5135	48
7	EL1004FR0002	GALLIKOS	1013.17	879	1260	3060	48
8	EL1005FL0008	VOLVI	2083.29	77	104	246	48
9	EL1005FR0005	DENDROPOTAMOS	133.15	273	374	868	24
10	EL1005FR0007	KALAMARIA	60.6	85	118	287	24
11	EL1005FR0009	THERMI	62.02	153	213	522	24
12	EL1005FR0010	VATONIA	251.5	529	739	1757	24
13	EL1005FR0011	EPANOMI	29.29	55	79	215	24
14	EL1005FR0012	CHAVRIAS	448.29	991	1393	3220	48
15	EL1005FR0013	TSAIRI	42.97	64	92	253	24
16	EL1005FR0014	ANTHEMOUS	319.56	599	836	2016	48
17	EL1005FR0015	SCHOLARI	42	64	94	254	24
18	EL1005FR0017	LAKKOMA	38.09	61	87	232	24
19	EL1005FR0019	KALLIKRATIA	74.22	84	124	347	24
20	EL1005FR0021	NEA SILATA	79.08	149	216	583	24
21	EL1005FR0023	XIROLAGKAS	76.76	197	276	676	24
22	EL1005FR0025	MANDRIA	58.26	177	242	561	24
23	EL1005FR0027	DIONYSIOU	51.94	164	222	515	24
24	EL1005FR0029	POLYGYROS	29.56	134	181	419	12
25	EL1005FR0031	SOLINA	18.05	45	68	213	12
26	EL1005FR0033	CHANIOTI	54.77	37**	62**	242**	24
27	EL1005FR0035	SIVIRI	38.67	92	135	379	24
28	EL1005FR0037	PANAGIA	12.1	62	87	221	12
29	EL1005FR0039	AG. NIKOLAOS	20.52	86	120	310	12
30	EL1005FR0041	SANI	26.26	88	120	294	24
31	EL1005FR0045	LIVADAKI	31.45	73	101	249	24
32	EL1005FR0047	SERMYLI	30.63	115	161	399	24
33	EL1005FR0049	KYPSA	14.42	58	83	209	24
34	EL1005FR0051	METOCHI	19.85	63	88	221	24
35	EL1005FR0053	NEA PLAGIA	38.91	140	192	442	24
36	EL1005FR0055	AGGELOCHORI	55.27	46**	66**	183**	24
37	EL1005FR0057	NEA MOUDANIA	38.95	61**	80**	175**	48
38	EL1005FR0059	NEA POTIDAIA	18.76	52	69	161	24
39	EL1005FR0061	ELANI	13.23	43	63	185	12
40	EL1005FR0063	NEA FOKEA	8.54	30**	41**	97**	12

no.	Basin ref.	Description	Area (km²)	Q (m³/s) T=50	Q (m³/s) T=100	Q (m³/s) T=1000	Rainfall Duration (hrs)
41	EL1005FR0065	NIKITI	24.68	63	83	181	24
42	EL1005FR0067	MYLOS	57.49	263	354	808	12
43	EL1005FR0069	LADARIO	6.56	37	52	137	6
44	EL1005FR0071	PETRENIO	47.36	189	266	684	12
45	EL1005FR0073	IERISSOS	23.29	140	191	461	24
46	EL1005FR0075	ASPROLAKKAS	91.16	452	616	1395	24
47	EL1005FR0077	BASDEKI	33.86	179	253	617	12
48	EL1005FR0079	MAVROS LAKKOS	42.81	208	290	720	12
49	EL1005FR0081	KRYONERI	17.12	35**	50**	131**	6

**This is a transboundary lake; data concerns the Greek part*

***These are basins with multiple discharging sub-basins; the maximum peak selected as representative*

5 Central Macedonia River Basin District (EL10) Hydraulic Simulation

In the course of the **1st implementation cycle** of Directive 2007/60/EC (First FRMP), a total of **307 sub-basins and 204 watercourses were defined**. In this **2nd implementation cycle**, **35 new watercourses** and **140 sub-basins have been added**, for which a hydraulic model has been developed. Specifically, hydraulic simulations were carried out for more than **1,100 km** of watercourse. Flood routing was performed in the following cases of watercourses:

- Rivers, streams and torrents in the areas added to the APSFRs during the 1st Review of the PFRA.
- Rivers, streams and torrents within the APSFRs that resulted from the First FRMP, for which no flood hydrographs were generated during the 1st Implementation Cycle of Directive 2007/60/EC.
- Rivers, streams and torrents of APSFRs that resulted from the 1st Cycle, to which new parts that have not been considered in the generation of their flood hydrographs have been added.
- Rivers, streams and torrents of the APSFRs that resulted from the 1st Cycle, where significant changes have occurred (e.g. implementation of flood defences).

The flood flow hydraulic calculations apply the **full two-dimensional field** solution, under unsteady flow conditions defined by the hydrographs prepared during the hydrological analysis. The following were considered as **inputs** to the hydraulic simulation for flood routing:

- The DTM, which was based on the most recent DTM used in the Cadastre with 2m x 2m resolution, as appropriately edited,
- Surveying data and engineering structures on-site surveys. Specifically, 600 engineering structures from the First FRMP, 163 new engineering structures and 174 river cross-sections surveyed under this FRMP were considered, as well as 108 engineering structures for which design data were obtained from the competent bodies.
- Hydrographs – Boundary conditions and hydrographs of transboundary basins – lakes, as derived from the hydrological analysis for average conditions.
- Values of Manning's roughness coefficient 'n' based on newer land use data.
- Initial conditions and specific hydraulic simulation assumptions.

The open-source software system USACE HEC-RAS, version 6.3.1 was used for the **hydraulic simulation**. The software performs calculations at steady and unsteady flow conditions and extracts the surface water profile. It also offers the possibility of solving a two-dimensional floodplain and extracting the water information (depth, level, flow rate), for any point in time of the simulation. It also provides simulation capabilities for a wide range of engineering structures and mainly bridges, culverts and spillways/terraces, as well as the ability to simulate natural lakes and reservoirs.

The following is a characteristic snapshot from the graphical interface of the HEC-RAS software, when introducing an engineering structure in a two-dimensional simulation field within APSFR EL10APSFR008.

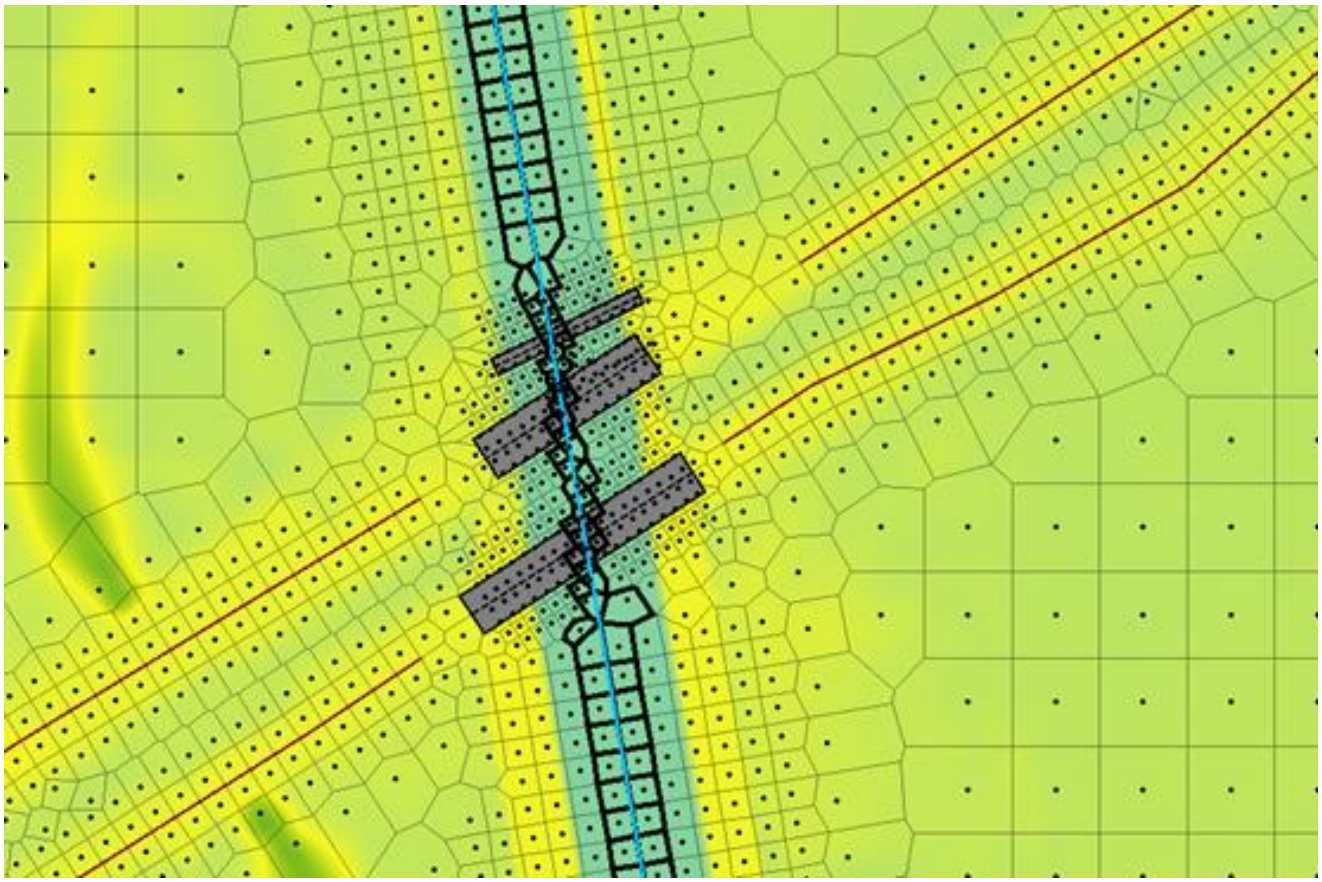


Image 5-1: Screenshot of the HEC-RAS 6.3.1 graphic interface, with the DTM in the background, the two-dimensional solution grid, and an engineering structure perpendicular to the watercourse flow.

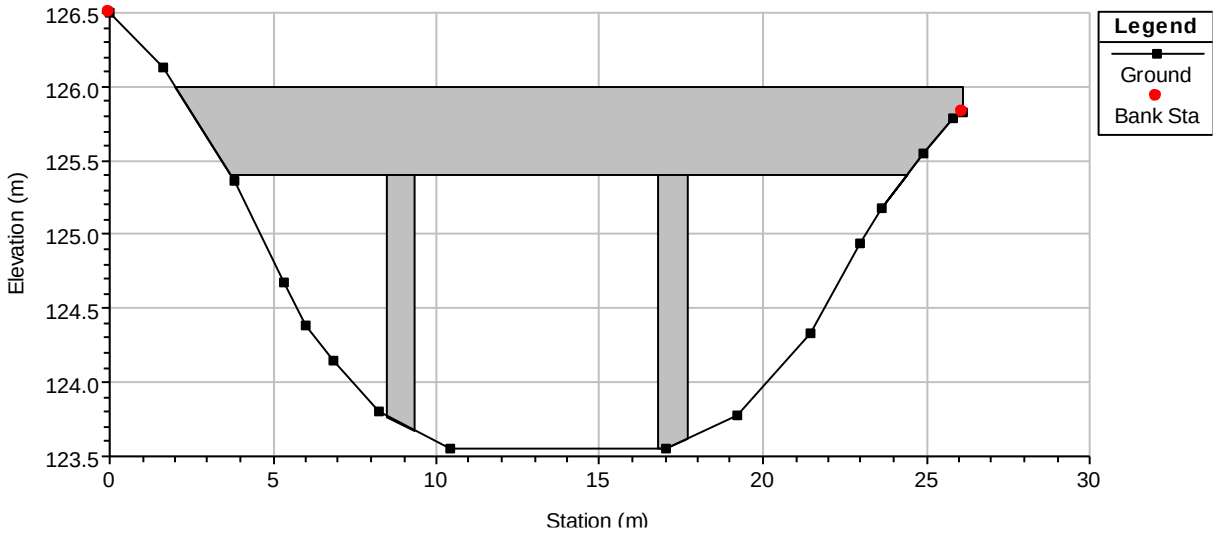


Image 5-2: Screenshot of the HEC-RAS 6.3.1 graphical interface, with the introduction of the geometric characteristics of the spans of a technical structure, upstream to downstream view.

6 Flood Hazard Maps - FHM

The FHM are presented on a 1:25,000 scale for the three river flow/lake flood scenarios, i.e. T=50, 100 and 1000 years, as mentioned above, and for the spatial distribution of the flooding area from sea level rising, and correspond to floods with a high exceedance probability of a 50-year return period and floods with an average exceedance probability of a 100-year return period.

River flow/lake FHMs show the spatial distribution of both maximum depth and maximum water velocity for the three scenarios under review. The maximum flow depth is represented by a blue five (5)-level scale, and the maximum velocity is represented by a red four (4)-level scale. The average sea level rise FHMs show the spatial distribution of the maximum flow depth, with a blue four (4)-level scale.

For all the points of interest affected by the river flow/lake floods under review, the flood wave arrival time and flood duration for flow depths ≥0.3 m has been calculated and indicated on the **river flow/lake FHM**. Arrival times and duration are indicated in a table and correlated with the reference number of each characteristic point. These maps also show:

- the locations and names of settlements in RBD EL10,
- constructed engineering structures that affect water flow and have been considered during the hydraulic simulation, such as bridges, culverts, dams, canals, etc.,
- the locations and unique reference number of each point of interest, such as important infrastructure, significant and potentially polluting facilities, important archaeological sites, etc., for which the arrival time and duration of the flood has been calculated,
- the Maximum Lake Level (MLL) or reservoir level, which is indicated below the name of the respective body of water,
- the location and reference number of each map in relation to the entire RBD EL10.

The **average sea level (ALL) rise FHMs** show the following:

- the locations and names of settlements in RBD EL10,
- the location and reference number of each map in relation to the entire RBD EL10.

For RBD EL10, EL10APSFR008 is the only coastal APSFR for which FHMs are being prepared for the following scenarios:

- ASL rise +1.06 m for a 50-year return period,
- ASL rise +1.13 m for a 100-year return period.

In relation to the river flow/lake FHMs of the First FRMP, note the following:

In **APSFR EL10APSFR002**, the simulation results are largely consistent as regards the progression of the flood but differ in the peaks and the floodplain. At the watercourse discharge area, the 1000-year flood lines of this analysis are slightly wider.

In **APSFR EL10APSFR003**, the simulation results are largely consistent with those of the First FRMP as regards the progression of the flood, and, in most cases, as regards the floodplain as well. Differences are observed in the area around the Thessaloniki – Nea Moudania National Road at the Metochi and Dionysios basins, while the most significant difference is observed at the Vatonia basin. This analysis shows a wide

floodplain due to the overflow of the stream upstream of the National Road, which is greatly expanded towards the coastal area. In the First FRMP, the stream appears adequate throughout the middle and downstream part.

In **APSFR EL10APSFR004**, the simulation results are to a degree consistent with those of the First FRMP as regards the progression of the flood but differ significantly as regards the extent of the floodplain. At the Epanomi basin, the floodplain in this analysis appears less extensive upstream but more extensive to the south and at the Epanomi lagoon. The upstream area of the Tsairi stream appears to have a wider floodplain in the First FRMP for T1000. Finally, at the Kallikratia basin, the hydraulic simulation results in the area upstream and downstream of the Thessaloniki – Nea Moudania National Road are more favourable compared to those of the First FRMP. At the downstream part and down to the estuary, the new hydraulic simulation shows limited widening of the floodplain in relation to the First FRMP.

In **APSFR EL10APSFR006**, the simulation results upstream of Egnatia Odos in the area of the Lagada and Kolchiko watercourses are more favourable than those of the First FRMP. In the areas of the Gerakaros, Chora, Cholomontas and Kerasia watercourses, the floodplain of this analysis is also more limited than in the First FRMP. The flood zone in the area south of Nymfopetra is wider compared to the First FRMP. There is also a difference in flood zones which were extended due to the addition of new stream segments in this analysis.

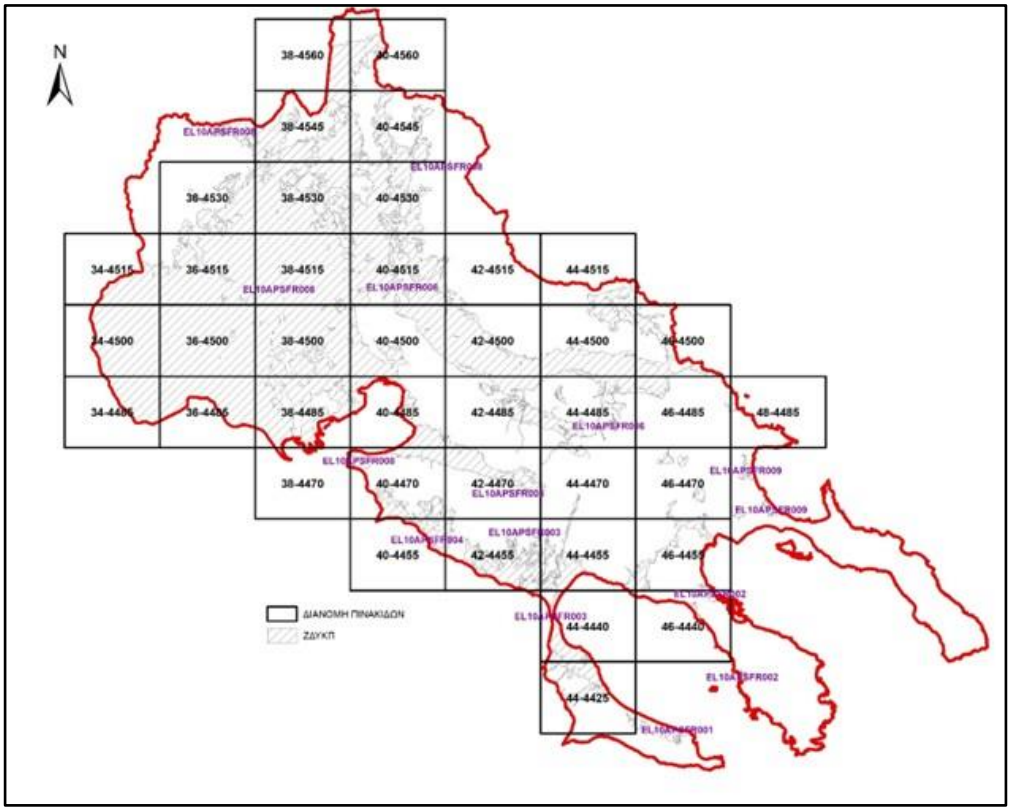
In **APSFR EL10APSFR008**, the simulation results differ significantly. The overflows of the T66 trench (RBD EL09) in the Loudias basin appear more extensive upstream of the Almopia plain up to the Athens-Thessaloniki Old National Road. At the Axios basin, in the upper part of the watercourses, more limited flooding is assessed compared to the First FRMP, whereas, downstream of the Ellis dam, this analysis shows overflows of the Axios riverbed and the Vardarovasi branch, and overbank flow on both sides of the new Axios riverbed for T1000. At the Doirani basin, the floodplains of this analysis appear more favourable in the upstream part of the watercourses at the estuary of the Mavrorema stream as well as in the plain towards Neo Myriophyto where there are no resulting overflows from the Xerorema stream. On the contrary, this analysis demonstrates that the Xerorema stream appears to be responsible for the extensive flood zone in the plains downstream of the archaeological site of Pezouli Mouries and down to the lake, an area which did not appear to be flooded in the First FRMP. At the Kalamaria basin, the floodplain resulting from the overflow of the Trench in this analysis appears bigger to the north and towards Agia Triada near the coastal area. At the Thermi basin, the floodplain appears to spread to the lower part and through the aforementioned overflow to the areas of the neighbouring Anthemountas basin. In the First FRMP, the floodplain appears extensive in the branch descending from Panorama but also in the upstream part at the Triadi area.

In **APSFR EL10APSFR009**, the simulation results are largely consistent with those of the First FRMP as regards the progression of the flood and the floodplain. The object of analysis differs as in this cycle the length of Chavrias river was extended upstream and additional eastern branches were included. In addition, the Basdeki basin was not examined under the First FRMP.

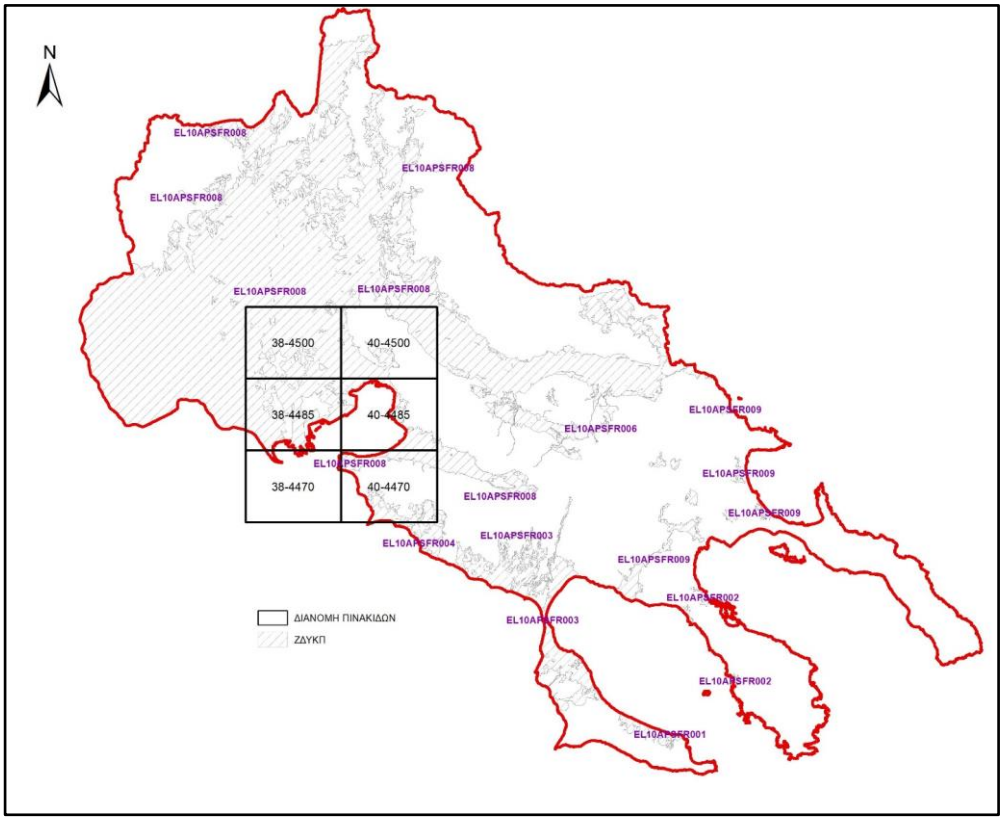
Note that, according to the methodological approach for selecting watercourses for routing and the selection process, as included in the Detailed Documentation "Area Characteristics and Flood Mechanisms Analysis", the watercourses falling under **APSFR EL10APSFR001** were not considered eligible. Therefore, no hydraulic models were designed to simulate the flow in the watercourses and there is no flood risk and hazard assessment for APSFR EL10APSFR001.

Below follows the distribution of FHMs, both for river flow/lake floods and for sea flooding. Note that the distribution tiles are common to the Flood Risk Maps (FRM) that will be presented below. There is also a characteristic sample of a maximum depth spatial distribution FHM map for APSFR EL10APSFR003.

Tile Distribution for river flow/lake FHM-FRM



Tile Distribution for ASL rise FHM-FRM



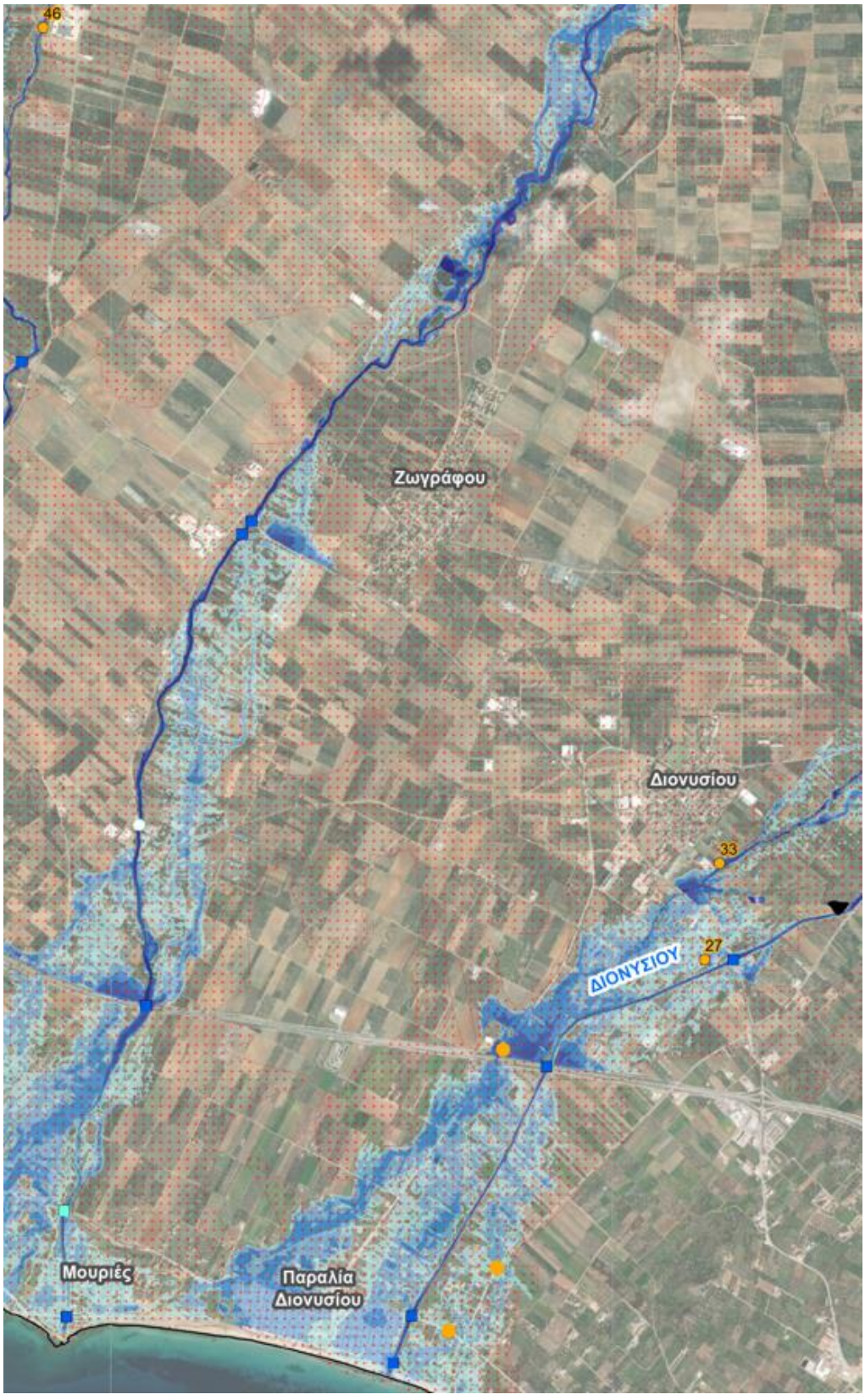


Image 6-1: Part of a FHM showing Dionysio, in Chalkidiki area, APSFR EL10APSFR003 with colour gradation of maximum floodwater depths.

Image 6-2: Part of a FHM showing Dionysio, in Chalkidiki area, APSFR EL10APSFR003 with colour gradation of maximum floodwater velocities.

7 Flood Risk Maps - FRM

FRMs are presented on a 1:25,000 scale for the three river flow/lake flood scenarios, T=50, 100 and 1000 years, and the T=100 year sea flood scenario. FRMs depict land uses, economic activities, protected areas, and cultural heritage sites that fall within flood zones and are delimited by flood boundaries.

Specifically, FRMs present the following flooded elements:

- Indicative affected population in urban areas (<500, 500-2,000, >2,000)
- Health Infrastructure (Hospitals, Clinics and Health Centres)
- Social Infrastructure (Education facilities: Kindergartens, Schools, Universities, Colleges, Vocational Training Institutes, Sports venues, Open Care Centres for the Elderly)
- Water Supply Infrastructure (Community water boreholes, Water pumping stations)
- Energy Infrastructure (Electricity Stations - Substations, Small hydroelectric plants)
- Civil Protection Infrastructure (Police, Fire Brigade, Central Ambulance Facilities)
- Agricultural areas (Greenhouses, Rice Crops, Other Crops)
- Livestock units (Stable facilities)
- Tourist facilities (Developed and Developing)
- Industrial concentrations (Industrial Areas, Industrial Parks, informal industrial concentrations)
- Industries outside industrial concentrations (SEVESO, IPPC, IED, Other industrial units)
- Networks (Trans-European, primary national road network, Secondary – Tertiary national road network, Primary provincial road network, Secondary – Tertiary provincial road network, Railway network)
- Airports
- Wastewater Treatment Plants (WWTP with a capacity of <10,000 PE, WWTP with a capacity of 10,000 – 100,000 PE, WWTP with a capacity of >100,000 PE)
- Municipal solid waste management and disposal sites (sanitary landfills)
- Protected areas (SACs and SPAs)
- Monuments - Archaeological sites (of international, national and regional importance)

In addition to the above, flood maps show the floodplain for the respective return period (T50, T100 and T1000 for river flow/lake floods and T100 for average sea level rise), the bodies of water that have been designated as recreational waters, the settlements, the watercourses and the boundaries of APSFRs, the names of settlements and streams, the border lines and the River Basin District boundaries.

The following Flood Risk Maps have been prepared for RBD EL10:

- **Fluvial Flood Risk Maps** for 50-, 100- and 1000-year return periods (120 maps, scale 1:25,000)
- **Sea Level Rise Flood Risk Maps** for 100-year return period (6 maps, scale 1:25,000)

FRMs also include the following maps:

- **Soil Erosion Vulnerability Map** (1 map, scale 1:300,000)
- **Maximum Potential Impact of Fluvial Flooding Map** for a 1000-year return period (1 map, scale 1:300,000)
- **Degree of Effect of Fluvial Flooding Maps** for 50-, 100- and 1000-year return periods (3 maps, scale 1:300,000)
- **Impact Assessment of Fluvial Flooding Maps** for 50-, 100- and 1000-year return periods (3 maps, scale 1:300,000)
- **Maximum Potential Impact of Sea Level Rise Flooding Map** for 100-year return period (1 map, scale 1:100,000)
- **Degree of Effect of Sea Level Rise Flooding Map** for 100-year return period (1 map, scale 1:100,000)
- **Impact Assessment of Sea Level Rise Flooding Map** for 100-year return period (1 map, scale 1:100,000)

The maps use the Greek Geodetic Reference System (EGSA '87). ESRI's Basemap satellite images are on the background of the maps. Satellite photos are sourced from "ESRI, Maxar, Earthstar Geographics, and the GIS User Community", as offered in ESRI's respective map background services (data retrieval November 2023).

The Flood Risk Assessment for RBD EL10 has revealed a high or very high risk for **T=50 years**:

- in the confluence areas of watercourses Nea Silata, Metochi, Xirolanga, Nea Plagia, Mandria, Dionysios with the Thessaloniki – Nea Moudania National Road, where the Vatonia stream crosses the Polygyros – N. Potidea provincial road and within the settlements Dionysios beach, Simantra and Siviri (**EL10APSFR003**),
- in the areas near the Serres junction of the Egnatia Odos Highway with the Thessaloniki – Kavala National Road, in the Kavallari and Ano Kavallari settlements, in the confluence areas with the Kavallari, Kolchiko and Arapitsa streams and near Rentina (**EL10APSFR006**),
- in the areas of the Thessaloniki Agglomeration south of Dendropotamos up to the area downstream of the Railway Station, in the area of the inner ring-road Kalochori junction, in parts within the informal Industrial Area of Kalochori, in the area of the Egnatia junction, at the International Hellenic University – Alexandria and the area of the Nea Magnesia junction, in the area of Nea Philadelphia near the Gallikos riverbed, in the areas of the road junctions of the Edessa – Thessaloniki National Road to Mylotopos and to Gypsochori in the Loudias basin, but also where Anthemountas river crosses the Thessaloniki – N. Moudania National Road and in the area near Makedonia airport (**EL10APSFR008**),

- in the area downstream of the Chavrias stream where it meets the Polygyros - Ierissos provincial road, in the area of the junction to the Ormylia settlement, in the Kaprinikia branch and at the confluence with the eastern branch of Xenoneri **(EL10APSFR009**).

In addition, there is high or very high risk for **T=100 years** in the following areas as well:

- near the location where Emmanouil Pappas street crosses the Lakkoma stream (**EL10APSFR004**),
- in the Lagadas and Xiropotamos settlements (**EL10APSFR006**),
- in the lowlands where the western branch of Xiropotamos Loudias passes near the Gypsochori, Trifylli, Palaifytos, Karyotissa and Melissi settlements, south of the Gefyra settlement, in the Kymina and Nea Malgara settlements and in the greater area on either side of Gallikos river in the areas of the Sindos and Kalochori Industrial Areas, in the regional trench overflow floodplain, in the upstream areas of Anthemountas river near the Vasilika settlement (**EL10APSFR008**),
- downstream of the Ormylia settlement **(EL10APSFR009**).

Finally, there is high or very high risk for **T=1000 years** in the following areas as well, in addition to those identified for T=50 and 100 years:

- in parts of the Olynthos settlement (**EL10APSFR003**),
- locally upstream of the Thessaloniki – N. Moudania National Road and in the downstream areas of the Lakkoma, Kallikrateia watercourses (**EL10APSFR004**),
- in the Scholari settlement (**EL10APSFR006**),
- in Diavata, in the Galarinos, Kallipoli, Palaios and Neos Mylotopos, Lipochori, Liparo, Aspro, Aggelochori, Akrolimni and Krya Vrisi settlements, to the west of the Loudias basin, upstream of Egnatia Odos and near the Kleidi settlement, south of the Gefyra settlement and in the greater area between Gallikos river and the Gallikos and Anatoliko Canal (**EL10APSFR008**),
- in the area of the Olympiada settlement, in the confluence of the branches and the estuary of Basdekis river **(EL10APSFR009**).

Areas with a high, medium and low flood risk for all return periods and the sources of flooding under review are described in detail in the Central Macedonia FRM Plan. To illustrate, the following figure shows the percentage distribution of river flow/lake flood risk categories in RBD EL10.

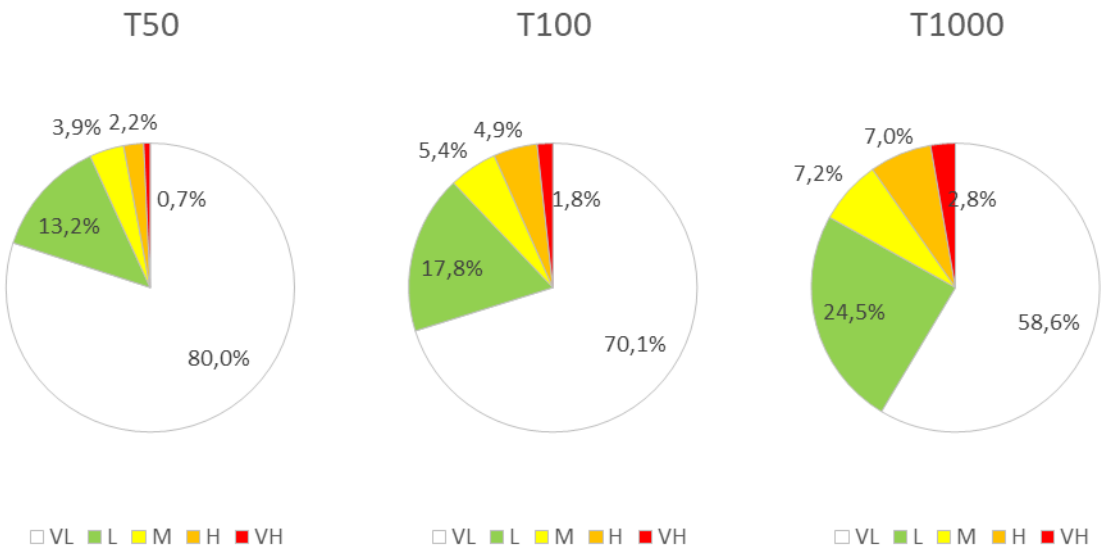


Image 7-1: Areas per flood risk category in RBD EL10 for T50, T100 and T1000.

The following tables summarize the potentially affected economic activities as well as significant infrastructure within the flooded areas for the three return periods reviewed in average conditions for the entire Central Macedonia River Basin District. The second table shows the potentially affected population per APSFR and return period.

Table 7-1: Infrastructure and economic activities within the flooded areas of the Central Macedonia RBD per return period.

Infrastructure – Economic Activity		T50	T100	T1000
Settlements		91	103	130
Education Facilities		88	106	160
Civil Protection Facilities		11	14	18
Health Care Units		4	5	9
Cultural Heritage Monuments		21	27	42
Sports Facilities		14	18	34
Power Substations		2	5	6
Livestock Units		185	230	481
Industrial Installations	*Industrial concentrations	7.99	11.78	18.88
	Industries outside industrial concentrations	59	76	137
Boreholes		833	1,007	1,735
WWTP		6	10	15
***Agricultural areas with crops**		402.91	506.41	843.48

* Areas are in square kilometres (km^2).

Table 7-2: Potentially affected population per APSFR and return period.

APSFR	T50	T100	T1000
EL10APSFR001	-	-	-
EL10APSFR002	1	2	3
EL10APSFR003	1,306	1,459	2,410
EL10APSFR004	22	26	38
EL10APSFR006	5,538	6,611	10,436
EL10APSFR008	86,432	112,509	168,158
EL10APSFR009	263	359	628
TOTAL	**93,562**	**120,966**	**181,673**

The following is a typical example of a FRM for EL10APSFR008.

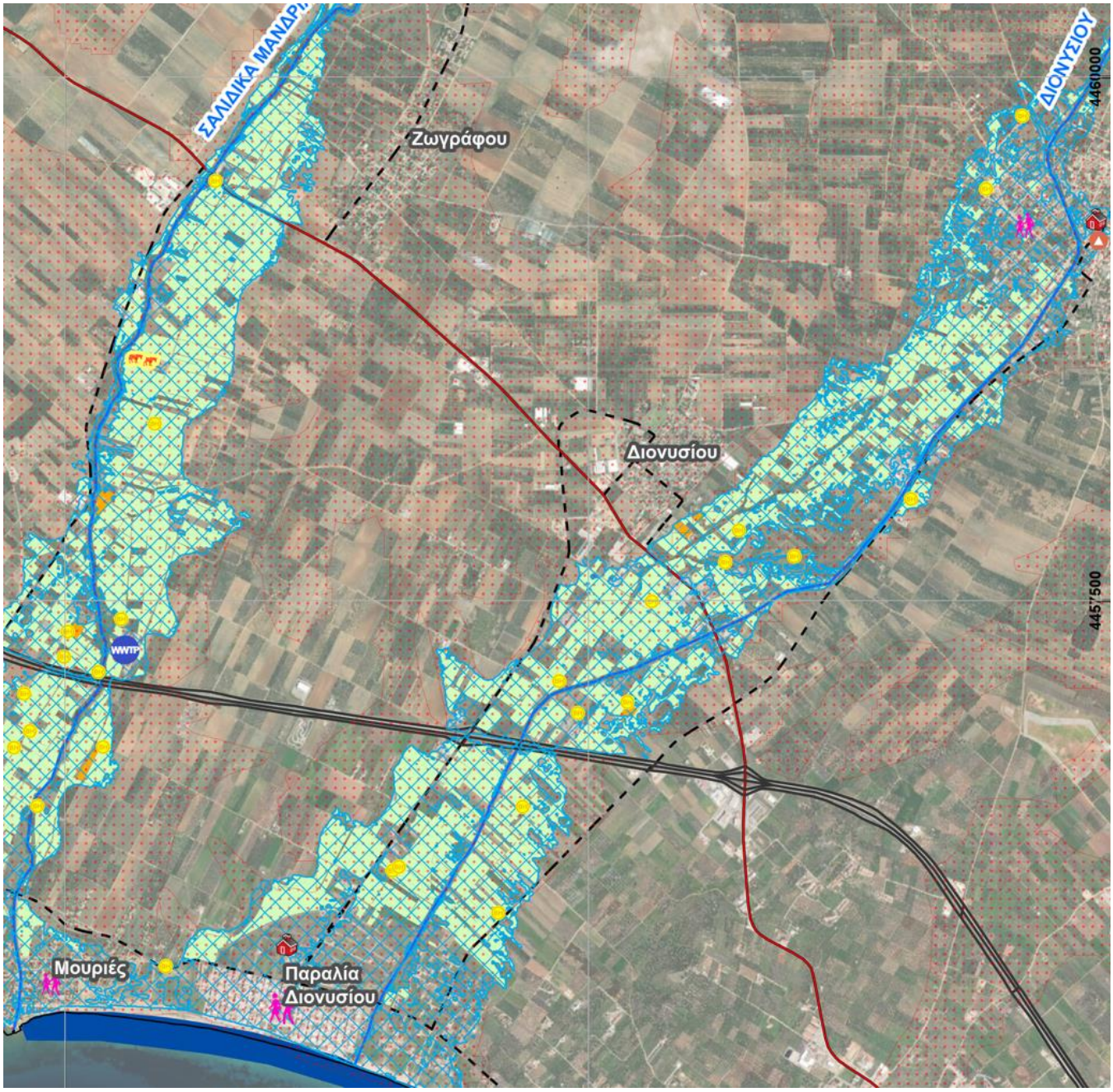


Image 7-2: Part of a FRM focusing on Dionysio, Chalkidiki, APSFR EL10APSFR003 showing the affected surface and point uses.

8 1st Review of the FRMP - Investigation of Climate Change

The EU recognises that changes in the intensity and frequency of extreme rainfall, coupled with land-use changes, are expected to increase the risk of flooding across Europe. The overall guiding principle of the EU is to adapt flood risk management to potential climate change. In accordance with Article 14 of Directive 2007/60/EC, the likely impact of climate change on the occurrence of flood events shall be taken into account in reviews of the flood hazard maps and risk maps and the Flood Risk Management Plans (FRMPs), in this 1st Review of the FRMPs.

The aim of this 2nd implementation cycle of Directive 2007/60/EC is to determine how climate change affects the occurrence of flood events. More specifically, the research looks into the reduction or increase of the return period of a flood event which in the current climatic conditions and data corresponds to an event with T= 50, 100 or 1000 years.

The Methodology applied to assess how climate change affects the occurrence of flood events based on rainfall intensity, uses climate projection data from 675 rainfall gauging station locations in Greece. These data were developed under the SWICCA program (Service for Water Indicators in Climate Change Adaptation, 2015-2018) and are derived from 9 combinations of Global Circulation Models (GCMs), Regional Climate Models (RCMs) and Representative Concentration Pathways (RCPs).

For each point determination of rainfall runoff curves position, the new frequency of recurrence of design floods of this 1st Review of the FRMP, as this results from the climatic projections, is defined for **two future climatic periods**:

- Mid-century (2041-2070 or 2050s) and
- End of century (2071-2100 or 2080s).

For **the entire RBD EL10**, there is an almost halving (doubling) of the return periods (frequency of occurrence) of intense rainfall event. This suggests that in the climatic future, rainfall intensities associated with a given occurrence will increase or, equivalently, the occurrence frequency of historically observed flood events will increase. Therefore, the climatic future is expected to be more unfavourable in terms of the observed flood events at River Basin District level, and to the extent that these concern medium and large-scale hydraulic structures.

- At the level of **RBD average values**, there are no major differences between the climatic periods 2041 - 2070 (2050s) and 2071 - 2100 (2080s), other than a reduction in the spatial variability of the estimated new return periods.
- The following Tables show the change in the average return period of River Basins in RBD EL10 during the future periods 2041 - 2070 (2050s) and 2071 - 2100 (2080s).

Table 8-1: Expected average return period values of River Basins in RBD EL10 during the future periods 2050s and 2080s.

no.	River Basin	$T^{hist.T50}$ 2041 - 2070 (2050s)	$T^{hist.T100}$ 2041 - 2070 (2050s)	$T^{hist.T1000}$ 2041 - 2070 (2050s)
1	AXIOS	24	45	594
2	GALLIKOS	33	69	921
3	CHALKIDIKI	31	62	873
no.	**River Basin**	$T^{hist.T50}$ 2071 - 2100 (2080s)	$T^{hist.T100}$ 2071 - 2100 (2080s)	$T^{hist.T1000}$ 2071 - 2100 (2080s)
1	AXIOS	24	45	660
2	GALLIKOS	26	50	901
3	CHALKIDIKI	28	57	750

9 Differences from the 1st Implementation Cycle of Directive 2007/60/EC

The most important differences of this 1st Review of the FRMP compared to the 1st Implementation Cycle of Directive 2007/60/EC (First FRMP) are found in the following points:

- Different boundaries of the Areas of Potentially Significant Flood Risk in the Central Macedonia River Basin District (EL10) in the 1st Review of the Preliminary Flood Risk Assessment.
- Use of a new Digital Terrain Model based on the most recent Digital Terrain Model (DTM) of the Cadastre, with a 2x2m resolution, created for the purpose of orthorectification and production of LSO25 orthophoto maps, in 2015-2016. All the required correction and improvement work was performed on the model, and on-site measurements were incorporated (see Detailed Documentation "Production of a High Resolution and Precision Digital Terrain Model in Mild Relief Areas as well as in High and Very High Risk Areas, as these resulted from the flood impact assessment maps of the 1st implementation cycle of Directive 2007/60/EC and described in the corresponding measure of the FRMPs").
- Change in land use, economic activities and infrastructure in the APSFR of the Central Macedonia River Basin District (EL10)
- Difference in the rainfall data and rainfall curves used in the preparation of flood hydrographs and, consequently, in the use of new hydrographs for all three return periods (see Detailed Documentation "Flood Hydrographs").
- Use of a different hydraulic simulation software compared to the First FRMP (HEC-RAS vs FLO 2D)
- the addition of new watercourses and parts of watercourses and rivers for routing (see Detailed Documentation "Analysis of area characteristics and flood mechanisms").

Based on the above observations, the differences in the assessment results of the Maximum Potential Impact –Vulnerability Assessment, Flood Hazard, Flood Risk and Soil Erosion Vulnerability of the 1st Review of the FRMP in the Central Macedonia RBD are summarized below compared to the first FRMP:

- The overall maximum flood area appears reduced by 11.7% compared to the First FRMP. The maximum potential impact for T1000 is significantly reduced in terms of distribution in the very high vulnerability category, as the area falling within the highest vulnerability category appears reduced by 65.1% compared to the first FRMP. Regarding the distribution in the high vulnerability category, the area falling into this category appears increased by 53.4% compared to the First FRMP.
- The total flood area is reduced by 40.8%, 42.0% and 11.7% for T50, T100 and T1000 respectively, compared to the First FRMP.
- The hazard for return periods T50 and T100 is significantly reduced in terms of distribution into very high and high hazard categories. Specifically, the area that falls into the highest category of very high hazard for T50 appears reduced by 97.8% compared to the First FRMP, and for T100 appears reduced by 64.3% compared to the First FRMP. Accordingly, in the high category the reductions are 90.4% and 61.6% for T50 and T100 respectively. On the contrary, the hazard for return period T1000 appears increased in terms of distribution into medium and very high hazard categories and reduced in terms of distribution into low and high hazard categories. The area that falls into the highest category of very high hazard appears increased by 32.9% compared to the First FRMP.

- The flood risk for return periods T50 and T100 is significantly reduced in terms of distribution into low up to very high risk categories. To illustrate, the area that falls into the highest category of very high risk for T50 appears reduced by 72.9% compared to the First FRMP, and for T100 appears reduced by 40.5% compared to the First FRMP. Accordingly, in the high category the reductions are 83.6% and 60.2% for T50 and T100 respectively. The percentage participation of the very high risk category in the total area is 1.10%, 2.61% and 3.97% for T50, T100 and T1000 respectively in this 1st Review of the FRMP, while in the First FRMP the respective percentages were 2.39%, 2.55% and 4.21%. The flood risk for T1000 return period is reduced in terms of distribution into low up to very high risk categories. The area that falls into the highest category of very high risk appears reduced by 16.7% compared to the First FRMP.
- The total average soil loss from the mountainous basins to the basins of the River Basin District's APSFR was estimated at 736,284.526 t/y, while the average soil loss from all the River Basin District's APSFRs was estimated at 453,006.460 t/y. These values are comparable to the results of the First FRMP with proportionally small differences of ~±4.5%.

10 Preparing the Programme of Measures for the 1st Review of the FRMP of the Central Macedonia RBD EL10

10.1 Objectives of the 1st Review of the FRMP for the Central Macedonia RBD EL10

In accordance with Directive 2007/60/EC Member States shall set objectives focusing on:

(a) the reduction of potential adverse consequences of flooding:

for human health,

the environment,

cultural heritage, and

economic activity, and/or

(b) the reduction of the likelihood of flooding (with construction or non-construction projects).

To date, no uniform methodology has been developed at European level to establish Flood Risk Management objectives. Thus, there is a considerable difference in approach between Member States.

The objectives established in the framework of the First FRMP for the Central Macedonia RBD took into account the provisions of Directive 2007/60/EC and the Guidance Texts, and were set as follows:

General Objectives of the First FRMP:

- Mitigation of exposure to flooding (Management Objective O1)
- Flood likelihood reduction (Management Objective O2)
- Enhancing flood preparedness (Management Objective S3)
- Improving the restoration mechanisms of affected areas (Management Objective O4)

The above General Objectives of the **First FRMP** correspond to the four lines of action of Flood Risk Management (Prevention, Protection, Preparedness, Restoration) and are strategic in nature to establish a common understanding and policy on the issues related to flood risk management.

In this **1st Review of the FRMP**, the above General Objectives are maintained, in accordance with the provisions of Directive 2007/60/EC and the Guidance Texts, and are further specified in **Specific Objectives** established to identify, distinguish and explain the individual objectives that together will effectively cover the achievement of each general objective, in correlation both with the axes of the programme of measures being prepared and with the proposed measures.

To achieve **General Objective O1 to mitigate exposure to flooding** affecting human health, the environment, cultural heritage and economic activity, the following **specific objective**s are established:

O1.1: Organisation and improvement of available information, by implementing actions and measures for obtaining and supplementing information, such as the creation of registers of flood events and technical data of flood defences and demarcations, to ensure the optimal monitoring of the Programme of Measures of the 1st Review of the Central Macedonia FRMP (RBD EL10).

O1.2: Improvement of knowledge on flood prevention by implementing actions and measures for training/information, modernisation and organisation of a network of meteorological and hydrometric data.

O1.3: Adoption of appropriate terms and restrictions, consistent with the FRMP by implementing actions and measures for spatial and urban planning, the controlled flooding of areas and the protection of critical infrastructure, through appropriate legislative/administrative arrangements.

To achieve **General Objective O2 to reduce the likelihood of flooding** affecting human health, the environment, cultural heritage and economic activity, the following **specific objective**s are established:

O2.1: Reduction of flood risk through natural water retention in lowland areas by implementing environmental actions and measures as well as technical measures leading to the creation and management of the floodplain of the mountain bed of watercourses.

O2.2: Reduction of flood risk using other means by implementing actions and measures for the development of reservoir projects, the modernisation, restoration and construction of drainage networks, rainwater management and flood defences.

O2.3: Strengthening flood risk management practices at the protection stage by implementing actions and measures for strategic planning of flood defences and rainwater projects while promoting natural retention solutions to improve runoff management through appropriate legislative/administrative arrangements.

To achieve **General Objective O3 to enhance flood preparedness** and mitigate the impact of flood events on human health, the environment, cultural heritage and economic activity, the following **specific objectives** are established:

O3.1: Increase the level of preparedness against flood risk by implementing actions and measures for the development of early flood warning tools and the organisation and licensing of actions for the restoration/maintenance of embankments.

O3.2: Improvement of knowledge on flood preparedness by implementing non-structural interventions, actions and measures for education/information and awareness-raising of the public and bodies, as well as actions to determine, in advance, alert levels and introduce signage/warnings for flood-risk areas.

O3.3: Strengthening flood risk management practices at the preparedness stage by implementing actions and measures for the preparation of plans and regulations for actions, by applying appropriate technical measures for controlled flooding, non-structural interventions and legislative/administrative arrangements.

To achieve **General Objective O4 to improve the restoration mechanisms of affected areas** (human health, the environment, cultural heritage and economic activity), the following **specific objectives** are established:

O4.1: Improvement of the post-flood loss valuation and compensation mechanism by implementing actions and measures of a financial and legislative/administrative nature to regulate actions and responsibilities for recording damages.

O4.2: Improvement of preparation for execution of restoration work by implementing actions and measures of an environmental nature to identify restoration methods and emergency actions after flood events.

O4.3: Improvement of the post-flood restoration mechanism by implementing actions and measures of a financial and legislative/administrative nature to support the affected population after flood events.

To achieve the abovementioned **Objectives**, the revised FRMP includes a comprehensive **Programme of Measures** as presented in the following sections. According to this, each Measure contributes to one Specific Objective. Therefore, **achievement of objectives can be quantified by measuring the implementation percentage (%) of proposed Measures per Specific Objective**.

10.2 Preliminary Assessment of All Measures

To achieve the Flood Risk Management objectives, as revised in the 1st Review of the Flood Risk Management Plan (FRMP), a superset, a "pool", of Measures, common to all River Basin Districts in the country, was prepared, considering:

- The requirements arising from the implementation of Directive 2007/60/EC.
- The measures of the first FRMP and the progress of their implementation.
- The EU's comments made on the country's first FRMP (September 2021)
- The available financing instruments and the funds that can be drawn from such instruments for Flood Risk Management and the implementation of specific actions.
- The National Climate Change Adaptation Strategy (NCCCA) and the Regional Climate Change Adaptation Plan (RCCAP) of the Region of Central Macedonia.
- The provisions and limitations of the RBMPs (2nd Review).
- The existing synergies between FRM measures and other measures and actions aimed at the protection and upgrading of the environment, and specifically the objectives of the Water Framework Directive - WFD (premium for measures which are compatible with the objectives of both Directives, win-win measures).
- The impact the measures may have on the economy, society and the environment.
- The existing institutional framework.

Moreover, all other actions currently implemented that contribute to the response to and management of flood risks were also considered.

In the context of the 1st Review of the FRMP and for the purpose of developing the programme of measures for the Management and Response to flood risks in each River Basin District, a Preliminary Assessment of the superset of measures reviewed at country level was carried out with the help of a single multi-criteria analysis methodology described in detail in the Detailed Documentation "Preliminary Assessment of measures of the 1st Review of the FRMP".

After the Preliminary Assessment, **out of a total of 40 reviewed measures** (initial pool of measures), **32 were selected for further investigation** as to their implementation in RBD EL10 and 8 measures were withdrawn.

Note, however, that after the consultation process, the following measure was also removed: "*Providing incentives for private flood insurance*", which according to the Preliminary Assessment methodology, had initially qualified. This measure was removed during the consultation and the documentation of its removal is included in Detailed Documentation: “Report on the Consultation Results”.

10.3 Programme of Measures for the FRMP of the Central Macedonia RBD EL10

Based on the above, out of the 32 measures of the Central Macedonia River Basin District (EL10) that were selected through the Preliminary Assessment process and submitted for consultation, **31 measures in total are finally proposed.** Of these, 9 are related to Prevention, 12 to Protection, 8 to Preparedness and 2 to Restoration.

Table 10-1: Number of measures per line of action in the Central Macedonia RBD

Measure axis	Total number of measures reviewed	Total number of measures after completion of preliminary assessment and public consultation processes
Prevention	11	9
Protection	14	12
Preparedness	10	8
Restoration	5	2
Total	40	31

A summary diagram of the measures of the 1st Review of the FRMP of the Central Macedonia RBD (EL10) per General Objective and Specific Objective is given below. The measures are further presented in the following paragraphs.

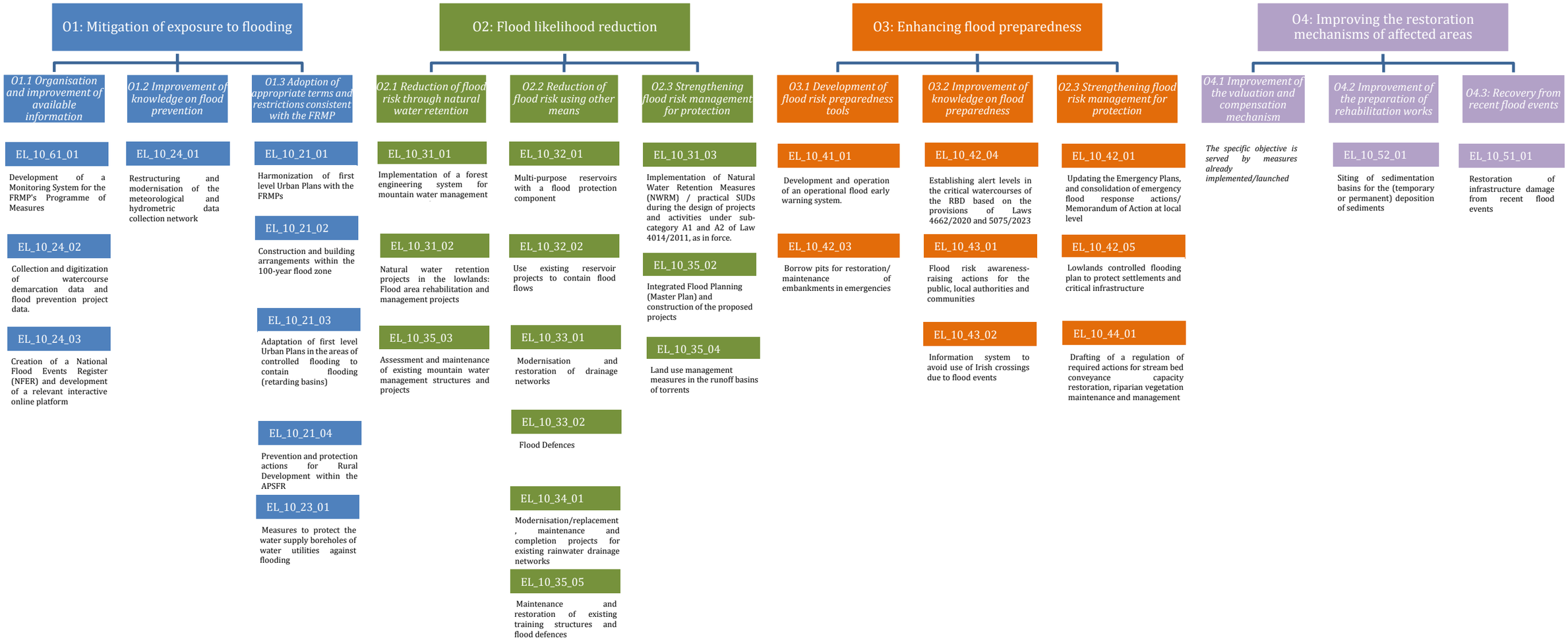


Image 10-1: Tree Diagram of Measures – General and Specific Objectives.

The 31 measures included in this 1st Review of the FRMP are presented in management action sheets, colour-coded per flood risk management line of action (Prevention, Protection, Preparedness and Restoration) and depending on the General Objective they serve: **O1**, **O2**, **O3** ή **O4**. Each management action sheet is accompanied by the documentation justifying the necessity of each measure.

The process of drafting the measures of this 1st Review of the FRMP includes specifying the spatial application and impact levels for all the measures. Specifically, out of the 31 measures proposed for implementation in this FRMP, 20 are applied across the entire RBD EL10. In addition, 11 specific measures are applied to individual sections of specific APSFR.

The following are general remarks that apply to the entire programme of measures of this 1st Review of the FRMP in the Central Macedonia River Basin District (EL10):

1. The preparation of the necessary designs is considered an integral part of the implementation of projects, since they ensure project maturity.
2. The programme of measures consists of measures relating to administrative or other arrangements that need to be implemented universally, as well as measures that may pertain to a very broad area (e.g. T100 flood zone or other) so as to examine their applicability within said area, considering both the nature of each area and its individual needs. Consequently, a measure concerning the River Basin District or all the APSFRs shall not be necessarily applied to all the areas therein if it turns out that there is no such need.

Note that this 1st Review of the Flood Risk Management Plan concerns the Areas of Potentially Significant Flood Risk and is based on the results of the Flood Hazard and Flood Risk Maps. Projects and actions of the FRMP Programme of Measures in areas that do not constitute Areas of Potentially Significant Flood Risk of the 1st Review of the Preliminary Flood Risk Assessment, but have suffered a large-scale flood event and/or a major forest fire either within such areas and/or downstream/upstream of them, may be financed by submitting a substantiated proposal to the financing instrument, provided that the compatibility of the projects/actions with the Objectives of Directive 2007/60/EC on the assessment and management of flood risks can be ensured, and that no conditions are created which are contrary to the relevant Flood Risk Management Plan and the provisions of this Programme of Measures.

The measures included in the 1st Review of the FRMP for the Central Macedonia RBD (EL10) are the following:

Table 10-2: Summary presentation of the measures for the 1st Review of the FRMP of the Central Macedonia RBD (EL10).

Measure Reference no.	Measure Title	General Objective	Area of Application	Implementing Agency
EL_10_61_01	Development of a Monitoring System for the FRMP's Programme of Measures	**O1 Mitigation of exposure to flooding**	RBD EL10	MACEDONIA – THRACE DECENTRALIZED ADMINISTRATION (Central Macedonia Water Directorate)
EL_10_21_01	Harmonization of first level Urban Plans with the FRMPs		RBD EL10	MINISTRY OF ENVIRONMENT AND ENERGY (General Secretariat for Spatial Planning and Urban Environment)
EL_10_21_02	Construction and building arrangements within the 100-year flood zone		RBD EL10	MINISTRY OF ENVIRONMENT AND ENERGY (General Secretariat for Spatial Planning and Urban Environment)
EL_10_21_03	Adaptation of first level Urban Plans in the areas of controlled flooding to contain flooding (retarding basins)		RBD EL10	MINISTRY OF ENVIRONMENT AND ENERGY (General Secretariat for Spatial Planning and Urban Environment)
EL_10_21_04	Prevention and protection actions for Rural Development within the APSFR		RBD EL10	MINISTRY OF RURAL DEVELOPMENT AND FOOD
EL_10_23_01	Measures to protect the water supply boreholes of Water Utilities against flooding		EL10APSFR006 EL10APSFR008	(1) Water Utilities (2) MACEDONIA- THRACE DECENTRALIZED ADMINISTRATION (Central Macedonia Water Directorate)
EL_10_24_01	Restructuring and modernisation of meteorological and hydrometric data collection network		RBD EL10	MINISTRY OF ENVIRONMENT AND ENERGY (General Directorate for Water)

Measure Reference no.	Measure Title	General Objective	Area of Application	Implementing Agency
EL_10_24_02	Collection and digitization of watercourse demarcation data and flood defences data		RBD EL10	MINISTRY OF ENVIRONMENT AND ENERGY (Technical Chamber of Greece) and MINISTRY OF INFRASTRUCTURE AND TRANSPORT
EL_10_24_03	Creation of a National Flood Events Register (NFER) and development of a relevant interactive online platform		RBD EL10	MINISTRY OF ENVIRONMENT AND ENERGY (General Directorate for Water)
EL_10_31_01	Implementation of a forest engineering system for mountain water management structures and projects	**O2: Flood likelihood reduction**	EL10APSFR006 EL10APSFR008 EL10APSFR009	MINISTRY OF ENVIRONMENT AND ENERGY (Directorates of Forests), Forestry Offices
EL_10_31_02	Natural water retention projects in the lowlands		RBD EL10	MINISTRY OF INFRASTRUCTURE AND TRANSPORT (Directorate for Flood Defences and Rehabilitation Projects D19), CENTRAL MACEDONIA REGION (Directorate for Technical Projects / Sub-Directorates for Technical Projects), MUNICIPALITIES
EL_10_31_03	Implementation of Natural Water Retention Measures (NWRM) / practical SUDs during the design of projects and activities under sub-category A1 and A2 of Law 4014/2011, as in force		RBD EL10	Implementing Agency of each project
EL_10_32_01	Multi-purpose reservoirs with a flood protection component		RBD EL10	Project owner

Measure Reference no.	Measure Title	General Objective	Area of Application	Implementing Agency
EL_10_32_02	Use existing reservoir projects to contain flood flows		EL10APSFR003 EL10APSFR004 EL10APSFR006 EL10APSFR008 EL10APSFR009	Reservoir Management Bodies
EL_10_33_01	Modernisation and restoration of drainage networks		EL10APSFR006 EL10APSFR008	MINISTRY OF INFRASTRUCTURE AND TRANSPORT (Directorate for Flood Defences and Rehabilitation Projects D19), CENTRAL MACEDONIA REGION (Directorate for Technical Projects / Sub-Directorates for Technical Projects), LAND RECLAMATION AGENCIES (OEB)
EL_10_33_02	Flood Defences		EL10APSFR001 EL10APSFR002 EL10APSFR003 EL10APSFR004 EL10APSFR006 EL10APSFR008 EL10APSFR009	MINISTRY OF INFRASTRUCTURE AND TRANSPORT (Directorate for Flood Defences and Rehabilitation Projects D19), CENTRAL MACEDONIA REGION (Directorate for Technical Projects / Sub-Directorates for Technical Projects), MUNICIPALITIES
EL_10_34_01	Modernisation/replacement, maintenance and completion projects for existing rainwater drainage networks		EL10APSFR001 EL10APSFR002 EL10APSFR003 EL10APSFR004 EL10APSFR006 EL10APSFR008 EL10APSFR009	CENTRAL MACEDONIA REGION (Directorate of Technical Projects / RU Sub-Directorates of Technical Projects), MUNICIPALITIES, Water & Sewage Companies, Road maintenance bodies
EL_10_35_02	Integrated Flood Planning (Master Plan) and construction of the proposed projects		RBD EL10	Action [A] : MINISTRY FOR CLIMATE CRISIS AND CIVIL PROTECTION (Technical Chamber of Greece)[4] Action [B] & Action [C] : To be determined in the Masterplan
EL_10_35_03	Assessment and maintenance of existing mountain water		EL10APSFR003 EL10APSFR006 EL10APSFR008	MINISTRY OF ENVIRONMENT AND ENERGY (Directorates of Forests), Forestry Offices

[4] According to article 225 of Law 4782/2021 (Government Gazette 36/A/9.3.2021) and Ministerial Decision No. ΥΠ 1086/2024 (Government Gazette 3955/B/5.7.2024).

Measure Reference no.	Measure Title	General Objective	Area of Application	Implementing Agency
	management structures and projects			
EL_10_35_04	Land use management measures in the runoff basins of torrents		RBD EL10	MINISTRY OF RURAL DEVELOPMENT AND FOOD
EL_10_35_05	Maintenance and restoration of existing training structures and flood defences		RBD EL10	CENTRAL MACEDONIA REGION (Directorate of Technical Projects / RU Sub-Directorates of Technical Projects)
EL_10_41_01	Development and operation of an operational flood early warning system	**O3: Enhancing flood preparedness**	EL10APSFR008 EL10APSFR009	Developer: MoEE Operator: MINISTRY FOR CLIMATE CRISIS AND CIVIL PROTECTION (General Secretariat for Civil Protection) or CENTRAL MACEDONIA REGION (Independent Civil Protection Directorate)
EL_10_42_01	Updating the Emergency Plans, and consolidation of emergency flood response actions/ Memorandum of Action at local level		RBD EL10	CENTRAL MACEDONIA REGION (Independent Civil Protection Directorate), MUNICIPALITIES (Civil Protection Offices), MACEDONIA-THRACE DECENTRALIZED ADMINISTRATION (Civil Protection Directorate)
EL_10_42_03	Borrow pits for restoration/ maintenance of embankments in emergencies		EL10APSFR006 EL10APSFR008 EL10APSFR009	CENTRAL MACEDONIA REGION (Directorate of Technical Projects / RU Sub-Directorates of Technical Projects, Independent Civil Protection Directorate)
EL_10_42_04	Establishing alert levels in the critical watercourses of the River Basin District based on the provisions of Laws 4662/2020 and 5075/2023		EL10APSFR003 EL10APSFR004 EL10APSFR006 EL10APSFR008 EL10APSFR009	CENTRAL MACEDONIA REGION (Directorate of Technical Projects / RU Sub-Directorates of Technical Projects, Independent Civil Protection Directorate)

Measure Reference no.	Measure Title	General Objective	Area of Application	Implementing Agency
EL_10_42_05	Lowlands controlled flooding plan to protect settlements and critical infrastructure		EL10APSFR003 EL10APSFR006 EL10APSFR008 EL10APSFR009	MINISTRY OF INFRASTRUCTURE AND TRANSPORT (Directorate for Flood Defences and Rehabilitation Projects D19), CENTRAL MACEDONIA REGION (Directorate for Technical Projects / Sub-Directorates for Technical Projects), Ministry for Climate Crisis and Civil Protection (General Secretariat for Civil Protection)
EL_10_43_01	Flood risk awareness-raising actions for the public, local authorities and communities		RBD EL10	MINISTRY FOR CLIMATE CRISIS AND CIVIL PROTECTION, MINISTRY OF EDUCATION, MINISTRY OF ENVIRONMENT AND ENERGY, MACEDONIA - THRACE DECENTRALIZED ADMINISTRATION (Civil Protection Directorate), CENTRAL MACEDONIA REGION (Independent Civil Protection Directorate), MUNICIPALITIES in cooperation with the administration of school units
EL_10_43_02	Information system to avoid use of Irish crossings due to flood events		RBD EL10	Road network operator
EL_10_44_01	Drafting of a regulation of required actions for stream bed conveyance capacity restoration, riparian vegetation maintenance and management		RBD EL10	MINISTRY OF ENVIRONMENT AND ENERGY in cooperation with jointly competent bodies
EL_10_51_01	Restoration of infrastructure damage from recent flood events	**O4: Improving the restoration mechanisms of affected areas**	RBD EL10	Competent bodies, depending on the type of infrastructure, for recording, designing and restoring/providing compensation, in accordance with the applicable legislation
EL_10_52_01	Siting of sedimentation basins for the (temporary or permanent) deposition of sediments		RBD EL10	CENTRAL MACEDONIA REGION (Directorate of Technical Projects / RU Sub-Directorates of Technical Projects, Independent Civil Protection Directorate) The results of the study will be communicated to the General Secretariat for Civil Protection and the Independent Civil Protection Directorates of the Regions

The following is the special measures form (**standard management action sheet**) used for the detailed presentation of the measures of the 1st Review of the FRMP in the Central Macedonia RBD (EL10). Each management action sheet is colour-coded according to the General Objective it fulfils. Note that in relation to the corresponding standard form of the First FRMP, some old fields have been changed, and new ones have been added, thus facilitating understanding of the content and implementation and monitoring of each measure.

Table 10-3: Standard management action sheet of the 1st Review of the FRMP for the Central Macedonia RBD (EL10).

MEASURE TITLE	*Includes the title of the measure*
MEASURE REFERENCE	*The measures are numbered as follows: EL_10 (River Basin District number)_XX (Measure Type according to WISE) _XX (Meter Serial Number)*
CORRELATION WITH MEASURE OF THE FIRST PLAN	*Ongoing from the first Plan or New Measure*
LINE OF ACTION	*Prevention, Protection, Preparedness, Restoration*
GENERAL OBJECTIVE	*The FRM General Objective to which the measure relates (O1, O2, O3, O4)*
TYPE OF FRM MEASURE	*The FRM type reference of the measure and its description*
TYPE OF NATURAL WATER RETENTION MEASURE	*The reference number of the Natural Water Retention measure type and its description according to the Text "EU policy document on Natural Water Retention Measures, Technical Report", WFD CIS Working Group Programme of Measures (WG PoM), 2014 and the Catalogue of NWRM | Natural Water Retention Measures*
SPECIFIC OBJECTIVE	*The FRM Specific Objective to which the measure refers (O1.1, O1.2, O1.3, O2.1, O2.2, O2.3, O3.1, O3.2, O3.3, O4.1, O4.2, O4.3)*
TYPE OF MEASURE	*Legislative/ Administrative arrangements* *Measures of an economic nature* *Education/information measures* *Non-structural interventions* *Obtaining, supplementing and improving information* *Environmental measures (green infrastructure)* *Technical Flood Defences*
MEASURE DESCRIPTION	*A detailed description of the measure*
IMPLEMENTING BODIES	*Reference to the Competent Authority responsible for the implementation, application and coordination of the proposed measure at national, regional, local level as well as to the other bodies involved in its implementation*

AREA OF APPLICATION OF THE MEASURE	*River Basin District, APSFR, Runoff Basin, Water Body, place, etc.*
MEASURE APPLICATION MONITORING INDICATOR	*Varies by measure*
TARGET VALUE	*Varies by measure*
MEASURE AREA OF IMPACT	*River Basin District, APSFR, Runoff Basin, Water Body, place, etc.*
MEASURE IMPACT MONITORING INDICATOR	*Varies by measure*
TARGET VALUE	*Varies by measure*
RESILIENCE TO CLIMATE CHANGE [5]	*The resilience of the Measure to climate change conditions. Performance is assessed as Critical, High, Medium, Low.*
CORRELATION WITH CLIMATE CHANGE TARGETS AND MEASURES	*The correlation of each Measure with the targets and actions of the National Climate Change Adaptation Strategy (NCCCA 2016), the CENTRAL MACEDONIA Regional Plan for Climate Change Adaptation (2023), the Climate Law and the EU Specifications.*
CORRELATION WITH RBMP OBJECTIVES AND MEASURES	*Notes on how the measure relates with the objectives and measures of the RBMP*
IMPLEMENTATION PHASE	• *Maturity* • *No tender* • *To be implemented* • *In a tendering or procurement procedure* • *Implementation*
IMPLEMENTATION DURATION	*Short-term : 0-2 years* *Medium-term : 2 - 6 years* *Long-term : > 6 years*

[5] Climate resilience is defined as "The ability of interrelated social, economic and ecological systems to address a dangerous event or trend or disruption, through their response or reorganization in ways that maintain their main function, identity and structure" [PROVISIONAL FRAMEWORK FOR THE ASSESSMENT OF CLIMATE RESILIENCE OF INFRASTRUCTURE PROJECTS SUBMITTED FOR CO-FINANCING IN THE NSRF 2021 – 2027 PROGRAMMES, National Coordination Authority, General Secretariat of Public Investments & NSRF, Ministry of Development & Investments, December 2022.

PROPOSED IMPLEMENTATION TIMELINE (MILESTONES)	• *Preparation and issuance of regulatory decision (for legislative arrangements) - 6 to 12 months* • *Planning and implementation of educational actions - duration up to 2 years* • *Project dossier preparation, technical sheets and inclusion in a financing instrument – securing funding - duration up to 1 year* • *Tender procedure for contract award - duration up to 1 year* • *Preparation of designs, procurement, development of registers/systems and other plans - Varies by measure.* • *Licensing (if required) - duration up to 2 years* • *Project dossier preparation, technical sheets and inclusion in a financing instrument- securing funding for construction projects - duration up to 1 year* • *Tender procedure for construction project contract award - duration up to 1 year* • *Construction project implementation - Varies by measure.*
PRIORITY RANKING ORDER	*The ranking of the measure's priority based on the results of the assessment of its economic effectiveness.*
ESTIMATED COST	*An estimate of the cost of the measure*
INDICATIVE FINANCING INSTRUMENT	*The agencies/programmes that may be financing sources for the measure.*

10.4 Final Description of Measures

EL_10_61_01: Development of a Monitoring System for the FRMP's Programme of Measures

The project concerns:

(1) the development of a database and interactive platform to collect and monitor the information required by all actors involved in the implementation of the Programme of Measures; and

(2) receiving advisory services for this purpose from qualified staff. The provision of advisory services will include but not be limited to: (a) monitoring the implementation of the River Basin District's FRMP measures, (b) preparing designs and regulatory decisions, (c) coordinating the services involved in the implementation of the measures, (d) recording and analysing data related to FRMP measures/actions, (e) preparing methodological texts and technical specifications for implementation of FRMP measures, (f) actions for the collection/ updating of key data and data used in the preparation of the FRMP, (g) support on issues of the revision of the Flood Risk Management Plan and participation in working groups to be established depending on the River Basin District's needs.

In the context of this project, evaluation reports will be drawn up on the progress of the implementation of the Programme of Measures, guidance will be given on the actions required to complete implementation, and measures will be evaluated for effectiveness.

EL_10_21_01: Harmonization of first level Urban Plans with the FRMPs

The measure concerns the issuance of a Circular Directive to recommend data that should be drawn from the FRMPs during the Analysis Stage/Diagnosis Section of the designs of the first level Urban Plans (Local Urban Plans/ Special Urban Plans), to formulate substantiated disaster hazard reduction Proposals, in accordance with the qualitative urban planning guidelines by way of the new Urban Planning Standards (Ministerial Decision ΥΠΕΝ/ΔΝΕΠ/32892/1414/2024, Government Gazette D' 200/01.04.2024).

EL_10_21_02: Construction and building arrangements within the 100-year flood zone

Introduction of special provisions in the Construction and Building Regulation to reduce the vulnerability of constructions / installations and structures within the 100-year Flood Zone from their exposure to flood risk, with the aim of reducing the disaster risk.

EL_10_21_03: Adaptation of first level Urban Plans in the areas of controlled flooding to contain flooding (retarding basins)

The measure concerns the appropriate adaptation of first level Urban Plans (Local Urban Plans/ Special Urban Plans) in the areas of controlled flooding, to recommend permitted uses and restrictions therein. The controlled flooding areas are identified in the special design of measure EL_10_42_05.

EL_10_21_04: Prevention and protection actions for Rural Development within the APSFR

The measure concerns actions such as, but not limited to, the following:

a) Identifying crops and sites that are subject to systematic flood damage. This is mainly related to the season and duration of flooding. It is a known fact that flooding for short periods and in wintertime or springtime may even be beneficial for some crops. In these cases, no compensations are paid out from ELGA (Agricultural Insurance Organisation) so particular care is required in collecting data from various bodies (in addition to ELGA).

b) Identifying and recording point, local or broader issues in artificial or natural drainage networks and their E/M equipment that exacerbate flood damage, and the improvement/restoration of which would reduce the losses, in order to propose restoration projects in application of measure EL_10_33_01 "Modernisation and restoration of drainage networks".

c) Recording the positions of livestock / poultry units suffering systematic flood damage (with IACS final data). Facilities with makeshift accommodation should be inventoried separately (Law 4056/2012 as in force) from the permanent stables.

d) Identifying crops and livestock facilities that need, as a priority and not exclusively, protection from flood.

e) Investigating alternative crops and/or varieties, which are effective, direct and can yield in the future the same level of agricultural income as existing crops, considering the suitability of soil and climate conditions, the knowledge of local producers and the available mechanical equipment and buildings of agricultural holdings. Further investigation into the possibility of irrigating them (since they will obviously be water-intensive) through land reclamation projects (existing or to be constructed) and the provision of irrigation and/or flood water, irrigation boreholes, irrigation network, etc., especially in times of water scarcity or drought.

f) Proposals for the use of alternative agricultural practices (sowing season, fertilization, harvesting, grazing sites, etc.), taking into account the seasonality of flood events and identifying the possible economic and other impacts of modifying agricultural practices.

g) proposals for financial and other incentives to change crops and/or relocate livestock units.

EL_10_23_01: Measures to protect the water supply boreholes of Water Utilities against flooding

The measure includes:

(1) The adoption by Water Utilities of appropriate measures for the flood protection of their water supply boreholes, located within the T=100-year flood zone. Such measures can be either e.g. lifting the electromechanical systems, piping and cabin of each borehole to a higher level, or constructing a protective perimeter embankment of appropriate height using suitable materials, etc.

(2) The River Basin Districts are to introduce a term stipulating the obligation to take flood protection measures in all water usage licenses issued under Joint Ministerial Decision 146896/27.10.2014 (Government Gazette B' 2878 and B' 3142) "Categories of licenses for the use and performance of water development projects. Procedure and terms for issuing licenses, content and term thereof and other relevant provisions", as amended and in force.

By taking appropriate flood protection measures, the risks inherent in a water supply borehole are avoided, and in addition to the damage to its above-ground electromechanical equipment, flood water ingress in the underground aquifer is also prevented.

EL_10_24_01: Restructuring and modernisation of meteorological and hydrometric data collection network

The measure concerns the upgrading and modernisation of the existing analogue network of hydrometeorological stations of the MoEE. The implementation of the measure includes, but is not limited to, the following actions:

a) the replacement of analogue hydrometeorological stations with digital telemetry stations across the country, and expansion of the network where required

b) the creation of a digital platform for recording and transmitting hydrometric and meteorological information.

The measure will be implemented in cooperation with the Water Directorates of the relevant Decentralised Administrations.

EL_10_24_02: Collection and digitization of watercourse demarcation data and flood defences data

The measure concerns the creation and maintenance of a database, by collecting and digitising information at APSFR level, regarding:

- Information on existing and new stream demarcation files per River Basin District and other useful information to prepare demarcation studies

- Already demarcated watercourses (geospatial elements of demarcation lines, etc.).
- Technical data of flood defences that affect water flow, including topographic surveys of existing structures conducted in the context of the FRMPs and other studies, as well as other available information on technical structures from designs and archives of other agencies.

EL_10_24_03: Creation of a National Flood Events Register (NFER) and development of a relevant interactive online platform

This is the design and development of a National Flood Events Register and a relevant interactive online platform, with the development of an appropriate spatial data system.

The NFR will at least include entries of flood events and their data made by competent services and involved agencies, in accordance with the General Emergency Response Plan and Immediate/ Short Term Management of Flood Consequences "DARDANOS", as applicable each time, based on guidelines to be issued by the competent service of the MoEE.

This way, the purpose is for all involved agencies to have and use uniform data to assess the damage and impact from extreme flood events, supporting management plans and flood risk assessments.

EL_10_31_01: Implementation of a forest engineering system for mountain water management structures and projects

The measure concerns natural water retention projects in mountainous areas.

(A) The Forest Engineering System for Mountain Water Training, which includes three organically linked and interdependent projects and measures:

1. Horticultural projects to create normal hydrogeonomic forests and shrubs, resistant to climate change, which contribute to the prevention of surface erosion, the increase of water retention and infiltration into the soil, the conversion of surface into subsoil runoff, and the deceleration of runoff.

2. Geotechnical projects (grading, scraping of slopes, drainage, trenches, dry stone walls, wattle, log erosion barriers, etc.) for the purpose of eliminating sediment-generating source or temporarily retaining rainwater.

3. Hydraulic technical structures involving a variety of technical constructions such as :

a) low dams built in the beds of the main and smaller branches used primarily to secure the beds, contain or sort sediments, prevent slides, contain flood peaks, abstract or store water, etc.

b) structures arranged in parallel to the water flow (embankments, linings, etc.) to protect the bank of streams and prevent slope erosion, limit the flow within a defined bed and protect riparian zones or enlarge the bed to allow natural formation.

(B) Open-type dam constructions and temporary sediment containment basins in intense torrentiality mountainous river basins.

This will include open barriers for sorting and temporary retention of sediments in order to stop massive sediment transfer (debris flows & Mud flows), the containment backwater effect, the temporary retention of sediments in basins, the control of the movement of sediments by sorting.

(C) Construction of dry detention ponds to contain flooding in mild torrentiality mountainous river basins.

Construction of dry detention ponds in the mountain stream beds to contain flooding. The action is applied only to mild torrentiality river basins or river basins whose torrentiality has been greatly absorbed and show normal debris & mud flow.

The mountain water management projects will be implemented as a priority from upstream to downstream and in addition from the lower-order branches to the higher-order branches according to Strahler. Methods and materials compatible with the natural environment will be used in their construction.

In the context of the flood defences integrated design of the FRMP, it should be clarified that:

For areas where the implementation of a Masterplan is indicated as a measure (EL_10_35_02), projects falling under this measure will result from the Masterplan.

Exceptions to the above are:

1. Projects for which there is approved funding may proceed.
2. Projects that have at least one of the main characteristics (A and B) of the following Table may proceed, provided that they also meet the supplementary condition

A	*EMERGENCY SITUATIONS* *Projects covering an emergency need for the area's protection against floods, following natural disaster events (e.g. fire, significant floods, etc.) may proceed.*
B	*MULTIPLE FUNCTIONS* *Projects that serve multiple uses and functions may proceed.*
	SUPPLEMENTARY CONDITION: *The projects of the above categories A and B will proceed if there is evidence that they do not have a negative impact on the downstream, in terms of flood risk.*

The areas selected for the implementation of the measure are mountainous basins/sub-basins upstream of the APSFR where mountain water management structures will be constructed in suitable locations following a relevant forest engineering study.

It is recommended that projects under this measure be implemented outside the usual breeding season (from 1st March to 15th July) to reduce the impact on protected fauna and avifauna species.

EL_10_31_02: Natural water retention projects in the lowlands

The measure concerns natural water retention projects at the boundaries of the lowland bed of watercourses, as defined together with the mountain bed boundaries in the decisions of the former Prefects of the country and in accordance with the legislation in force, and as a priority in the 100-year flood zones within the APSFR (or upstream thereof) and/or in locations with high and very high risk (see Flood Impact Assessment Map).

The proposals for construction of NWRP projects will be developed according to the specifications during the preparation of flood protection project designs on the specific requirements and/or the preparation of Flood Protection Plans (Master Plan), where such plans are prepared.

The measure includes:

- floodplain restoration and management projects (N03) – "make room to river" - by removing artificial embankments to increase storage capacity and accelerate restoration after flood events.
- watercourse bed re-naturalisation (N05).
- re-meandering (N04) to increase storage capacity and buffer capacity.
- construction of offline dry detention basins and online ponds (N01) in the stream beds to contain flooding and lateral runoff/ and store flood flows.
- wetland restoration and management (N02) through riparian vegetation to increase storage capacity and slow the flow.
- restoration and reconnection of seasonal streams (N06) to increase storage capacity and drainage.
- Natural bank stabilization (N10) using bioengineering materials to increase drainage and reduce sediment delivery.

In the context of the flood defences integrated design of the FRMP, it should be clarified that:

For areas where the implementation of a Masterplan is indicated as a measure (EL_10_35_02), projects falling under this measure will result from the Masterplan. Exceptions to the above are:

1. Projects for which there is approved funding may proceed.
2. Projects that have at least one of the main characteristics (A and B) of the following Table may proceed, provided that they also meet the supplementary condition.

A	*EMERGENCY SITUATIONS* *Projects covering an emergency need for the area's protection against floods, following natural disaster events (e.g. fire, significant floods, etc.) may proceed.*
B	*MULTIPLE FUNCTIONS* *Projects that serve multiple uses and functions may proceed.*
	SUPPLEMENTARY CONDITION: *The projects of the above categories A and B will proceed if there is evidence that they do not have a negative impact on the downstream, in terms of flood risk.*

EL_10_31_03: Implementation of Natural Water Retention Measures (NWRM) / practical SUDs during the design of projects and activities under sub-category A1 and A2 of Law 4014/2011, as in force

During the design of projects and activities under sub-category A1 and A2 of Law 4014/2011, as in force, the implementation of Natural Water Retention Measures (NWRM) / practical SUDs should be considered as a priority, when flood defences are required, to limit surface runoff and contain flood flows.

EL_10_32_01: Multi-purpose reservoirs with a flood protection component

During the preparation of designs for new large dams that fall within the definition of Large Dams of the International Commission on Large Dams (ICOLD), i.e. dams with a height of 15 metres or greater from lowest foundation to crest or dams between 5 metres and 15 metres impounding more than 3 million cubic metres, used for irrigation or other functions, it is mandatory to consider the possibility of the dams operating for flood protection purposes in basins located upstream of APSFR. Flood protection requires additional storage volume and an appropriate reservoir operation schedule. Under these conditions, the reservoir can achieve flood containment, i.e. a reduction in the duration and magnitude of the flood peak. All planning must consider the multiple feasibility and requirements of environmental legislation and the Water Framework Directive 2000/60.

The planning of the projects should also take into account the provisions of the Dam Safety Regulation (Government Gazette B'4420/30.12.2016), and provide for the continuous improvement of the safety procedures for dams subject to this Regulation, as it falls within the remit of the Dams Administrative Authority (DMA) as a Commission operating under the General Secretariat for Infrastructure of the Ministry of Infrastructure and Transport.

EL_10_32_02: Use existing reservoir projects to contain flood flows

The measure includes actions to optimize the management of existing reservoirs so that, on the one hand, they meet the needs of the uses they serve in the best possible way and, on the other hand, they offer maximum flood protection downstream.

The reservoirs implementing the measure will be selected based on the results of the Flood Hazard and Flood Risk Maps and in particular the results of the flood risk assessment in the context of this revision of the FRMP, downstream of existing or future Dams.

EL_10_33_01: Modernisation and restoration of drainage networks

The measure includes the following actions:

- Identifying problematic, in terms of drainage, lowland cultivated areas - assessment of the current situation.
- Checking the adequacy of drainage networks and E/M equipment in these areas.
- Drafting proposals and implementation of restoration projects/ upgrading of drainage works that may include:
  - clearing of existing trenches from vegetation and sediments
  - maintenance/replacement of technical structures for road crossings and flow control structures (gates, locks)
  - modernization of the existing E/M equipment (installation of an automatic adjustment and remote management system of the existing equipment for regulating the flow control structures).
- Prioritization of scheduling
- Implementation of interventions.

EL_10_33_02: Flood Defences

This measure shall be implemented if it is not possible to adequately implement measure EL_10_31_02 of this 1st Review of the FRMP concerning natural water retention projects in the lowlands. The measure includes the construction of new flood defences and/or the completion/reinforcement of existing flood defences in the lowland beds of the watercourses (for restoration/ maintenance projects see measure EL_10_35_05), as a priority in the 100-year flood zones within the APSFRs and in locations with high and very high risk (see Flood Impact Assessment Map), which are

(A) Proposed in the context of this document

or

(B) planned to be studied as per the proposals for the maturation of future projects of the Flood Protection Plans (Master Plan), where these are being prepared or will be prepared (Measure EL_10_35_02).

In the context of the flood defences integrated design of the FRMP, it should be clarified that:

For areas where the implementation of a Masterplan is indicated as a measure (EL_10_35_02), projects falling under this measure will result from the Masterplan. Exceptions to the above are:

1. Projects for which there is approved funding may proceed.
2. Projects that have at least one of the main characteristics (A and B) of the following Table may proceed, provided that they also meet the supplementary condition.

A	*EMERGENCY SITUATIONS* *Projects covering an emergency need for the area's protection against floods, following natural disaster events (e.g. fire, significant floods, etc.) may proceed.*
B	*MULTIPLE FUNCTIONS* *Projects that serve multiple uses and functions may proceed.*
	SUPPLEMENTARY CONDITION: *The projects of the above categories A and B will proceed if there is evidence that they do not have a negative impact on the downstream, in terms of flood risk.*

Note that the reference to T=100 concerns the geographical effect of the measure and is not related to the design size of flood defences, which is defined based on the regulations applicable each time and the technical specifications of the designs of said projects.

The measure shall include, as appropriate, projects comprising one or more of the following:

1. River/torrent training projects to increase their drainage capacity and to protect the bed from erosion (shaping the cross-section with or without lining the bottom or the slopes, supporting the slopes, construction of individual groynes within watercourses).
2. Construction of terraces/cascades to reduce the longitudinal slope where required.
3. Construction or reinforcement of embankments along the watercourses
4. Replacement or construction of culverts and bridges at road crossings that interrupt the continuity of watercourses.
5. Stream confluence training and watercourse/river estuary technical structures.
6. Construction of an artificial watercourse branch.
7. Silt removal from an untrained section of watercourse.

EL_10_34_01: Modernisation/replacement, maintenance and completion projects for existing rainwater drainage networks

The measure includes replacement, reinforcement and completion projects of rainwater drainage structures (rainwater collection, transport and disposal to the available recipients), affording priority to areas of high residential needs and requirements within the Areas of Potentially Significant Flood Risk.

The measure is implemented in the following phases:

1. Phase one, mapping the existing rainwater drainage networks
2. Assessment of the adequacy of the existing infrastructure by competent bodies, to determine the type of interventions required, if any, (such as: maintenance, reinforcement, replacement, extension),
3. Project preparation and implementation during this or the next management period.

EL_10_35_02: Integrated Flood Planning (Master Plan) and construction of the proposed projects

(A) Implementation of Flood Protection Plans (Masterplan) for selected areas, to identify and prioritize the required Projects:

- within the APSFRs and upstream basins to mitigate the effects in the areas included in the T=100 Flood Hazard and Risk Maps of this 1st Review of the FRMP.
- in the remaining part of the area where a Masterplan is required.

Note that:

(a) the needs in Masterplans (number and spatial qualification) are defined in the context of this measure

(b) Masterplans specify projects of the categories included in measures EL_10_31_01, EL_10_31_02, EL_10_33_02 and EL_10_42_05 and do not include restoration and maintenance projects.

(B) Preparation of the required designs for project maturity

(C) Construction of proposed projects

The Master Plan must be consistent with the provisions of the Management Plans of Directive 2000/60/EC (River Basin District status, exceptions, etc.) and for this purpose it must have the assent of the competent Water Directorate.

EL_10_35_02: Integrated Flood Planning (Master Plan) and construction of the proposed projects

Note that the reference to T=100 concerns the implementation areas of the measure and is not related to the design size of flood defences, which is defined based on the regulations applicable each time and the technical specifications of the designs of said projects.

EL_10_35_03: Assessment and maintenance of existing mountain water management structures and projects

The measure includes the assessment of the status of existing Mountain Water Management Structures in torrent and river basins and their maintenance to mitigate the effects in the areas included in T=100 flood zones. Operations will be studied and planned by the Forest Directorates and Forestry Offices responsible for the maintenance of the structures in their area of responsibility.

EL_10_35_04: Land use management measures in the runoff basins of torrents

The pasture management plans, in accordance with the requirements of Law 4351/2015 (Government Gazette A' 164) and Joint Ministerial Decision 1058/71977/2017 (Government Gazette B' 2331/07.07.2017) and in areas upstream of the APSFRs that have not been excluded from grazing land (they have not been characterized as protective), shall consider the provisions of the FRMP and RBMP and apply hydronomic criteria to determine grazing intensity (grazing capacity).

EL_10_35_05: Maintenance and restoration of existing training structures and flood defences

The measure includes the following actions that should be carried out annually:

- Performing onsite visits and recording problems after the end of the wet (winter) period (e.g.: April)
- Identifying critical positions and techniques in need of maintenance/restoration and setting priorities
- Preparation of annual maintenance/restoration work programme by the Region's competent technical services, which will include:
  - Clearing sediment and removing silt from the bed of watercourses that hinder the free runoff of the watercourse
  - Repairs of slope retaining/lining structures
  - Repairs of bed protection/lining structures
  - Embankment repairs
  - Repairs of technical structures (terraces, culverts, crossings, etc.)
- Securing funds
- Implementation of interventions

EL_10_41_01: Development and operation of an operational flood early warning system.

Development of an Operational Early Flood Warning System (ESEPP) with priority to selected T100 flood zones. The system shall include:

(a) Design and development of an early warning system for floods, using the hydrometeorological data of the updated network specified in measure EL_10_24_01, other data/models and appropriate software, based on the specifications of the ESEPP implemented by the MoEE in Evros and Axios rivers and with the possibility of interconnection with their operating platform (ESEPP developer: MoEE/GDW).

(b) Design and development of a communication protocol between the ESEPP operator and the body competent for timely notifying the public and activating the competent bodies (notification process, alerts, information transmission mechanisms/tools e.g. sms), based on ESEPP data (ESEPP operator: Independent Civil Protection Directorate of the relevant Region or Ministry Climate Crisis and Civil Protection/GSCP).

EL_10_42_01: Updating the Emergency Plans, and consolidation of emergency flood response actions/ Memorandum of Action at local level

According to the provisions of the General Civil Protection Plan "Xenocrates", in 2019 the Directorate of Planning and Emergency Response of the Ministry Climate Crisis and Civil Protection/GSCP, in cooperation with all involved agencies, issued the General Emergency Response Plan and Immediate/Short Term Management of Flood Consequences, which was sent to all involved agencies with document 8794/06.12.2019 of the Ministry of Climate Crisis and Civil Protection/GSCP ("DARDANOS 1"). In 2023, the Emergency Planning Directorate of the Ministry Climate Crisis and Civil Protection/GSCP, taking into account that the 1st version of the plan brought about administrative and organisational changes, which mainly concerned central government agencies, issued the 2nd General Emergency Response Plan and Immediate/ Short Term Management of Flood Consequences, named "DARDANOS 2".

When fulfilling the obligations regarding the preparation or updates of Emergency Plans, Action Plans - Memoranda of Action by the competent agencies, pursuant to the applicable institutional framework, the results of the risk analysis of this 1st Review of the FRMP should also be taken into account.

EL_10_42_03: Borrow pits for restoration/ maintenance of embankments in emergencies

In the T1000-year flood zone where embankments have been constructed or are about to be constructed, the following actions shall be taken :

1) Study for the selection and demarcation of borrow pits for prompt availability of materials for embankment restoration;
2) Environmental Impact Assessment and compliance with the licensing procedure of the applicable provisions. The activity is part of Group 5, Mining and Related Activities of the Joint Ministerial Decision as amended and in force, no. 5 Borrow pits for aggregates and earth or other soil materials exclusively for the needs of infrastructure projects.

If an emergency is declared in the area, the Technical Control Directorate may issue a decision on the right to grant material directly, provided steps 1 and 2 have been completed.

EL_10_42_04: Establishing alert levels in the critical watercourses of the River Basin District based on the provisions of Laws 4662/2020 and 5075/2023

According to article 6 of Law 4662/2020 "State of Preparedness Scaling" and Law 5075/2023, the National Mechanism is activated on a scale depending on the state of preparedness.

The measure includes the following actions, with a view to setting the alert limits corresponding to the four levels of mobilization defined in legislation:

- Hydraulic control of watercourses and determination of their conveyance capacity (maximum flow rate they can safely convey - with the required margin according to the specifications)
- Identifying critical positions on watercourses where it would be possible to monitor and record the flow of the river (bridge positions, positions with accesses, linear positions suitable for water measurements)
- Identifying critical positions in relation to the progression of the flood wave routing and the position/distance of the adjacent affected uses and mainly of the settlements and road access infrastructure.
- Defining the level and flow at the above positions for the four (4) preparedness levels included in the legislation.

Defining the water flow corresponding to all the above preparedness levels at critical selected positions of the level - absolute elevation values.

EL_10_42_05: Lowlands controlled flooding plan to protect settlements and critical infrastructure

The measure concerns planning controlled flooding of lowland areas that will be selected as a priority within or upstream of the T100 flood zones and with the aim of protecting the areas within the T100 flood zones or reducing the flood risk as a priority of areas with high flood risk (as defined in the relevant Flood Risk Assessment maps), in the context of a special design of controlled area flooding, either during the preparation of flood defences MasterPlan (see EL_10_35_02) or other relevant design.

Controlled flooding areas are an internationally recognized flood protection practice, more and more acknowledged as a method of adaptation to climate change. Such areas, usually land of low value, contribute to the protection of downstream areas against flooding by controlled channelling of part of the flood volume to riverside areas using appropriate manoeuvres (opening gates or breaking embankments) during a flood event.

Once the boundaries of the mountainous and lowland bed of the watercourses are defined under the applicable legislation, and the boundaries of the settlements and the critical infrastructure to be protected are determined, the hydraulic behaviour of the watercourses for various flood flows shall be reviewed to identify the potential flood volume discharge sites and protect the settlements and/or critical infrastructure, checking the hydraulic behaviour of each proposal. Furthermore, it is necessary to formulate proposals and establish the positions where the existing embankments will be broken in a controlled manner and, finally, to establish a mechanism for assessing the effectiveness of the options (if they actually contributed to addressing the risk), after each flood event and updating /adjusting the plan.

This special design shall lead to the enactment of controlled flooding areas and the determination of the permitted uses and prohibitions within their boundaries, in accordance with measure EL_10_21_03.

For the purposes of this measure, critical infrastructure means units relating to human health, the natural environment, transport networks, public interest projects (irrigation, drainage, flood defences, etc.) and cultural heritage sites, and as otherwise defined following the harmonization of Greek legislation with Directive 2022/2557/EC.

In the context of the flood defences integrated design of the FRMP, it should be clarified that:

For areas where the implementation of a Masterplan is indicated as a measure (EL_10_35_02), projects falling under this measure will result from the Masterplan. Exceptions to the above are:

1. Projects for which there is approved funding may proceed.
2. Projects that have at least one of the main characteristics (A and B) of the following Table may proceed, provided that they also meet the supplementary condition.

A	*EMERGENCY SITUATIONS* *Projects covering an emergency need for the area's protection against floods, following natural disaster events (e.g. fire, significant floods, etc.) may proceed.*
B	*MULTIPLE FUNCTIONS* *Projects that serve multiple uses and functions may proceed.*
	SUPPLEMENTARY CONDITION: *The projects of the above categories A and B will proceed if there is evidence that they do not have a negative impact on the downstream, in terms of flood risk.*

EL_10_43_01: Flood risk awareness-raising actions for the public, local authorities and communities

The measure includes the implementation of information and awareness-raising actions for citizens and bodies about the flood risk in their area and the precautions to take in case of flood risk. Such actions may be: television, radio and internet broadcasts, events, educational workshops, presentations in schools, etc. The above will be implemented by the Ministry of Climate Crisis and Civil Protection, the Ministry of Education, the Ministry of

Environment and Energy, the Civil Protection Directorate of the relevant Decentralized Administrations, the Independent Civil Protection Directorates of the relevant Regions and the Municipalities in cooperation with schools.

Actions may concern issues such as:

- information on the local Areas of Potentially Significant Flood Risk (APSFR)
- information on the provisions of the relevant FRMP and its programme of measures
- the importance of ensuring that rainwater and watercourse drainage systems are cleared and accessible
- the possibility and need for private/community protection measures
- information on Emergency Response Plans and the importance of their observance by the competent authorities
- on existing Irish crossings, the associated hazards and actions to be taken to avoid accidents
- protection of economic activities (agriculture, livestock breeding, etc.).

EL_10_43_02: Information system to avoid use of Irish crossings due to flood events

The purpose of the measure is to enhance the preparedness of citizens and involved agencies to limit accidents during the transverse crossing of streams and rivers through Irish Crossings.

The object of the measure is the installation of a system consisting of, at least, warning signs and a level rods with depth markings at Irish Crossings within the River Basin District, in order to provide clear information and support the prevention of vehicles passing during floods.

This measure will be implemented on the one hand at all Irish Crossings within T=100-year flooding areas, according to the calculations of this 1st Review of the FRMP, and on the other hand at any other Irish Crossings that studies or data of the Competent Bodies show that they must be marked immediately.

The specifications of the warning system will be established by the Technical Services and the Civil Protection Directorates before tendering the projects. The specifications will cover the content and dimensions of the signs, the colours and markings of the level rods, whether or not the signs will provide and alternative route, whether or not bars will be installed to prevent passage through critical crossings, any required telemetry functionality or other bar handling devices, etc.

EL_10_44_01: Drafting of a regulation of required actions for stream bed conveyance capacity restoration, riparian vegetation maintenance and management

This measure includes the preparation of a regulation/specifications for the periodic actions of watercourse cleaning, and riparian vegetation maintenance and management. The regulation/specifications shall be formulated taking into account the specific characteristics of these watercourses (geomorphological and hydraulic characteristics, type of watercourse, ecological elements, etc.) as well as the protection status of the area over which they extend.

The regulation/specification(s) shall concern at least the following:

- The body responsible for cleaning operations, etc., based on the legislation applicable each time (in Natura areas, forests, etc.)
- the cleaning method applied
- the time and frequency of cleaning operations
- the position(s) to be cleaned
- the areas for disposal of cleaning materials or the recovery thereof
- the procedure to be followed such as environmental permits and/or informing authorities

- detailed instructions for the appropriate handling of riparian vegetation in the various parts of the hydrographic network (small mountain streams, tributaries, large rivers in floodplains) and the use of means that will not cause damage to the river ecosystem.
- the methodology for keeping a record of the interventions carried out

In any case, the cleaning of watercourses should be carried out where absolutely necessary, in a way that does not conflict with the objectives of the River Basin Management Plans of Directive 2000/60/EC.

Where bodies of water related to "Areas designated for the protection of habitats or species" of the Protected Areas Register of the approved RBMP fall within the area of application of the measure, ensure timely cooperation with the competent Management Unit of OFYPEKA to include terms and conditions in the proposed regulation in order to address their potential impact on the object meriting protection.

EL_10_51_01: Restoration of infrastructure damage from recent flood events

The measure aims to restore infrastructure damage due to intense flood events that have occurred. This infrastructure includes, but is not limited to: Road and Railway Network, Irrigation and Drainage Projects, Flood Defences (Embankments, Trainings, Transverse Projects), Projects of cultural interest, Health Units, etc.

The project includes:

(a) recording losses,

(b) preparing relevant studies depending on the type of infrastructure, which will include, inter alia:

1. Resizing of the structures according to the updated flood sizes
2. Analysis of flood mechanisms that led to the failure of the infrastructure during occurrence of the flood event, to be taken into account during the redesign
3. Proposals for alternative interventions based on milder operations. And,

(c) restoration of damaged infrastructure.

EL_10_52_01: Siting of sedimentation basins for the (temporary or permanent) deposition of sediments

The scope of the measure is to determine the procedure for selecting the optimal sediment management process after each flood event. There are 2 distinct cases:

- Case 1: Sediments that contain no pollutants hazardous for public health. The measure in question establishes areas that can be used as temporary or permanent sediment deposition sites. For example, but not limited to: disposal as a soil coating material in sanitary landfills or quarries for rehabilitation. The possibility of using these materials by sorting and processing will be investigated at a later stage.
- Case 2: the sediments have been contaminated by pollutants hazardous for public health (including but not limited to: sewage, petroleum products, etc.). In this case, a sediment management study is required to define the separation, transportation and deposition process (including, but not limited to: disposal to sanitary landfill, hazardous waste landfill, etc.). Cooperation with the Sanitary Landfill or Waste Treatment Unit project owner (Municipality or FODSA (Solid Waste Management Agency)) is required.

The measure will consider the flooding areas as they result from the Flood Hazard and Risk Maps as well as the soil erosion maps drawn up under this 1st Review of the FRMP, in conjunction with the lists of diffuse and point source pollution prepared under the 2nd Review of the RBMP for the River Basin District (the spatial distribution of which is available in shapefiles) to enable assessment in advance of the sediment deposition sites and the sedimentation basins, for the different flood return periods under review.

10.5 Prioritization of Measures

The measures of the 1st Review of the FRMP of the Central Macedonia RBD (EL10) are prioritized according to their economic effectiveness. The purpose of the prioritization is to highlight the measures that achieve a flood damage reduction (benefit) at the lowest cost.

All measures are complementary to each other and there is no question of choosing a measure with high cost-effectiveness index over another with a low index. Therefore, cost-effectiveness analysis makes sense mainly as an indication of the implementation priority of measures, taking into account the scarcity of available funds which dictates that high cost-effectiveness measures are to be promoted immediately.

The applied methodology for assessing the measures of the 1st Review of the FRMP of the Central Macedonia RBD is a modification of the methodology applied in the 1st Implementation Cycle of the Floods Directive. The adopted steps are:

- The proposed measures are divided into two categories: the measures that indirectly contribute to the prevention of damage (Category 1) and the measures that directly contribute to the prevention/addressing of damage (Category 2).
- Assessment of the expected benefit of each measure in the two categories
- Assessment of the nature/line of action of the measure (prevention, protection, preparedness, restoration)
- Correlation with other policies (climate change, RBMP)
- Multi-criteria analysis of the overall benefit index of each measure
- Estimation of the total cost of each measure (investment cost, operating cost)
- Calculation of the cost-effectiveness index of each measure and prioritization of measures

Note that, no cost is provided for the 3 measures not included in the prioritization. The cost of 2 of these measures (EL_10_31_02 "Natural water retention projects in the lowlands" and EL_10_42_05 "Lowlands controlled flooding plan of lowlands to protect settlements and critical infrastructure") will result from the Master Plans (measure EL_10_35_02) and will then be prioritized. The cost of the 3rd measure (EL_10_51_01 "Restoration of infrastructure damage from recent flood events") is calculated on a case-by-case basis depending on the restoration needs. It is worth noting that in RBD EL10, the Master Plan for the flood defences of the Prefecture of Thessaloniki has already been completed, covering an area that takes up a large part of APSFR EL10APSFR008, from which projects of considerable cost have been proposed. These projects are therefore included in the scope of the technical flood defences and other protection measures, including the cost of their implementation, which is considered in the prioritization.

For all the prioritized measures, the following quantitative elements are considered, describing each measure in terms of: the value of potential damage, the assessment of contribution to addressing the damage, the applicability factor, the results timeline, the social discount rate, the expected benefit, the line of action of the measure, the resilience to climate change, the correlation with climate change objectives and measures, as well as the correlation with RBMP objectives and measures. The above make up index D11, which is the total benefit index of each measure.

Furthermore, the following financial information is taken into account for the prioritized measures: the typical year's operating cost, the initial investment cost, the annualization factor of the investment cost as

well as the annualized investment cost, in order to obtain index D16, which is the annualization factor of investment cost.

Note that the measures are complementary to each other to achieve the set of design objectives. Cost-effectiveness analysis can help prioritize measures in a context of limited available funds under which high cost-effectiveness measures should be prioritized.

The number and total initial investment cost of all thirty-one (31) measures proposed per line of action for the Central Macedonia River Basin District (EL10) is summarized in the following Table:

Table 10-4: Number of measures per line of action and total cost in the Central Macedonia RBD, 1st Review of the FRMP

Measure Line of Action	Number of Programme Measures	Number of Prioritization Measures	Total cost of the measures' initial investment €
Prevention	9	9	~ 2,200,000
Protection	12	10	530,000,000
Preparedness	8	8	4,160,000
Restoration	2	1	250,000
Total	**31**	**28**	**536,610,000**

The results of the implementation of the measures prioritization methodology are presented in the two tables below, by Category of measures. The information presented includes:

- 28 of the 31 measures of the overall Programme which are assessed in the context of prioritization in this 1st Review of the FRMP, based on the assumptions mentioned above. Of these, 18 measures are Category 1 and 10 measures are Category 2.
- The reference number and title, the colour-coding per flood risk management action line (**Prevention**, **Protection**, **Preparedness** **and** **Restoration**) and the type of measure (legislative, technical, environmental, etc.)
- The total benefit index D11 of the measure, receiving values from 0-100
- The total annualized cost index D16 of the measure, with a minimum value of 0 for no cost measures
- The regular RD11 value assigned to each measure (ranging from 1 to 18 for category 1 and from 1 to 10 for category 2). This value is an indication of how beneficial a measure is in relation to the rest. The smaller the value, the more beneficial the measure is. Two or more meters may receive the same value.
- The regular RD16 value assigned to each measure (ranging from 1 to 18 for category 1 and from 1 to 10 for category 2). This value is an indication of how costly a measure is in relation to the rest. The smaller the value, the more costly the measure is. A tie is not impossible but is unlikely due to the parameters involved in the calculation of the value.
- The Benefit index/Cost index ratio: RD11/ RD16
- The Priority Group (1, 2 or 3) that each measure belongs to.

Table 10-5: Prioritization of the measures of the 1st Review of the FRMP for RBD EL10, by priority group for Category 1 indirect contribution to flood risk.

MEASURE REFERENCE	MEASURE TITLE	TYPE OF MEASURE	Δ11: Overall benefit index	Δ16: Total annualized costs	RΔ11	RΔ16	RD11/ RD16	Priority group
EL_10_61_01	Development of a Monitoring System for the FRMP's Programme of Measures	Obtaining, supplementing and improving information	99.33	41,721	3	9	0.33	1
EL_10_21_01	Harmonization of first level Urban Plans with the FRMPs	Legislative/ Administrative arrangements	71.50	0	9	15	0.60	1
EL_10_21_02	Construction and building arrangements within the 100-year flood zone	Legislative/ Administrative arrangements	71.50	0	9	15	0.60	1
EL_10_21_03	Adaptation of first level Urban Plans in the areas of controlled flooding to contain flooding (retarding basins)	Legislative/ Administrative arrangements	70.50	0	12	15	0.80	1
EL_10_21_04	Prevention and protection actions for Rural Development within the APSFR	Obtaining, supplementing and improving information	71.50	60,465	9	7	1.29	2
EL_10_23_01	Measures to protect the water supply boreholes of water utilities against flooding	Legislative/ Administrative arrangements & Technical Flood Defences	99.00	221,705	4	4	1.00	1

MEASURE REFERENCE	MEASURE TITLE	TYPE OF MEASURE	Δ11: Overall benefit index	Δ16: Total annualized costs	RΔ11	RΔ16	RD11/ RD16	Priority group
EL_10_24_01	Restructuring and modernisation of meteorological and hydrometric data collection network	Obtaining, supplementing and improving information	97.50	15,116	5	11	0.45	1
EL_10_24_02	Collection and digitization of watercourse demarcation data and flood defences data.	Obtaining, supplementing and improving information	55.50	100,775	16	5	3.20	3
EL_10_24_03	Creation of a National Flood Register (NFR) and development of a relevant interactive online platform	Obtaining, supplementing and improving information	50.50	4,022	18	14	1.29	2
EL_10_31_03	Implementation of Natural Water Retention Measures (NWRM) / practical SUDs during the design of projects and activities under sub-category A1 and A2 of Law 4014/2011, as in force.	Measures of an environmental nature	69.67	0	14	15	0.93	1
EL_10_35_02	Integrated Flood Planning (Master Plan) and construction of the proposed projects	Technical Flood Defences	99.50	604,650	1	2	0.50	1
EL_10_35_05	Maintenance and restoration of existing training structures and flood defences	Technical Flood Defences	99.50	5,596,499	1	1	1.00	1

MEASURE REFERENCE	MEASURE TITLE	TYPE OF MEASURE	Δ11: Overall benefit index	Δ16: Total annualized costs	RΔ11	RΔ16	RD11/ RD16	Priority group
EL_10_42_01	Updating the Emergency Plans, and consolidation of emergency flood response actions/ Memorandum of Action at local level	Obtaining, supplementing and improving information	70.50	12,093	12	12	1.00	1
EL_10_42_03	Borrow pits sites for restoration/ maintenance of embankments in emergencies	Measures of an environmental nature	55.67	100,775	15	5	3.00	3
EL_10_42_04	Establishing alert levels in the critical watercourses of the River Basin District based on the provisions of Laws 4662/2020 and 5075/2023	Non-structural intervention	90.83	282,170	7	3	2.33	3
EL_10_43_01	Flood risk awareness-raising actions for the public local authorities and communities	Education/information measures	96.50	20,155	6	10	0.60	1
EL_10_44_01	Drafting of a regulation of required actions for stream bed conveyance capacity restoration, riparian vegetation maintenance and management	Legislative/ Administrative arrangements	74.83	10,077	8	13	0.62	1
EL_10_52_01	Siting of sedimentation basins for the (temporary or permanent) deposition of sediments	Measures of an environmental nature	55.17	50,387	17	8	2.13	3

Table 10-6: Prioritization of the measures of the 1st Review of the FRMP for RBD 10, by priority group for Category 2 direct contribution to flood risk.

MEASURE REFERENCE	MEASURE TITLE	TYPE OF MEASURE	Δ11: Overall benefit index	Δ16: Total annualized costs	RΔ11	RΔ16	RD11/ RD16	Priority group
EL_10_31_01	Implementation of a forest engineering system for mountain water management structures and projects	Measures of an environmental nature	28.92	120,774	6	5	1.20	1
EL_10_32_01	Multi-purpose reservoirs with a flood protection component	Legislative/ Administrative arrangements & Technical Flood Defences	16.32	40,258	10	8	1.25	2
EL_10_32_02	Use existing reservoir projects to contain flood flows	Technical Flood Defences	25.65	74,477	7	6	1.17	1
EL_10_33_01	Modernisation and restoration of drainage networks	Technical Flood Defences	86.56	410,632	2	3	0.67	1
EL_10_33_02	Flood Defences	Technical Flood Defences	80.56	13,929,288	4	1	4.00	3
EL_10_34_01	Modernisation/replacement, maintenance and completion projects for existing rainwater drainage networks	Technical Flood Defences	91.50	5,314,064	1	2	0.50	1
EL_10_35_03	Assessment and maintenance of existing mountain water management structures and projects	Technical Flood Defences	19.80	57,972	9	7	1.29	2
EL_10_35_04	Land use management measures in the runoff basins of torrents.	Measures of an environmental nature	23.72	0	8	10	0.80	1

MEASURE REFERENCE	MEASURE TITLE	TYPE OF MEASURE	Δ11: Overall benefit index	Δ16: Total annualized costs	RΔ11	RΔ16	RD11/ RD16	Priority group
EL_10_41_01	Development and operation of an operational flood early warning system	Obtaining, supplementing and improving information	85.85	396,379	3	4	0.75	1
EL_10_43_02	Information system to avoid use of Irish crossings due to flood events	Non-structural intervention	78.85	26,852	5	9	0.56	1

11 Public Consultation

Public consultation processes play a fundamental role in drafting, reading and revising Flood Risk Management Plans.

Article 10 of Directive 2007/60/EC refers to the publication and public consultation of stakeholders. Specifically, Chapter V of Directive 2007/60/EC on coordination with Directive 2000/60/EC, public information and consultation, Articles 9 & 10 refer to informing the public at the stage of Preliminary Flood Risk Assessment, preparation of Flood Hazard Maps and Flood Risk Maps and ensuring the active participation of the public in the formulation and review of Flood Risk Management Plans in coordination with Directive 2000/60/EC.

Thus, to inform the public and the Bodies and Institutions involved, a sufficient number of meetings were organized where the Draft Flood Risk Management Plans were published for consultation.

The consultations were mainly held at local/regional level and aimed on the one hand at the active participation of involved parties either by attending the events or by submitting proposals on the issues in consultation.

The list of social partners of the Central Macedonia River Basin District who were informed about the consultation of the 1st Review of the Flood Risk Management Plan, includes 772 bodies, at National, Regional and Local level. Of all the bodies identified, 306 are decision-making bodies, 172 are management bodies, 116 are Experts / Specialists, 57 are Flood Response Bodies and 121 are Media - News agencies.

In the context of the consultation procedure, in accordance with article 7 para. 4.1 and 4.2 of Joint Ministerial Decision no. ΥΠΕΧΩΔΕ/ΕΥΠΕ/οικ.107017/06 (Β' 1225), as amended and in force by Joint Ministerial Decision No. 40238/17 (Β' 3759), as in force, the file of the Strategic Environmental Impact Assessment (SEIA) of Flood Risks for the River Basins of River Basin District EL10 was posted on the website of the Ministry of Environment and Energy: https://floods.ypeka.gr/2round-consultation-smpe-el10/.

The competent departments were asked to express their opinion, within their remit, and any comments by sending them to the following email address sec.dipa@prv.ypeka.gr.

The Public Consultation of the 1st Review of the FRMP was met with satisfactory participation on the part of Public Administration bodies and citizens who attended the conference in person and online, sent comments and filled-in questionnaires. During the SEIA consultation and approval process, nineteen (19) opinions were forwarded to the competent bodies and taken into account.

The consultation process is considered successful as it contributed to informing local bodies and the public about the 1st Review of the FRMP, highlighted issues and problems faced by bodies regarding flood risk management and local specificities to be taken into account, conveyed the experience of bodies from the implementation of the first FRMP and the main problems they face, demonstrated the need for amendments and ultimately contributed to the final formulation of the 1st Review of the Flood Risk Management Plan for the Central Macedonia River Basin District (EL10).

Considering the comments, observations and suggestions made during the Consultation of the Draft Flood Risk Management Plan of the Central Macedonia River Basin District and the SEA, the main conclusions are the following:

- The need to modernize or install new meteorological and gauging stations.

- The need for flood prevention and protection actions for crops and livestock facilities and the restoration of the sewer and drainage network.
- The need to take into account the influence of fires on flood risk.
- The prioritization of natural water retention projects over other flood defences and stream training projects, and the review of all emerging solutions in the context of integrated planning (Flood Protection Master Plan) in areas of the River Basin District.
- The need to promote the flood defences proposed through the approved Master Plan for the Regional Unit of Thessaloniki.
- The broadening of the obligation to consider natural water retention projects in the context of other projects which, inter alia, include flood defences.
- The need to draw up and apply appropriate specifications for cleaning watercourses, construction of mountain water management structures and natural water retention measures in the lowlands.
- The need to harmonize urban plans with flood risk management measures in accordance with the 1st Review of the FRMP and to impose additional building restrictions on existing or new facilities and structures within high risk Flood Zones and in areas of controlled flooding.
- The need for a detailed and comprehensive approach to the forecast and management of flood risks in the Edessaio - T66 – Loudias system, concerning both the Western Macedonia RBD (EL09) and the Central Macedonia RBD (EL10).
- The need to implement projects and actions related to the management of flood risks, such as cleaning, maintenance and training projects, in accordance with the provisions of the 2nd Review of the EL10 River Basin Management Plan, so that they do not threaten existing habitats and do not create new hydromorphological alterations.
- The need to correlate the measures of the 1st Review of the FRMP with the National Climate Change Adaptation Strategy (NCCCA) and the Regional Climate Change Adaptation Plans (RCCAPs).
- The need to provide the implementing bodies, per their competence, with practical instructions and specifications on the implementation of the measures, so that they have the appropriate methodological guidelines and coordination between the bodies, to ensure implementation effectiveness of the FRMP.
- The need to inform the public about flood risks in the event of extreme events but also about the actions taken to prevent them, to understand the objectives and actions of the FRMP, to monitor and implement flood protection practices as individuals, obtain flood insurance and adopt environmental practices in homes and businesses, with a view to limiting the effects of flooding.
- The need to promote the actions of the Programme of Measures, taking into account the availability of resources (financial as well as human), as this is one of the main factors that affect the effectiveness of the Plan's implementation, in accordance with the prioritization results. Substantial cooperation with funding agencies in order for the proposed measures to be implementable within the current cycle of Management Plans will also help significantly in this direction.
- The need to amend the content of the Plan, the Programme of Measures and the SEA with regard to the current legislative framework for flood management and other provisions related to the object of the FRMP, implementing bodies, sources of funding, descriptions of certain measures, further specification of descriptions and areas of implementation, excluding a measure originally proposed and information on the current situation.