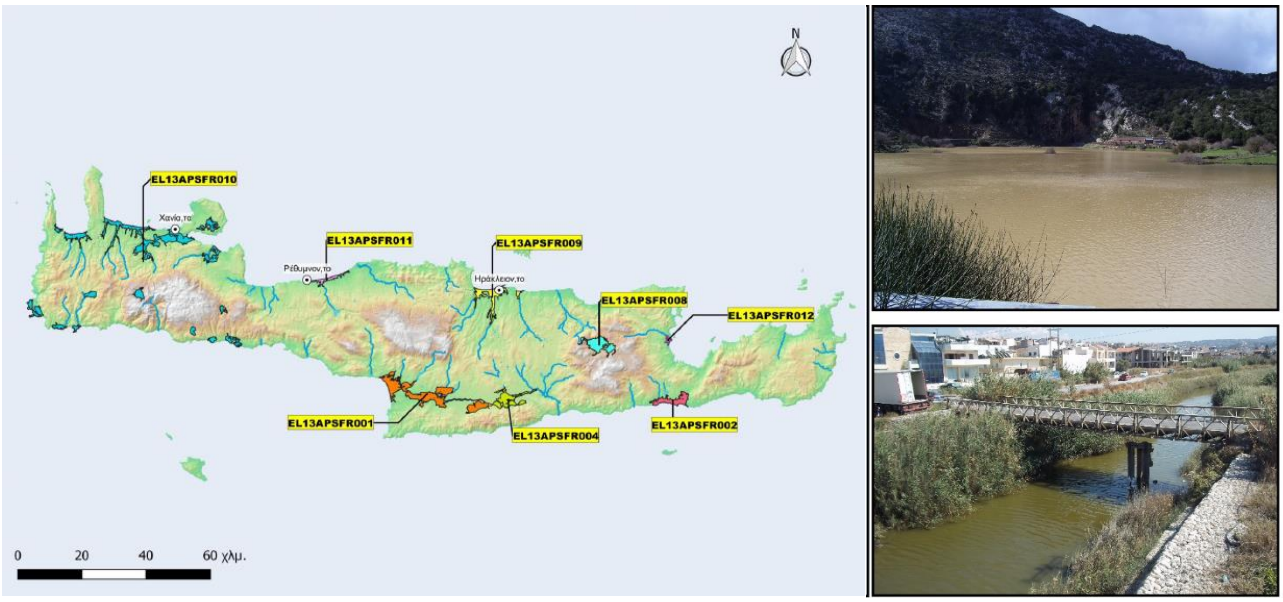
HELLENIC REPUBLIC

ΥΠΟΥΡΓΕΙΟ ΠΕΡΙΒΑΛΛΟΝΤΟΣ & ΕΝΕΡΓΕΙΑΣ

GENERAL SECRETARIAT FOR NATURAL ENVIRONMENT AND WATER

GENERAL DIRECTORATE FOR WATER



1st REVISION

OF FLOOD RISK MANAGEMENT PLANS

of the River Basins of Crete Water District (EL13)

Stage 2 - Deliverable 19

Translation into English of the summary reports of the methodologies and results of the Deliverables studies

Co-funded by the European Union

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HELLENIC REPUBLIC
MINISTRY OF ENVIRONMENT AND ENERGY
GENERAL SECRETARIAT FOR NATURAL ENVIRONMENT AND WATER
GENERAL DIRECTORATE FOR WATER

PROJECT NAME: 1st REVIEW OF FLOOD RISK MANAGEMENT PLANS OF THE RIVER BASINS OF WESTERN, NORTHERN AND EASTERN PELOPONNESE AND CRETE WATER DISTRICTS

JOINT VENTURE FOR THE 1ST REVISION OF FLOOD RISK MANAGEMENT PLANS OF PELOPONNESE AND CRETE

ADT OMEGA CONSULTING ENGINEERS TECHNICAL COMPANY
with the distinctive title: ADT OMEGA S.A.

ADVANCED ENVIRONMENTAL STUDIES CONSULTING ENGINEERS S.A.
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Revisions:

Issue	**Date**	**Observations**
Edition 1	27/08/2024	Original Version
Edition 2	19/12/2024	Incorporation of comments/feedback from the General Directorate for Water and the Technical Consultant (Protocol No. MoEE/ DfWSPaM/113875/18-10-2024)
Edition 3	22/05/2025	Incorporation of comments/feedback from the General Directorate for Water and the Technical Consultant (Protocol No. MoEE/DfWSPaM/7939/49/23-01-2025)

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1 The Floods Directive 2007/60/ EC in Greece

- Floods Directive 2007/60/EC, of European Parliament and the Council of the 23rd of October 2007 for the flood **risk assessment** and **management**.
- Incorporation in the Greek Legislation: Joint Ministerial Decision No. 31822/1542/E103/2010 (Government Gazette Issue B' 1108/21.07.2010).
- Amendment by Joint Ministerial Decision No. 177772/924/2017 (Government Gazette Issue B'2140/22.06.2017).
- Amendment by Law 5037/2023 (Government Gazette Issue A' 78/29.03.2023).

The Floods Directive 2007/60/EC is implemented in Greece in three stages:

Stage 1: Preparation of the **Preliminary Flood Risk Assessment (PFRA)** for each river basin and the identification of Areas of Potential Significant Flood Risk – APSFRs.

Stage 2: Preparation of **Flood Hazard Maps** and **Flood Risk Maps** in Areas of Potential Significant Flood Risk – APSFRs

Stage 3: Preparation of **Flood Risk Management Plans**, including **Program of Measures**, for the Areas of Potential Significant Flood Risk – APSFRs.

The above shall be reviewed every **6 years**.

1st implementation cycle of Directive 2007/60/EC

1. Preparation and submission to the EU of the Preliminary Flood Risk Assessment (PFRA) for the 14 Water Districts of Greece and identification of the Areas of Potential Significant Flood Risk – APSFRs (2012).
2. Preparation and submission to the EU of the 1st Flood Hazard Maps and Flood Risk Maps (2017).
3. Preparation and submission to the EU of the 1st Flood Risk Management Plans . The 1st Flood Risk Management Plans of the Crete Water District (EL13) was approved with Decision MoEE/SSSfW/41397/335 / Government Gazette Issue B' 2687 /06-07-2018 (Government Gazette Issue B' 5646/14-12-2018 Corrections).

2nd implementation cycle of Directive 2007/60/EC

1. Preparation and submission to the EU of the 1st Revision of the Preliminary Flood Risk Assessment (1st PFRA) for the 14 Water Districts of Greece and review of the Areas of Potential Significant Flood Risk – APSFRs (2020).
2. Following the open international tender, the General Directorate of Water of the Ministry of Environment and Energy assigned the:
    a. Preparation of Flood Hazard Maps (FHP) and Flood Risk Maps (FRM) in the Areas of Potential Significant Flood Risk – APSFRs (2023),

b. Preparation of the 1st review of the Flood Risk Management Plan (FRMP) which is under consultation

c. Preparation of the Strategic Environmental Assessment (SEA) for the 1st Revision of the FRMP.

Competent Authorities

The **Hellenic Ministry of Environment and Energy / General Directorate for Water** formulates the policy for water protection and management while also monitors its implementation. The **Water Directorates, under the** Decentralized Administration, are responsible for water protection and management, including flood risk. For the Crete Water District (EL13), the competent authority is the Water Directorate of Crete.

Table 1-1: River basins and the competent Decentralized Authorities of the Crete Water District (EL13)

Water District	River Basin	Regions within the Basin	Competent Decentralized Administration/ Water Directorate [1](according to Government Gazette 1383/B/2-9-10, Government Gazette 1572/B/28-9-10 and Government Gazette 87/A/7-6-2010)
Crete (EL13)	Streams of Northern Chania–Rethymno–Heraklion (EL1339)	Crete (100 %)	Decentralised Administration of Crete / Water Directorate of Crete
	Streams of Southern Chania–Rethymno–Heraklion (EL1340)	Crete (100 %)	Decentralised Administration of Crete / Water Directorate of Crete
	Streams of Eastern Crete (EL1341)	Crete (100 %)	Decentralised Administration of Crete / Water Directorate of Crete

[1]*The Official Gazette refers to the former "state" Regions, whose responsibilities are exercised, according to Article 280 of Law 3258/2010 (Official Gazette 87/A/7-6-10), by the Decentralized Administrations, with the exception of the responsibilities that fall under Article 186 of the same law to the Elected Regions.*

2 The Crete Water District (EL13)

The Water District of Crete (EL13) is the southernmost Water District of the country, bounded to the north by the Northern Sea of Crete and to the south by the Southern Sea of Crete. It comprises of the island of Crete itself together with its surrounding small islands —most notably Gavdos and Dia. It includes the regional units of Chania, Rethymno, Heraklion, and Lasithi. Its total area is 8 327 km^2.

The Crete WD (EL13) is composed of three (3) River Basins:

- **Streams of Northern Chania–Rethymno–Heraklion (EL1339) with an area of 3 644 km^2**
- **Streams of Southern Chania–Rethymno–Heraklion (EL1340) with an area of 2 798 km^2**
- **Streams of Eastern Crete (EL1341) with an area of 1 885 km^2**

The island's relief is rugged, with major mountainous massifs. The principal mountain ranges are, in the west, the Lefka Ori (maximum elevation 2 453 m); in the centre, Psiloritis or Ida, whose highest peak is Timios Stavros (2 456 m); in the north, Kouloukonas (1 083 m); in the south, the Asterousia Mountains (1 231 m); in the east, Dikti (2 148 m); and further east, the Lasithi Mountains or Sitia Mountains (1 476 m). Within these great massifs lie significant plateaux such as Omalos and Askifou in the White Mountains and the Lasithi Plateau in the Dikti range. At the foot of these mountains lie the island's most fertile plains: the extensive plain from Kastelli – Kissamos to Axos, the Messara Valley, the Heraklion–Malia Valley, the Ierapetra Plain, and the Agios Nikolaos Plain. A large part of Crete's coastline—especially along the southern shore—is rocky, steep, and difficult to access. Between the cliffs are extensive and smaller beaches of sand and pebbles, with dunes, salt-tolerant shrubs, and reedbeds.

Grasslands is the dominant land use in the Crete WD, accounting for over 50 %. According to the 2021 census, the total resident population in the Crete WD is 624 408 inhabitants, marking a slight increase (0,22 %) compared to the 2011 population. Within Crete's individual regional units, mixed trends are observed. Specifically, over the decade 2011–2021, the population of

- Rethymno Regional Unit decreased by 0,87%
- Heraklion Regional Unit decreased by 0,15% (about 49% of the island's population)
- Chania Regional Unit increased by 0,08%
- Lasithi Regional Unit increased by 3,23%

Across the entire Water District of Crete (EL13), total annual water abstractions for all activities and uses amount to approximately 389 hm^3, with about 49 % of these abstractions originating from the Streams of Northern of Chania–Rethymno–Heraklion Basin (EL1339). Agriculture (irrigated areas), which is the primary water user, consumes roughly 73,3 % (285,2 hm^3) of the total water demand; industry accounts for about 0,9 % (3,54 hm^3); public water supply for approximately 22,5 % (87,5 hm^3); and livestock farming for around 3,3 % (12,7 hm^3).

Figure 2-1: Crete Water District (EL13) and its River Basins

3 1st revision of the Preliminary Flood Risk Assessment

During the 1st revision of the Preliminary Flood Risk Assessment (PFRA), the following have been reviewed and updated: the Preliminary Flood Risk Assessment for all the Water Districts of the country, the list of Historical Floods and Significant Historical Floods as well as the Areas of Potential Significant Flood Risk (APSFRs).

Between the 1st PFRA and the 1st revision of the PFRA (2012–2018) in the Crete WD (EL13), **88 historical flood events were recorded**, of which **51** were classified as **significant historical flood events** since they had particularly large consequences in terms of either human casualties, financial compensation, or size of the flooded area. The highest concentration of floods occurred in the northern part of Chania Regional Unit, near the outlets of the Giflos, Tavronitis, Keritis, Klados and Koiliaris streams (from west to east).

For the Crete Water District, 8 Areas of Potential Significant Flood Risk (APSFRs) in total are identified according to the methodology applied. These 8 Areas of Potential Significant Flood Risk (APSFRs) resulted from the consolidation and expansion of the APSFR that were identified in the 2012 PFRA and the addition of new ones.

Table 3-1: Revised APSFR in the Crete Water District (EL13)

no.	Name	Code	RB	% of RB	Area (km ²)
1	Lower basin of Geropotamos	EL13APSFR001	EL1340	3,1%	86,24
2	Low zone of Gra-Lygia–Ierapetra streams	EL13APSFR002	EL1341	1,2%	21,54
3	Low zone of Agia Fotia area	EL13APSFR004	EL1340	1,0%	28,70
4	Low zone of Lasithi plateau basin	EL13APSFR008	EL1339	0,8%	28,86
5	Low zone of Heraklion streams	EL13APSFR009	EL1339	0,8%	29,65
6	Low zone of Chania streams	EL13APSFR010	EL1339 & EL1340	2,3%	147,13
7	Low zone of Rethymno streams	EL13APSFR011	EL1339	0,2%	8,56
8	Low zone of Agios Nikolaos	EL13APSFR012	EL1341	0,1%	2,13
				TOTAL	**352,78**
				Difference with PFRA 2012	**+60,35%**
				Percentage of total WD ***	**4,2%**

*** The total area of the WD EL13 is 8.327 km²

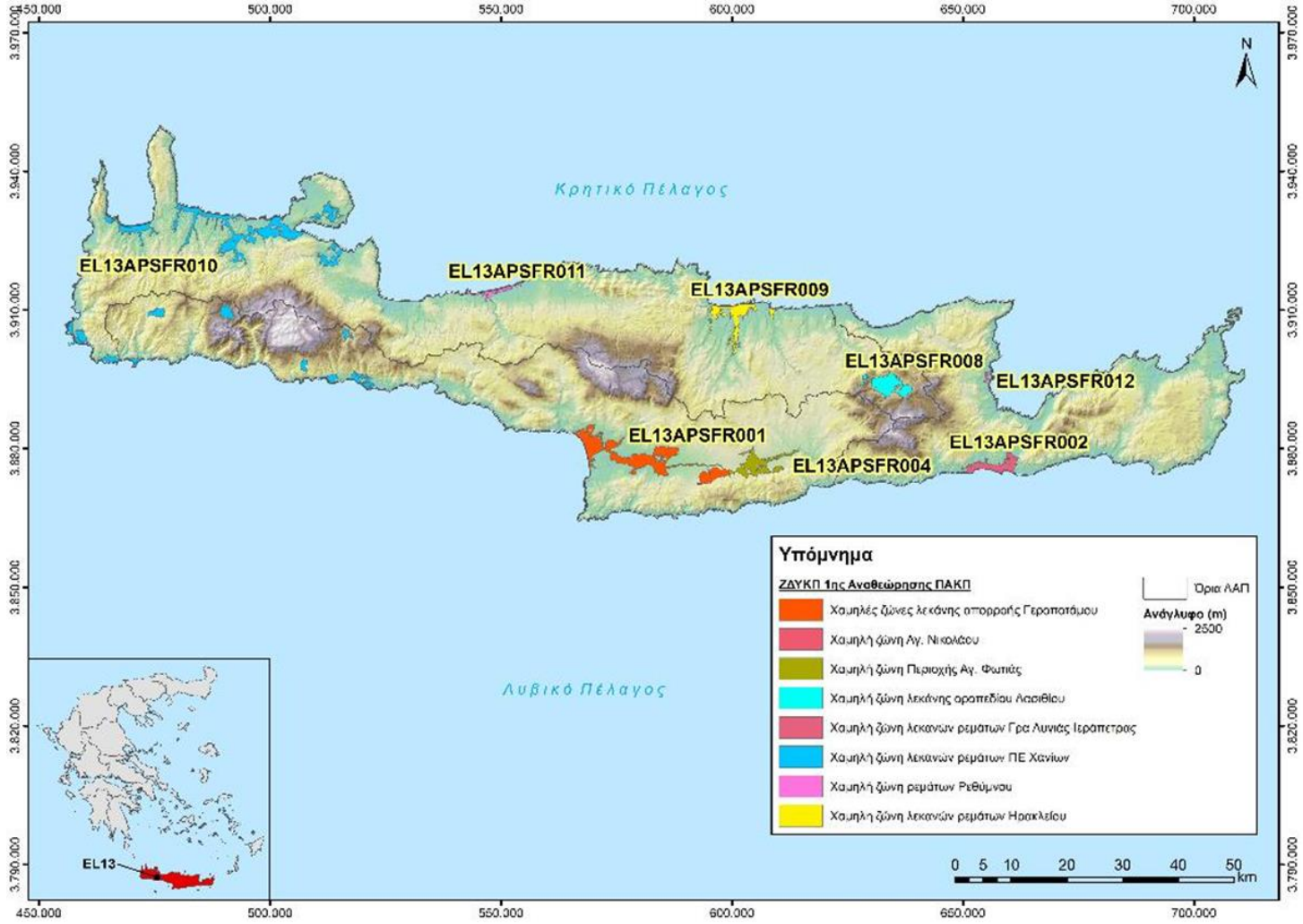

Figure 3-1: Revised APSFR in the Crete Water District (EL13)

4 Hydrology of the Crete Water District (EL13)

According to the Floods Directive 2007/60/EC and the relevant Joint Ministerial Decision No. 31822/1542/E103/21.7.2010 which incorporates the Directive into the National Law, it is foreseen that for each watercourse the hydrographs (average, favorable and unfavorable conditions) are carried out for the following scenarios:

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

During the 1st revision of the FRMP, the rainfall curves are revised. This work is carried out for the entire country. The rainfall curves are a parametric relationship that connects the intensity of rainfall with the return period for each rainfall duration. As for the design rainfall (ΔH) and the peak flow (ΔQ) in the WD EL13, the following are observed:

Design Rainfall (DH)

- For T=50 years return period, the variations in design rainfall are small . Mostly small negative variations appear, meaning decrease of rainfall in the largest part of the Crete Water District (EL13).
- For T=100 years return period, the variations in design rainfall are small and moderate. Mostly small negative variations appear, meaning decrease of rainfall in the largest part of the Crete Water District (EL13).
- For a return period of T = 1000 years, the changes in design rainfall are predominantly small increases in most basins, while a number of basins show small decreases in rainfall.

Peak Flow (ΔQ)

- For return periods of T = 50 and 100 years, the flow changes are negative in all basins of the Crete WD (EL13), exhibiting peak flow reductions of up to 50%.
- For return period of T = 1000 years, peak flow changes are predominantly negative, although the peak flow of the Anopodaris River increases, as two new sub-basins were added to the existing ones (from the 1st management cycle).

For the hydrological simulation the new Digital Terrain Model is used, which is based on the latest 2m x 2m resolution DTM of the Hellenic Cadastre. Thus, the morphometric-geometric characteristics of the basins and sub-basins were extracted: area, maximum, average and outlet elevation as well as the length of the main river reach. Hyetograph were calculated for design storms with return periods T = 50, 100, and 1000 years and rainfall duration D, multiple of the basin concentration time, based on the revised rainfall curves and the morphometric-geometric characteristics. The point precipitation was converted to surface precipitation, through a surface runoff coefficient. The hyetograph were calculated as follows:

- with the **alternating block method** for moderate and high probability of flood occurrence, i.e. with return periods of 100 and 50 years, respectively
- with the method of the least favorable order of design hyetogram for low probability floods, i.e. with return periods of 1000 years (**worst profile**)

The effective precipitation is estimated separately in each sub-basin, using the curve number (**CN**). The estimation is made for three types of soil moisture conditions. In addition to that, the burnt areas are taken into consideration to increase the curve number in each sub-basin. To convert the hyetograph (rainfall) into runoff (discharge), the flood hydrographs of each rain event are estimated taking into account the concentration time, the duration of rainfall and the Unit Hydrograph of each basin / sub-basin. For the **hydrological routing** of the flood wave within a stream reach, the **Muskingum method and the lag time method** are used. The flood hydrographs are generated using the free of charge software HEC - HMS 4.10 (Hydrologic Engineering Center – Hydrologic Modeling System). With HEC - HMS it is possible to model all the hydrological processes (calculation of hydrological losses, transformation of active precipitation into direct runoff, hydrological routing, etc.) that happen during the transformation of precipitation into runoff in dendritic- type basins.

The following table contains the results of the hydrological simulation for the three return periods considered and for average humidity conditions:

Table 4-1: Overview of the hydrological simulation results per basin for average humidity conditions (WD EL13)

no	Basin Code	Description	Surface area (km^2)	Q (m^3/s) T=50	Q (m^3/s) T=100	Q (m^3/s) T=1000	Rainfall Duration (hrs)
1	EL1339FR00F1	Spilianos River	39,24	275,8	347,4	686,7	24
2	EL1339FR0003	Tavronitis River	130,3	1050,6	1315,5	2417,4	24
3	EL1339FR00F5	Spelios River	18,94	189,2	240,3	481,1	12
4	EL1339FR0004	Keritis River	178,15	1304,6	1668,9	3358,2	24
5	EL1339FR00F10	Kladissos River	56,49	284,2	385	956,5	12
6	EL1339FR0013	Gazanos River	186,74	608,8	808,5	1938,7	24
7	EL1339FR0014	Giophyros River	183,8	664,4	850,1	1794,7	24
8	EL1339FR00F13	Xeropotamos River	49,33	233,5	299,1	625,4	24
9	EL1339FR00F14	Sylamianos River (Katsampadianos)	42,4	187,1	242,2	525	24
10	EL1339FR00F15	Chavgas River	130,04	538,5	705	1302,9	24
11	EL1340FR00F30	Klimatianos River	48,94	171,2	230	554,1	12
12	EL1340FR0002	Geropotamos River	592,92	1941,5	2573,3	6128,7	48
13	EL1340FR0001	Anopodaris River	276,62	973,2	1238	2656,2	48
14	EL1341FR0006	Kalamafkianos River	35,46	117,9	163,9	444	12
15	EL1341FR0005	Bramianos River	28,29	16,7	23	73,7	12
16	EL1341FR00F18	Kotovianos River	40,69	200,7	266,2	603	12
17	EL1339FR0015	Karteros River	195,19	540,2	706,6	1595,7	24
18	EL1339FR00F64	Prinos Stream	14,92	75	101,1	243,9	12
19	EL1339FR00F63	Stavromenos Stream	33,83	109,6	154,2	432,1	12

no	Basin Code	Description	Surface area (km^2)	Q (m^3/s) T=50	Q (m^3/s) T=100	Q (m^3/s) T=1000	Rainfall Duration (hrs)
20	EL1339FR00F62	Sfakaki Stream	13,17	74,9	100,5	239,4	12
21	EL1339FR00F61	Loutra Stream	4,89	31,9	42,9	101,5	12
22	EL1339FR00F54	Rethymno A	3,99	39,7	51,6	105,3	12
23	EL1339FR00F55	Rethymno B	3,51	35,7	46	92,7	12
24	EL1339FR00F57	Rethymno D	5,79	45,7	60,2	132,2	12
25	EL1339FR00F58	Pnigmenou River	6,96	47,2	64,8	161,4	12
26	EL1339FR0010	Sfakoryako Stream	120,47	534,8	701,7	1745,1	24
27	EL1341FR00F78	Agios Nikolaos South	24,73	54,8	82,8	283,2	12
28	EL1341FR0001	Almyros of Lasithi	121,06	473,1	635,7	1562	24
29	EL1339FR00F59	Adele Stream	3,43	29,7	39,8	91	12
30	EL1339FR00F60	Porofarango Gorge	18,58	92,8	126,3	316,6	12
31	EL1340FR00F67	Chora Sfakion A	2,02	64,6	82,6	147,5	12
32	EL1340FR00F71	Arvanitis River	31,25	192,6	264,6	701,2	12
33	EL1340FR00F66	Anopoli	32,11	248,9	322,9	686,9	12
34	EL1340FR00F68	Chora Sfakion B	5,57	102,8	131,1	244,4	12
35	EL1340FR00F70	Sfakiano Gorge	32,82	296,4	382,5	793,3	12
36	EL1340FR00F74	Asfendiotiko Gorge	10,72	127,9	166,8	351,3	12
37	EL1340FR00F77	Kallikratis Gorge	29,53	292,5	389,2	893,4	12
38	EL1339FR00F53	Chania Airport	15,7	94,5	122,2	261,7	24
39	EL1339FR00F52	Mesopotamos	12	100,8	130,7	279,4	12
40	EL1339FR0005	Koiliaris River	130,97	743,6	978,7	2172,9	24
41	EL1339FR00F50	Souda D	17,72	114,3	148,4	318,9	12
42	EL1339FR00F51	Souda	6,54	40,3	54,7	131	12
43	EL1340FR00F65	Omalos Plateau	25,75	112	152,3	387,9	12
44	EL1339FR00F38	Monastery of Chryssoskalitissa	5,91	49,6	64,7	134,9	12
45	EL1339FR00F34	Agia Kyriaki	6,87	47,8	64,2	143,6	12
46	EL1339FR00F32	Perdiki Gorge	3,9	23	32,6	87,6	12
47	EL1340FR0008	Pelekaniotis River	40,47	180	235	508,9	12
48	EL1340FR0007	Kakodikianos River	77,56	327,4	429	888	12
49	EL1339FR00F47	Arapi River	41	285	366,4	810	12
50	EL1339FR0002	Giflos River	76,32	453,1	568,3	1129,4	24
51	EL1339FR00F45	Milias River	16,38	104,5	133,5	267,8	12
52	EL1339FR0001	Tsichlianos River	31,73	141	187,9	437,3	12
53	EL1339FR00F44	Kissamos	22,15	119,5	157,8	323	12
54	EL1339FR00F40	Agios Georgios	10,67	73,8	97,7	212,1	12
55	EL1339FR00F39	Kalyviani Stream	6,56	40,2	56,3	142,2	12

5 Hydraulic Simulation of the Crete Water District (EL13)

During the **1st implementation cycle** of the Directive 2007/60/EC, 38 river basins and 1215 watercourses were identified. In the present **2nd implementation cycle,** 2 of the 38 river basins are revised **while 55** new **river basins** and **960 watercourses** are added. Hydraulic simulation is carried out for the following watercourses:

- Rivers, streams and torrents that are added in the APSFRs according to the 1st review of the PFRA,
- Rivers, streams and torrents within the APSFRs, since the 1st implementation cycle of the 2007/60/EC Directive, and had not been included in the hydraulic simulation
- Rivers, streams and torrents within the APSFRs since the 1st implementation cycle but with newly added reaches in the present cycle
- Rivers, streams and torrents within the APSFRs since the 1st implementation cycle that underwent significant changes (e.g. implementation of flood protection structures).

For the hydraulic simulation, **2D model analysis is performed** with non-steady conditions, using the hydrographs derived from the hydrological analysis. The i**nput data for** the hydraulic simulation consist of the following:

- The Digital Terrain Model, based on the latest 2m x 2m resolution DTM of the Hellenic Cadastral, processed adequately,
- Topographic data and site inspections of existing structures,
- Hydrographs – Boundary conditions and hydrographs for cross-border basins–lakes, as derived from the hydrological analysis,
- roughness of the Manning coefficient based on the latest land use data,
- Initial conditions and assumptions for the sake of the hydraulic simulation.

For the **hydraulic simulation,** the free-of-charge HEC - RAS software version 6.4.1 created by the U.S. Army Corps of Engineers (U.S. Army Corps of Engineers), is used. The software can be used both for steady and unsteady flow conditions and calculates the water characteristics such as depth, level and flow velocity any time during the simulation as well as their maximum and minimum values. Finally, it can simulate a wide range of structures, including bridges, culverts and spillways/elevators.

In the following figure, a snapshot of the HEC - RAS 6.4.1 graphical environment while adding a bridge into a 2D model is presented.

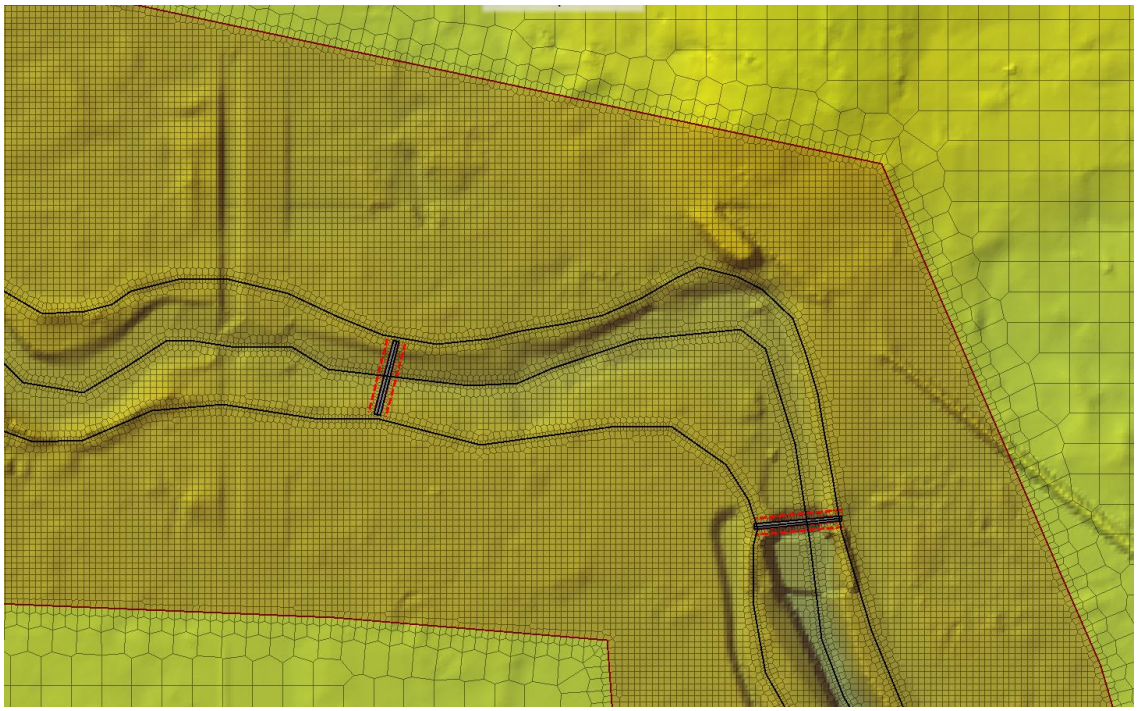

Figure 5-1: Snapshot of the HEC - RAS 6.4.1 graphical environment showing the DTM, the 2D grid and structures perpendicular to the stream flow

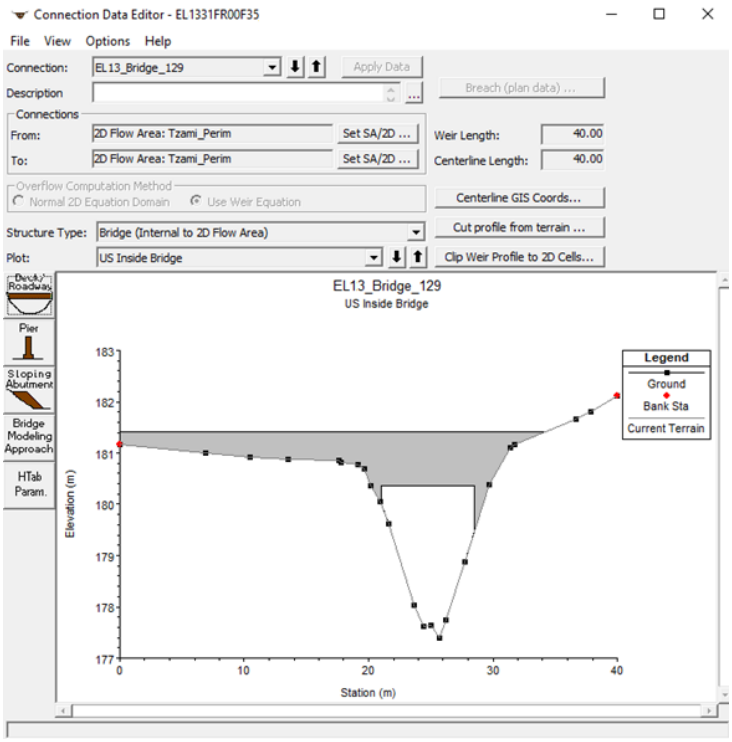

Figure 5-2: Snapshot of the HEC - RAS 6.4.1 graphical environment showing the geometric characteristics of the bridge when inputting it in the 2D model

6 Flood Hazard Maps – FHMs

The FHMs are presented at a scale of 1:25,000 for the three return period scenarios (T=50, 100 and 1000 years) for flooding due to river/lakes.

For all the points of interest affected by river/lake flooding, the arrival and residence time of the flood wave are calculated for flow depths ≥0.3 m. The FHMs from river/lake flooding present the spatial distribution of both the maximum depth and the maximum water velocity for the three return period scenarios. The FHMs from the average sea level rise present the spatial distribution of the maximum flow depth. The above-mentioned are presented in the appropriate color scales. The FHMs from river/lake flooding additionally present:

- The points of interest
- The arrival and residence time of the flood wave at the points of interest in the form of table
- the boundaries of the APSFRs as determined at the 1st revision of the Preliminary Flood Risk Assessment (PFRA)
- The names of local city/towns
- Existing structures (bridges, culverts, dams, embankments, terraces). It is noted that structures also include the site inspections carried out to ensure the dimensions of the most important structures along the streams to be considered in the hydraulic simulation.
- Inundation surface due to sea level rise for T=50 and T=100 years return period
- Coastline
- The axis and the chainage (every 500 or 1000 meters from downstream to upstream) of the rivers that are simulated
- the boundaries of neighboring Water Districts
- Points showing
  - ✓ small settlements or places within cities
  - ✓ locations of important projects (bridges, embankments, culverts, dams, etc.)
  - ✓ important land uses (archaeological sites, industries, WWTP, WTP, etc.)

For the EL13 WD, mean sea level rise is estimated less than 1m and therefore, **FHMs for Sea Flooding (SF) were not created.**

Comparing the FHMs from river/lake flooding of the 1st implementation cycle with the ones of the 2nd implementation cycle of the 2007/60/EC Directive, the following are observed:

In the present implementation cycle of the FRMPs, an increase in the total area is observed for all three (3) return periods scenarios, compared to the 1st implementation cycle of the FRMPs. Specifically:

- **T = 50 years:** the total inundated area increased by approximately 38 %.
- **T = 100 years:** the total inundated area increased by approximately 27 %.
- **T = 1000 years:** the total inundated area increased by approximately 14 %.

Regarding flood-impact classes, all five intensity-impact categories appear in the 1st Revision—as in the 1st Cycle—but the "very low" class is substantially reduced.

For T = 50 years in the 1st Revision:

- "Very low" impact area is reduced by 61 %.
- "Low" impact area is increased by 57 %.
- "Moderate" impact area is increased by 79 %.
- "High" impact area is reduced by 19 %.
- "Very high" impact area is increased by 1.620 %.

For T = 100 years in the 1st Revision:

- "Very low" impact area is reduced by 65 %.
- "Low" impact area is increased by 36 %.
- "Moderate" impact area is increased by 64 %.
- "High" impact area is reduced by 29 %.
- "Very high" impact area is increased by 720 %.

For T = 1000 years in the 1st Revision:

- "Very low" impact area is reduced by 81 %.
- "Low" impact area is reduced by 34 %.
- "Moderate" impact area is increased by 39 %.
- "High" impact area is reduced by 45 %.
- "Very high" impact area is increased by 660 %.

The next figure shows the distribution of the Flood Hazard Maps (FHM) for river/lake flooding. Following, a Flood Hazard Map (FHM) showing the spatial distribution of maximum depths and maximum velocities within APSFR EL13APSFR001 is presented indicatively for river/lake flooding

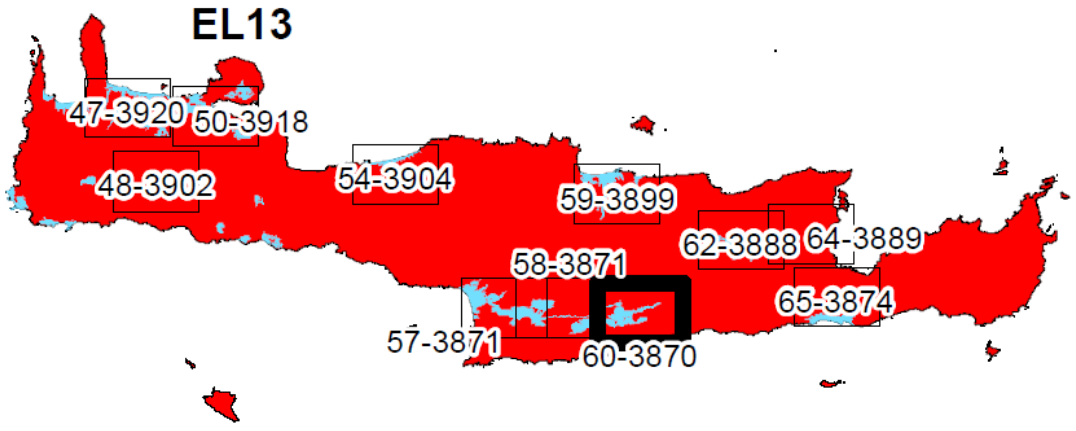

Figure 6-1: Distribution of FHMs and FRMs for river/lake flooding

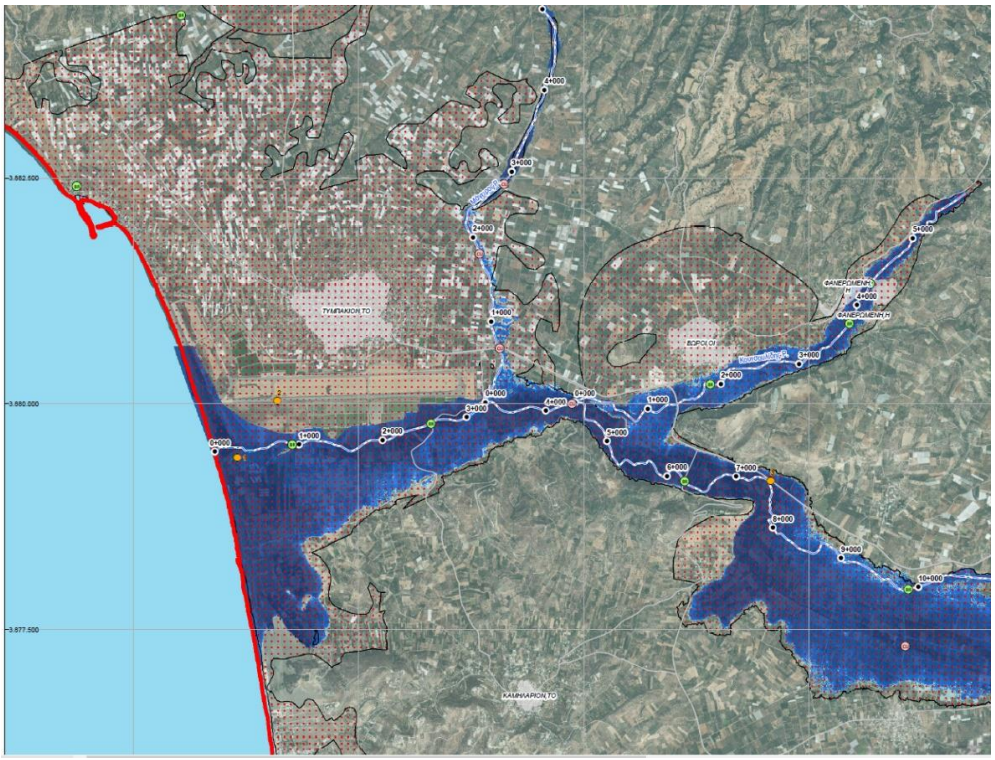

Figure 6-2: Indicative section of a FHM from river/lake flooding in the wider area of Tympaki (Geropotamos Estuary), APSFR EL13APSFR001, with color grading of maximum depth for T=100 years return period

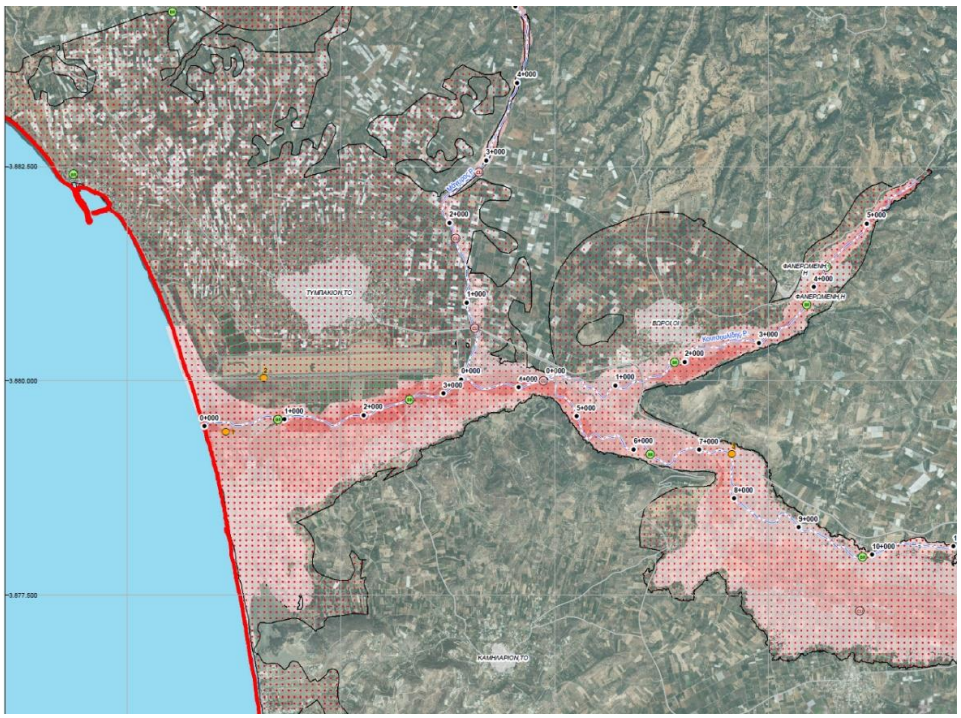

Figure 6-3: Indicative section of a FHM from river/lake flooding in the wider area of Tympaki (Geropotamos Estuary), APSFR EL13APSFR001, with color grading of maximum velocity for T=100 years return period

7 Flood Risk Maps – FRMs

The FRMs due to river/lake flooding are presented at a scale of 1:25,000 for the three return period scenarios (T=50, 100 and 1000 years). The FRMs show land uses, economic activities, protected areas and cultural heritage monuments which fall with the inundated area.

More specifically, the FRMs depict the following elements that are inundated: affected population, health and social infrastructure, water supply infrastructure, energy infrastructure, civil protection infrastructure, rural areas, livestock units, tourist attraction spots, industries both inside and outside industrial concentrations, road network, railway network, airports, Wastewater Treatment Plants, urban waste disposal and management areas, protected areas, monuments, archaeological sites, recreational areas and settlements.

The FRMs are accompanied by the following maps:

- **Soil Erosion Map**, in scale 1:200.000, and the soil erosion classes with appropriate chromatic grading in 5 levels.
- **Flood Maximum Potential Impact Map** (for river/lake flooding), at a scale of 1:200.000 and the vulnerability classes with appropriate chromatic grading in 5 levels.
- **Flood Intensity Degree of Influence Map** (for river/lake flooding)**,** at a scale of 1:200.000, and the influence level classes with appropriate chromatic grading in 5 levels.
- **Flood Impact Assessment Map** (for river/lake flooding), at a scale of 1:200.000, and the impact level with appropriate chromatic grading in 5 levels.

From the Flood Risk Assessment in the Crete WD (EL13), it emerges that the greatest flood risk occurs for **T = 50 years**:

- In the areas of the city of Chania and to the southwest (Kladisos River), downstream of the Keritis River (between the settlements of Gerani and Platanias), in parts of the Tavronitis River near the settlement of the same name and Voukolies, and along the lower and middle course of the Koiliaris River **(EL13APSFR010).**
- In the region of Rethymno (east – Sfakoryako Gorge and the Pnigmenou River) **(EL13APSFR011)**
- In the Heraklion region (Almyrós River, Gazanós River, Xeropotamos River, Giophyros River, Sylamianos River, and Karteros River) **(EL13APSFR009).**
- In the area of Agios Nikolaos **(EL13APSFR012)**
- In the middle course of the Geropotamos River (area of the Phaistos archaeological site). **(EL13APSFR001)**,
- In a section of the middle course of the Anopodaris River near the settlement of Protorias. **(EL13APSFR004)** and
- In parts of Ierapetra and the coastal areas to its west (Gra Lygia and Stomio). **(EL13APSFR002)**

The greatest flood risk for **T = 100 years** is encountered:

- In the same areas identified for T = 50 years, but covering larger extents.
- Additional areas in the upper course of the Koiliaris River (northeast of the settlement of Stylos). **(EL13APSFR010)**.

Finally, the greatest flood risk for **T = 1000 years** is encountered:

- In the same areas identified for T = 50 years and T = 100 years, but covering larger extents.
- Additional areas concerning the lower course of the Spilianós River (east of Kolymbari) and the Spilios River (west of Kolymbari). **(EL13APSFR010)** And the stream south of the settlement of Loutra, Rethymno. **(EL13APSFR011)**

The areas exhibiting high, medium, and low flood risk for all return periods and flood sources are detailed within the Flood Risk Management Plan for the WD of Crete (EL13). The following figures show the percentage of the flood risk classes' distribution within the WD of Crete (EL13) for river/lake floods.

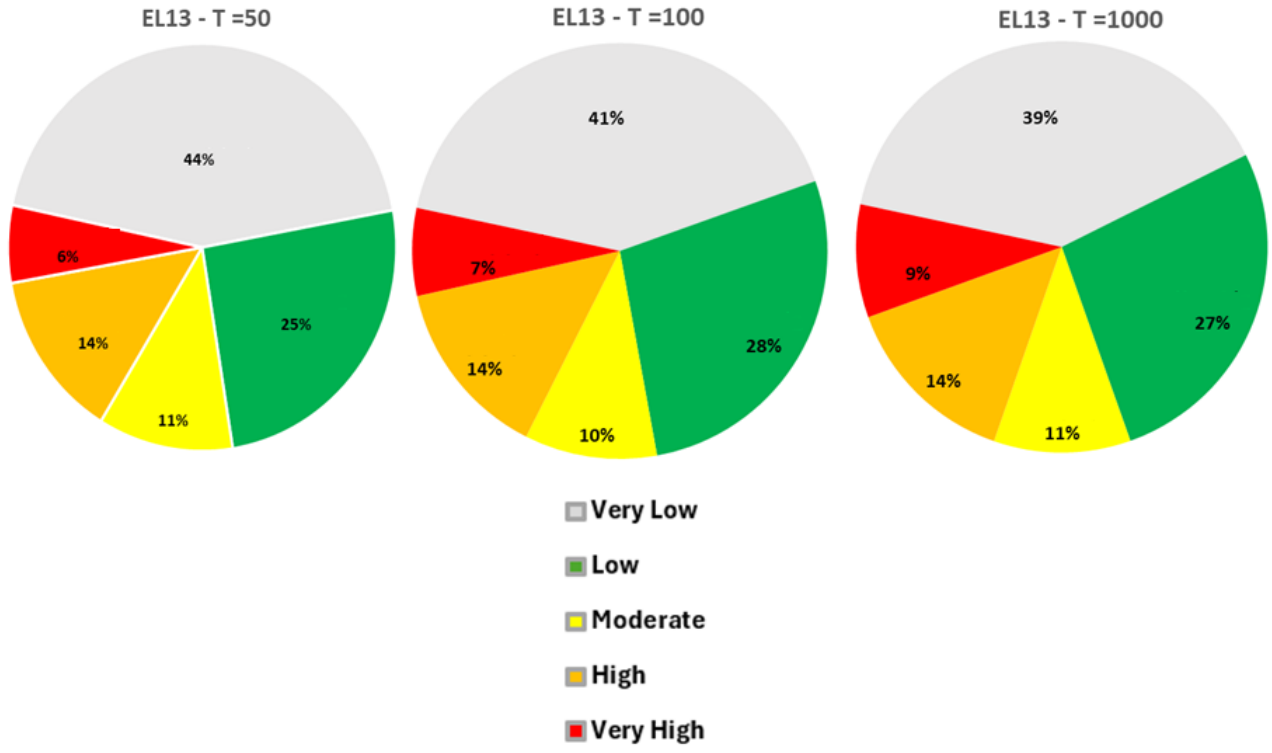

Figure 7-1: Percentage of flood risk classes from river/lake flooding in the WD EL13 for T50, T100 and T1000, respectively

The table below summarizes, for each APSFR, the potentially affected economic activities and the important infrastructure located within the flooded areas by a T=1000-year return period event.

Table 7-1: Amount of infrastructure and economic activities located within the flooded area of a T=1000-year event for each APSFR in the Crete WD

Infrastructure – Economic Activity	EL13APSFR001	EL13APSFR002	EL13APSFR004	EL13APSFR008	EL13APSFR009	EL13APSFR010	EL13APSFR011	EL13APSFR012
Airports	1					1		
Clinics								
Monuments of National Importance	6			2	3	8	2	2
Monuments of International Importance	1							
School Units	2				17	6		3
Fire Services								
Boreholes	10		7		5	3	6	
Industries					3	2	1	
Livestock Farms	23	1	7	12	5	17	15	
Police departments								
Sports facilities	1	1			3	5		4
Nursing homes								
Wastewater Treatment Plants	1				2			
Water Treatment Plants								
Habitats	1					2	1	
PPC substations					2			

Below, an indicative section of a Flood Risk Map (FRM) within the APSFR EL13APSFR001.

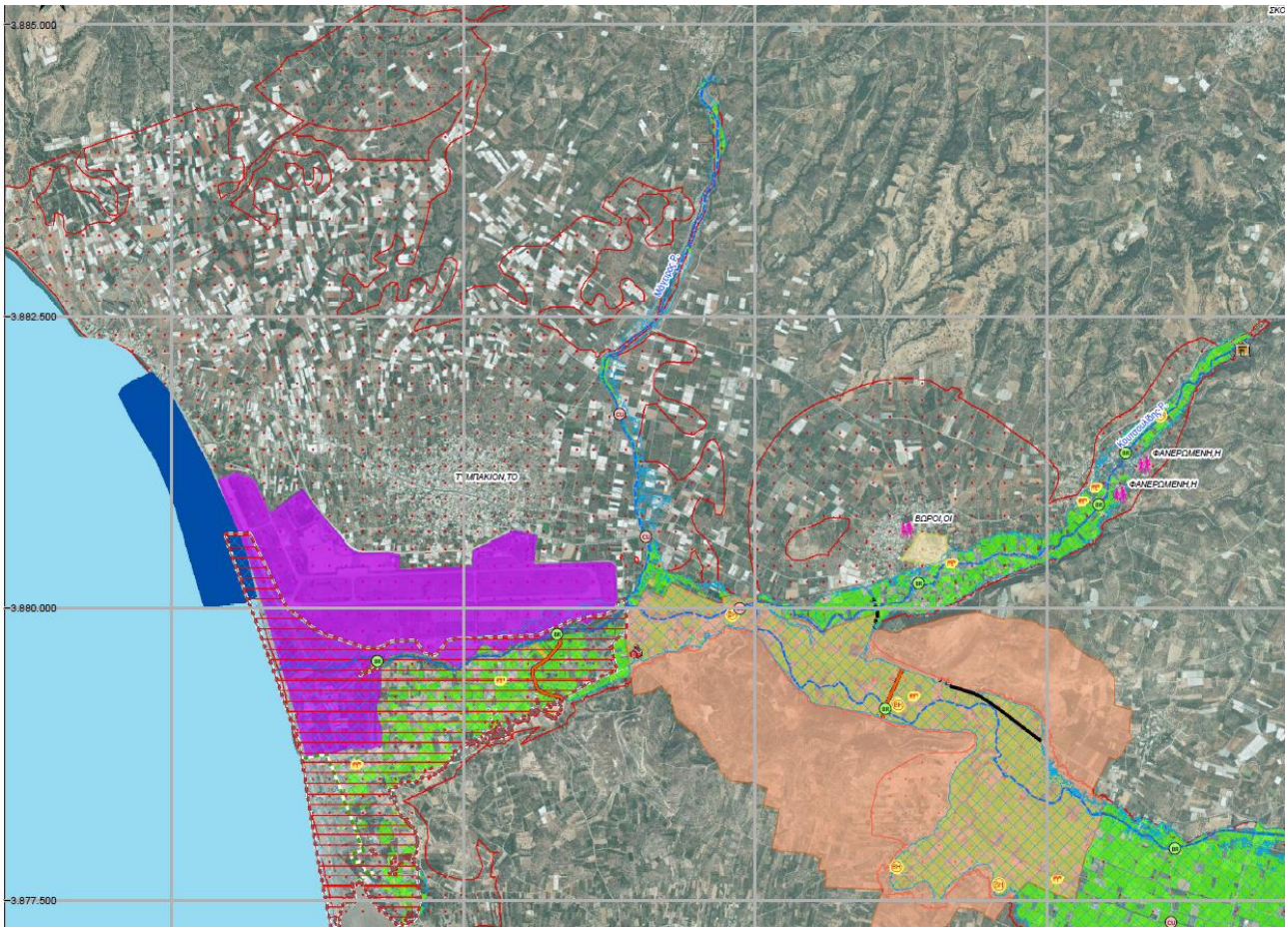

Figure 7-2: Indicative section of a FRM in the wider area of Tympaki (Geropotamos Estuary), APSFR EL13APSFR001, illustrating the affected land uses for T = 100 years

8 Consideration of climate change in the 1st revision of the FRMPs

The European Union recognizes that changes in the intensity and frequency of extreme rainfall events, combined with land use change, are expected to increase flood risk across Europe. The present 1st revision of the FRMPs examines how climate change may affect the frequency of flood events. More specifically, it is examined whether a current flood event with a 50-, 100- or 1000-year return period will experience a decrease or increase in its return period due to climate change.

According to the methodology, climate projection data from 675 rain gauge stations across the country are used to estimate the influence of climate change on the frequency of flood events in terms of rainfall intensity. These data come from the SWICCA (Service for Water Indicators in Climate Change Adaptation, 2015-2018) program and are based on 9 combinations of Global Circulation Models (GCMs), Regional Climate Models (RCMs) and Representative Concentration Pathway (RCP) scenarios.

In the current first revision of the FRMPs, the determination of the new frequency of occurrence of the design floods—at each point along the rainfall–runoff curve based on climate projections—is carried out for **two future climate periods:**

- The middle of the century (2041-2070 or 2050s) and
- The end of the century (2071-2100 or 2080s).

For the **EL13 Water District,** the impact of climate change is quite pronounced throughout the Water District**.** More specifically:

- A stronger influence is observed in RB EL1341 “Streams odEastern Crete,” where return periods decrease markedly for the future period 2041–2070 (the 2050s) and even more so for 2071–2100 (the 2080s), particularly for the T = 1000-year return period.
- In RB EL1340 “Streams of Southern Chania–Rethymno–Heraklion,” for the examined future periods, climate-change impacts are also evident but are milder compared to RB EL1341.
- In RB EL1339 “Streams of Northern Chania–Rethymno–Heraklion,” results diverge between the two future periods for the T = 1000-year return period. For 2041–2070 (the 2050s), a more favorable climatic future is indicated (an increase in return period for T = 1000 years). This occurs because, in the western part of the basin—which has a sparse network of meteorological stations—the stations at Meska, Palea Roumata, Souda, and Chania show negative percentage changes (decreases in rainfall for T = 10, 50, and 100 years) under RCP4.5 scenarios. Given the low station density, these results have wide influence, resulting in an increased return period for the basin. For 2071–2100 (the 2080s), the situation reverses, and return periods decrease, although to a lesser extent than in the other basins of the district.
- For the future period 2041–2070 (the 2050s), the mean return period under the influence of climate change for a current T = 50-year event in the Crete WD (EL13) is approximately 33 years.

- For the future period 2041–2070 (the 2050s), the mean return period under the influence of climate change for a current T = 100-year event in the Crete WD (EL13) is approximately 66 years.
- For the future period 2041–2070 (the 2050s), the mean return period under the influence of climate change for a current T = 1000-year event in the Crete WD (EL13) is approximately 882 years.
- For the future period 2071–2100 (the 2080s), the mean return period under the influence of climate change for a current T = 50-year event in the Crete WD (EL13) is approximately 22 years.
- For the future period 2071–2100 (the 2080s), the mean return period under the influence of climate change for a current T = 100-year event in the Crete WD (EL13) is approximately 39 years.
- For the future period 2071–2100 (the 2080s), the mean return period under the influence of climate change for a current T = 1000-year event in the Crete WD (EL13) is approximately 372 years.

9 Differences compared to the 1st FRMPs WD EL13

Compared to the 1st implementation cycle of the Directive 2007/60/EC, the main differences in the 1st revision of the FRMPs are as follows:

- New rain gauges are added from stations that were not included in the 1st implementation cycle of the FRMPs, such as the ones from the National Observatory of Athens (NoA). Most of the stations' time series that have been also used in the 1st implementation cycle are extended with the latest barometric data (up to 2022).

- The equation of the ombrian curve is modified, both in terms of its parameters and the method of its derivation. As a result, both the hyetograph and the flood hydrograph used are modified as well.

- In the 1st revision of the PFRA, the amount and boundaries of the APSFRs are changed compared to the 1st implementation cycle of the PFRA. Consequently, new basins, sub-basins and watercourses are added that fall within the revised APSFRs. Therefore, new areas are included in the fluvial flood routing analysis, while the areas examined for flood risk due to sea level rise are expanded.

- The Digital Terrain Model used in the present 1st revision of the FRMPs is the most updated from the LSO project of 2014-2015 provided by the Public Legal Entity Hellenic Cadastre with a resolution of 2m x 2m. In the 1st implementation cycle of the FRMPs, the DTM used was from the earlier LSO project of 2007-2009 with a resolution of 5m x 5m. Therefore, the DTM forming the basis of the flood routing models differs from the one used in the 1st implementation cycle.

- The calculation of the curve number CN requires both the land use data and the soil types (A, B, C, D), as defined by the underlying hydrogeological formations. The land use data used in the current implementation cycle are the most up-to-date CORINE 2018 data, whereas older versions were used in the 1st implementation cycle. As for the soil type data, some modifications are made in the current implementation cycle compared to the 1st implementation cycle, as analyzed in Deliverable 02 titled: “Analysis of regional characteristics and flooding mechanisms".

- In the current implementation cycle of the FRMPs, the burnt areas are taken into account resulting in changes to the CN values in specific basins and sub-basins, as described in detail in Chapter 7 of Deliverable 02, titled: “Analysis of regional characteristics and flooding mechanisms".

- In the current implementation cycle of the FRMPs, both data from level–volume curves and data for newly operational reservoirs, which were either not yet constructed or not in operation during the 1st implementation cycle, are taken into account.

- Given that in the current implementation cycle the most updated Corine 2018 land use data are used, the Manning coefficient for the entire Water District is modified/updated.

- Additional topographical surveys (culverts and bridges) are conducted along the rivers during the current implementation cycle, compared to the 1st implementation cycle. Furthermore, supplementary studies on existing structures are collected, providing information on their geometry and location.

- In most cases, the hydraulic analysis is performed using the 2D model in HecRas.

- The hydraulic analysis of endorheic basins is performed based on net outflow, meaning that infiltrated rainwater is subtracted.

- Data for assessing the health and safety impact (ΕκΑc) are obtained from specialized and, in some cases, newly developed databases. More specifically:

  √ The 2011 census of the de facto population is taken into account with regard to urban agglomerations, in comparison to the 2001 census data which had been used in the 1st implementation cycle of the Spatial and Urban Planning Framework. It is noted that the 2021 census data are not yet available at the settlement level.

  √ The database of public hospitals has been updated/enriched using information from: https://www.hc-crete.gr/ (7th Health Region of Crete) and https://www.eumedline.eu/

  √ Health centres (HC) and Regional Clinics (RC) have been updated/enriched from https://www.hc-crete.gr/(7th Health Region of Crete)

  √ The clinics are updated and enriched using the following websites: https://www.moh.gov.gr/, https://www.eumedline.eu/ and https://www.moh.gov.gr/

  √ Data on social welfare facilities and Nursing Homes, are obtained from the official websites of the Municipalities (for the social welfare facilities) and the following website: https://www.ecclesia.gr/.

  √ Information on Water Treatment Plants (WTPs) was sourced from municipal and municipal-water-utility (DEYA) websites

  √ For primary and secondary public and private education, the most up-to-date 2022 data were obtained from https://data.gov.gr/datasets/minedu_schools/

  √ For higher education, facility locations were identified via satellite imagery (Google Earth) and from university websites

  √ Civil-protection structures (police and fire stations) were sourced from: https://www.astynomia.gr/ and https://www.fireservice.gr/el

  √ PPC electricity substations were located via satellite imagery (Google Earth) and from https://www.admie.gr/systima/perigrafi/hartis-grammon

  √ Data on public utility infrastructure such as water boreholes, springs, etc. are obtained from the systematic inventory of water boreholes of all http://lmt.ypeka.gr/public_view.htmluses throughout the country and the databases of National Register of Water Intake Points (http://lmt.ypeka.gr/public_view.html) of the

Ministry of Environment http://lmt.ypeka.gr/public_view.htmland http://lmt.ypeka.gr/public_view.htmlEnergy. Data for other infrastructure (bridges, culverts, flood control structures http://lmt.ypeka.gr/public_view.htmletc.) are obtained from the database that was updated in the context of Deliverable 02 titled: "Analysis of regional characteristics and flooding mechanisms".

- Data for assessing the economic impacts (ΕκΟc) are obtained from specialized and, in some cases, newly developed databases. More specifically:
  - √ Θέσεις και στοιχεία μεταλλείων, λατομείων κλπ έχουν ληφθεί από την ιστοσελίδα http://www.latomet.gr/
  - √ The most recent land use data (crops, greenhouses, etc.) are obtained from OPEKEPE (2021)
  - √ Livestock units, in terms of their spatial location, are obtained from the spatial data of OPEKEPE (2021)
  - √ The developed and developing tourist areas are identified according to Government Gazette 3155/B/12-12-2013 and Government Gazette 1138/B/11-6-2009
  - √ Industrial-park locations were drawn from the "ETBA Business & Industrial Parks" portal SEVESO and IED facility locations were determined from the SEVESO industrial units list on http://geodata.gov.gr and the register of installations under Directive 2010/75/EU (IED) as of 31/12/2013, published by the Ministry of Environment and Energy
  - √ The remaining industrial units were identified from the 2nd Revision of the River Basin Management Plan (RBMP).
  - √ Regarding transport infrastructure, the national road network was obtained from the digital archives of the Ministry of Infrastructure and Transport / General Secretariat of Infrastructure / Directorate of Road Infrastructure, Traffic Management & Road Infrastructure Registry Department. For airports, the list of Greek airports published on the "GEODATA.gov.gr" geospatial data portal was used, and digitization was also carried out based on the most recent Google Earth satellite imagery.

- Data for assessing the environmental impacts (ΕκΠεc) are obtained from specialized and, in some cases, newly developed databases. More specifically:
  - √ Location and information of WWTPs are obtained from the 2nd revision of the RBMP and from the database of the General Directorate for Water regarding Wastewater Treatment Plants, under the Ministry of Environment and Energy (http://astikalimata.ypeka.gr/Services/Pages/Browse.aspx)
  - √ Locations and data of uncontrolled and sanitary landfills (XADA and XYTA) are obtained from the 2nd Revision of the River Basin Management Plans (RBMPs)
  - √ Data on habitats and biotopes obtained from their mapping as part of the designation process for areas falling under the Natura 2000 network.

- Data for assessing the cultural heritage impacts (ΕκΠοc) are obtained from:

√ Data from the Archaeological Cadastre (https://www.arxaiologikoktimatologio.gov.gr/) for cultural heritage monuments of national and regional importance, for monuments of historical and cultural importance and museums.

- In the present implementation cycle, the soil erosion maps use the most updated data from the European Soil Data Centre (ESDAC) of the Joint Research Centre (http://esdac.jrc.ec.europa.eu/) for the quantification of the rainfall erosivity factor R, soil erodibility factor K, the topographic coefficient LS, cover-management factor C and the support practice factor P.

- The effect of climate change on the frequency of extreme events, particularly in terms of rainfall intensity, is taken into account.

10 Program of measures of the 1st revision of FRMPs for the Crete WD (EL13)

10.1 Objectives of the 1st revision of FRMPs for the Crete WD (EL13)

The **general objectives** since the 1st implementation cycle of the FRMPs for the Crete WD EL13 are determined as follows:

- Mitigating exposure to flooding (Objective S1)
- Reducing the probability of flooding (Objective S2)
- Improving flood preparedness (Objective S3)
- Enhancing post-flood recovery mechanisms (Objective S4)

The above-mentioned general objectives correspond to the four action pillars of the Flood Risk Management Plans (Prevention, Protection, Preparedness, Rehabilitation) and are of a strategic nature. In this 1st revision of the **Flood Risk Management Plans**, the above-mentioned general objectives are further detailed into specific objectives. These are defined in order to identify, differentiate and clarify the individual goals that collectively contribute to the effective achievement of each general objective.

To achieve **General Objective S1 -mitigate exposure** of human health, environment, cultural heritage and economic activities **to flooding**- the following specific objectives are defined:

- S1.1: implementation of actions to gather, supplement, organize and improve available information
- S1.2: implementation of actions to update and organize the meteorological and hydrometric network in order to improve the level of knowledge for flood prevention
- S1.3: adoption of appropriate conditions and restrictions to be imposed in accordance with the FRMPs.

To achieve **General Objective S2 -reduce the probability of flooding** and thereby increase the protection level of human health, the environment, cultural heritage, and economic activities- the following specific objectives are defined:

- S2.1: implementation of environmental actions and measures for the retention, formation and management of the flood zone in the mountainous areas of the watersheds, as well as water retention measures in lowlands to reduce flood risk.
- S2.2: implementation of actions and measures for the utilization of retention ponds, modernization, restoration and construction of drainage networks, stormwater management and flood protection works, to reduce the flood risk through alternative means.
- S2.3: implementation of actions and measures to strengthen flood risk management practices at the protection stage, through the promotion of strategic planning for flood protection and

stormwater management projects, while also promoting nature-based retention solutions or controlled flooding, in order to improve runoff management through appropriate legislative and administrative measures.

To achieve **General Objective S3 -improve flood preparedness** and mitigate the impacts of flooding on human health, the environment, cultural heritage and economic activities- the following specific objectives are defined:

- S3.1: implementation of actions and measures to develop early warning systems for floods, as well as to organize and authorize the replacement or maintenance of embankments, in order to enhance flood preparedness.
- S3.2: implementation of non-structural interventions, actions, and measures for the education, information, and awareness-raising of the public and stakeholders, as well as initiatives for the pre-identification of alert thresholds and the marking/warning of areas that are hazardous during flooding, in order to improve the level of flood preparedness.
- S3.3: implementation of actions and measures for the development of plans and operational protocols to organize and strengthen flood risk management practices at the preparedness stage, through appropriate non-structural interventions and legislative/administrative measures.

To achieve **General Objective S4 -enhance post-flood recovery mechanisms** of affected areas (people, environment, cultural heritage and economic activities)- the following specific objectives are defined:

- S4.1: improvement of the damage assessment and compensation mechanism following a flood event through the implementation of economic and legislative/ administrative actions and measures aimed at regulating the procedures and responsibilities for damage recording.
- S4.2: improvement of rehabilitation efforts through environmental actions and measures aimed at establishing post-flood recovery mechanisms.
- S343: improvement of the rehabilitation mechanisms following a flood event through the implementation of economic and legislative/ administrative actions and measures aimed at supporting flood-affected populations.

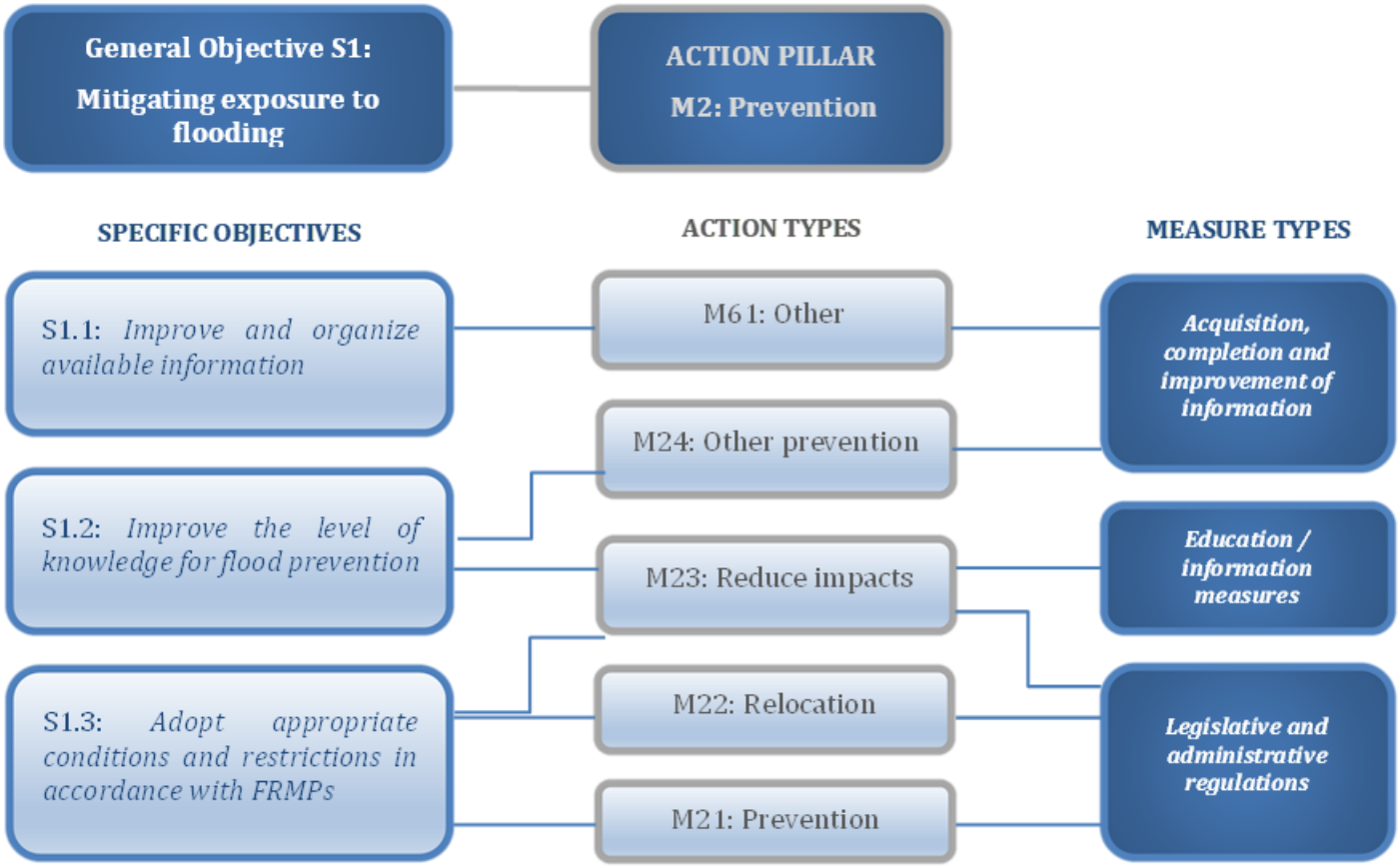

Figure 10-1: Correlation diagram of General Objective S1 - Specific Objectives with Action and Measure Types of the action pillar M2 Prevention[2] of the 1st revision of FRMPs

[2] *In the diagram above, the dashed lines alternate with solid lines only for reasons of clear illustration and without any semantic difference.*

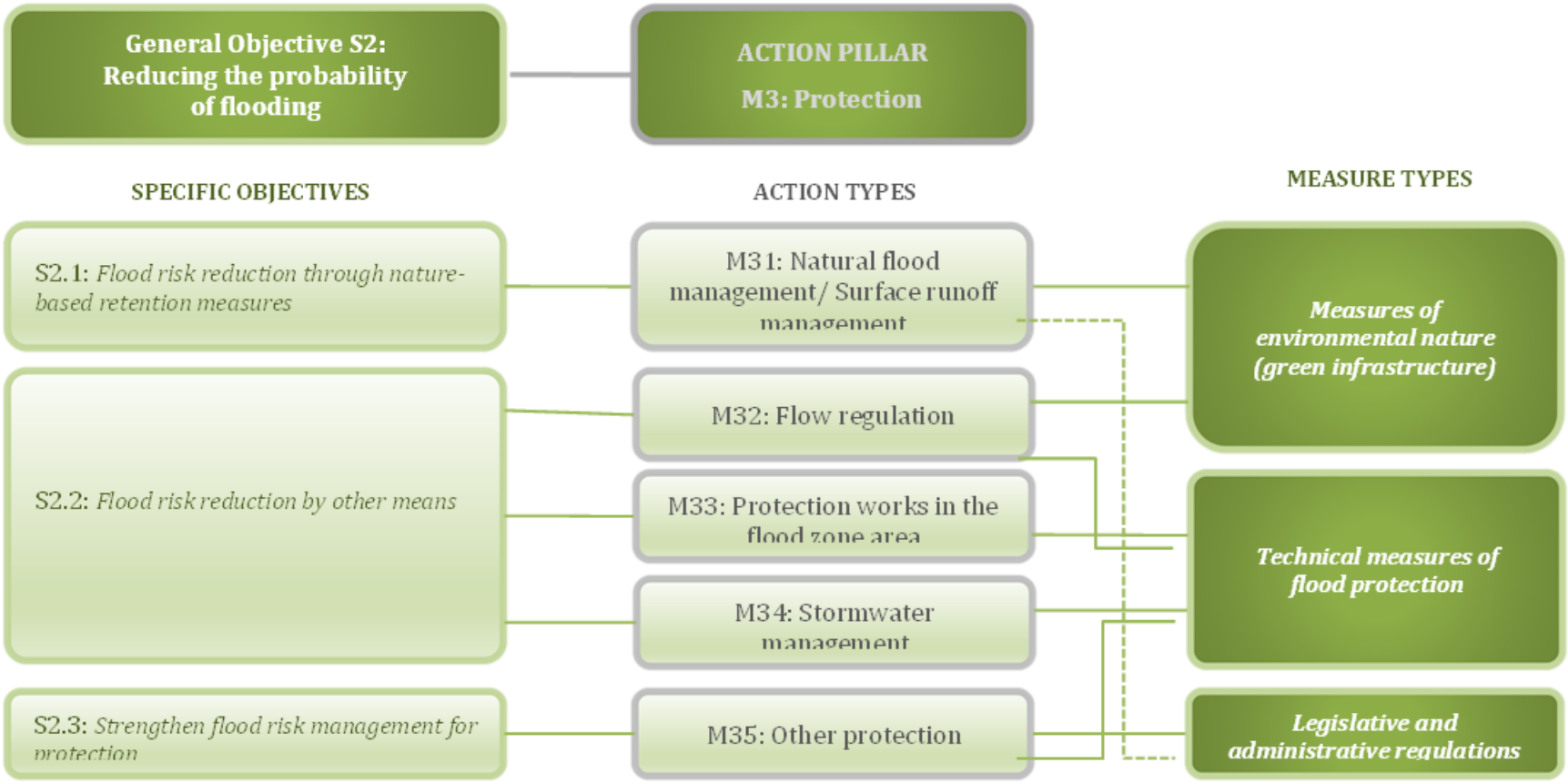

Figure 10-2: Correlation diagram of General Objective S2 - Specific Objectives with Action and Measure Types of the action pillar M3 Protection[3] of the 1st revision of FRMPs

[3] *In the diagram above, the dashed lines alternate with solid lines only for reasons of clear illustration and without any semantic difference.*

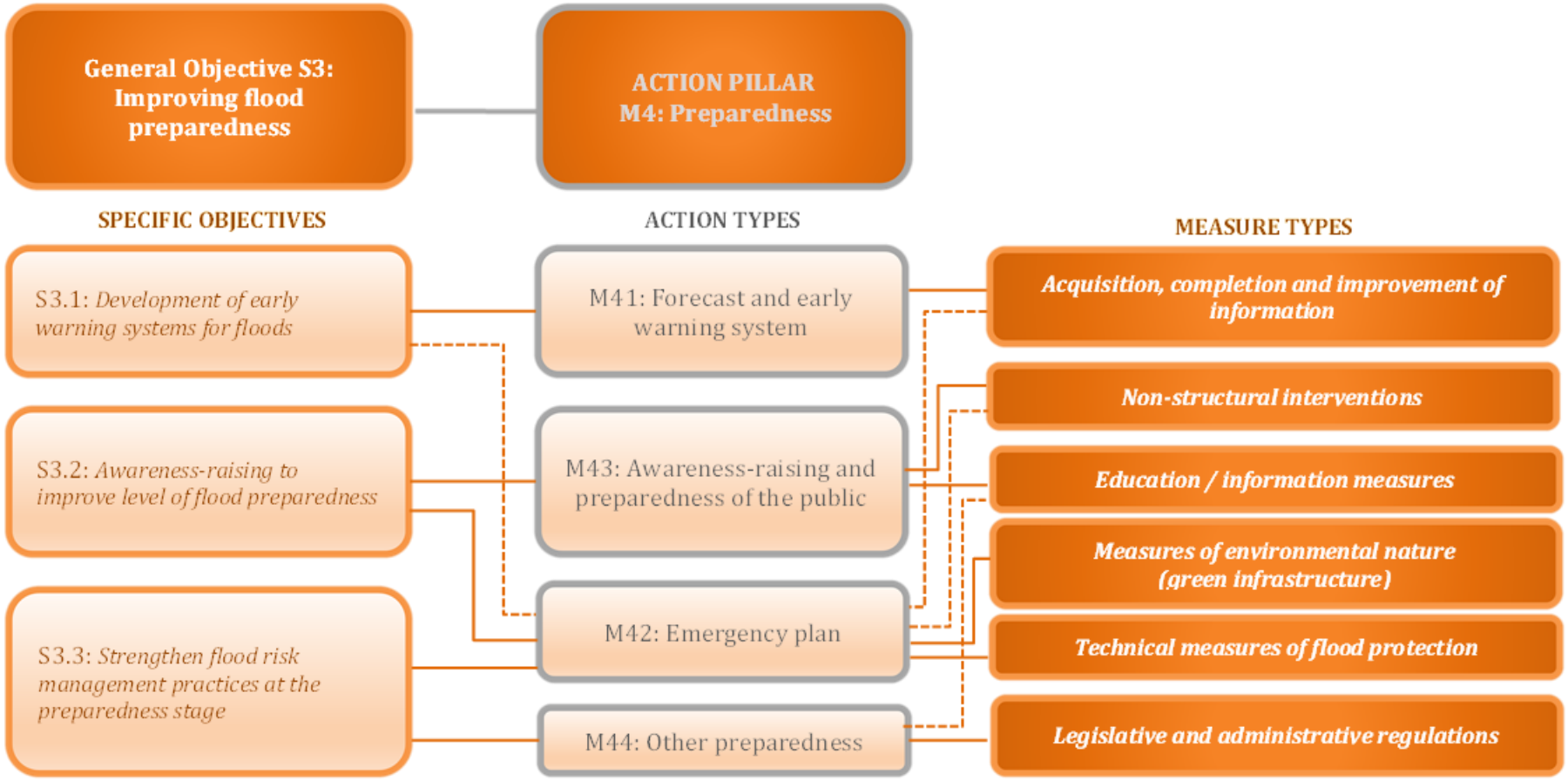

Figure 10-3: Correlation diagram of General Objective S1 - Specific Objectives with Action and Measure Types of the action pillar M2 Preparedness[4] of the 1st revision of FRMPs

[4] *In the diagram above, the dashed lines alternate with solid lines only for reasons of clear illustration and without any semantic difference.*

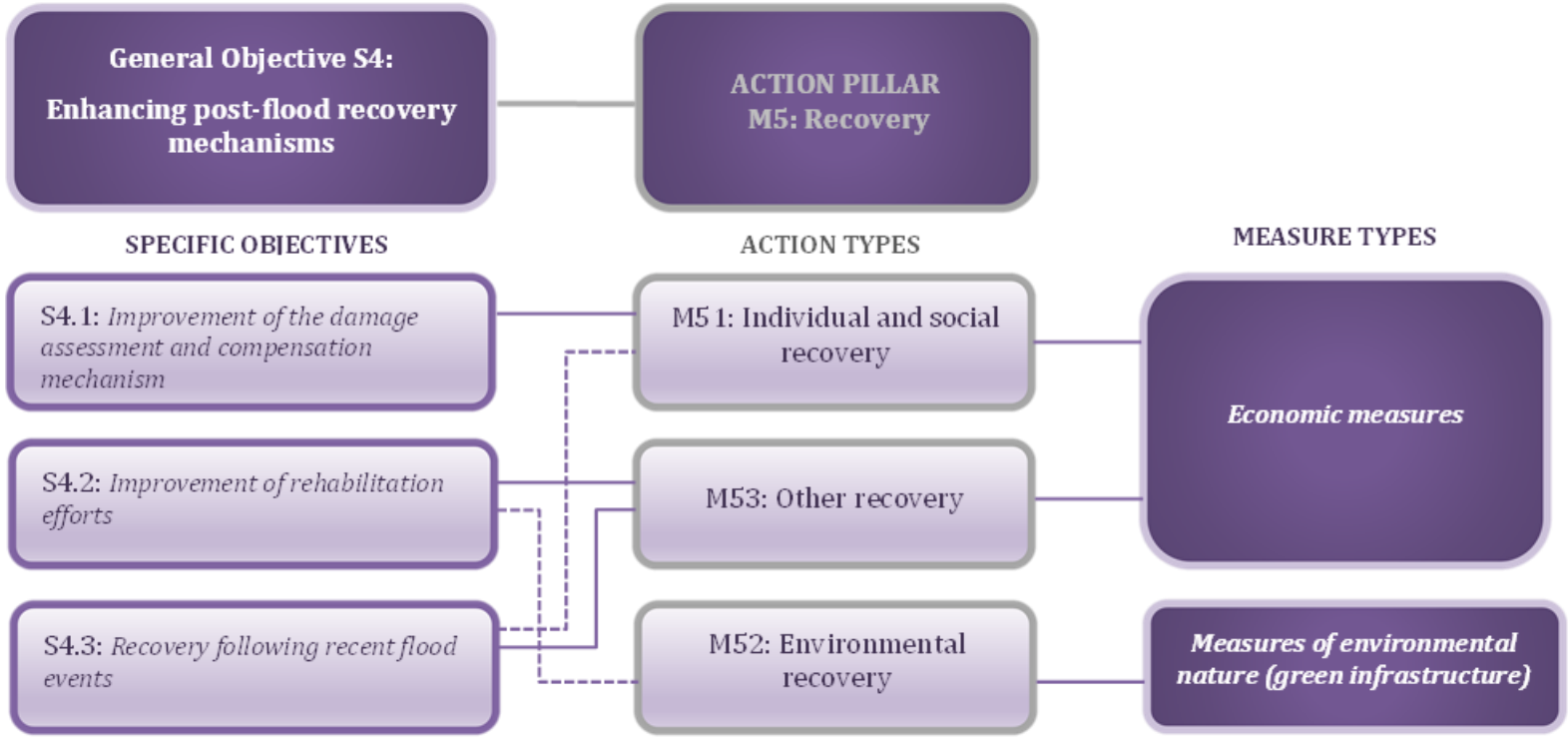

Figure 10-4: Correlation diagram of General Objective S2 - Specific Objectives with Action and Measure Types of the action pillar M5 Rehabilitation[5] of the 1st revision of FRMPs

[5] *In the diagram above, the dashed lines alternate with solid lines only for reasons of clear illustration and without any semantic difference.*

10.2 Preliminary Assessment of measures

In the context of this 1st revision of the FRMPs, a Preliminary Assessment of a set of measures is conducted. Following this assessment, out of a total of 40 measures examined, 32 are selected for further investigation regarding their applicability in WD EL13, while 8 measures are excluded. However, it is noted that after the consultation process, the measure titled: *"Provision of incentives for private flood insurance"* is also excluded, even though it was initially qualified according to the methodology of the Preliminary Assessment.

Thus, out of the 32 measures that are selected for further investigation regarding their applicability in WD EL13 and are put up for consultation, **a total of 31 measures are finally proposed.** Of these, 9 correspond to General Objective S1, 12 to General Objective S2, 8 to General Objective S3 and 2 to General Objective S4. Finally, 19 out of the 31 measures are applied either to the entire Crete Water District EL13 or to all the APSFRs. The remaining 12 measures are applied at selected locations within individual APSFRs, based on the available data and calculations.

10.3 FRMP's program of measures for the Crete WD EL31

The 31 measures included in this 1st revision of the FRMPs are presented in appropriate measure sheets, with specific color grading according to the General Objective they serve: Blue for S1, Green for S2, Orange for S3 and Purple for S4. Under each measure sheet, a paragraph explains the necessity of implementing the measure and its relevance to the FRMP. For the 12 measures applied to individual APSFRs, the corresponding sheets are also included within each respective APSFR. The 31 measures finally proposed in this FRMP are presented in the table below

Table 10-1: Linking measures to the spatial level of implementation

Measure Code	Measure Name	General Objective	ALL APSFR / Water District EL13	Specific APSFR	Authorities responsible for the implementation of measures
EL_13_61_01	*Development of a Monitoring System for the Flood Risk Management Plan's Program of Measures*	**S1. Mitigating exposure to flooding**	✓		*Decentralised Administration of Crete – Water Directorate of Crete*
EL_13_21_01	*Alignment of the urban development plans with the provisions of the FRMPs*		✓		*Ministry of Environment and Energy (General Secretariat for Spatial Planning and Urban Environment - GSSP)*
EL_13_21_02	*Building and structural regulations within the 100-year flood zone*		✓		*Ministry of Urban Planning and Environment (General Secretariat for Spatial Planning and Urban Environment - GSSP)*
EL_13_21_03	*Adaptation of the urban development plans in flood prone areas (retention basins)*		✓		*Ministry of Urban Planning and Environment (General Secretariat for Spatial Planning and Urban Environment - GSSP)*
EL_13_21_04	*Actions to prevent and protect rural development within the APSFRs*		✓		*Ministry of Rural Development and Food*
EL_13_23_01	*Flood protection measures for the boreholes of the water service providers*			**EL13APSFR001 EL13APSFR004 EL13APSFR009 EL13APSFR010 EL13APSFR011**	*(1) Service Providers Water supply (2) Decentralised Administration of Crete – Water Directorate of Crete*
EL_13_24_01	*Restructuring and modernization of the meteorological and hydrometric data collection network*		✓		*Ministry of Environment and Energy (General Directorate for Water)*
EL_13_24_02	*Collection and digitization of data regarding stream delineation and flood control structures.*		✓		*Ministry of Environment and Energy (Technical Chamber of Greece) and Ministry of Infrastructure, Transport and Networks*
EL_13_24_03	*Creation of a national Flood Event database and development of related interactive online platform*		✓		*Ministry of Environment and Energy (General Directorate for Water)*
EL_13_31_01	*Implementation of water control measures in upland regions*	**S2.**	✓		*of Ministry Environment and Energy (Forest Directorates), Forest Services*

Measure Code	Measure Name	General Objective	ALL APSFR / Water District EL13	Specific APSFR	Authorities responsible for the implementation of measures
EL_13_31_02	*Nature-based water retention structures in the lowlands*	**Reducing the probability of flooding**		**EL13APSFR001 EL13APSFR002 EL13APSFR004 EL13APSFR009 EL13APSFR010 EL13APSFR011 EL13APSFR012**	*Ministry of Infrastructure, Transport and Networks (Directorate of Flood-Protection and Land-Reclamation Works D19), Region of Crete (Directorate of Technical Works / Deputy Directorates of Technical Works RU), Municipalities*
EL_13_31_03	*Implementation of natural water retention measures / SUDs practices for projects and activities of subcategory A1 and A2 of Law 4014/2011, as in force.*		✓		*Implementing authority of each respective project*
EL_13_32_01	*Multipurpose reservoirs with a flood protection component*			**EL13APSFR010**	*Project Owner*
EL_13_32_02	*Utilization of existing reservoirs for flood retention*			**EL13APSFR001 EL13APSFR002 EL13APSFR004 EL13APSFR008 EL13APSFR010 EL13APSFR011**	*Reservoir Management Authorities*
EL_13_33_01	*Modernization and rehabilitation of drainage networks*			**EL13APSFR001 EL13APSFR002 EL13APSFR004 EL13APSFR008 EL13APSFR010**	*Ministry of Infrastructure, Transport and Networks (Directorate of Flood-Protection and Land-Reclamation Works D19), Region of Crete (Directorate of Technical Works / Deputy Directorates of Technical Works ΠΕ), Land Improvement Organizations*
EL_13_33_02	*Flood protection measures*			**EL13APSFR001 EL13APSFR002 EL13APSFR004 EL13APSFR009 EL13APSFR010 EL13APSFR011**	*Ministry of Infrastructure, Transport and Networks (Directorate of Flood-Protection and Land-Reclamation Works D19), Region of Crete (Directorates of Technical Works / Deputy Directorates of Technical Works RU), Municipalities*

Measure Code	Measure Name	General Objective	ALL APSFR / Water District EL13	Specific APSFR	Authorities responsible for the implementation of measures
				EL13APSFR012	
EL_13_34_01	*Modernization, replacement and maintenance of existing stormwater drainage networks*		✓		*Region of Crete (Directorate of Technical Works / Deputy Directorates of Technical Works RU), Municipalities, Water Supply & Sewerage Companies (DEYA), Road Maintenance Authorities*
EL_13_35_02	*Integrated Design of flood protection measures (Master Plan) and construction of the proposed measures*		✓		*ACTION [A]: Ministry of Climate Crisis & Civil Protection (Technical Chamber of Greece)[1]* *ACTIONS [B] & [C]: Based on Masterplan*
EL_13_35_03	*Evaluation and maintenance of existing water control measures in upland regions*			**EL13APSFR001** **EL13APSFR004** **EL13APSFR008** **EL13APSFR010**	*Ministry of Environment and Energy (Forest Directorates), Forest Services*
EL_13_35_04	*Land use management*		✓		*Ministry of Rural Development and Food (under Law 5184/2025 (A' 34))*
EL_13_35_05	*Maintenance and rehabilitation of existing flood protection structures*			**EL13APSFR002** **EL13APSFR009** **EL13APSFR010**	*Region of Crete (Directorate of Technical Works / Deputy Directorates of Technical Works RU)*
EL_13_41_01	*Development and operation of an early warning system for floods*	**S3. Improving flood preparedness**		**EL13APSFR001** **EL13APSFR004** **EL13APSFR009** **EL13APSFR010**	*Development: Ministry of Environment and Energy* *Operation: Ministry of Climate Crisis & Civil Protection (General Secretariat for Civil Protection) or Region of Crete (Independent Directorate of Civil Protection)*
EL_13_42_01	*Updating of Emergency Plans, and standardization of emergency flood response procedures / Development of a Local Action Plan Memorandum*		✓		*Region of Crete (Independent Directorate of Civil Protection), Municipalities (Civil Protection Offices), Decentralised Administration of Crete (Directorate of Civil Protection)*

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

Measure Code	Measure Name	General Objective	ALL APSFR / Water District EL13	Specific APSFR	Authorities responsible for the implementation of measures
EL_13_42_03	*Identification of borrow pit locations for embankment restoration/maintenance in case of emergency*		✓	**EL13APSFR001 EL13APSFR002 EL13APSFR004 EL13APSFR009 EL13APSFR010 EL13APSFR011 EL13APSFR012**	*Region of Crete (Directorate of Technical Works / Deputy Directorates of Technical Works RU, Independent Directorate of Civil Protection)*
EL_13_42_05	*Plan for controlled flooding of lowland areas to protect settlements and critical infrastructure*		✓		*Ministry of Infrastructure, Transport and Networks (Directorate of Flood-Protection and Land-Reclamation Works D19), Region of Crete (Directorate of Technical Works / Deputy Directorates of Technical Works ru), Ministry of Climate Crisis & Civil Protection (General Secretariat for Civil Protection)*
EL_13_43_01	*Awareness-raising actions for the public, local authorities and communities against flood risk*		✓		*Ministry of Climate Crisis & Civil Protection, Ministry of Education, Ministry of Environment and Energy, Decentralised Administration of Crete (Directorate of Civil Protection), Region of Crete (Independent Directorate of Civil Protection), Municipalities (in cooperation with school administrations)*
EL_13_43_02	*Warning system to avoid crossing Irish crossings during flood events*			**EL13APSFR001 EL13APSFR002 EL13APSFR004 EL13APSFR009 EL13APSFR010 EL13APSFR011 EL13APSFR012**	*Road Network Authority*
EL_13_44_01	*Formulation of a regulatory framework for restoring the conveyance capacity of streambeds*		✓		*Ministry of Environment and Energy in cooperation with relevant authorities*

Measure Code	Measure Name	General Objective	ALL APSFR / Water District EL13	Specific APSFR	Authorities responsible for the implementation of measures
	and for the maintenance and management of riparian vegetation				
EL_13_42_04	*Establishment of alert thresholds for critical watercourses of WD EL13 based on the provisions of laws 4662/2020 and 5075/2023*			**EL13APSFR001 EL13APSFR002 EL13APSFR004 EL13APSFR009 EL13APSFR010 EL13APSFR011 EL13APSFR012**	*Region of Crete (Directorate of Technical Works / Deputy Directorates of Technical Works ΠΕ, Independent Directorate of Civil Protection)*
EL_13_51_01	*Restoration of infrastructure following recent flooding events*	**S4. Enhancing post-flood recovery mechanisms**	✓		*Competent bodies, depending on the type of infrastructure, for recording, preparing studies and remediation/compensation, in accordance with applicable legislation*
EL_13_52_01	*Identification of locations for (temporary or permanent) sediment deposition sites (sediment storage areas)*		✓		*Region of Crete (Directorate of Technical Works / Deputy Directorates of Technical Works RU, Independent Directorate of Civil Protection)*

Below, an **indicative measure sheet is provided**. Each measure sheet is color-coded according to the General Objective it addresses. It should be noted that there are differences between the measure sheets of the 1st revision and those of the initial FRMPs; some old fields are modified and new fields are added to facilitate understanding, implementation and monitoring of each measure.

MEASURE NAME	Includes the name of the measure
METER CODE	The Measures are coded as follows: EL_XX (WD code)_XX (Measure Type according to WISE) _XX (Measure serial number)
CORRELATION WITH 1ST CYCLE MEASUREMENT	Continuing from the 1st FRMP or New Measure
PILLAR OF ACTION	Prevention, Protection, Preparedness, Recovery
GENERAL OBJECTIVE	The General Objective of the FRM the measure addresses (S1, S2, S3, S4)
TYPE OF FRM MEASURE	The code of the FRM type of measure and its description are given.
TYPE OF NATURAL WATER RETENTION MEASURE	The code of the type of Natural Water Retention measure and its description are given.
SPECIFIC OBJECTIVE	The Specific Objective of the FRM the measure addresses (S1.1, S1.2, S1.3, S2.1, S2.2, S2.3, S3.1, S3.2, S3.3, S4.1, S4.2, S4.3, S4.3)
TYPE OF MEASURE	Legislative/Administrative regulations Economic measures Education/information measures Non-structural interventions Acquisition, completion and improvement of information Environmental measures (green) infrastructure) Technical Flood Protection Measures
MEASURE DESCRIPTION	Includes a detailed description of the measure
AUTHORITIES RESPONSIBLE FOR IMPLEMENTATION	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 authorities involved in its implementation
IMPLEMENTATION AREA	Water District, APSFR, River Basin, Water System etc.
IMPLEMENTATION MONITORING INDICATORS	Varies depending on the measure
TARGET PRICE	Varies depending on the measure
AREA OF IMPACT OF THE MEASURE	Water District, APSFR, River Basin, Water System etc.
IMPACT MONITORING INDICATORS	Varies depending on the measure
TARGET PRICE	Varies depending on the measure
CLIMATE CHANGE RESILIENCE[1]	How the measure performs under climate change. The performance is assessed as Critical, High, Medium, Low.
LINKAGE WITH CLIMATE CHANGE GOALS AND MEASURES	Relevance of the Measure with the objectives and actions of the National Strategy for Adaptation to Climate Change (ESPKA 2016), the PESPKA AMTH (2023), the Climate Law and the EU Specifications.

[1]Climate resilience is defined as "The ability of interconnected social, economic and ecological systems to cope with a hazardous event or trend or disturbance, through their response or reorganization in ways that maintain their main function, identity and structure" [INTERIM FRAMEWORK FOR THE ASSESSMENT OF THE CLIMATE RESILIENCE OF INFRASTRUCTURE PROJECTS SUBMITTED FOR CO-FUNDING IN THE NSRF PROGRAMMES 2021 – 2027, National Coordinating Authority, General Secretariat for Public Investments & NSRF, Ministry of Development & Investments, December 2022.

RELATIONSHIP WITH RBMP GOALS AND MEASURES	Commentary on the synergy of the measure with the objectives and measures of the RBMP
IMPLEMENTATION STAGE	• Mature • No competition is being held • To be implemented • In a tender or contract award procedure • Implemented
IMPLEMENTATION DURATION	Short term: 0-2 years Medium term: 2-6 years, Long term: > 6 years
PROPOSED IMPLEMENTATION TIMETABLE (MILESTONES)	• Project Maturation • No tender procedure is being conducted • Pending implementation • In tendering or contract award process • Implementation
PRIORITY RANKING	Priority ranking of the measure based on the results of its cost-effectiveness assessment
ESTIMATED COST	cost estimate of the measure
INDICATIVE FINANCIAL PROGRAM	Potential sources of funding for the measure

Indicative Documentation of the Necessity of a Measure:

The necessity of adopting and implementing the measure is supported by current developments in flood risk management, as well as by flood risk and climate change assessments conducted within the framework of this FRMP.

10.4 Specialization of measures for the Crete WD EL13

During the 1st revision implementation cycle of the FRMP for the Crete Water District, a significant specialization of the Program of Measures is carried out, providing more detailed proposals for projects and measures at the Water District level or per APSFR. This specialization takes into account not only the requirements of Directive 2007/60 and the General and Specific Objectives of the 1st revision for flood risk reduction, but also other flood prevention plans and studies implemented in the relevant areas.

All 31 measures of the program are briefly mentioned below, some of which are specialized for individual APSFRs and are accompanied by brief descriptions. A detailed description of all 31 measures of the Program of Measures for WD EL13, along with all relevant information, can be found in the corresponding chapter of the FRMP.

EL_13_61_01: Development of a Monitoring System for the Flood Risk Management Plan's Program of Measures
This measure is a continuation of EL_13_61_01 from the 1st Plan and concerns the development of a database and interactive platform to collect and monitor all required information from the stakeholders involved in implementing the Measures Programme, as well as the procurement of advisory services for this purpose from specialised personnel. The responsible implementing authority is the Decentralised Administration of Crete, specifically the Water Directorate of Crete.

EL_13_21_01: Alignment of the urban development plans with the provisions of the FRMPs

This measure is introduced for the first time in the 1st Revision of the FRMP for EL13 and applies across the entire Crete WD. It involves issuing a Directive Circular that specifies the data to be drawn from the FRMP during the Analysis/Diagnosis phase of first-level urban-planning studies (Local Urban Plans / Special Urban Plans), so as to develop well-substantiated risk-reduction proposals in line with the qualitative directives of urban planning under the new Urban Planning Standards (Ministerial Decision YPEN/DNEP/32892/1414/2024, D'200)

EL_13_21_02: Building and structural regulations within the T = 100-year flood zone.

The measure is a continuation of EL_13_23_03 from the 1st Flood Risk Management Plan (FRMP) and concerns the formulation of special provisions within the Building and Construction Regulation aimed at reducing the vulnerability of structural works, installations, and constructions located within the 100-year flood zone, due to their exposure to flood risk. The goal is to reduce disaster risk. The measure applies to settlements located within the flood zone corresponding to a flood with a return period of T = 100 years. Indicatively, certain settlements and cities located within the Areas of Potential Significant Flood Risk (APSFR) of the Crete Water District are mentioned:

- EL13APSFR001
  - Municipality of Faistos (2 settlements/towns)
  - Municipality of Gortyna (2 settlements/towns)
- EL13APSFR002
  - Municipality of Ierapetra (2 settlements/towns)
- EL13APSFR004
  - Municipality of Gortyna (1 settlement – Protorias)
- EL13APSFR008
  - Municipality of Oropedio Lasithiou (8 settlements/towns)
- EL13APSFR009
  - Municipality of Malevizi (1 settlement/town – Gazi)
  - Municipality of Heraklion (2 settlements/towns – Heraklion and Nea Alikarnassos)
- EL13APSFR010
  - Municipality of Chania (3 settlements/towns, including Chania)
  - Municipality of Platanias (8 settlements/towns)
  - Municipality of Apokoronas (1 settlement – Stylos)
- EL13APSFR011
  - Municipality of Rethymno (2 settlements/towns, including Rethymno)
- EL13APSFR012
  - Municipality of Agios Nikolaos (1 town – Agios Nikolaos)

EL_13_21_03: Adaptation of the urban development plans in flood prone areas (retention basins)

The measure is introduced for the first time in the 1st revision of the FRMP for EL13 and applies to the flood-controlled areas that will be defined by the Master Plans (measure EL_13_35_02), which will also specify the necessary flood flow retainment measures for each APSFR, as well as those arising from the implementation of measure EL_13_42_05. The measure concerns the appropriate adaptation of urban plans (Local Urban Plans / Special Urban Plans) within the flood-prone areas, in order to propose adequate land uses and restrictions.

EL_13_21_04: Actions to prevent and protect Rural Development within the APSFRs

The measure is introduced for the first time in the 1st revision of the River Basin Management Plan (RBMP) for EL13 and applies to cultivated areas within the Areas of Potential Significant Flood Risk (APSFR). According to the results of the Flood Hazard Maps (FHMs), as well as recent experience with flood events, extensive agricultural holdings within the 100-year flood inundation zone (T=100) are located in APSFR in the Crete Water District.

The measure aims to protect cultivated land and support rural development. It promotes the development of an action plan, which may include:

a) Identification of crops and areas that are systematically affected by flooding;

b) Assessment of drainage network deficiencies that contribute to flooding;

c) Identification of alternative crops that are flood-resistant and provide equivalent agricultural income;

d) Proposals for financial and other incentives to support crop changes;

e) Identification of livestock units for potential relocation and related incentives;

f) Proposals for alternative agricultural practices where crop restructuring or relocation is not feasible;

g) Economic impact analysis of the proposed actions.

EL_13_23_01: Flood protection measures for the boreholes of the water service providers

The measure is a continuation of EL_13_23_03 from the 1st Flood Risk Management Plan (FRMP) and includes:

(1) The adoption of flood protection measures by the Water Service Providers. More specifically, Water Service Providers shall adopt appropriate flood protection measures for wells located within the 100-year flood zone (T = 100). Such measures may include, for example, the elevation of electromechanical systems, piping, and well housing, the construction of protective perimeter embankments of suitable height and materials, and other relevant interventions.

(2) The incorporation of flood protection requirements in water use permits. The Water Directorates shall incorporate a requirement for the adoption of flood protection measures in water use permits, in accordance with Joint Ministerial Decision 146896/27.10.2014 (Government Gazette B' 2878 and B' 3142), "Categories of permits for the use and execution of water development projects. Procedure

EL_13_23_01: Flood protection measures for the boreholes of the water service providers

and conditions for issuing permits, their content and duration of validity, and other relevant provisions," as amended and currently in force.

The adoption of appropriate flood protection measures will mitigate the risks associated with hydraulic wells, including damage to above-ground electromechanical equipment and the potential inflow of floodwaters into the underground aquifer.

This measure must be applied to all existing drinking-water boreholes located within the T = 100-year floodplain. According to the data in this FRMP, the measure requires immediate implementation at the following 33 boreholes

- 10 boreholes (Municipalities of Gortyna and Faistos) within or near APSFR EL13APSFR001
- 7 boreholes (Municipality of Archanes–Asterousia) within or near APSFR EL13APSFR004
- 7 boreholes (Municipality of Heraklion) within or near APSFR EL13APSFR009
- 3 boreholes (Municipalities of Chania, Apokoronas, and Platanias) within or near APSFR EL13APSFR010
- 6 boreholes (Municipality of Rethymno) within or near APSFR EL13APSFR011

EL_13_24_01: Restructuring and modernization of the meteorological and hydrometric data collection network

The measure is a continuation of EL_13_24_04 from the 1st FRMP, applies to the entire Water District, and concerns the upgrade and modernization of the existing analog network of hydrometeorological stations operated by the Ministry of Environment and Natural Resources. The implementation of the measure includes, indicatively, the following actions:

a) Replacement of analog hydrometeorological stations with digital telemetric stations across the country, along with the expansion of the network where necessary

b) Development of a digital platform for the recording and transmission of hydrometric and meteorological data.

The measure will be implemented in cooperation with the Water Directorates of the respective Decentralized Administrations.

In the Crete WD (EL13), there are 24 Ministry of Environment and Energy stations (rain gauges/recorders), which will be verified and evaluated under this measure.

EL_13_24_02: Collection and digitization of data regarding stream delineation and flood control structures

The measure is a continuation of EL_13_24_04 from the 1st FRMP. It applies across the entire Water District, with priority given to catchment areas affecting the APSFRs. The measure concerns the creation and maintenance of a database through the collection and digitization of information at the APSFR level, specifically regarding:

- Data on existing and new stream delineation projects and as well as other relevant information for the implementation of such projects
- Already delineated watercourses

EL_13_24_02: Collection and digitization of data regarding stream delineation and flood control structures

- Technical data of flood control projects that influence water flow, including site inspection of existing projects implemented under the FRMPs or other studies, along with additional technical information from studies and archives of other competent authorities.

EL_13_24_03: Creation of a national Flood Events database and development of related interactive online platform

This measure is a continuation of EL_13_24_07 from the 1st FRMP and applies across the entire Crete WD. It involves designing and developing a National Flood-Event Registry, along with a related online interactive platform built on an appropriate spatial-data system.

The NFER will include, at minimum, entries of flood events and their associated data sourced from competent authorities and stakeholders, in accordance with the General Emergency Response and Short-Term Management Plan for the Consequences of Flood Events ("DARDANOS"), as in force at any given time, following guidelines issued by the competent Directorate of the Ministry of Environment and Energy.

This will enable the availability and unified use of standardized damage-and-impact data from extreme flood events by all involved agencies, thereby supporting management plans and assessments related to flood risk.

EL_13_31_01: Implementation of water control measures in upland regions

This measure modifies EL_13_31_08 from the 1st FRMP and concerns natural-water-retention works in mountain catchments. It includes the construction of:

a. Phytotechnical, geotechnical, and hydraulic structures Low dams and in-stream barrier works parallel to flow to reduce erosion and sediment yield and to increase water retention in the mountains.

b. Open-type dam structures and temporary sediment-retention basins Designed for highly torrential mountain catchments to capture and hold coarse bedload and debris.

c. Dry detention lakes Offline basins in mildly torrential mountain catchments to attenuate flood peaks.

Primarily in second-order mountain catchments with high erodibility that drain into the APSFR of the Crete WD, which exhibit high flood-risk areas according to the Flood Risk Maps. Indicative catchments include:

- Geropotamos mountain catchments draining to EL13APSFR001
- Kotovianos and Kalamafkianos mountain catchments draining to EL13APSFR002
- Anopodaris mountain catchments draining to EL13APSFR004
- Chavgas mountain catchments draining to EL13APSFR008
- Gazanós, Xeropotamos, Giophyros, Katsampadianos, and Karteros mountain catchments draining to EL13APSFR009
- Tavronitis, Keritis, and Koiliaris mountain catchments draining to EL13APSFR010

EL_13_31_01: Implementation of water control measures in upland regions

- Sfakoryako mountain catchments draining to EL13APSFR011
- Almyros Lasithiou mountain catchments draining to EL13APSFR012

EL_13_31_02: Nature-based water retention structures in the lowlands

This measure is introduced for the first time in the 1st Revision of the FRMP for EL13. It concerns natural-water-retention works along the margins of the floodplain—prioritising the 100-year flood zones within each APSFR (or immediately upstream)—and in locations of high flood risk (areas of high vulnerability with sensitive land uses). It includes: Floodplain restoration and management works (N03), Reinstatement of riverbeds to their natural state (N05), Re-meandering works (N04), Construction of offline dry detention basins and online retention ponds/lakes (N01), Wetland restoration and management via riparian planting (N02), Restoration and reconnection of seasonal streams (N06), Natural bank stabilization works (N10), Removal of unlicensed transverse structures in riverbeds, and demolition of abandoned or damaged structures within the flood zone

This measure applies in APSFR EL13APSFR001, EL13APSFR002, EL13APSFR004, EL13APSFR009, EL13APSFR010, EL13APSFR011, and EL13APSFR012 of the Crete WD (EL13), in the plains within the 100-year flood extent as mapped in the current FHMs—or upstream of these—where studies show effective flow attenuation and flood-risk reduction. For example, potential sites for these natural-retention works include:

- The area of the Phaistos archaeological site (Geropotamos River) – EL13APSFR001
- Low-lying areas of Gra Lygia–Ierapetra (Kalamafkianos and Kotovianos Rivers) – EL13APSFR002
- The area near the settlement of Protorias (Anopodaris River) – EL13APSFR004
- Low-lying areas of Gazi, Heraklion, and Nea Alikarnassos (Gazanos, Giophyros, Katsampadianos, and Karteros Rivers) – EL13APSFR009
- Low-lying areas of Tavronitis (Tavronitis River), Platanias (Keritis River), Chania (Kladissos River), and between Kalami and Gouves (Koiliaris River) – EL13APSFR010
- Low-lying areas of Rethymno (Sfakoryako and Pnigmenou Rivers) – EL13APSFR011
- The area of Agios Nikolaos (Almyros River of Lasithi) – EL13APSFR012

EL_13_31_03: Implementation of natural water retention measures Natural Water Retention Measures (NWRM) / SUDs practices for projects and activities of subcategory A1 and A2 of Law 4014/2011, as in force.

This measure is introduced for the first time in the 1st Revision of the FRMP for EL13 and applies to the APSFR of the Crete WD (EL13).

The measure concerns the planning of projects and activities of subcategory A1 and A2 according to Law 4014/2011, as in force, where the implementation of Natural Water Retention measures (NWRM) / SUDs practices should be considered as a priority, when flood control projects are required, to limit surface runoff and contain flood runoff.

EL_13_32_01: Multipurpose reservoirs with a flood protection component

This measure modifies EL_13_32_09 from the 1st FRMP and mandates the construction of a new dam with a flood-protection component—requiring additional storage capacity and an appropriate reservoir-operation schedule. It applies to the Tavronitis Dam, located within APSFR EL13APSFR010. (This concerns the "Utilisation of the Tavronitis River Water Potential" PPP project, whose procurement process began on 30 November 2022 with a call for expressions of interest.)

EL_13_32_02: Utilization of existing reservoir projects to intercept flood flows

This measure modifies EL_13_32_10 from the 1st Plan and comprises actions to optimize the operation of existing reservoirs so that they both meet the needs of their intended uses as effectively as possible and provide the maximum downstream flood-protection benefit.

In this context, for the Crete WD (EL13), the measure applies to the following reservoirs

- Faneromeni area in APSFR EL13APSFR001
- Bramianos in APSFR EL13APSFR002
- Plakiotissa in APSFR EL13APSFR004
- Agios Georgios Plateau reservoir (Lasithi Plateau) in APSFR EL13APSFR008
- Agia and Valsamiotis in APSFR EL13APSFR010
- Potamoi in APSFR EL13APSFR011

EL_13_33_01: Modernization and rehabilitation of drainage networks

This measure modifies EL_13_33_11 from the 1st FRMP and includes actions for the evaluation, adequacy assessment, cleaning, maintenance, replacement, and modernization of drainage networks.

The measure is proposed for priority implementation in drainage networks within the Regional Units of Chania, Heraklion, and Lasithi (APSFR EL13APSFR001, EL13APSFR002, EL13APSFR004, EL13APSFR008, EL13APSFR010). Indicative (non-exhaustive) examples of these networks include:

APSFR EL13APSFR001 & EL13APSFR004

Heraklion Prefecture

- A, B, and C Zones of Messara. The networks are managed by the respective TOEBs and irrigate a total area of over 50,000 hectares.

APSFR EL13APSFR002

Lasithi Prefecture

- Ierapetra. The network is managed by the TOEB of Ierapetra and irrigates a total area of about 40,000 hectares

APSFR EL13APSFR008

Lasithi Prefecture

- Lasithi Plateau. The network is managed by the TOEB of Lasithi Plateau and irrigates a total area of about 3,000 hectares

EL_13_33_01: Modernization and rehabilitation of drainage networks

APSFR EL13APSFR010

Chania Prefecture

- Agia Kolymbari. The network is managed by the TOEB of Agia Kolymbari and irrigates a total area of about 16,000 hectares.
- Varipetro. The network is managed by the TOEB of Varipetro and irrigates a total area of about 12,000 hectares.
- Agia Marina-Platanias. The network is managed by the TOEB of Agia Marina-Platanias and irrigates a total area of about 7,000 hectares.
- Fournes. The network is managed by the TOEB of Fournes and irrigates a total area of about 5,000 hectares.
- Vatolakos. The network is managed by the TOEB of Vatolakos and irrigates a total area of about 3,500 hectares.
- Alikianos. The network is managed by the TOEB of Alikianos and irrigates a total area of about 2,000 hectares.
- Koufo. The network is managed by the TOEB of Koufo and irrigates a total area of about 2,000 hectares.

EL_13_33_02: Flood Protection Measures

This measure modifies EL_13_33_12 from the 1st FRMP. It includes constructing new flood-protection works and/or supplementing/reinforcing existing flood-protection structures—studied or planned—for implementation along the alluvial plains of watercourses, prioritising the T = 100-year flood zones within the APSFR and locations of high flood risk (areas of high vulnerability with sensitive uses). It includes channel regulation works, weirs, embankments, culverts, artificial side channels, and the removal of sediment deposits.

The measure is proposed for watercourses within APSFR EL13APSFR001, EL13APSFR002, EL13APSFR004, EL13APSFR009, EL13APSFR010, EL13APSFR011, and EL13APSFR012, with priority given to those lying within the T = 100-year inundation areas of high and very high risk. Indicative (non-exhaustive) examples include:

- In the APSFR EL13APSFR001, the Geropotamos River is located.
- In the APSFR EL13APSFR002, the Kalamafkianos, Bramianos, and Kotovianos Rivers are located.
- In the APSFR EL13APSFR004, the Anopadaris River is located.
- In the APSFR EL13APSFR009, the Gazanos, Giophyros, Katsampadianos, and Karteros Rivers are located.
- In the APSFR EL13APSFR010, the Tavronitis, Keritis, Kladisos, and Kiliaris Rivers are located.
- In the APSFR EL13APSFR011, the Sfakoryako (Platanias) and Pnigmeno (Adele) Rivers are located.
- In the APSFR EL13APSFR012, the Almyros River of Lasithi is located.

Indicatively and not exhaustively, the following works are mentioned

EL_13_33_02: Flood Protection Measures

APSFR_EL13APSFR001
Works for Demarcation and Regulation in a Section of the Geropotamos River and in Sections of Smaller Streams Contributing to It, with a Total Length of Approximately 21,4 km, Starting to the East of the Settlement of Choustouliana and Ending to the Sea (Coastal Line)

APSFR_EL13APSFR002
Works for Demarcation and Regulation of the Bramianou Stream Downstream of the Dam, Municipality of Ierapetra (Regulation Works Downstream of the Bramianou Dam for a Length of Approximately 2.2 km)

APSFR_EL13APSFR004
Works for Demarcation and Regulation in Sections of the Anapodaris River and in Sections of Smaller Streams Contributing to It, with a Total Length of Approximately 10,3 km.

APSFR_EL13APSFR009

1. Demarcation and Regulation of the Karteros River
2. Demarcation and Regulation of the Gazanos River
3. Demarcation, Regulation, and Rehabilitation of the Giophyros River
4. Demarcation and Regulation of the Katsampadianos Watercourse

APSFR_EL13APSFR010

1. Regulation of the Kladisos River from the Kladisos Bridge on the National Road to the New National Road
2. Regulation and Flood Protection on the Tavronitis River, Municipality of Platanias, Chania Prefecture
3. Demarcation and Regulation of the Floodplain of the Keritis River

APSFR_EL13APSFR011
Works for Demarcation and Regulation of the Platanias Stream, Municipality of Rethymno

EL_13_34_01: Modernization, replacement and maintenance of existing stormwater drainage networks

This measure is a modification of EL_13_34_13 from the 1st FRMP. It includes works to replace, reinforce, and supplement storm-water drainage systems (collection, conveyance, and disposal works to available receptors), prioritising areas with high urban demand within the Potentially Significant Flood Risk Zones. Specifically, for the Crete WD (EL13), the measure is proposed for implementation in various urban centres within the APSFR . Indicatively (but not exhaustively), it is suggested for the following urban centres:

- In the settlement of Mitropoli in the APSFR EL13APSFR001.
- In the settlements of Ierapetra and Gra Lygia in the APSFR EL13APSFR002.
- In the settlement of Prothoria in the APSFR EL13APSFR004.
- In the settlements of Kato Metochi and Ag. Konstantinos in the APSFR EL13APSFR008.
- In the cities of Gazi, Heraklion, and Nea Alikarnassos in the APSFR EL13APSFR009.
- In the settlements/cities of Chania, Vamvakopolo, Perivolia, Platanias, Alikianos, Fournes, Voukoles, Stylos, Gerani, and Kalami in the APSFR EL13APSFR010.
- In the settlements/cities of Rethymno and Sfakaki in the APSFR EL13APSFR011.
- In the city of Agios Nikolaos in the APSFR EL13APSFR012.

EL_13_35_02: Integrated Design of flood protection measures (Master Plan) and construction of the proposed measures

This measure continues EL_13_35_15 from the 1st FRMP. It is noted that the Crete Development Agency (CDA) has already completed the "Master Plan for Crete's Hydraulic Works," whose Section Y2 is the "General Management Plan (Master Plan) for Flood-Protection Works on the Island of Crete." This Master Plan must now be updated and supplemented with the additional requirements listed above (e.g. detailed projects under measures EL_13_31_01, EL_13_31_02, EL_13_33_02 and EL_13_42_05).

Following this update/supplement to the Master Plan (which will cover the Crete WD or its part—including APSFR EL13APSFR001, EL13APSFR002, EL13APSFR004, EL13APSFR008, EL13APSFR009, EL13APSFR010, EL13APSFR011 and EL13APSFR012, as well as their upstream basins), the required feasibility and detailed design studies will be carried out, followed by construction of the proposed works.

The updated Master Plan will exclude those watercourses within APSFR for which works are proposed under Lists (A) and (B) of Measure EL_13_33_02: Flood-Protection Works.

EL_13_35_03: Evaluation and maintenance of existing water control measures in upland regions

This measure is a continuation of EL_13_35_16 from the 1st FRMP. It involves assessing the condition of existing mountain-water-management works in the torrent and mountain-stream catchments and carrying out their maintenance to mitigate impacts in areas included within the T = 100-year inundation zones. Indicatively (but not exhaustively), the following second-order mountain catchments—draining into T = 100-year flood zones as identified on the Flood Risk Maps—require priority maintenance works:

- In the mountain basins that drain into the flood zones of the Geropotamos River in the APSFR EL13APSFR001 and are traversed by the streams of Koutsoulidis River (upstream of the settlements of Voroi and Faneromeni), Magieros River, Tourki River (upstream of the settlement of Moires), Lithaios River (upstream of the settlement of Mitropolis).
- In the mountain basins that drain into the flood zones of the Anopadari River in the APSFR EL13APSFR004 upstream of the settlement of Plakiotissa.
- In the mountain basins that drain into the flood zones of the Chavga River in the APSFR EL13APSFR008 (wider areas of the settlements of Katharo and Koudoumalia).
- In the mountain basins that drain into the flood zones of the Spilianios River (settlements of Zymbrago and Kakopetros), Tavronitis River (settlements of Palea Roumata and Fotakado), Spilios River (settlement of Manoliopoulo), Keritis River (settlements of Meskla and Kares), Kladisos River (settlement of Therisos), Kiliaris River (upstream of the settlement of Mazxairon) in the APSFR EL13APSFR010.

EL_13_35_04: Land use management

The measure is a continuation of EL_13_35_17 from the 1st FRMP. It concerns management plans for grazing lands, per Law 4351/2015 (A' 164) and Joint Ministerial Decision 1058/71977/2017 (Gov. Gaz. B 2331/7-7-2017), for areas above the APSFR that are still designated as grazing lands (i.e., not classified as conservation areas). These plans must take into account the provisions of the Flood Risk

EL_13_35_04: Land use management

Management Plan (FRMP) and the River Basin Management Plan (RBMP) and apply hydrological criteria when determining grazing intensity (grazing capacity).

The measure applies at the WD level, with priority in the catchments of watercourses draining into APSFR . It is especially important to implement this measure immediately to control grazing and prevent deforestation in mountain catchments. Indicative (non-exhaustive) watercourses whose catchments are recommended for this measure include:

- That drain into the Geropotamos River in the APSFR EL13APSFR001.
- Kalamafkianos River, Bramiannos River, and Kotovianou River that drain into the APSFR EL13APSFR002.
- That drain into the Anopadari River in the APSFR EL13APSFR004.
- That drain into the Lassithi Plateau in the APSFR EL13APSFR008.
- Gazanos River, Xeropotamos, Yofyris River, Katsampadianos, Karteros that drain into the APSFR EL13APSFR009.
- Spilianios, Tavronitis, Spilios, Keritis, Kladisos, Kiliaris that drain into the APSFR EL13APSFR010.
- That drain into the APSFR EL13APSFR011.
- Almyros of Lasithi and Agios Nikolaos N.# that drain into the APSFR EL13APSFR012.

EL_13_35_05: Maintenance and rehabilitation of existing flood protection structures

This measure is introduced for the first time in the 1st Revision of the FRMP for EL13 and applies to APSFR EL13APSFR002, EL13APSFR009 and EL13APSFR010 of the WD. It covers all existing flood-protection infrastructures and any works within the watercourses that affect the rivers' hydraulic regime. Priority for maintenance and restoration is given to structures located within—or upstream of—the APSFR that influence flood flows.

The measure includes the following actions that should be carried out on an annual basis:

1. Conducting site visits, noting problems after the end of the wet period
2. Identification of critical positions that need maintenance/ replacement and prioritization
3. Setting an annual maintenance program by the competent authorities which will include:
   - ✓ Cleaning from debris materials hindering the free flow
   - ✓ Slope supporting works
   - ✓ Repair of lining works
   - ✓ Embankment repairs
   - ✓ Repairs of the structures (steps, culverts, crossings, etc.)
4. Secure funding
5. Implementation

EL_13_41_01: Development and operation of an early warning system for floods

The measure is a continuation of EL_13_41_18 from the 1st FRMP. The development of an early-warning system for the Crete WD is proposed in APSFR EL13APSFR001, EL13APSFR004, EL13APSFR009, and EL13APSFR010. Indicatively (but not exhaustively), the following areas are proposed:

- The entire course of the Geropotamos River (Basin EL1340: Streams of Southern Chania–Rethymno–Heraklion; APSFR EL13APSFR001)
- The entire course of the Anopodaris River (Basin EL1340: Streams of Southern Chania–Rethymno–Heraklion; APSFR EL13APSFR004)
- The entire courses of the Giophyros and Katsampadiános Rivers (Basin EL1339: Streams of Northern Chania–Rethymno–Heraklion; APSFR EL13APSFR009)
- The entire courses of the Tavronítis, Kerítis, and Kládissos Rivers (Basin EL1339: Streams of Northern Chania–Rethymno–Heraklion; APSFR EL13APSFR010)

EL_13_42_01: Updating of Emergency Plans, and standardization of emergency flood response procedures/ Development of a local Action Plan Memorandum

The measure is a continuation of EL_13_42_19 from the 1st FRMP and is applied at the Water District level. The Flood Hazard Maps (FHM) and Flood Risk Maps (FRM) produced under this FRMP enhance flood-risk awareness and must be incorporated into Emergency Response Plans to be developed.

For the Crete WD (EL13), within the T = 100-year floodplain, the following Municipalities are included (indicatively): Heraklion; Archanes–Asterousia; Gortyna; Malevizi; Minoa Pedias; Phaistos; Hersonissos; Agios Nikolaos; Ierapetra; Oropedio Lasithiou; Rethymno; Chania; Apokoronas; Kantanos–Selino; Platanias.

In accordance with the provisions of the General Civil Protection Plan "Xenokrates," in 2019, the Directorate of Planning and Emergency Response of the General Civil Protection Agency, in collaboration with all involved authorities, issued the General Plan for Emergency Response and Immediate/Short-Term Management of the Consequences of the Flood Phenomenon. This plan was distributed to all relevant entities by document number 8794/06-12-2019 from the General Civil Protection Agency for implementation of their respective responsibilities ("DARDANOS 1"). In 2023, the Emergency Planning Department of the General Directorate of the Hellenic Republic, considering administrative and organizational changes since the first edition—primarily affecting central administration authorities—issued the 2nd General Plan for Emergency Response and Immediate/Short-Term Management of the Consequences of the Flood Phenomenon, named "DARDANOS 2."

EL_13_42_03: Identification of borrow pit locations for embankment restoration/maintenance in case of emergency

The measure is a continuation of EL_13_53_27 from the 1st FRMP and applies in APSFR EL13APSFR001, EL13APSFR002, EL13APSFR004, EL13APSFR009, EL13APSFR010, EL13APSFR011, and EL13APSFR012 where, according to the Flood Hazard Maps, existing embankments are overtopped and adjacent plains are inundated. In the T = 1000-year floodplain—where flood-

EL_13_42_03: Identification of borrow pit locations for embankment restoration/maintenance in case of emergency

protection embankments have been constructed or are planned—the following actions are carried out:

1. Administrative actions: These define the procedures by which::
   (α) Immediate extraction of required embankment-repair materials, following extreme flood events, is permitted from specific, pre-designated sites (borrow-pits),
   (β) Selection criteria for these sites are established.,
   (γ) The precise boundaries of these sites are delineated,
   (δ) Permitted uses within the chosen and delineated sites are specified
2. Additional actions/studies required to finalize and license the sites:
   (α) Site-selection and delineation study for borrow-pits for immediate material extraction to restore embankments, which must: Identify suitable borrow-pit locations. Define the maximum allowable extraction volumes. Perform geotechnical suitability testing of the materials. Provide typical cross-sections of the existing embankments to guide their immediate reconstruction. Specify the extraction methodology and environmental restoration measures for the borrow-pit area. Assess site accessibility and propose access routes under T = 50, 100, and 1000-year flood conditions.
   (β) Environmental Impact Assessment (EIA) and compliance with the licensing procedures required by current legislation. This activity falls under Group 5 “Mineral-extraction and related activities” of the relevant Joint Ministerial Decision (as amended)—specifically entry 5: “Borrow-pits for inert, earthy, or other soil materials exclusively for infrastructure-project needs.”.

Indicative (non-exhaustive) locations for these measures include the flood zones of:

- EL13APSFR001: channel works on Geropotamos River
- EL13APSFR002: downstream channel works on Bramianos River near its dam
- EL13APSFR004: channel works on Anopodáris River
- EL13APSFR009: channel works on Karteros, Gazanos, Giophyros, and Katsampadianos Rivers
- EL13APSFR010: channel works on Kladissos, Tavronítis, and Kerítis Rivers
- EL13APSFR011: channel works on Sfakoryako Stream
- EL13APSFR012: channel works on Almyros River of Lasithi

EL_13_42_04: Establishment of alert thresholds for critical watercourses of WD EL13 based on the provisions of laws 4662/2020 and 5075/2023

This measure is introduced for the first time in the 1st Revision of the FRMP for EL13. It includes the following actions to establish flood-alert thresholds corresponding to the four legally defined mobilization levels:

- Hydraulic Analysis of Watercourses and Determination of Their Conveyance Capacity (maximum flow they can safely convey – with the required freeboard according to specifications)

EL_13_42_04: Establishment of alert thresholds for critical watercourses of WD EL13 based on the provisions of laws 4662/2020 and 5075/2023

- Identification of Critical Locations on Watercourses where monitoring and recording of river flow is possible (bridge locations, accessible areas, straight sections suitable for hydrological measurements).
- Identification of Critical Locations in Relation to the Flood Wave Propagation and the position/distance of adjacent affected uses, primarily settlements and road access infrastructure.
- Determination of Stage and Flow at the Above Locations for the four (4) levels of preparedness outlined by the legislation.
- Determination of Water Stage (absolute elevations) and Flow at critical selected locations for all the above preparedness levels.

The implementation of the measure is considered essential for critical watercourses, which are those that exhibit high and very high risk. Therefore, by way of example and not limited to:

- In the APSFR EL13APSFR001, the Geropotamos River is located.
- In the APSFR EL13APSFR002, the Kalamafkianos, Bramiannos, and Kotovianos Rivers are located.
- In the APSFR EL13APSFR004, the Anopadaris River is located.
- In the APSFR EL13APSFR009, the Gazanos, Giophyros, Katsampadianos, and Karteros Rivers are located.
- In the APSFR EL13APSFR010, the Tavronitis, Keritis, Kladisos, and Kiliaris Rivers are located.
- In the APSFR EL13APSFR011, the Sfakoryako (Platanias) and Pnigmeno (Adele) Rivers are located.
- In the APSFR EL13APSFR012, the Almyros River of Lasithi is located.

EL_13_42_05: Plan for controlled flooding of lowland areas to protect settlements and critical infrastructure

This measure is introduced for the first time in the 1st Revision of the FRMP for EL13. It concerns the design of controlled inundation of low- or very-low-risk plains, to be selected primarily within the T = 100-year flood zones—or immediately upstream—with the aim of protecting areas inside the T = 100-year zone or reducing flood risk in priority high-risk areas (as identified in the Flood Risk Maps), within the framework of the Master Plan for flood-protection works (measure EL_13_35_02). Completion of this specialised study will lead to the formal designation of controlled-inundation areas and the determination of permitted uses and prohibitions within their boundaries, in accordance with measure EL_13_21_03.

This measure is recommended for detailed investigation in the Master Plans prepared under measure EL_13_35_02. Indicative (non-exhaustive) candidate watercourses—where the FHMs show extensive flooding even at the T = 50-year level—include:

- APSFR EL13APSFR001: Watercourse: Geropotamos
- APSFR EL13APSFR002: Watercourses: Kalamafkianos, Kotovianos
- APSFR EL13APSFR004: Watercourse: Anopadari

EL_13_42_05: Plan for controlled flooding of lowland areas to protect settlements and critical infrastructure

- APSFR EL13APSFR008: Watercourse: Chavga
- APSFR EL13APSFR009: Watercourses: Almyros, Gazanos, Yofyris, and Karteros
- APSFR EL13APSFR010: Watercourses: Keritis and Kiliaris
- APSFR EL13APSFR011: Watercourses: Sfakoryako and Pnigmeno
- APSFR EL13APSFR012: Watercourse: Almyros of Lasithi

EL_13_43_01: Awareness-raising actions for the public, local authorities and communities against flood risk

The measure is a continuation of EL_13_43_21 from the 1st FRMP and applies at the Water District level. It involves conducting public-information and awareness-raising activities for citizens and stakeholders about flood risk in their area and the precautions they should take in the event of a flood. Such activities may include television, radio, and online programmes; public events; educational workshops; school presentations; etc. These 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 Directorates of the relevant Decentralised Administrations, the Civil Protection Units of the respective Regions, and the Municipalities, in cooperation with school administrations.

EL_13_43_02: Warning system to avoid crossing Irish crossings during flood events

The measure is a continuation of EL_13_43_22 from the 1st FRMP and applies at the APSFR level, with priority given to areas where a significant number of Irish crossings present a very high risk to residents under high-flow conditions. The objective of the measure is to enhance the preparedness of both citizens and responsible authorities, with the aim of reducing accidents involving vehicle crossings over rivers and streams via Irish crossings during flood events.

To achieve this, the measure involves the installation of systems consisting, at a minimum, of warning signage and water depth indicators at Irish crossings within the Water District. These systems will provide clear and timely information to discourage vehicle crossings under hazardous conditions.

The total number of fords identified per APSFR in the Crete WD is as follows:

- APSFR EL13APSFR001: A total of 17 Irish crossings.
- APSFR EL13APSFR002: A total of 11 Irish crossings.
- APSFR EL13APSFR004: A total of 7 Irish crossings.
- APSFR EL13APSFR009: A total of 3 Irish crossings.
- APSFR EL13APSFR010: A total of 11 Irish crossings.
- APSFR EL13APSFR011: A total of 2 Irish crossings.
- APSFR EL13APSFR012: A total of 3 Irish crossings.

EL_13_44_01: Formulation of a regulatory framework for restoring the conveyance capacity of streambeds and for the maintenance and management of riparian vegetation

The measure is a continuation of EL_13_44_23 from the 1st FRMP and is implemented at the level of the Water District. It involves the development of regulations for the periodic cleaning of watercourses, as well as the maintenance and management of riparian vegetation. These regulations are to be formulated considering the specific characteristics of the watercourses, including geomorphological and hydraulic conditions, type of watercourse, ecological and environmental attributes and the protection status of the area in which the watercourse is located.

EL_13_51_01: Restoration of infrastructure following recent flooding events

The measure is introduced for the first time in the 1st revision of the FRMPs for EL13 and concerns the restoration of areas affected by severe flooding.

Regarding the required interventions in flood defense embankments, they should be implemented following a thorough evaluation and in coordination with Measure EL_13_35_02 (Master Plan), within which the following aspects are examined:

(a) The impact on flood risk reduction in the lowlands, considering the effectiveness of mountain hydrology projects (Measure EL_13_31_01), the utilization of existing regional reservoirs (Measure EL_13_32_02), and the construction of new regional reservoirs (Measure EL_13_32_01) with flood protection components.

(b) The need to implement natural water retention measures in the lowlands (Measure EL_13_31_02), and controlled flooding in low-vulnerability floodplain areas (Measure EL_13_42_05)

(c) The necessity for other flood protection works (Measure EL_13_33_02), which will also define the required restoration interventions for existing embankments.

EL_13_52_01: Identification of locations for (temporary or permanent) sediment deposition sites (sediment storage areas)

This measure is introduced for the first time in the 1st Revision of the FRMP for EL13. It concerns defining the procedure by which the optimal management option for floodborne sediments is selected after each flood event. The measure applies to all APSFR of the Crete WD, with one "sediment-deposition-site identification" study to be carried out per zone (a total of 8 studies). All APSFR lie within the Region of Crete.

11 Prioritization of measures of the 1st revision of the FRMPs WD EL13

Prioritization of the measures is carried out through the assessment of their economic effectiveness. The purpose of prioritization is to highlight the measures that achieve the greatest reduction in flood damage (benefit) at the lowest cost.

The methodology applied in the current cycle of FRMP's is a modification of the methodology applied in the 1st cycle of implementation of the Floods Directive. The adopted steps are as follows:

- Classification of the proposed measures into two categories: measures that contribute indirectly to damage prevention (Category 1) and measures that contribute directly to damage prevention/management (Category 2)
- Assessment of the expected benefit of each measure of the two categories
- Evaluation of the nature/aspect of each measure (prevention, protection, preparedness, recovery)
- Correlation with other policies (climate change, RBMP)
- Multi-criteria analysis of the overall benefit index of the measure
- Estimate of the total cost of each measure (investment cost, operating cost)
- Calculation of cost-effectiveness index of a measure and prioritization of measures

Particular emphasis is placed on flood risk protection, which is why the proposed measures primarily focus on this aspect. The total initial investment cost of the program of measures is estimated at ~299 million €. Measures under the flood protection aspect represent the largest share of the total cost, ~283 million €. The remaining €16 million concerns the remaining three aspects (prevention, preparedness and recovery.)

Table 11-1: Number of measures per action pillar and total cost on the Crete Water District

Measure pillar	Number of proposed measures for EL13	Total initial investment cost of measures €
Prevention	9	5.341.385
Protection	12	282.981.161
Preparedness	8	10.170.000
Recovery	2	640.000
Total	**31**	**299.132.546**

The following tables present:

- the Benefit Index (D11)
- the total annualized investment cost (D16) and

More specifically, the Benefit Index (D11) -Table 11-2 ranges between 0 (smallest benefit from the implementation of the measure) to 100 (greatest benefit from the implementation of the measure). In the Crete Water District, the measures with the greatest benefit (>90) of Category 1 are:

- Development of a Monitoring System for the Flood Risk Management Plan's Program of Measures (EL_13_61_01)
- Actions to prevent and protect Rural Development within the APSFR (EL_13_21_04)
- Flood protection measures for the boreholes of the water service providers (EL_13_23_01)
- Awareness-raising actions for the public, local authorities and communities against flood risk (EL_13_43_01)
- Restructuring and modernization of the meteorological and hydrometric data collection network (EL_13_24_01)
- Integrated Design of flood protection measures (Master Plan) and construction of the proposed measures (EL_13_35_02)
- Alignment of the urban development plans with the provisions of the FRMPs (EL_13_21_01)

while the measure with the greatest benefit (>90) of Category 2 is Implementation of water control measures in upland regions (EL_13_31_01).

With regard to the total annualized investment cost (D16) - Table 11-3, the most expensive measures by category are:

Category 1 Measures:

Maintenance and rehabilitation of existing flood protection structures (EL_13_35_05)

Category 2 Measures:

Flood Protection measures (EL_13_33_02) and

Modernization, replacement and maintenance of existing stormwater drainage networks (EL_13_34_01).

Table 11-2: Prioritization of measures of the 1st revision of the FRMPs for the WD EL13based on the overall benefit index (D11)

MEASURE NAME	CODE	PILLAR	TYPE OF MEASURE	D11 (overall benefit index)
CATEGORY 1 MEASURES				
Development of a Monitoring System for the Flood Risk Management Plan's Program of Measures	EL_13_61_01	**Prevention**	Acquisition, completion and improvement of information	**100**
Actions to prevent and protect Rural Development within the APSFRs	EL_13_21_04	**Prevention**	Acquisition, completion and improvement of information	**98**
Flood protection measures for the boreholes of the water service providers	EL_13_23_01	**Prevention**	Legislative / Administrative Regulations and Technical Flood Protection Measures	**98**
Awareness-raising actions for the public, local authorities and communities against flood risk	EL_13_43_01	**Preparedness**	Education/information measures	**97**
Restructuring and modernization of the meteorological and hydrometric data collection network	EL_13_24_01	**Prevention**	Acquisition, completion and improvement of information	**93**
Integrated Design of flood protection measures (Master Plan) and construction of the proposed measures	EL_13_35_02	**Protection**	Technical flood protection measures	**92**
Alignment of the urban development plans with the provisions of the FRMPs	EL_13_21_01	**Prevention**	Legislative/Administrative regulations	**92**
Formulation of a regulatory framework for restoring the conveyance capacity of streambeds and for the maintenance and management of riparian vegetation	EL_13_44_01	**Preparedness**	Legislative/Administrative regulations	**75**
Implementation of Natural Water Retention measures (NWRM) / SUDs practices for projects and activities of subcategory A1 and A2 of Law 4014/2011, as in force.	EL_13_31_03	**Protection**	Measures of environmental nature (green infrastructure)	**74**
Updating of Emergency Plans, and standardization of emergency flood response procedures/ Development of a local Action Plan Memorandum	EL_13_42_01	**Preparedness**	Acquisition, completion and improvement of information	**72**
Maintenance and rehabilitation of existing flood protection structures	EL_13_35_05	**Protection**	Technical flood protection measures	**72**

MEASURE NAME	CODE	PILLAR	TYPE OF MEASURE	D11 (overall benefit index)
Building and structural regulations within the 100-year flood zone	EL_13_21_02	Prevention	Legislative/Administrative regulations	72
Adaptation of the urban development plans in flood prone areas (retention basins)	EL_13_21_03	Prevention	Legislative/Administrative regulations	71
Establishment of alert thresholds for critical watercourses of WD EL13 based on the provisions of laws 4662/2020 and 5075/2023	EL_13_42_04	Preparedness	Non-structural interventions	70
Collection and digitization of watercourse demarcation data and flood control project data.	EL_13_24_02	Prevention	Acquisition, completion and improvement of information	52
Creation of a National Flood Events database and development of a related interactive online platform	EL_13_24_03	Prevention	Acquisition, completion and improvement of information	50
Identification of borrow pit locations for embankment restoration/maintenance in case of emergency	EL_13_42_03	Preparedness	Measures of environmental nature (green infrastructure)	48
Identification of locations for (temporary or permanent) sediment deposition sites (sediment storage areas)	EL_13_52_01	Recovery	Measures of environmental nature (green infrastructure)	47
CATEGORY 2 MEASURES				
Implementation of water control measures in upland regions	EL_13_31_01	Protection	Measures of environmental nature (green infrastructure)	100
Nature-based water retention structures in the lowlands	EL_13_31_02	Protection	Measures of environmental nature (green infrastructure)	77
Modernization and rehabilitation of drainage networks	EL_13_33_01	Protection	Technical flood protection measures	50
Modernization, replacement, maintenance of existing stormwater drainage networks	EL_13_34_01	Protection	Technical flood protection measures	44
Utilization of existing reservoirs with a flood protection component	EL_13_32_02	Protection	Technical flood protection measures	21
Development and operation of an early warning system.	EL_13_41_01	Preparedness	Acquisition, completion and improvement of information	21

MEASURE NAME	CODE	PILLAR	TYPE OF MEASURE	D11 (overall benefit index)
Evaluation and Maintenance of Existing water control measures in upland regions	EL_13_35_03	Protection	Technical flood protection measures	19
Flood Protection measures	EL_13_33_02	Protection	Technical flood protection measures	18
Land use management	EL_13_35_04	Protection	Measures of environmental nature (green infrastructure)	16
Warning system to avoid crossing Irish crossings during flood events	EL_13_43_02	Preparedness	Non-structural interventions	15
Plan for controlled flooding of lowland areas to protect settlements and critical infrastructure	EL_13_42_05	Preparedness	Technical flood protection measures	15
Multipurpose reservoirs with a flood protection component	EL_13_32_01	Protection	Legislative / Administrative Regulations and Technical Flood Protection Measures	11

Table 11-3: Prioritization of measures of the 1st revision of the FRMPs for the WD EL13 based on the total annualized investment cost (D16)

MEASURE NAME	CODE	PILLAR	TYPE OF MEASURE	D16 (total annualized investment cost)
CATEGORY 1 MEASURES				
Maintenance and rehabilitation of existing flood protection structures	EL_13_35_05	**Protection**	Technical flood protection measures	**932.750**
Actions to prevent and protect Rural Development within the APSFRs	EL_13_21_04	**Prevention**	Acquisition, completion and improvement of information	**453.875**
Flood protection measures for the boreholes of the water service providers	EL_13_23_01	**Prevention**	Legislative / Administrative Regulations and Technical Flood Protection Measures	**320.866**
Establishment of alert thresholds for critical watercourses of WD EL13 based on the provisions of laws 4662/2020 and 5075/2023	EL_13_42_04	**Preparedness**	Non-structural interventions	**272.325**
Identification of borrow pit locations for embankment restoration/maintenance in case of emergency	EL_13_42_03	**Preparedness**	Measures of environmental nature (green infrastructure)	**127.085**
Identification of locations for (temporary or permanent) sediment deposition sites (sediment storage areas)	EL_13_52_01	**Recovery**	Measures of environmental nature (green infrastructure)	**116.192**
Development of a Monitoring System for the Flood Risk Management Plan's Program of Measures	EL_13_61_01	**Prevention**	Acquisition, completion and improvement of information	**113.254**
Integrated Design of flood protection measures (Master Plan) and construction of the proposed measures	EL_13_35_02	**Protection**	Technical flood protection measures	**90.775**
Restructuring and modernization of the meteorological and hydrometric data collection network	EL_13_24_01	**Prevention**	Acquisition, completion and improvement of information	**55.965**
Collection and digitization of watercourse demarcation data and flood control project data.	EL_13_24_02	**Prevention**	Acquisition, completion and improvement of information	**55.965**
Awareness-raising actions for the public, local authorities and communities against flood risk	EL_13_43_01	**Preparedness**	Education/information measures	**14.524**

MEASURE NAME	CODE	PILLAR	TYPE OF MEASURE	D16 (total annualized investment cost)
Formulation of a regulatory framework for restoring the conveyance capacity of streambeds and for the maintenance and management of riparian vegetation	EL_13_44_01	Preparedness	Legislative/Administrative regulations	**10.893**
Updating of Emergency Plans, and standardization of emergency flood response procedures/ Development of a local Action Plan Memorandum	EL_13_42_01	Preparedness	Acquisition, completion and improvement of information	**10.893**
Creation of a National Flood Events database and development of a related interactive online platform	EL_13_24_03	Prevention	Acquisition, completion and improvement of information	**2.665**
Alignment of the urban development plans with the provisions of the FRMPs	EL_13_21_01	Prevention	Legislative/Administrative regulations	**-**
Implementation of Natural Water Retention measures (NWRM) / SUDs practices for projects and activities of subcategory A1 and A2 of Law 4014/2011, as in force.	EL_13_31_03	Protection	Measures of environmental nature (green infrastructure)	**-**
Building and structural regulations within the 100-year flood zone	EL_13_21_02	Prevention	Legislative/Administrative regulations	**-**
Adaptation of the urban development plans in flood prone areas (retention basins)	EL_13_21_03	Prevention	Legislative/Administrative regulations	**-**
CATEGORY 2 MEASURES				
Flood Protection measures	EL_13_33_02	Protection	Technical flood protection measures	**6.638.359**
Modernization, replacement, maintenance of existing stormwater drainage networks	EL_13_34_01	Protection	Technical flood protection measures	**5.298.437**
Modernization and rehabilitation of drainage networks	EL_13_33_01	Protection	Technical flood protection measures	**687.601**
Evaluation and Maintenance of Existing water control measures in upland regions	EL_13_35_03	Protection	Technical flood protection measures	**376.413**
Development and operation of an early warning system.	EL_13_41_01	Preparedness	Acquisition, completion and improvement of information	**343.055**

MEASURE NAME	CODE	PILLAR	TYPE OF MEASURE	D16 (total annualized investment cost)
Warning system to avoid crossing Irish crossings during flood events	EL_13_43_02	**Preparedness**	Non-structural interventions	**67.028**
Land use management	EL_13_35_04	**Protection**	Measures of environmental nature (green infrastructure)	**44.284**
Utilization of existing reservoirs with a flood protection component	EL_13_32_02	**Protection**	Technical flood protection measures	**36.232**
Multipurpose reservoirs with a flood protection component	EL_13_32_01	**Protection**	Legislative / Administrative Regulations and Technical Flood Protection Measures	**8.815**
Implementation of water control measures in upland regions	EL_13_31_01	**Protection**	Measures of environmental nature (green infrastructure)	**-**
Nature-based water retention structures in the lowlands	EL_13_31_02	**Protection**	Measures of environmental nature (green infrastructure)	**-**
Plan for controlled flooding of lowland areas to protect settlements and critical infrastructure	EL_13_42_05	**Preparedness**	Technical flood protection measures	**-**

12 Public information and consultation

To inform the public and the relevant bodies and institutions, a sufficient number of meetings were organized during which the Draft Flood Risk Management Plans were presented for public consultation.

The consultations took place at both the local/regional and central levels, aiming to encourage the active participation of stakeholders, either by attending the events or by submitting their proposals on the issues under consultation.

During the implementation of the consultation and communication activities, some or all of the actions described in the following paragraphs were carried out in combination.

- In the first 4 months, inspections were conducted in the study area, meetings were held with relevant agencies and services, and an inspection report was submitted for the special areas located outside the APSFRs.
- The Flood Hazard Maps, along with the accompanying Technical and Non-Technical Reports, were subsequently posted on the website of the General Secretariat for Natural Environment and Water of the Ministry of Environment and Energy: https://floods.ypeka.gr/ .
- Subsequently, the Flood Risk Maps along with the accompanying Technical and Non-Technical Reports were posted on the website of the Directorate General of the Ministry of Environment and Natural Resources: http://floods.ypeka.gr/ .
- The Flood Risk Management Drafts and the Strategic Environmental Impact Studies (SEIS) were posted on the website of the General Secretariat for Natural Environment and Water of the Ministry of Environment and Energy: https://floods.ypeka.gr/consultation/2round-consultation/ .
- A form for submitting observations and corrections to the Draft Plans was posted on the website of the General Secretariat for Natural Environment and Water of the Ministry of Environment and Energy: https://floods.ypeka.gr/2round-consultation-el13/
- The invitation and program for the Consultation Workshop in Heraklion, for the 1st Revision of the Flood Risk Management Plan of the Crete Water District (EL13), have been posted on the website of the General Secretariat for Natural Environment and Water of the Ministry of Environment and Energy
- The List of Social Partners for the Consultation Day in Kalamata, regarding the 1st Revision of the FRMP for the Crete Water District (EL13), has been posted on the website of the General Secretariat for Natural Environment and Water of the Ministry of Environment and Energy
- Questionnaires were posted to enable participation in the consultation process, allowing institutions and the public to briefly express their views. The questionnaires were digital and accessible through the website of the General Secretariat for Natural Environment and Water of the Ministry of Environment and Energy (https://floods.ypeka.gr/consultation/consultation-events/). The questionnaire is also included in the Deliverable entitled 'Consultation Results Report'.
- On Monday 22 July 2024, the Consultation Workshop in Heraklion for the 1st Revision of the Flood Risk Management Plan of the Crete Water District (EL13), was held, during which the following materials were provided in printed and/or electronic formQ
  - ✓ Draft Summary of the Flood Risk Management Plan (FRMP) for the Crete Water District (EL13).

- ✓ Questionnaire on the consultation issues of the Crete Water District (EL13).

The Consultation Workshop in Heraklion was held in a hybrid format, with over 50 participants attending in person and more than 200 joining remotely via live streaming or recorded broadcast of the workshop at the following link:

https://www.youtube.com/watch?v=yfYVF6d6Z_M&ab_channel=SympraxisTeam.

- The consultation on both the Draft Flood Risk Management Plan and the Strategic Environmental Assessment (SEA) of the 1st Revision of the Flood Risk Management Plan for the Crete Water District (EL13) lasted more than seven months.

The conclusions of the consultation process are summarized as follows:

1. The need to reassess the methodology for determining APSFRs, incorporating the results of the flood hazard and risk analysis from the Flood Risk Management Plan as well as new data on flood events.
2. The necessity of developing specifications for the construction of mountain hydrological management projects, the cleaning of watercourses, and the implementation of natural retention measures for sediments in the lowlands.
3. The necessity of prioritizing nature-based flood protection projects.
4. The necessity of modernizing, maintaining and cleaning the existing drainage ditch network.
5. The impact of climate change on the return period of flood events and the necessity to align the proposed measures with climate change objectives and measures (PESPKA).
6. Adaptation to the most recent administrative divisions as defined by the Ministerial Decision No. 64436/2023 (Government Gazette Issue 4821/B/01-08-2023).
7. The impact of recent fires on the intensity or even potential occurrence of flooding phenomena.
8. The necessity to enhance the completeness and accuracy of data used in flood risk assessment, including background information, hydrometeorological data, records of historical flood events, technical registries of flood protection projects, and data on human activities.
9. The need to include the competent authorities in the program of measures.
10. The need to modify various fields in the measure sheets of the Program of Measures, or even to remove a measure where necessary.
11. The need to update and supplement Ministerial Decisions, Presidential Decrees, Official Gazette entries, and related legal documents.
12. The further utilization of local knowledge and experience from various agencies and services for the assessment of and response to the impacts of flood events.
13. The contribution of pumped storage projects and hydroelectric projects in general to the flood protection of downstream areas.
14. In areas of controlled flooding, Local and Special Spatial Plans should be taken into account.
15. The need to further specify certain measures of the Flood Risk Management Plan to enable their implementation at the local level.

16. The need to provide compensatory benefits for residents, livestock breeders, farmers, and professionals who will be negatively affected by the implementation of the measures (e.g., relocation of activities, restructuring of agricultural production toward more flood-resistant crops, etc.).
17. The prioritization of the roles and responsibilities of the involved bodies, considering the applicable legislation, to ensure effective utilization of the results of the Flood Risk Management Plan (FRMP), given that in many cases the bodies involved at each stage of prevention, preparation, and response to flood phenomena are numerous and interdependent.
18. The possibility of financing actions and projects in areas outside the APSFRs.
19. The urgency of promptly initiating and promoting the measures outlined in the Flood Risk Management Plan.
20. The necessity of comprehensive planning for flood protection projects at the catchment level, taking into account the results of the flood hazard and risk analysis from the Flood Risk Management Plan, Directive 2000/60/EC, current Environmental, Spatial, and Urban Planning legislation, as well as all alternative options for managing flood runoff.
21. The difficulties faced by the Public Administration in utilizing the results of the Flood Risk Management Plan, due to insufficient staffing and lack of appropriate expertise within the competent bodies.
22. The issue of non-rational urban planning, which in many cases in Greece follows development rather than precedes it.
23. The complexity of legislation and the division of responsibilities among state bodies, which hinders the easy and rapid resolution of arising issues.
24. The lack of citizen education on dealing with natural disasters, as well as insufficient environmental education and awareness.
25. The importance of synergy between certain Flood Risk Management Plan measures and specific measures of the River Basin Management Plans.