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COMMISSION STAFF WORKING DOCUMENT

Third River Basin Management Plans
Second Flood Hazard and Risk Maps and Second Flood Risk Management Plans
Member State: Croatia

Accompanying the document

REPORT FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT

on the implementation of the Water Framework Directive (2000/60/EC) and the Floods Directive (2007/60/EC)

Third River Basin Management Plans
Second Flood Risk Management Plans

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Country specific staff working document

Croatia

ENVIRONMENT

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Content

SECTION A:

WATER FRAMEWORK DIRECTIVE

1. General info, member state characterisation

Croatia, a predominantly mountainous country, encompasses terrestrial and marine areas of over 56,000km^2. It comprises the Slavonia lowlands in the interior and the coastal Dinaric Alps, along with numerous islands and islets scattered throughout the Adriatic Sea. It has a population of 3.87 million inhabitants (9.64% less than in the 2011 census). There are roughly 73 people per km2 which is below EU average. Croatia's geography ranges from the lowlands of the Pannonian basin to the Dinaric Alps and the Dalmatian coastline, (over 1800 km long). In addition, Croatia has over 1200 coastal islands. Hence the country features a quite unique geographical situation with a long and narrow stretch of land with a long coast and many islands, which makes the interactions between freshwater and sea water very prominent. It remains a country with very rich biodiversity and natural areas where a very high proportion (38.1%) of the country is covered by protected areas. There are three types of climate in Croatia: Mediterranean, Alpine and Continental.

Croatia has two RBDs: the Adriatic RBD ("HRJ") and the Danube RBD which is part of the international

Danube RBD. Croatia's Adriatic RBD shares four smaller river basins with Bosnia and Herzegovina (Cetina, Neretva, Trebišnjica and Krka) and three river basins with Slovenia (Dragonja; Mirna and Rječina).

The Croatian territory is administratively divided into 20 counties and the City of Zagreb, as well as 128 cities, 428 municipalities and 6.755 settlements. The spatial distribution of the population is very uneven. The north-west is the most populated part of Croatia, where 15% of the total population is situated in 15% of the territory. Eastern Slavonia, Istria, Croatian Littoral and Southern Dalmatia

have an above-average and average population while the remainder of Croatia has a sparser population.[1]

Reporting

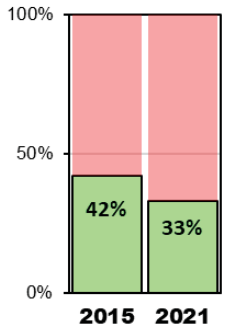
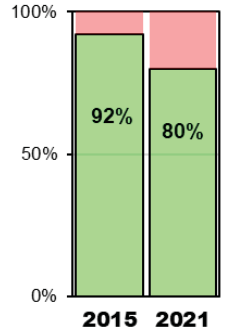
The deadline for reporting the 3rd RBMPs was in March 2022. The Commission and the EEA together with Member States developed an electronic reporting system in WISE (Water Information System for Europe). Its use was voluntary. Some Member States used it to fulfil their obligations, others reported the plans in pdf format. The cut-off date for the WISE e-reporting was September 2023 and the MS were assessed based on the datasets available by this date.

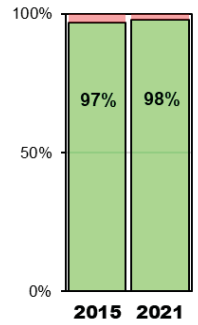
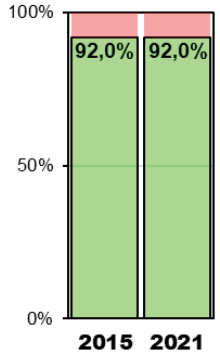
By September 2023 Croatia submitted full electronic reporting and therefore the assessment is based on this dataset.

Despite the cut off dates for the production of this report, reporting continued and, for the State of Water report, the EEA aggregated the results available by July 2024 in their products and dashboards available at WISE Freshwater web portal.

[1] https://climate-adapt.eea.europa.eu/en/countries-regions/countries/croatia

Changes in Status, Pressures, Exemptions & Measures

Surface Water Bodies	Trend (% good status/potential)	Main Pressures & Changes & Exemptions
ECOLOGICAL STATUS		The number of SWB in good ecological status decreased from 50% (1st RBMP) to 42% (2nd RBMP) and 33% (3rd RBMP). It is not entirely clear whether this continuous decrease is due to better knowledge (improved monitoring) and/or due to more pollution or both. The re-delineation of SWBs between the 2nd and 3rd RBMP makes direct comparisons also difficult. Diffuse source pressures from discharges, agriculture, transport and physical alterations exert pressures on > 50 % SWB, water abstractions on 7.9 % SWB. Nutrient pollution (41%) and morphological changes (40 %) are the most relevant impacts. No improvements are expected until 2027. Croatia's programme of measures lacks a cost effectiveness analysis for prioritising and leaves open if funding is secured. Croatia invoked Article 4(4) WFD in relation to 105 SWB (5.3 %) on grounds of natural conditions and for 1406 SWB (71.7 %) for disproportionate cost.
CHEMICAL STATUS		Due to the uPBTs mercury, PBDEs and PFOS, about 20% of SWB fail good chemical status. Without these uPBT, 7% SWB would fail the objective, only. It is not entirely clear whether the decrease from 92 % to 80 % represents a genuine deterioration since the 2nd RBMP or rather us due to a re-delineation of SWBs as well as better knowledge about the pollution. It is of concern that 100% of coastal waters and 100% transitional waters faill a good chemical status and that Croatia fails to identify the sources of anthropogenic pressures on these surface water bodies. Croatia does not expect that the chemical status will improve by 2027. Croatia continues to bring its water management in full alignment with the WFD and UWWTD: most basic measures deal with investments in water infrastructure, monitoring network and data management and amending the regulatory framework. Croatia mapped KTM1: Alignment with standards for wastewater discharge and KTM14: Developing a methodology for assessing waste water emissions. For the ca. 20% SWBs, Croatia invoked Article 4(4) exemptions. More specifically, it invoked technical feasibility in relation to 158 SWB (8%) and disproportionate cost in relation to 216 SWBs (10.9 %).

Ground Water Bodies	Trend (% good status/potential)	Main Pressures & Changes & Exemptions
QUANTITATIVE STATUS		The slight change between 2015 and 2021 seems due to the re-delineation of Ground Water Bodies. The 3rd RBMP identifies only one Ground Water Body in the Adria River Basin District to be in poor quantitative status. Since 2016, total water abstractions have increased (4.8 %), due potentially to the increase in electricity generation while decreasing trends were observed in households and services (5.9 %) and industry (9.4 %). 5 GWBs (9.8 %) are reported to be at risk of losing their good quantitative status by 2027. Croatia invoked Article 4(4) exemptions for 1 GWB (2 %) on grounds of technical feasibility, natural conditions and disproportionate costs.
CHEMICAL STATUS		In the 3rd RBMP, 47 out of 51 GWBs (i.e., 92.2 %) were reported to be in a good chemical status with 4 GWBs (i.e. 7.8 %) being in a poor chemical status in 2021 (one in the Danube RBD and four in the Adriatic RBD). These GWBs fail to achieve good chemical status due to the general water quality assessment (3 GWBs) and regional saline or other intrusions resulting from anthropogenically induced sustained changes in flow direction (1 GWB). Pollutants causing failure of good chemical status are nitrates, saline intrusion and water temperature. The 4 GWBs failing good status in 2021 are also at risk of failing good chemical status in 2027. Croatia has significantly improved monitoring of priority substances in GWBs since the 2nd RBMP. In the 3rd RBMP, 95.3 % of the total GWB area has chemical monitoring. No measures were mapped for pressures of saline intrusion and water temperature, but measures were mapped for nitrate pollution. Croatia invoked Article 4 (4) WFD for 4 GWBs failing good chemical status. More precisely, Croatia invoked natural conditions in relation to 1 GWB (2 %) and technical feasibility and disproportionate cost in relation to 3 GWB (5.9 %).

2. Horizontal aspects

2.1 Governance

In the Republic of Croatia, three authorities are competent for managing water and elaborating the RBMPs: the Ministry of Economy and Sustainable Development, the national body responsible for water management *Croatian Waters* and the *Josip Juraj Strossmayer Water Institute* (a public research institution created in 2020 and responsible for monitoring water bodies). Croatia's Flood Risk Management Plan is an integral part of the RBMP: the preparation of Croatia's RBMP and the FRMP ran jointly, and there was a joint consultation for both plans. The RBMP and FRMP have separate programmes of measures, however, some of the RBMP measures (mainly measures related to hydromorphological issues) refer to flood risk management among the relevant sectors.

Regrettably, given the very strong link between freshwater and marine areas in the country, there does not seem to be any evidence that Croatia's 3rd RBMP and the Programmes of measures under the Marine Strategy Framework Directive (MSFD) have been developed in an integrated manner and the objectives do not appear to be streamlined.

The draft and final RBMP were available for public consultation for at least six months. Interested members of the public could provide comments and ask questions to the re

2.2 Characterization of River Basin District

Year	RBD	Rivers		Lakes		Transitional		Coastal		Territorial	
		Number of water bodies	Total length (km)	Number of water bodies	Total area (km²)	Number of water bodies	Total area (km²)	Number of water bodies	Total area (km²)	Number of water bodies	Total area (km²)
2021	HRC	1365	15651	79	181	0	0	0	0	0	0
2021	HRJ	387	2937	30	90	35	129	81	13755	1	17712
2021	**Total**	**1752**	**18588**	**109**	**271**	**35**	**129**	**81**	**13755**	**1**	**17712**

It is striking that the number of delineated waterbodies has increased very considerably compared to the previous 2nd cycle. The number of delineated surface water bodies increased from 1572 to 1978 SWBs (+26 %) and groundwater bodies increased from 33 to 51 GWBs (+55 %). The new GWBs – not yet included in Croatia's electronic reporting - belong to various types of geological formations, e.g. fissured and karstic aquifers, fractured aquifers and porous aquifers. The review of the GWB delineation affected mainly the first type, the fissured and karstic aquifers, which increased from 19 in the 2nd RBMP to 33 in the 3rd RBMP.

The number of river water bodies has increased by 268 (18 % increase). The number of lakes has increased by 72 which amounts to a near tripling in their number (195 % increase). The number of transitional water bodies has increased by 10 (40 % increase). The number of coastal water bodies has increased by 55, more than tripling their number (212 % increase). The changes in the number of water bodies are a result of new monitoring data, so due to new and better information. A reason for the increase in the number of river water bodies is due to a changed river typology in which certain biotic types have been further divided according to abiotic characteristics.

According to the 3rd RBMP and other publicly available sources, the methodological changes are explained by the need to update the specific water classification system based on the results of implemented intercalibration. Due to late accession of Croatia to the EU in 2013, the intercalibration process was started for the first time in the late phases of 2nd RBMP implementation, only. The methodological changes led to an amendment of SWB and GWB because of new monitoring results and various research findings where new data on chemical and ecological status were used for characterisation, along with the size. As a result, some river SWBs were split or merged. For GWB separate studies for the assessment of background concentrations and limiting values were prepared for Pannonian part of Croatia and for karstic areas that provided more precise information. In addition, small water bodies were assigned to a provisional type.

Table 1. Number and area / length of delineated surface water bodies in Croatia in 2nd RBMP (2015) and 3rd RBMP (2021)

Year	RBD	Rivers		Lakes		Transitional		Coastal		Territorial	
		Number of water bodies	Total length (km)	Number of water bodies	Total area (km2)	Number of water bodies	Total area (km2)	Number of water bodies	Total area (km2)	Number of water bodies	Total area (km2)
2021	HRC	1365	15651	79	181	0	0	0	0	0	0
2021	HRJ	387	2937	30	90	35	129	81	13755	1	17712
2021	Total	1752	18588	109	271	35	129	81	13755	1	17712
2015	HRC	1126	16095	33	125	0	0	0	0		
2015	HRJ	358	2979	4	41	25	150	26	13747		
2015	Total	1484	19074	37	166	25	150	26	13747		

Likewise, the number of groundwater bodies increased due to a re-delineation from 33 to 51 GWB. At the time the 3rd RBMP was established, chemical monitoring results were still outstanding for the 18 newly delineated GWBs.

Table 2. Number and area of delineated groundwater bodies in Croatia in 2nd RBMP (2015) and 3rd RBMP (2021)

Year	RBD	Groundwater

		Number of water bodies	Total area (km2)
2021	HRC	37	37812
2021	HRJ	14	20745
2021	Total	51	58557
2015	HRC	20	35084
2015	HRJ	13	20718
2015	Total	33	55802

Source: 3rd RBMP e-reporting

The largest users of freshwater in Croatia are public water supply (440million m3), followed by the energy sector (167 million m3), agriculture (30 million m3)[2] and the manufacturing industry (25.07 million m3).[3]

It is positive that Croatia has significantly improved the establishment of physico-chemical quality elements for lakes, which are now established for 100 % of lake types compared to 40 % in the 2nd RBMP. However, there remain still gaps in Croatia's type-specific reference conditions. In particular for transitional and coastal surface water bodies, Croatia has failed to set any hydromorpholgical[4] reference conditions (see table 4). The absence of hydromorphological reference conditions for Croatia's coastal and transitional waters may hamper the identification of anthropogenic pressures that degrade the ecological status of Croatia's coastal water bodies (e.g.: construction of hotels and tourism etc).

Table 3. Percentage of surface water body types in Croatia with reference conditions established for all, some and none of the biological, hydromorphological and physicochemical quality elements.

Established reference conditions for:				
Surface water category	Surface water types	Biological quality elements	Hydromorphological quality elements	Physicochemical quality elements
Rivers	All	73%	99%	84%
	Some			
	None	27%	1%	16%
Lakes	All	79%	98%	100%
	Some		2%	
	None	21%		
Transitional	All	80%		

[2] Note, however, that Croatia still estimates abstractions in agriculture rather than measuring it, which also explains that the figure of 30 million m3 stayed the same since 2015.
[3] Source Eurostat 2021.
[4] Such conditions would for instance include the depth variation, structure and substrate of the coastal bed, both the structure and condition of the inter-tidal zones etc.

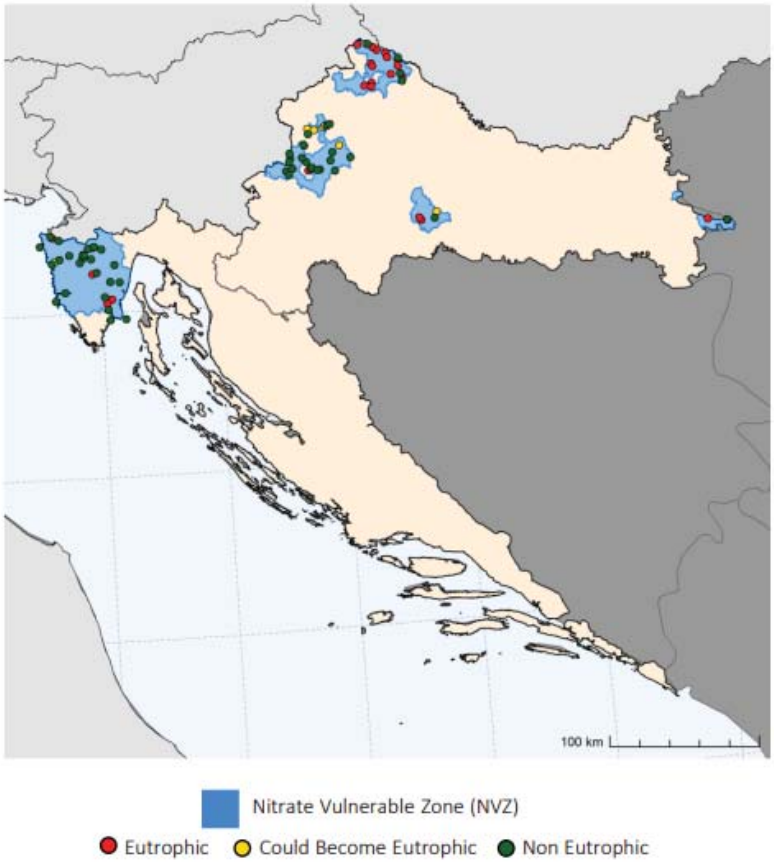
	Some			80%
	None	20%	100%	20%
Coastal	All	78%		
	Some			78%
	None	22%	100%	22%

Source: 3rd RBMP e-reporting

Pressures

The 3rd RBMP of Croatia also establishes the main pressures on surface water bodies (SWB) which appear similar to those in the 2nd RBMP. Namely, the most significant pressures are, in declining order of relevance, diffuse discharges not connected to the sewage network, diffuse pressures from agriculture, diffuse pressures from the transport sector, and finally also physical alterations.

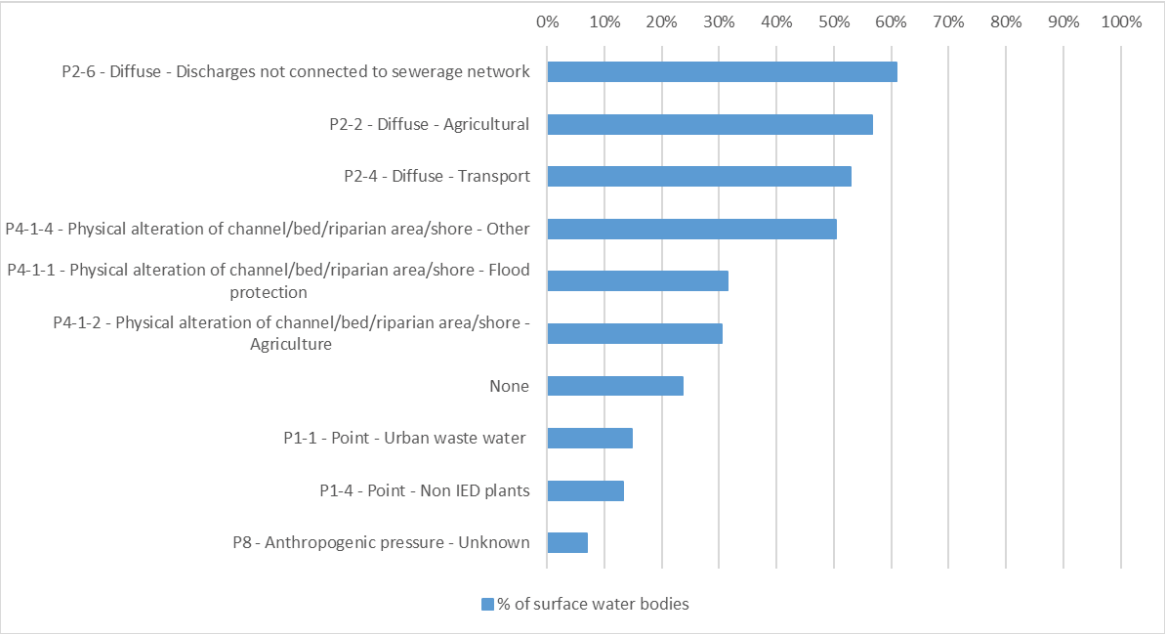
Figure 1. Map of the monitoring points showing eutrophication assessment in Croatia, according to the reporting of the Nitrates Directive



Source: Joint Research Center of European Commission (n.d.). JRC NITRATES DIRECTIVE - Reporting Period 7 (2016-2019) Trophic Status. [online] water.jrc.ec.europa.eu. Available at: https://water.jrc.ec.europa.eu/portal/apps/dashboards/cb6034c2a75e4df282f8a62f90c16caa

Note : 1% of the monitoring stations are above the threshold of 50mg/l

Figure 2. he most significant pressures on surface water bodies in Croatia by 2021 (expressed as percentages of numbers of water bodies affected)



Note that Croatia's Accession Treaty to the EU derogates from Articles 3, 4, 5, 6 and 7 of the Urban Waste Water Treatment Directive such that the requirements for collecting systems and treatment of urban waste water applies in Croatia only since very recently, namely from 1 January 2024, only. Now that Croatia must fully comply with the UWTD, this should normally accelerate the process of cleaning Croatia's surface water bodies from pollution coming from urban sources ("discharges not connected to sewerage network"). From data published under the Urban Waste Water Treatment Directive, it appears that waste water is in particular still collected *without* appropriate treatment or not collected at all in the region of Split-Solin, a coastal town in the Adriatic RBD.

Table 4. Waste water treatment in big cities without treatment (2020)

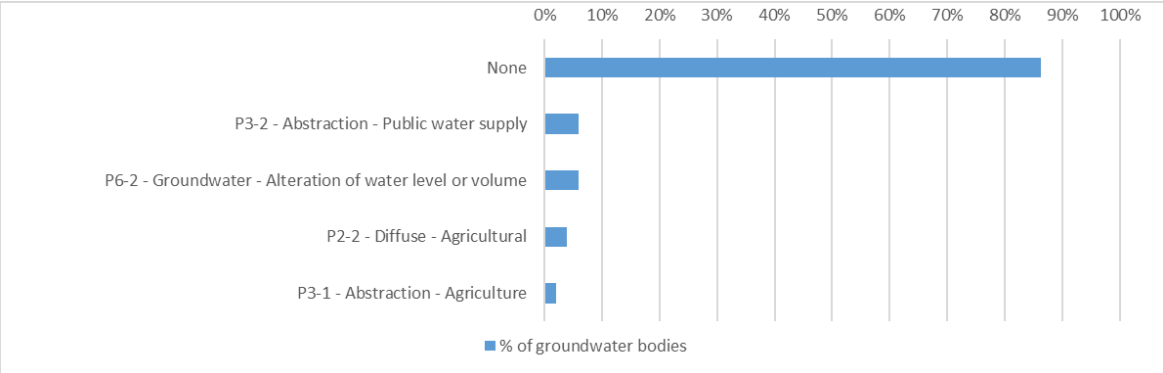
Reported period	Member state	Region	Big city/big discharger
2020	Croatia	(All)	(All)

		Addressed through individual and appropiate systems (IAS)	Collected in collecting system without treatment	N-Removal	Not collected nor addressed via IAS	NP-Removal	Other treatment	P-Removal
Croatia	Rijeka	46.081,27	0,00		0,00			
	Split-Solin	51.212,40	11.482,60		11.482,60			
	Zagreb	55.384,40	0,00		0,00			

Source: Country reporting under UWWTD

For groundwater bodies (GWB), the most significant pressures are abstractions (public water supply, alteration of water level or volume, for agriculture) and diffuse pressures from agriculture, together causing ca. 8 % GWB to fail good status. The pressures on 18 newly delineated GWBs remains to be reported.

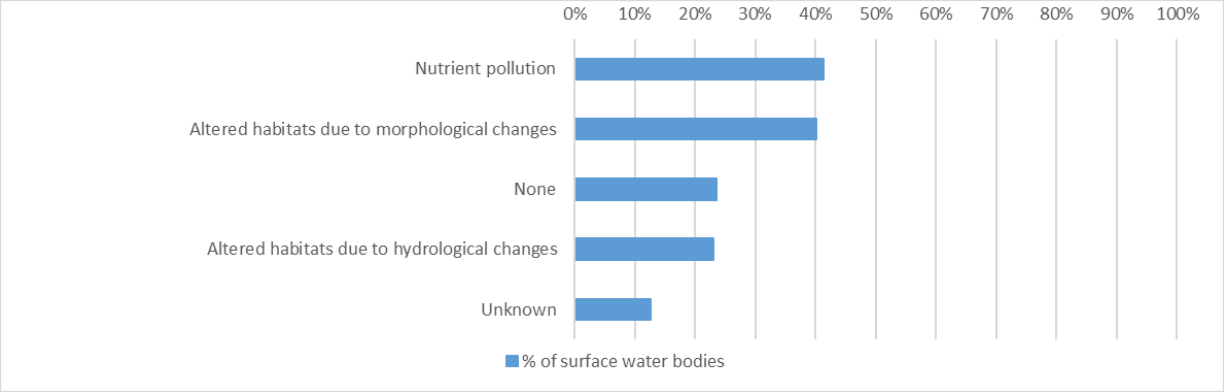
Figure 3. The most significant pressures on groundwater water bodies in Croatia by 2021 (expressed as percentages of numbers of water bodies affected)



Source: 3rd RBMP e-reporting

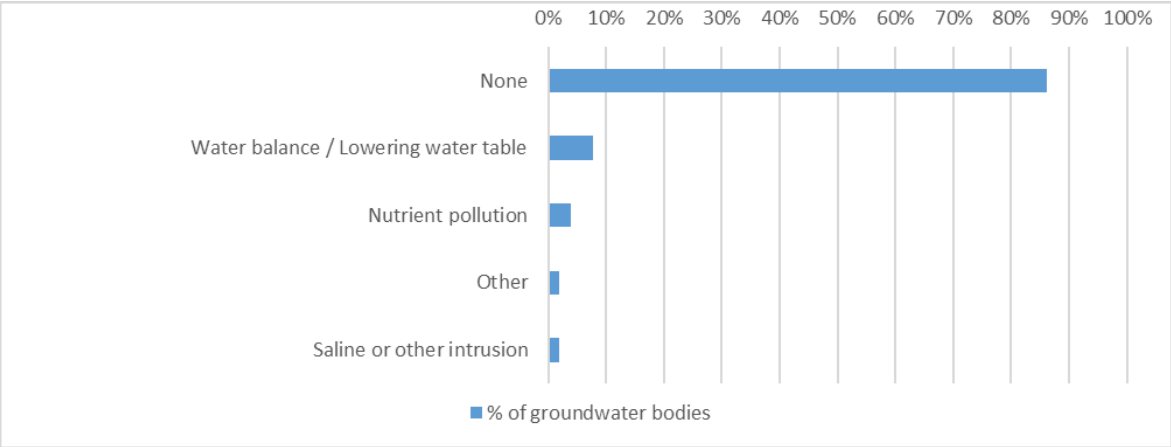
Significant impacts affecting the highest percentage of SWB are shown below in Figure 3. Nutrient pollution affects 41% of SWB, a slight decrease from 43 % in the 2nd RBMP. While organic pollution has seemingly slightly decreased since the 2nd RBMP, the percentage of SWB affected by altered habitats due to morphological and hydrological changes has increased. Only 24 % SWB are reported to be affected by no significant impact and for more than 10% the impacts remain unknown. It is, however, unclear whether these changes since the 2nd RBMP are the result of re-delineation of water bodies, or genuine change.

Figure 4. The most significant impacts on surface water bodies (SWB) in Croatia 2021 (expressed as percentages of numbers of water bodies)



As can be seen in table 6 below, Croatia considers that a large majority (86 %) of its groundwater bodies have been spared from significant pressures. Yet, it is recognised that 10% are affected by abstractions, nutrient pollution, and to a limited extent also saline (or other) intrusion. This is roughly comparable to the 2nd RBMP, when less than 10 % of GWBs were reported to be affected by nutrient pollution, saline pollution / intrusion and abstractions. The impacts on 18 newly delineated GWBs remains to be reported.

Figure 5. The most significant impacts on ground water bodies (GWB) in Croatia 2021 (expressed as percentages of numbers of water bodies)



Source: 3rd RBMP e-reporting

Croatia is a highly biodiverse country. Currently, 38.1% of Croatia's terrestrial territory is designated as protected areas, which is significantly above the EU value of 26.4%. Croatia counts approximately 200 terrestrial invertebrate species, 220 freshwater invertebrate species, 20 marine invertebrate species, and over 10 new freshwater fish species.

Croatia is predominantly characterised by two main types of ecosystems: forest ecosystems, which cover 51.8% of the country, followed by agroecosystems occupying 39.2% of the land area. While urban areas account for 4.5% and heathlands contribute to 3.4%, Croatia has relatively smaller proportions of rivers and lakes (0.8%) and wetland ecosystems (0.2%).

Farming in Croatia is done largely on small farms. However, the share of organic farming is around 7%, which is lower than the EU average. Besides abstractions, agriculture also exerts strong pressures on surface waters through nutrient pollution. The most significant impacts affecting the highest percentage of surface water bodies are actually nutrient pollution (affecting 41 % SWB).

Croatia has 28 hydropower plants. They are distributed in three production areas: North, West and South and they constitute a significant part of their energy mix.

Invasive alien species

Morphological changes affect 40 % of Croatia's surface water bodies. As regards other pressures, such as invasive alien species, they proliferate steadily in some of Croatia's Surface Water Bodies including for instance the bivalve species zebra mussel (*Dreissena polymorpha*), and the plant Canadian waterweed (*Elodea canadensis*).[5] Moreover, the invasive signal crayfish has spread from Austria through the Mura river into Slovenia and from there to Croatia. Also, the spiny-cheek crayfish has spread into Croatia from the Hungarian part of the Danube River.[6] While these invasive crayfish species still appear to be present in Northern Croatia[7], only, experience in other EU Member States suggest that they procreate very quickly. The invasive North American crayfish are resistant to the crayfish plague, which they carry, and gradually replace local crayfish species. They also endanger local fish populations.

[5] See The Nature Protection Strategy and Action Plan of the Republic of Croatia for the period 2017-2025, page 29, available at https://www.cbd.int/doc/world/hr/hr-nbsap-v3-en.pdf .
[6] (PDF) Update on the distribution of freshwater crayfish in Croatia (researchgate.net).
[7] These data form 2011 may, however, meanwhile be outdated. (PDF) Update on the distribution of freshwater crayfish in Croatia (researchgate.net)

3. Policy elements contributing to biodiversity and climate change adaptation

3.1 Surface Water: what is their ecological status or potential

Monitoring

Article 8(1) of the WFD requires Member States to establish monitoring programmes to assess the status of surface water and groundwater, in order to provide a coherent and comprehensive overview of water status within each RBD. The WFD distinguishes between surveillance and operational monitoring.[8]

Due to Croatia's late accession to the EU, the 2nd RBMP was still based on incomplete monitoring. Extensive investigative monitoring has been carried out in the period from 2016 to 2021 on about 195 new measuring sites providing data for a revision of the classification system of ecological status, biological quality elements, for the implementation of intercalibration procedures, as well as for development of a classification system of ecological potential for heavily modified and artificial water bodies. Hydromorphological monitoring was also carried out for the first time during the 2nd RBMP. In addition, the analysis of pressures and impacts improved and for the first time monitoring was revised in an intercalibration process.

This all resulted in a very different methodology and results. For example, the number of biotic types of rivers has increased from 28 to 35. As a result, the determination of ecological status in the 3rd RBMP is more akin to the approach used in other Member States and data now come closer to the real situation than the 2nd RBMP suggested.

Despite the significant improvements to monitoring, only 17.3% of the total length of Croatia's rivers and only 18.5% of the total length of Croatia's lakes are so far subject to surveillance monitoring to determine the ecological and chemical status. This is because most of Croatia's "smaller" water bodies are still not subject to *any* monitoring of ecological (or chemical) status. This is of concern as Croatia has an unusually large number of such smaller surface water bodies, that is rivers with a catchment area of less than 10 km^2 and lakes with a surface area that is less than 0.5 km^2. These smaller surface water bodies, however, make up 80 % of the total length of all recorded rivers and about 98 % of the total area of all recorded lakes.

[8] Surveillance monitoring is carried out for one year, once per six-year cycle and is mainly aimed at assessing impacts and long-term changes in natural conditions or resulting from anthropogenic pressures and is used for the purpose of designing future monitoring programmes. Operational monitoring is carried out throughout the cycle and aims mainly at establishing the status of bodies identified as being at risk of failing to meet their environmental objectives and assessing any changes in status resulting from the Programmes of Measures. All water bodies must be classified for ecological "status" or (if heavily modified) ecological "potential".

Table 5. Coverage of surveillance or operational monitoring

Ecological status		3rd RBMPs
River length %	Surveillance monitoring	17.3%
River length %	Operational monitoring	36.0%
Lake area %	Surveillance monitoring	18.5%
Lake area %	Operational monitoring	44.5%
Coastal length %	Surveillance monitoring	N/A
Coastal length %	Operational monitoring	N/A
Coastal area %	Surveillance monitoring	100.0%
Coastal area %	Operational monitoring	10.6%
Transitional length %	Surveillance monitoring	N/A
Transitional length %	Operational monitoring	N/A
Transitional area %	Surveillance monitoring	91.7%
Transitional area %	Operational monitoring	81.2%

Source: 3rd RBMP e-reporting

Where monitoring takes place, a comprehensive set of quality elements is being measured.

Table 6. Monitoring of quality elements for ecological status (per water body)

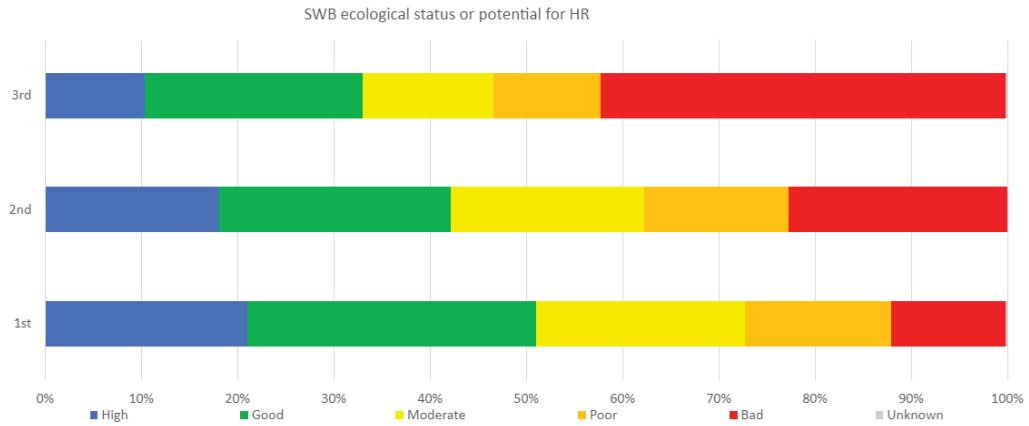
	Biological quality elements								Hydromorphological quality elements		
	Phytoplankton	Macrophytes	Phytobenthos	Benthic invertebrates	Fish	Angiosperms	Macroalgae	Other aquatic flora	Hydrological or tidal regime	Continuity conditions	Morphological conditions
Rivers	Yes (0.3%)	Yes (95.5%)	Yes (98.7%)	Yes (98.7%)	Yes (89.9%)	N/A	N/A	N/A	Yes (98.7%)	Yes (98.7%)	Yes (98.7%)
Lakes	Yes (78.0%)	Yes (89.0%)	Yes (99.1%)	Yes (93.6%)	Yes (99.1%)	N/A	N/A	N/A	Yes (100.0%)	N/A	Yes (100.0%)
Transitional	Yes (100.0%)	N/A	N/A	Yes (37.1%)	Yes (94.3%)	Yes (40.0%)	No	N/A	No	N/A	Yes (65.7%)
Coastal	Yes (95.1%)	N/A	N/A	Yes (74.1%)	N/A	Yes (75.3%)	Yes (95.1%)	N/A	No	N/A	Yes (95.1%)

Gap to Target

Croatia's gap to reach good ecological status, however, remains substantial, namely 66.9% SWB. Croatia does not expect that more than 33.1 % of its SWB will reach good ecological status already by 2027. By 2021, the number of SWB in good ecological status has dropped from 50% (1st RBMP) to 42% (2nd RBMP) and in the 3rd RBMP of 2021 to only 33.1%. The reasons for this deterioration

appear largely due to the methodological changes and stricter monitoring after the 2nd RBMP as opposed to a genuine decrease of water quality.

Figure 5. Ecological status or potential of surface water bodies in the 1st, 2nd and 3rd RBMPs



Source: 3rd RBMP e-reporting

Regrettably, the ecological status of surface water bodies in Croatia has continued to deteriorate steadily since the 1st RBMP (50%) and 2nd RBMP (42%). In the 3rd RBMP, merely 33% SWB are reported to meet the objective of good (or better) status and Croatia does not expect major improvements by 2027. As in the 2nd RBMP, main pressures remain discharges not connected to sewerage network, agricultural, transport and physical alterations (>50 % SWB) and the ecological status of SWB is also under pressure from water abstractions (7.9% SWB).

It is of concern that 100% of transitional water bodies and 100% of coastal water bodies failed the objective of good ecological status in 2021 with no prospect for improvement by 2027. Little progress has been achieved since the 2nd RBMP when it comes to identifying the "unknown" anthropogenic (man-made) pressures on coastal and transitional surface water bodies: pressures remain "unknown" for 23 of 35 transitional and for 77 of 81 coastal waterbodies although monitoring of transitional waters and coastal waters has improved since the 2nd RBMP.

3.2 Hydromorphological changes and artificialization (HMWBs and AWBs)

Table 7. Modifications of surface water bodies (2021)

Modifications	Rivers	Lakes	Transitional	Coastal
Heavily modified	**11%**	**57%**	**3%**	**5%**
Artificial	**11%**	**28%**	**N/A**	**N/A**

Equally striking is that, compared to the previous cycle, the number of heavily modified water bodies has almost doubled from 135 (2nd RBMP) to 256 (3rd RBMP). This is particularly evident for lakes from 0 (0%) to 62 (57 %) and less prominent but still significant for rivers from 120 (8 %) to 189

(11 %). On the contrary, the number of heavily modified transitional water bodies decreased from 11 (44 %) to 1 (3%), only heavily modified coastal water bodies remained 4 (5 %).

According to the 3rd RBMP and other publicly available sources, the methodological changes to the designation as HMWB are explained by the need to improve the methodology and consequently the designation of HMWBs, as the 2nd RBMP still contained (due to late EU accession) only proposed HMWB, based on the assessment of hydromorphological status, biological status and a limited analysis of the anthropogenic activities. The methodological changes led to an increase of HWMB because of more thorough analysis - a technical study for on the influence of the existing hydroelectric power plants on the hydromorphological state of the waters and consequently on designation of HMWBs and AWBs was made, a more thorough consideration of flood protection issues was performed and data on navigation use were used. However, more detailed information on agricultural use (irrigation, drainage) were not considered yet, thus further amendments of the HMWB methodology are to be expected.

Hydromorphological characteristics of surface water bodies concern the quantity and dynamics of water flow, the connection of surface water bodies to groundwater bodies, continuity of rivers, as well as river depth, river width and their variation in structure as well as the substrate of the riverbed structure of the riparian zone.

In Croatia, the regulation of watercourses and changes in the water regime represent a key threat to water-dependant habitat types such as river gravels, sand shores and muddy shores, karst watercourses with tufa-creating communities and tufa barriers, as well as all types of wet grasslands and floodplain forests. Coastal habitats are under strong pressures due to expanding construction areas.[9]

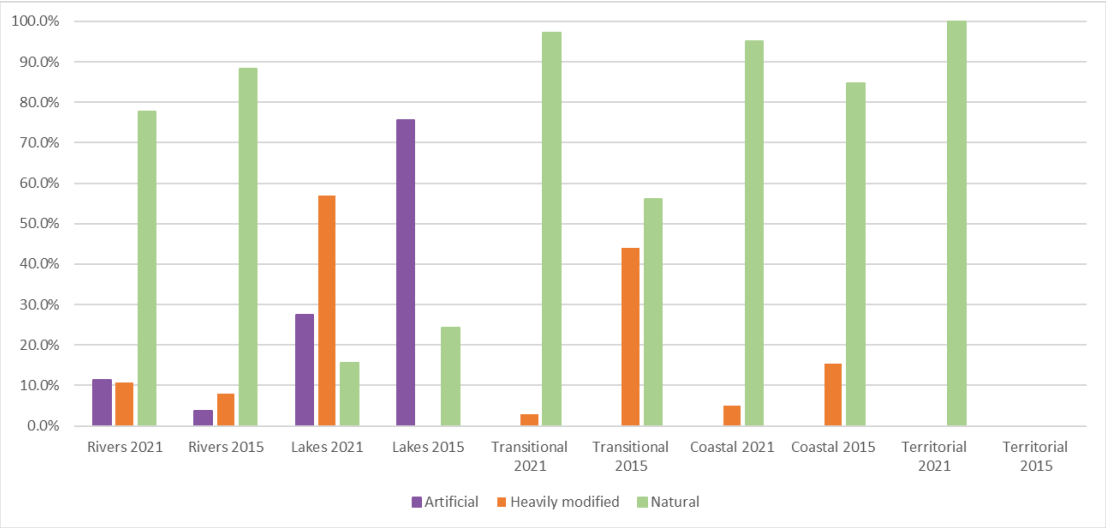
In the 3rd RBMP, Croatia defined 189 river bodies (11 %) and 62 lakes (57 %) as “heavily modified”. It is positive that Croatia successfully established a classification for the ecological potential of artificial and heavily modified water bodies. Croatia should now require operators of plants to implement projects that achieve this good ecological *potential* of artificial and heavily modified water bodies.

For all other water bodies, that is 56% SWB, the target remains “good ecological status”. Croatia must reduce pressures from all significant hydromorphological pressures reported in the 3rd RBMP for both RBDs (main drivers are agriculture, flood protection and hydropower).

The percentages of natural, heavily modified and artificial water bodies are shown Table 9 below. There have been overall increases in the number of surface water bodies since the 2nd RBMP. Due to the increases in the number of surface water bodies overall, a direct comparison of the distribution of numbers of water body designations since the 2nd RBMP is complex. Overall, very few lakes in Croatia are natural while comparatively few rivers have been heavily modified.

[9] Section 2.5.2. of Croatia’s Nature Protection Strategy and Action Plan for the period 2017-2025, available at https://www.cbd.int/doc/world/hr/hr-nbsap-v3-en.pdf.

Figure 6. Percentage of surface water bodies in Croatia designated as natural, heavily modified or artificial in 2nd (2015) and 3rd (2021) RBMPs, per water category



Source: 3rd RBMP e-reporting

3.3 Groundwater bodies - have they sufficient water – quantitative status

The number of monitoring sites for quantitative monitoring has increased from 143 in the 2nd RBMP to 217 in the 3rd RBMP. Furthermore, the number of groundwater bodies with quantitative monitoring has increased in absolute number, from 22 GWBs in the 2nd RBMP (out of 33 groundwater bodies in total) to 33 groundwater bodies in the 3rd RBMP (out of 51 groundwater bodies in total). Therefore, all previously delineated GWBs by the 2nd RBMP were covered with quantitative monitoring until 2021. The overall confidence in the assessment of the quantitative status of groundwater bodies has increased significantly since the 2nd RBMP. Hence, it can be concluded that Croatia's knowledge of the quantitative status of groundwaters has much improved.

Recharge of groundwater bodies has so far not been a problem in Croatia. While there were 1 out of 33 in the previous cycle, in the 3rd RBMPs, only 1 out of 51 groundwater bodies (i.e., 2.0 % of total groundwater bodies) fails to achieve good status. This difference emanates rather from a change in typology and delineation performed to achieve a more focused management of the waterbody found in poor quantitative status. It is worth noting that Croatia invoked an Article 4(4) exemption for this groundwater body which is also to two Natura 2000 areas, for which conservation objectives have not been set, because good status pursuant to the WFD was considered sufficient.

However, 5 groundwater bodies, that is roughly 10% of total groundwater bodies, are at risk of failing to achieve good quantitative status by 2027. This comprises four in the Danube RBD and one in the Adriatic RBD. The reasons quoted for this failure are: excessive water abstractions for the four GWB in the Danube RBD and saline intrusion for the one GWB in the Adriatic.

Hence there is an upward trend on pressures from abstractions affecting groundwater bodies. While in 2021 only 1 GWB (connected to Natura 2000 preserves) fails good quantitative status due to abstractions, there is now a risk that this number will further increase to 5 GWB (9.8%) by 2027. 4 GWB (7.8%) also missed the objective of good chemical status in 2021. Pollutants causing failure of groundwater to meet good chemical status are mainly nitrates but also saline intrusion. Croatia mapped measures to tackle nitrate pollution.

3.4 Protected Areas (identification, monitoring, objectives and measures)

Since the 2nd RBMP the number of protected areas in Croatia has changed. While Natura 2000 sites have increased, drinking water protected areas have slightly decreased. Croatia reported the following protected areas under the 3rd RBMP:

Table 8. Number of water bodies associated with protected areas in Croatia (2022)

Protected area type	Number of Water Bodies Associated with protected areas in					
	Rivers	Lakes	Coastal	Transitional	Territorial	Groundwater
Natura 2000 protected site	1130	75	71	26	1	33
Nitrate vulnerable zone	245	12	8	7		15
Sensitive area	1751	109	67	29	1	
Shellfish designated water			14	6	1	

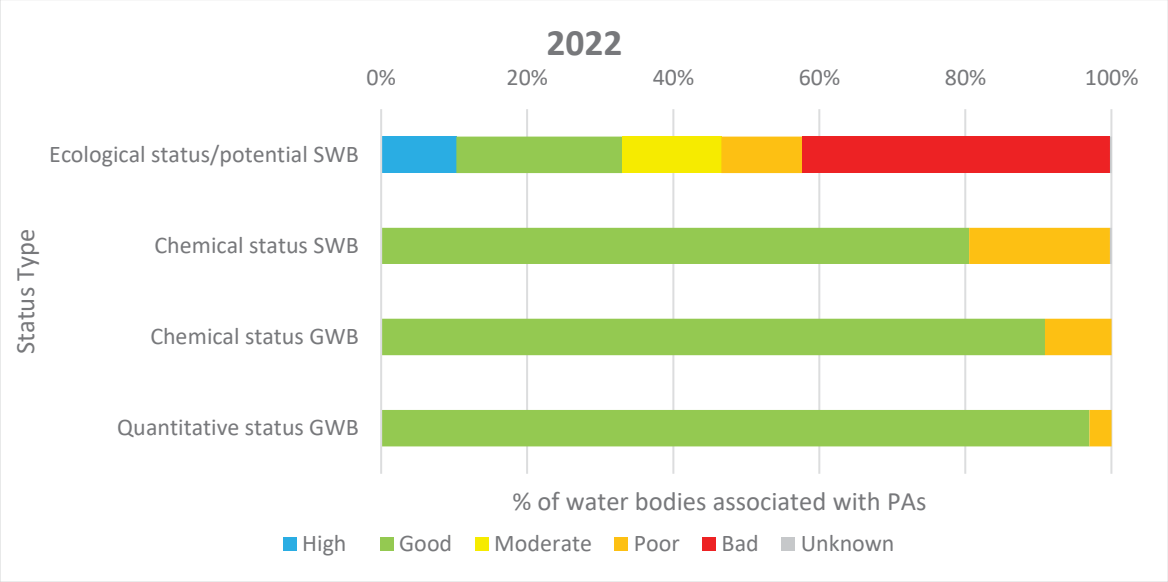
Source: 3rd RBMP e-reporting

Surface water and groundwater protected areas have been identified for all relevant Directives in Croatia. This includes protected areas under the WFD Article 7 drinking water protection zones, Bathing Water Directive, Natura 2000 sites (including Birds and Habitats Directives), Urban Waste Water Treatment Directive and economically significant aquatic species (under the now repealed Fish and Shellfish Directives). Croatia also identified Nationally Designated Areas (CDDA). The table below summarises the information reported by Croatia in the 3rd RBMP electronic reporting. Given the very large area under protection in the country and the rich biodiversity, Croatia has a particularly high number of surface water bodies whose quality has direct repercussions on the status of Natura 2000 sites, namely 1130 river water bodies and 76 lake water bodies.

Croatia has made progress with the monitoring of protected areas. Monitoring sites for surface waters associated with protected areas are reported for bathing waters, drinking water protection areas, freshwater fish designated waters, nationally designated areas (CDDA), Natura 2000 areas, nitrate vulnerable zones and sensitive areas. Monitoring sites reported for groundwater bodies include those associated with drinking water protection areas, nationally designated areas (CDDA), Natura 2000 sites. When compared with the monitoring sites identified in the 2nd RBMP it is apparent that the 3rd RBMP monitoring includes for the first time monitoring for bathing waters, freshwater fish designated waters, and for nationally designated areas (CDDA).

Regrettably, the number of surface water bodies connected to protected areas that feature good ecological status has decreased since the 2nd RBMP. While in the 2nd RBMP almost 20% of SWB connected to protected areas reached good ecological status, the 3rd RBMP reports less than 10% of SWB connected to protected areas to reach this objective. In a similar vein, the percentage of SWB linked to protected areas in "poor" status almost doubled from ca. 20% to slightly more than 40%. It is uncertain whether this decline is due to more accurate monitoring (and/or a change in the number of protected areas), or whether there has been an actual deterioration due to stronger pressures. The chemical status of SWB and GWB linked to protected areas is much closer to target (see below Figure 7).

Figure 7. Status of water bodies (SWB and GWB) linked to protected areas.



Source: 3rd RBMP e-reporting

3.5 What is being done to prevent/reduce hydromorphological pressures

In respect of surface water bodies that are subject to morphological pressures, Croatia reports operational measures in both RBDs.

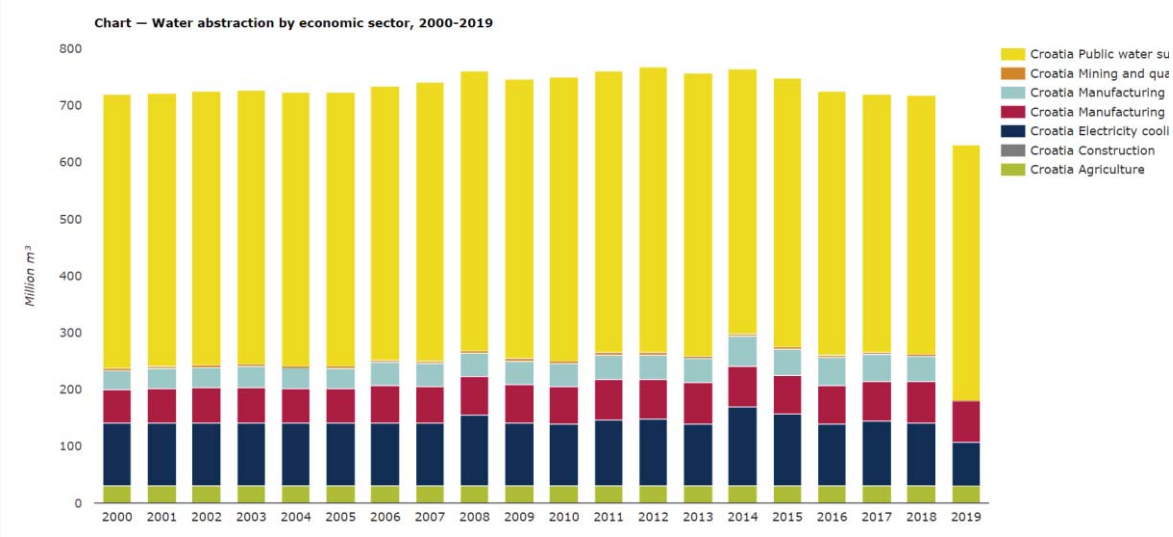
These operational measures include KTM 5 - "*Improving longitudinal continuity* (e.g. establishing fish passes, demolishing old dams)", KTM7 - "*Improvements in flow regime* and / or establishment of ecological flows", KTM 14 - "*Research*, improvement of knowledge base reducing uncertainty" and KTM 23 - "*Natural water retention measures*".

It is noteworthy that the large bulk of these measures still focuses on research of underlying issues and on improved monitoring. There are still relatively few technical measures that actually implement changes to reduce pressures (e.g.: creation of retention basins to capture the rainwater runoff in urban areas, measures to reduce impact on fish populations, limiting the potential alteration of water flow where permits are in place and the impacts of changes in flow regime). Yet, in view of Croatia's accession date, this backlog was to be expected. It is, however, regrettable that Croatia's measures will not go beyond improving *longitudinal* continuity only (i.e.: KTM 96 but not KTM6).

3.6 What Croatia is doing for abstractions and water scarcity

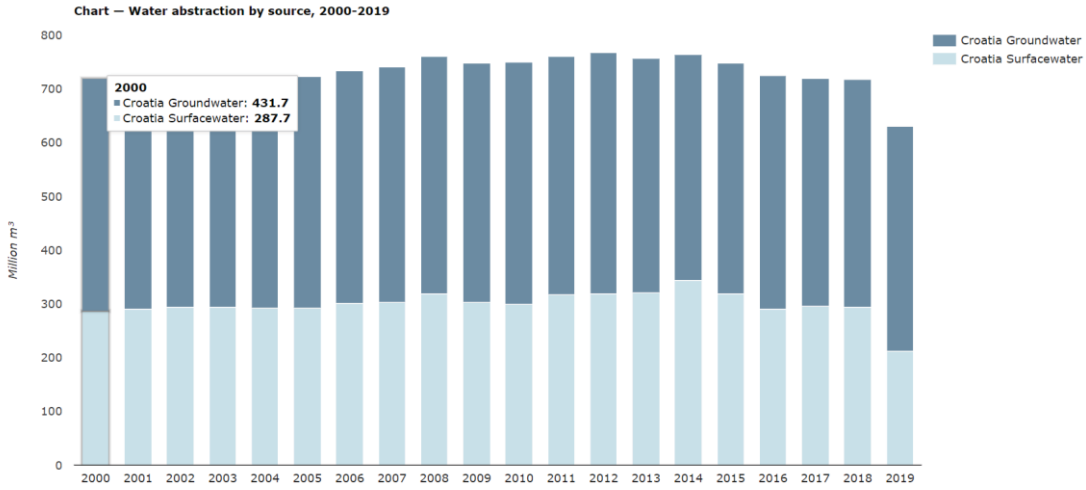
The 3rd RBMP does not specifically elaborate on issues of water scarcity. Water abstraction is, however, a significant pressure affecting 7.9 % of SWB failing to achieve good ecological status or potential. Most water is abstracted for public water supply, followed by the manufacturing sector. Table 16 shows the trends since 2000 (EEA data 2020).[10]

Figure 8. Water abstraction in Croatia by economic sector 2000-2019



Source: EEA Water abstraction index

Figure 9. Source of water abstraction in Croatia (2000-2019)



Source: EEA Water abstraction index

[10] Conventional statistic abstraction data of Eurostat, EEA and OECD exclude water disappearing after abstraction via leakages or evaporation from the surfaces of reservoirs and canals. Leakage and evapotranspiration losses can however be significant in MSs with many reservoirs and/or older distribution systems, as is illustrated by French data. Page 14, French analytical note on total water consumption (incl. evapotranspiration and losses) adding up to 54.000 million m3 abstracted, instead of 30.000 million m3 used: https://www.strategie.gouv.fr/sites/strategie.gouv.fr/files/atoms/files/fs-2024-na_136_enjeux_et_usages_de_leau_avril.pdf

According to Croatia's 3rd RBMP and reporting under the Drinking Water Directive, a significant volume of freshwater is lost between the point of abstraction and the point of use. The water losses in the public water supply system are estimated around 50 %. The average leakage rate for drinking water networks is 23% in the EU (2018). Croatia must significantly improve its water transportation and distribution network.

According to the Article 169 of Croatia's Water Act, a permit is required for any use of water going beyond personal needs/consumption, which is defined in Article 88 as "household use", "bathing", "sports" and "recreation". Users holdings abstraction permits are also obliged to keep records and must regularly report to Croatian Waters.11 Water rights permits shall be reviewed and harmonised within a RBMP planning cycle, that means every 6 years and can then be cancelled or revised as appropriate. The Water Act contains clear rules on the modification of permits. Permits for industrial water use/water rights define the location, place, method, conditions and scope of water use and are issued for a definite period, with the possibility to modify/restrict the approved conditions, if that is in public interest due to water regime modifications.

Permits for abstractions to drain land are for a period of 3 to 5 years. Permits for "public irrigation services" are equally for 3 to 5 years. Permits for "works" in public irrigation activities shall be for a maximum period of 20 years. "Public" irrigation services are activities for abstraction groundwater and surface water for the purpose of irrigating agricultural land through irrigation structures owned by regional self-governing bodies or mixed structures owned by the Republic of Croatia.12

Funded by Croatia's national Recovery & Resilience Plan 2021-2026, devices for measuring water abstractions at wells are gradually being implemented. However, it appears that so far mainly water abstraction sites in the public water supply sector carry such measuring devices, not necessarily also wells for agricultural irrigation. As far as the latter are concerned, Croatia estimates the quantities of water abstracted using as a proxy the size of agricultural land and an assumed water consumption per hectare per year.

Croatia has not yet defined let alone implemented ecological flows. Croatia, however, plans to develop e-flows as part of its measures under the 3rd RBMP. Ecological flows are considered within the context of the WFD as "an hydrological regime consistent with the achievement of the environmental objectives of the WFD in natural surface water bodies as mentioned in Article 4(1)". 13 The lack of established e-flows is not only problematic for the ecological status of surface water bodies (as fish and invertebrates need sufficient flows to survive), but also matters as e-flows in surface waters depend on the quantitative status of groundwater bodies.14 Prior to granting water abstraction permits from surface and ground water bodies, Croatia must therefore know the e-flows for surface water bodies, to assess whether the permission to abstract water could endanger the ecological status of surface water bodies.

The respect of e-flows will also ensure that Croatia is better prepared to address future water scarcities, by anticipating the need to timely adapt water abstraction permits for surface and ground

[11] RBMP until 2027, page 422.
[12] The Water Act also foresees that companies, cooperatives and associations can be formed for the construction, management and maintenance of irrigation systems which are in the interest of multiple stakeholders. OG 66/19, 84/21, 47/23; Zakon o vodama (nn.hr).
[13] See CIS Guidelines no 31 *Ecological flows in the implementation of the Water Framework Directive*
[14] The long-term annual average rate of abstraction from groundwater must not exceed the "available groundwater resource". The "available groundwater resource" (Articles 1 (27) WFD) is defined by reference to the "long-term annual rate of flow" required "to achieve the ecological quality objectives for associated surface water bodies".

water bodies under pressure. This will be particularly important for the Adriatic RBD which is drier than the Danube RBD and is more vulnerable to droughts.

Although the 3rd RBMP includes measures to improve metering, monitoring, control and use of rainwater, there is no consideration of temporary restrictions to abstractions. Furthermore, no definition of water scarcity is offered, nor any indication that modelling of future water scarcity is taking place.

Due to climate change, water scarcity conditions may also aggravate in the country, as indicated by the Danube Climate Change Adaptation Strategy developed and updated by ICPDR. It is therefore welcome that Croatia plans to develop of a Drought Management Plan in the future.

3.7 Adaptation to climate change

As regards flood risks, climate change impacts on flooding were not yet considered in Croatia's first FHRMs due to unreliable data. Over the last few years, however, there has been significant progress in climate change modelling. This has resulted in the inclusion of climate change impacts in Croatia's flood modelling of coastal areas which are recognised as most endangered regarding climate change.

Croatia's FRMP identifies two key challenges of climate change: sea-level rise and increased frequency of urban flooding due to storms. The plan moreover identifies key areas expected to face a significant increase in flood risk due to climate change, and provides a map of these areas[15]. All areas at increased risk are located in the Adriatic UoM (HRJ). It also provides estimates of the total square kilometres of area facing a significant increase of flood risk[16]. The second FRMP indicates that the remaining areas of the country face a moderate increase of flood risks. Consequently, there is no area where climate change impacts on flood risk can be ignored. The plan identifies responses to address the two climate challenges, including: capacity-building in research and management; development of structural and non-structural measures; implementation of integrated water management measures; and strengthening the protection of freshwater and marine systems to protect them from climate impacts and for adaptation purposes. The first FRMP assessment recommended integrating ongoing studies of potential impacts of climate change into new FRMP. That recommendation has been fulfilled. The second FRMP also takes a more in-depth approach to addressing climate change impacts, building on Croatia's 2020 Climate Change Adaptation Strategy and the 2019 interpretation of climate change analysis for water management planning and incorporating some of their measures.

As regards droughts and water scarcity, Croatia's 3rd RBMP builds upon the conclusions, recommendations and measures of Croatia's national Climate Change Adaptation Strategy 2020-2040. However, there are limited details on how the national strategy has informed the RBMP's development (the selection of measures relevant for climate change adaptation and how any analyses on the impacts of climate change on water bodies have been utilised).

Climate change adaptation measures have been included in the RBMP, building upon the conclusions, recommendations and measures for the water sector from the Climate Change Adaptation Strategy 2020-2040 (with a perspective to 2070). The Strategy was used to assess against climate change impacts under four scenarios. [17]

[15] Section C.5, Figure C.14.
[16] Section C.5, Table C.21.
[17] Ministry of Economy and Sustainable Development (2020) Climate Change Adaptation Strategy in the Republic of Croatia for the Period Until 2040, With a View to 2070. https://www.voda.hr/sites/default/files/dokumenti/PUVP3%20-%20OUE%20-%200008.pdf

Climate change adaptation measures included in the RBMP include research[18], monitoring (upgrades of monitoring of groundwaters in Danube RBD and Adriatic RBD in order to improve monitoring of climate change impacts), and educational aspects (spatial planners and civil engineers specialised for water infrastructure on new trends and climate change adaptation solution of urban water systems). In addition, measures to improve water retention capacity to reduce pressures on sewage systems (nature-based solutions) are included. A climate proofing of measures is foreseen during implementation.

Croatia does not define the concept of "water scarcity" or "droughts" in the RBMP or a DMP which makes planning ahead more difficult. However, a drought management plan is under development.

Studies undertaken by the United Nations suggest that a sea level rise of more than 80 cm would have a pronounced effect on Croatia's coastal areas by increasing risks of inundation and surge flooding, affecting in particular islands and coastal areas where erosion is taking place. For instance, existing sand and gravel beaches could be inundated. In some locations, projected sea-level rise might also affect the groundwater supply for agricultural irrigation.[19]

It is welcome and good practice that Croatia considers climate adaptation measures which imply hydromorphological changes to surface or groundwater bodies only after an environmental Impact assessment.

4. Policy elements contributing to zero pollution

4.1 Surface Water: what is their chemical status

Monitoring

Croatia successfully improved the scale of its monitoring network to support the chemical status assessment since the 2nd RBMP. The 3rd RBMP suggests that the monitoring network now covers around 40 % of all water bodies nationally, including much greater coverage of both rivers and lakes. Croatia in particular booked progress as the 3rd RBMP now reports that all 45 priority substances are included in monitoring, whereas in the previous reporting cycle only 29 out of (then) 33 priority substances were included, with polybrominated diphenyl ethers (PBDEs), short-chain chlorinated paraffins, tributyltin, and trifluralin being missing substances. All four missing substances along with the 12 new substances added to the priority substances list in 2013 have been added to the monitoring programme for the 3rd RBMP.

Croatia also takes credit for including more priority substances in the inventories of each RBD. While in the 2nd RBMP, only 6 of the 41 Priority Substances were included in inventories of each RBD, the electronically reported data for the 3rd RBMP now contain emissions inventories for 53 chemical substances in the Danube RBD and for 54 chemical substances in the Adriatic RBD.

Croatia has, however, made comparatively less progress with identifying the source of pressures on transitional and coastal water bodies. Regrettably, anthropogenic (man-made) pressures remain unknown for 23 out of 35 transitional water bodies and for 77 out of 81 coastal water bodies.

[18] Modelling of the relationship between climate groundwater status; modelling of the relationship between groundwater and sea level rise; assessment of climate change impact on change of abiotic and biotic characteristics of water ecosystems in Protected Areas and Natura 2000 network).
[19] See Potential Implications of Sea-Level Rise for Croatia by Ante Baric, Branka Grbec, and Danijela Bogner Institute of Oceanography and Fisheries, Split, Croatia available at untitled (unizd.hr).

Status

The 3rd RBMP reports an increase in the number of water bodies failing to achieve good chemical status across all categories. It appears that chemical status results steadily decreased as Croatia's monitoring improved. There is notably a pronounced deterioration of the chemical status of transitional and coastal waters, where the precise anthropogenic pressures remain unknown.

Figure 10. Chemical Status SWB in Croatia 1st, 2nd and 3rd RBMP

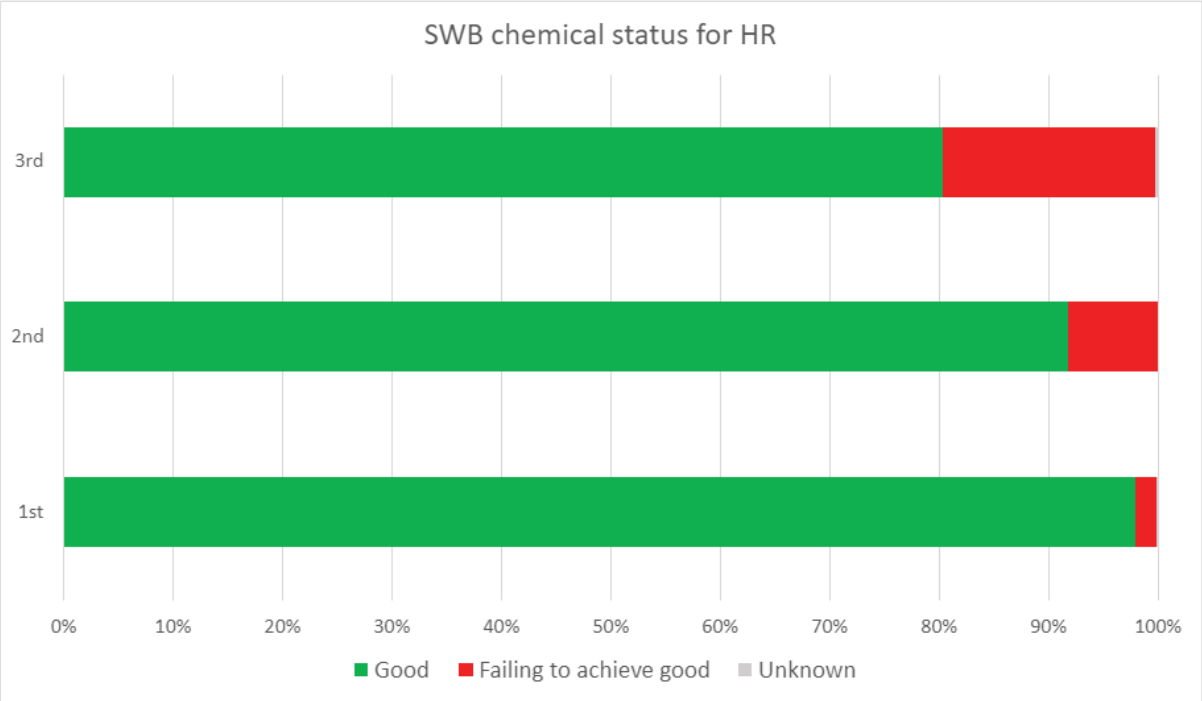
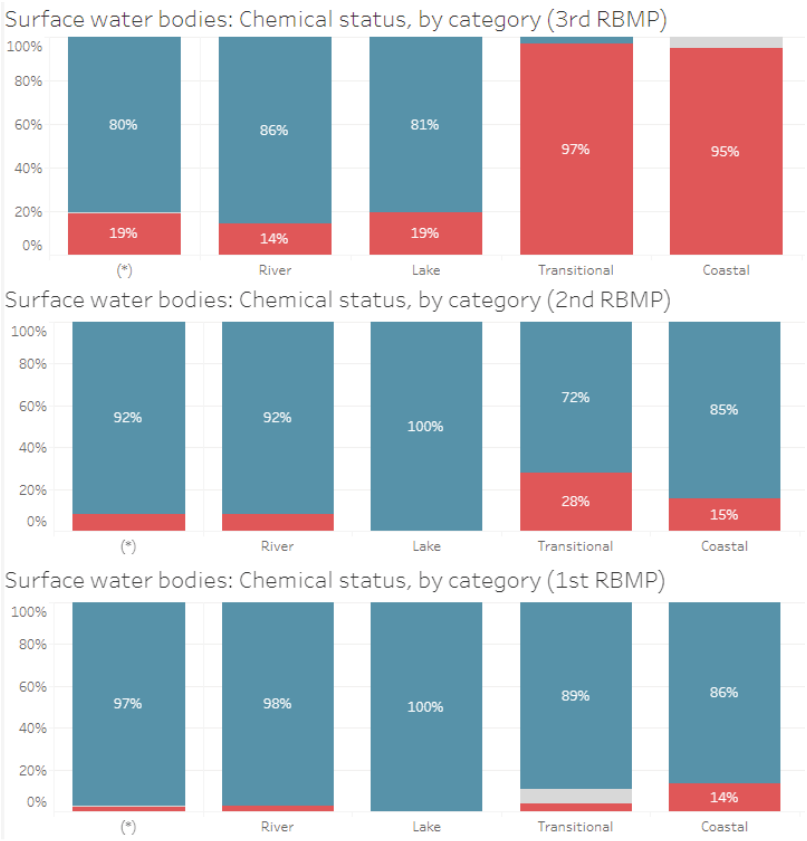


Figure 11. Number of SWB in Croatia in good status 1st, 2nd and 3rd RBMP
blue = good status; red = not in good status (including unknown status)



Source: WISE electronic reporting.

Croatia reported that - in addition to other sources of pollution – it is agricultural pollution that causes 1112 out of 1978 surface water bodies to fail good chemical status in the 3rd RBMP (see below section 4.3.).

Compared to the 2nd RBMP, the lower values for good status of rivers and lakes are apparently due to Croatia's ability of measuring now also ubiquitous persistent bioaccumulative and toxic (uPBT) substances, namely polybrominated diphenyl ethers (PBDEs) and perfluorooctane sulphonic acid (PFOS), which had apparently not been monitored in previous RBMP cycles.

Similarly, the pronounced deterioration of the chemical status of transitional and coastal waters is due to these uPBTs as well as due to the uPBT Tributyltin (TBT), a biocide in anti-fouling paint, commonly known as bottom paint, applied to the hulls of oceangoing vessels to poison organisms that otherwise end up settling. When TBT accumulates in sediments, its half-life is about 2 years. However, TBT often bonds to suspended material and sediments, where it can remain and be released for up to 30 years. TBT was globally banned on ship hulls from 2003 onwards, only.

While Croatia's biodiversity assessment under the Marine Strategy Framework Directive (MSFD) is still evolving, the Good Environmental Status (GES) Decision for Croatia of 2018 adopted under the MSFD reported some values for birds. These data seem to suggest that around 2/3 of surface feeding

birds in Croatian territorial waters are not in a good environmental status.[20] This could be due to the bad chemical status of Croatia's transitional and coastal waters, as reported in this RBMP cycle.

Croatia does not expect that more SWB can achieve a good chemical status until 2027.

4.2 Groundwater Bodies: what is their chemical status

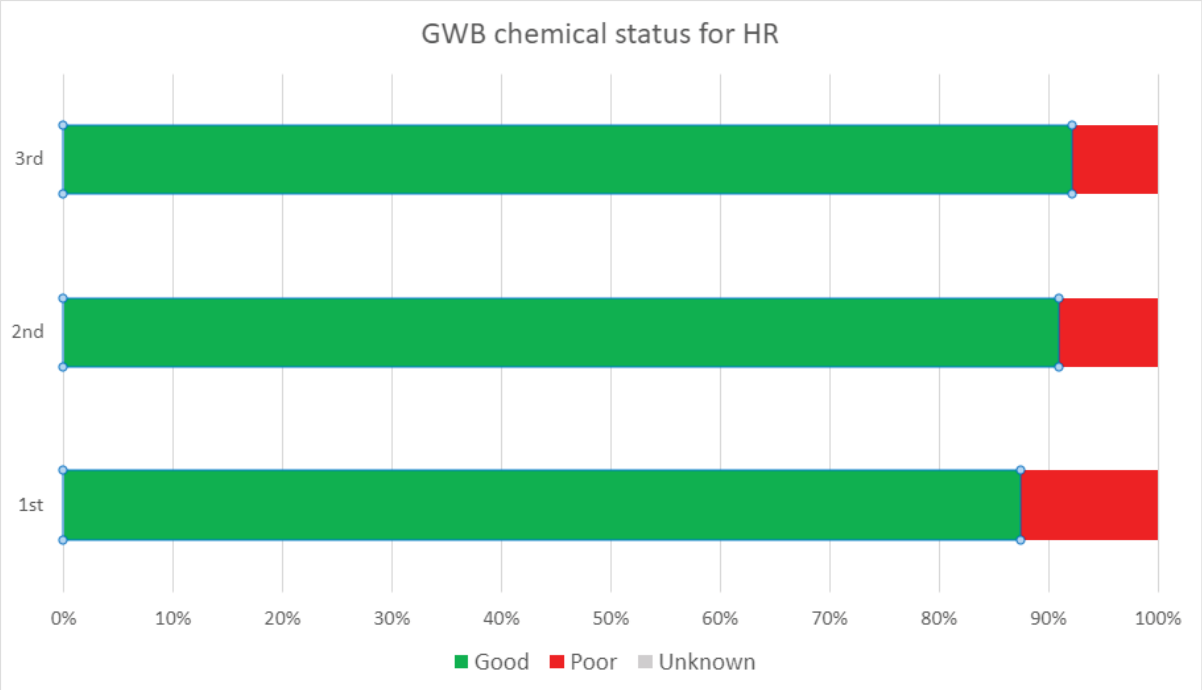
Monitoring

64.7% of Croatia's GWBs are subject to chemical monitoring (33 out of 51) which compares to 84.8 % GWBs in the 2nd RBMP. Note, however, that the numbers for the 3rd RBMP do not yet include the 18 newly created GWB.

Status

In the 3rd RBMP, 47 out of 51 GWBs reported in total (i.e., 92.2 % of total groundwater bodies) have been in good chemical status and 4 GWBs (i.e., 7.8 % of total GWBs) have been in poor chemical status by 2021 (see Figure 12). Croatia does not expect improvements until 2027. In the 2nd RBMP, 3 out of 33 GWBs reported in total (i.e., 9.1 % of total GWBs) were in poor chemical status by 2015. Note that the number of GWB increased significantly between the 2nd and 3rd RBMP and that the assessment of 18 GWBs was outstanding at the time of reporting the 3rd RBMP.

Figure 12. Chemical status of ground water bodies in the 2nd and 3rd RBMP



Source: 3rd RBMP e-reporting

There are three pollutants (or indicators of pollution) causing failure to achieve good chemical status of GWBs, namely nitrates, water temperature and electrical conductivity. Electrical conductivity is the indicator of pollution causing failure to achieve good chemical status in the GWB which is affected by saline intrusion. Water temperature is the indicator of pollution causing failure to achieve good

[20] These numbers shoud be treated with caution, though, as Croatia's reporting under the MSFD is still evolving. See the MSFD Dashboard at Good Environmental Status (GES) assessments by EU Member State and Descriptor (europa.eu).

chemical status in one GWB. The 3rd RBMP does not elaborate on the origin of this failure and the specific measures taken to address it. For the other 2 out of these 3 GWBs failing to achieve good chemical status due to the general water quality assessment, the failure is caused by pollution with nitrates.

4.3 What Croatia is doing to combat pollution from agriculture

As set out above, Croatia's gap to achieve a good ecological status of its surface water bodies is very substantial, namely 66.9%. Agricultural pressures contribute to a significant amount to the magnitude of this gap. The 3rd RBMP reports that 2 out of 51 GWBs fail good status due to nitrate pollution from agriculture. For surface water bodies, it is reported that 1112 out of 1978 surface water bodies fail status due to diffuse agricultural pollution. Croatia's 3rd RBMP refers in particular to agricultural pressures on water quality due to the use of manure and mineral fertilisers as well as pesticides; runoff from livestock grazing is also noted.

The focus of the 3rd RBMP's measures for nitrates pollution is on support for investments for compliance (manure storage and its management) and adjusting of the agricultural practices both in terms of the technology / techniques used and management practices. Croatia has mapped 12 basic measures to reduce nutrient pollution from agriculture as well as 8 supplementary measures. These include, for instance, compliance with standards for the storage and use of manure on farms through the construction of manure tanks; measures to reduce the use of mineral and organic fertilisers; implementing agrotechnical measures, such as crop rotation and improving the methods of applying mineral fertilisers as well as organic fertilisers; intensify the supervision of the implementation of Good Agricultural and Environmental Conditions (GAECs) especially in the part related to the reduction of the use of mineral and organic fertilisers; In areas with intensive agricultural production, plan and encourage the establishment of windbreaks in order to reduce the impact of wind erosion on soil and water. Croatia has reported that KTM2 measures should be applied on around 12,000 km^2 of the area, which is about twice the surface area of Croatia's Nitrates Vulnerable Zones (NVZs).

Geographically, the focus of the measures in the RBMP is on Nitrates Directive vulnerable zones and areas outside where the WFD-objectives are likely not going to be met, with the ambition to later expand across the country. There is, however, no information on the gap between the current use of pesticides and the reduction needed to achieve good status (electronic RBMP reporting does not include any gap in relation to pesticide pollution).

The RBMP includes measures to address agricultural pollution, but the 3rd RBMP does not include an assessment of the expected effects of the planned measures and how far they will contribute to closing the gaps. The measures are generically described, and it is reported that they should be applied to all agricultural areas. Based on the reported information, and notable the lack of information and assessment of the expected effects of the planned measures, it is not possible to assess the expected progress of the 3rd RBMP in relation to reducing pollution from agriculture and close the gap towards compliance with the WFD objectives.

4.4 What Croatia is doing to combat pollution from other sectors

To reduce pressures, Croatia has mapped KTMs for the identified pressures from pollution in sectors other than agriculture. These KTMs include:

- KTM1 – "Construction or upgrades of wastewater treatment plants";
- KTM14 – "Research, improvement of knowledge base reducing uncertainty";

- KTM15 – "Measures for the phasing-out of emissions, discharges and losses of Priority Hazardous Substances or for the reduction of emissions, discharges and losses of Priority Substances";
- KTM16 – "Upgrades or improvements of industrial wastewater treatment plants (including farms)"; and
- KTM21 – "Measures to prevent or control the input of pollution from urban areas, transport and built infrastructure".

Basic measures to reduce point source discharges include a multi-year programme for the construction of urban wastewater infrastructure for the period up to 2030 with the objective to achieve full compliance with the Urban Wastewater Treatment Directive. Agglomerations larger than 15000 population equivalent regardless of the sensitivity of the receiving waters are identified as priority for measures to be implemented, except for agglomerations of 15000 - 50000 p.e. in touristic areas where wastewater is discharged into the sea that has not been declared to be a sensitive area. In relation to the pollution from industrial sources, Croatia reports that 12 measures address industrial pollution, including measure 3.0SN.05.13 related to compliance with industrial wastewater discharge standards, a measure already foreseen in Croatia's 2nd RBMP. There are 11 measures (ten basic and one supplementary) which are dedicated in the Programme of Measures to prevent or control the input of diffuse pollution from urban areas, transport and built infrastructure, and forestry. Most (six) of these are a continuation of measures from the 2nd RBMP, whilst five measures were introduced on the basis of the SEA Report for the RBMP. Overall, 10 of the measures are going to be implemented in both RBDs. The only exception to this is measure 3.0SN.06.13 for establishing a Registry of Marine Litter, which will be implemented in the Adriatic RBD. There is no information on whether Croatia expects these measures to be sufficient for achieving the objectives.

11 measures aim at preventing and/or controlling the input of pollution from urban areas, transport and built infrastructure. 6 of these 11 measures continue measures of the 2nd RBMP, whilst the following 5 measures are new:

- monitoring of pesticides in forestry;
- control of pesticides for forestry in inundation and retention areas;
- prepare a methodology for assessing emissions from landfills into water;
- control of herbicides and retardants used for maintenance of railway corridors;
- encourage the implementation of green infrastructures to solve the problem of surface runoff from urban areas[21]

The majority of the measures will be implemented in both RBDs, only one measure for establishing a registry of marine litter is specific to the Adriatic RBD.

This all suggests that Croatia is on the right track to tackle pressures on the chemical status of SWB and GWB from sources other than agriculture. A notable exception are pressures on coastal and transitional water bodies. The 3rd RBMP also does not explain to which extent measures can exactly close the gap. This all should be improved in the next cycle.

To reduce pressures at the coast, Croatia must also both look inland (agriculture) and at tourism and lack of urban infrastructures. I particular the coastal region around Split has been known to be one of the most polluted areas of the eastern coast of the Adriatic. The environmental pollution has been a consequence of fast industrialisation and urbanisation without development of appropriate urban

[21] During rain, storms, and other precipitation events, these surfaces (built from materials such as asphalt and concrete), along with rooftops, carry polluted stormwater to storm drains, instead of allowing the water to percolate through soil.

infrastructures. The existing wastewater treatment plants in this region still do not meet EU requirements and lack adequate purification capacity. Discharge of untreated wastewater into the sea has been observed.[22]

4.5 What Croatia is doing to combat significant pressures – overall assessment of the Programmes of Measures

The overall assessment of Croatia's Programem of Measures under the 3rd RBMP is positive, as Croatia achieved a number of significant improvements since the 2nd RBMP. In the 3rd RBMP e-reporting, Croatia mapped measures in both RBDs against all KTMs and basic and specific measures are listed in great detail.

It is unclear why Croatia omitted to map KTM 19 ("*measures to prevent adverse impacts of recreation*") to reduce pressures on the ecolgical status of coastal and transitional water bodies. Croatia's coastline is affected by mass tourism and this pressure can grow. For instance, KTM 19 could address pollution of coastal waters by cruise ships. 100% of Croatia's coastal and transitional water bodies fail good ecological status.

Gap analyses are presented for all significant pressures, with quantitative pressure indicators and measure indicators and gap values for 2022, but no gap analsys has been presented for 2027. Information is also presented for groundwater bodies with pressure indicators, measure indicators and gap values for 2022. No gap analysis has been presented for 2027.

Some elements are still missing though, in particular the use of cost effectiveness and the prioritisation of measures. Croatia has reported estimated funding requirements from national and EU funds for the implementation of measures. However, no details are provided confirming whether this funding has been secured.

5. Exemptions and economics

5.1 To what extent are exemptions applied in Croatia

Croatia invoked the exemption of Article 4(4) WFD which allows Member States more time if all necessary improvements in the status of bodies of water cannot reasonably be achieved within the timescales set out in article 4 (4) WFD for reasons of technical feasibility, disproportionate cost or natural conditions of the water body. Croatia used all three reasons to justify non- compliance with Article 4 WFD objectives. To the contrary, Croatia did not invoke exemptions according to Article 4(5), Article 4(6), 4(7) WFD and Article 6(3) of the Groundwater Directive.

As regards surface water bodies, for the ecological status, Article 4(4) exemptions have been applied in relation to 105 surface water bodies (5.3 % of surface water bodies) on the grounds of natural conditions and in relation to 1406 surface water bodies (71.7 % of SWBs) on the grounds of disproportionate costs. For chemical status, Article 4(4) exemptions have been applied in relation to 158 surface water bodies (8% of surface water bodies) on the grounds of technical feasibility and in relation to 216 SWBs (10.9 % of surface water bodies) on grounds of disproportionate costs.

[22] https://ec.europa.eu/regional_policy/en/projects/croatia/water-infrastructure-in-croatias-split-solin-agglomeration-to-be-upgraded.

As regards groundwater bodies, for 1 groundwater body (2 %), Article 4(4) exemptions have been applied in relation to the failure to achieve good quantitative status on the grounds of technical feasibility, natural conditions and disproportionate costs (same groundwater body). For chemical status, exemptions have been applied in relation to 1 GWB (2 % of GWBs) on the grounds of natural conditions and in relation to 3 groundwater bodies (5.9 % of groundwater bodies) on the grounds of both technical feasibility and disproportionate costs (same groundwater bodies).

Regrettably there seems to be no detailed information at the water body level clarifying how each of these exemptions have been justified. Thus, the Commission cannot conclude whether these exemptions have been lawfully applied.

It is of note that Article 4 (4) c WFD limits exemptions according to Article 4 (4) WFD to "two further updates" of the river basin management plans except in cases where natural conditions are such that the objectives cannot be achieved.

Croatia joined the European Union on 1 July 2013 and its first cycle lasted from 2012 – 2015 with the first RBMP published in 2016. This is only Croatia's second cycle of the RBMP (Croatia's RBMP is being referred to as "3rd" RBMP to align with the terminology used for all other MS I the present cycle). This means that the possibility for Croatia to exempt from Article 4 objectives according to Article 4 (4) WFD expires at the very latest with Croatia's next RBMP, i.e.: by 2033.

5.2 Use of economic analysis and water pricing – cost recovery

Croatia's 3rd RBMP includes a chapter on economic analysis. There is a global presentation of pricing schemes. Price differences exist between the two RBDs reflecting differences in financial costs of providing water services. Water fees and tariffs are set and regulated by the Croatian Government. Croatian Waters are in charge of calculation and collection of the tariffs.

Water services as well as uses with significant impact on water bodies have been clearly identified. The reporting of financial cost consists of costs totals for the broad water services, drinking water supply and sanitation services, as well as for irrigation services, at basin and sub-basin level. Water pricing schemes are presented in a transparent way, but neither adequacy of neither price incentives nor of the contribution of different users and polluters is explained.

The 3rd RBMP foresees two types of investments, namely investments in water supply and wastewater collection and treatment that could be funded by economic instruments[23] and investments in improvement of costing[24]. The latter include the introduction of individual metering[25] and setting up various IT tools, such as improved management benchmarking[26], a system for economic analysis with clear reporting requirements[27], and setting up the system for economic analysis that could be used for development for water policy, analysis and projections of "tariffs" of users for different governmental decisions[28].

It remains generally uncertain how much funding has actually been secured already and which measures in the 2nd RBMP have meanwhile been implemented.

[23] 3rd RBMP chapter on economic analysis, 3rd RBMP, pp. 376-379.
[24] 3rd RBMP, summary programme of measures, pp. 405-407.
[25] Measure 3.0SN.01.08 of implementation of the programme of introducing individual water meters, a continuation of a measure from 2nd RBMP.
[26] Measure 3.0SN.01.06.
[27] Measure 3.0SN.01.09.
[28] Measure 3.0SN.01.17.

6. WFD recommendations

Recommendations: Croatia should

1. Accelerate action and enhance the overall level of ambition for restoring to good ecological status (natural water bodies) or good ecological potential (heavily modified water bodies) all rivers, lakes, transitional and coastal water bodies. This presupposes that Croatia:
    a) conducts a more comprehensive gap assessment for diffuse pollutant loads from agriculture (nutrients, agri-chemicals, sediment, organic matter) across waters in RBDs and links them clearly and directly to mitigation measures in the 3rd RBMPs (as per WFD Article 11(3)(h)), to facilitate the achievement of WFD objectives; and
    b) adopts and implements a legally binding standard for establishing the volume and rate of flow in surface water bodies ("ecological flows" - see also CIS Guidance Document no. 31) within the meaning of Article 8 (1) first indent (i) WFD (in coordination with transboundary river basin authorities of other neighbouring countries) linking also water abstraction permits to the respect of e-flows; and
    c) adopts and implements a legally binding standard for the ecological potential of river stretches that are qualified as "heavily modified" within the meaning of Article 4 (7) WFD;
    d) maps and commits funding for concrete measures to improve the longitudinal continuity of rivers that are under pressures from dams, physical alteration of channel/bed/riparian area/shore, and other forms of hydrological alterations. There should be a concrete timeline for such measures with funding commitments following a cost effectiveness analysis of alternative options.; and
    e) maps measures under KTM 19 to prevent adverse impacts of recreation (mass tourism, cruise ships) affecting Croatia's coastal and transitional water bodies;
    f) maps measures to curb pressures from saline intrusion into ground water bodies;
    g) monitors and contains more aggressively invasive alien species and in particular adopt measures to constrain the spreading of North American crayfish; and
    h) Implements all programmed amounts for sustainable water management and climate adaptation under the Cohesion Policy 2021-27.
2. Moreover, to reach objectives for the chemical status of Croatia's surface and groundwater bodies, Croatia should increase its ambition to:
    a) Enhance and upgrade wastewater treatment such that no more wastewater is being released into surface or ground water bodies without being processed, and particularly so in the region around Split and Solin;
    b) Reduce nitrates beyond measures required under the Nitrates Directive where necessary to meet WFD objectives by adopting more nutrient related measures funded under the Common Agricultural Policy such as broader buffer strips for arable land that is being farmed with pesticides; and
    c) Identify and curb remaining point sources of pollution for ubiquitous PBTs such as mercury and brominated diphenylethers as well as PFOS; monitor specifically whether uPBT Tributyltin (TBT), a biocide in anti-fouling paint, still originates from the bottom paint of certain ship

hulls and more controls of ships and boats in Croatia's harbours should be conducted to verify if boats still carry TBT on their hulls (and if so order their owners to remove it at their cost); pollution from uPBT mercury can be addressed by reducing combustion processes in traffic and heating of houses.

3. On the use of economic tools, Croatia should apply the polluter pays principle more consistently and consider better pricing of water related service according to Article 9 WFD where public funding or other WFD tools are not enough to achieve good status or good potential of water bodies; this applies in particular for measures to enhance river continuity and wastewaters and point pollution from industrial plants and large agricultural plants.

4. As regards adaptation to climate change, it is recommended that Croatia:

    a) reduces water abstractions as significant pressure affecting 7.9 % of SWB failing to achieve good ecological status or potential by adapting water abstraction permits; reduce remaining carve-outs for "non-significant abstractions" from permitting where needed to achieve a good status; step up monitoring to curb unauthorised abstractions;

    b) reduces water losses in the public water supply system estimated at ca. 50 % which is roughly twice as much the average in the European Union,

    c) Addresses more proactively the increasing risk of salinisation of groundwater bodies in coastal areas due to sea level rise by curbing abstractions from these ground water bodies; it is also recommended to exchange best practices with other EU Member States in similar situation like Portugal, Spain or The Netherlands.

5. As regards Croatia's progress with applying the Water Framework Directive, Croatia should in the next cycle of River Basin Management Planning in particular

    a) Analyse and report pressures on the 18 newly delineated Ground Water Bodies

    b) Step up efforts to identify the originators of anthropogenic pressures which remain "unknown" for 23 out of 35 transitional and 77 out of 81 coastal water bodies, which is very problematic in view of the fact that 100% of Croatia's transitional water bodies and 100% of its coastal water bodies failed the objective of good ecological status in 2021 with no prospect for improvement by 2027; Croatia should amongst others assess the impact of mass tourism and of pollution caused by cruise ships as well as pollution caused by insufficient wastewater treatment on smaller coastal islands and in touristic coastal regions; measures should then be taken to reduce these anthropogenic pressures significantly;

    c) Link measures more specifically to problems in the gap analysis as regards diffuse pollutant loads (nutrients, agri-chemicals, sediment, organic matter) from agriculture and include in particular an analysis of pesticides in order to quantify the gap needed to achieve good status and add data on the gap to its electronic RBMP reporting;

    d) Improve the programme of measures by providing a more thorough cost effectiveness analysis to prioritise measures and by clarifying which of the reported estimated funding requirements for the implementation of measures has been secured yet, or not; and provide information on which measures announced under the previous programme of measures have been implemented and which ones not (yet).

6. Use all funding instruments agreed in the context of the European Green Deal to join up implementation efforts for the benefit of the Water Framework Directive and increase effectiveness and efficiency.

SECTION B:

FLOODS DIRECTIVE

7. Flood risk management under floods directive (FD)

The Directive requires each Member State (MS) to scan its territory for flood risks, assess the potential adverse consequences of future floods for human health, the environment, cultural heritage and economic activity, identify the significant risks, map the flood extent and the potential adverse consequences, and take measures to reduce the flood risk. These activities are reflected in (a) the preliminary flood risk assessments, or PFRAs (including the identification of areas of potential significant flood risk, or APSFRs), (b) the preparation of flood hazard and risk maps, or FHRMs, and (c) the establishment of flood risk management plans, or FRMPs.

Information from the PFRA/APSFR assessment

There are two Units of Management (UoMs) in Croatia, which are the same as the Water Framework Directive's River Basin Districts (RBD). Fluvial, pluvial, groundwater, sea water, and Artificial Water Bearing Infrastructure types of floods are considered as potentially significant sources of flooding in Croatia. Croatia has designated 3 685 Areas of Potential Significant Flood Risk (APSFRs). The impacts of climate change on flood risk have been considered in Croatia. It was concluded that the impact of climate change on flood risks is relevant throughout Croatia, and climate change should be carefully considered in all aspects of flood risk management. The results of the model indicate that, in general, the adverse effects of climate change on flood risks increase: (1) from northeast to southwest and (2) on the coast where meteorological effects are superimposed with the effects of the sea level rise.

7.1 Flood hazard and risk maps

Highlights

Croatia is using a GIS-based geoportal[29] for their FHRMs. FHRMs were prepared at the national level and show the whole country. Maps for floods with low probability (1/1 000 years), with medium probability (1/100 years) and with high probability (1/25 years) are provided. Flood extent is shown on all maps. Water depth is shown on all maps. Number of inhabitants is shown on all maps. Likewise, type of economic activity is shown on all maps. IED installations are shown. Potentially affected protected areas identified in Annex IV(1)(i), (iii) and (v) to Directive 2000/60/EC are shown in the FHRMs.

Changes since the first FHRMs

Information on sectors of economic activity in areas potentially affected by flooding is partially improved. Another positive change is the mapping of cultural heritage (one of the four focus areas of the Floods Directive). The mapping has been improved by including cultural heritage protected on the national level (not only by UNESCO). Information of structures for provision of social services is also given in more detail (for example homes for the elderly are added).

Changes of contextual information since the first FHRMs

It is stated that the maps are created for the public and the entire approach is adjusted accordingly. The aim was to include the public in the entire process of risk management in an easier and more

[29] http://korp.voda.hr/ (accessed in July 2023) replaced now by https://preglednik.voda.hr/

informative way. There are not many technical details about modelling, limitations or uncertainties of the FHRMs.

Changes in methodologies used to prepare flood hazard maps since the first FHRMs

No changes have been identified.

Changes in methodologies used to prepare flood risk maps since the first FHRMs

Criteria used to select and assess the potential risk to human health and economic activities are developed compared to the first FHRMs – more institutions of social services, and more IED structures are included. The criteria used to select and assess the potential risk to WFD protected areas are the same. The criteria used to select and assess the potential risk to cultural heritage have significantly developed by using more data. In the second FHRMs there is more information about museums and other cultural assets from the national Register of Cultural Property.

As regards the consideration of climate change effects in the preparation of flood hazard and risk maps, reference is made to section 3.7 on 'adaptation to climate change'.

7.2 Flood risk management plans

Highlights

The combined FRMP and RBMP can be downloaded from two government webpages[30] (on the websites of the Ministry of Economy and Sustainable Development, and Hrvatske vode). The FRMP was developed along with the RBMP by Croatia's water management authority, Hrvatske vode, nevertheless, the FRMP provides few details on that coordination. The second FRMP contains the same objectives as the first one. The FRMP sets two main objectives, one strategic objective and two aims for flood protection. One of the FRMP's main objectives is to protect people and material goods from floods, implying a reduction in adverse impacts of floods. The objectives do not specifically refer to non-structural initiatives (although non-structural measures are included in the FRMP). The strategic objective refers to ensuring acceptable flood risk. The two aims refer to improved flood protection. The main objectives refer to the protection of people from floods. The objectives do not refer to the environment and cultural heritage, however, the approach for selecting priority APSFRs includes environmental and cultural heritage related criteria. The FRMP identifies 72 measures. The priority is not directly defined but can be assumed through the completion date. Croatia did not report information on the priority of its measures to EIONET and instead opted for including references to the timetable for implementation. The FRMP indicates the number of protection projects in the previous Multiannual Programme that were completed, under construction, or abandoned. Little information was found on the progress of non-structural measures.

The FRMP provides information on the costs of measures and monetary estimates of potential flood damages, which could be used to calculate benefits of the measures. Croatian Waters (Hrvatske vode) provides the main source of funding for measures in both UoMs, according to the FRMP[31]. In turn, the model of funding used in Croatia for FRM sees water charges paid to HV as the main sources of revenue to finance both structural and non-structural measures. Water charges thus finance flood

[30]The combined FRMP and RBMP can be found in Croatia's official national gazette, https://narodne-novine.nn.hr/clanci/sluzbeni/2023_07_84_1335.html
https://mingor.gov.hr/o-ministarstvu-1065/djelokrug/uprava-vodnoga-gospodarstva-i-zastite-mora-2033/planski-dokumenti-upravljanja-vodama/plan-upravljanja-vodnim-podrucjima-2022-2027/5556
https://voda.hr/sites/default/files/2023-07/PLAN%20UPRAVLJANJA%20VODNIM%20PODRUCJIMA%20DO%202027..pdf

[31] Chapter C.7.2.

measures. The FRMP identifies a range of EU funds as possible sources of finance for the measures, including Cohesion Policy funds, Recovery and Resilience Funds, the Solidarity Fund, and the CAP. It also mentions the possible use of loans from the Council of Europe Development Bank[32]. The FRMP does not mention the use of CBA. The objectives refer to the ecological status of water and the FRMP includes 'win-win' and 'no regrets' measures, such as NWRMs. The FRMP takes natural water retention into account and identifies several natural water retention measures. The FRMP includes measures to address nature conservation, including nature protection in the maintenance of water courses and for water works, as well as measures to address flood management issues in administrative activities connected to forestry and hunting. Several measures are related to spatial planning, e.g. including NWRMs in spatial planning documents. Croatia reported 26 prevention measures. The FRMP has objectives to improve flood protection systems, and Croatia reported 15 protection measures. Croatia reported 50 preparedness measures.

The Multiannual Programme identifies whether each measure is linked to the 2023 or the 2038 target for flood protection – and the FRMP includes measures whose purpose is to monitor these indicators. The FRMP indicates that there has been progress towards the strategic objectives of the previous plan but does not provide details. The FRMP provides some information on the progress of measures, identifying protection projects completed, underway and abandoned, and also noting that earthquakes in Croatia and global crises have hindered implemented. The plan states, however, that the measures implemented under the first FRMP have 'contributed significantly' towards the achievement of its strategic objectives.

Croatia reported to EIONET that coordination took place at international level for both UoMs. The FRMP and RBMP[33] reports that exchanges of information were organised in the framework of the ICPDR and the ISRBC, but no specific details are provided. The FRMP and RBMP[34] also lists the cross-border consultations held with neighbouring countries. The plan provides no further information on the topics discussed[35].

The FRMP explains that public and interested parties were informed in the two UoMs via media (newspapers, TV, radio), internet, direct mailing, invitations to stakeholders, local authorities and expert meetings. This refers to the joint consultation of the combined RBMP/FRMP document. The public consultation was coordinated by the Ministry of Economy and Sustainable Development, Directorate of Water Management. Consultation on the draft RBMP and FRMP lasted for six months.

As regards the consideration of climate change effects in the preparation of flood risk management plans, reference is made to section 3.7 on 'adaptation to climate change'.

8. FD recommendations

On the basis of the assessment performed and in addition to the progress already achieved, Croatia should:

- consider pluvial flooding in the FHRM;

[32] The Council of Europe Development Bank is a multilateral development bank with an exclusively social mandate, https://coebank.org/en/
[33] In Chapter F, which covers both flood risk and river basin management.
[34] Ibid.
[35] Croatia declares that more information is available in the meeting notes from the meetings.

- provide detail on how the FHRM was used in the choice of objectives and measures in the FRMP;.
- make objectives more specific and where possible linked to quantitative indicators and be timebound. An assessment of the progress made towards the achievement of the objectives should be included in the FRMP;
- provide the cost for all measures, not just structural measures in the FRMP
- set out in the FRMP the methods used to monitor measures, including non-structural measures;
- link both structural and non-structural measures to the objectives in the FRMP;
- where relevant, incorporate Cost Benefit Analysis for the prioritisation of measures that lend themselves to it and provide a clear description of the methodology used;
- consider the use of insurance as a measure for adaptation to climate change;
- provide more detail on the public consultation and stakeholder involvement in the FRMP, such as the specific stakeholders that participated, the meetings and advisory groups convened, the comments received, and how they were taken into account;
- where appropriate, consider in the FHRM the flow velocity or relevant water flow and in the FRMP flood conveyance routes, as these are relevant to emergency response.