



Rhine 2040



International Commission for the Protection of the Rhine

The Rhine and its Catchment: Sustainably Managed and Climate-resilient

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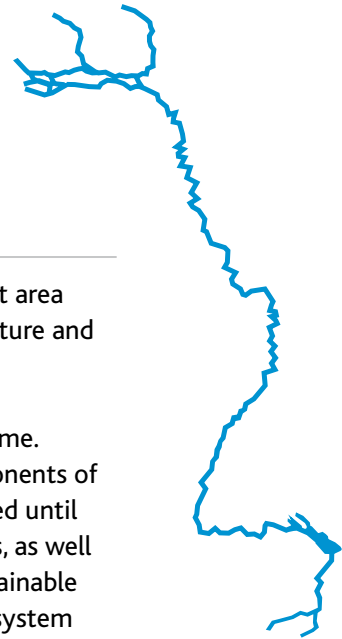


Valley of the Middle Rhine
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Programme Rhine 2040

The Rhine and its Catchment: Sustainably Managed and Climate-resilient

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Summary

The "Rhine 2040" programme aims to create a sustainably managed Rhine catchment area that is resilient to the effects of climate change, with valuable lifelines created for nature and people.

The "Rhine 2040" programme builds on the assessment of the "Rhine 2020" programme. As yet unfulfilled goals that require further efforts and new problems are core components of the new programme. The ICPR's climate change adaptation strategy is to be developed until 2025 in coordination with the relevant national climate change adaptation strategies, as well as cooperation with user interest groups being intensified in order to ensure the sustainable use of the waters in the Rhine catchment area, in line with the protection of the ecosystem in the future. Win-win and no-regret measures that as far as possible integrate the focal areas water quality, ecology, and high and low water, represent the backbone of the planned measures.

Ecology

The long-term trends of the past 20 years already show clear and sustainable ecological improvements. However, in order to make the Rhine ecosystem and its tributaries more resistant to the effects of climate change, its functional capabilities must be significantly strengthened by 2040. The ecological passability of the Rhine main stream for migratory fish - as the most important connection axis for the entire ecosystem - is to be restored upstream and downstream from the mouth to the Rhine Falls and in the programme waters of the Master Plan Migratory Fish. Habitats typical of the Rhine are to be preserved, protected, expanded and reconnected with one another again. In this way, the biotope network on the Rhine will be significantly improved overall. In addition, the negative influence of uses, in particular thermal discharges, on the temperature and oxygen conditions must be reduced.



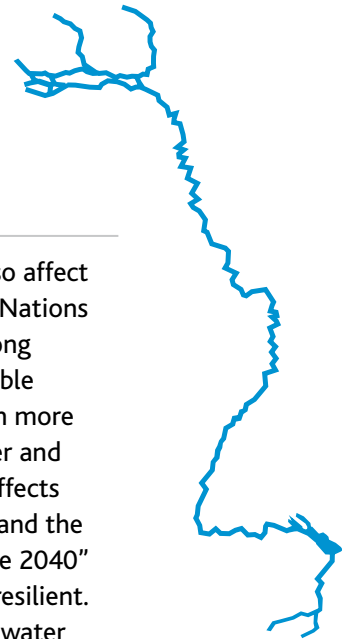
Water quality

In 2040, the Rhine should continue to be a usable resource for drinking water production using the simplest possible, most natural treatment processes. The introduction of nutrients into surface waters and groundwater is to be further reduced. The influx of micropollutants into waters from municipal waste water collection and treatment systems, industry and commerce and agriculture is to be reduced by at least 30% in comparison to the period 2016-2018 - consistent with a longer-term ambition to further decrease pollution throughout the Rhine catchment area. In order to be able to numerically check the reduction in influx at regular intervals and, if necessary, to increase the reduction target, the ICPR is tasked with developing a joint evaluation system for the reduction across the three areas by 2021. The European and ICPR regulations for pollutants should be adhered to as far as possible. In addition, the quality of the sediments in the main stream must be further improved by implementing the ICPR Sediment Management Plan, and the entry of waste, in particular plastic, into the body of water must be significantly reduced.

Flooding and low water

Flood risk management remains an ongoing, long-term task. Flood risks are to be reduced by at least 15% on the Rhine and its tributaries by 2040 in comparison to 2020, through an optimal combination of measures. To this end, further measures to reduce the level of flooding are to be implemented by 2030 and additional spaces that go beyond the measures already planned up to 2030 are to be kept free for flood retention on the Rhine and on the tributaries. Consciousness of flood risks and through this, also personal precautions, as well as the risk culture should be further strengthened through information, training and the raising of awareness.

In addition to effects on water quality and temperature as well as the aquatic ecosystem, low water can also have negative economic consequences for the Rhine catchment area. Low water should therefore continue to be monitored and joint efforts should be taken to find ways to avoid negative effects.



1. Introduction

The "Rhine 2040" programme centres around global environmental problems that also affect water management issues. This is particularly true in light of the SDGs of the United Nations 2030 Agenda and similar international efforts, such as the European Green Deal. Among other things, the programme focuses on topics where adjustments to the already visible and possible future effects of climate change are necessary. The effects can be seen in more frequent, pronounced drought, low water and flooding phases, in the increase in water and air temperatures as well as in the change in the overall water balance. The negative effects are numerous, both in ecological terms, in terms of the chemical status of the water and the quality of natural areas, and the diverse uses of the water. The main goal of the "Rhine 2040" programme is therefore the sustainable management of the Rhine, which is climate-resilient. The year 2018 provides an example of the impact of significant low water phases on water resources, natural spaces and uses. Such situations can be expected to occur more frequently in the future. The Rhine catchment area is climate-resilient if it is optimally armed against the effects of climate change.

The "Rhine 2040" programme builds on the assessment of the "Rhine 2020" programme. This assessment makes it clear that it has been possible to achieve or make progress towards achieving many of the goals of the "Rhine 2020" programme. However, not all of the goals set out at the time could be fully met. The efforts to reach these goals, as far as the "Rhine 2040" programme addresses them, must therefore continue.

In order to be able to measure the success of the implementation of the "Rhine 2040" programme, monitoring the condition of the waters in the Rhine catchment area will continue to be indispensable. Monitoring is based on the measurement programmes coordinated at ICPR level. These programmes are set up in the ICPR, with the data merged and evaluated. Water monitoring and the assessment of the state of the water take place on the basis of the legal regulations of the nations in the Rhine catchment area.

The programme can support the initiation of intra-regional projects or projects on cross-border sections of the Rhine or on cross-border Rhine tributaries, with EU funding (e.g. INTERREG, LIFE, etc.).

The "Rhine 2040" programme is also intended to help strengthen the sense of community in the common living environment of the nations in the Rhine catchment area that share a history, common values and a common destiny. The ICPR's cooperation with water users such as those in shipping, industry, agriculture, power plant operators, drinking water production, interest groups, associations and environmental organisations etc. is to be further expanded in order to promote the sustainable management of waters in the Rhine catchment area.

Just as with the "Rhine 2020" programme, this new programme is a substantiation of Article 3 (objectives) and Article 4 (principles) of the 1999 Convention for the Protection

¹ Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions "The European Green Deal" COM(2019) 640 final

² Publication of the assessment "Rhine 2020" from the 16th Rhine Ministerial Conference in 2020



of the Rhine. At the same time, it supports the ongoing implementation of the EU directives relating to water and flood risks in the EU countries throughout the Rhine catchment area, in particular the Water Framework Directive (WFD directive 2000/60/EC) and the Flood Risk Management Directive (FRMD) - Directive 2007/60/EC). Switzerland is not bound by the WFD and the FRMD, but supports the EU member states in the coordination and harmonisation work within the framework of international agreements and their national legislation.

The "Rhine 2040" programme supports the implementation of the Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda, in particular SDG 6 "Ensuring the availability and sustainable management of water and sanitation for all". This clearly reflects the ICPR's ambition to together sustainably shape the Rhine catchment area – the ambition upon which this programme is based.

The "Rhine 2040" programme is implemented through activities at ICPR level, but also in particular through practical measures in the various nations. Relevant stakeholders and recognised observers of the ICPR will also actively contribute.

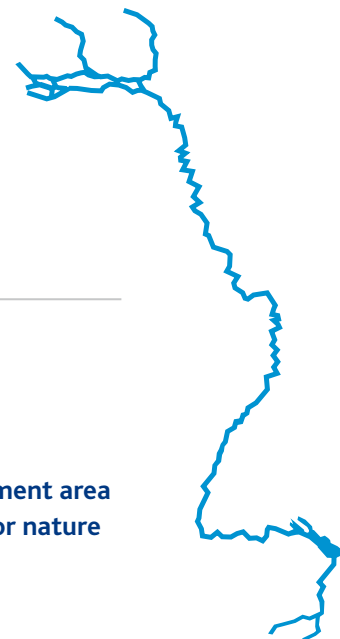
With the "Rhine 2040" programme, the ICPR wants to open up new paths for the development and implementation of innovative measures in water management. To this end, it should serve as a cross-border exchange platform and as a pioneer and initiator for cross-border and multilateral strategies.

The programme focuses on a unified, cross-border and integrated approach. It is the common "business basis" for future cooperation within the ICPR. It is intended to further increase the mutual understanding of the nations around the challenges of water management in the main flow of the Rhine and in the entire Rhine catchment area.

The orientation of the "Rhine 2040" programme and its implementation in the Rhine catchment area should be reviewed at regular intervals. If necessary and in the light of developments, for example at EU level, as well as new knowledge and experience gained, it should be adjusted and/or tightened. The assessment regarding the implementation of the "Rhine 2040" programme is carried out every 6 years or, depending on the development of ambitious political goals in all nations of the Rhine catchment area, more frequently, and finally in 2039.

³ https://www.iksr.org/fileadmin/user_upload/DKDM/Dokumente/Fachberichte/EN/rp_En_0219.pdf

⁴ The relationship between the SDGs of the United Nations 2030 Agenda and the "Rhine 2040" programme can be found in a separate document.



2. Perspectives, goals and procedures

2.0 The Rhine and its catchment: sustainably managed and climate-resilient

General objective for 2040

The "Rhine 2040" programme aims to create a sustainably managed Rhine catchment area that is resilient to the effects of climate change, with valuable lifelines created for nature and people.

Framework conditions and measures

The consistent implementation of the activities described in the "Rhine 2040" programme will strengthen the overall functionality of the Rhine ecosystem, such as the self-cleaning power of water and the natural runoff behaviour. Biodiversity in the Rhine catchment area will continue to increase. The system as a whole is becoming more resilient.

A prerequisite for increasing biodiversity is sufficient spatial and species-specific knowledge of the ecological interdependencies. The need for action to further strengthen the resilience of the ecosystem must be determined, and necessary measures must be defined. Here, invasive species and their effects on local flora and fauna must also be taken into account.

Climate change has an impact on runoff behaviour and water temperature, with consequences for water quality, ecology and biodiversity as well as for the uses of water. The impacts in the Rhine catchment area must be recorded in a coordinated manner on a regular basis in order to obtain a comprehensive overview. The different approaches, methods and experiences must be exchanged as well as the results of scientific studies in the various nations with regard to adapting to climate change. Multifunctional, natural solutions are preferred due to their higher resilience and better cost-effectiveness ratio.

In 2011, the ICPR published the first research results on the effects of climate change on runoff behaviour for the near (2050) and distant future (2100)⁵. Accordingly, an increase in winter precipitation, and downstream of the Middle Rhine, also an increase in flood discharge are expected. In addition, a decrease in rainfall and runoff in summer and an increase in low water periods are forecast. Building on this, in 2014, the ICPR adopted and published its first climate change adaptation strategy⁶.

⁵ ICPR Technical Report No. 188 (2011): Study of Scenarios for the Discharge Regime of the Rhine

⁶ ICPR Technical Report No. 219 (2015): Strategy for the IRBD Rhine for adapting to climate change



Measures

1. Updating the discharge projections for 2050 and 2100 for the Rhine catchment area and the individual Rhine levels by 2023, based on current IPCC⁷-data (expected to be available in 2021); inclusion of socio-economic developments for different water uses such as forecasts for irrigation in agriculture or water consumption in industry and households; updating of knowledge regarding the effects of climate change on water ecosystems and biodiversity; regular updates (every 10 years) are to be provided;
2. Updating the projections for water temperatures in the Rhine based on the discharge projections up to 2024 mentioned under point 1;
3. Updating the ICPR's climate change adaptation strategy up to 2025;
4. Exchange on how to deal with torrential rain within the ICPR;
5. Further intensification of cooperation with user interest groups in order bring the use of the water in the Rhine catchment area in line with the protection of the ecosystem, when considered as a source of drinking water, cooling water and service water for industry, trade and agriculture, for shipping, professional and recreational fishing, the use of hydropower as well as for recreation and tourism; within the context of considering it integral in terms of sustainability and also safeguarding it in the future.

The measures under the "Rhine 2040" programme also help to protect the marine environment. This applies in particular to measures for migratory fish and measures to reduce micropollutants, nutrients and pollutants as well as waste.

In order to manage the Rhine and its catchment area sustainably and to make it more climate-friendly, the following objectives are a core focus:

- (1) Networked habitats - more biodiversity**
- (2) Good water quality**
- (3) Mitigation of flood risks**
- (4) Managing low water**

These perspectives are important, among other things, with regard to the effects of climate change and are elaborated upon below. Cooperation between all parties involved is therefore an important part of the "Rhine 2040" programme, and is described in Chapter 3.

⁷ IPCC: Intergovernmental Panel on Climate Change



Salmons © Jakub Rutkiewicz - Shutterstock.com



2.1 Networked habitats – more biodiversity

General objective

The functionality of the Rhine ecosystem with its tributaries has improved significantly: ecological passability has been restored and biodiversity has increased.

Specific goals for 2040

- (1) The ecological passability for migratory fish has been achieved upstream and downstream in the main flow of the Rhine, from the mouth to the Rhine Falls and in the programme waters of the Master Plan Migratory Fish⁸.
- (2) Habitats typical of the Rhine have been preserved, protected or restored. The biotope network on the Rhine has improved significantly due to the expansion of core areas and the networking of suitable, sufficiently large stepping stone biotopes⁹.
- (3) The sediment balance in the Rhine is improved.
- (4) The temperature and oxygen conditions are not negatively influenced by anthropogenic thermal discharges.

Framework conditions and measures

Goal (1): „The ecological passability for migratory fish has been achieved upstream and downstream in the main flow of the Rhine, from the mouth to the Rhine Falls and in the programme waters of the Master Plan Migratory Fish.

Framework conditions

The basis for measures relating to water passability is the Master Plan Migratory Fish Rhine¹⁰, which was updated in 2018 and relates to selected migratory fish. As leading fish species, these are, in particular, the salmon that alternate between fresh and salt water and the Lake Constance lake trout that migrate in the catchment area of the Lake Constance-Alpine Rhine, as well as the eel that alternate between salt and fresh water. These migratory fish represent fish communities with particularly high demands on passability and habitat quality. The ecological passability discussed in the ICPR relates primarily to long-distance migratory fish populations. However, the functional ecological networking of migratory obstacles is an essential prerequisite for a stable population for all fish species. Restoring passability will also have a positive impact on many other water-dependent communities.

⁸ ICPR Technical Report No. 247 (2018): Master Plan Migratory Fish Rhine 2018

⁹ ICPR Technical Report No. 154 (2006) Biotope Network on the Rhine

¹⁰ ICPR Technical Report No. 247 (2018) Master Plan Migratory Fish Rhine 2018



Measures

to the Rhine Falls (including thresholds in the Rhine loops) and in its large tributaries, in particular the Moselle (to the mouth of the Sauer) as an international tributary, including the programme waters of the Master Plan Migratory Fish.

In order to continue efforts to restore ecological passability, the fishway near Rhinau will be operational in 2024. The fishway at Marckolsheim will be operational in 2026. The fishway for the complex Vogelgrün area will be operational as soon as possible to ensure compliance with the relevant EU legislation, so that the migratory fish can reach the Old Rhine (Restrhein) and Basel again. France will specify the necessary technical and financial measures in anticipation of this.

The restoration of fish passability in the High Rhine to the Rhine Falls and in the Swiss programme waters (Aare, Reuss, Limmat) will be implemented by 2030.

By 2030, a further 300 fish migration obstacles in the catchment area are to be made passable again. Through these measures, a total of around 60% of the potential and valuable migratory fish habitats can be connected to the Rhine again.

Ecological passability for migratory fish is realised in the Upper Rhine loops as follows:

- Loop Gerstheim, the lower threshold (Rappenkopf) by 2023 at the latest;
- Loop Rhinau, the two lower thresholds (Salmengrien and Hausgrund) by 2023 at the latest; if necessary, these two thresholds will be made passable as part of the planned larger Rhinau Taubergießen renaturation project, then by 2025 at the latest;
- With regard to further thresholds in the Gerstheim and Marckolsheim loops, bilateral coordination between Germany and France will continue.

The French "Rhin Vivant" programme is expressly welcomed as an additional project to increase biodiversity on the Upper Rhine.



2. Dismantling thresholds and weirs in tributaries and secondary waters - wherever the effects and uses make it possible to thereby restore functional habitats and reduce fish mortality during descent. Where this is not possible, these migration obstacles for fish ascent and descent must be equipped with well-functioning migration aids;
3. Fundamentally, no provision of construction approvals for new migration obstacles in the programme waters, especially in those routes still freely flowing, in order not to complicate the restoration of the continuity and accessibility of still existing spawning and juvenile habitats;
4. Continuation of the activities regarding innovative descent techniques on transverse structures that have been running since 2014, in order to reduce the loss of fish and damage to fish (e.g. salmon, eels) in turbines, among others:
 - Implementation of fish protection and descent techniques in practice to reduce fish mortality in small, medium and mid-sized hydropower plants (flow rate <math>< 150 \text{ m}^3/\text{s}</math>);
 - Improvement of the level of research and knowledge for large hydropower plants (flow rate > 150 m³/s) through pilot projects within the framework of research and development projects for the development of useful technical solutions; examination of adapted turbine management, for example in the transition period;
5. As a result, the development of recommendations for fish protection and fish descent in hydropower plants by 2024 and the common setting of goals - depending on technical progress in this area - for sufficient population-preserving fish protection;
6. Regular testing, documentation and communication of the implementation and current state of research (best practice) for the restoration of fish ascent and descent at transverse structures;
7. Regular review and updating of the Master Plan Migratory Fish Rhine.

Goal (2): "Habitats typical of the Rhine have been preserved, protected or restored. The biotope network on the Rhine has improved significantly due to the expansion of core areas and the networking of suitable, sufficiently large stepping stone biotopes."

Framework conditions

The concept of the "Biotope Network on the Rhine" (2006) forms the basis for the activities related to the biotope network¹¹. A biotope network consists of core areas that serve as a kind of reservoir from which plants and animals can colonise new habitats, and composite structures (= stepping stone biotopes or migration corridors). It represents the need for action, determined for individual biotope type groups for the different sections of the Rhine main stream. The main stream is the most important connecting main axis for the entire catchment area and ecosystem. With the implementation of the "Biotope Network on the Rhine", the loss of natural habitats in the Rhine catchment area has been counterbalanced and much "lost" space has been regained since the beginning of the 20th century or even as early as during the 19th century.

¹¹ ICPR Technical Report No. 154 (2006): Biotope network on the Rhine (brochure) and ICPR Technical Report No. 155 (2006): Biotope Network on the Rhine (Atlas)



Preserving, expanding and restoring the diversity of aquatic, semi-aquatic and related terrestrial habitats increases the biodiversity of the ecosystem and makes it more resilient to the effects of climate change.

Measures

1. Comprehensive evaluation of the implementation of the biotope network on the Rhine using innovative investigation and monitoring methods (e.g. remote sensing data);
2. Restoration of the hydromorphological diversity and expansion of current-based habitats by restoring 200 km² of flood meadow areas (= floodplains) and the reconnection of 100 oxbow lakes and secondary waters to the Rhine. As a result, the stocks of many fish species migrating in fresh water, which seek adjoining bodies of waters for spawning, are recovering;
3. Qualitative improvement of the habitats, including the bank areas on waterways that have been greatly changed by humans, e.g. through the removal of bank structures, and stone fillings to increase structural diversity, on 400 km bank;
4. Reduction of hydromorphological pollution in the Rhine main stream and secondary waters as well as the guarantee of ecological minimum water outflows that ensure good living conditions in the rivers when the tide is low;
5. Preservation, protection, restoration and expansion of natural habitats in and on the water and the adjacent riparian forests;
6. Initiation of partnerships and regular rounds of talks along the Rhine for (cross-border) pilot projects on the biotope network;
7. Regular review and, if necessary, updating of the "Biotope Network on the Rhine" concept, taking into account the expected effects of climate change on the individual biotope type groups;
8. Continuous adaptation and further development of biological monitoring, taking into account innovative investigation methods (e.g. environmental DNA) in order to record the effect of the implemented measures on the biocenosis.

Goal (3): "The sediment balance in the Rhine is improved."

Framework conditions

A sediment balance specific to the type of water has an essential effect on the runoff, the morphodynamic processes, and the flow dynamics, and has a positive effect on the ecological functionality of the water and its accompanying floodplains, on the groundwater and on flood protection. On several sections of the Rhine, especially in the delta, there is a significant erosion of the bed, which can only be partially reduced by extensive bed load additions below Iffezheim on the Upper Rhine and downstream. The lowering due to the bed erosion is not only problematic for shipping, but also for the groundwater level, especially in areas close to the water, and for drinking water abstraction. The bed load deficits also have a significant impact on the hydraulic connection between the Rhine, secondary waters and floodplains - which is particularly noticeable in low water phases.



There are also problems with the sediment balance in the dammed Upper Rhine to Iffezheim (Rhine km 334) with 10 barrages, and further below in the dammed tributaries Neckar, Main, Moselle, Lahn and Ahr.

The 142 km-long Upper Rhine is dammed on almost 100 km. Due to the lack of bed load supply from the tributaries, bed load transport in the river is greatly reduced and the habitat favourable for fish and small animals is significantly limited. The bed is mostly colmated and therefore structurally poor, which limits the diversity of the habitats in the river bed. Reference is made to the "Master plan for bed activation in the Upper Rhine" as an example for the improvement of the sediment balance¹².

Measures

1. Improvement of the level of knowledge by taking stock of the quantity and dynamics of sediments, recording deficits and estimating the effects, initially for the main stream;
2. Development of requirements for a balanced, ideally water type-specific sediment balance; here, knowledge and approaches that have already been acquired to improve the quantitative sediment balance - if necessary with the inclusion of qualitative aspects - must be included in this process;
3. Formulation of measures to improve the sediment balance corresponding to these requirements, including their technical and financial feasibility, taking into account their effects on water use;
4. Development of a quantitative sediment management plan for the Rhine, if necessary.

Goal (4): "The temperature and oxygen conditions are not negatively influenced by anthropogenic thermal discharges."

Framework conditions

The ICPR has addressed the temperatures on the Rhine in two studies. The water temperature has been shown to have risen on average by around 1 °C to 1.5 °C between 1978 and 2011¹³. This Rhine water temperature development has been supplemented by an "Assessment of the consequences of climate change on the development of Rhine water temperatures in the near future (2021-2050) and the distant future (2071-2100)"¹⁴.

These studies also included anthropogenic thermal discharges;

¹² See Master plan for bed activation in the Upper Rhine

¹³ ICPR Technical Report No. 209 (2013): Development of Rhine water temperatures based on validated temperature measurements between 1978 and 2011

¹⁴ ICPR Technical Report No. 213 (2014): Estimation of the effects of climate change (short report) and ICPR Technical Report No. 214 (2014): Estimation of the effects of climate change (extensive version)



Measures

1. Updating the long-term development of water temperatures on the basis of continuous monitoring and regular data exchange, as well as continuous observation and documentation of the effects of the rise in temperature and potentially the lack of oxygen, based on jointly developed parameters;
2. Regular inventory every 6 years of significant anthropogenic heat discharges into the Rhine and in future also into the major Rhine tributaries;
3. Promotion of the improvement of research and knowledge on the effects of water temperatures on Rhine fish coenosis and with regard to the stabilisation of the oxygen balance;
4. Regular exchange of information by the nations regarding experiences with the reduction or avoidance of thermal discharges, corresponding modelling and protective measures for aquatic communities against excessive temperatures;
5. Development of a recommendation for action across national and federal borders, where necessary.



2.2 Good water quality

General objective

The quality of water, suspended matter, sediment and biota in the Rhine and its tributaries as well as in the groundwater is good. The Rhine continues to be a usable resource for drinking water production with the simplest possible, most natural treatment processes.

Specific goals for 2040

(1) Nutrients:

The influx of nutrients (phosphorus and nitrogen) into surface waters and groundwater has been further reduced significantly.

(2) Micropollutants:

The influx of micropollutants into the water from the areas of municipal waste water collection and treatment systems, agriculture, industry and commerce has been reduced by at least 30% in comparison to the period 2016-2018 - consistent with a longer-term ambition to further decrease pollution in the entire Rhine catchment area. In order to be able to numerically check the reduction in influx at regular intervals and, if necessary, to increase the reduction target, the ICPR is tasked with developing a joint evaluation system for the reduction across the three areas by 2021.

(3) Other pollutants:

The European and ICPR regulations (EQS, EQS-Rhine, targets) for pollutants are adhered to as far as possible.

(4) The quality of the sediments in the main stream has been further improved due to the implementation of the ICPR Sediment Management Plan.¹⁵

(5) The International Warning and Alarm Plan Rhine¹⁶ is state of the art and the reporting processes function flawlessly in practice.

(6) The influx of waste, especially plastic, into the water is significantly reduced.

Framework conditions and measures

Goal (1): "Nutrients: The influx of nutrients (phosphorus and nitrogen) into surface waters and groundwater has been further reduced significantly."

Framework conditions

The reduction thus far in nutrient loads is mainly due to the efforts of the past decades in the area of municipal and industrial wastewater treatment. A further significant reduction in the influx of nutrients from diffuse sources (with a focus on agriculture, but also urban systems) is essential, as they entail a significant component of the water pollution.

Measures

1. Continuation of the monitoring of influx pathways. The use of technical capabilities for phosphorus and nitrogen elimination in sewage treatment plants must be optimised. In the case of diffuse influxes, the level of knowledge has to be improved and the corresponding influx pathways must be identified and quantified more specifically, as far as possible;

¹⁵ ICPR Technical Report No. 175 (2009): Sediment Management Plan Rhine

¹⁶ ICPR Technical Report No. 256 (2019): International Warning and Alarm Plan Rhine



2. Reduction of the diffuse influxes from agriculture into surface water and groundwater, especially with regard to the protection of water for drinking water extraction;
3. Promotion in particular of ecological as well as location-based and water-protective agriculture.

Goal (2): "Micropollutants: The influx of micropollutants into the water from the areas of municipal waste water collection and treatment systems, agriculture, industry and commerce has been reduced by at least 30% in comparison to the period 2016-2018 - consistent with a longer-term ambition to further decrease pollution in the entire Rhine catchment area. In order to be able to numerically check the reduction in influx at regular intervals and, if necessary, to increase the reduction target, the ICPR is tasked with developing a joint evaluation system for the reduction across the three areas by 2021."

Framework conditions

Since 2008, the ICPR has compiled information regarding the relevance of various micropollutants in the Rhine catchment area and approaches to reducing water pollution, and published the information in substance group-specific ICPR technical reports. The ICPR has developed a strategy for micropollutants and adopted recommendations for reducing their entry in 2019¹⁷.

The ICPR recommendations refer to:

- Municipal sewage collection and treatment systems (e.g. pharmaceutical residues and X-ray contrast media),
- Agriculture (e.g. plant protection products) and
- Industry and trade (e.g. industrial chemicals).

Measures

1. Practical implementation in the Rhine catchment area, regular review and, if necessary, adjustment of the ICPR recommendations adopted in 2019 for the reduction of micropollutants in water;
2. In order to be able to numerically check the reduction in influx at regular intervals, the ICPR is tasked with developing a joint evaluation system for the reduction across the three areas by 2021 compared to the base period 2016 to 2018. In a first step, the micropollutants contained in the common, regularly checked list of Rhine substances are taken as a basis. Building on this, representative parameters are selected and common methods for evaluating reductions in influxes are established;
3. Continuous adaptation and further development of monitoring, measuring techniques and evaluation methods, e.g. through non-target screening to determine unknown loads or bioanalytical approaches to record the overall effect of substance loads; notably, persistent and mobile substances pose a particular challenge for water management, as the standard drinking water treatment and wastewater treatment processes often do not significantly reduce these substances, for example X-ray contrast media;

¹⁷ ICPR Technical Report No. 253 (2019): ICPR Recommendations for Reducing Micropollutants in Waters



4. Intensification of the cooperation between the laboratories on the Rhine and its major tributaries and the improvement of the standardisation of analytics including digitisation and evaluation along the Rhine and ensuring a platform for the evaluation of non-target data between the laboratories.

Goal (3): "Other pollutants: The European and ICPR regulations (EQS, EQS-Rhine, targets) for pollutants are adhered to as far as possible."

Framework conditions

Other pollutants, such as heavy metals, are regularly measured and evaluated in the Rhine catchment area. The environmental quality standards of the WFD as well as the Rhine environmental quality standards and targets set by the ICPR are used for this. The influx of metals into rivers was massively reduced during the Rhine Action Programme in the years 1987 to 2000 and has further decreased due to the construction, optimisation and modernisation of municipal and industrial water treatment plants. Other pollutants were also reduced mainly at the point sources, which is why the diffuse sources in particular will be pivotal in the future.

Measures

1. Continuation of clarification of sources of influx and monitoring of relevant pollutants;
2. Continuation of reduction measures and, if necessary, adoption of additional measures to comply with the requirements.

Goal (4): "The quality of the sediments in the main stream has been further improved due to the implementation of the ICPR Sediment Management Plan."¹⁸

Framework conditions

The measures to improve sediment quality identified in the ICPR Sediment Management Plan of 2009, have been implemented in many locations, particularly in the lower course. However, the implementation is in part still pending.

Measures

1. Implementation of the measures identified in the ICPR Sediment Management Plan by 2025 and transparent communication in the event of implementation problems;
2. Examination of the updating of the Sediment Management Plan in close coordination with the planned work on the water type-specific sediment balance.

Goal (5): "The International Warning and Alarm Plan Rhine¹⁹ is state of the art and the reporting processes function flawlessly in practice."

Framework conditions

According to Article 5 paragraph 6 of the Rhine Convention, in the event of incidents or accidents whose effects are likely to threaten the water quality of the Rhine, nations in the Rhine catchment area shall immediately inform the Commission and contracting parties who may be affected.

The International Warning and Alarm Plan (IWAP) Rhine, which is based on this and has been in existence for decades, has been running with a web application since 2019.

¹⁸ ICPR Technical Report No. 175 (2009): Sediment Management Plan Rhine

¹⁹ ICPR Technical Report No. 256 (2019): International Warning and Alarm Plan Rhine



Measures

1. Checking the functioning of the IWAP Rhine by means of regular tests (at least every 2 years); the test results are evaluated jointly and the IWAP - if necessary - optimised and brought up to date, including its cyber security;
2. Implementation of joint cross-border exercises;
3. By 2030, development and introduction of a new Rhine flow time model²⁰.

Goal (6): "The influx of waste, especially plastic, into the water is significantly reduced."

Framework conditions

Since 2013, the ICPR has been exchanging information on national activities to reduce the influx of waste. The EU Marine Strategy Framework Directive (MSFD - Directive 2008/56/EC) aims to reduce the influx of waste into the oceans. The OSPAR action plan on marine litter also addresses the rivers as influx pathways, and provides for cooperation with the river basin commissions. The reduction and avoidance of waste primarily fall under the task of waste management. The ICPR can provide support to reduce the influx of waste, especially plastic, into the water.

Measures

1. Collection of existing studies and support in reducing the amount and type of waste that is discharged into the water. The effects on inland water are examined;
2. Reduction of influx at source, through the better management of plastics along the value chain, in particular through waste management; the EU plastics strategy is implemented e.g. the EU Single-Use Plastics Directive;
3. Continuation of regular exchanges;
4. Supporting the development of standardised sampling, measuring and evaluation methods for microplastics;
5. Raising public awareness by supporting coordinated collection campaigns for waste and plastic, and in particular also the avoidance of littering.

²⁰ This model can be used to estimate the spread of sudden water contamination in the river (flow time and concentration).



2.3 Mitigation of flood risks

General objective: Flood risk mitigation

The flood risks are reduced by at least 15% on the Rhine and its tributaries by 2040 in comparison to 2020, through an optimal combination of measures²¹.

Specific goals for 2040

- (1) The flood information, forecast and warning systems are up to date and adequate training is undertaken. The nations and/or federal states/regions continue to support each other in the event of a flood.
- (2) The measures to reduce flood levels planned for 2020+ will be implemented by 2030. These represent an effective reduction in flood levels on the Rhine, meaning that the flood risk on the Rhine is significantly reduced²².
- (3) Other spaces that go beyond the scope of measures already planned for 2030 are charted, secured by spatial planning and kept free for use, with regard to flood retention on the Rhine and on the tributaries.
- (4) Synergies are drawn upon between measures to improve flood protection and to improve the ecological situation on the Rhine and its tributaries.
- (5) Undeveloped flood areas are kept free from development.
- (6) New buildings and, where applicable, also existing buildings in flood-prone areas are adapted to the flood risks (building precautions).
- (7) Consciousness of flood risks and through this, also personal precautions are strengthened through information, training and the raising of awareness.

Framework conditions and measures

Goal (1): "The flood information, forecast and warning systems are up to date and adequate training is undertaken. The nations support each other in the event of a flood."

Framework conditions

The ICPR is still the platform for the annual exchange of experience and information on the functionality of the flood information system, forecasting and flood warning.

The flood information, forecast and warning from the source of the Rhine to the mouth of the North Sea as well as crisis management must function efficiently in the event of a flood, so that people can be warned in good time and flood damage can be reduced. According to Article 5, paragraph 6 of the Rhine Convention, in the event of imminent flood events, the nations in the Rhine catchment area shall inform the Commission and contracting parties that may be affected. The international cooperation between the flood warning and flood forecasting centres on the Rhine, which is based on this, has been in place since the major flood events in 1993/1995.

²¹ See results **IKSR-Fachbericht Nr. 236 (2016)**: The calculations with the FloRiAn instrument assume that the economic activities - in the case of the full implementation of all measures - will result in a relative risk reduction in the 3 scenarios of -20% to -45% in comparison to 2015.

²² See Annexes 11.1 and 11.2 of the Flood Risk Management Plan International River Basin Rhine 2015



Measures

1. Continuous improvement of flood information, forecasting and warning on the basis of current/new knowledge as a permanent task of flood risk management;
2. Future exchange of experience with parties in civil protection and crisis management, in the context of comprehensive flood risk management.

Goal (2): "The measures to reduce flood levels planned for 2020+ will be implemented by 2030. These represent an effective reduction in flood levels on the Rhine, meaning that the flood risk on the Rhine is significantly reduced."

Framework conditions

With the implementation of the Action Plan on Floods²³, the measures of which were adopted in the Flood Risk Management Plan in 2015²⁴ the flood risk on the Rhine was reduced by 25% in comparison to 1995. The implementation process of the Action Plan on Floods has been regularly evaluated. The effectiveness of the implemented measures has been proven, just as it has been for the measures planned to reduce the flood water level by 2030²⁵.

Flood risk management focuses on prevention, protection and preparedness, including flood predictions and early warning systems. It is necessary to further improve knowledge about risks and the effectiveness of measures, also taking into account the effects of climate change.

Measures

1. Realisation of further water retention measures by 2030; implementation must be accelerated;
2. Keeping free from construction the areas on the Rhine and the tributaries, for the retention areas still to be implemented;
3. Further methodical improvement of knowledge about the risks and effectiveness of different measures of flood risk management, for example with the help of verification instruments like the FloRiAn tool (Flood Risk Analysis); regular reviews of effectiveness every 6 years (2027, 2033 and 2039); recalculation of the effectiveness of planned measures - depending on the availability of data.

Goal (3): "Other spaces that go beyond the scope of measures already planned for 2030 are charted, secured by spatial planning and kept free for use, with regard to flood retention on the Rhine and on the tributaries"

Framework conditions

The 15th Rhine Ministerial Conference in 2013 emphasised that in view of the anticipated climate change, there is a need to provide additional measures for flood retention beyond the measures already planned, in order to avoid or reduce damage.

²³ ICPR Action Plan on Floods

²⁴ Flood Risk Management Plan IRBD Rhine 2015

²⁵ ICPR Technical Report No. 236 (2016): Assessment of Flood Risk Reduction (Action Plan on Floods, Action Target 1) with Due Regard to Types of Measures and Receptors of the Directive 2007/60/EC (FD)



Measures

Identification and compilation of other possible areas for further flood retention on the Rhine and Rhine tributaries and/or in the Rhine catchment area, which go beyond the measures to be implemented by 2030.

Goal (4): "Synergies are drawn upon between measures to improve flood protection and to improve the ecological situation on the Rhine and its tributaries."

Framework conditions

There are synergies between measures that have a positive impact on flood protection issues as well as ecology and water quality. Wherever possible, these should be favoured when selecting measures. The ICPR has dealt intensively with this topic²⁶.

Measures

1. Implementation of programmes of measures tailored to individual cases in the relevant nations using the variety of protection and water level-reducing measures, e.g. the creation of retention or "Room for the river" measures, renaturation of rivers and wetlands, especially in the catchment area, reactivation of flood areas, increasing the storage and infiltration capacity of soils (e.g. through extensification of agriculture), nature development, afforestation and promotion of precipitation seepage;
2. Selection of measures using potential synergies with other goals; in so doing, it is important to strike a balance between short-term costs and long-term effects, and to deal with uncertainties regarding the indications of climate change and knowledge of the effects on other objectives or functions of the water.

Goal (5): "Undeveloped flood areas are kept free from development."

Framework conditions and measures

In the context of risk-based spatial planning, existing knowledge of the dangers and risks posed by flooding is taken into account.

Basic maintenance of undeveloped floodplains.

Goal (6): "New buildings and, where applicable, also existing buildings in flood-prone areas are adapted to the flood risks (building precautions)."

Framework conditions

In the context of risk-based construction, existing knowledge of the dangers and damage risks posed by flooding is taken into account.

²⁶ ICPR Technical Report No. 260 (2019): Report over the results from the workshop floods prevention and river restoration in the Rhine catchment



Measures

1. The examination of property protection measures in the case of existing buildings in flood areas, in particular in the event of changes or renovations within the framework of building approval;
2. The flood-adapted construction of new buildings that cannot be avoided in flood areas;
3. The promotion of the continuous exchange of knowledge between the nations regarding these measures.

Goal (7): "Consciousness of flood risks and through this, also personal precautions, are strengthened through information, training and the raising of awareness."

Framework conditions

Flood risk awareness wanes if there have been no flood events for a long time. The public must be ever aware of the flood risk, be prepared for floods and take preventive measures. Through awareness-raising measures, those affected learn about local flood risks and approach them properly, in order to better protect themselves and their property.

Measures

1. Improving flood risk communication with the aim of expediting the implementation of non-technical measures (damage prevention, building precautions, natural hazard insurance, etc.), i.e. the focus is on independent action. The ICPR supports these activities with appropriate events;
2. Promotion of an intensive exchange of information, and the involvement of the public in the nations of the Rhine catchment area via the provision of information, advice, training, exercises, prevention in educational, civic and youth projects, round tables and the formation of municipal flood partnerships for the correct, damage-reducing handling of flood events. The ICPR can support these activities.



2.4 Managing low water

General objective

Due to low water monitoring and jointly developed evaluation methods and solutions, the Rhine catchment area can better manage the negative effects of pronounced low water events.

Specific goals for 2040

- (1) The ICPR monitoring of low water events functions smoothly and will be optimised where necessary, based on the knowledge gained.
- (2) Common assessment and solution approaches have been developed in order to be better prepared for periods of low water. There is a common approach for dealing with the effects of low water events across the Rhine catchment area.

Framework conditions and measures

Goal (1): "The ICPR monitoring of low water events functions smoothly and will be optimised where necessary, based on the knowledge gained."

Framework conditions

A representative joint monitoring of low-water situations on the main flow of the Rhine has been permanently established since 2019²⁷. As part of this monitoring, current low water events are directly compared and classified, and possible changes in the low water runoff are demonstrated²⁸. The effects of climate change on low water and drought periods in the Rhine catchment area must be continuously considered.

Measures

1. Regular evaluation of the results of the low water monitoring and updating of the criteria where necessary (water level, runoff, duration, temperature, oxygen, chlorides, etc.) in coordination with the relevant experts to assess the effects on water quality and ecology;
2. Extension of monitoring to make potential drought periods predictable and to represent them in relation to spatial areas. To this end, national or institutional indices such as rainfall deficit or soil moisture status for the Rhine area should be examined extensively and shown continuously. By comparing and classifying patterns of past drought periods, the potential extent of a predicted low water event can be estimated at an early stage;
3. Studies on future water availability in the Rhine catchment area (surface water, groundwater) for the year 2050. Hydro-climatic, socio-economic developments and impacts on the Rhine and in the catchment area as well as changes in national low water management should in future be closely monitored within the ICPR, in order to identify potential cross-border problems or solutions in good time;
4. A decision on further activities, based on the results of the monitoring and the investigations, e.g. coordinated recommendations for measures in response to low

²⁷ Undine Monitoring, ICPR Technical Report No. 261 (2019): ICPR low water monitoring for the Rhine and in its basin

²⁸ ICPR Technical Report No. 248 (2018): Inventory of the low water conditions on the Rhine;

ICPR Technical Report No. 263 (2020): Report on the low-water event from July-November 2018



water levels and the regular exchange and evaluation of measures taken in practice.

Goal (2): "Common assessment and solution approaches have been developed in order to be better prepared for periods of low water. There is a common approach for dealing with the effects of low water events across the Rhine catchment area."

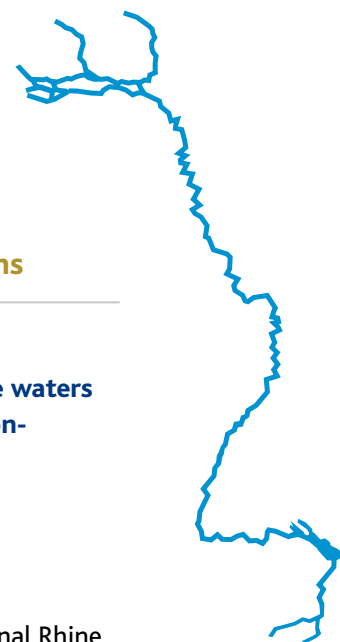
Framework conditions

Initial statements on how to deal with low-water events can be found in the ICPR climate change adaptation strategy²⁹.

Measures

1. Compilation and evaluation of measures taken in the relevant nations when low water events occur;
2. Development of common assessment approaches for low water events in terms of their duration and the effects/impact on uses, in order to be able to better assess and quantify low water events;
3. Implementation of measures such as restoration, removal of drainage, promotion of natural seepage and natural water retention in the area combined with expansions of floodplains and wetlands; support for sustainable groundwater management;
4. Raising public awareness among different user groups with regard to water availability and personal responsibility for taking adequate countermeasures;
5. In order to be better prepared for low water periods, common evaluation criteria and approaches are being developed. A common approach is sought for dealing with the effects of low water events across the Rhine catchment area.

²⁹ ICPR Technical Report No. 219 (2015): Strategy for the IRBD Rhine for adapting to climate change



All together: cooperation with other commissions and stakeholders, public relations

General objective

The ICPR is still the most important coordinating international platform for the waters in the Rhine catchment area. Cooperation with other intergovernmental and non-governmental organizations (IGOs and NGOs) has intensified. The public is informed about the goals and work of the ICPR and awareness is increasingly raised regarding water protection.

Framework conditions and measures

The ICPR is the relevant international platform for water protection in the international Rhine catchment area. It is also used by the relevant nations to discuss new water-related issues and to provide stimuli for improved water protection. The work of the ICPR influences discussions at EU level.

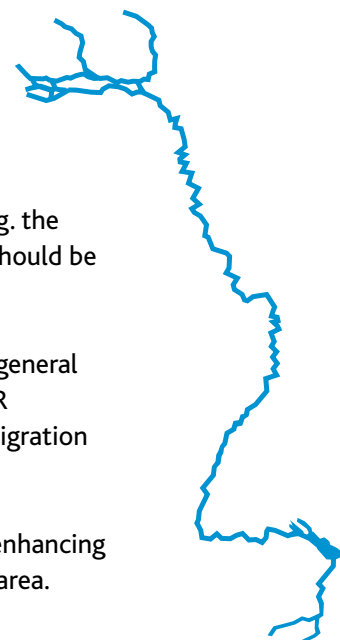
Public awareness should also be raised regarding this role of the ICPR and the success of cross-border cooperation. The "Rhine 2040" programme additionally serves this purpose.

The ICPR will continue to exchange information with other river basin commissions (e.g. the International Commission for the Protection of the Rivers Moselle and Saar, the International Maas Commission), other commissions (e.g. Central Commission for the Navigation of the Rhine, International Commission for the Hydrology of the Rhine basin) and marine organisations (e.g. the Commission for the Protection of the Marine Environment of the North-East Atlantic, The North Atlantic Salmon Conservation Organization), among other things, within the framework of workshops on current topics such as the conditions for inland navigation. If necessary it will intensify this information exchange, to learn from one another and avoid the duplication of efforts.

In the future, the ICPR will increasingly exchange ideas with scientific institutions, such as universities, to incorporate their findings into the work of ICPR.

Cooperation with recognised observers on the Rhine will be continued and further developed if necessary. Contact and cooperation with other stakeholders will be improved. The dialogue with agriculture is to be re-established in the ICPR in addition to discussions between agriculture and the European Union or the relevant nations.

The general public should be better informed about the challenges relating to river basin protection and the work carried out under the auspices of the ICPR. The ecosystem services of the bodies of water must be better communicated not only to the general public, but also to stakeholders and at a political level. Publicity campaigns such as fish stocking measures with



public participation, joint monitoring campaigns including citizen science projects, e.g. the observation of ascending fish or of migrating or hibernating water-dependent birds should be undertaken in coordination with the relevant NGOs and ICPR observers.

With regard to these activities, the ICPR website plays a significant role, also for the general public, as a central instrument for passing on information, easily understandable ICPR information material, providing awareness about special events such as World Fish Migration Day, World Wetlands Day, World Water Day or the network of visitor centres.

In general, the activities should contribute to the public becoming more involved in enhancing the common natural, cultural and historical heritage of the Rhine and its catchment area.



Rhine 2040

