ICPR low water monitoring for the Rhine and its basin: *Updates since spring 2024*

1 Initial cause

After an extensive test phase, during which the low water of summer 2022 in particular provided the opportunity to test the ICPR low water monitoring system under real conditions, it was found that the monitoring system has basically proven its suitability, but that some methodological adjustments are necessary. These have been implemented since spring 2024, see monitoring page on the UNDINE platform of the BfG.

In 2024, the ICPR Expert Group on Low Water (EG LW) spoke out in favour of adapting the ICPR technical report no. 261, which describes the methodology of the monitoring system. The corresponding text section describing the methodology is to be updated. The evaluation examples do not need to be adapted. This document contains **important adjustments to report no. 261.**

2 Methodological changes

The duration-based classification of low flow events and the associated colour coding in the monitoring system is no longer based on the current discharge value (tQ), but on a comparison of the discharge mean value of the last seven days (NM7Q as a continuous seven-day moving average) with the frequency quantiles NM7Q, which originate from the statistical analysis of measured data from the reference period 1961 to 2010 and are listed in the following Table 10 of ICPR Report No. 248. In this way, measured data and classification frameworks belong to the same (seven-day) aggregation level, which avoids event overestimations (meaning that erroneous more extreme frequencies would be reported than exist). It also prevents singularities, e.g. caused by short-term weir control in the High and Upper Rhine, from causing distortions in the classification. Time reference of the visualisation: For technical reasons, the last (final) value of the respective NM7Q averaging period is usually calculated on the day preceding the publication date.

Procedure for classifying the duration of events: The current moving final NM7Qs are compared with the classification in Table 10 below, determining the duration of the event in the various classes and documenting it in the colour-coded duration table on the monitoring page.

Table 10: Low water discharges NM7Q of certain recurrence intervals, determined for annual series (j) in relation to the water balance year April to March (4,3)

Low water discharge probability: Series type **NM7Q**(j,4,3), distribution GEV-LM, discharges in [m³/s]						
Return period:	T=2a	T=5a	T=10a	T=20a	T=50a	T=100a
Diepoldsau/Rhine	92.6	77.2	69.3	62.9	55.8	51.2
Rekingen/Rhine	234	194	176	162	147	137
Basle/Rhine	518	439	402	374	344	325
Maxau/Rhine	644	530	473	427	377	345
Worms/Rhine	716	593	533	486	434	401
Mainz/Rhine	839	702	638	588	535	501
Kaub/Rhine	841	699	632	580	524	489
Andernach/Rhine	982	812	732	670	604	563
Cologne/Rhine	1010	840	761	701	637	597
Lobith/Rhine	1075	908	829	769	705	665

The monitoring of the occurrence of low water and the classification of its discharge-related intensity is carried out by comparing the current discharges at the gauging station with the return intervals of the NM1Q (lowest daily mean) of the reference period 1961 to 2010, which are listed in the following Table 8 of the ICPR Report 248 mentioned above.

Table 8: Low water discharge NM1Q of certain recurrence intervals, determined for annual series (j) in relation to the water balance year April to March (4,3)

Low water discharge probability: Series type **NM1Q**(j,4,3), distribution GEV-LM[5], discharges in [m³/s]						
Return period:	T=2a	T=5a	T=10a	T=20a	T=50a	T=100a
Diepoldsau/Rhine	71.6	60.4	54.7	50.2	45.2	42.0
Rekingen/Rhine	229	189	170	156	140	130
Basle/Rhine	502	426	390	362	333	314
Maxau/Rhine	618	510	454	410	361	330
Worms/Rhine	693	576	518	471	419	386
Mainz/Rhine	817	687	624	574	521	487
Kaub/Rhine	816	682	617	565	511	476
Andernach/Rhine	955	793	716	656	592	551
Cologne/Rhine	985	821	743	683	619	578
Lobith/Rhine	1053	884	802	739	670	627

[5] General extreme value distribution with L-moment parameter estimation method

3 Further improvements

The tabular overviews of the current water temperature and oxygen content have been expanded to include the Rekingen monitoring station on the High Rhine.

In cooperation with the European Drought Observatory (EDO)[1], the gauge based ICPR monitoring is being supplemented with maps of the standardised precipitation index (SPI)[2] and the soil moisture index (SMI Anomaly)[3] for the spatial categorisation of an existing drought. The standardised precipitation index (SPI) describes the precipitation occurrence at a specific location based on a comparison of the observed sum of precipitation for any given observation period (here: the six previous months, calculated from the time of observation) with the long-term historical precipitation data for the period 1981 to 2010. The Soil Moisture Index (SMI Anomaly) is used to determine the start and duration of drought periods (i.e. in agriculture) that occur when the availability of soil moisture for plants drops to a level that affects crop yield. The index is calculated on the basis of daily modelling of soil moisture using the LISFLOOD model and its deviation from a reference period (1995 to the latest available full year).

[1] https://drought.emergency.copernicus.eu/

[2] For details see https://drought.emergency.copernicus.eu/data/factsheets/factsheet_spi.pdf

[3] For details see https://drought.emergency.copernicus.eu/data/factsheets/factsheet_soilmoisture.pdf