

Pursuant to Article 54 paragraph 2 of the Law on Waters (Official Gazette of the Republic of Montenegro 27/07 and Official Gazette of Montenegro 32/11 and 48/15), the Ministry of Agriculture and Rural Development adopted, with prior consent of the Ministry of Sustainable Development and Tourism, the following

RULEBOOK
on the manner of determining
environmental flow of surface water

(„Official Gazette of the Republic of Montenegro”, no. 2/16 date: 14th January)

Subject-matter
Article 1

This Rulebook sets out the manner of determination of environmental flow of surface water (hereinafter referred to as: the EF).

Determination of EF
Article 2

EF shall be determined in the water bodies of surface water on which water abstraction is in accordance with the water acts except for supplying population with drinking water.

The EF for the water body profile shall be determined on the point where water is abstracted.

Environmental flow (EF or Q_{EF}) means the flow that must be provided downstream of the intake structure for the purpose of preserving natural balance of aquatic and aquatic-related ecosystems;

Goals of Determining the EF
Article 3

The EF shall be determined for the purpose of maintaining or restoring the structure and functions of aquatic and aquatic-related ecosystems and preventing degradation of water condition in accordance with the law.

Definitions
Article 4

Terms used in this Rulebook have the following meanings:

- 1) **maximum ecological potential** means the best possible environmental status that a modified water body may attain in given conditions and which is the closest to the natural condition;
- 2) **ecologically important flow regime parameters** mean hydrological components of the EF (minimum flow, seasonal variations, flood waves) which drive ecological and geomorphological processes needed for the maintenance of structures and functioning of aquatic ecosystems;
- 3) **mean minimum flow** (${}_mQ_{MIN}$) is arithmetic mean of the minimum annual values of mean daily flows on the watercourse profile in a given period of time.
- 4) **mean monthly flow** (${}_mQ_{M(o)}$) is arithmetic mean of the mean monthly values of flows on the watercourse profile and it is expressed in m³/s.
- 5) **seasonal flow variation** means time distribution of minimum flows needed for establishment of time variability of the flow regime, in accordance with needs of the species of flora and fauna of a given water body;
- 6) **flood wave** means artificially caused hydrologic event which simulates dynamics of river and wetland flooding needed for the preservation of ecosystems;
- 7) **maximum hydrological potential** means hydrological regime of a water body during which the maximum ecological potential of that water body is attained;
- 8) **special site intended for preservation** means the site at which, due to its importance, the measures laid down for preservation and restoration of the favourable condition of natural habitats or population of species are implemented;
- 9) **holistic approach** means functional expert analysis which takes into consideration a broad area of ecological and hydrological aspects of river ecosystems.

Assessment the EF Article 5

Assessing the EF is determined on the basis of ecological importance of a water body, properties of the aquatic and aquatic-related ecosystems, their different needs and water protection goals, as well as the needs of water users.

The EF is determined on the basis of hydrological data, by carrying out general or specific assessments.

General assessment of the EF shall be carried out for all the water bodies by using methods set out in articles 7 and 8 of this Rulebook.

Specific assessment of the EF shall be carried out as a supplement to the general assessment of the EF by using holistic approach, laying down biological and hydrological criteria, defining habitats model, and also including preparation of holistic, hydrological and hydraulic studies.

Specific assessment of the EF shall be carried out for the water bodies in protected natural resources, extremely modified water bodies and in particular:

- in lakes and wetlands;

- if the watercourse belongs to the protected natural resource;
- if the watercourse contributes considerably to the water balance of the downstream protected natural resource;
- if protected species live in the watercourse or if that watercourse represents significant part of the area they inhabit;
- if the watercourse is used, from time to time, by protected species during certain phases of their life cycle;
- if the watercourse makes significant part of the area inhabited by some protected species or if a specific population lives in it as the one which, owing to its genetic diversity and specificity, represents a very important population for preservation of the species at the national, regional or global levels;
- if the watercourse is the main source of drinking water for living organisms of the surrounding terrestrial ecosystems.

Hydrological Data

Article 6

The following hydrological time series shall be used for determining the EF:

- those representing natural hydrological regime;
- those that have no errors or missing data;
- those lasting at least 10 years respectively 30 consecutive years whenever that is possible;
- those representing various hydrological conditions, with the balance between wet and dry years;
- those obtained on the basis of mean daily flows, whenever that is possible.

Where data on natural condition are unavailable, these may be determined on the basis of hydrological data from the other relevant hydrological station (hereinafter referred to as: the benchmark station).

In order to provide sufficient data for establishing a satisfactory correlation between water flow on the specific water body profile and flow on the benchmark station profile, the observation of the water level on the subject profile needs to be carried out for 15 months.

During the period referred to in paragraph 3 of this Article, simultaneous hydrological measurement of the flow on both profiles needs to be carried out, at least six times in different hydrological conditions, in order to enable construction of the flow curve.

The correlation is deemed satisfactory if the value of the correlation coefficient is $k \geq 0,7$ and if the trust interval is 95%.

Hydrological measurement shall be carried out in accordance with the standards ISO 748:2007, ISO 1088:2007, ISO 9555-1:1994, ISO 9555-3:1993, ISO 9555-4:1992, ISO/TR 11656:1993 or ISO/TR 25377:2007.

General Assessment of the EF

Article 7

The following hydrological components of the EF shall be determined in the procedure for general assessment of the water abstraction impact on natural hydrological regime of the water body: minimum flow, seasonal variations and flood wave.

Manner of Determination of EF

Article 8

The EF shall be determined on the basis of values of the mean minimum flow (${}_mQ_{\min}$) and mean monthly flow (${}_mQ_{M(o)}$) of the watercourse profile where abstraction is planned.

Mean minimum flow shall be calculated on the basis of the following formula:

$${}_mQ_{\min} = \sum_{i=1}^{i=N} Q_{\min,i} / N$$

where $Q_{\min,i}$ represents minimum mean daily flow in the i^{th} calendar year, while N represents the number of years in a given period of time;

Mean monthly flow shall be calculated on the basis of the following formula:

$${}_mQ_{M(j)} = \sum_{i=1}^{i=N} Q_{M(o),i} / N$$

where ${}_mQ_{M(o)}$ represents mean monthly flow in the j^{th} month and in the i^{th} calendar year, while N represents the number of years in a given period of time.

Values of the parameters mentioned above are calculated on the basis of hydrological data, referred to in Article 6 of this Rulebook.

Calculation leads to the value of $Q_{(EF)}$ for each month of the year which presents annual distribution of the flows.

The EF for a specific month of the year is calculated on the basis of correlation between the mean minimum flow and mean monthly flow (${}_mQ_{\min} / {}_mQ_{M(o)}$).

If the correlation of mean minimum flow and mean monthly flow is below 10 in the observed month, then the EF value equals the value of the mean minimum flow, and if such correlation is equal to or exceeds 10 then the EF value is equal to 20% of the mean monthly flow which is calculated on the basis of the following formula:

$$Q_{(EF)} = \left\{ \begin{array}{ll} {}_mQ_{\min} & \text{for } {}_mQ_{\min} / {}_mQ_{M(o)} < 10 \\ 0.2 \times {}_mQ_{M(o)} & \text{for } {}_mQ_{\min} / {}_mQ_{M(o)} \geq 10 \end{array} \right\}$$

Determining the Flood Wave

Article 9

Flood wave shall be provided in the natural flow conditions when the first higher flows after the summer dry period occur (September, October or November).

The flood wave is determined on the basis of the correlation between the mean minimum flow and mean monthly flow for each month referred to in paragraph 1 of this Article, in a way that value of the flood wave flow amounts to 50% of the mean monthly flow in the first month in which the correlation between these two parameters is equal to or higher than 20 (${}_mQ_{\min} / {}_mQ_{M(o)}$).

Specific Assessment of the EF

Article 10

The EF determined in specific assessment should make possible the following:

- 1) preservation of the structure and function of associated ecosystems;
- 2) satisfaction of ecological needs of habitats and species (principally the most endangered ones and those that are the most sensitive to the flow alterations)
- 3) maintenance of the prescribed level of water quality.

The analysis of ecosystem response to the flow alterations is carried out in the specific EF assessment, particularly in relation to the following:

- 1) ecosystem components (certain species, communities, processes);
- 2) biological phenomena that need to be made possible (fish migration, fish spawning, biodiversity of the community);
- 3) fulfilling of the conditions prescribed by Law on waters;

Termination of validity

Article 11

The Rulebook on the manner of determining the guaranteed minimum flow downstream of the intake structure (Official Gazette of Montenegro 22/08) shall be repealed on the day this Rulebook enters into force.

Entry into Force

Article 12

This Rulebook shall enter into force on the eighth day following the date of its publication in the Official Gazette of Montenegro.

Number: 327-53/15-9
Podgorica, 29.12.2015.

**Minister,
Petar Ivanović, PhD**