ENVIRONMENTALY ACCEPTABLE FLOW RATE

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„EAF is a flow value which must be ensured in the downstream water course due to preservation the natural balance of the aquatic ecosystems and ecosystems depending of the water“

Regulation on the way of determination of the Environmentaly Acceptable Flow rate of surface waters-EAF ("Off. paper of MN", No 2/16 and 23/16)

- EAF is determined in surface water bodies where the water is captured according to the water act, except as a drinking waters.

- Goal: EAF is determined due to preservation or restoration the structure and function of aquatic and water-bound ecosystems as well as prevention the degradation of water status in accordance with the law.
Terms, used in the Regulation:

- **Maximal environmental potential**: the best possible state of the ecosystem that a modified water body can achieve under given conditions and which is closest to the natural state.

- **Environmentally significant parameters of the flow rate regime**: hydrological components of EAF (minimal flow rate, seasonal variations, flood waves) that trigger the environmental and geomorphological processes necessary for maintaining the structures and functioning of aquatic ecosystems.

- **Average minimal flow rate**: the arithmetic mean of the minimum annual values of the average daily flow rates in the watercourse profile in the appropriate period.

- **Average monthly flow rate**: the arithmetic mean of the average monthly flow values in the watercourse profile, expressed in m3/s.

- **Flow rate seasonal variations**: the time distribution of the minimal flow required to establish the time variability of the flow regime, in accordance with the requirements of fauna and flora of that water body.

- **Flood wave**: artificially caused hydrological event that simulates the dynamics of river and swamp floods required to preserve the ecosystem.

- **Maximal hydrological potential**: hydrological regime of the water body in which the maximum environmental potential of this water body is realized.

- **Special site of conservation**: a site where, due to its significance, are taken measures of preservation or restoration of the favorable conservation status of natural habitats or species populations.
Estimation of EAF

- On the base of environmental importance of water body, characteristics of aquatic ecosystems and water-bound ecosystems, their needs, protection of water and use of the waters.

- EAF is determined on the base of hydrological data, by general and particular estimation.
General estimation of EAF

- Hydrological components of EAF are: minimal flow, seasonal variations and flood wave.
- EAF is calculated by the average minimal flow ($srQ_{(min)}$) and average monthly flow ($srQ_{M(j)}$) of watercourse at profile of planning capture.
- Average minimal flowrate is calculated by the next equation:

$$srQ_{min} = \frac{\sum_{i=1}^{N} Q_{min,i}}{N}$$

where $Q_{min,i}$ is minimal average daily flow in "$i" calendar year and "N" number of year in considered period.
Average monthly flow rate is calculated by next equation:

\[ srQ_{M(j)} = \frac{\sum_{i=1}^{i=N} Q_{M(j),i}}{N} \]

where \( srQ_{M(j),i} \) is average monthly flow in "j" month and "i" calendar year, and "N" number of year in considered period.

EAF is calculated by \( Q_{(EPPj)} \) for each month which represent annual distribution of prescribed flow rate.

EAF for some month is calculated on the base of ration of average monthly flow and average daily minimal flow \( \left( \frac{srQ_{M(j)}}{srQ_{min}} \right) \).

EAF is equal to average minimal flow if the ratio between average monthly and minimal flow is lower than 10.

EAF is 20% of average monthly flow if the ratio between average monthly and minimal flow is equal or bigger than 10.

This is calculated by equation:

\[ Q_{(EPPj)} = \begin{cases} 
    srQ_{min} & \text{za } srQ_{M(j)}/srQ_{min} < 10 \\
    0.2 \times srQ_{M(j)} & \text{za } srQ_{M(j)}/srQ_{min} \geq 10 
\end{cases} \]
Determination of flood wave

- It is determined in the period when, in natural conditions of flow rate, are appear the first higher flows after summer dry period (September, October or November).

- Flood wave is calculated as a ratio between average monthly and average minimal flows for each month, so that value of flow of flood wave amounts 50% of average monthly flow for the first month in which mentioned ratio equal to or greater than 20 \( (srQM(j) / srQmin \geq 20) \).
**Particular estimation**

- It is used as a supplement of general estimation, applying of holistic approach; It is done by determination of biological and ecological criteria, type of habitat, including production of holistic hydrological and hydraulic studies.

- Particular estimation of EAF is determined for water bodies in protected natural areas, in highly modified water bodies, especially:
  - for lakes and swamps
  - if watercourse is part of protected natural good
  - if watercourse significantly contributes to water balance of the downstream protected natural good
  - if protected species live in watercourse or a watercourse represents important part of their areal
  - if water stream temporary, during particular phases of the life cycle, used by protected species
  - if watercourse represents important part of areal of some protected species or in it lives population which by own genetic diversity and specificity represents very important population for conservation of species at national, regional or global level
  - if watercourse represents a basic source of water for living world of surrounding land ecosystems.
In determination of EAF are used hydrological time data series which:

- represent natural hydrological regime
- there are no errors and missing data
- last for at least 10 years, or 30 years in continuity, according to the possibilities
- represent different hydrological conditions, with balanced rainy and drought years
- are obtained on the basis of average daily flows, according to the possibilities

If such time data series not available, EAF can be determined on the base of hydrological data from corresponded hydrological station (benchmark) at which the measurement of flow has done.

Measurement of flow at benchmark station is done during 15 months due to provide valid correlation between this flow rate with that at water body where water abstraction takes place. Simultaneous hydrometric flow measurements are carried out on the part of water body and the benchmark station, at least six times in different hydrological situations, in order to make a flow curve. The correlation is satisfactory if the correlation coefficient is $\geq 0.7$, with a confidence level of 95%.

EAF, determined by particular estimation, should allow:
- preservation of the structure and function of the respective ecosystems;
- satisfaction of the ecological needs of habitats and species (the most endangered and most vulnerable to flow changes);
- maintenance of the prescribed level of water quality.

Within particular estimation of EAF, has done the analysis of ecosystem state in relation to the changes of flow, particularly for:
- ecosystem components (some species, communities and processes);
- the biological phenomena to be enabled (fish migration, fish spawning and biodiversity of the community);
- Fulfillment of the conditions, prescribed by Water law.

By establishment of EAF, it ceases to be valid the guaranteed minimum flow, downstream of the water intake.