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A METHOD TO COLLECT FIELD DATA FOR HYDROMORPHOLOGICAL MONITORING OF RIVERS IN ROMANIA

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ABSTRACT. The monitoring of rivers' hydromorphological characteristics represents a requirement of the EU Water Framework Directive 2000/60/EC (WFD) amended in 2014 (2014/101/EU), which introduces several standards regarding the monitoring of the quality elements of all surface water categories. Thereby, for the hydromorphological elements, the Standard 14614:2004 Water quality – Guidance standard for assessing the hydromorphological features of rivers became mandatory. In this view, a method for field data collection was developed considering the specifications of the mentioned Standard. The method, focused on surface water bodies – rivers, is based on both field surveys and desk work, the information being registered in two types of records (A and B). The hydromorphological monitoring is to be conducted on survey units (SU) of fixed length (500 m) and variable widths, with detailed observations and measurements in three sections: upstream and downstream (at SU' boundaries) and a base section (approx. at the middle of the SU). The field measurements are supplemented by visual observations and estimation of some hydrological and morphological characteristics. At the same time, if on field measurements and samplings are not possible,the method permits the collection of data only from visual observations and estimations. Given the fact that the *Methodology for hydromorphological assessement of Romanian rivers*, which is included in the second *Romanian River Basin Management Plan* 2016-2021 (RBMP), considers the indicators for three main categories of hydromorphological elements: hydrological regime, river continuity and morphological conditions and that the proposed method for data collection follows the specifications of the same documents (WFD, RBMP etc.), we consider the method provides good support in desk resulted data validation and completion, for both, monitored rivers (through gauging stations) and unmonitored rivers.

Keywords. rivers, hydromorphology, monitoring, field survey, survey unit, Water Framework Directive (WFD)

1. INTRODUCTION

Monitoring water quality parameters is a complex activity, essential for the management of aquatic ecosystems at local or national level decision making. According to the European legislation, the Member States should develop an

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integrated surface water quality monitoring system by using three categories of water quality elements: biological, hydromorphological and physico-chemical.

The methods for monitoring and evaluation of rivers' hydromorphological characteristics should be developed in accordance with the requirements of the Water Framework Directive 2000/60/CE (WFD), amended in 2014 with the standards SR EN 14614/2004 and EN 15843/2010. These standards, elaborated by the European Comittee for Standardization (Ilnicki et al., 2010), reffer to the monitoring of the quality elements for all types of surface waters and their specifications are compulsory for all Member States.

Regarding the existing monitoring and assessment methods, a first analysis was made by Birk (2003) through the STAR project (Standardisation of River Classification – Framework Method for Calibrating different Biological Survey Results against Ecological Quality Classification to be developed for the Water Framework Directive), in which 23 methodes were identified and analysed.

A more recent analysis of the monitoring and assessment methods of rvers' hydromorphological characteristics was conducted in the European project REFORM (Restoring Rivers for Effective Catchment Management), finished in October 2015 (Wolter et al., 2013, Gurnell et al., 2016). The project considered 139 methods, of which 73 european and 66 non-european and focuses on highliting the methods' features: their reference conditions, the parameters/characteristics considered and recorded, the processes in the riverbed and their application in the context of WFD implementation (namely if a method is the official tool or it is frequently used, but not compulsory in the state that developed it).

Given the fact that the implementation of the WFD was in initial state at the time of STAR project, just three of the methods analysed within STAR project are found in the European project REFORM.

The results of REFORM project show that the main limitations of the methods are: (i) none of the methods includes the monitoring of all the characteristics/attributes required by the Standard EN 14614:2004; (ii) the monitoring is conducted on representative river reaches with fixed or variable dimentions, not at water body level; (iii) the morphological features/processes are, in general, insufficiently analyzed.

Romania has a long tradition in hydromorphological monitoring of rivers, especially through the hydrometric activity conducted at gauging stations, where the data collected/recorded over the years led to a historical database. An assessment method based especially on data from gauging stations has been developed in 2015, applied and adopted as the unique tool for hydromorphological assessment at national level (INHGA, 2015; Moldoveanu et al., 2015), through the updated National Management Plan 2016-2021 (ANAR, 2016).

However, the correlation of the monitoring activity at the gauging stations with the WFD and recent standards requirements became a necessity in the last years. Therefore, the present paper presents a method to collect field data for hydromorphological monitoring of rivers, adapted to the posibilities and conditions of our country (INHGA, 2016).

2. DATA AND METHODS

The method takes into account the Water Framework Directive requirements in terms of hydromorphological status assessment (hydrological regime, river continuity and morphological conditions) and the specifications of the international standards (SR EN 14614/2004 and EN 15843/2010) regarding how the field observations (the scale) should be made and what features should be recorded. Therefore, the method considers the hydromorfological features of the river channel, banks and riparian zone, including floodplain.

Regarding the scale of surveys the method uses "survey units" of fixed lenght and variable width. The deliniation (location and dimension) of the survey units within the river water bodies have been presented in detail in Lupu et al. (2017).

The categories and features used for hydromorphological monitoring of Romanian rivers according to the proposed method are presented in Table 1.

Table 1. ***Categories and features for hydromorfological monitoring of Romanian rivers (O = Office, F = Field; WB = water body, SU = survey unit***

No.	Categories and features	Specification on collecting the data	Work stage	Spatial scale
0	*1*	*2*	*3*	*4*
CHANNEL				
1	Channel form	-	O F	WB SU
	Long section profiles	3 points + additional points for special conditions	O F	SU
	Cross profiles	At least 3 cross sections	O F	SU
2	Observations on the material making up the river bed	Type and condition of material of river bed	F	SU
	Observations on alluvial materials	Samples from river bed, particle-size distribution curves	F	SU
3	Observations on existing aquatic macrophytes and their development	Information from monitoring activity + additional activity where applicable	F	SU
	Observation on existing of leafy and woody debris	-	F	SU
	Observations on existing vegetation management activity	-	F	SU
4	Observations on the evolution of channel and banks regarding erosion/deposition of alluvial material	Cross sections' comparative analyses (over time)	F O	SU
5	Observations on flow type	-	F	SU
	Observations on flow features	-	F	SU
	Inventory of water uses at water body level Annual average flow extracted/introduced in the water body	Type of water usage Analogy with annual average discharge in natural flow conditions	O F	WB SU

No.	Categories and features	Specification on collecting the data	Work stage	Spatial scale
6	Inventory of artificial barriers Location of obstacles on the longitudinal profile	-	O F	WB SU
BANK				
7	Observations on bank material types	Material type estimation and particle-size distribution curves (at least in 3 points at cross section profiles)	F	SU
	Observations on revetment or protection material	Specifications on type and condition of water works (e.g.: good condition, bad condition)	O F	WB SU
8	Observations on vegetation types	Information from monitoring activity + additional activity where applicable	F	SU
	Observations on vegetation condition at field survey moment	-	F	SU
RIPARIAN ZONE (FLOODPLAIN)				
9	The share of the three main categories of land cover, according to Corine Land Cover methodology recognition of vegetation types and human activities causing vegetation discontinuity	According to the Methodology for hydromorphological assessment of rivers, (ANAR, 2015 - Annex 6.1.2.A)	O F	WB SU
	Observations on riparian floodplain morphology (anthropogenic changes)	Description of river meadow (shape) and of the existing changes (polder, fish ponds, irrigation channels)	O F	WB SU
10	Inventory of water works Dikes length and height; distance from the dikes to the river channel	-	O F	WB SU

The hydromorfological categories and features listed above are the subject of the two field survey forms used to collect and record the results of the field measuremets and observations, inluding new anthropogenic pressures identified.

3. RESULTS AND DISCUSSIONS

The monitoring method for river hydromorphological parameters/characteristics proposes the selection and establishment of survey units (US) with a fixed length of 500 m and a variable width, depending on the width of the riparian (floodable) zone, estimated on field. The field forms elaborated follow the requirements and recomandations of SR EN 14614/2004 standard and includes the three zones of the river: the minor riverbed, the banks and the riparian zone (floodplain).

In order to record and highlight the hydromorphologic features of the river, three sections are selected within the survey unit: upstream section, downstream section and base section, observations and measurements being recorded for each of them. They are located at the limits of the suvey units (the upstream and downstream sections) and approx. at the middle of the suvey unit (base section).

The process of montoring the hydrological and morphological parameters/characteristics is carried out in three steps: planning the fieldwork, the field step (field campaign) and the data post-processing step (fig. 1).

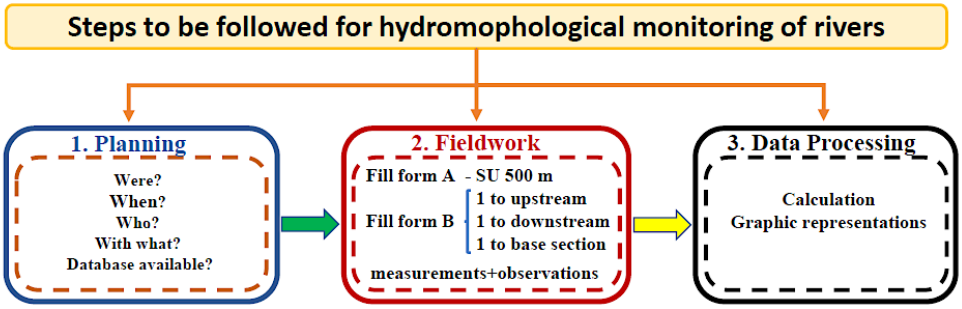


Fig. 1. Schematic representation of steps and main activities for hydromorphological monitoring of rivers

3.1. Planning the fieldwork

In the planning step of the monitoring process, activities which are the basis for the preparation of the field campaign are conducted, as follows:

- the responsible with the activity is established;
- the team that will carry out the field campaign is established, with at least 2 people from different fields of research (hydrologists, geologists, geodesists, biologists etc.);
- the survey units and survey sections are selected/delimited and marked on maps;
- the team identifies the equipments necessary to fulfill the field campaign and the measurements required (topographic equipments, protective and work equipments, hydrological measurement equipments, recipients and sampling equipments, forms/questionnaires for recording data from observations, standard field forms for hydrological measurements etc.);
- depending on the available equipments, the actual work methods are established (measurements/determination of parameters, direct or indirect identification of the characteristics/parameters);
- the existing data/information is collected, analysed and recorded in the forms/questionnaires for the survey units, namely for the surface water bodies.

The collection and analysis of the existing data and information is an important step preceding the field campaign, because it reduces the time for the actual on-field activity (some characteristics being defined beforehand).

In this regard, the data/information can be obtained form the databeses available (thematic maps, aerial images, digitized and raster files processed in GIS environment). The data collected in this stage are used for the efficient coordination and development of the field campaign.

3.2. Field campaign

This step implies the on-field campaign, where the team fills out the forms type A and B (Fig. 2a and b, Fig. 3a and b) according to the measurements and/or the visual observations on hydrological and morphological parameters/characteristics. Topographic measurements regarding the cross sections, as well as discharge measurements and alluvia sampling are made, if the technical and field conditions allow it.

The type A form refers to *Observations and measurements for hydromorpological monitoring of the surface water bodies - rivers through survey units* and contains information for the suvey unit on the whole (500 m).

The type B form refers to *Observations and measurements for hydromorpological monitoring of the surface water bodies - rivers through survey units* and contains information for each of the three sections within the survey unit: upstream, downstream and base sections (one form for each section).

Both types of forms have the same structure, namely: general information (about the water body, survey unit and sections); aspect, alluvia and vegetation in the minor riverbed; aspect and structure of the bank and of the riparian zone, but with a different degree of detail of the observations to be made.

3.3. Post-processing of the field obtained data

The post-processing of the data mainly refers to discharge measurements calculation, calculation and graphical representation of the cross sections, alluvia samples processing and representation of the resulting particle size curves. The data obtained are filled in the forms type A and B.

5. CONCLUSIONS

The process of water quality monitoring implies the periodic update of the information on water quality status. This fact entails the necessity of reconsidering and adapting the hydrometric program on rivers, taking into account the current possibilities and the monitoring methods implemented at national level.

Due to its novelty elements (survey units including or not survey sections overlaping monitoring sites from the national hydrometric nework, structured forms with well delimited parts, for each main element defined in the WFD and standards, recording data on biological aspects etc.), the presented method supports the integrated monitoring of river water bodies, being an usefull tool in WFD implementation in Romania.

The presented method, tested on river water bodies from all typologies, provides good support in desk resulted data for both, monitored rivers (through gauging stations) and unmonitored rivers, for the purpose of water quality assessement.

Data collection for all quality elements that define the ecological status of rivers (the chemical, the biological and the hydromorphological elements), in the same place and at the same time is useful and necessary to create an integrated database.

Fig. 2a. Form type A - Observations and measurements for hydromorphological monitoring of the surface water bodies - rivers through survey units, which refers to data collection on the survey unit on the whole - 500 m (pages 1-2)

Water Basin Administration		Fill out date:	
Name(s) and Surname(s) of the person/people filling out the form		Signature of the person/people filling out the form	
Position/Employer			

Form A

Observations and measurements for hydromorphological monitoring of surface water bodies - rivers through survey units

Form for the SURVEY UNIT on the whole

A1. GENERAL INFORMATION ON THE SURVEY UNIT

A1.1. Information about the surface water body-river (SWB-R)

SWB-R name					
Code			Symbol (e.g.: RO01)[1]		
Ecoregion		Type of flow:	☐ permanent	☐ intermittent	
Type of SWB-R:	☐ natural	☐ modified	☐ artificial		
Observations regarding the anthropic pressures in the SWB-R:					

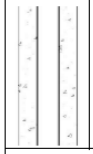
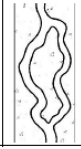
A1.2. Information about the survey unit (SU)

SU name[2]				
River name		Cadastral code of the river		
Is there a hydrometric station on the SU?			☐ yes	☐ no
Is there a water quality monitoring section (WQMS) on the SU?			☐ yes	☐ no
Is there an auxiliary ("satellite") monitoring section on the SU?			☐ yes	☐ no
Weather conditions on field, at the time of the observations/measurements:				
• air temperature (°C):		• cloud coverage:	☐ clear (unclouded)	☐ cloudy	☐ covered
• wind:	☐ calm	☐ weak	☐ moderate	☐ strong	☐ very strong
When did it rain last time and with what intensity?[3]				

[1] The symbol assigned to the watercourses part of a SWB-R, according to the typology used nationally (e.g.: situated in a mountainous area, situated in a depression of a mountainous area).
[2] If the survey unit overlaps an already existing monitoring section (water quality monitoring section, hydrometric station, "satellite" section), the SU will take its name; otherwise, it will be named after a local toponym (e.g.: a locality nearby, a hill etc.).
[3] Note details regarding the duration and the intensity of the rainfall from the last 7-10 days before the field campaign (e.g.: "heavy rain three days ago"; "rain of low intensity, but quantitatively significant (duration: 1½ days).

A2. CHANNEL

A2.1. Planform

☐ straight	☐ slightly sinuous	☐ meandering	☐ braided	Are there observable interventions on the natural planform? (e.g.: regulations, meander cutoffs, groynes, dykes, embankments):
				

Is the longitudinal continuity affected?	☐ yes	☐ no

If yes, specify by what type of elements:

☐ Natural			☐ Artificial		
Type	Number	Height[4] (m)	Tip	Number	Height[5] (m)
☐ natural check dams			☐ check dams		
☐ cascades			☐ weirs		
☐ other, specify:			☐ temporary/impromptu dams		
.....			☐ other, specify:		

Is the lateral continuity with the floodplain affected?	☐ yes	☐ no

If yes, specify by what type of elements[6]: .....

A2.2. Alluvial deposits

Are there alluvial deposits?	☐ yes	☐ no

If yes, specify their type/position:

river islands	☐ with vegetation	☐ without vegetation		
deposits at obstacles	☐ with vegetation	☐ without vegetation		
deposits at the base of the banks	☐ left bank		☐ right bank	
	☐ with vegetation	☐ without vegetation	☐ with vegetation	☐ without vegetation

A2.3. Observations on vegetation and other objects in river water

Is there aquatic vegetation?	☐ yes	☐ no
Are there vegetal debris in the water? (ex.: wooden debris, leaves etc.)	☐ yes	☐ no
If yes, specify their type, position and the degree of obstruction of the river section:		
Is there waste in the water?	☐ yes	☐ no

☐ household waste	☐ construction site waste	☐ oil, petroleum waste	☐ other, specify: .....

[4] If there is more than one element that affects the continuity (e.g.: three check dams), their heights will be noted, in order, from upstream to downstream.
[5] Idem.
[6] E.g.: "dykes form local materials, of 1.5 m height" etc.

Fig. 2b. Form type A - Observations and measurements for hydromorpological monitoring of the surface water bodies - rivers through survey units, which refers to data collection on the survey unit on the whole - 500 m (pages 3-4)

A3. RIVER BANKS

A3.1. Observations on vegetation

Is there vegetation on banks? ☐ yes	☐ no	
If yes, specify its type:	Left bank	Right bank
trees	☐	☐
shrubs	☐	☐
herbaceous vegetation	☐	☐
Is the vegetation creating shading conditions of the water surface? ☐ yes	☐ no	
If yes, the shading conditions are:	Left bank	Right bank
in the first part of the day (in the morning)	☐	☐
in the second part of the day (in the afternoon)	☐	☐
throughout the day	☐	☐

Details regarding the cause of the shading conditions: .....

A3.2. Observations on waste and debris

Are there vegetal debris on the banks? (ex.: wooden debris, leaves etc.)	☐ yes	☐ no
Is there waste on banks?	☐ yes	☐ no

☐ household waste ☐ construction site waste ☐ other, specify: .....

A4. RIPARIAN ZONE - FLOODPLAIN

A4.1. Observation on the floodplain

Micro-relief:	Left side	Right side
cut off/abandoned meander	☐	☐
old/inactive channel	☐	☐
old meander core (deposition form)	☐	☐
river beach	☐	☐
other, specify:	☐	☐
Morphological alterations/modifications:	Left side	Right side
lateral, non-permanent accumulations (polders)	☐	☐
fish ponds	☐	☐
channels (adduction/restitution, irrigation etc.)	☐	☐
other, specify:	☐	☐

A4.2. Lateral and longitudinal continuity

Is the lateral continuity affected in the floodplain?	☐ yes	☐ no
If yes, specify what type of elements are affecting it:		
Are there dykes on the SU?	☐ yes	☐ no

If yes, are the dykes continuous?	Left side		Right side	
	☐ yes	☐ no	☐ yes	☐ no

Characteristics of the dykes:

	Left side	Right side		Left side	Right side
estimated length on the SU (m)			material used for the dyke construction (e.g.: concrete, local materials)		
estimated height on the SU (m)			dyke status at field survey moment (e.g.: grass-covered, degraded)		
estimated width on the SU(m)			estimated distance from the highest elevation of the river bank to the dyke (m)		

Other structures[7]:	Left side	Right side
	☐ yes, specify: ..... ☐ no	☐ yes, specify: ..... ☐ no

Is the longitudinal continuity affected in the floodplain? ☐ yes ☐ no

If yes, specify by what type of elements[8]: .....

A4.3. Land cover[9]

	Left side	Right side
Natural and semi-natural areas:	☐	☐
arboreal vegetation (groves)	☐ .....%	☐ .....%
shrubs	☐ .....%	☐ .....%
herbaceous vegetation	☐ .....%	☐ .....%
sparse vegetation areas	☐ .....%	☐ .....%
other, specify:	☐ .....%	☐ .....%
Are there natural water surfaces (oxbow lakes, ponds) or swampy areas?	☐ yes	☐ no

If there are natural water surfaces, estimate their surface area, the distance from the riverbanks etc.:
.....

	Left side	Right side
Agricultural areas:	☐	☐
arable lands	☐ .....%	☐ .....%
permanent crops (orchard, vineyard)	☐ .....%	☐ .....%
pastures	☐ .....%	☐ .....%
Artificial areas:	☐	☐
industrial	☐ .....%	☐ .....%
transport units (road and rail networks)	☐ .....%	☐ .....%
other types of constructions, specify:	☐ .....%	☐ .....%
Are there artificial water surfaces (ponds etc.)?	☐ yes	☐ no

If there are artificial water surfaces, estimate their surface area, the distance from the river banks etc.:
.....

Attached documents: *N° of docs/photos*

☐ Sketch of the SU site

☐ Photos upstream/downstream the SU

☐ Photos of significant elements/aspects

☐ Other, specify: .....

[7] E.g.: artificial channels, urban construction, roads etc.
[8] Idem.
[9] The sum of all the percentage filled out (natural and semi-natural, agricultural and artificial areas) shall be 100%.

Fig. 3a. Form type B - Observations and measurements for hydromorphological monitoring of the surface water bodies - rivers through survey units, which refers to data collection on the survey sections (pages 1-2)

Water Basin Administration		Fill out date:	
Name(s) and Surname(s) of the person/people filling out the form		Signature of the person/people filling out the form	
Position/Employer			

Form B

Observations and measurements for hydromorphological monitoring of surface water bodies - rivers through survey units

Form for the ..... SECTION[1]

B1. GENERAL INFORMATION OF THE SECTION				
SU name[2]			Observations start time	
River name			hh	mm
Cadastral code of the river				
Coordinates Stereo 1970		Left bank	Right bank	Observations end time
	North [m]			hh mm
	East [m]			

B2. OBSERVATION AND MEASUREMENTS IN THE SECTION						
B2.1. Discharge						
At the field survey moment, the water has:	☐ no turbidity (clear)	☐ low turbidity	☐ high turbidity	☐ very high turbidity		
Type of flow:	☐ turbulent	☐ slightly turbulent	☐ laminar			
Equipment used for the discharge measurement[3]:						
Discharge (m³/s)		Inactive spaces		Left bank ☐	Right bank ☐	
Mean velocity of the water (m/s)		Water velocity near the banks (m/s)		Left bank	Right bank	
Maximum velocity of the water (m/s)		Water depth at the banks (m)		Left bank	Right bank	
Mean depth of the water (m)		Distance from the water surface to the banks (m)		Left bank	Right bank	
Maximum depth of the water (m)						
Vertical distance from the water surface to the water mark on the bank (m)		Water surface width (m)				
Is there a hydrometric station in the measurement section?				☐ yes	☐ no	
Is there a water quality monitoring section in the measurement section?				☐ yes	☐ no	
Is there a "satellite" section in the measurement section?				☐ yes	☐ no	
Were water/sediment samples taken for determining the physico-chemical and/or biological parameters' values?				☐ yes	☐ no	

[1] The respective section within the SU shall be noted: upstream, median or downstream.
[2] If the survey unit overlaps an already existing monitoring section (water quality monitoring section, hydrometric station, "satellite" section), the SU will take its name; otherwise, it will be named after a local toponym (e.g.: a locality nearby, a hill etc.).
[3] E.g.: hydrometric current meter type OTT C31, serial number ...../ADCP etc.

Observations and measurements for hydromorphological monitoring of surface water bodies - rivers FORM B
SU: Date:

B2.2. Measurements for the transversal profile[4]			
Date of the measurements		Water surface slope (‰)	
Equipment used		Type and equipment serial number	
Left bank point description:			
Right bank point description:			

B3. CHANNEL

On how many channels the flow occurs?

☐ 1 ☐ 2 ☐ >2 (braided/anabranching), specify: .....

B3.1. Aspect general in profil transversal

☐ asymmetric on the left	☐ asymmetric on the right	☐ "U" shaped	☐ deep and narrow
☐ "in steps"	☐ wide	☐ trapeze shaped	☐ artificial, with a low water channel

Are there dykes in the river channel?	Left bank	Right bank
	☐ yes, estimated height: .....m ☐ no	☐ yes, estimated height: .....m ☐ no

B3.2. Observations on river bed

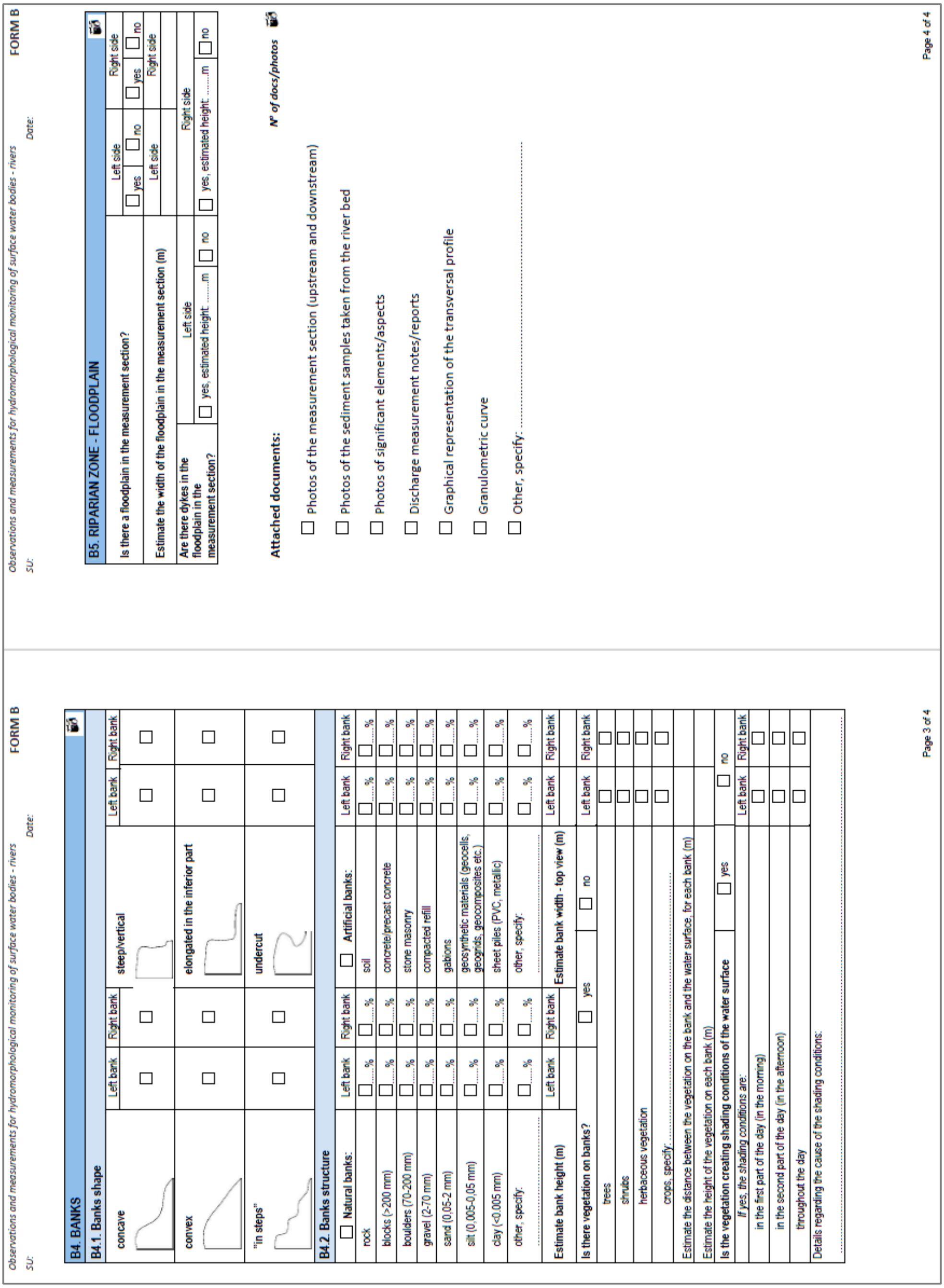
☐ Natural		☐ Artificial
☐ rock .....%	☐ sand (0,05-2 mm) .....%	☐ concrete .....%
☐ blocks (>200 mm) .....%	☐ silt (0,005-0,05 mm) .....%	☐ stone masonry .....%
☐ boulders (70-200 mm) .....%	☐ clay (<0.005 mm) .....%	☐ other .....%
☐ gravel (2-70 mm) .....%		specify: .....

Granulometric composition is obtained through: ☐ granulometric curve[5] ☐ visual observations

B3.3. Observations on vegetation and other objects in river water

Is there aquatic vegetation?	☐ yes	☐ no
If yes, specify its type and the degree of development:		
Are there vegetal debris in the water? (ex.: wooden debris, leaves etc.)	☐ yes	☐ no
Is there waste in the water?	☐ yes	☐ no

[4] The graphical representation of the transversal profile shall be attached.
[5] The granulometric curve and a photograph of the sediment sample shall be attached.



Observations and measurements for hydromorphological monitoring of surface water bodies - rivers **FORM B**

SU: *Date:*

B4. BANKS					
B4.1. Banks shape					
	Left bank	Right bank		Left bank	Right bank
concave	☐	☐	steep/vertical	☐	☐
convex	☐	☐	elongated in the inferior part	☐	☐
"in steps"	☐	☐	undercut	☐	☐
B4.2. Banks structure					
☐ Natural banks:	Left bank	Right bank	☐ Artificial banks:	Left bank	Right bank
rock	☐ ....%	☐ ....%	soil	☐ ....%	☐ ....%
blocks (>200 mm)	☐ ....%	☐ ....%	concrete/precast concrete	☐ ....%	☐ ....%
boulders (70-200 mm)	☐ ....%	☐ ....%	stone masonry	☐ ....%	☐ ....%
gravel (2-70 mm)	☐ ....%	☐ ....%	compacted refill	☐ ....%	☐ ....%
sand (0,05-2 mm)	☐ ....%	☐ ....%	gabions	☐ ....%	☐ ....%
silt (0,005-0,05 mm)	☐ ....%	☐ ....%	geosynthetic materials (geocells, geogrids, geocomposites etc.)	☐ ....%	☐ ....%
clay (<0.005 mm)	☐ ....%	☐ ....%	sheet piles (PVC, metallic)	☐ ....%	☐ ....%
other, specify:	☐ ....%	☐ ....%	other, specify:	☐ ....%	☐ ....%
Estimate bank height (m)	Left bank	Right bank	**Estimate bank width - top view (m)**	Left bank	Right bank
Is there vegetation on banks?	☐ yes		☐ no	Left bank	Right bank
trees				☐	☐
shrubs				☐	☐
herbaceous vegetation				☐	☐
crops, specify:				☐	☐
Estimate the distance between the vegetation on the bank and the water surface, for each bank (m)					
Estimate the height of the vegetation on each bank (m)					
Is the vegetation creating shading conditions of the water surface		☐ yes		☐ no	
If yes, the shading conditions are:				Left bank	Right bank
in the first part of the day (in the morning)				☐	☐
in the second part of the day (in the afternoon)				☐	☐
throughout the day				☐	☐
Details regarding the cause of the shading conditions:					

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Observations and measurements for hydromorphological monitoring of surface water bodies - rivers **FORM B**

SU: *Date:*

B5. RIPARIAN ZONE - FLOODPLAIN				
	Left side		Right side	
Is there a floodplain in the measurement section?	☐ yes	☐ no	☐ yes	☐ no
Estimate the width of the floodplain in the measurement section (m)	Left side		Right side	
Are there dykes in the floodplain in the measurement section?	Left side: ☐ yes, estimated height: ....m	☐ no	Right side: ☐ yes, estimated height: ....m	☐ no

Attached documents: *N° of docs/photos*

- ☐ Photos of the measurement section (upstream and downstream)
- ☐ Photos of the sediment samples taken from the river bed
- ☐ Photos of significant elements/aspects
- ☐ Discharge measurement notes/reports
- ☐ Graphical representation of the transversal profile
- ☐ Granulometric curve
- ☐ Other, specify: ....

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Fig. 3b. Form type B - Observations and measurements for hydromorpological monitoring of the surface water bodies - rivers through survey units, which refers to data collection on the survey sections (pages 3-4)

This database, developed and updated in time, will support and guide the future research on river hydromorphology and a better understanding of the effects of hydromorphological changes on river biota.

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REFERENCES

1. Administrația Națională “Apele Române” (ANAR) (2016), *Planul Național de Management actualizat 2016-2021*.
2. Birk S. (2003), *Review of European assessment methods for rivers and streams using Benthic Invertebrates, Aquatic Flora, Fish and Hydromorphology*, PhD Thesis, Universitatea Duisburg-Essen, Germania, 107 p.
3. Gurnell A. M., Rinaldi M., Belletti B., Bizzi S., Blamauer B., Braca G., Bujse A. D., Bussettini M., Camenen B., Comiti F., Demarchi L., Garcia de Jalon D., Gonzales del Tanago M., Grabowski R. C., Gunn I. D. M., Habersack H., Hendriks D., Henshaw A. J., Klosch M., Lastoria B., Latapie A., Marcinkowski P., Martinez-Fernandez V., Mosselman E., Mountford J. O., Nardi L., Okruszko T., O’Hare M. T., Palma M., Percopo C., Surian N., Van de Bund W., Weissteiner C., Zilliani L. (2016), A multi-scale hierarchical framework for developing understanding of river behaviour to support river management, *Aquatic Sciences*, 78, 1-16 p.
4. Ilnicki P., Górecki K., Grzybowski M., Krzemi A., Lewandowski P., Sojka M. (2010), Principles of hydromorphological surveys of Polish rivers, *J. Water Land Dev*. 14, 3-13 p.
5. Institutul Național de Hidrologie și Gospodărire a Apelor (INHGA) (2015), *Metodologie de determinare a indicatorilor hidromorfologici pentru cursurile de apă din România*.
6. Institutul Național de Hidrologie și Gospodărire a Apelor (INHGA) (2016), *Ghid privind determinarea parametrilor hidrologici și morfologici pentru râuri în conformitate cu Anexa V actualizată a Directivei Cadru Apă 2000/60/EC*.
7. Lupu I., Moldoveanu M., Perju R., Gălie A. C. (2017), An approach for hydro-morphological monitoring of river water bodies, *Air and Water Components of the Environment*, Edit. Casa Cărții de Știință, Cluj-Napoca, ISSN: 2067-743X, 18-25 p.
8. Moldoveanu M., Galie A., Rădulescu D. (2015), Methodology for hydromorphological assessment of Romanian rivers - Results of testing, *15th International Multidisciplinary Scientific Geoconference 2015, Albena, Conference Proceedings*, ISBN 978-619-7105-36-0 / ISSN 1314-2704, Book 3 Vol. 1, p. 427-436.

9. Wolter C., Lorenz S., Scheunig S., Lehmann N., Schomaker C., Nastase A., Diego García de Jalón D., Marzin A., Lorenz A., Kraková M., Brabec K., Noble R., (2013), *Review on ecological response to hydromorphological degradation and restoration*, REFORM Project (Restoring Rivers for Effective Catchment Management).
10. *** (2005), *Water quality — Guidance standard for assessing the hydromorphological features of rivers,* SR EN 14614/2005.
11. *** (2010), *Water quality – Guidance standard on determining the degree of modification of river hydromorphology*, EN 14614/2010.
12. *** (2014), *Directiva 2014/60/UE a Comisiei din 30 octombrie 2014 de modificare a Directivei 2000/60/CE*, Parlamentul European şi Comisia de stabilire a unui cadru de politică comunitară în domeniul apei.