SOURCES OF POLLUTION AS A HAZARD FOR RIVER ENVIRONMENT IN CASE OF FLOOD

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ABSTRACT. – Sources of pollution as a hazard for river environment in case of flood. In the case of flood the main damages on the environment may occur as a consequence of accidents at sources of pollution. The issue of pollution sources is a key area of environmental protection. While pollution from point sources can be disposed by suitable technology, for diffuse pollution are essential proposals of preventive measures, that creating conditions to prevent contamination. The paper presents results of evaluation the sources of pollution in Hornad river basin in the eastern Slovakia in flooded area. Environmental risk assessment methods can be particularly useful in evaluating whether uses are threatened when a stressor of concern is not expressed as a numeric criterion in water quality standards. The risk assessment framework can add value to watershed-based management.

Keywords: sources of pollution, flooded area, environmental risk, river basin

1. INTRODUCTION

The European Parliament and the Council of the European Union establishing a framework for Community action in the field of water policy on 23 October 2000 by Directive 2000/60/EC, in short EU Water Framework Directive or WFD. The purpose of this Directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater which (WFD, 2000):

a) prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems;

b) promotes sustainable water use based on a long-term protection of available water resources;

c) aims at enhanced protection and improvement of the aquatic environment, inter alia, through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation or

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phasing-out of discharges, emissions and losses of the priority hazardous substances;

d) ensures the progressive reduction of pollution of groundwater and prevents its further pollution;

e) contributes to mitigating the effects of floods and droughts and thereby contributes to:

- the provision of the sufficient supply of good quality surface water and groundwater as needed for sustainable, balanced and equitable water use,

- a significant reduction in pollution of groundwater,

- the protection of territorial and marine waters, and

- achieving the objectives of relevant international agreements, including those which aim to prevent and eliminate pollution of the marine environment.

Effective water management, as required by the WFD, helps Member States prepare for extreme weather events which, due to climate change, are becoming more frequent and cause tremendous damages. The paper concern on the assessment of the sources of pollution in Hornad river basin in the eastern Slovakia which are located in flooded area. These sources of pollution could presents serious risk for water body in case of flood.

2. MATERIAL AND METHODS

The WFD requires information to be collected and maintained on the type and magnitude of significant anthropogenic pressures, and indicates a broad categorisation of the pressures into:

- Point sources of pollution;
- Diffuse sources of pollution;
- Changes in water levels and flow caused by abstraction or recharge.

Any other hazards must also be identified. There is also a necessity to consider land use patterns (e.g. urban, industrial, agricultural, forestry etc) as these may be useful to indicate areas in which specific risks are located. The risk assessment should use both information from the review of hazards to determine the likelihood that the water body will fail to meet its environmental quality objectives. For water bodies at risk will be necessary to consider the implementation of measures (EC, 2003). It is clear from the WFD that the risks are the result of hazards. An example of the analytical framework is illustrated in Figure 1.

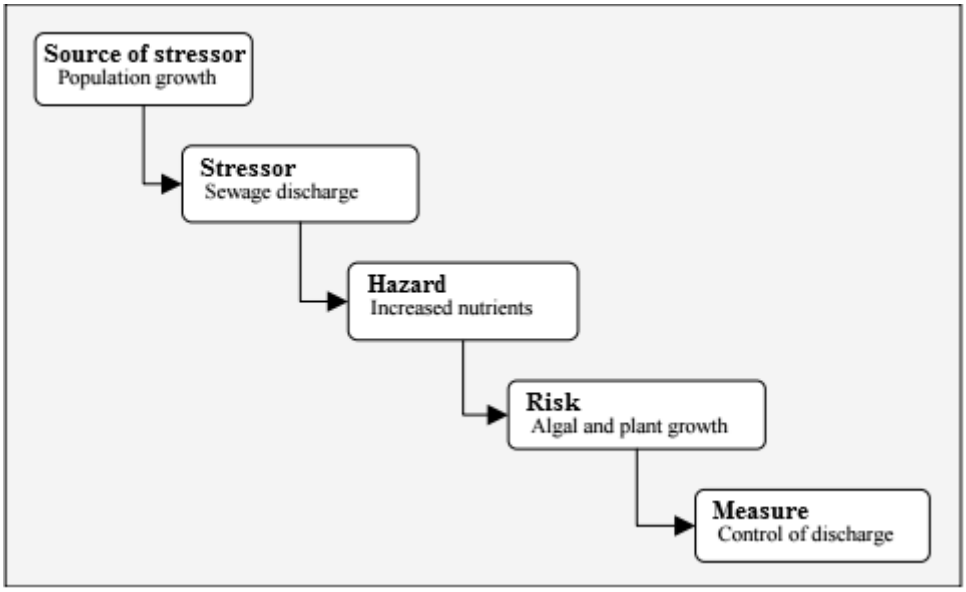

Fig. 1. ***Example of the framework***

A hazards and risks assessment will be a four-step process:

1. describing the stressors and identifying hazards with possible impacts on the water body, by considering the its magnitude especially land use, urban development, industry, agriculture and other activities which lead to risks;

2. analysing the impacts resulting from the hazards and state the criteria based on the significance of the impact;

3. evaluating the likelihood of causing the risk based on the localisation of the source of pollution in the flooded area; and

4. assessing the risk for water body.

In the first instance the list of hazards (sources of pollution) and the assessment of impacts on a water body, and possibly on up- or downstream situated water bodies, shall ensure the identification of all of the potentially important problems. Assessing the likely impacts arising from each of the hazars will produce a list that can be used to identify the water bodies in a risk – these situased in the flooded area. This list becomes a basis for developing a programme of measures which might be undertaken in order to achieve good status of water body.

In the paper the Hornad River basin is considered as a study area for the assessment. The Hornad watershed (figure 2) is situated in the Hornád river valley, between the city of Kosice, which is the second largest city in Slovakia and the Hungarian border. The source of the Hornad is in the Low Tatra Mountains under the Kralova hola hill, southwest of Poprad. It flows through the Slovak regions of Spis and Abov, and through Hungary. It is 286 km long, 193 km of which are located on the territory of Slovakia. Cities along its course are Spisska Nová Ves and Kosice and its tributaries include the rivers Hnilec and Torysa (Presov). It

flows into the river Sajo southeast of Miskolc which is itself a tributary to the river Tisza.

Fig. 1. ***Hornad river basin in Slovakia within Danube river basin***

Preliminary flood risk assessment which was done in 2011 in Slovakia according to the requirements of Flood Directive 2007/60/EC of 23 October 2007 on the assessment and management of flood risks identified the geographical areas with potentially significant flood risk and geographical areas with probably potentially significant flood risk in river basin Hornad. For these areas flood hazard and flood risk maps were done in 2013 which are available at web of Ministry of Environment of the Slovak Republic for flood with return period of 5, 10, 50, 100 (figure 3) and 1000 years. Potential sources of water contamination are all activities in the catchment, all contaminated sites and landfills, industrial activities, agricultural activities, and other. Point sources of pollution in river basin Hornad are identified in figure 3.

3. RESULTS AND DISCUSSION

Flooding of mentioned sources of pollution as well as from diffuse sources of pollution may leak out pollutants and thus deteriorate the quality of surface water, groundwater, and soils, which can lead to environmental disasters, such as

damage of habitats, fauna and flora as well as diseases and epidemics occurrence (Ondrejka Harbulakova and Hudakova, 2014; Markovic et al, 2014; Zelenakova and Oravcova, 2015).

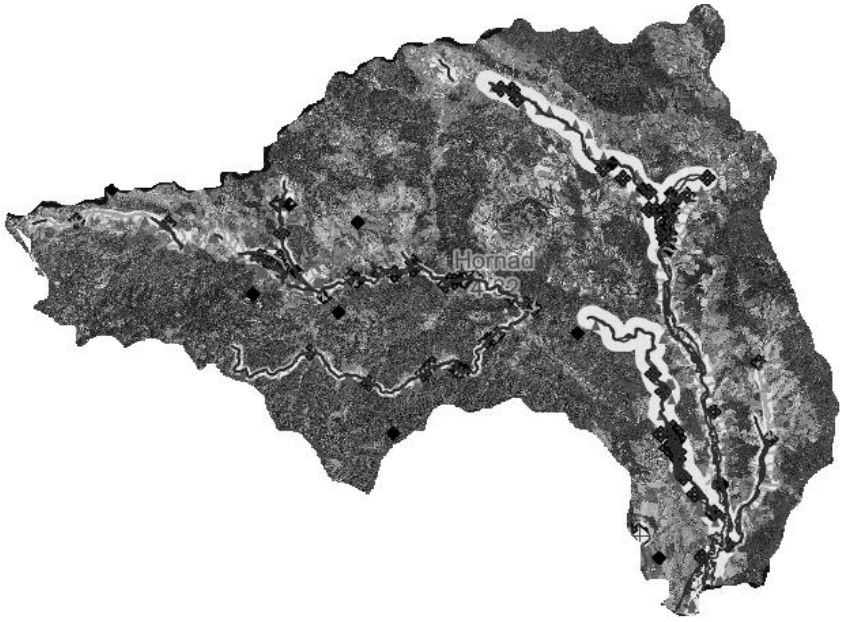

Figure 3. ***Point sources of pollution in flooded areas of river basin Hornad*****.**

Table 2 gives information source of pollution and their classification according the degree of danger for environment, stated by authors. Each source was divided into categories according different criteria based on literature studying, consultation and experiences. The more dangerous source of pollution has the higher point classification.

The actual sources of pollution in the studied area – Hornad River (without its tributaries), situated in the flooded area are marked in bold in table 2. It is resulted as follows:

– Industrial enterprises and sewage treatment plants were identified in the area as it is stated in the Table 2;

– Surface mine area near Kosice City was identified;

– Agricultural area contains 47.0 % from whole the flooded area (by Q100);

– Percentage of population without sewerage is 24.0 as from 705 102 of equivalent inhabitants 47.0 % is connected to sewerage systems and 29.0 has individual systems of wastewater treatment;

– Environmental burden – there are likely as well as confirmed burden in the study area – according the Register of contaminated sites (REZ).

Table 2. ***Calculation of consequences of contamination on the environment.***

Labelling	Source of contamination (SC)	Component category of source of contamination	Point classification of hazard (H)	Weight (W)	SC in flooded area Q_{100} (SCF)	H x W x SCF
Point sources of contamination (SC)						
A1	Enterprises with hazardous substances present	Not assigned	5	0.2	11	11
		A		0.3	2	3
		B		0.5	0	0
A2	Sewage treatment plant	to 2000 EO	5	0.14	0	0
		2000 – 10000 EO		0.21	10	10.5
		10000 – 100000 EO		0.29	2	2.9
		over 100000 EO		0.38	1	1.9
A3	Pumping station	-	3	1	0	0
Diffuse sources of contamination (SC)						
B1	Waste dumps	for inert waste	5	0.12	0	0
		for non-hazardous waste		0.29	0	0
		for hazardous waste		0.59	0	0
B2	Sludge beds	-	3	1	0	0
B3	Mine activities	underground	4	0.4	0	0
		surgace		0.6	1	2.4
B4	Population with no sewerage	0 – 40%	4	0.12	1	0.48
		40 – 60%		0.29	0	0
		60 – 100%		0.59	0	0
B5	Agriculture	0 – 40%	3	0.12	0	0
		40 – 60%		0.29	1	0.87
		60 – 100%		0,59	0	0
B6	Environmental burden	probable (A)	3	0.29	0	0
		confirmed (B)		0.59	11	19.47
		reclaimed/re-cultivated location (C)		0.12	3	1.08
Σ of consequences (C_j)						53.60

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key area of environmental protection. While pollution from point sources can be disposed by suitable technology, for diffuse pollution are essential proposals of preventive measures, that creating conditions to prevent contamination.

Risks in river basins are close-knit with quality of water in water bodies and sources of pollution in the catchment area. Sources of pollution in river basins are mainly urbanization, industry and agriculture, which cause a threat to water resources. The negative impacts of human activities are reflected in both the contamination of water bodies and the deterioration of natural water circulation. The sources of pollution present a great hazard for aquatic environment mainly in case of flood. The flooded area within each is situated point or diffuse source of pollution deteriorated water quality in high rate. Systematic determination and evaluation of occurrence and condition of water bodies is the mission of a state, being an indispensable necessity for the provision of creation the concepts of sustainable development, for the execution of state administration and for keeping public informed.

4. CONCLUSIONS

Implementation of the mitigation measures will be based on the prepared project documentation in accordance with the Planning and Building Act as amended, as well as later regulations determining the subsequent issue of a building permit. Documentation of flood-protection measures will include all the requirements for taking measures to mitigate the negative impacts of the proposed activity on the environment, and to prevent, mitigate, minimize or compensate the expected impacts of the activity which may arise during its implementation. For the implementation of the construction, it is necessary to follow these precautions:

- territorial planning measures;
- technical measures (only the necessary belt of riparian vegetation may be cut before the construction; interventions in the area situated in the immediate vicinity of the construction site must be minimized);
- technological measures (the technological part of the work must be carried out in accordance with the prepared project documentation);
- organization and operation measures (safety requirements must be respected on the construction site; the construction site and dumps of material must be located where there will be no devastation of existing grasslands);
- other measures (the disposal of generated waste must be carried out in accordance with applicable legislation; an appropriate monitoring system of surface and ground-water quality must be maintained during the implementation of the construction; monitoring and evaluation of the activity (post-project analysis) must be performed.

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