

# PROVISIONS FOR FLOODS PREVENTION AND CONTROL IN GILORT HYDROGRAPHIC BASIN

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**ABSTRACT. Provisions for Floods Prevention and Control in Gilort Hydrographic Basin.** This study consist in the explanation, analysis and synthesis of the data regarding the effects generated by the high waters manifestations at basin level, for the interval 1995-2007. Those effects were divided in three categories (social, economic and ecological effects), and were analyzed at both years and localities repartition level, accompanied by a value estimation of the damages and losses localization maps.

**Key-words:** Gilort, high waters, social effects, economic effects, ecological effects, damages

## 1. Introduction

Structural provisions represented in the past the only way of defense against floods. Known and used as far back as antiquity, these ones experienced in time a tremendous typological diversification, leading, with the apparition, acceptance and utilization on large scale, of non-structural provisions, to a much more efficient prevention and control activity of floods and high waters manifestation effects.

## 2. Structural Provisions

The main structural provisions unfolded in the Gilort's hydrographic basin in order to protect the territory against high waters and floods are represented by banking, rectification and bank protection works, plus, with less important heaviness, de-siling, water course adjustments or anti-erosion crossings. In the analyzed area there are no permanent water storages or dam systems.

Therefore, of the most important such works, we mention: *rectification of the Călnic creek at Prigoria*, with a total length of 2,8 km; it was first deployed in the year 1969 (in that period the work's length was of only 1,5 km); on this sector

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was performed more recently the de-silting of the riverbed in order to ensure the active flow section. For the same structure it was also compiled the feasibility study for the expansion with the sector *Zorlești – Dobrana*, with an estimated value close to 7500 euro. This sector proposed for development will have a total length of 5 km, being comprised between the confluence of Lia creek with Câlnic river and past Dobrana locality, situated downstream.

The work of *rectification and bank defense of Galben river at Baia de Fier*, when it was deployed for the first time, in the year 1980, was composed from a bank defense on 1,5 km length (constituted from gabions and retaining wall) and a rectification of the riverbed on 15 km length. Following the various damages of the facilities during the 1999 high waters, were executed a series of works (finalized in the year 2008), which consisted in: bank consolidations (L=3,79 km), riverbed field calibration (L=8,46 km), disposition of a total number of 22 crossings and establishment of 2 chutes and 6 under-crossings. All these works have an inventory value of over 4.500.000 lei. In the present days, the banks stability is ensured, the de-silting of the riverbed ensuring also the active water flow section.

*Rectification and banking of the Ciocadia river at Ciocadia* was deployed in the year 1977, including in that period banking and rectification works (on 2 km length), with a height of 2 m and a width at base of 3 m. In the year 2010 were retrieved the critical points emerged, by banks consolidations with rocks and gabions (on 80 m length) and were executed riverbed de-silting works on 1,5 km, in order to ensure the active flow section.

The work of *rectification of the Blahnița river at Săcelu* is composed from 3 km of rectification and bank defense, being commissioned in the year 1977. In the year 2010 were executed rehabilitation works in critical points, materialized in rocks and gabions bank consolidations (in the sections where the retaining wall was damaged were executed underpinnings with a total length of 100 m), plus riverbed de-silting works.

Regarding the work of *rectification and banking of the Gilort river at Novaci*, it was deployed in the year 1978, comprising 5 km of dams (with a height of 2 m and a width at base of 3 m), 5 km of bank defense and 5 km of rectifications. Following the damages produced by the high waters, were contracted rehabilitation works, completed in the year 2008, materialized in the riverbed reshaping on a total length of 8 km, the retaining wall construction on 4,34 km length and the deployment of 11 crossings and 2 chutes. This work has an inventory value of approximately 11.000.000 lei. In the year 2010 were necessary other reparations in some areas, by rocks reinforcement of the banks. In the same time, were executed also works that included groundwork dam consolidations on the right bank on 2 km length, in order to bring it to the projection mark.

*The rectification and banking of the Gilort river at Pociovaliște*, was completed in the year 1981, including in 5 km of dams (with a height of 2 m and a width at base of 3 m), plus 6,3 km of bank defense (formed from gabions and retaining walls) and 6,3 km of rectifications. During the past high waters, the works

have suffered damages, being repaired, reaching a total length of 11 km. In the year 2010 were necessary new interventions in order to achieve bank consolidations with rocks. In the same year were executed also various works of dam maintenance (deforestation, land trimming, vegetation mowing, evergreen grass seeding).

In Târgu-Cărbunești locality were installed over 20 anti-erosion crossings, with heights varying from 4 m to 20-30 cm, deployed first of all in order to avoid vertical erosion at bridges abutments located in the riverbed. Initially, these crossings were oversized, accelerating the erosion processes, instead of attenuate them, especially at bridges abutments that cross Blahnița and Gilort rivers. That fact led to the construction of supplementary crossings, in order to decrease the force exerted by the chutes.

Apart from these crossings, that cover approximately 6 km length, are deployed extensive rectification and bank defense works, periodically being deployed also riverbed de-silting activities.

*Rectification of the Gilort river at Brănești* is of a smaller amplex, formed from rectifications on a total length of 0,9 km, which until present days never required reparations. It was first used in the year 1977.

Equally reduced, in terms of dimensions, in the work of *rectification of the Gilort river at Frasinu*, in Vldimir commune, having a total length of the rectification of 0,5 km and being functional from the year 1983. Due first of all to the reduced dimensions, never needed the adoption of reparation measures until present days.

In the same direction it is registered the work of *rectification of the Socu creek at Socu*, in the Bărbătești commune area, having a total length of 0,3 km and being used starting with the year 1972.

Referring to the future measures, they include either starting new projects, either the expansion of the already existing buildings in some areas from the basin; of the most important, we mention: rectification of Purcaru creek, in the Purcaru and Săulești area, till the confluence with Gilort river; rectification of the Blahnița river on various sectors, situated upstream and downstream Târgu-Cărbunești locality, till the confluence with Gilort river; rectification of the Gilort river downstream Târgu-Cărbunești locality; rectification of the Gilort river past Albeni locality; rectification of Galben river upstream Baia de Fier locality; rectification of the Blahnița river in the confluence area with the Turbați creek; banking works on Călnic creek, in the confluence area with the Bârzei creek.

### **3. Non-structural Provisions**

#### **3.1. Brief History of Legislation in Study Field at European and National Level**

**At European level**, starting with the years '80, was born a growing concern regarding the phenomenon represented by flood, high waters and the

connected effects, materialized in the attempt to elaborate laws and other legislative documents in order to attend the issue of prevention, protection, control and mitigation measures of the effects induced by these extreme events.

The most important documents for the present study were the *Directive 2000/60/EC of the European Parliament and of the Council* (from October 23, 2000 establishing the framework for Community action in the field of water policy) and *Directive 2007/60/EC of the European Parliament and of the Council* (October 23, 2007), *on the assessment and management of flood risks*.

**At national level**, the first relevant document for the present study from Romania after World War II is the **Ministers Council Decree no. 307**, from May 16, 1963, for the approval of the *Regulation regarding the defense against floods and ices* and of the *Normative for the constitution of the minimum reserve of materials and tools necessary to the defense against floods and ices*.

In chronological order, were analyzed the main legislative documents regarding the issue represented by high waters and floods on state's territory, more developed presentations being reserved for the following documents: **Law 8/1974** (from March 8, 1974, representing the first **Water Law** from post-war Romania); **Law 1/1976** (issued on April 15, 1976, referring to the enactment of the „National perspective plan for the hydrographic basins schemes from Social Republic of Romania”); **Law 107/1996** (Water law); **Law 575/2001** (it refers to the approval of the *National landscaping plan – Section V – Natural risk zones*); **Decree 823/2006** and **Decree 1427/2006** (issued by the minister of the environment and water management and by the minister of the administration and internal affairs, regarding the approval of the *Codification procedure for the meteorological notifications and warnings emitted in the case of the production of dangerous meteorological phenomena at national or regional scale* and *Codification procedure for the hydrological warnings and alerts emitted in the case of the production of dangerous hydrological phenomena at national or regional scale*); **Decree 132/2007** (regarding the approval of the *Methodology for the elaboration of the Analysis and Coverage Plan of the Risks (ACPR) and its Framework*); **Decree 762/2008** (for the adoption of the *National strategy for the prevention of emergency situations*); **Decree 976/2008** (by which it is approved the *Methodology for the determination of hydrographic basins with torrential character in which are located human settlements exposed to the risk of rapid high waters*); **Law 260/2008** (regarding the obligatory assurance of the houses against earthquakes, landslides or floods); **Decree 846/2010** (for the approval of the *National strategy for the management of flood induced risk on medium and long term*) etc.

### 3. 2. Organizational Provisions

**Elaborating Defense Plans against Floods** This stage has at base the *Regulation regarding the management of the emergency situations generated by floods, dangerous meteorological phenomena, accidents at the hydro-technical*

constructions and accidental pollutions. Within the annexes are presented the contents of the defense plans against floods, ices, accidents at the hydro-technical constructions and accidental pollutions of the hydro-technical system at various organizational levels.

**Table 1** – Defense provisions against floods at county level  
(source: *E.S.I. „Lt. Col. Dumitru Petrescu” of Gorj County*)

<p><b>Provisions for warning- alarming population when are received hydrological and meteorological warnings</b></p>	<ul style="list-style-type: none"> <li>- Information transmission regarding hydro-meteorological dangerous events via TV, cable and local mass-media.</li> <li>- Warnings transmission to the local committees for emergency situations via Operational Center of the Emergency Situations Inspectorate Gorj.</li> </ul>
<p><b>Provisions when is reached :</b> - <b>attention level AL</b> - <b>phase I dams defense</b> - <b>phase I ices defense</b> - <b>precipitations</b> <b>forewarning thresholds</b></p>	<ul style="list-style-type: none"> <li>- Data and information transmission according to the information flow approved by the defense plan against floods;</li> <li>- Rods reading and data transmission once a day;</li> <li>- Water courses surveillance on the sectors where ice is stuck and on the points where ice dams or ice gorges are formed.</li> </ul> <p><b>RAINFALL CRITICAL THRESHOLDS:</b> -15 mm /3 h -25 mm /6 h -25 mm / 1 h</p>
<p><b>Provisions when is reached :</b> - <b>flooding level FL</b> - <b>phase II dams and ices defense</b></p>	<ul style="list-style-type: none"> <li>- When it is meet a forecast with remarkable discharge augmentations, it is possible to advance the beginning some of intervention works, such as those against crest of wave overflow;</li> <li>- Regarding the ices, it is impossible to elaborate forecasts on maximum levels, consequently intervention materials will be transported in the areas where are meet the conditions of ice dams formation;</li> <li>- On the internal rivers confined by dikes, blockings begin especially in narrow locations and upstream bridges, being necessary routing provisions for the floes, in order to avoid ice dams formation.</li> </ul>
<p><b>Provisions when is reached :</b> - <b>danger level DL</b> - <b>phase III dams and ices defense</b></p>	<ul style="list-style-type: none"> <li>- Data and information transmission according to the information flow approved by the defense plan against floods;</li> <li>- Defense of the objectives from non-impounded areas by specific works: dams, circular ditches, “rabbit” dams;</li> <li>- People, animals and goods evacuation from their households in the established areas;</li> <li>- Shelter, drinking water, medicine and food assurance for the distressed.</li> </ul> <p>During the floods, water may act destructive against dams:</p> <ol style="list-style-type: none"> <li>1.the streams along external bevel and anaphors formed in their proximity;</li> <li>2.waves patter which may destruct and wash the external bevel;</li> <li>3.dams infiltrations, softening and drifting;</li> <li>4.leaks through dams bodies;</li> <li>5.infiltrations through foundations, leaks under the dam, grafts apparition and dam collapse;</li> <li>6.dam’s crest of wave overflow.</li> </ol> <p>If all these are not refuted through specific provisions:</p> <ol style="list-style-type: none"> <li>1.spurs construction, in order to carry off the streams from the bank;</li> <li>2.works execution for the bank’s consolidation, through:             <ol style="list-style-type: none"> <li>a)rolling the twigs cylinders filled with stones on the whole length of the erosion;</li> <li>b)depositing rough stone in the erosion areas;</li> <li>c)execution of a horseshoe-dam on the whole eroded length, with bevel collapse.</li> </ol> </li> <li>2.Bank defenses with floating works (fascine mattress, fences with frontal stakes).</li> <li>3.Defense against infiltrations:             <ol style="list-style-type: none"> <li>a)- dams wedging;</li> <li>- applying earth sacks at “rabbit” dams;</li> </ol> </li> </ol>

	<ul style="list-style-type: none"> <li>- wall from wood cofferdams;</li> <li>- wall from metal cofferdams;</li> <li>- wall from planks with pilots.</li> <li>4. Defense against dam's drifting:             <ul style="list-style-type: none"> <li>- wall of sacks filled with earth;</li> <li>- pilots wall;</li> <li>- making the internal bevel heavy using sacks with earth (counterweights);</li> <li>- constructing the second ramrod.</li> </ul> </li> <li>5. Detecting the entrance gallery of the water, the intervention being performed from water side:             <ul style="list-style-type: none"> <li>- concreting the bevel;</li> <li>- intercepting the gallery by digging a ditch, which is then filled with sacks of dry earth;</li> <li>- covering the entrance with sacks of earth;</li> <li>- walls from cofferdams;</li> </ul> </li> <li>6. Applying of some concrete tubes or even opened barrels, over the eruption crater;             <ul style="list-style-type: none"> <li>- wall formed from sacks of earth deployed circular around the exit aperture (neutralization of the graft);</li> </ul> </li> <li>7. Simple over-elevations :             <ul style="list-style-type: none"> <li>- over-elevations on walls of sacks basis.</li> </ul> </li> </ul>
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### **Actions for Educating and Informing Population and Risk Perception**

The education and information of the population is realized by the Civil Protection Service from Departmental Inspectorate for Emergency Situations of Gorj Department, which effectuate periodically various checking actions, while the Compartment for the Population Education from the same institution organizes technical-applicative circles for students. Professional contests for the voluntary and private services for emergency situations and exercises of evacuation in emergency situations.

Regarding the perception of the risk associated to high waters and floods, it was applied a perception questionnaire of the flood induced risks (after Sorocovschi, 2004), including a set of 24 questions, structured and framed in 4 sections:

- I – Subjects profile;
- II – Experience, knowledge and didactics level;
- III – Perception of the proportion in which the authorities are involved in the high waters and floods management activities;
- IV – Availability to charity actions, evacuation and displacement measures.

The questionnaire was applied in 10 of the 18 administrative-territorial units from the basin, to a total number of 240 subjects, by direct questioning, in the interval March 1 – April 30, 2011.

**The conclusions** draw would be the following ones:

- a great deal of the population do not detain complete and correct information referring to the structural provisions existing in the residence locality, nor yet related to what it is recommendable to be done;

- an elevated percent of the old population, that leads to a decreasing number of affirmative responses regarding voluntary actions and availability to evacuate the residence in case of flood manifestations;
- a low degree of trust in authorities and the lack of information regarding the measures taken by these ones;
- the low number of cases in which high waters produced floods in the analyzed basin and the absence of the catastrophic episodes, that could be one of the explanations for the lack of information;
- the relative high number of persons that wish to acquire a certain information level on the manifestation of extreme phenomena, by virtue of meteorological forecasts presented at national or regional level, at radio or television posts.

### **3. 3. Insuring and Relieving Provisions for Population**

On November 10, 2008, the Romanian Parliament adopted the *Law 260/2008*, regarding the obligatory insurance of the houses against earthquakes, landslides or floods. As the result of risk perception questionnaire application in March-April 2001 interval, from the total number of interviewed persons, a percent of 14,6% declared that they detain an assurance policy of the house or of various other properties against dangerous natural phenomena.

Referring to the indispensable relief measures in case of high waters or floods manifestation, the authorities published various lists, including the hospitals, the units belonging to the scholar system that can assure lodging and soup kitchen, plus the number of touristic units that can provide the same facilities. Therefore, in the basin are functioning 2 hospitals, Târgu-Cărbunești Public Hospital (323 beds) and Novaci Public Hospital (133 beds), there is a number of 5435 lodging place and can be assured soup kitchen for at least 2235 persons.

### **3. 4. Warning, Alert and Forecasting Provisions in Case of High Waters or Floods Occurrence**

The necessary observations and provisions in order to compile the documentation of forecast or to elaborate the warnings according to the color code are made, depending on their destination, using either data recorded at the 6 hydrometric stations from the basin, either at the meteorological stations located near the basin, with multiple references in the previous chapters. It is to mention the fact that, against the lack of meteorological data from the basin, the hydrometric stations perform also meteorological data records, so that each one of these has designated both critical thresholds for the exceeding of attention, flood, or danger levels on the rivers and precipitations critical thresholds, according to the color code (table 2).

**Table 2 . Values of Critical Thresholds for Precipitations and Levels, according to Color Code**

Water Course	Hydrometric Station	Critical Thresholds <b>YELLOW</b> CODE			Critical Thresholds <b>ORANGE</b> CODE			Critical Thresholds <b>RED</b> CODE		
		Precipitations		Level	Precipitations		Level	Precipitations		Level
		1 h (mm)	3 h (mm)	AL (cm)	1 h (mm)	3 h (mm)	IL (cm)	1 h (mm)	3 h (mm)	DL (cm)
Galbenu	Baia de Fier	20-30	45	220	30-50	60	280	50	80	350
Ciocadia	Ciocadia	20-30	45	200	30-50	60	300	50	80	400
Blahnița	Săcelu	20-30	45	230	30-50	60	300	50	80	450
Blahnița	Tg.Cărbunești	20-30	45	400	30-50	60	500	50	80	600
Gilort	Tg.Cărbunești	20-30	45	320	30-50	60	420	50	80	550
Gilort	Turburea	20-30	45	250	30-50	60	350	50	80	550

In the annexes of the *Analysis and Coverage Plan of the Risks* are to be found detailed the behavior rules in various emergency situations, among which are found high waters and floods. Of the most important such provisions designated after the high waters manifestation, we mention: avoiding house access if it was damaged, avoiding the usage of natural gas and electricity supply network before a check performed by specialists in the domain, avoiding contact with bare wires and cables, sterilizing water and aliments and avoiding the consume of those ones that are contaminated with water resulted from the high water manifestation, plus, on longer term, disposal of the consequences, banks release and cleaning, decontamination or reparation actions at household level. It is recommended also to assist the affected population with material aids and work force.

In the *Analysis and Coverage Plan of the Risks* are included, as information tools, 2 local radio stations (Radio Omega and Radio Târgu-Jiu) and 6 local television stations (RCS Târgu-Jiu, Gorj TV, RTV GO, Antena 1 Târgu-Jiu and Tele 3).

Another method used in order to obtain an efficient cooperation is the utilization of a radio-telephonic network for cooperation in emergency situations (figure 1).

At local level, the authorities have the obligation to use various other methods in order to forewarn and to alarm the population, using local radio and television networks, the radio-telephonic network for the cooperation in emergency situations and the pre-warning and warning system in the case when are reached critical thresholds and to use the system installed in order to alarm the population for evacuation (represented by an alarming center with 10 lines and a number of 26 hooters).

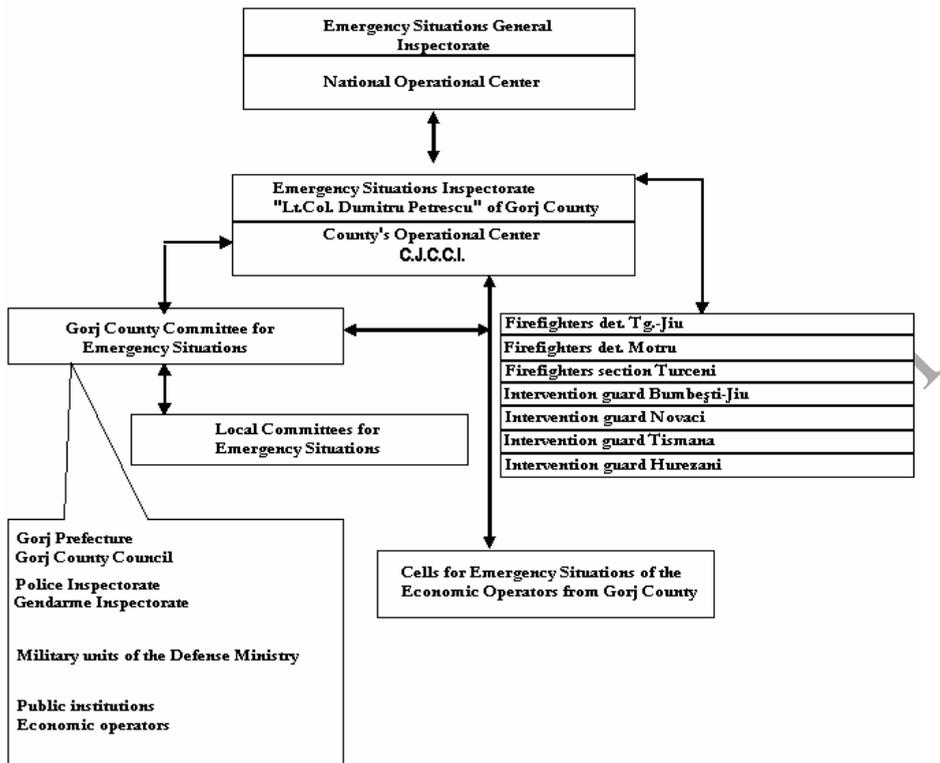


Figure 1. Radio-telephonic Network for Cooperation in Civilian Emergency Situations  
(source: E.S.I. „Lt. Col. Dumitru Petrescu” of Gorj County)

### 3. 5. Management Plans

The management plan for the Jiu hydrographic basin was published initially in a preliminary version, intended for consultations and debates (in year 2008), followed by the final version. In this last issued version, the plan has a structure with 13 chapters, that include the general presentation of the basin, surface and underground waters presentation, protected areas identification and mapping, water state monitoring and characterization, environment objectives and the exceptions from these ones, economic analysis, measures programmer, quantitative aspects and climatic changes, a chapter dedicated to the public information, consultation and participation, another dedicated to the difficulties and uncertainties and a last one including the conclusions, plus annexes.

#### 4. Conclusions

Regarding the structural provisions, it is highlighted the growing importance given to the development and rehabilitation works (for the damaged ones) over the time, plus a series of proposals, accompanied by feasibility studies, situated in various stages, for new investments in this direction.

Concerning the non-structural provisions, these ones are focused mainly on the implementation of the demands expressed at European Union level, demands which Romania, as a member state, engaged to respect, to document and to implement. In this context, it is important to remind that, despite all efforts, the terms imposed by the European Commission in the Directive 2007/60/CE (on the assessment and management of flood risks) were totally not respected.

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