Flood protection Expert Group

Flood Action Programme
South-Central Tributaries - ROMANIA

Ministry of Environment

National Administration APELE ROMÂNE

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1 Introduction

In response to the damages provoked by disastrous flood events that have occurred in the Danube River basin, the **International Commission for the Protection of the Danube River (ICPDR)** decided to establish the long-term Action Programme for Sustainable Flood Prevention in the Danube River Basin.
The overall goal of the Action Programme is to achieve a long term and sustainable approach for managing the risks of floods to protect human life and property, while encouraging conservation and improvement of water related ecosystems.
The **four major basin-wide targets** of the Action Programme are:

- Improvement of flood forecasting and early flood warning systems; interlinking national or regional Systems;
- Support for the preparation of and coordination between sub-basin-wide flood action plans;
- Creating forums for exchange of expert knowledge;
- Recommendation for a common approach in assessment of flood-prone areas and evaluation of flood risk.

At the **sub-basin level**, six targets have been identified in the Action Programme:

- To reduce the adverse impact and the likelihood of floods in each sub-basin through the development and implementation of a long-term flood protection and retention strategy based on the enhancement of natural retention as far as possible;
- To improve flood forecasting and warning suited to local and regional needs as necessary.
- To increase the capacity building and raise the level of preparedness of the organizations responsible for flood mitigation;
- To develop flood risk maps;
- To harmonize design criteria and safety regulations along and across border sections;
- To prevent and mitigate pollution of water caused by floods.

This action plan for the South-Central Tributaries sub-basin reviews the current situation in flood protection in Romania and sets the targets and the measures for reduction of damage risks and flood levels, increasing the awareness of flooding and for improvement of flood forecasting. The targets and measures are based on the regulation of land use and spatial planning, increase of retention and detention capacities, technical flood defences, preventive actions, capacity building, awareness & preparedness raising and prevention and mitigation of water pollution due to floods.

The high torrentially degree of watercourses, due to the climate conditions, physical and geographical factors conduct to a frequent phenomenon of flooding on Romanian territory.
In last years the occurrence of flooding was higher. In 2005, 2006 and 2008, dangerous, atypical hydrological and meteorological phenomena took place with human lives and huge material losses.
In 2005 the total value of material damages, due to the flooding in Timiş, Olt, Siret and Ialomiţa hydrographical basins was app. 1.66 bn. euro, representing 0.6 % of national GDP
The registered high-flood on Romanian sector of the Danube in April 2006 was the highest since 1898. The consequences were that dikes failed on many sectors.
In July 2008, historical values of water discharge and levels have been registered in Tisa, Siret and Prut basins.

According to the Water Law, the strategy and national politics in water management field are tasks for the Ministry of Environment and for the application and control of activities is responsible "Romanian Waters" National Administration through its water directorates.
The National Plan for Prevention and Flood Protection is part of national politics and constitutes a necessary tool for national coordination and basin correlation of investments in water management domain.
The National Strategy for Flood Risk Management on short term adopted in December 2005 takes into consideration the following aspects and priorities:

- preliminary estimation;
- critical analysis of existing flood defences;
- basic principles for national strategy for flood risk management on medium and long term;
- risk reduction means both vulnerability and objective factors mitigation;
- both structural an non-structural measures are necessary;
- we should take into consideration all local and regional conditions;
- European context: directives, funds.

The existing legislative framework offer to the central authorities and public local administration the legal support for the prevention, protection and preparation activities in flood risk management (Regulations regarding flood adopted in 2005)

It is necessary a strong coordination of these activities based on regulations regarding strategies and politics for flood risk mitigation, cost-benefit analysis, economic, social and environment impact assessment, programmes and plans for spatial planning.

National Strategy for Flood Disaster Prevention and the Flood Action Plan

The short-term strategy for flood protection has the following principles:

- Sustainable development;
- Economic, social end ecological acceptability;
- Strategic assessment for a period of time;
- Simplicity and transparent aspects;
- Basin approach of the flood problem;
- Interdisciplinary approach;
- Solidarity;
- Equilibrium maintenance among preventive, response and post-factum measures, using the national territory plans, structural and non-structural measures, as intervention plans for emergency situations.

Applications of best practices proposed by EU and UN Economic Commission for Europe regarding flooding preventive measures, protection and effects mitigation are under implementation.
Flood Action Plan for the short term strategy implementation started in 2005 by integrated actions for 5years (2010):

- development of the hydrological information system and modernization of the early warning system – DESWAT Project
- rehabilitation of the old flood defence hydraulic infrastructure and building new ones in areas of high risk,
- Flood hazard mapping and flood management plans. The first pilot basin was Siret. Nowadays, interdisciplinary studies in eight river basins are under implementation

(Siret, Mureş, Crişuri, Banat, Jiu, Olt, Someş-Tisa, Ialomiţa-Buzău) and will be finalized during 2009, beginning of 2010.

For the pilot-sub-basin Raznic, tributary of Jiu River the study was finalised, being prepared the hazard map and damages evaluation for flood risk map.

The National Plan will be finished in the frame of the River Basin Management Plans – Flood management Section first draft, till December 2009 and is planned to be adopted till mid 2010.

In mean time, during 2009 will be finalized mid and long term National Strategy for Flood Risk management, which will take into account the need for Flood Directive implementation.

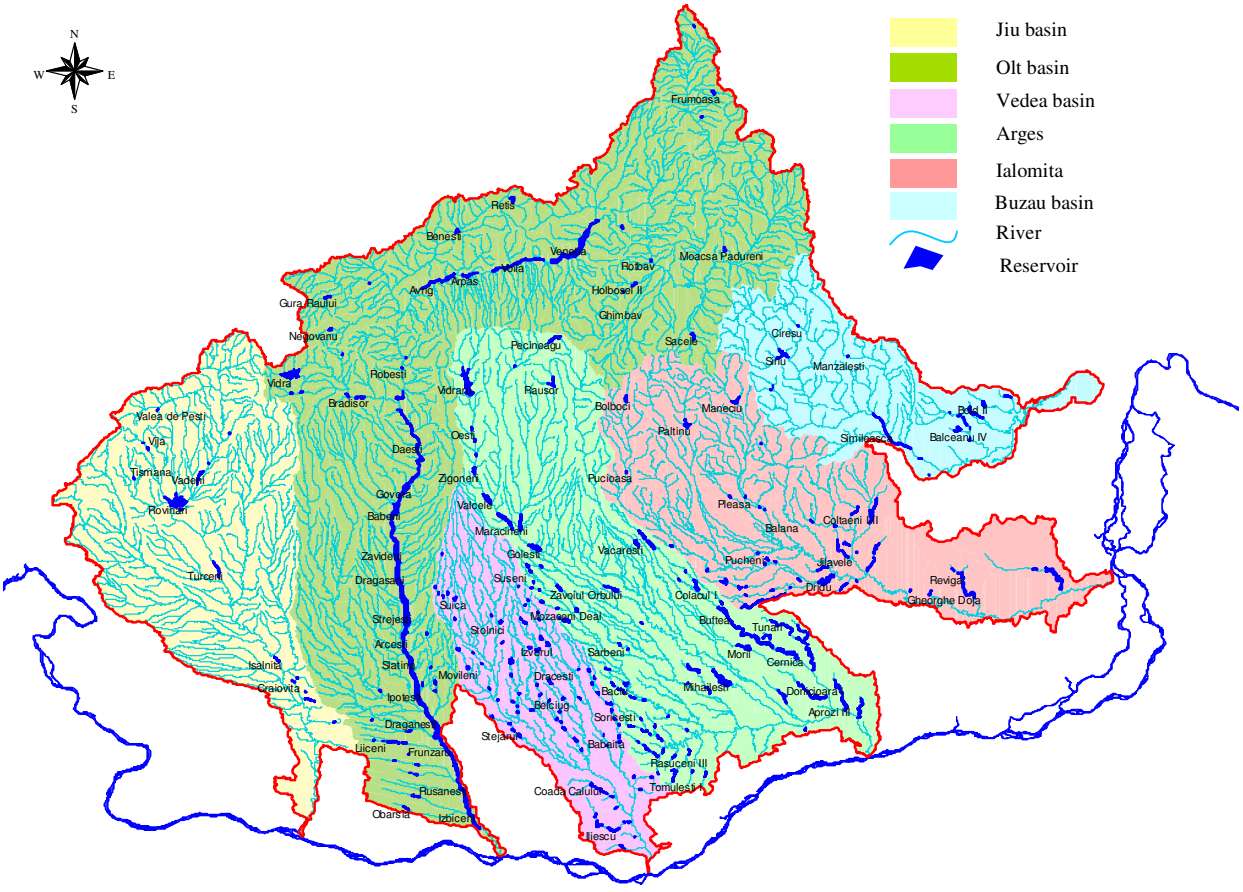
2 Characterisation of Current Situation

2.1 Natural conditions

The South-Central Tributaries region (SCT) is composed by **Jiu, Olt, Argeş-Vedea and Buzău-Ialomiţa** hydrographic spaces.

The North and North-Eastern part of the Jiu area is occupied by mountains (about 21 % of the total basin), hills 47 % (Podişul Getic and Podişul Mehedinţi), and 32 % plain, near to the Danube.

The Olt basin relief is very fragmented: beginning with wide intracarpathic depressions and finishing with Danube's lowlands (30 % mountains, 53 % hills and 17 % plain).



The Arges-Vedea and Buzău-Ialomița areas relief characteristics is the same with Olt and Jiu, being various from Făgăraş Mountains peaks (2544 m and 2140 m) to Danube floodplain (12 m) in Argeş-Vedea - and from Bucegi and Leaota peaks (2000-2500 m) and Carpații de Curbură mountains to lowland zone (40%) formed by Câmpia Târgoviştei, Câmpia Ploieştilor, Câmpia Gherghiței, Câmpia Buzăului şi Râmnicului in Buzau and Ialomita sub-basins.

Hydrography

Jiu hydrographic basin is situated at south-west and has a surface of 10,080 km^2. From administrative view point it goes on: Dolj, Gorj, Mehedinți, Alba, Vâlcea and Hunedoara counties territory.
The multi-annual average stock of Jiu river is estimated at 2800 $mn.m^3$/year (88.7 m^3/s). Jiul has not important tributaries, the stock being made up almost evenly along its course.
From the water uses view point the water resources of Jiu hydrographic space, there can be identified areas reach in waters like Jiu de Vest river (19.2 l/ km^2), Jiu de Est river (16 l/ km^2), Orlea river (39.1 l/ km^2) etc., but also areas poor in waters like Amaradia river (2.6 l/ km^2). The specific average discharge for Jiu h.b. is of 8.8 l/s/ km^2.
The maximum volumes are registered in Spring (47% from the annual volume), and the minimum ones at the end of Summer – early Autumn (7-14% from the annual volume).
Due to its flow direction, from north to south, of the Jiu hydrographic space and of having a maximum width in its superior third, floods are in general concentrated in mid course and attenuated in the inferior course. The statistical analyze of these floods show that, in Jiu basin, the origin of floods is of 90% pluvial nature.
In the Jiu hydrographic space the biggest floods have been registered in 1940, 1960, 1964, 1965, 1970, 1972, 1973 and 1991.
The daily average flows are of 95%. Variations are between 5.20 m^3/s in Filiaşi sector and of 8.1 m^3/s in Podari sector on Jiu, in Topleț on Cerna river and Goicea on Desnățui river sections these being of 3.8 m^3/s respectively 0.2 m^3/s.

The **Olt** hydrographic space is situated in central-southern part of the country, with a total surface of 24,050 km^2 and a length of the main course of the Olt river of 615 km. From the water uses view point, Olt h.b. covers territories in 8 counties: Harghita, Covasna, Braşov, Sibiu, Vâlcea, Olt and partially Argeş and Dolj.
The Olt hydrographic space has as important tributaries: Râul Negru, Cibin, Lotru and Olteț. By consequence, Olt has a compensated and well balanced hydrological regime.
The multi-annual average stock of Olt in the discharge section to the Danube is of 5,491 mn. m^3 (174 m^3/s), placing Olt the 2-nd (after Siret), among the most important rivers of Romania. Oltul does not have important tributaries, its water stock being almost uniform on its entire course.
From the water resources view point of the Olt hydrographic space there can be identified the tributaries of Olt – left banks - Făgăraş area, but also areas of scarce resources like Homorod, Hârtibaciu, Teslui river basins.
The maximum volume of water flow is registered in April on the superior course of Olt and in May on the mid and the inferior one, and the minimum flow in January and September–November.
In Olt basin, the highest flows have been registered in 1790, 1972, 1975, 1981 and 1984.
The minimum flow happens both in Summer-Autumn, due to the small quantities of water from August-September and of the high temperatures, and during winters with very low temperatures, when the supply of the rivers is exclusively from the underground reserves.

Argeş-Vedea hydrographic space is situated in the southern part of Romania, including the territories of: Argeş, Dâmbovița, Teleorman, Călăraşi, Giurgiu, Ilfov counties and the Bucureşti municipality area. The Argeş-Vedea hydrographic space has a surface of 19,393 km^2 being centered on the Argeş main rivers, in length of 350 km and Vedea, in length of 224 km.

Argeş has as important tributaries: Vâlsanul, Râul Doamnei, Sabarul, Neajlovul and Dâmbovița rivers.

Vedea river has as main tributary Teleorman.

The territory of Argeş h.b. is characterized by a strong industrial development, as well as of the hydro-energetic potential from the superior and mid basins of Argeş, Dâmbovița, Vâlsan, Târgului and Doamnei river.

In the Arges hydrographic space the smallest flows had values of 1.87 m^3/s at Malul Spart on Argeş river and of 0.72 m^3/s at Conțeşti on Dâmbovița river.

The multi-annual average stock of Argeş river at the reach of Danube is of 2193 $mn.m^3$ (69.5 m^3/s), placing Argeş river on average, among the important rivers of Romania.

More then 1/2 from the stock (1170 mn.cu.m-54%) comes from the superior sector of the basin, downstream the confluence of Argeş river with Doamnei, the main contributors being Doamnei river (30%), Dâmbovița river (17%) and Neajlov river (10%).

The rich water resources are in Doamnei basin (11.2 l/s km^2); the scarce areas are in Dâmbovița (4.2 l/s km^2, Sabar (2.67 l/s km^2) and Neajlov (1.98 l/s km^2) basins.

The maximum flow volume (50% from stock) is registered in April-June, and minimum flow in January (in the mountains) and September-November (in plain areas).

The multi-annual average flow of Vedea, while reaching the Danube is of 14 m^3/s.

The minimum flow in Vedea basin are in general of small values, due to the lack of catchments basins in the mountain area. On Cotmeana platform all local rivers are intermittent, with annual drougth periods.

Characteristic to the Argeş hydrographic space is that on the rivers with small catchments basins, the heavy rains produce very high flows, while in sub-basins of big surfaces, the rains effect decreases significantly; the major role in forming the maximum flows being due to the overlapping of Spring rains with the Winter snows melt.

The biggest flows in the Argeş hydrographic basin have been on Argeş and Dâmbovița rivers:

- at Malu Spart (Argeş) - 2000 m^3/s (1941), 1522 m^3/s (1975), by report to the multi-annual average flow in section of 38.5 m^3/s;
- at Conțeşti (Dâmbovița) - 654 m^3/s (1975) by report to the multi-annual average flow in section of 11.2 m^3/s.

One of the main floods produced in Vedea hydrographic space was in 1972, when the maximum discharges have had values with the probability between 5% and 1%.

Buzău-Ialomița hydrographic space is situated in South–Eastern part of the country and has a total surface of 15,614 km^2, which is afferent to the Ialomița and Buzău basins. The area comprises territories from: Prahova, Buzău and Ialomița counties and partially from: Covasna, Dâmbovița, Călăraşi and Brăila.

Ialomița river (L = 417 km) has as main tributaries: Prahova, Cricovul Dulce and Sărata, and the ones of Buzău river (L = 302 km) are: Bâsca Roziliei, Bâsca Chiojdului and Slănic.

The multi-annual average stock of Ialomița at its reach to Danube section is of 1430 mn.cu.m (45.5 m^3/s), from which 57 % to Prahova. Buzău River has its reach of Siret 1030 $mn.m^3$ (33 m^3/s), from which 68 % to Buzău, downstream to the confluence with Bâsca Roziliei.

The stock of Ialomița upstream to the confluence with Prahova is of 490 $mn.m^3$/year (15.6 m^3/s) to the superior part of the basin in Târgovişte section, and for Prahova River to upstream

of the confluence is of 810 mn.m^3/year (25,8 m^3/s), 50% coming from the section downstream to the confluence with Doftana.
From the water uses view point, in Ialomița h.b. there are areas with rich specific discharges (l/s.sqkm) of high values, like the sub-basins: Azuga 25 l/s.km^2, Ialomița Superioară 18 l/s.km^2, Doftana 17 l/s.km^2, and in Buzău h.b., the sub-basins: Buzăul Superior and Bâsca Roziliei with 14.0 l/s.km^2, but also some poor areas like: Sărata, Slănic, Câlnău with very large catchments surfaces and very low specific flows of 1.0–1.5 l/s.km^2.
On Ialomița, Prahova and Buzău rivers the biggest flows (p=2%) have been registered in July 1975, and the losses have been very high.
The minimum monthly stock is registered in January-February for rivers from the mountain area and in September-October for the mid and inferior part of the hydrographic space.

Climate
The climate in Jiu basin is temperate with variations from North to South and from West to East. The mean multiannual precipitation varies from 400 mm (Danube Plain) to 1200 mm (high mountains area).
The Olt basin's is climate is from continental-moderate with atlantic influences in the North to sub-mediterannean and continental in the South.
The Argeş-Vedea cimate is temperate-continental with some specific aspects. In the plains part of the basin is characteristic the high amplitude of the temperatures.
In the Buzău-Ialomița area has a temperate continental climate, with big differences between the North-Western part and the South-Eastern part, regarding precipitations and temperatures.

2.2 Anthropic influence. Flood defences

The main hydraulic works affecting the flow regime of the rivers are: reservoirs, deviations and water transfers from neighborough basin into a reservoir and dykes. These types of infrastructures are in fact the most useful instruments for water management, offering possibilities in getting regulation of different volumes during the seasons and sometimes during the year, to offer flood protection or dilution in case of accidental pollution.

In order to protect goods and human lives, on Romanian territory have been realised hydraulic structures which compose the National System for Flood Defence.

JIU

The multi-annual average stock of Jiu River is estimated at cca. 2,800 mn.m^3/year (88.7 m^3/s). Jiul does not have important tributaries, the stock being made up almost evenly along its course.

From the water uses view point the water resources of Jiu hydrographic space, there can be identified areas reach in waters like Jiu de Vest River (19.2 l/s.km^2), Jiu de Est River(16 l/s.km^2), Orlea River (39.1 l/s.km^2), Joiş River (27.8 1/s km^2) etc., but also areas poor in waters like Amaradia River (2.6 l/s.km^2). The specific average flow for Jiu basin is of 8.8 l/s/km^2.
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In the Jiu the biggest floods have been registered in 1940, 1960, 1964, 1965, 1970, 1972, 1973 and 1991.

The daily average flows are of 95%. Variations are from 5.20 m^3/s in Filiaşi sector to 8.10 m^3/s in Podari sector on Jiu River, in Topleț on Cerna River and Goicea on Desnățui sections these being of 3.8 m^3/s respectively 0.2 m^3/s.

Reservoirs

In the Jiu hydrographic space, there have been retained as most important **12** reservoirs, from which **11** are permanent and **1** temporary. The maximum volume of these reservoirs gathers **200.0** mn.m^3, from which **100.0** mn.m^3 in permanent reservoirs and **100.0** mn.m^3 in temporary reservoirs. The permanent reservoirs gather a total utile volume is **94.0** mn.m^3.

In Jiu the most important reservoir has a complex role - **Fântânele** on Desnățui brook, and the **Valea de Peşti** reservoir, on the brook of the same name, has the main role to supply with potable water of the localities on Valea Jiului.

The **Valea Mare** reservoirs on Motru, **Vija** and **Clocotiş** on Bistrița and **Tismana - downstream** on Tismana River, which pertains to the hydro-energetic system and for the water supply from Cerna-Motru–Tismana, has energetic role and also supply the industries of Turceni, Rovinari and Işalnița.

Only one temporary reservoir is **Rovinari** on Jiu River.

From the total of **12** reservoirs, **1** is of complex purposes, **2** for water supply, **8** with energetic purpose and **1** for floods mitigation.

Derivations and intakes

In the Jiu hydrographic space, there have been retained as most important **8** derivations in total length of **212.6** km and with an installed discharge of **95.5** m^3/s. From the water uses view point, **5** are for the supply with potable and industrial water and **3** for water supply the electric power production. These are:

- **Buta - Valea de Peşti** intake, Hunedoara county, which catches water from Jiul de Vest upstream and transfers them in Valea de Peşti reservoir, situated on the tributary from downstream of the river with the same name. The purpose of the intake is the supplementation the discharge for the supply with water of the localities from Valea Jiului;
- **Valea de Peşti – Petroşani** intake, Hunedoara county, which draws off water from Valea de Peşti reservoir and brings them to Petroşani for water supply of the localities from Valea Jiului;
- **Runcu** - **Târgu Jiu** intake, Gorj county, which catches the waters of Runcu brook – Vâlceaua, tributary of Jiu in Rovinari area, for the water supply of Târgu Jiu town;
- **Suşița** - **Târgu Jiu** intake, Gorj county, which catches the waters of Şuşița brook, tributary of Jiu in Rovinari area, for the water supply of Târgu Jiu town;
- **Izvarna - Craiova** intake, Gorj and Dolj county, which brings water from the catching of Izvarna source (Orlea brook, sub-basin Tismana) to the reservoirs of Craiova town, for the water supply of the city;
- **Cerna – Motru** derivation, Gorj county, which derives waters from Valea lui Iovan reservoir situated on Cerna River in Valea Mare reservoir situated on Motru River and which pertains to Cerna-Motru–Tismana system, meant for the supply with industrial water at Turceni, Rovinari and Işalnița and for the production of electric power;

- **Motru - Pocruia – Tismana** derivation, Gorj county, which derives waters from Valea Mare reservoir – Motru and Pocruia brook -upstream to Tismana – downstream, for the supply with water in the same system Cerna -Motru –Tismana;
- **Bistrița – Tismana** derivation, Gorj county, which derives the waters from Clocotiş reserevoir – Bistrița brook (tributary of Jiu, Rovinari area) and from catching of some tributaries of Bistrița and Tismana brooks on Tismana River – downstream, for water supply in the same system Cerna -Motru –Tismana;

Dikes and river regulations

In the Jiu hydrographic space there exist 127 regulations of river beds of a total length of 290 km and 130 dikes of a total length of 432 km. These works protect against floods 26 towns, 65 industrial units, cca 6,000 houses and residences, a surface of cca. 33,000 ha, roads, bridges, railways and other objectives.

From the regulation and dike works of the Jiu hydrographic space, there have been retained as most important **23** works of a total of **392.3** km regulations of river beds and **508.1** km dikes.

These works protect localities and agricultural areas, as well as bridges, roads, railways and others.

Among the main works there are:

- Regulations and dikes on Jiu de West and tributary, jud. Hunedoara (Lreg = 30.7 km, Ldike = 19.1 km);
- Regulation of Jiu on Rovinari Plopşoru sector, Gorj county (Lreg = 25.8 km, Ldike = 51.6 km);
- Regulations and dikes Huşnița River, Mehedinți county (Lreg = 24.9 km, Ldike = 6.4 km);
- Regulations and dikes Jiu River, Dolj county (Lreg = 24.2 km, Ldike = 125.7 km);
- Regulations and dikes Amaradia River, Dolj county (Lreg = 11,6 km, Ldike = 7,2 km);
- Regulations and dikes Raznic River, Dolj county (Lreg = 30.7 km, Ldike = 5.0 km);
- Regulations and dikes Zlaştiu brook la Budieni - Drăguțeasti, Gorj county (Lreg = 17.0 km, Ldike = 24.0 km);
- Regulations and dikes Jiu River between Tatomireşti city and the river reaching of Danube, Dolj county (Lreg = 84.7 km, Ldike = 123.2 km);
- Regulation Jilț River in Drăgoteşti area, Mătăsari sector – Calo brook, Gorj county (Lreg = 25.6 km);
- Regulation Raznic brook in Cernăteşti area, Tiu-Rasnicu Oghian sector, Gorj county (Lreg = 24.3 km).
- Runcu - Stolojani.

OLT

The Olt hydrographic space is situated central-south, with a total surface of 24,050 km^2 and a length of the main course of the Olt river of 615 km. From the water uses view point, Olt watershed covers territories in 8 counties: Harghita, Covasna, Braşov, Sibiu, Vâlcea, Olt and partially Argeş and Dolj .

The Olt hydrographic space has as important tributaries: Râul Negru, Cibin, Lotru and Olteț. By consequence, Olt has a compensated and well balanced hydrological regime.

The multiannual average stock of Olt in the discharge section to the Danube, is of 5,491 mn.m^3 (174 m^3/s), placing Olt on the 2-nd place (after Siret), among the most important rivers of Romania. Oltul does not have important tributaries, its water stock being almost uniform on its entire course.

From the water resources view point of the Olt hydrographic space there can be identified the tributaries of Olt – left banks - Făgăraş area, but also areas of scarce resources like Homorod, Hârtibaciu and Teslui basins.

The maximum volume of water flow is registered in April on the superior course of Olt and in May on the mid and the inferior one, and the minimum flow in January and September – November.

In Olt basin, the highest flows have been registered in 1790, 1972, 1975, 1981, 1984 and 2005.

The minimum flow happens both in Summer-Autumn, due to the small quantities of water from August-September and of the high temperatures, and during winters with very low temperatures, when the supply of the rivers is exclusively from the underground reserves.

Reservoirs

In the Olt hydrographic space, there have been retained as most important **44** reservoirs, from which **40** are permanent and **4** temporary. The total maximum volume of these reservoirs is of **1579.5** mn.m^3, from which **1554.3** mn.m^3 in permanent reservoirs and **25.2** mn.m^3 in temporary reservoirs. The permanent reservoirs gather a total utile volume of **986.1** mn.m^3 and of a total attenuation volume of **111.7** mn.m^3. The attenuation volume afferent to the temporary reservoirs is of **24.3** mn.m^3.

For the supply with potable water there are in function 5 reservoirs: **Measteacănu** on Olt, **Frumoasa** on Frumoasa, **Săcele** on Târlung, **Dopca** on Valea Mare, **Gura Râului** on Cibin).

The capitalization of the hydro-energetic potential called for the regulation of **Olt** through **24** reservoirs disposed in cascades, with a total volume of cca. 1000 mn.m^3, the utile volume totaling cca. 500 mn.m^3.

Due to the high hydro-energetic potential, **Lotru** River and **Sadu** brooks have been entirely controlled for energetic exploitation. On Lotru there exist 3 energetic reservoirs, from which the most important is **Vidra** with a utile volume of 300 mn.m^3.

The existing reservoirs in the energetic cascade on **Băbeni-Izbiceni** sector of the Olt, can secure, at the same time, the water needs for the irrigation of cca. 190,000 ha in Lower Olt basin.

From the total of **44** reservoirs, **5** are for water supply, **35** for energetic purpose and **4** for floods attenuation purpose.

Derivations and intakes

In the Olt watershed, there have been retained as most important **18** derivations of total length of **352.5** km and with an installed discharge of **223.3** m^3/s. From the water uses view point, **6** are for electric power production, **8** for supply with water of localities, **2** for irrigation waters and **2** are derivations for high waters. These are:

- **Sădurel-Sadu V HPP** derivation, Sibiu county, which is meant for the supplementation of the water stock used by Sadu V HPP through the catching of the Sădurel brook, tributary of Sadu;
- The energetic derivations for the supplementation of the stock in **Vidra** reservoir (Lotru), Vâlcea county: catchments of **Lotru, Olteț, Gilort** and **Jieț** tributaries **(North, South** and **West** arms);
- The energetic derivations for the supplementation of the water stock in **Brădişor** reservoir (Lotru), Vâlcea county, catching of **Lotru** and **Olt** tributaries;
- **Brădişor** intake having as water source Brădişor reservoir and as purpose the supply with water of Râmnicu Vâlcea municipality and of other localities;
- **Bâsca Mare–Covasna** derivation, Covasna county, which derivates water from Bâsca Mare brook in Olt for the supply of Covasna town.
- **Frumoasa** intake from Frumoasa reservoir for the supply with water of Miercurea Ciuc municipality;
- **Vârghiş-Harghita** derivation for the supply with water of Vlăhița city area;
- **Timiş** Canal having as water source Timişul Sec and as purpose the water consumption in Braşov area;
- **Vulcănița–Bârsa** derivation which transfers the flows in case of high waters between l Vulcănița canal and Bârsa River;
- **Vulcănița** Canal which draws off water from Bârsa River upstream for the water supply of Codlea – Feldioara area;
- Derivation of high waters **Berivoi-Racovița-Hurez** derivation which discharges waters from Berivoi and Racovița brooks in Hurez brook;
- **Târlung** intake (I+II) which draws off water from Săcele reservoir and brings it to the treatment unit of Braşov city;
- **Ipoteşti** derivation, Olt, which has for the source of water Ipoteşti reservoir on Olt River and it is aimed for securing irrigation waters in Ipoteşti North 1 and 2 irrigation systems;
- **Drăgăneşti** derivation through which water is drawn off from Drăgăneşti reservoir for irrigations in the Drăgăneşti system.

Dikes and river regulations

In the Olt hydrographic space there exist 184 regulations of river beds of a total length of 801 km and 259 dikes of a total length of 912 km. These works protect against floods 33 towns, 79 industrial units, 8000 houses and residences, a surface of 33,000 ha, roads, bridges, railways and other objectives.

From the regulation and dike works of the Olt hydrographic space, there have been retained as most important **23** works with a total of **324.4** km regulations of river beds and **642.1** km dike.

Most of these dikes are on the superior watercourse of Olt (upstream to Hoghiz).

The main of these works would be:

- Regulations and dikes on Olt River at Siculeni-Tuşnad Băi, Harghita county (Lreg = 39.5 km, Ldike = 92.0 km);
- Regulations and dikes on Negru River and tributaries, Covasna county (Lreg = 11.0 km, Ldike = 171.3 km);
- Regulation and dikes on Olt River in Sâmontru -Racoş area, Braşov and Covasna counties (Lreg = 67.0 km, Ldike = 115.1 km);
- Regulations and dikes Ghimbăşel brook at Bod, Braşov county (Lreg = 11.4 km, Ldike = 25.0 km);
- Regulations and dikes on Hârtibaciu River, Sibiu county (Lreg = 49.7 km, Ldike = 99.7 km);
- Regulation on Gemărtălui brook, Olt (Lreg = 22.0 km);
- Dike on Olt River on Sf. Gheorghe – Chichiş sector (Ldike = 47.0 km).

ARGEŞ–VEDEA

The Argeş-Vedea hydrographic space is situated to the south of Romania, including the territories of: Arges, Dâmbovița, Teleorman, Călăraşi, Giurgiu, Ilfov, counties and the Bucureşti municipality area. The Argeş-Vedea hydrographic space has a surface of 10,464 km^2 being centered on the Argeş main river, in length of 350 km and Vedea, in length of 224 km. This basin is of the greatest importance for the WATMAN Project, regarding the applications that are developed, being the pilot basin for the project.

Argeş River has as important tributaries: Vâlsan, Râul Doamnei, Sabarul, Neajlov and Dâmbovița.

Vedea River has as main tributary Teleorman River, and in Argeş–Vedea hydrographic space there is included also the Călmățui River basin, with flow into Suhaia lake, at the limits to the Danube.

The territory of Argeş watershed is characterized by a strong industrial development, as well as of the hydro-energetic potential from the superior and mid basins of Argeş, Dâmbovița, Vâlsan, Târgului and Doamnei.

In the Argeş hydrographic space the smallest flows had values of 1.87 m^3/s at Malul Spart on Argeş River and of 0.72 m^3/s at Conțeşti on Dâmbovița River.

The multi-annual average stock of Argeş River at the reach of Danube is of 2.193 $mn.m^3$ (69.5 m^3/s), placing Argeş River on average, among the important rivers of Romania.

More then 1/2 from the stock (1170 $mn.m^3$ - cca. 54%) comes from the superior sector of the basin, downstream the confluence of Argeş River with Doamnei River, the main contributors being Doamnei River (cca. 30%), Dâmbovița Rriver (cca. 17%) and Neajlov River (cca. 10%).

The rich water resources are in Doamnei basin (11.2 $l/s.km^2$); the scarce areas are in Dâmbovița River (4.2 $l/s.km^2$, Sabar (2.67 $l/s.km^2$) and Neajlov (1.98 $l/s.km^2$) basins.

The maximum flow volume (50% from stock) is registered in April-June, and minimum flow in January (in the mountains) and September-November (in plain areas).

The multi-annual average flow of Vedea River, while reaching the Danube is of 14 m^3/s, and for Călmățui River at the reach of Suhaia lake of 1.7 m^3/s.

The minimum flow in Vedea and Călmățui basins are in general of small values, due to the lack of catchments basins in the mountain area. On Cotmeana platform all local rivers are intermittent, with annual draining periods.

Characteristic to the Argeş hydrographic space is that on the rivers with small catchments basins, the heavy rains produce very high flows, while in sub-basins of big surfaces, the rains effect decreases significantly; the major role in forming the maximum flows being due to the overlapping of Spring rains with the Winter snows melt.

The biggest flows in the Argeş hydrographic basin have been on Argeş and Dâmbovița Rivers:

- at Malu Spart (Argeş) – 2,000 m^3/s (1941), 1,522 m^3/s (1975), by report to the multi-annual average flow in section of 38.5 m^3/s;
- at Conțeşti (Dâmbovița) - 654 m^3/s (1975) by report to the multi-annual average flow in section of 11.2 m^3/s.

The majority of the rivers from Vedea and Călmățui hydrographic basins in torrent regime, have the report between the maximum flows and the multi-annual average ones very high.

One of the main floods produced in Vedea hydrographic space was in 1972, when the maximum discharges have had values with the probability between 5% and 1%.

Reservoirs

In the Argeş–Vedea hydrographic space, there have been retained as most important **29** reservoirs from which **28** are permanent and **1** temporary. The total maximum volume maxim of these reservoirs is of **1113.1** mn.m^3, from which **1077.4** mn.m^3 in permanent reservoirs and **38.7** mn.m^3 in temporary reservoirs. The permanent reservoirs gather a total utile volume of **771.1** mn.m^3 and a total attenuation volume of **206.4** mn.m^3. The attenuation volume afferent to the temporary reservoirs is of **38.5** mn.m^3.

The most important reservoirs of complex uses from Argeş–Vedea hydrographic space:

- **Vidraru**, **Vâlcele**, **Budeasa**, **Goleşti**, and **Mihăileşt**i on Argeş River;
- **Pecineagu** and **Văcăreşti** on Dâmbovița River;
- **Râuşor** on Râul Târgului.

These reservoirs provide the supply with potable and industrial water for Curtea de Argeş, Câmpulung Muscel towns and of Piteşti and Bucureşti municipalities, the production of electric power, the irrigation of a surface of more then100,000 ha downstream to Piteşti and for other purposes (dilution - Dâmbovița River Bucureşti, lake refreshing - on Colentina valley etc.).

- **Bascov**, **Prundu**, **Ogrezeni** and **Zăvoiul Orbului** lakes have the purpose of potable and industrial water supply of Piteşti and Bucureşti
- **Oieşti**, **Cerbureni**, **Curtea de Argeş lakes**, situated in cascade immediately downstream to the Vidraru lake have main the energetic destination.

In Călmățui hydrographic basin there is the complex reservoir of **Crângeni,** and in Vedea the reservoir **Rusciori** on Plapcea.

From the temporary reservoirs there are to be listed: **Mărăcineni** on Râul Doamnei, which is in progress for regulation, and the polders **Budeasa** and **Văcăreşti.**

From the total of **29** reservoirs, **18** have complex purposes, **4** the water supply, **6** are main energetic and **1** for floods mitigation.

Derivations and intakes

In the Argeş – Vedea hydrographic space, there have been retained as most important **17** derivations of total length of **146.2** km and with an installed flow of **1322.1** m^3/s. From the water uses view point, **4** are for the supply with potable and industrial water, **4** are derivations for high waters and **9** have complex character for other uses (irrigations, fishery, recreation, etc). These are:

- **Argeş–Ilfovăţ** derivation, Giurgiu county, which transfers water from Argeş (downstream Crivina) in Grădinari and Făcău reservoirs on Ilfovăţ River for irrigations;
- **Argeş–Sabar** derivation, Giurgiu county, which transfers water from Argeş River (downstream Crivina) in Sabar River for irrigations;
- **Crivina–Arcuda** derivation, Giurgiu county, which transfers water from Argeş River (Crivina) to the Arcuda treatment station with the discharge in Ciorogârla River for the supply with potable water of Bucureşti city area;
- **Crivina–Bucureşti** derivation, Giurgiu and Ilfov counties which draws off water from Argeş River (Crivina) and transfers them to the Roşu treatment station with discharge in Lacul Morii for supply with potable water of Bucureşti;
- **Dâmboviţa–Ilfov** derivation, Dâmboviţa county, which transfers water from Văcăreşti reservoir on Dâmboviţa River in Adunaţi and Ilfoveni reservoirs for water supply of Bucureşti and for irrigations;
- **Dâmboviţa-Argeş (Brezoaiele)** derivation, Dâmboviţa and Giurgiu counties, which draws off high waters on Dâmboviţa River(Brezoaiele locality) and deviates them in Argeş River (upstream Ogrezeni reservoir), being meant for the protection against floods of Bucureşti;
- **Doamnei-Vâlsan–Vidraru** derivation, Argeş county, which catches water from the superior basins of Vâlsan and Doamnei for supplementing the stock of water of the Vidraru reservoir;
- **Dragomireşti–Chitila** derivation, Giurgiu and Ifov counties, which draws off water from Argeş River through the Crivina–Roşu deviation, transfers them in Colentina River for the supply with industrial water of Bucureşti;
- **Ilfov-Colentina (Bolovani)** derivation, Dâmboviţa county, which deviates the waters of Ilfov River (downstream Bolovani) in Colentina River (upstream Ciocăneşti) for protecting Bucureşti and supplements the flows in the lakes along the Colentina Valley;
- **Lungulețu** derivation, Dâmboviţa county, which draws off flows from Argeş River (Zăvoiul Orbului intake dam) and transfers them in Dâmboviţa River (Arcuda) for supplementing water at Arcuda station and for irrigations in Titu – Ogrezeni system;
- **Găieşti** derivation, Dâmboviţa county, which deviates the high on Cobia River, Potopu and Răstoaca and discharges them in Argeş upstream Zăvoiul Orbului reservoir, for the protection against floods of Găieşti town;

- **Ilfov-Dâmbovița–Ciorogârla** derivation, Giurgiu county, which deviates the high waters of Ilfov and Dâmbovița Rivers (downstream Brezoaiele Hydraulic Knot) in Ciorogârla River, for the protection against floods of Arcuda station and of Bucureşti;
- **Ilfov - Dâmbovița (Mircea Vodă)** derivation**,** Dâmbovița county, which transfers water from Ilfov River (Mircea Vodă) to the treatment station Arcuda for supply with water of Bucureşti;
- **Topolog-Argeş** derivation, Argeş River, which transfers through Topolog intake, downstream Topologel flows from Olt in Argeş for supplementing the water stock in Vidraru reservoir;
- **Bilciureşti–Ghimpați** derivation, Dâmbovița county which derivates water from Ialomița River in the reservoirs on Colentina River for recreation and fishery;
- **Cocani Dârza** derivation, Dâmbovița county which derivates water from Ialomița to Cociovalıştea Valley for irrigations;
- **Snagov Ialomița** derivation which drains and transfers the water excess on Snagov Valley, in Ialomița River.

Dikes and river regulations

In the Argeş-Vedea hydrographic space there are 144 regulations of river beds of a total length of 244 km and 61 dikes of a total length of 332 km. These works protect against floods: 12 towns, 63 industrial units, 16,000 houses and residences, a surface of 27,000 ha, roads, bridges, railways and other objectives.

From the regulation and dike works of the Argeş–Vedea hydrographic space, there have been retained as most important **28** works of a total length of **195.5** km regulations of river beds and **169.4** km dikes.

These works protect both localities (Câmpulung-Muscel and Alexandria) and agricultural areas, as well as industrial units, bridges, roads and others.

From the main works:

- Regulations on Sabar River downstream Poenari (highway bridge), Giurgiu county (Lreg = 11.4 km, Ldike = 25.0 km);
- Regulations on Cărcinov River- at Topoloveni, Argeş county (Lreg = 23.5 km);
- Regulation on Ilfov River at Conțeşti - Bălteni, Dâmbovița county (Lreg = 13,0 km);
- Regulations and dikes Răstoca brook around Potlogeni Valley, Dâmbovița county (Lreg = 11.4 km, Ldike = 22.7 km);
- Dikes on Argeş River at Grădinari, Giurgiu county (Ldike = 14.0 km);
- Dike on Dâmbovița River at Conțeşti (Ldike = 10.0 km);
- River bed regulation on Argeş downstream Zăvoiu Orbului reservoir in Petreşti – Corbeanca areas (Ldike = 11.2 km);
- Regulations and dikes on Vedea River on Tufeni-Văleni sector, Teleorman county (Lreg = 1.4 km, Ldike = 18.0 km);
- Regulation Călmățuiu Sec River- area Mihăieşti (Lreg = 15.0 km);

- Regulation on Teleorman River on Costeşti–Orbeasca sector, Argeş and Teleorman counties (Lreg = 4.4 km, Ldike = 13.5 km);
- Regulation on Vedea River at Ţigăneşti-Brânceni area, Teleorman county (Lreg = 1.9 km, Ldike = 10.0 km).

In Argeş-Vedea space, from the **areas of major risk for flooding**, there are:

- Neajlov Rievr on Vadu Lat – Călugăreni sector;
- Sabar River on Puţu cu Salcie-Găiseni sector and on derivations Brezoaiele-Ogrezeni.
- Ciorogârla River - on Joiţa - c.f. Videle sector;
- Ilfov River, on Mircea Vodă-Cuza Vodă River.
- Dâmboviţa River- area Săveşti, on the Tătărani-Săveşti sector.
- Argeş River - Găiseni-Popa Nae area.

IALOMIŢA – BUZĂU

The Ialomiţa–Buzău hydrographic space is situated to south–east and has a total surface of 15,614 km^2, which is afferent to the Ialomiţa and Buzău basins. The area comprises territories from: Prahova, Buzău and Ialomiţa counties and partially from: Covasna, Dâmboviţa, Călăraşi and Brăila.

Ialomiţa River (L = 417 km) has as main tributaries: Prahova, Cricovul Dulce and Sărata, and the ones of Buzău River (L = 302 km) are: Bâsca Roziliei River, Bâsca Chiojdului River and Slănic River.

The multi-annual average stock of Ialomiţa River at its reach to Danube section is of 1430 mn.m^3 (45.5 m^3/s), from which cca. 57% pertains to Prahova River.

Buzău River has its reach of Siret 1030 mn.m^3 (33.0 m^3/s), from which 68% pertains to Buzău, downstream to the confluence with Bâsca Roziliei section.

The stock of Ialomiţa upstream to the confluence with Prahova is of 490 mn.m^3/an (15.6 m^3/s) where cca. 60% pertains to the superior part of the basin in section Târgovişte and for Prahova to upstream of the confluence is of 810 mn.m^3/year (25.8 m^3/s), 50% coming from the section downstream to the confluence with Doftana.

From the water uses view point, in Ialomiţa h.b. there are areas with rich specific flows of high values, like the sub-basins of: Azuga 25 l/s, km^2, Upper Ialomiţa 18.0 l/s, km^2, Doftana 17,0 l/s, km^2, and in Buzău h.b., the sub-basins: Buzăul Superior and Bâsca Roziliei with 14.0 l/s.km^2, but also some poor areas like: Sărata, Slănic and Câlnău with very large catchments surfaces and very low specific flows 1.0–1.5 l/s.km^2.

On Ialomiţa, Prahova and Buzău River the biggest flows (p=2%) have been registered in July 1975 and the losses have been very big.

The minimum monthly stock is registered in January-February for rivers from the mountain area and in September-October for the mid and inferior part of the hydrographic space.

Reservoirs

In the Ialomiţa–Buzău hydrographic space, **17** reservoirs which are all permanent are most important. The maximum global volume of these is **860.4** mn.m^3; the total utile volume is **562.3** mn.m^3 and the total attenuation volume is **182.0** mn.m^3.

For satisfying the needs for potable and industrial water in Ialomiţa-Buzău hydrographic space there have been made 5 important reservoirs of complex character: **Paltinu** on Doftana River, **Pucioasa** and **Bolboci** on Ialomiţa, **Mâneciu** on Teleajen, **Siriu** on Buzău.

There also have been made 2 other important reservoirs: **Dridu** on Ialomiţa River, **Căldăruşani** on Cociovalişţea valley, for irrigation purposes.

As temporary reservoirs of volumes for floods attenuation there are: **Lata Sărata** on Valea Strachina.

From the total of **17** reservoirs, **15** have complex purposes and **2** are main energetic.

Derivations and intakes

In the Ialomiţa-Buzău hydrographic space, there have been retained as most important **12** derivations of total length of **177.4** km and with an installed discharge of **231.8** m^3/s. From the water uses view point, **2** are for the supply with potable and industrial water, **3** are derivations for high waters and **7** are derivations for complex purposes (irrigations, fishery, recreation etc). These are:

- **Iazul Morilor** Canal, Prahova county, which draws off water from Prahova River, Floreşti intake and transfers it in Cricovul Dulce River at Băltiţa for irrigations;
- **Leaotu** Canal, Prahova county, which draws off water from Prahova River (Nedelea Buda canal) for irrigations, with discharge also in Prahova River;
- **Nedelea–Dâmbu** Canal, Prahova county, which draws off water from Prahova River (Nedelea Buda canal) for irrigations, with discharge in Dâmbu brook;
- **Cotorca–Sărata** derivation, Ilfov county, which functions as evacuator of high waters from Cotorca valley (upstream railway) in Sărata River (upstream railway bridge Bucureşti– Urziceni), for flood protection of Urziceni town;
- **Ialomiţa–Ilfov** derivation, Dâmboviţa county, which draws off water from Ialomiţa River at Valea Voevozilor intake (Târgovişte city) and transfers them in Ilfov River (upstream Udreşti reservoir) in the reservoirs on Ilfov River for irrigations and water supply;
- **Ialomiţa–Mostiştea** derivation, Ilfov county, which transits exceeding flows from Ialomiţa River (Dridu reservoir) in Mostiştea valley (Hagieşti hydraulic knot) for irrigations in Mostiştea system;
- **Iazul Morilor-Teleajen** Canal**,** which draws off water from Teleajen River downstream Vălenii de Munte for irrigation on Valea Teleajenului, with discharge also in Teleajen upstream railway Ploieşti – Buzău bridge;
- **Plopi valley–Cotorca** derivation, Ilfov county, which derivates the high waters from Plopi valley (upstream Plugari dam) in Cotorca valley (Cotorca 1 lake), for flood protection of Urziceni town;
- **Ialomiţa–Scroviştea** derivation, Ilfov county, which derivates water from Ialomiţa River (upstream railway Bucureşti–Ploieşti) in Scroviştea valley (upstream railway Bucureşti-Ploieşti) for recreation and fishery;
- **Pârscov–Ialomiţa** derivation which derivates the high discharges of Pârscov brook in Ialomiţa River for the protection of Gheboaia locality;

- **Voila-Movila Vulpii** intake which transports water from Doftana River (Paltinu reservoir) toward the distribution knot Movila Vulpii for the supply with water of Ploieşti city, Brazi industrial platform and of other localities from the area;
- **Vălenii de Munte - Movila Vulpii** intake which transports water from Teleajen River (Măneciu reservoir) toward the distribution knot Movila Vulpii for the supply with water of Ploieşti municipality, Brazi and Petrotel industrial platforms and of other localities from the area.

Dikes and river regulations

In the Ialomiţa–Buzău hydrographic space, there have been executed and are in function 403.6 km of dikes and 472.3 km of regulations of water courses. These works protect against floods: 115 localities, 8 towns and cities, 10,000 houses, 200 km national and county roads, 100 km railways and 80,000 ha terrains.

From the regulation and dike works of the Ialomiţa-Buzău hydrographic space there have been retained as most important 18 works with a total of 202.5 km regulations of river beds and 319.5 km dikes.

These works protect a series of localities (Buzău and Slobozia municipalities), agricultural terrains and industrial units, as well as bridges, roads, railways and others.

From the main works there can be listed:

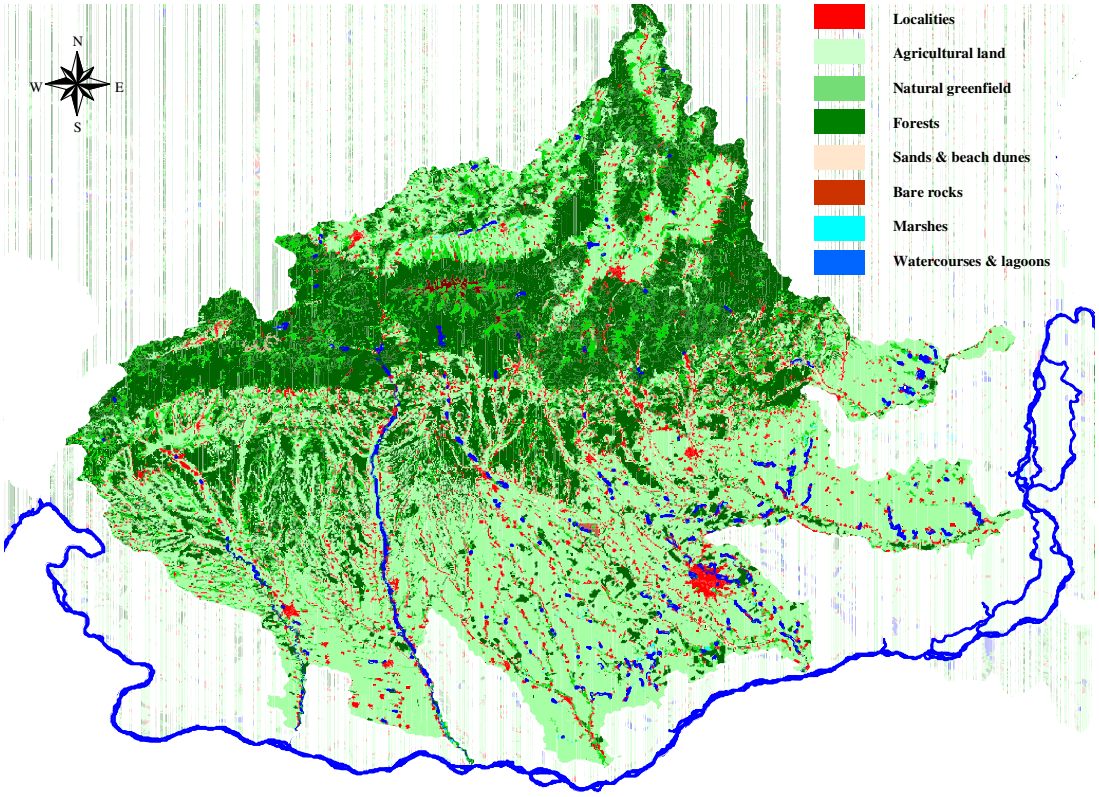
- Regulation of Ialomiţa River between Slobozia and Danube, Ilfov county (Lreg = 70.5 km);
- Regulation of Cricovul Dulce River at Măneşti and Vişineşti, Dâmboviţa county (Lreg = 16.5 km);
- Regulation of Teleajen River, Prahova county (Lreg = 13.6 km);
- Regulation of Strâmnil, Dâmbu, Bălana, Vitrău, Bertea tributaries of Prahova River, Prahova county (Lreg = 64.8 km);
- Regulation of Sărăţel, Bercani, Bălăneasa, Pleşcari tributaries of Buzău River (Lreg = 14.9 km, Ldike = 8.6 km);
- Dike of Ialomiţa River between Dridu and Slobozia, Ilfov county (Ldike = 101.2 km);
- Dike of Ialomiţa River between Slobozia and Danube, Ilfov county (Ldike = 116.1 km);
- Dike of Buzău River, Buzău River (Ldike = 73.2 km).

In this space the potential for floods exists in the inferior sectors of Ialomiţa and Buzău, were there have been produced flood related damages, especially in July 1975. At the same time, in the superior sector, within the mountains, the floods have created complex damages: erosions, banks deterioration, land sliding, losses at objectives social-economic.

2.3 Landuse

The landuse is influenced by physical, geographical and anthropogenic conditions.

In Jiu space the prevalent are the arable land (48%) and forests (29%).



The repartition of the terrain in Olt hydrographic space is the following: 35% agricultural land, 34% forests and perennial cultures 16%.
In Argeş-Vedea the arable field represents about 55% from the total, forests 18% and perennial cultures 16% and in Buzău-Ialomiţa the agriculture is on about 70% from the total, 3% are wineyards and fruit trees and forests 20%.

2.4 Flood forecasting and warning

The National Institute for Hydrology and Water Management (NIHWM) has the responsibility in order to issue warnings regarding watercourses (including Danube) levels increase.
The methodology and procedures used in warning elaboration are based on well known hydrology law (precipitation transformation in base run-off, concentration, creating high flood waves and downstream attenuation).
For improving the information-decision flow and for the raising population awareness concerning the risk of flooding and the possibilities of decrease the damages and causalities, a new type of hydro meteorological warnings which is based on colour codes was approved in 2006, through a joint order of the Ministry of Interior and the Ministry of Environment.
The colours code (green, yellow, orange and red) depend of the intensity of the meteorological or hydrological phenomena which are forecasted.

2.5 Institutional and legal framework

It has been issued or updated important regulations as follows:

- The National Strategy for Flood Risk Management on short term (Governmental Decision 1854 from 2005), which establish prevention and protection measures for flood effects mitigation for each of involved structures from central to local level;
- National Plan for Prevention and Flood Protection at Hydrographic Basin level (Governmental Decision 1309 from 2005);
- The Water Law 107 from 1996 modified and completed according tot the National Strategy;
- Emergency Order regarding safety operation of the reservoirs for pisciculture, recreation or local importance, establishing operating conditions;
- Regulations for management of emergency situations generated by flooding, dangerous meteorological phenomena and accidents at hydraulic structures adopted in May 2005.

Based on these regulations, taking into account the 2005 and 2006 floods, new flood protection plans at basin, county and local level have been approved in 2006. These plans comprise maps with level curves that bordered flooded zones by watercourses overflow and versant run-off corresponding to the maximum known discharges. In 2009 all flood protection plans will be updated.

3 Target Settings

The Action Plan for flood protection on medium-term (2009-2012) launched and comprises new hydraulic structures in frequently affected zones, higher safety degree of existing works and finalization of ongoing ones.

The Action Plan foresees 1850 km river regulation 976 km of dikes, 810 km riverbank consolidation, finalization of two wetlands in Crisul Negru hydrographic basin and identification of new zones as wetlands and DESWAT and WATMAN Projects finalisation.

The prioritisation criteria for promoting investments for flood protection have been made following:

- Inclusion of the proposed works in the Strategy of Ministry of Environment;
- Actual safety degree of the flood protection structures;
- Amplitude of avoided damages as result of the projects;
- The elaboration status of technical and economic documents;
- Financing possibility
- Occupied field status.

3.1 Regulation on Land Use and Spatial Planning

The existing local urban plans for development should contain maps with actually flooded areas, based on historic and studies data.

These maps are from the Local Flood Protection Plans and are updated every 4 years.

3.2 Reactivation of former, or creation of new, retention and detention capacities

The Ecologic and Economic Resizing Lower Danube Floodplain Programme

During the last century, almost entire Danube floodplain was embanked (53 enclosures with a total area of 430,000 ha and 1200 km of dikes), which affected the hydro morphologic and local-regional climate.

In Spring 2006, Romania faced to biggest Danube's flows. Some dikes collapsed on 50-100 m length, flooded the riparian localities, over 15,000 people being evacuated.
In the following years this kind of event could be repeated and the need for a strategic and adequate approach for flood risk management on the Romanian sector of the Danube appeared.
A real analysis is more and more necessary for some alternate measures to remake wetlands, initially existing, in comparison with the classic defences.
The study regarding ecological and economic resizing on the Romanian sector of the Danube River will be a vital instrument for a strategic co-ordination on all Romanian Danube's sector of the investments for flood prevention and for the future economic development measures.
Elements and principles that we are taking account in the Danube's improvement are:

- changing of the hydrologic regime characteristics;
- realising of an adequate habitat in order to preserve the aquatic natural biodiversity;
- the improvement variants for the Danube take into account the following: riparian localities should be defended, proposed ecologic restored zones in various studies of the "National Institute for Research and Development Danube Delta" and World Wild Fund, controlled flooded zones and areas which the Danube created breaches in the longitudinal dikes.

Public debates have been realized in Bucharest, Giurgiu and Galati with this subject.

In the rest of the country, one wetland was realised in 2007 on Jijia river at Ciobârciu and for other 2 are realised the feasibility studies (in Crişul Negru hydrographic basin near to Sudrigiu and Tinca localities).

3.3 Technical Flood Defences

The structural flood defences are realized in order to make an effective protection for populated areas, to avoid human and material losses.

The Action Plan (2009-2012) foresees 1850 km river regulation 976 km of dikes, 810 km riverbank consolidation.
For all investments works are realized feasibility studies.

3.4 Preventive Actions

These actions are concentrated towards prevention/mitigation of potential damages generated by floods through:

a) avoiding houses, social and cultural or/and economic objectives constructions in potentially flooded area;
b) realisation of structural and non-structural measures for protection;
c) geographical delimitation of natural flood risk zones and noting these in the general urban planning studies;
d) modern forecast, warning and alarming systems implementation in case of floods;
e) existing infrastructure for flood protection and riverbed maintenance;
f) effective communication and people education regarding flood risk and the action ways in emergency situations.

A good system for people warning and preparation could save many lives. For this reason, in the last years was and are in development three projects: SIMIN (National Meteorological Integrated System), DESWAT (Destructive Water) and WATMAN (Water Management).
SIMIN integrates the provided data from existent systems in Romania with a high technology in meteorological radars field, stations with surface hydrologic sensors, data processing

systems and forecast decision based on satellite transmission. System was released in September 2003.
The DESWAT project has in its first stage as objective, the modernisation of informational hydrological system, beginning with data acquisition through 600 automatic stations placed on rivers, 250 automatic gauging stations and 64 automatic quality stations, continuing with transmission support which will comprise the actual classic radio system, the GSM and satellite systems.
The programme package for hydrological forecast will be modernised, enlarged and will include semi-automatic procedures for elaboration of warnings, forecasts and information products for various decision makers, media and population.
WATMAN is a project through that the National Strategy for water management in case of disaster will be applied. It will integrate the output data from SIMIN and DESWAT, finally being carrying-out the Information-Decisional Integrated System. Those two projects, through modernised hydrologic and meteorological information systems will provide data and forecast in real-time, which represents input data for WATMAN infrastructure, optimising the integrated water management system.

Financial insurance for flood risk
In 1 January 2010, a law referring to the obligatory insurance for houses against natural disasters such earthquakes, landslides and flooding will come into force.

3.5 Capacity building of professionals

It was planned an intensive programme for raising personnel capacity from the water management units of Romanian Waters responsible with flood defences maintenance and with means and equipments for interventions in case of flooding.
It is developing the training action of new elected mayors and public local administration.

3.6 Raising Awareness and Preparedness of General Public

- Improvement reaction capacity, response and intervention;
- Information and awareness of the population regarding floods and its effects;
- Eco-centres setting-up in frequently affected zones;
- Public meeting presenting the local flood protection plans and the warning procedures based on colours code;
- Exercises for flood simulation at basin and county level with the participation of population.

3.7 Prevention and Mitigation of Water Pollution Due to Floods

A characteristic is represented by the pollution with heavy metals, especially in Săsar, Crişul Negru, Crişul Alb and Arieş river basins, where there are important mining perimeters with rocks which reach the surface and which are washed by the precipitation. Another significant pressure is represented by the suspended solid loads caused by coal mining activities, especially on Jiu river.
The Law 466 (regarding dam safety) covers the safety problems of dams and dikes of the mining waste deposits.

Now, according to the EU Directive 1999/31/CE and Governmental Decision 349 from 2005 the major part of the mining ponds with high risk stopped the activity.
The actual legislation foresees the continuity monitoring of the closed ponds.

4 Measures to Achieve Targets

4.1 Regulation on Land Use and Spatial Planning

Measures	Type of intervention	Institution in charge	Costs (mn.€)	Deadline	Comment
Implementation of the medium- and long-term flood risk management strategy - Land-use control - Relocation, land purchasing & cultural changes	Technical Administrative	Ministry of Environment Ministry of Agriculture Ministry of Administration and Interior Romanian Waters		2020	
Including the results of the study "Identification and delimitation of the natural hazards (earthquakes, landslides and floods). Hazards maps at county level" into local and regional developing plans	Administrative	Public Administration	120	2009	
Including the maps from Local Flood Protection Plan (Contingency Plans) into the Urban Development Plans	Administrative	Public Administration	20/year	continuous	This actions include flood risk evaluation (flooded areas maps and estimation of damages)

4.2 Reactivation of former, or creation of new, retention and detention capacities

Measures	Type of intervention	Institution in charge	Costs (mn.€)	Deadline	Comment
Implementation of the study "Ecologic and economic resizing of the Lower Danube	Administrative and technical	Ministry of Environment	2.5	2010	Including contributions for Romania in the Danube Floodrisk Project

floodplain"					

4.3 Technical Flood Defences

Measures	Type of intervention	Institution in charge	Costs (mn.USD)	Deadline	Comment
Implementation of the medium- and long-term flood risk management strategy- Improvement & maintenance of defence structures	Technical Administrative	Ministry of Environment Ministry of Agriculture Ministry of Administration and Interior Romanian Waters		2020	
Cibin river regulation, downstream Gura Râului dam and Olt confluence, Sibiu county	Technical	Romanian Waters	2.322	2010	Hazard Risk Mitigation & Emergency Preparedness Project – World Bank
Flood protection works of Teleorman, Cotmeana, Vedea and Vedița river in affected localities, Teleorman, Argeş and Olt county	Technical	Romanian Waters	7.366	2010	Hazard Risk Mitigation & Emergency Preparedness Project – World Bank
Vâlsan river control on Brădet-Vâlcele sector, Argeş county	Technical	Romanian Waters	1.462	2010	Hazard Risk Mitigation & Emergency Preparedness Project – World Bank
Increase safety degree for Dridu dam, Ialomița county	Technical	Romanian Waters	10.434	2010	Hazard Risk Mitigation & Emergency Preparedness Project – World Bank
Increase safety degree for Siriu dam, Buzău county	Technical	Romanian Waters	9.404	2010	Hazard Risk Mitigation & Emergency Preparedness Project – World Bank
Increase safety degree for Pucioasa dam, Ialomița county	Technical	Romanian Waters	3.877	2010	Hazard Risk Mitigation & Emergency Preparedness Project – World Bank
Increase safety degree for Buftea dam, Ilfov county	Technical	Romanian Waters	3.587	2010	Hazard Risk Mitigation & Emergency Preparedness Project – World Bank
Increase safety degree for Măneciu dam,	Technical	Romanian	7.337	2010	Hazard Risk Mitigation & Emergency

Measures	Type of intervention	Institution in charge	Costs (mn.USD)	Deadline	Comment
Prahova county		Waters			Preparedness Project – World Bank

Measures	Type of intervention	Institution in charge	Costs (mn. €)	Deadline	Comment
Jiu river control in Schitu locality, Dolj county	Technical	Romanian Waters	0.95	2009	External funds
Water works on Terpezița river in Gabru locality, Dolj county	Technical	Romanian Waters	0.55	2009	External funds
Water works on Prodila river in Podari locality, Dolj county	Technical	Romanian Waters	0.83	2009	External funds
Maleia river control in Petroşani town, Hunedoara county	Technical	Romanian Waters	0.94	2009	External funds
Racovăț river regulation at Ilovița locality, Mehedinți county	Technical	Romanian Waters	1.01	2009	External funds
Water works on Vodița river at Vodița monastery, Mehedinți county	Technical	Romanian Waters	0.85	2009	External funds
Lower Coşuştea Mare river control on Ilovăț locality-Motru river confluence sector, Mehedinți county	Technical	Romanian Waters	1.66	2010	External funds
Topolnița river control on Baloteşti-Drobeta-Turnu Severin sector, Mehedinți county	Tehnical	Romanian Waters	2.04	2009	External funds
Increase of safety degree of Işalnița dam, Dolj county	Technical	Romanian Waters	21.88	2010	External funds
Săcele dam over heightening, Braşov county	Technical	Romanian Waters	7.87	2009	External funds
Frumoasa river regulation downstream Frumoasa dam - Olt confluence, Harghita county	Technical	Romanian Waters	1.69	2009	External funds
Olt river embankment on the Făgăraş-	Technical	Romanian	4.54	2010	External funds

Measures	Type of intervention	Institution in charge	Costs (mn. €)	Deadline	Comment
Hoghiz sector, Braşov county		Waters			
Valea Seacă river regulation at Budila, Braşov county	Technical	Romanian Waters	1.22	2009	External funds
Bârsa river regulation on the Zărneşti-Hălchiu sector, Braşov county	Technical	Romanian Waters	1.34	2009	External funds
Olteț riverbank protection in Moruglav, Olt county	Technical	Romanian Waters	1.92	2010	External funds
Olt river embankment on Islaz-Moldoveni sector, Teleorman county	Technical	Romanian Waters	0.90	2009	External funds
Muereasca river regulation at Muereasca, Vâlcea county	Technical	Romanian Waters	3.97	2010	External funds
Băiaşu river regulation at Perişani, Vâlcea county	Technical	Romanian Waters	0.77	2009	External funds
Cerna river and tributaries regulation on the Rungetu-Măciuca sector, Vâlcea county	Technical	Romanian Waters	1.82	2009	External funds
Dopca dam rehabilitation, Braşov county	Technical	Romanian Waters	0.65	2009	External funds
Dâmboviţa river control , downstream Vitan bridge, Bucureşti city	Technical	Romanian Waters	5.74	2010	External funds
Ogrezeni reservoir, Giurgiu county	Technical	Romanian Waters	13.71	2009	External funds
Bilciureşti intake dam rehabilitation, Dâmboviţa county	Technical	Romanian Waters	10.12	2010	External funds
Road rehabilitation on left part Râuşor reservoir, Argeş county	Technical	Romanian Waters	0.26	2009	External funds
Argeş river control between Goleşti dam-Ogrezeni dam sector, Argeş, Dâmboviţa and Giurgiu county	Technical	Romanian Waters	20.19	2009	External funds
Dâmboviţa riverbank protection in the	Technical	Romanian	2.35	2009	External funds

Measures	Type of intervention	Institution in charge	Costs (mn. €)	Deadline	Comment
Dragomireşti, Sălcioara and downstream Conţeşti railway bridge zone, Dâmboviţa county		Waters			
Argeş river control for flood protection in Popa Nae-Găiseni localities zone, Giurgiu county	Technical	Romanian Waters	2.06	2009	External funds
Ciorogârla river regulation downstream Hydraulical Knot Brezoaiele, Giurgiu county	Technical	Romanian Waters	9.26	2010	External funds
Vedea river regulation in Văleni locality, Olt county	Technical	Romanian Waters	2.17	2009	External funds
Vedea river regulation in Corbu locality, Olt county	Technical	Romanian Waters	0.49	2009	External funds
Călmăţui river regulation, Teleorman county	Technical	Romanian Waters	2.13	2009	External funds
Pecineagu reservoir rehabilitation, Argeş county	Technical	Romanian Waters	6.86	2010	External funds
Increase of safety degree of Vâlcele dam, Argeş county	Technical	Romanian Waters	0.21	2009	External funds
Clucereasa intake dam on Râul Târgului river, Argeş county	Technical	Romanian Waters	2.45	2010	External funds
Water supply for Cotmeana zone, Argeş, Vâlcea and Olt counties	Technical	Romanian Waters	3.20	2010	External funds
Flood defences downstream Siriu dam for flood protection in Bâsca Mare-Bâsca Roziliei h.b., Buzău county	Technical	Romanian Waters	7.45	2010	External funds
Bălăneasa river embankments in Pârscov locality, Buzău county	Technical	Romanian Waters	0.94	2008	External funds
Teleajen river control downstream Măneciu dam, Prahova county	Technical	Romanian Waters	2.03	2009	External funds

Measures	Type of intervention	Institution in charge	Costs (mn. €)	Deadline	Comment
Bâsca Chiojdului riverbank protection on Chiojdu-Cătina sector, Buzău county	Technical	Romanian Waters	4.88	2010	External funds
Slănic river regulation in Lopătari, Mânzăleşti, Vintilă-Vodă, Berceni and Cernăteşti localities, Buzău county	Technical	Romanian Waters	2.61	2010	External funds
Buzău river regulation on Întorsura Buzăului-Sita Buzăului sector, Covasna county	Technical	Romanian Waters	9.34	2010	External funds
Ialomiţa river regulation upstream and downstream Târgovişte in Brăneşti, Secuieni, Comisani, Bucşani, Mărceşti, Dobra, Gheboaia, Finta, Corneşti, Dâmboviţa county	Technical	Romanian Waters	13.59	2010	External funds
Valea Voievozilor intake rehabilitation, Dâmboviţa county	Technical	Romanian Waters	0.67	2009	External funds
224 objectives (polders, riverbank regulations, dams)	Technical	Romanian Waters	2000	2013	9 dams, 4 polders, 211 regulations works

4.4 Preventive Actions

Measures	Type of intervention	Institution in charge	Costs (mn.€)	Deadline	Comment
Implementation of the medium- and long-term flood risk management strategy - Elaboration & implementation of Flood Risk Management Plans - Forecasting, monitoring & warning - Emergency plan & management - Flood Risk Asessment	Administrative Technical	Ministry of Environment Ministry of Agriculture Ministry of Administration and Interior Romanian		2020	

Measures	Type of intervention	Institution in charge	Costs (mn.€)	Deadline	Comment
- Run-off control - Improvement of flow conditions in river beds - Improvement of the flood defence capacity - Reduction of flood vulnerability of infrastructures and agriculture - Reduction of flood vulnerability of the environment - Social vulnerablity to floods - Individual vulnerability mitigation - Funding & compensation - International Cooperation		Waters			
DESWAT – Carrying of a hydrologic information-decisional system for the management of emergency situations (314 automatic stations)	Technical	Romanian Waters	45	2011	
WIMS – Investment supporting the information system and database for water management (PHARE project) at national level	Technical	Romanian Waters	2.4	2009	
Information system for integrated water management (WATMAN)	Technical	Romanian Waters	138.4	2015	
DANUBE FLOODRISK - flood risk reduction: risk assessment, risk mapping, involvement of stakeholders, risk reduction by adequate spatial planning.	Administrative Public	Romanian Waters	6.38	2012	
Contributions to the development of the flood risk management strategy	Technical	Romanian Waters	1.7	2009	
High-flood forecasting and flood	Administrative	Romanian	0.1	2009	

Measures	Type of intervention	Institution in charge	Costs (mn.€)	Deadline	Comment
management in Romania – feasibility study - the analysis for implementing of the decision support system	Technical	Waters			
Developing an integrated management plan in Olt hydrographic basin, as support for WFD implementation	Technical	NIHWM	0.11	2010	
Cross-border cooperation improving regarding the integrated management of the water resources in the Lower Danube Euroregion - TACIS	Administrative Technical	Romanian Waters	0.48	2009	
Update the Water Law	Administrative	Ministry of Environment			
Update the Flood Protection Plans at basin, county and local level	Administrative	Romanian Waters		Every 4 years	
Update the Plan for warning-alarming for downstream localities in case of accidents at dams	Administrative	Romanian Waters		Every 10 years	

4.5 Raising Awareness and Preparedness of General Public

Measures	Type of intervention	Institution in charge	Costs (mn.€)	Deadline	Comment
Implementation of the medium- and long-term flood risk management strategy - Population preparedness & feedback - Individual vulnerability mitigation	Technical Administrative	Ministry of Environment Ministry of Agriculture Ministry of Administration and Interior		2020	

Measures	Type of intervention	Institution in charge	Costs (mn.€)	Deadline	Comment
		Romanian Waters			
Exercises for general public preparedness for flood simulation	Public participation	Romanian Waters, General Inspectorate for Emergency Operations	0.50	Continuous	
Flood Protection leaflets	Public participation	Ministry of Environment	0.01	Continuous	
Setting-up New Eco-centres	Administrative	Ministry of Environment	0.02	Continuous	

4.6 Prevention and Mitigation of Water Pollution Due to Floods

Measures	Type of intervention	Institution in charge	Costs (mn.€)	Deadline	Comment
Monitoring the closed ponds and waste deposits	Administrative, Technical	Ministry of Industry	5.00	2012	USTDA estimation of the minimum needed equipment for monitoring and communication