Project funded by the
EUROPEAN UNION

SIRET WATER BASIN ADMINISTRATION - PP3

JOINT OPERATIONAL PROGRAMME
ROMANIA - UKRAINE - REPUBLIC OF MOLDOVA 2007 - 2013
Common borders. Common solutions.

Ref: The trilateral project **"The prevention and protection against floods in the upper Siret and Prut River Basins, through the implementation of a modern monitoring system with automatic stations - EAST AVERT",** cod **966,** funded by the **Joint Operational Programme Romania - Ukraine - Republic of Moldova,** European Neighbourhood and Partnership Instrument (**ENPI**)

JOINT FLOOD PROTECTION PLAN

for Prut and Siret rivers
in the common border aria between
Ukraine, Romania and Republic of Moldova

CONTENT

PRUT RIVER BASIN

1. General description of PRUT river basin

The Prut river basin originates on the southeastern slopes of the Goverla Mountains (Ivano-Frankivsk Oblast). It flows through two regions in Ukraine (Ivano-Frankivsk and Chernivtsi), as well as on the border with Moldova and Romania.

Prut river is of 952,9 km length from witch 742 km forms a natural border between Romania and Ukraine (for 31 km) and between Romania and Republic of Moldova (for 711 Km).

Ukraine:

On the territory of Ivano-Frankivsk oblast, the Prut river basin covers the following administrative and territorial units: Nadvirnyansky, Verkhovyna, Kolomyia, Snyatinsky districts.
On the territory of the Chernivtsi region, the river basin covers the following administrative and territorial units: the Putyla, Vyzhnytsky, Kitsmansky, Zastavnivsky, Novoselytsky, Hertsaevsky, and Sokyryansky districts.

The estimated number of people living on the territory of the Ukrainian part of the Prut river basin is 650 thousand people.

The major streams are:

Right: the river Luchka (length 42 km), the river Pistinka (length 57 km), Rybnitsa (length 56 km), Cheremosh River (length 80 km), the river Derelui (length 34 km), the Basheu River, Zhyzhya, Elanului;

Left: Turku stream (length 41 km), Chornyava river (length 63 km), Beleluya river (length 30 km), Ovitsa stream (length 39 km), Stary Kordon river (length 33 km), Ryngach river (length 42 km), Cherlene River (length 36 km, Vilya river (length 50 km), Lopatinka river (length 57 km), Rakovets river (length 67 km), Chugur river (length 90 km), p Kamenka (length 93 km), Girlamare River (length 40 km), Delia River (length 30 km), Nirnova River (length 49 km), Gora-Lopushna River (length 70 km), p. Saratov (length 59 km), river Tigech (length 43 km).

General conditions:

Very high rain floods were observed in the basins of the Prut rivers in 1911, 1927, 1941, 1955, 1964, 1969, 1970, 1974, 1996, 1998, 2008, and 2010.

The catastrophic flood on June 8th-12th, 1969, which, at elevation levels, exceeded all previous floods, was formed from exceptionally heavy rains that covered an area of 22,000 km2. The maximum flow on the Prut River - Chernivtsi was 5200 m3/s.

In the case of the 2008 floods in the Prut basins, the maximum flow on the Prut River - Chernivtsi was 4585 m3/s.

In the first decade of July 2010, the flood was formed due to the very strong storm rainfall. The maximum daily rainfall in the upper reaches of the river Prut was about 120 mm. The maximum flow on the Prut River - Chernivtsi was 2081 m3/s.

Romania:

The Romanian part of the basin falls into four admninistrative units: Botoșani, Iași , Vaslui and Galați counties.

Prut River is the last large tributary and the second one as lenghth of the Danube river and is situated in the north - eastern part of Romania on the Moldavian Plain.

The confluence with the Danube is just upstream of the Danube Delta. The mean elevation of the Prut river is 150 m above Black Sea level. The river basin has a elongated shape, especially the southern part, where mean with of width of the basin is only 30 km. The river network of the Prut river basin has a dendritic pattern. The total length of the streambeds is about 10.280 km and are enregistrated 246 water courses of Prut river basin on Romanian territory. .

One of the characteristics is that 80% of the hydrographic network is of non permanent flow, 60% of which are temporary streambeds (in the upper basin appears the phenomena of drying up due to the periods without the precipitations.) and 18% has semi permanent flow –only in periods with precipitations.

On the wright part of the Prut River, on the Romanian territory the main tributaries are : Volovăț (L= 43 km, S = 214 km2), Bașeu (L = 118 km, S = 965 km2), Jijia (L = 275 km, S = 5757 km2), Elan (L = 73 km, S = 606 km2) and Chineja (L = 79 km, S = 780 km2).

The hydrographic system:

The Prut river springs from the north-eastern slope of the Carpathian Mountains on Ukraine territory. From the moment it reaches the Ukraine- Romanian border till the tail of the Stanca-Costești reservoir the tributaries on the right hand side (the Romanian side) are very short and have only a semi-permanent flow.

Downstream of the Stânca-Costești reservoir larger tributaries are present on the Romanian side of the river. The most important of these are the Bașeu, and the Jijia (with its tributaries Sitna, Miletin and Bahlui).

- *Bașeu* river L= 104 km and its basin has a surface of 965 km^2.

- springs from Dealul Ibănești, from which the highest peak is 300 m.
- streams into the Prut 9 km downstream of the Stanca- Costești reservoir, at an altitude of 58 m.
- the average slope of the river bed is of 2,3 °/$_{00}$ •
- As most rivers in the area the Bașeu has a catchment basin with an oblong shape and the rivers with its tributaries form a dentritic network.

- *Jijia* river L=222 km and its its basin has a surface of 5536 km^2.

- the length is measured unto the man-made confluence with the Prut, 18 km downstream of the Ungheni gauging station. Originally the Jijia streamed for another 56 km parallel with the Prut, until the confluence at the village Gorban. This last part is now a non streaming branch, called the Old Jijia.
- downstream the confluence with the Milletin the watercourse is regulated and endiked till the confluence with Prut river, because of frequent floodings in the area.
- In the area of Vladeni village several large fishponds are created, which are supplied with water from the Jijia and its tributary Miletin by pumping network.

- *Miletin* river L= 90 km and its basin has a surface of 675 km^2.
- springs from the area south-west of Botoșani town, from an altitude of almost 320 m.
- flows into the Jijia river at an altitude of 47 m, near the village Vladeni.
- downstream from the village Copălău the river is meandering strongly and in these areas the floodplain is often inundated.
- In the Hălceni area a reservoir is built and the streambed is straightened till the confluence with Jijia.
- *Bahlui* river L=119 km and its basin has a surface of 1967 km^2.
- springs from an altitude of 500 m.
- an average slope of slope is of 3 °/$_{00}$-
- has a permanent flow of water due to the underground water inflow, from the descendent stratification of the valley.
- at the confluence with the river Jijia the mean yearly discharge is almost 4 m^3/s.
- *Sitna* river L= 78 km and its basin has a surface of 943 km^2
- springs from an altitude of 261 m,
- flows into the Jijia river at an altitude of 60 m.
- It meanders strongly, especially downstream the Sulita pond. In this area the slope of the streambed is only 0.03 ^{0}/$_{00}$.
- the average value for the whole river is 2.08 °/oo-
- in the river basin are almost 120 ponds.

General conditions:
The local communities from Prut river basin faced huge floods in 1969, 1970, 1975 , 2008, 2010.
The reasons for increasing floods frequency are multiple and diverse :

- modifications in the general circulation of the atmosphere, determined by the climate natural cycles trends-
- last years tide of the central - eastern European climate to become arid
- increase of torrential degree of the rain fall end of water flow
- anthropic activities effects (excessive deforestation of river basins,)
- deforestation, lack of hydraulic works on torrents and soil erosion control frequently determined the decrease of mobile river beds transport capacity

Historical developments:

In the 19th century the Bașeu, Jijia and Volovăț rivers catchment basins had more forest and higher number of lakes then in the first half of the 20th century. Starting in 1915, large surfaces were deforested and a part of the ponds were reclaimed, to create possibilities for agricultural expansion. Starting in 1950 elaborate water management studies were carried out within the bilateral cooperation with former URSS. This led to the building of the Stanca-Costesti reservoir on the Prut river and the building and restoration of numerous reservoirs on its tributaries. These reservoirs have a function in flood protection, water supply and fishery. Also large parts of the rivers were regulated and diked.

Following the floods in the years 1969, 1970, 1975 there were carried out hydraulic works such as :

- regularization of Baseu river and of some of its tributaries, and reservoirs have been built in the upper part of the Bașeu catchment basin. The river was diverted into Prut, 9 km downstream of the Stanca-Costești reservoir; the downstream part of almost 22 km, is supplied by natural precipitations and the input from the slopes;

- regularization and embankments of the Prut and Jijia rivers, as well as the diversion of the Jijia River into Prut at Chiperesti through a 5 km channel. The downstream 56 km of the river, now called the Old Jijia, is a small stream, mainly fed by some very small tributaries.
- 17 reservoirs have been built for flood protection or for water storage for the dry summer period in the Bahlui river basin;

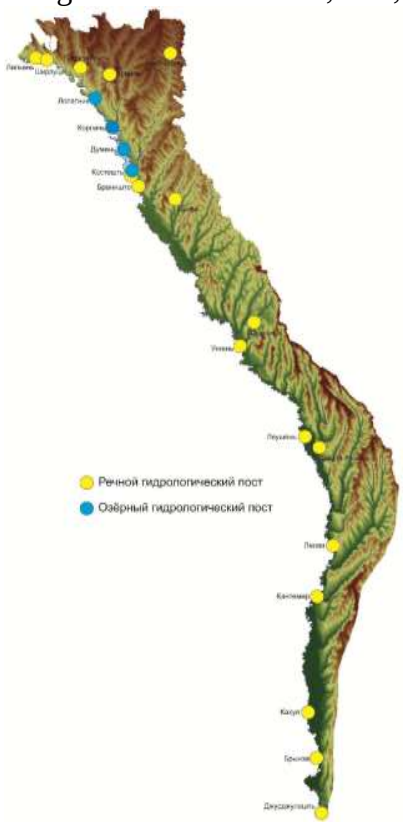
Republic of Moldavia:

Total area of left side Prut river tributaries on Republic of Moldavia teritory is of 7294,3 km2

Main tributaries on the left side are: Vilia (50 km), Lopatnic (57 km), Racovăț (67 km), Ciuhur (90 km), Camenca (93 km), Gârla Mare (40 km), Delia (30 km), Nârnova (49 km), Lăpușna (70 km), Sărata (59 km) and Tigheci (43 km).

High waters normally occur in spring caused by snowmelt and in summer caused by heavy rains. The autumn season is characterized lower and more stable waters, nevertheless sometimes floods may occur.

The high waters are registered during the floods caused by rains that are formed in the mountain part of the river basin, where cca. 1000 mm of precipitations/year fall. The average height of the middle high level above the average level constitutes 1,2 - 5,7 m.



General conditions:

The most significant floods may be considered those that occurred in 1911, 1913, 1932, 1941, 1948, 1949, 1955, 1969, 1973, 1991, 1994, 2006 (only in the inferior course, due to the Danube river afflux) , the catastrophic flood from July-August 2008 and 2010.

Maximum rainfall flows exceed maximum spring water. In Iaremcea, the maximum flow rate of the pluvial floods of June 8, 1969 was 1530 m3 / s, and the maximum flow of large spring waters observed on 2 April 1952 was 299 m3 / s. In Cernauti on July 9, 1969, the maximum rainfall rate was 5200 m3 / s, and the maximum spring water - 1320 m3 / s was recorded on June 6, 1932.
Levels can be observed almost throughout the whole year, eg 1961, throughout the summer of 1946, 1950 or may be interrupted by pluvial floods - 1911, 1965 and so on.

During the open bed, the minimum flow of 30 days in Ungheni is on average 40.5 m3 / s. The maximum and minimum flows in this period are, respectively, 100 m3 / s (1981) and 9,98 m3 / s (1964) respectively. Minimum daily water flow rates are as follows: multi-annual average - 29.2 m3 / s, maximum - 74.5 m3 / s (1980), minimum - 13.6 m3 / s (1963).

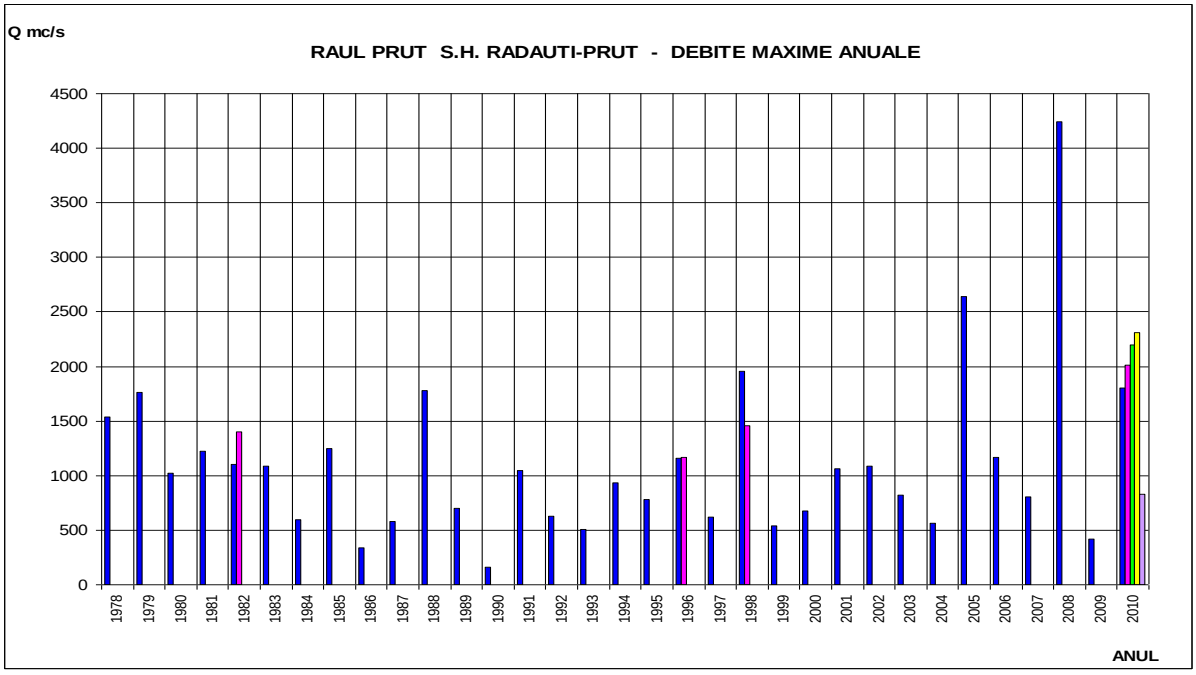
The catastrophic situation of the July-August 2010 floods it appeared in the result of the formation of the flood wave that entered the lake. There are clearly two main waves in the Cernauti and Şirăuţi sections. The triple peak form of flood hydrographs certifies the variability in time of the reflection. The first flood wave shaped double formed during the period from June 22 to July 7, 2010 almost simultaneously at the two stations, and the second immediate wave lasted until July 15-18.

2. Presentation of the extreme events at the PRUT river basin level

Extreme Floods -2008 and 2010

Gauging station Radauti – Prut, natural regime:

- in 2008 the maximum pick registered Q max = 4.240 mc/s exceeded the 1% probability = 3.700 mc/s; The flood volume = 1.400 mil cm;



- **Floods in 2008**

Dangerous hydro meteorological events took place between 23-28 July 2008. as a result of rainfall falling in the upper basin of the Prut river

The discharges registered at the hydrometric stations exceeded the probabilities of 1%.

Main rainfall between from the 23-28 July 2008 period

Data	23	24	25	26	27	28	Total
Cernauti	5.0	34.0	7.0	40.0			86.0
Sneatin	14.0	73.0	35.0	96.0			218.0
Putila	3.0	41.0	81.0	128.0			253.0
Kuti	38.0	77.0	8.0	133.0			256.0
Verhovina	31.0	33.0	186.0	46.0			296.0
Oroftiana	6.9	5.7	28.1	23.3	38.3	2.1	104.4
Radauti Prut	2.0	11.8	15.3	29.2	15.4	5.2	78.9

Hydro meteorological characterisation for 23-28.07.2008 :

- Due to the heavy rainfall from the upper part of the basin , in the mountains area, a flood wave with a maximum discharge 3740 m3 / s was registered at the hydrometric station Cernauti at 8.00 on July 26;
- The dispatching service of the Costeşti-Stânca reservoir began to evacuate a discharge of 180 m3 / s, which increased to 550 m3 / s and finally to 700 mc/s
- The second pick of the flood wave at Cernauti station on the morning of July 27 increased to 4000 m3 / s;
- The evacuated discharge from the reservoir increased to 1000 m3/s as a necessity to operate in safety conditions the Stanca- Costesti Hydraulic Knot.
- In the downstream streambed there were flooded areas where the crest of the dam was below water level or there were no dikes.
- The water level in the Stanca-Costesti reservoir increased with 747 cm above the normal level of retention and was attenuated a volume of 554 million cubic meters of water.

Registered damages :
There were affected:

- Upstream Stanca – Costesti reservoir: 127 collapsed houses, 52 damaged houses >50%, 62 slightly damaged houses, 22.9 km D.J., 4877 ha agricultural land, 11 bank consolidations, Horodistea dam;
- Downstream Stanca-Costesti reservoir: 2123 hectares of agricultural land in communes situated downstream: Stefanesti, Romanesti and Santa Mare.

The Maximum recorded flows downstream the Stanca –Costesti reservoir :
h.s. Ungheni 630 cm / s,
h.s. Prisacani 731 cm / s, ,

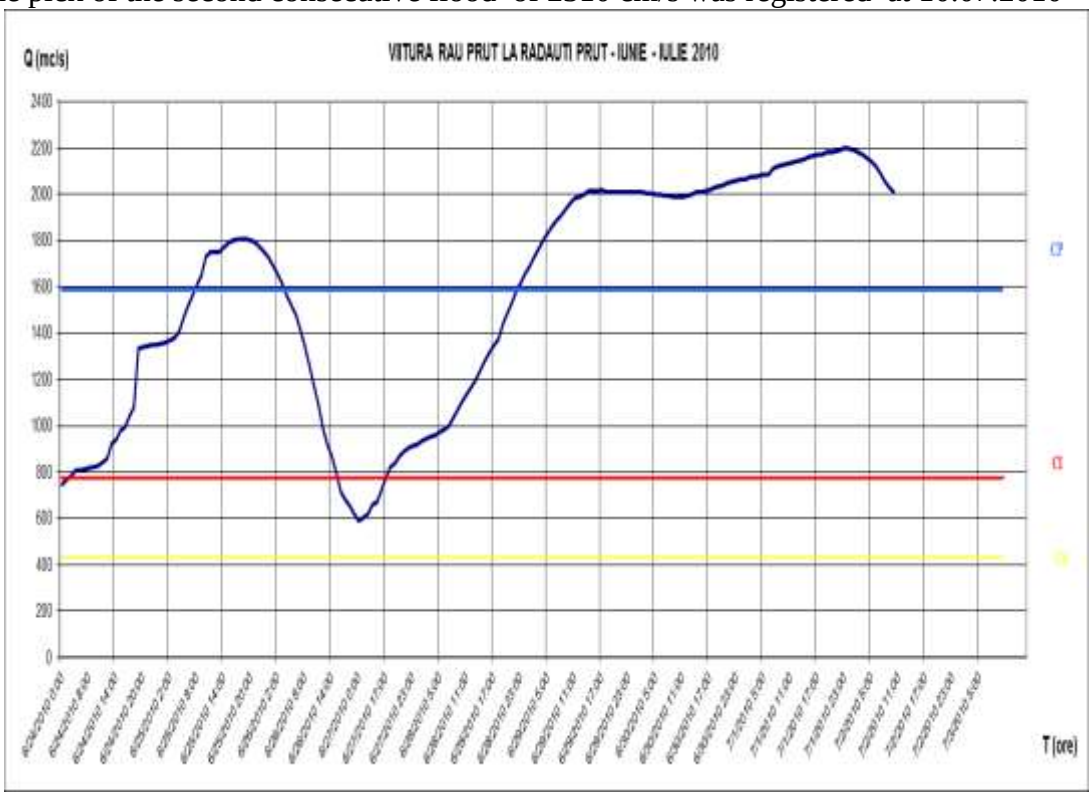
h.s. Dranceni 672 cm / s,
h.s. Falciu 658 cm / s,
h.s.. Oancea 587 cm / s.

- **Floods in 2010**

Dangerous hydro meteorological events took place between June - July 2010.

Hydro meteorological characterisation for the two flood events:

- between 23.06- 25.06 2010, a important rainfall was registered in the upper part of the basin;
- the pick of the flood event at the h.s. Radauti was of 2070 m3/s;
- the dispatch service from the Stanca-Costesti began a progressive evacuation of the water;
- in the first week of July there have been recorded heavy rainfalls;
- the pick of the second consecutive flood of 2310 cm/s was registered at 10.07.2010



Registered damages :

- in June : The progressive evacuation of important flows from Stanca –Costesti reservoir led to the flooding agricultural lands and affecting Mata Radeanu, Sovarca and Cotu Chiului . The damages were evaluated at approx. 1921 thousand lei.
  Maximum recorded discharge of 2070 cm/s at h.h. Radauti-Prut and 788 cm/s downstream Stanca Costesti reservoir.
- In the june –july period: were affected 3 houses, 1 destroyed house, 3 houses in danger of collapse in the village of Baranca, 11 bank consolidations, 141 m of the Horodistea dam, balastieresi and 24.2 km of communal road (D.C.) and 1184 hectares of agricultural land in communes situated downstream: Stefanesti, Romanesti and Santa Mare

The Maximum recorded debits downstream the Stanca –Costesti reservoir in July 2010 :

- h.s. Ungheni 796 cm / s,
- h.s. Prisacani 900 cm / s, ,
- h.s. Dranceni 736 cm / s,
- h.s. Falciu 722 cm / s,
- h.s.. Oancea 6987 cm / s.

Floods in 2010

Hydrometrical stations	**Flow before flooding**		**Maximum flow**		**Flood ending date**	**Total flood volume mil.m^3**
	m^3/s	Date	m^3/s	Date		
Şirăuţi Catchment area 9230 km^2	171	22.06	1930	02.07	07.07	1343
	327	08.07	1610	10.07÷11.07	18.07	600
Costeşti-Stânca Catchment area 12000 km^2	135	22.06	806	01.07÷03.07	07.07	832
	710	08.07	830	10.07÷11.07	27.07	952

3. Structural measures in flood protection in PRUT basin

Ukraine:

Prepared proposals for a joint project "Modernization of Infrastructure for Flood Protection and Protection against Accidental Pollution in the Romania-Ukraine Transboundary Area".

According to the project, it is proposed to take measures on:

1. Repair of coastal fastenings and dams on the river Prut in the area of Tarasivtsi-Mamaliga. The total length is 3500 m (software 905-922). Estimated cost of 2.0 million euros.
2. Construction of a dry plain flood reservoir near the villages of Prriputya - Boyanivka, Novoselytsya district.
3. Construction of the border bridge on the river Prut in the village. Tarasivtsi of Novoselytsya region (905 software) for joint measurements of expenses and joint sampling of water.
4. Adjustment and calibration of the river bed of the Prut in the area of Marshyntsi - Mamaliga.

Republic of Moldova :

Tabel - List of structural measures for flood risk management in Moldova

River Basin	River/s	District/s	Description
Upper Prut	Prut	Briceni	New dykes to protect Criva and Drepcăuți
Upper Prut	Prut	Briceni	New dykes to protect Lipcani
Lower Prut	Prut	Râșcani	Provide more flood storage: modify Costeşti Stânca management rules and repair existing gates
Lower Prut	Prut	Râșcani	New dykes along the River Prut and Avrameni
Lower Prut	Prut	Fălești	New dykes along the River Prut
Lower Prut	Prut	Ungheni	New dykes along the River Prut
Lower Prut	Prut	Hâncești	New dykes along the River Prut
Lower Prut	Prut	Hâncești, Leova, Cantemir.	Reconnect floodplain with the River Prut in two areas near Sărata-Răzeşi and Antonești
Lower Prut	Prut	Ungheni	New dyke in Costuleni
Lower Prut	Prut	Hâncești	Rehabilitate dykes in Leuseni, Cotul Morii and Nemțeni
Lower Prut	Prut	Hâncești	Rehabilitate dykes in Cioara and Dancu
Lower Prut	Prut	Hâncești	Rehabilitate dykes in Pogănești
Lower Prut	Prut	Leova	Rehabilitate dykes in Tochile-Răducani
Lower Prut	Prut	Cantemir and Cahul	Rehabilitate dykes in Țiganca, Goteşti, Cantemir, Zîrnești, Chircani and Cucoara
Prut tributaries	Lopatnic	Briceni	Rehabilitate and improve dykes and increase the capacity of the River Lopatnic in high risk areas
Prut tributaries	Ciuhur	Ocnița, Edineț and Râșcani	Rehabilitate and improve dykes and increase the capacity of the River Ciuhur in high risk areas.

Prut tributaries	Delia	Ungheni	Rehabilitate and improve dykes in high risk areas for the River Delia.
Prut tributaries	Calmaţui	Hânceşti	Provide more flood storage volumes for the River Călmăţui through the improvement of an existing dam.
Prut tributaries	Lăpuşna	Hânceşti	Rehabilitation and improvement of an existing flood storage area on the River Lăpuşna at Carpineni.
Prut tributaries	Tigheci	Cantemir	Rehabilitate and improve dykes and increase the capacity of the River Tigheci in high risk areas.
Prut tributaries	Larga	Cantemir	Re-meandering one reach of the River Larga.
Prut tributaries	Nârnova	Hânceşti	Re-meandering one reach of the River Nârnova.
Prut tributaries	Calmaţui	Hânceşti	Re-meandering one reach of the River Călmăţui.
Prut tributaries	Lăpuşna	Hânceşti, Leova	Re-meandering two reaches of the River Lăpuşna.
Prut tributaries	Tigheci	Cantemir	Re-meandering one reach of the River Tigheci.

4. Nonstructural measures in flood protection in PRUT basin

Ukraine:

Construction of automated hydro-meteorological stations has made it possible to improve the system of warning, forecasting and simulation of emergency situations to make sound management decisions.

To predict meteorological factors that significantly affect the formation of surface runoff, a model of meteorological forecasting in the basins of the Prut and Siret - WRF is used. This model is configured and adapted for meteorological forecasting with spatial resolution (estimated grid) of up to 3 km.

For the implementation of the transformation of the surface runoff into the flood, the UCEU-HYDROS program complex corresponds to the receipt of numerical characteristics of the levels and water consumption, which in the future are the source data for the prediction of flood zones modeling. Due to such forecasting, the time increases for the adoption of appropriate management decisions and preparatory measures with the use of forces and means to prevent the emergence and / or elimination of possible consequences of an emergency.

In the event of emergencies associated with the destructive effects of flood waters, a system of automatic alert of the population was created, whose elements are located in 22 settlements of the Prut river basin.

Republic of Moldova :

List of non-structural measures.

Capacity building and extension of the flood hazard and flood risk assessment to medium floods.

- Capacity building for the preparation and updating of flood management plans
- Define a programme for soil and water conservation
- Preparation of a database of existing dams
- Management and flood risk assessment of existing dams
- Preparation of a plan and programme for inspection, maintenance and management of flood protection works
- Enhancement of existing flood forecasting systems.
- Establish or improve emergency planning
- Updating of floodplain designations and flood hazard maps.
- Land use planning: remove pollution sources from flood risk areas.
- Topographic LiDAR survey for areas not currently covered
- Preparation and updating of flood management plans
- Promote measures to increase natural water retention by conserving and improving the water storage capacity of soils and ecosystems.
- Promote measures to reduce farmland erosion and therefore sediment input into rivers.
- River basin reforestation
- Updating plans and programmes for inspection, maintenance and management of flood protection works
- Maintenance of rivers and flood protection works.
- Routine collection of data on floods, to be used for planning purposes.

- Reorganisation of the hydrological data management systems based on river basin management principles
- Enhancement of existing flood forecasting systems: improvement of existing telemetered rainfall and river gauges
- Enhancement of existing flood forecasting and warning systems including information for different recipients.
- International exchange of data and forecasts.
- Update emergency planning and provision of resources
- Flood response exercises. These may include the public.
- Public awareness raising.
- Public preparedness raising
- Updating of the National legislation on flood management

5. PRUT river basin map/list of the hydro-meteorological information system

Ukraine:

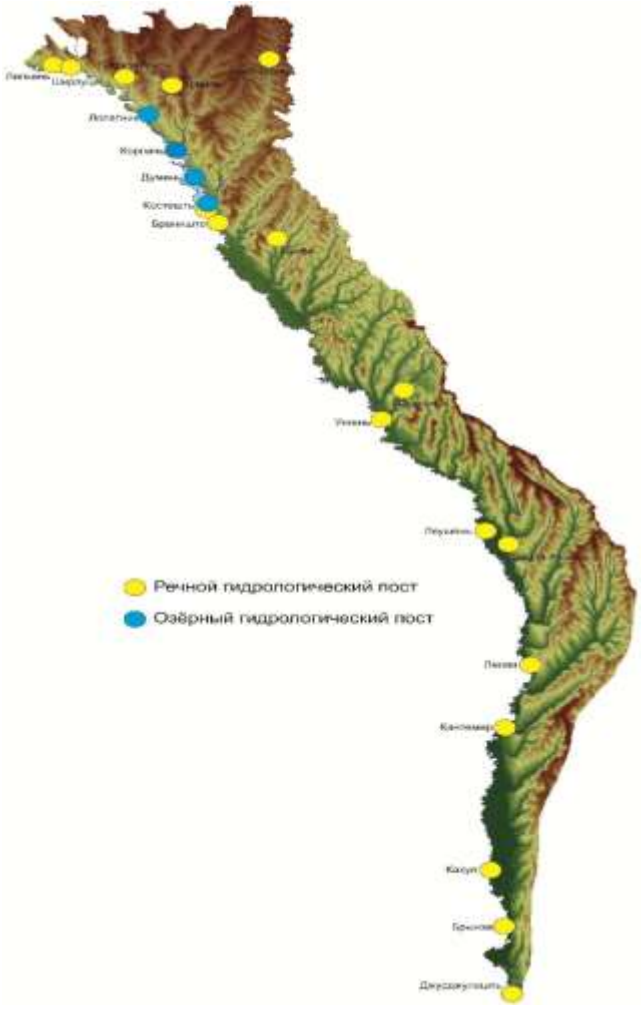
List of automatic stations and their technical support of AIVS "Prykarpattya" in the basin of the Prut River

№	The name of the settlement	Stage	expenses	precipitation
Chernivtsi region				
1	Prut river – Tarasivtsi village	x	-	x
2	Prut river - Chernivtsi	x	x	x
3	Derelui river – Ostrytsia village	x	-	-
4	Derelui river – Valia Kuzmina village	-	-	x
5	Putyla river – Putyla village	x	-	x
6	Sovytsia river - Kitsman	-	-	x
7	Cheremosh river – Chortoryia village	x	-	
8	Prut river – Dubivtsi village	x	-	-
Ivano-Frankivsk region				
9	Prut river - Vorokhta	x	-	-
10	Prut river - Yaremche	x	-	x
11	Prut river - Sniatyn	x	-	x
12	Prut river - Kolomyia	x	x	x
13	Prut river – Pozhezhevska station	-	-	x
14	Rybnytsia river – Dzhuriv village	x	-	x
15	Zhonka river – Yaremcha	x	-	x
16	Chorny Cheremosh river - Verkhovyna	x	x	x
17	Chorny Cheremosh river – Zelene village	-	-	x
18	Bily Cheremosh river – Yablunytsia village	x	-	x
19	Bily Cheremosh river – Holoshyna village	-	-	x
20	Cheremosh river – Usteriky village	x	x	x

21	Cheremosh river - Kuty	x	-	x
22	Kamianka river – Dora village	x	-	x
23	Iltsia river – Iltsi village	x	-	x
24	Veretyn river – Verkhni Yaseniv village	x	-	x
25	Pistenka river – Prokurava village	-	-	x
26	Chorniava river – Liubkivtsi village	x	-	-
27	Prut river – Tatariv village	x	-	-

Republic of Moldova :

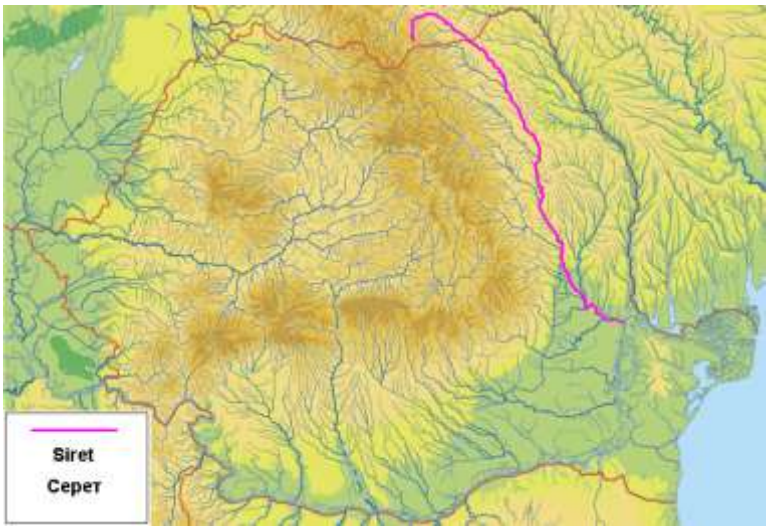
On Prut river there are automatic hydrometric stations according to the following map:



SIRET RIVER BASIN

6. General description of SIRET river basin

Siret is a river that rises from the Carpathians in the Northern Bukovina region of Ukraine, and flows southward into Romania before it joins the Danube. It is 647 km long of which 559 km in Romania, and its basin area is 44,811 km2, of which 42,890 km2 in Romania. Its average discharge is 250 m3/s (8,800 cu ft/s).



Ukraine:

The upper part of r. Siret basin is located in the eastern Carpathians, in district of Pokutsko-Bukovynian Carpathians and on the Bukovynian foothill height.

Siret river takes its origin at the merger of mountain streams of Cheremosh and Buretski, near the village Petrovets on the height 740 km.

The length of the river in Ukraine is 100 km and the catchment area 1510 km^2. General falling within Ukraine is 435 m, medium slope 4,4%.

The river basin covers next administrative-territorial units: Vyzhnytsky, Storozhinets, Glibotsky districts. The approximate population, which lives on the territory of Ukrainian part of Siret river basin consist of – 230 thous. people.

Main tributaries in Ukraine are on the right river Mygova (length 21 km), river Malyi Siret (length 61 km) and on the left river Mihidra (length 32 km), river Kotovets (length 18 km).

Romania:

Siret hydrographic space comprises almost integrally Suceava, Vrancea, Neamt and Bacau counties and in a smaller proportion Galati, Harghita, Iasi, Botosani, Buzau, Braila, Covasna, Bistrita and Maramures counties.

The hydrographic network has a total length of 15,157 km, from which Siret has 559 km and an average density of 0.35 km/km2.

The multi-annual flows volume (5,800 mn.m3) is distributed unevenly on seasons and month, so that during the vegetation time (April - September) the flow is maxim (70% from the total), and the minimum flow is registered during Winter. The minimum flow is produced in Siret watershed during winter when the supply of the rivers comes exclusively from the underground waters, and during summer-autumn when the high temperatures favorite intense water evaporations.

The maximum historic discharges in Siret hydrographic space is due to some powerful cyclones, while the maximum usual flows are generated by local heavy rains.

SH Siret - Harta administrativa

The main rivers are Siret river and its Ist order tributaries:

- Suceava
- Moldova
- Bistriţa
- Trotuş
- Putna
- Râmnicu Sărat

From administrative point of view, Siret hydrographical space counts 11 counties, from which the main are Suceava, Neamţ, Iaşi, Bacău and Vrancea.

General conditions:
The local communities from Siret river basin faced huge floods in 1972, 1975, 1985, 1991, 2005, 2006, 2008 and 2010.
The reasons for increasing floods frequency are multiple and diverse:

- modifications in the general circulation of the atmosphere, determined by the climate natural cycles trends
- last years tide of the central - eastern European climate to become arid
- increase of torrential degree of the rain fall end of water flow
- anthropic activities effects (excessive deforestation of river basins)
- deforestation, lack of hydraulic works on torrents and soil erosion control frequently determined the decrease of mobile river beds transport capacity

7. Presentation of the extreme events at the SIRET river basin level

Extreme Floods -2008 and 2010

❑ Floods in 2008

Dangerous hydro meteorological events took place between July - August 2008.
Hydro meteorological characterisation for 22.07 - 01.08.2008 :

- between 22-31.07.2008 in Siret basin, especially in upper Siret, Suceava, Moldova and Bistriţa sub basins, the rainfall was very important;
- in northern Moldova and Bucovina appeared a very low pressure centre, characterised by a huge height and a long standing time (about 48 hours);
- those synoptic conditions and the escalade of mountain crests led to huge rainfall in short time;
- first time upper Moldova basin was affected, with floods in Pojorâta - Câmpulung - Stulpicani area, and, after about 24 hours, were affected Suceava, upper Siret and upper Prut;

Main rainfall between 23.07- 05.08.2008, in the northern part of Siret hydrographical space

Nr. crt.	River	Hydro / pluvial post	Rainfall / day (l/mp)							
			22.07	23.07	24.07	25.07	26.07	27.07	28.07	Total
1	Siret	Siret		13,5	6,3	68,2	16,3	71,6	2,7	178,6
2	Siret	Zvorişte a		11,2	2,9	51,6	12,8	10,7	9,2	98,4
3	Siret	Huţani		11,9	1,3	56,4	22,7	3,5	30,0	125,8
4	Suceava	Brodina		8,4	55,2	102,3	107,7	10,2		284,0
5	Suceava	Vicovu de Jos		8,5	33,4	113,0	135,0	88,0	54,0	431,9
6	Suceava	Ţibeni		8,9	1,9	11,8	23,2	27,6	12,6	86,0
7	Suceava	Iţcani	0,1	8,6	1,4	24,1	19,8	1,9	10,4	66,3
8	Putna	Putna	2,5	7,2	55,4	26,6	5,0	33,9		129,3
9	Pozen	Horodnic		15,2	73,2	90,0	81,7	37,2		297,3
10	Suceviţa	Suceviţa	0,4	13,7	54,8	115,9	73,7	7,3		265,8
11	Soloneţ	Părhăuţi		10,8	12,8	124,2	13,0	16,8	5,9	183,5
12	St. meteo	Rădăuţi	5,2	7,4	65,0	75,4	45,8	3,8		202,6
13	St. meteo	Suceava	7,2	1,6	58,1	77,8	5,2	19,2		169,0

After 28.07.2008, rainfall was strictly local and insignificant

Maximum flows in 2008 compared with previous historical flows:

Nr. crt.	River	Hydro post	Qmax before 2008 mc/s	Date	P%	Qmax 2008 mc/s	P%
1	Siret	Siret	1193	VII.1969	1-2	920	5
2		Huţani	866	VII.1969	2	672	
3		Lespezi	1133	VII.1969	5	1561 1855	1-2 0.5-1
4		Nicolae Bălcescu	919	VIII.2005	5-10	1412 1875	1-2 0.5
5		Drăgeşti	1948	VIII.2005	2-5	2410 2676	2 1
6	Suceava	Brodina	325	VI.1969	5	465	2
7		Ţibeni	520	VI.1995	10	858 966	2-5 2
8		Iţcani	1354	VI.1969	2	1640 1946	1 0.5
9	Pozen	Horodnic	108	VI.1975	5	104	5
10	Soloneţ	Părhăuţi	309	VII.2006	2	360	1
11	Moldova	Prisaca Dornei	304	VI.1972	8	274	8-10
12		Gura Humorului	694	17.VIII.2002	8	664	8-10
13		Tupilaţi	1402	VII.1991	2-5	646	
14		Roman	1415	VII.1991	2-5	797	
15	Moldoviţa	Lunguleţ	186	VII.1969	8	254	2
16		Dragoşa	463	VIII.2002	2	539	2

Hydro meteorological characterisation for 22.07 - 01.08.2008 :

- the majority of hydro posts in the affected area registered 2 consecutive floods, in a relatively short time (24-36 hours);
- downstream Bacău, the flood did not produce damages, because of the attenuation of about 100 million mc in the lakes Galbeni, Răcăciuni, Bereşti and Călimăneşti;

Registered damages :

- hydro technical works were damaged, two dams collapsed (on r. Horodnic and Topliţa (Suceava county), dikes on Suceava river in Suceava county and on Siret river in Iaşi, Neamţ and Bacău counties were overflowed and broken;
- total amount of damages produced by floods in the summer of 2008 is about 164 million lei;

❑ Floods in 2010

Dangerous hydro meteorological events took place between June - July 2010.

Hydro meteorological characterisation for 17.06 - 10.07.2010 :

- between17.06- 10.07 2010, important rainfall was registered in several rounds of 2-3 days each one;
- in 17.06.2010, in Siret hydrographical space, has started a period with high atmospheric instability, with almost generalized rainfall, but with important differences of quantity between areas;
- first stage - rainfall between 23- 25.06.2010, in upper and middle basins of Suceava and Moldova, where it produced medium amplitude floods;
- second stage - between 26-27.06.2010, on almost all Carpathian rivers (the most important flows, ending with floods, were in Trotuş basin);
- third stage - between 29.06.-1.07.2010, in upper Siret basin and in Suceava, Moldova and Bistriţa basins (Bistricioara, Bicaz, Tarcău and other small tributaries);

Hydro meteorological characterisation for 17.06 - 10.07.2010 :

- flows on Bistriţa river downstream Izvorul Muntelui dam were artificially increased by controlled discharges from the lake;
- forth stage - 2-3.07.2010, with important rainfall in the northern part of Siret basin;
- in 2010 the flood on Siret river downstream the confluence with Suceava river had two different points that had merged in Drăgeşti hydrometric station sector;
- the composed flood was determined by the rainfall produced between 29.06 – 01.07.2010;
- an important role in decreasing of the flood volume was insured by the operation of the lakes Rogojeşti and Bucecea, in the upper area of Siret river;
- the transition of the flood wave by those lakes was done by well correlated manoeuvres of the dams' equipments, in order to obtain downstream Bucecea the smallest possible flows;

Representatives rainfalls between 29.06.2010 – 1.07.2010

Nr. crt.	River	Hydrometric station	Rainfall (l/m^2)	Nr. crt.	River	Hydrometric station	Rainfall (l/m^2)
1	Siret	Siret	133,4	11	Moldova	Gura Humorului	62,6
2		Zvoriştea	202,5	12	Moldoviţa	Lunguleţ	125,6
3	Suceava	Brodina	109,1	13		Dragoşa	96,7
4		Ţibeni	209,7	14	Suha	Stulpicani	66,0
5		Iţcani	32,8	15	Ozana	Dumbrava	84,6
6	Pozen	Horodnic	115,2	16	Bistricioara	Tulgheş	54,8
7	Suceviţa	Suceviţa		17	Schit	Ceahlău	76,1
8	Soloneţ	Părhăuţi	120,3	18	Bicaz	Taşca	60,0

9	Moldova	Fundu Moldovei	79,8	19	Tarcău	Cazaci	51,5
10		Pr. Dornei	94,8	20	Trebeş	Podiş	

Maximum flows in 2010compared with previous historical flows

Nr. crt.	River	Hydrometric station	First point		Second point		Qmax 2008 (m^3/s)	Qmax before 2008 (m^3/s)
			Q (m^3/s)	Date/hour	Q (m^3/s)	Date/hour		
1	Siret	Siret	1115	29 / 13			920	1193
2		Zvorişte a	766	29-30 / 23-3				
3		Huţani	815	30 / 8-11			672	866
4		Lespezi	1678	2 9 / 21-23	2049	1 / 5-8	1855	1133
5		Nicolae Bălcescu	1339	1 / 1-7	1824	2 / 0-1	1875	919
6		Drăgeşti	2058	30 / 12	2884	2 / 7-11	2676	1948
7		Adj. Vechi						
8		Lungoci	2576	1 / 6	2567	3-4 / 11-12		
9	Suceava	Brodina	151	29 / 4	136	30 / 15	465	325
10		Ţibeni	973	29 / 8	747	30 / 20	966	520
11		Iţcani	883	29 / 3	1050	30 / 20	1946	1354
12	Soloneţ	Părhăuţi	346	29 / 0				
13	Moldova	Fundu Moldovei	58,4	29 / 2-4	96,5	30 / 17-18		
14		Prisaca Dornei	222	29 / 0	209	30 / 17-18	274	304
15		Gura Humorului	617	29 / 2	585	30 / 20	664	694
16		Tupilaţi	660	29 / 16	592	1 / 10	646	1402
17		Roman	846	29 / 19	887	1 / 12	797	1415
18	Moldoviţa	Lunguleţ	45,4	29 / 6	126	30 / 13	254	186
19		Dragoşa	238	29 / 0	368	30 / 18	539	463

Hydro meteorological characterisation for 17.06 - 10.07.2010 :

- downstream Bacău, the large flows from Siret river and from Bistriţa river (natural flows and overflows from Izvorul Muntelui - up to 900 m^3/s), were transported by the lakes, by correlated manoeuvres of the dams' equipments;
- taking into account the large flows on the Danube and some problems on the lower stream of Siret river, the flows discharged downstream Movileni dam were maintained between 2300 - 2500 m^3/s, with a maximum value of 2567 m^3/s;

Registered damages :

- hydro technical works from Trotuş basin (Trotuş, Tazlău Sărat rivers) and Bistriţa basin (Tazlău, Cracău, Bicaz rivers) were damaged , dikes on Siret river in Iaşi, Neamţ and Bacău counties were overflowed and broken (Hălăucești, Roman- Răchiteni, Săucești);
- total amount of damages produced by floods in the summer of 2010 is about 368 million lei;

8. Structural measures in flood protection in SIRET basin

Ukraine:

The list of shore-fastening, protective, anti-flooded and regulative structures to Siret river basin, which are on a balance of Dniester – Prut БУВР as of 01.01.2017 year listed in Addition 1.

Prepared propositions for common project « Modernization of infrastructure of flood protection and protection against accidental pollution in the Romania-Ukrainian cross-border zone ».In accordance to project is offered Shore-fastening at Siret river in cross-border zone Ukraine – Romania Terebleche 1500 m.

Romania:

Examples of flood defense measures in SIRET basin
Flood Risk Management Plan For Siret WBA

Measures	Nr. Measures
Reconnection and restauration of the flood plain	1
Improving forests management in flooded areas	37
Reforestation of the upper basins, in mountain areas	47
Reforestation around the lakes	1
Increasing the water transport capacity of the bridges, by redesigning and reconstruction	11
Insurance of drainage capacity	3
Increasing of the water transport capacity of the streams, by recalibrations and cleaning the clogged zones	96
Insurance / increase of storage capacity of the reservoirs	1
Construction of new non-permanent reservoirs / maintain of the capacity of existing ones	2
Construction of new small non-permanent reservoirs	3
Increasing of the security in exploitation of existing hydraulic works	7
Reconnection and restauration of the flood plain	1
Improving forests management in flooded areas	37
Reforestation of the upper basins, in mountain areas	47
Reforestation around the lakes	1
Increasing the water transport capacity of the bridges, by redesigning and reconstruction	11
Insurance of drainage capacity	3
Increasing of the water transport capacity of the streams, by recalibrations and cleaning the clogged zones	96
Insurance / increase of storage capacity of the reservoirs	1
Construction of new non permanent reservoirs / maintain of the capacity of existing ones	2
Construction of new small non permanent reservoirs	3
Increasing of the security in exploitation of existing hydraulic works	7

Total number of measures in Siret river basin 374

9. Nonstructural measures in flood protection in SIRET basin

Ukraine:

In frames of solution the problems of prevention and protection against destructive flood actions, increase of readiness to extraordinary situations caused by spontaneous phenomenon related to water factor, created common international programme "Romania – Ukraine - Republic of Moldova 2007-2013". In a frame-work program of Dnister-Prut БУВР common with partners from Ukraine, Romania and Moldova Republic realized project "Prevention and protection against flood in upper basins of rivers Siret and Prut, introducing modern monitoring system with automatic stations - EAST AVERT". The main purpose of project is protection cross-border districts of upper part of rivers basins of Prut and Siret against floods ,and also decreasing ecological, economical and social susceptibility settlements, which located in flood-danger zone.

Construction of automated hydro-meteorological stations has made it possible to improve the warning system, forecasting and modeling emergency situations to make sound to substantiated decisions.

For forecasting meteo-factors, which substantially have affect to formation of surface runoff, uses the model of meteorological forecasting in the basins of rivers Prut and Siret - WRF. This model This model is configured and adapted for meteorological forecasting with spatial resolution (estimated grid) to 3 km. For realization of transformation of surface runoffin in flood is responsible software complex УЦЕВП – HYDROS, receiving numerical characteristics of levels and water consumption, which which in the future are the source data for the prediction of flood zones modeling. This model make a forecast to 4 days, which in turn, allows to pre-identify the possibility of emergency. Due to such forecasting, the time increases for the adoption of appropriate management decisions and preparatory measures with the use of forces and means to prevent the emergence and liquidation of possible consequences of emergency.

УЦЕВП – COASTOX use the results of forecasting number characteristics of levels and costs of input design and the features of the relief, obtained as a result of the creation of a digital model, allows to obtain a flood zone in the form of a mesh, with triangular elements, which solves the equations by the finite volume method. For operative receiving of data to parameters of possible flood zone, uses one-dimensional model RIVTOX.

In case of nascence emergency situations related with destructive flood actions ,was created automatic system for notification of population, the elements of which are located in 2 settlements in the basin of the river Siret. The map of system location presented in Addition 2.

Notification system Siret basin	
1	Glybotsky district, v.Cherepkivka
2	Vyzhnytsky district, v.Beregomet

To provide speech and electro-siren sounding at the territory of village and village councils are placed loudspeakers , antenna feeders and other hardware.

End devices , technique means and and the points of the automatic notification system are connected with the control point of Chernivtsi BOUV , using broadband communication channels based on MPLS technology , multi-protocol switching of labels.

Romania:

The general measures proposed for Siret basin are:

- Cleaning of watercourses;
- Delimitation of main watercourses;
- Restoration of forest protection curtains;
- Prohibition of new construction in major riverbeds and floodplains;
- Prohibition of access to the dyke coronation;
- Forecasting dangerous hydro-meteorological phenomena:- Quantitative and qualitative improvement of hydrometeorological data;
- Improvement of alarm systems;
- Flooding campaigns to inform the population about flood risk.

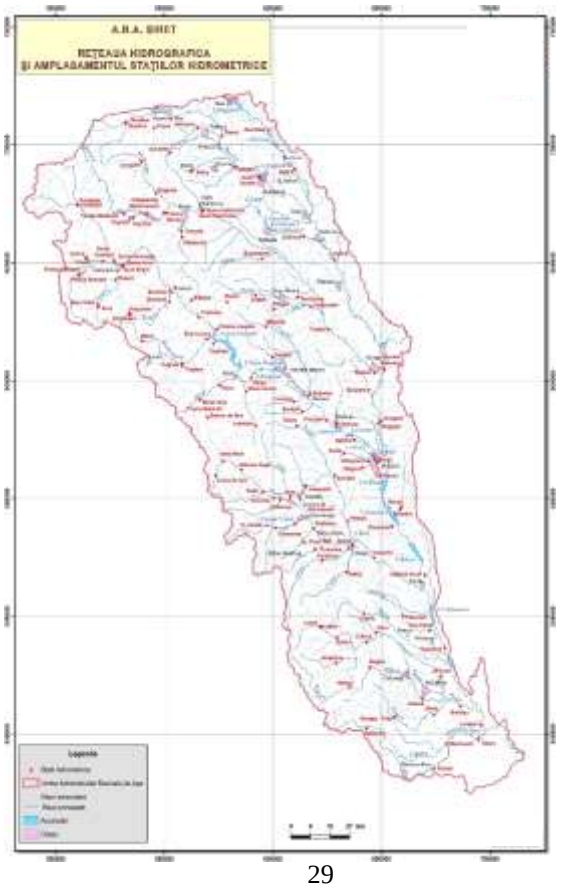
10. SIRET river basin map/list of the hydro-meteorological information system

Ukraine:

List of automatic stations and their technical support AIBC "Prykarpattya "in basin of Siret river

№	River name and settlement	Basin of r. Siret		
		Level	Costs	Fall-out
Chernivtsi district				
1	Siret river – Storozhynets city	x	x	x
2	Mikhidra river – Stara Zhadova village	x	-	x
3	Maly Siret river – Verkhni Petrivtsi village	x	-	x
4	Siret river - Cherepkivtsi village	x	-	-
5	Siret river – Dolishni Shepit village	x	-	x
6	Sucheava river – Seliatyn village	-	-	x
7	Siret river – Lopushka village	x	-	-
8	Siret river – Kamianka village	x	-	-

Romania:



11. The agreements and common regulations between Romania, Ukraine, Republic of Moldova

Romania -Ukraine

The Agreement on cooperation in the field of water management on the border waters between the Government of Romania and the Government of Ukraine was signed in Galati (Romania) September 30, 1997 .

The following Regulations of Cooperation are applied by the 4 river basin working groups :

- Regulation for the assessment of the quality of the boundary water.
- Regulations on measures taken in the case of hazardous and extraordinary pollution of border rivers, which can not be avoided.
- Regulations for cooperation on protection against floods on watercourses and inland waters.
- Regulations for the exchange of meteorological and hydrological data between Ukraine and Romania.

Romania -R. Moldova

The Agreement between the Government of Romania and the Government of R. Moldova on protection and sustainable usage of the Prut and Danube river waters -signed in Chisinau, on 28 June 2010

The cooperation will be applied by the next subcomisions:

- Subcomision for the operation and maintenance of the Stanca Costesti Hydraulical Knot;
- Subcomision for the flood and ice defence;
- Subcomision for the quantitative water management and hydrometeorology;
- Subcomision for the water quality and water bodies biodiversity protection;
- Ad-hocSubcomisia.

-the text and content of the technical specific regulations have to be negotiated and approved by the Intergovernmental Hydrotechnical Commission.