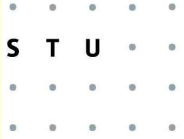


# Analysis of the Kláštorské lúky wetland



**Dept. of Land and Water Resources Management  
Slovak University of Technology  
in Bratislava**

**Jana Skalová, Branislav Jaroš,  
Kamila Hlavčová, Silvia Kohnová**

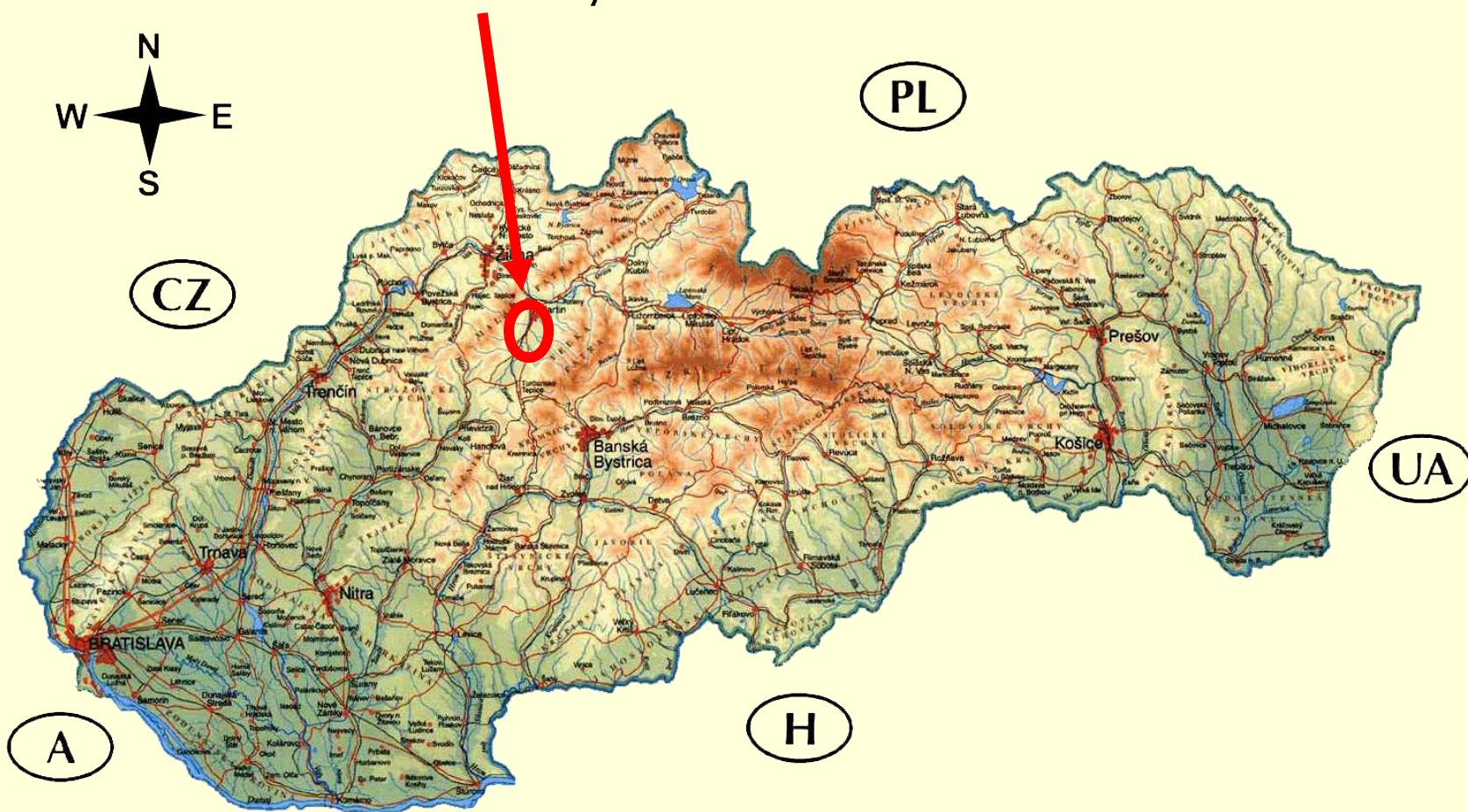


**Tatranská Štrba 2009**

# Motivation

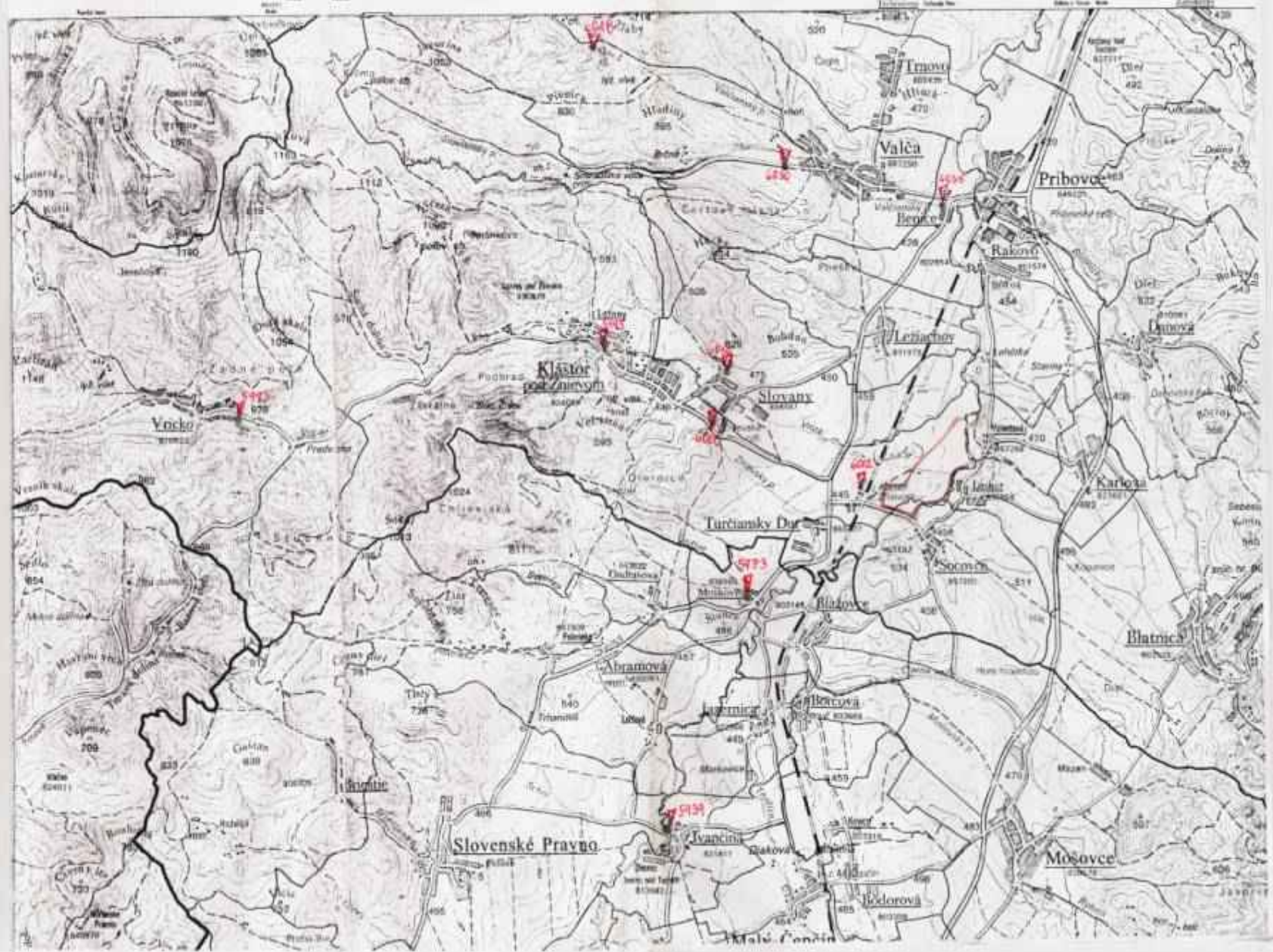
- within the framework of the GEF project „Conservation, Restoration and Wise Use of Rich Fens in the Slovak Republic“
- DAPHNE - Institute of Applied Ecology
- Analysis of hydrological regime of wetlands
- To identify reasons of wetlands degradation:
  - Changes in hydrological regime
  - Human activities (drainage systems)
  - **Changes in management of wetlands**
- Proposal of measures to improve hydrological regime

Kláštorské lúky



Kláštorské lúky









# **Content of the study**

- 1. Analysis of hydrological and climatological regime of the wetland system**
- 2. Analysis of effect of management practices**
- 3. Effect of hydro-melioration measures on the wetland system**
- 4. Proposal of measures for revitalization of the wetland**



# **1. Analysis of hydrological and climatological regime**

- **Discharges**
- **Precipitation**
- **Air temperature**
- **Ground-water level**

## 2. Analysis of effect of management practice on soil water regime

- Grass
- Reed



### **3. Effect of hydro-melioration measures on the wetland system**

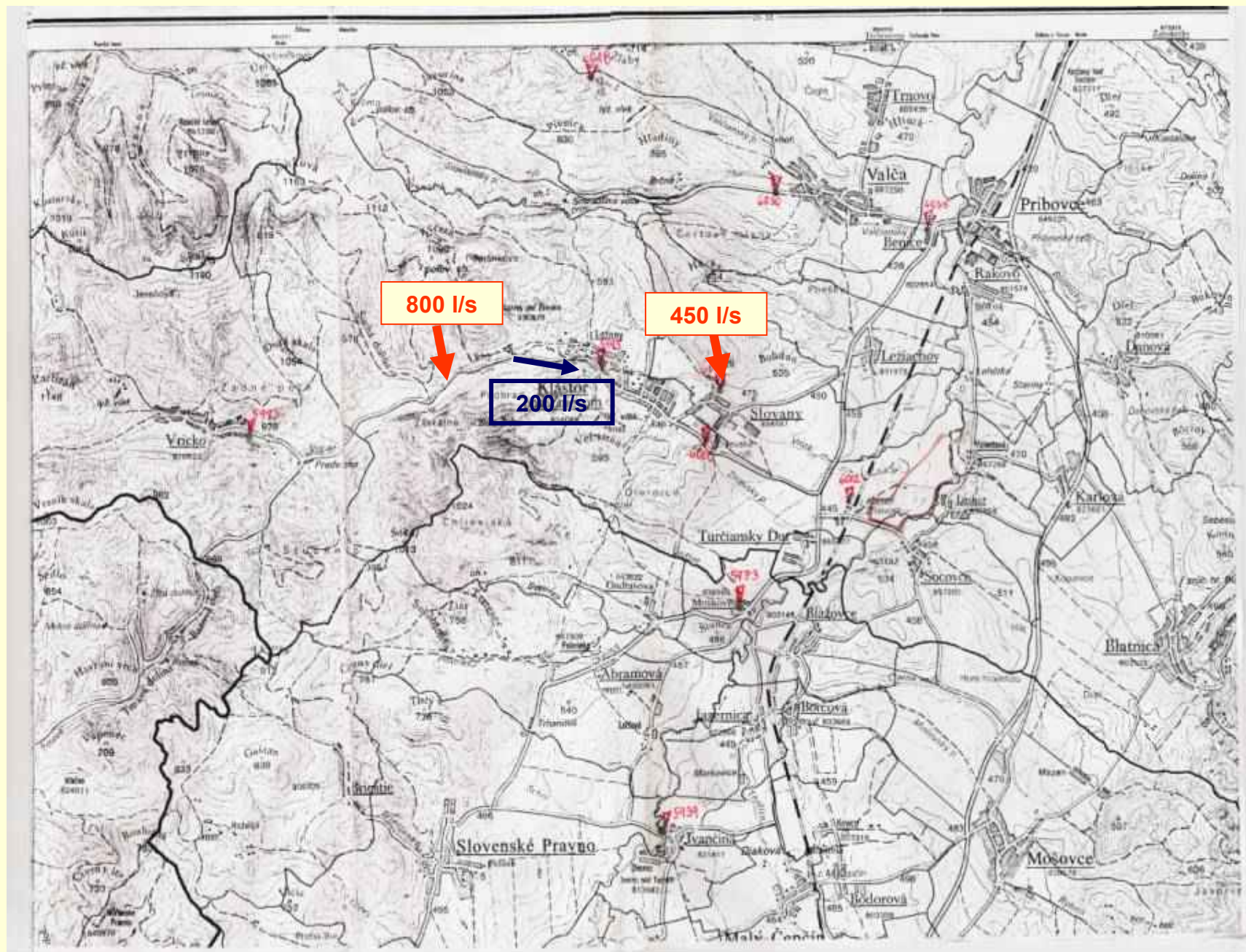
- **Effect of the drainage system**
- **Abstract of water from the Suchá Vřica river**

## **4. Proposal of measures for revitalization of the wetland**

- Dams on the small stream in the west-southern part of the wetland**
- Abstract of water from Znievsky potok**

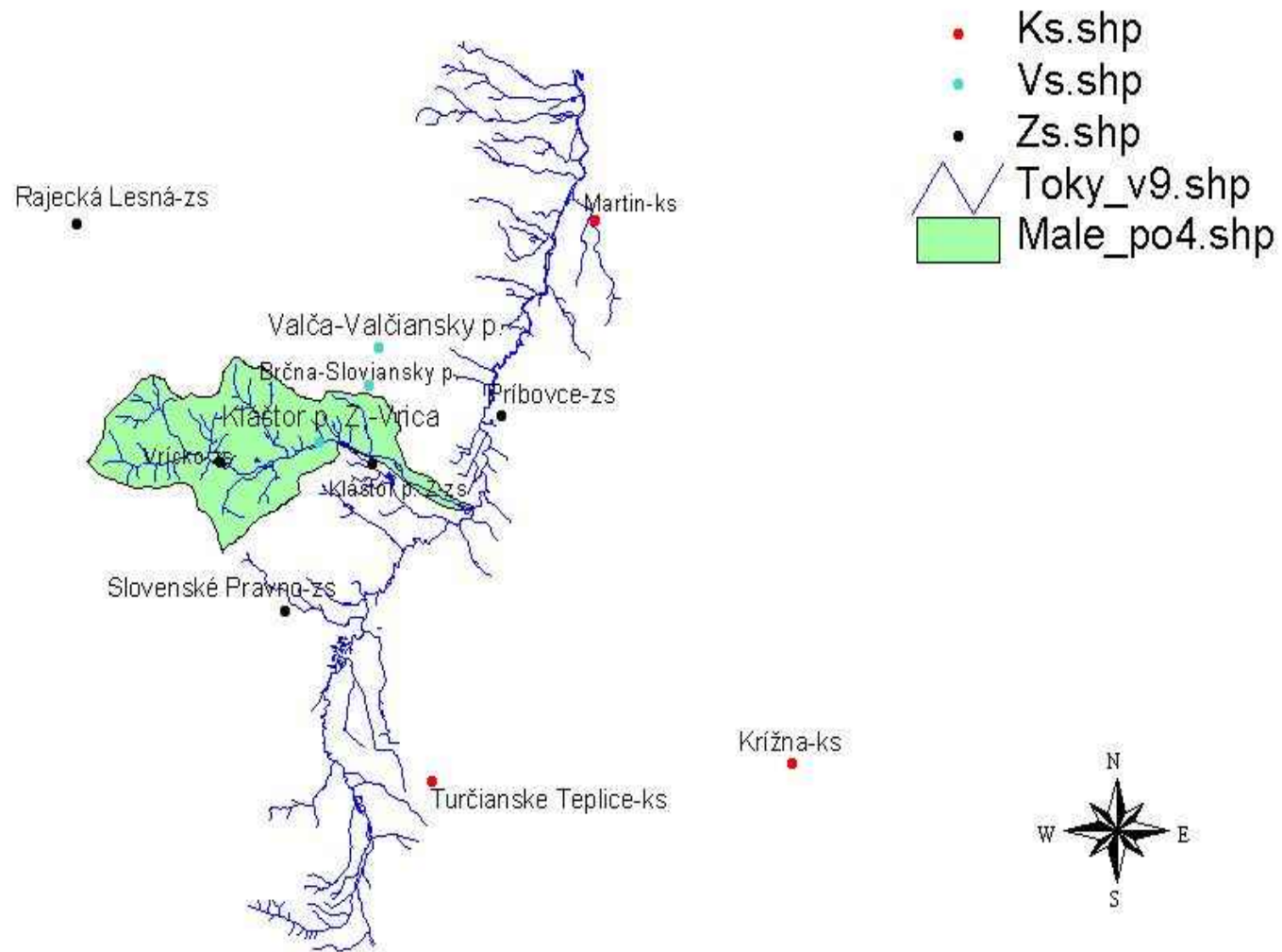


# 1. Analysis of hydrological and climatological regime





## Hydrologická rozvodnica potoka Vríca



# Gauge stations

<b>ID</b>	<b>Gauge</b>	<b>River</b>	<b>Period</b>	<b>Area [km<sup>2</sup>]</b>
<b>5973</b>	<b>Moskovec</b>	<b>Vedžer</b>	<b>1969 - 1971 1983 - 1987</b>	<b>2,73</b>
<b>5995</b>	<b>Kláštor pod Znievom</b>	<b>Vríca</b>	<b>1984 - 2004</b>	<b>44,95</b>
<b>6000</b>	<b>Kláštor pod Znievom</b>	<b>Znievsky potok</b>	<b>1969 - 1987 1994 - 1996</b>	<b>48,01</b>
<b>6010</b>	<b>Slovany</b>	<b>Vríca</b>	<b>1969 - 1987</b>	<b>53,26</b>





# Precipitation stations

ID	Station	Period
24160	Vrícko	1981 – 2005
24180	Kláštor pod Znievom	1981 – 2005 (1901-2005)
24220	Príbovce	1981 – 2005 (1901-2005)
25280	Rajecká Lesná	1981 – 2005
24120	Slovenské Pravno	1981 – 2005

# Climate stations

<b>ID</b>	<b>Station</b>	<b>Period</b>
<b>11907</b>	<b>Krížna</b>	<b>1963 – 2000</b>
<b>11893</b>	<b>Martin</b>	<b>1991 – 2005</b>
<b>11897</b>	<b>Turčianske Teplice</b>	<b>1990 – 2005</b>
<b>11864</b>	<b>Bystrička</b>	<b>1961 - 1991</b>



# Analysis of discharges

- **Statistical analysis of mean daily discharges**
- **Analysis of mean annual discharges**
  - Homogeneity
  - Trend analysis
- **Analysis of mean monthly discharges**
  - Basic statistical analysis
  - Autocorrelation functions

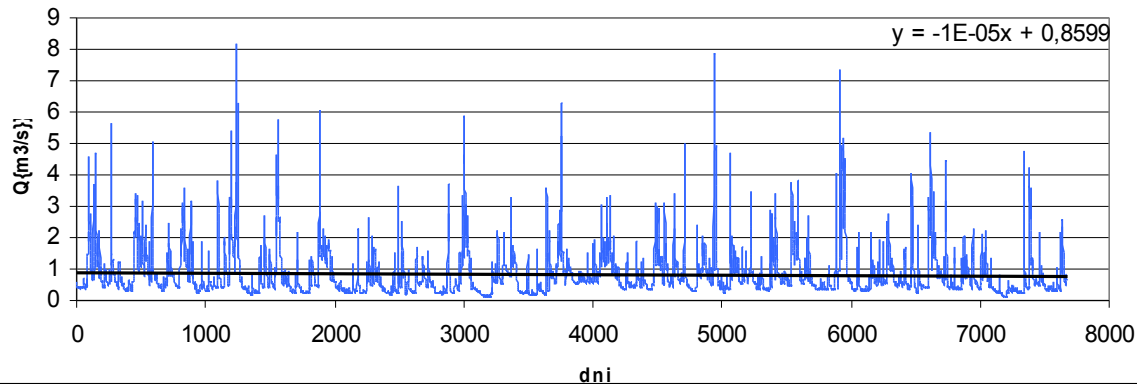


# **Analysis of precipitation and air temperature**

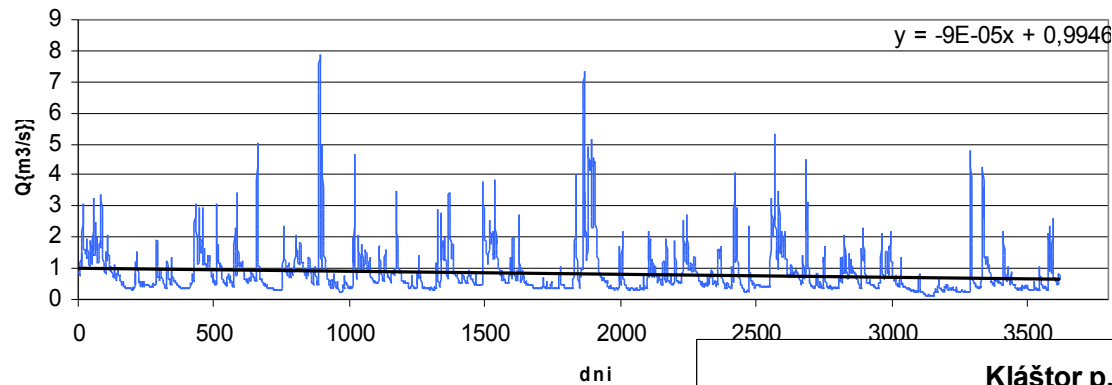
- **Analysis of daily precipitation totals**
- **Analysis of annual precipitation totals**
  - Testing of homogeneity
  - Trend analysis
- **Analysis of monthly precipitation totals**
  - Basic statistical analysis
  - Analysis of 30-years periods
- **Analysis of mean annual air temperature**

# Kláštor pod Znievom – Vrica- discharges

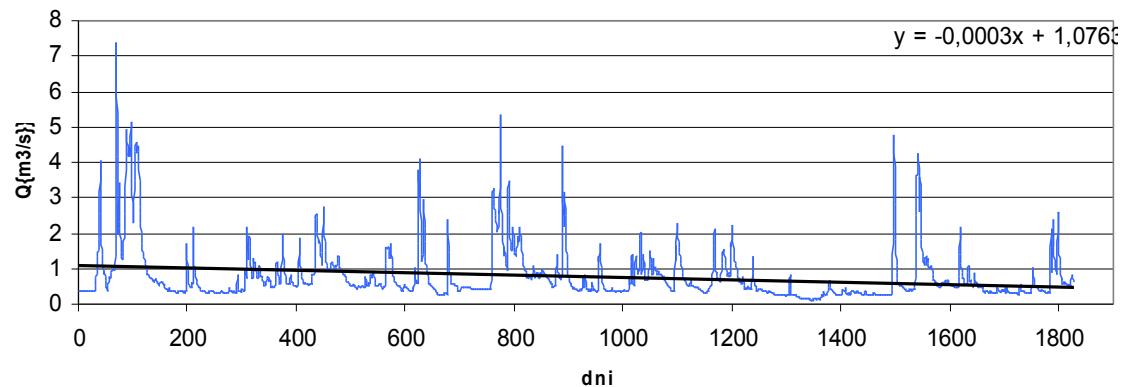
Kláštor p.Znievom - Vrica (1.1.1984 - 31.12.2004)



Kláštor p.Znievom - Vrica (1.1.1995 - 31.12.2004)

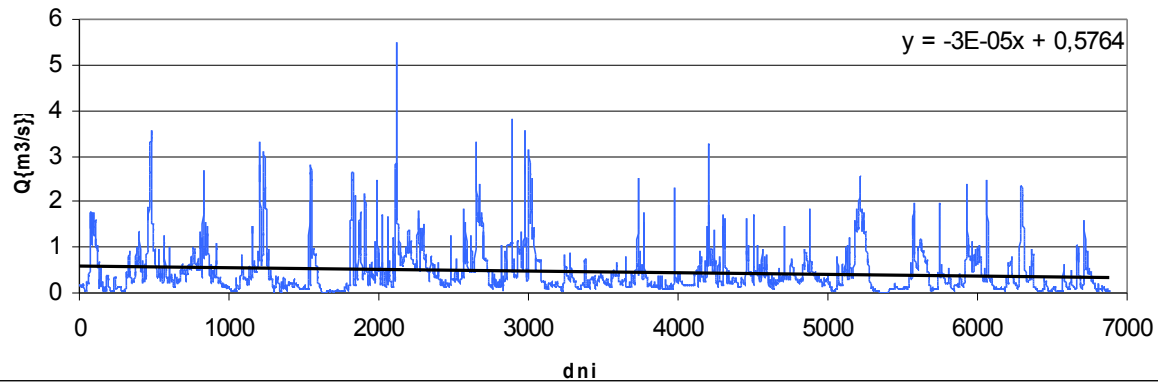


Kláštor p.Znievom - Vrica (1.1.2000 - 31.12.2004)

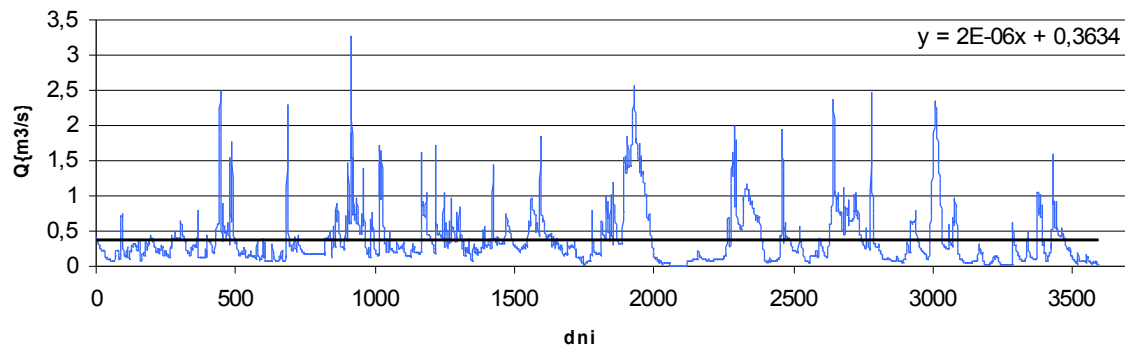


# Slovany - Vrica discharges

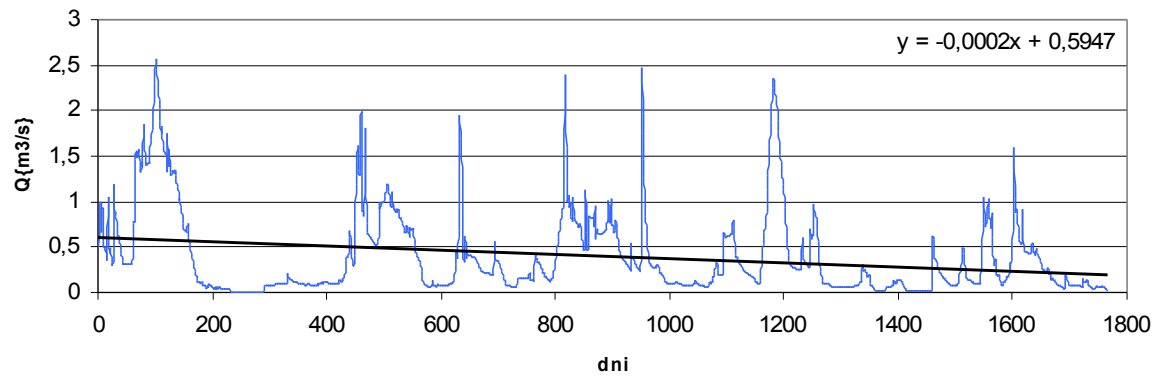
**Slovany - Vrica (1.1.1969 - 31.12.1987)**



**Slovany - Vrica (1.1.1978 - 31.12.1987)**



**Slovany - Vrica (1.1.1983 - 31.12.1987)**

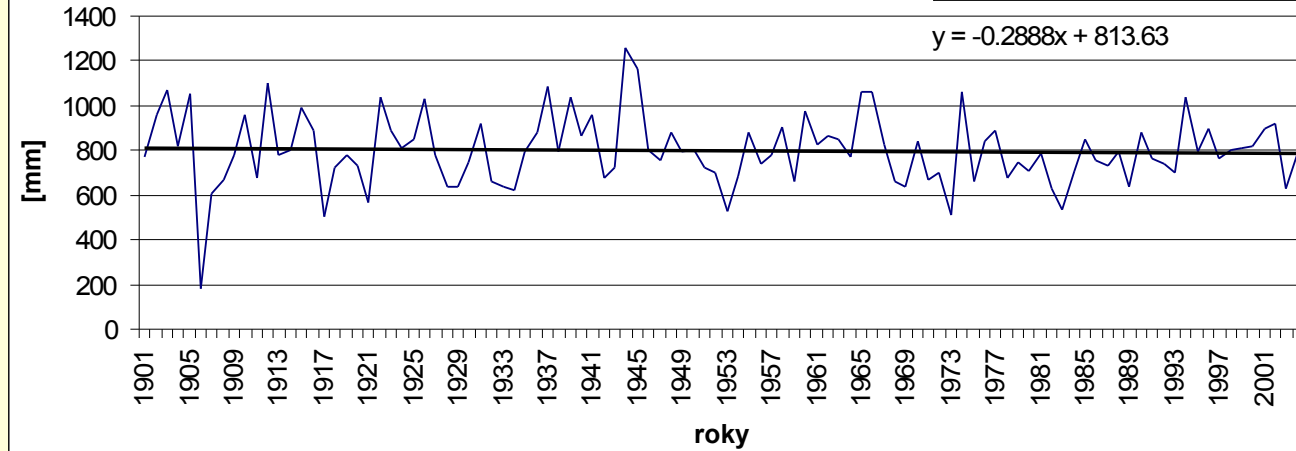


# Kláštor pod Znievom - precipitation

Kláštor pod Znievom - ročné úhrny zrážok [mm]

— ročné úhrny zrážok  
— Linear (ročné úhrny zrážok )

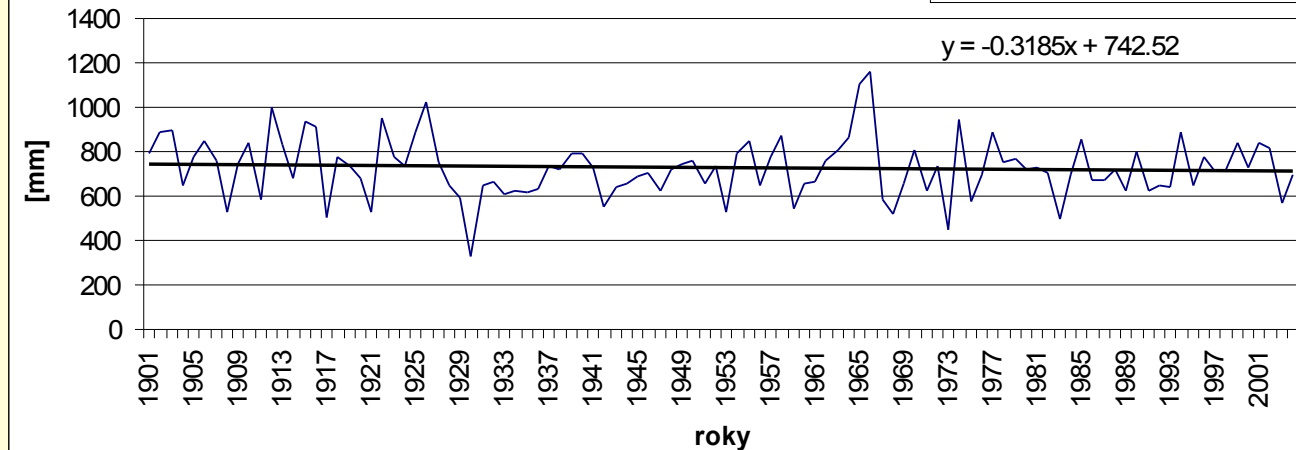
$$y = -0.2888x + 813.63$$



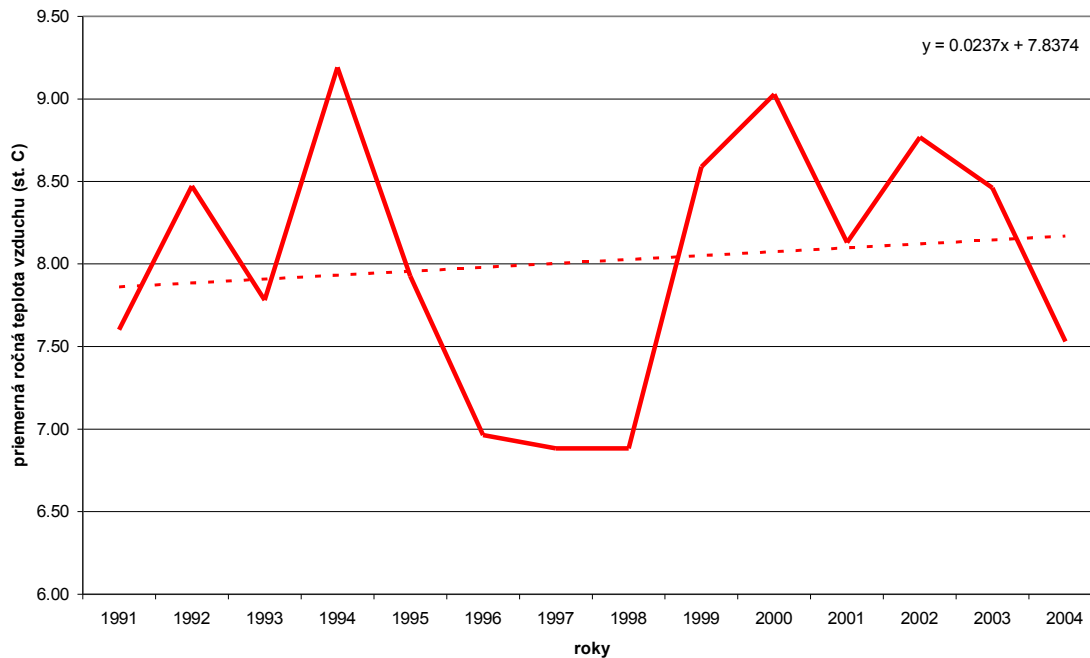
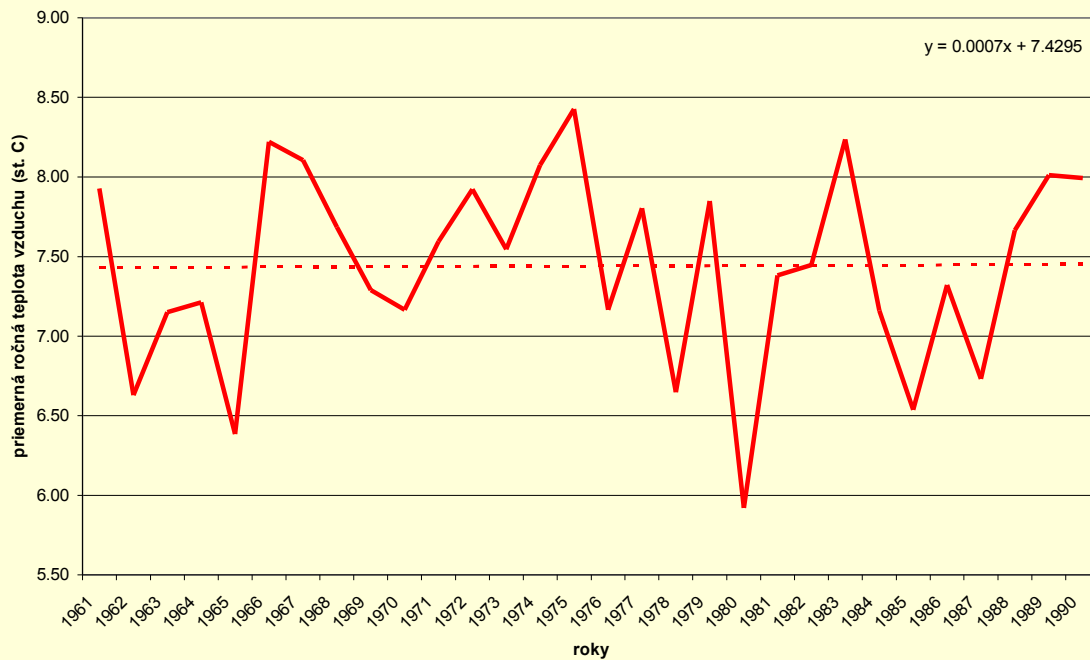
Príbovce - ročné úhrny zrážok[mm]

— ročné úhrny zrážok  
— Linear (ročné úhrny zrážok )

$$y = -0.3185x + 742.52$$



# Bystrička and Martin – air temperature





# Conclusion – discharges

- **Problems – no gauged data**
- **Short time series**
- **Kláštôr pod Znievom - Vríca**
  - trend of mean daily discharges is slightly decreasing for the whole period of observation
  - decrease in mean daily discharges is little higher in the last period of 2000-2004 (mean daily discharge = 0,732 m<sup>3</sup>/s, max. daily discharge = 0,783 m<sup>3</sup>/s), in 1984-2004 mean daily discharge = 0,808 m<sup>3</sup>/s, max. daily discharge = 0,819 m<sup>3</sup>/s)
- **Slovany – Vríca**
  - trend of mean daily discharges is slightly decreasing
- **Time series of discharges in both stations were homogenous**

# Conclusion – precipitation

- Slight decrease in annual precipitation totals in all stations
- about 30 mm/year within 100 years period of observation
- From 30 years period the most dry period was in 1961-1990

# Conclusion - air temperature

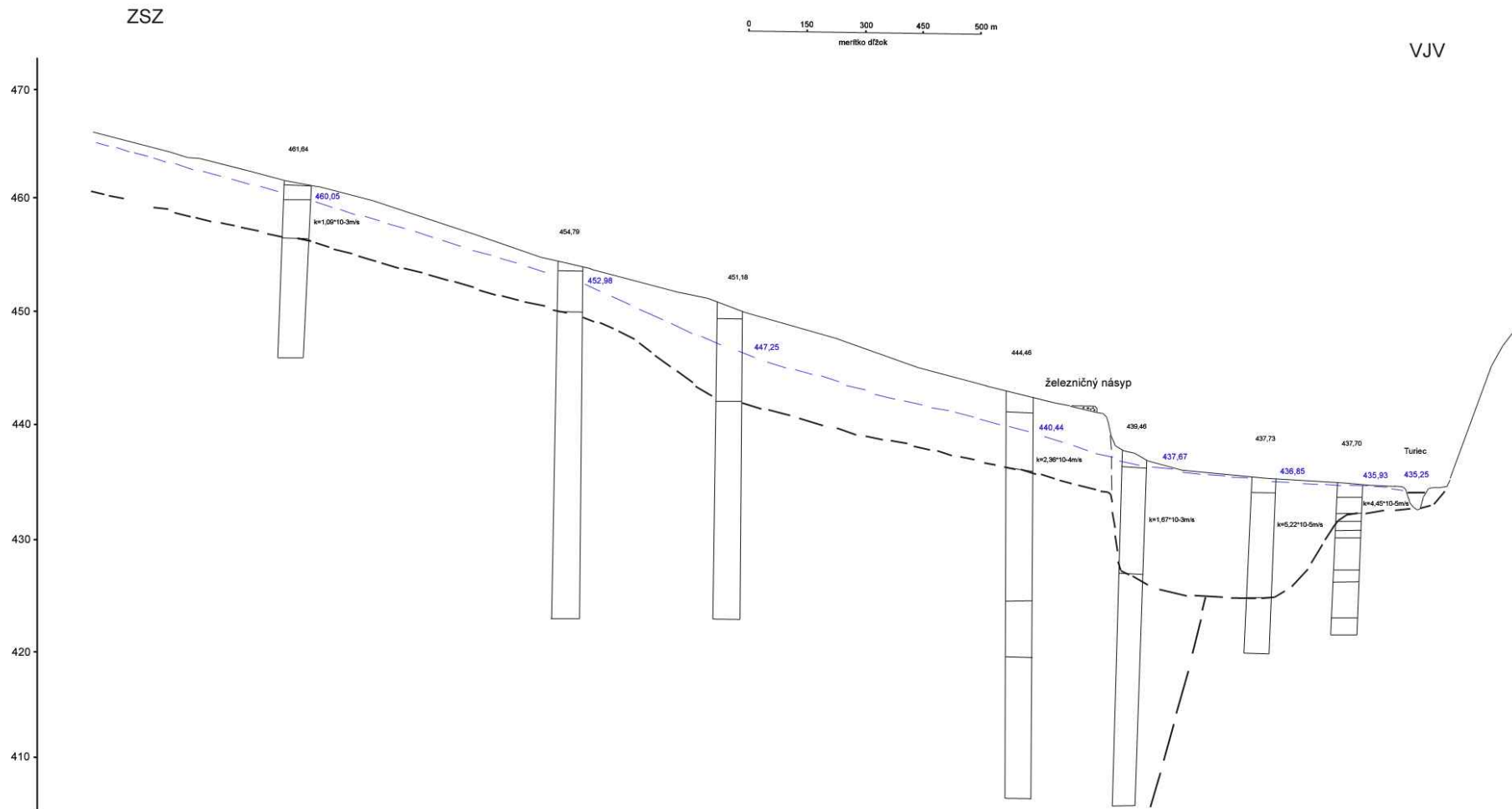
- **Slight increase in mean annual air temperature**

# **Ground-water regime**

- **Gravel-sandy fluvial sediments of the Suchá Vřica river**
- **Lower layer consists of clays**

# Hydrogeological profile of sediments of the Suchá Vřica river

Schematický hydrogeologický rez pozdĺž náplavového kužeľa Suchej Vřice a naprieč poriečnou  
nívou Turca v priestore Kláštor p/ Znievom - Socovce

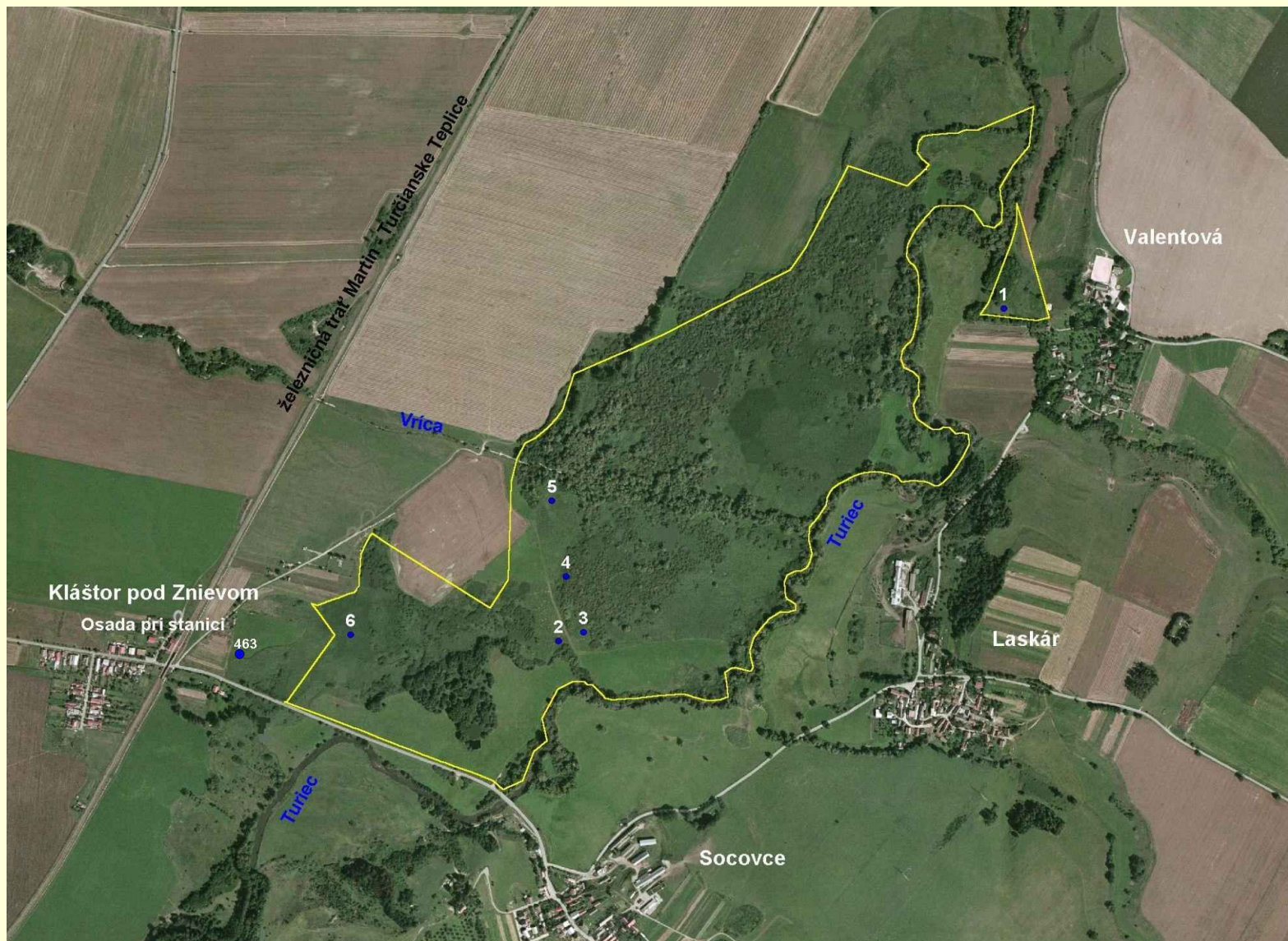




# **Observation network of ground-water level**

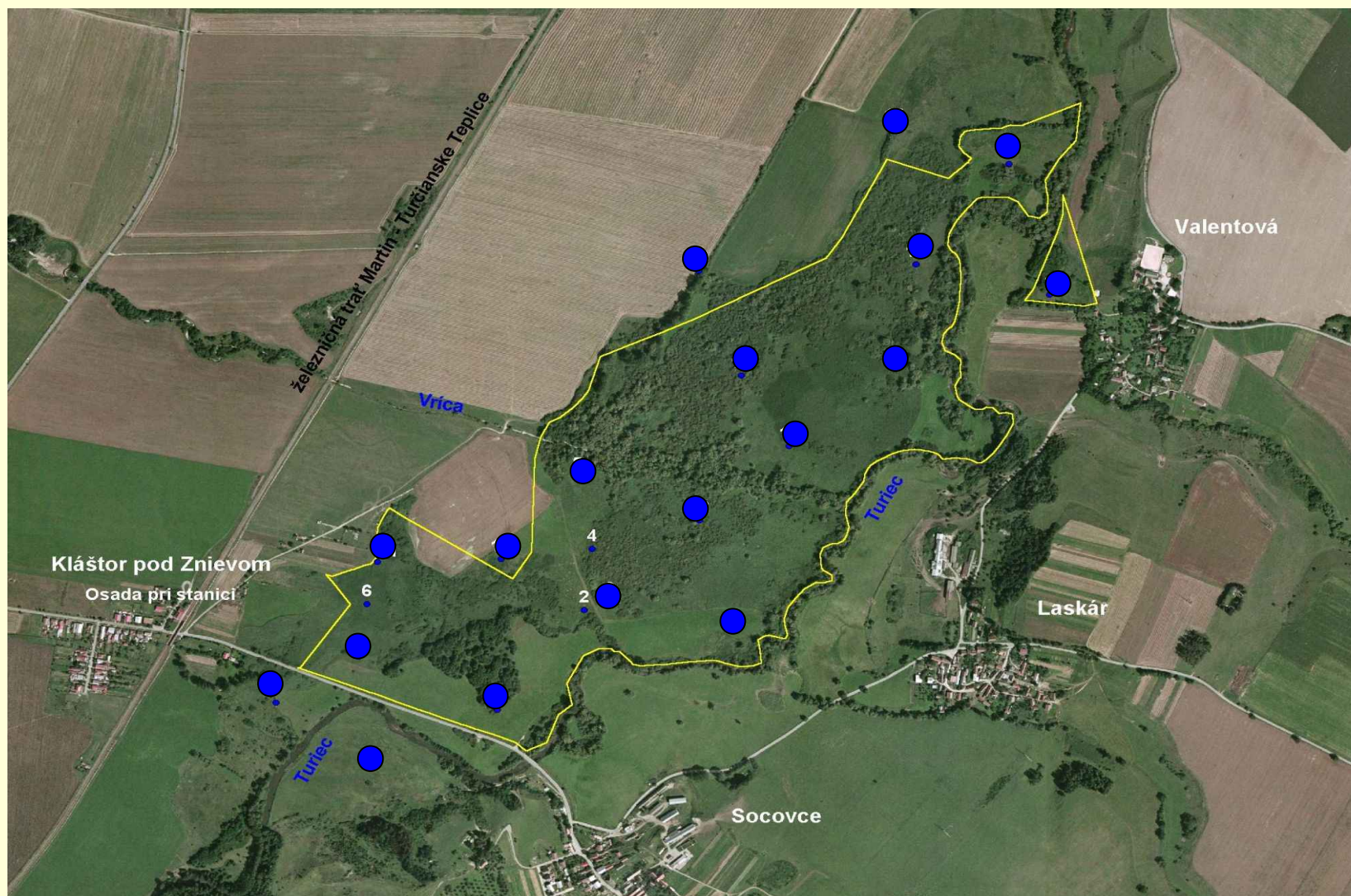
- **1 observation object provided by SHMI (Klášt'or pod Znievom č. 463, observation from 1958)**
- **1996 – 2004 – 6 observation objects in the wetland region (some of them were stolen, observation finished)**
- **From 2005 – observation in 18 objects, new location was proposed**

## Observation in 1996-2004



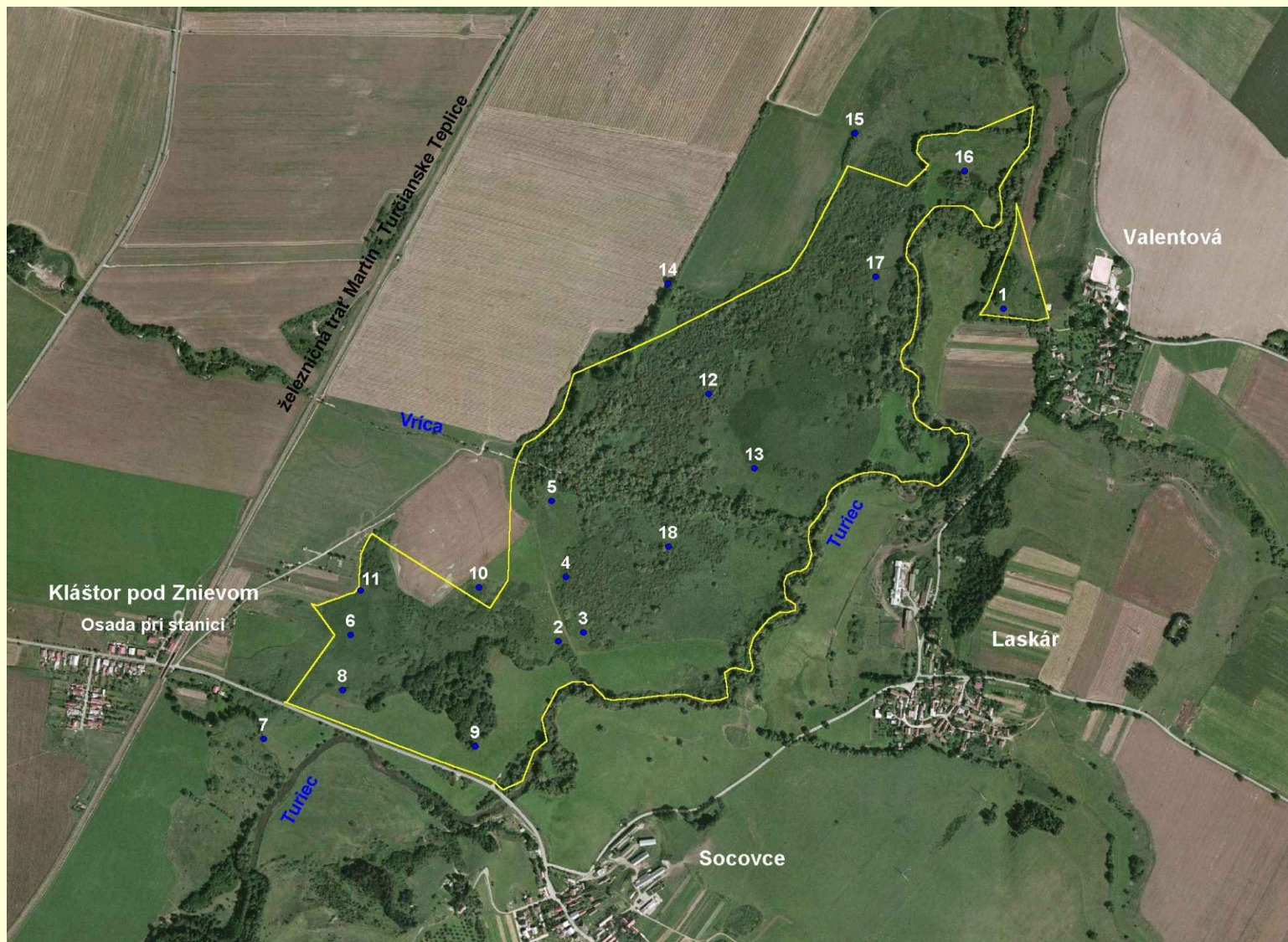


## Proposal a new observation system



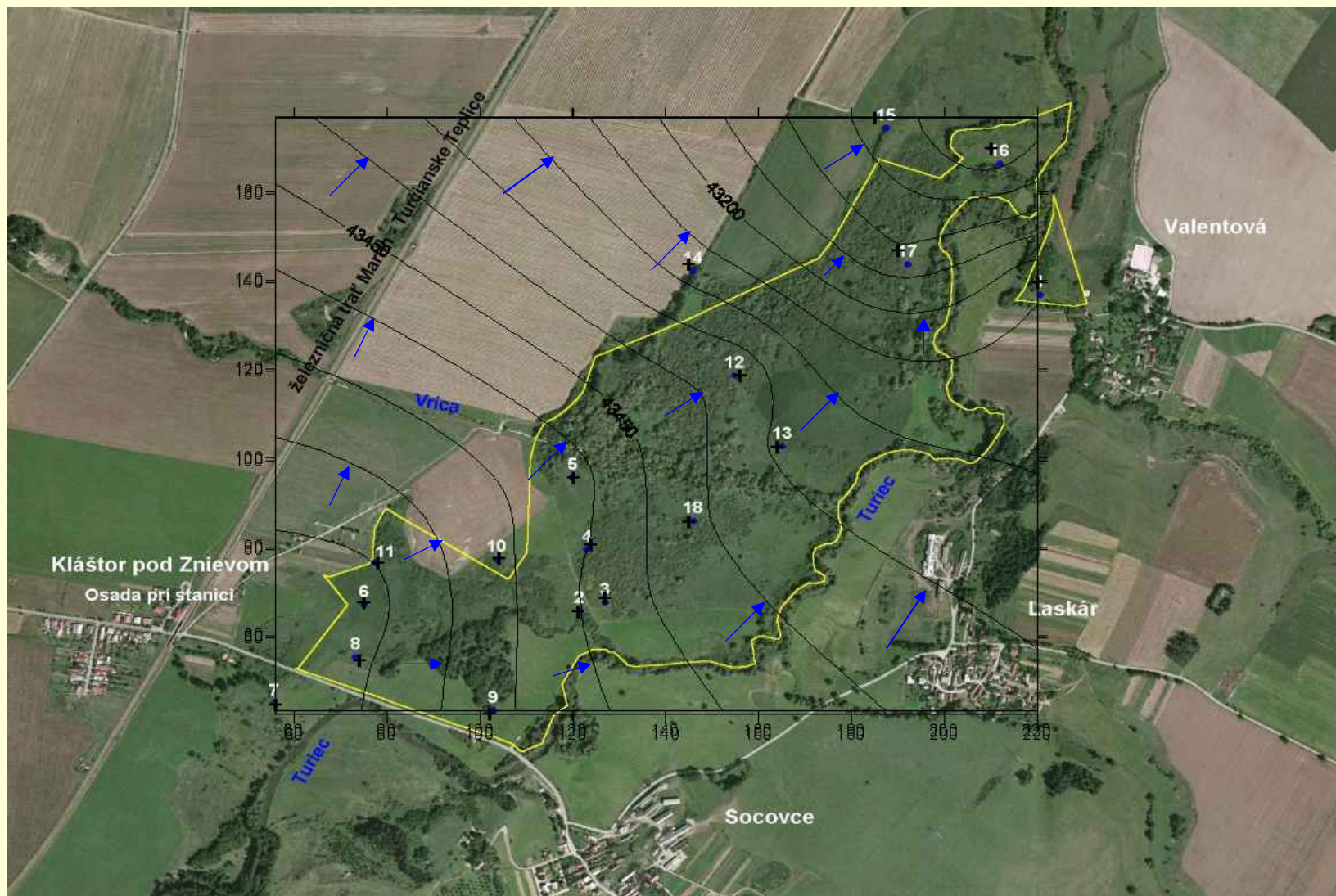


## New network of ground-water observation (1-18) from 2005





## Hydroisohyps of ground-water

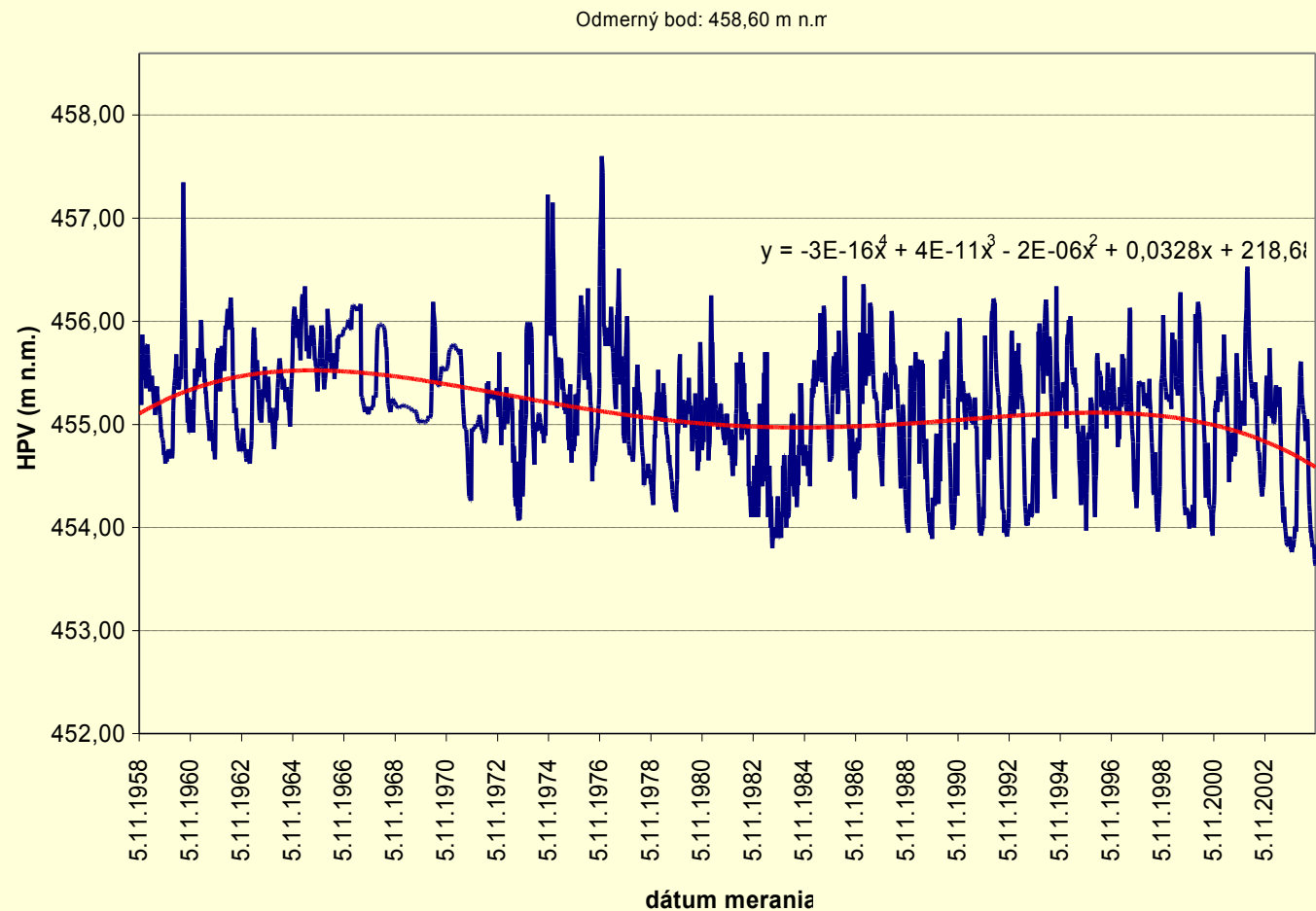




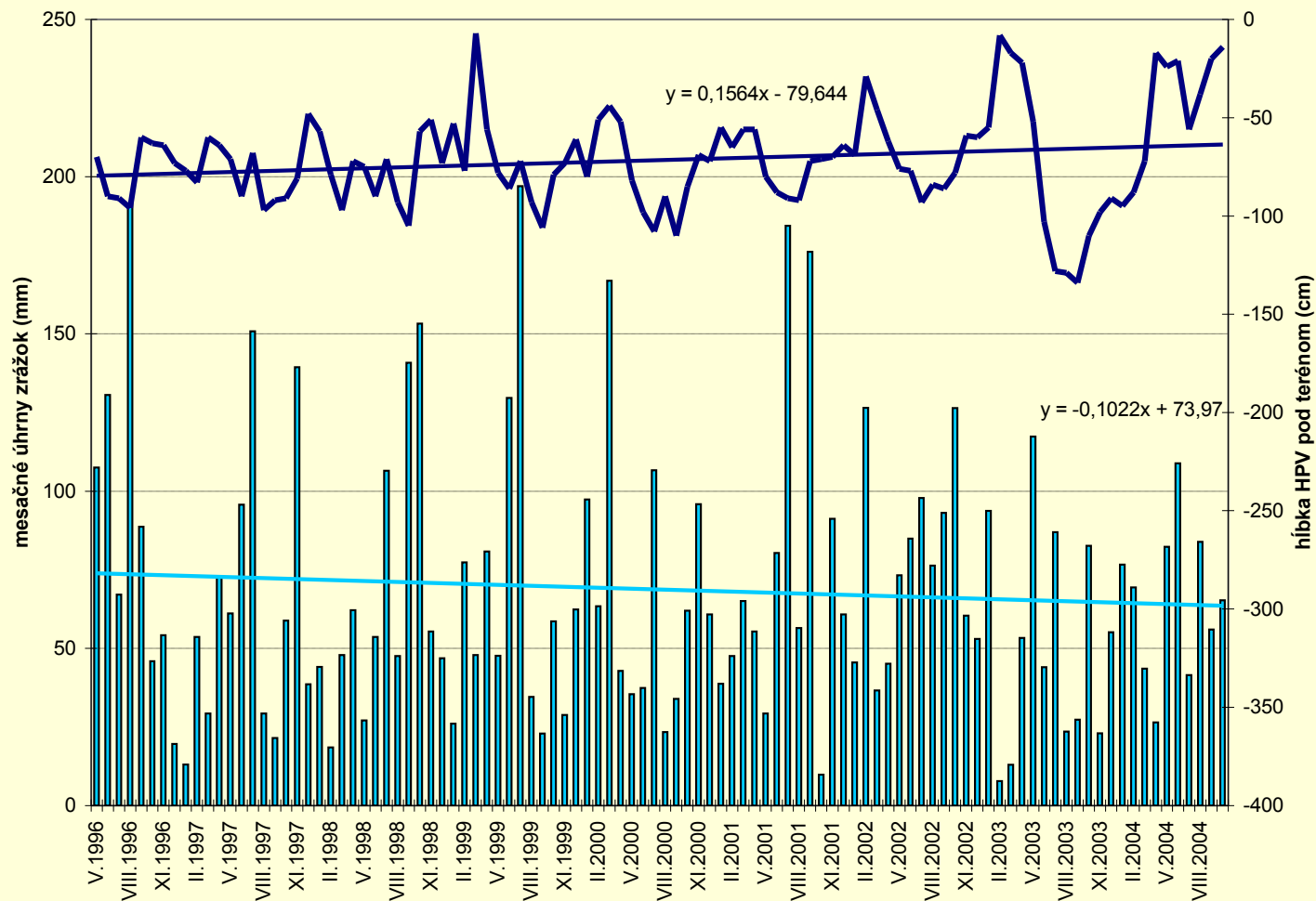
# **Analysis of ground-water level**

- **Object of SHMI No. 463: 1958 - 2004**
- **Objects 1, 2, 3, 4, 6: 1996 – 2004**
- **Mean monthly values of ground-water levels**
- **Trend analysis**

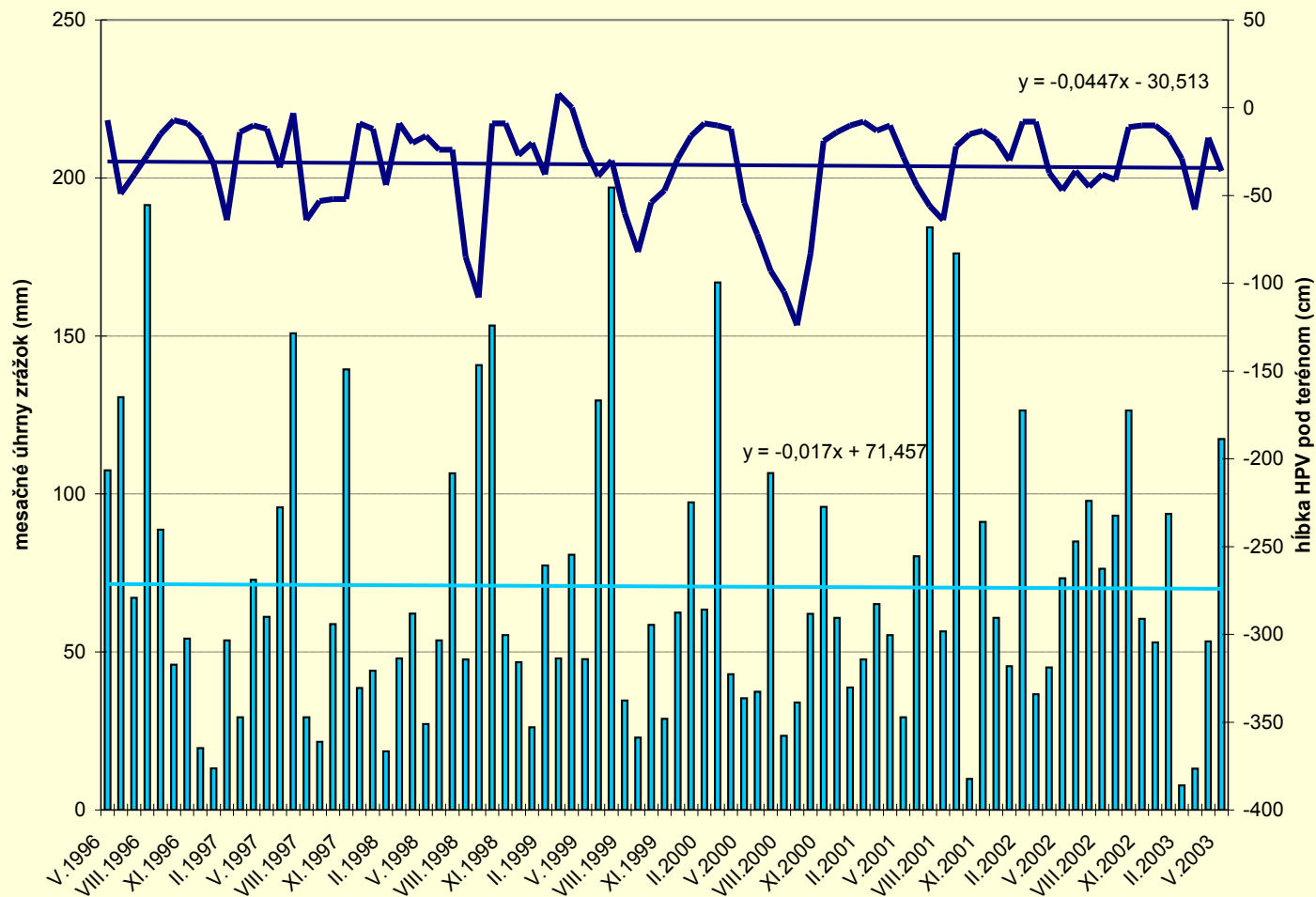
# Object of SHMI No. 463: 1958-2004



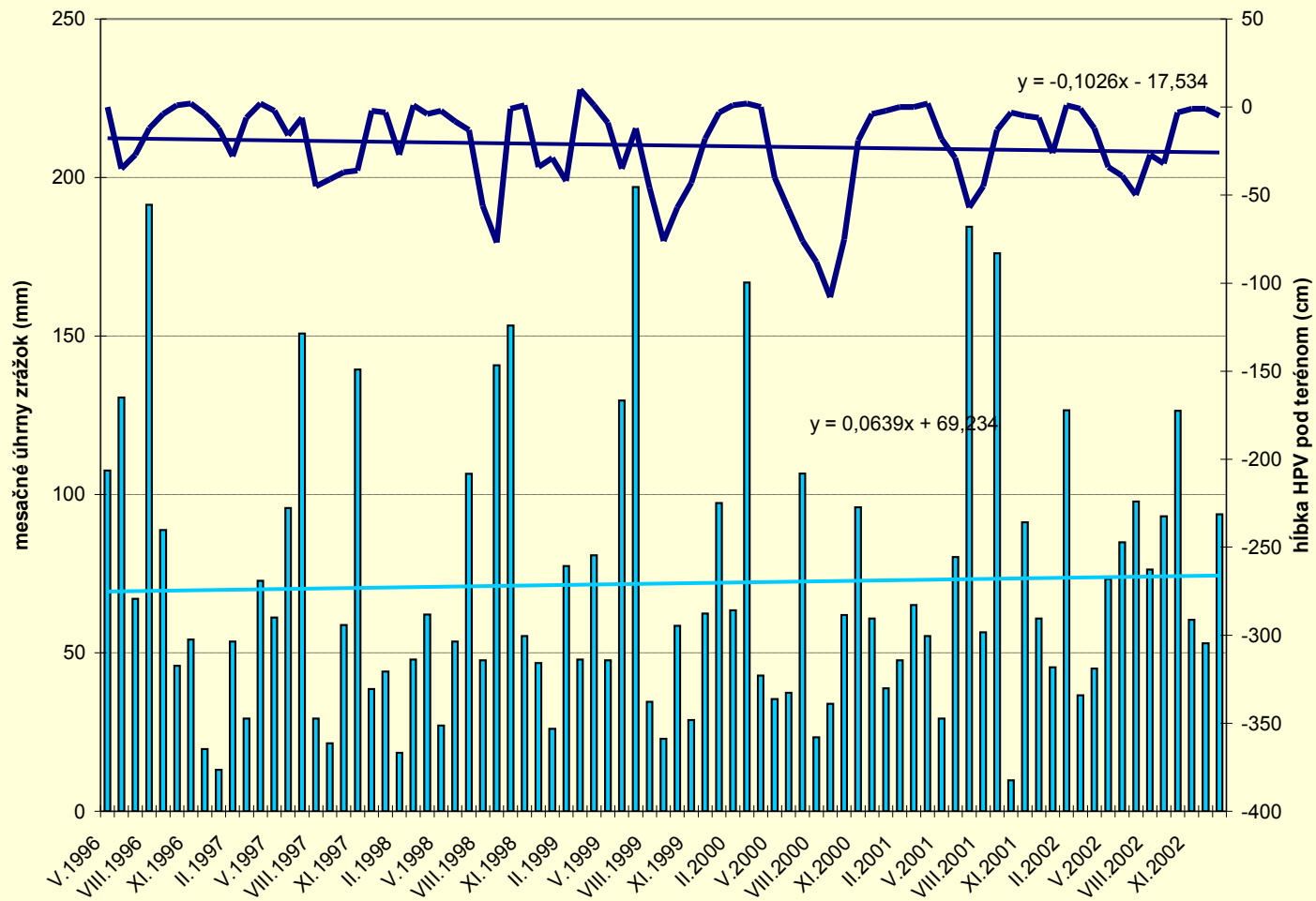
# Object 1: 1996-2004



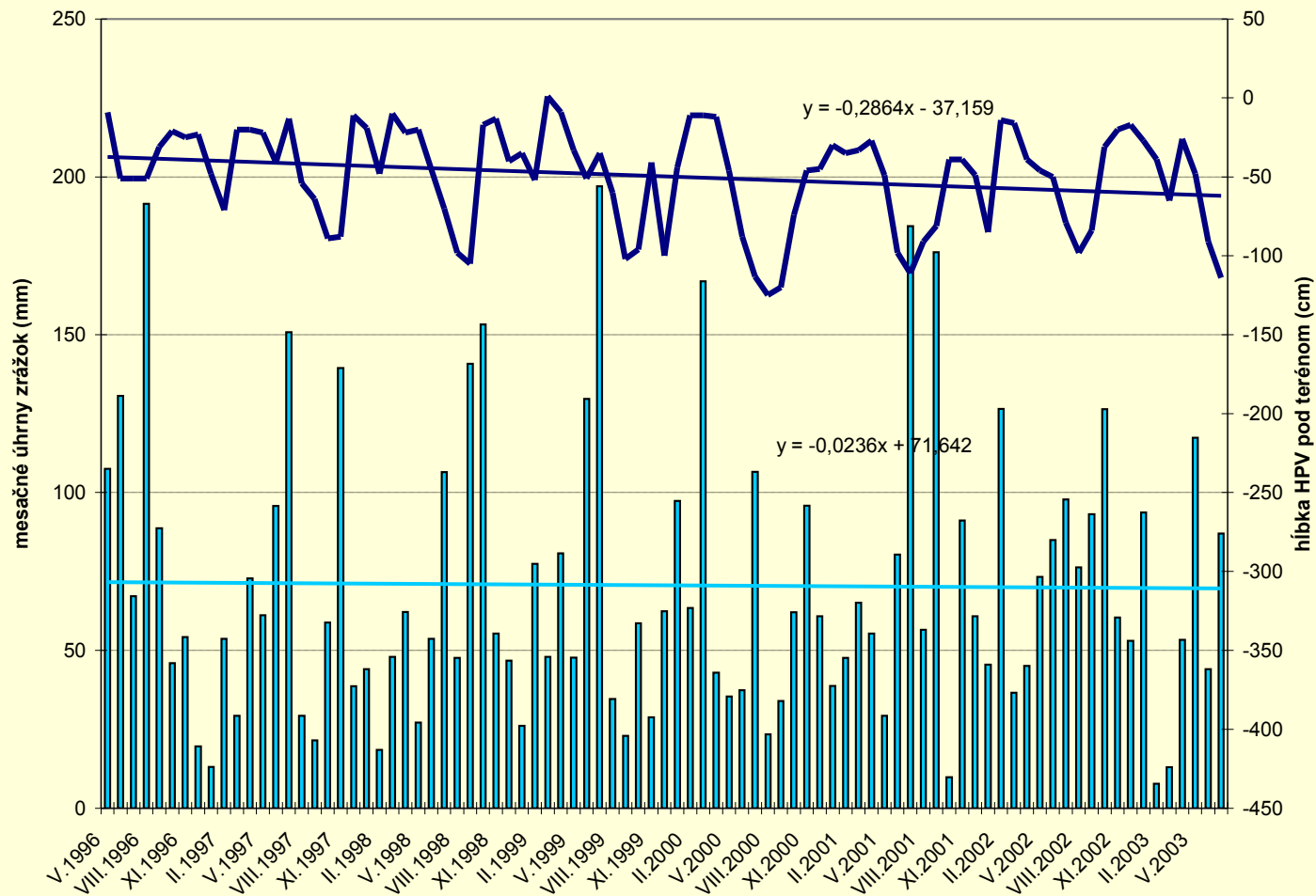
## Object 2: 1996-2004



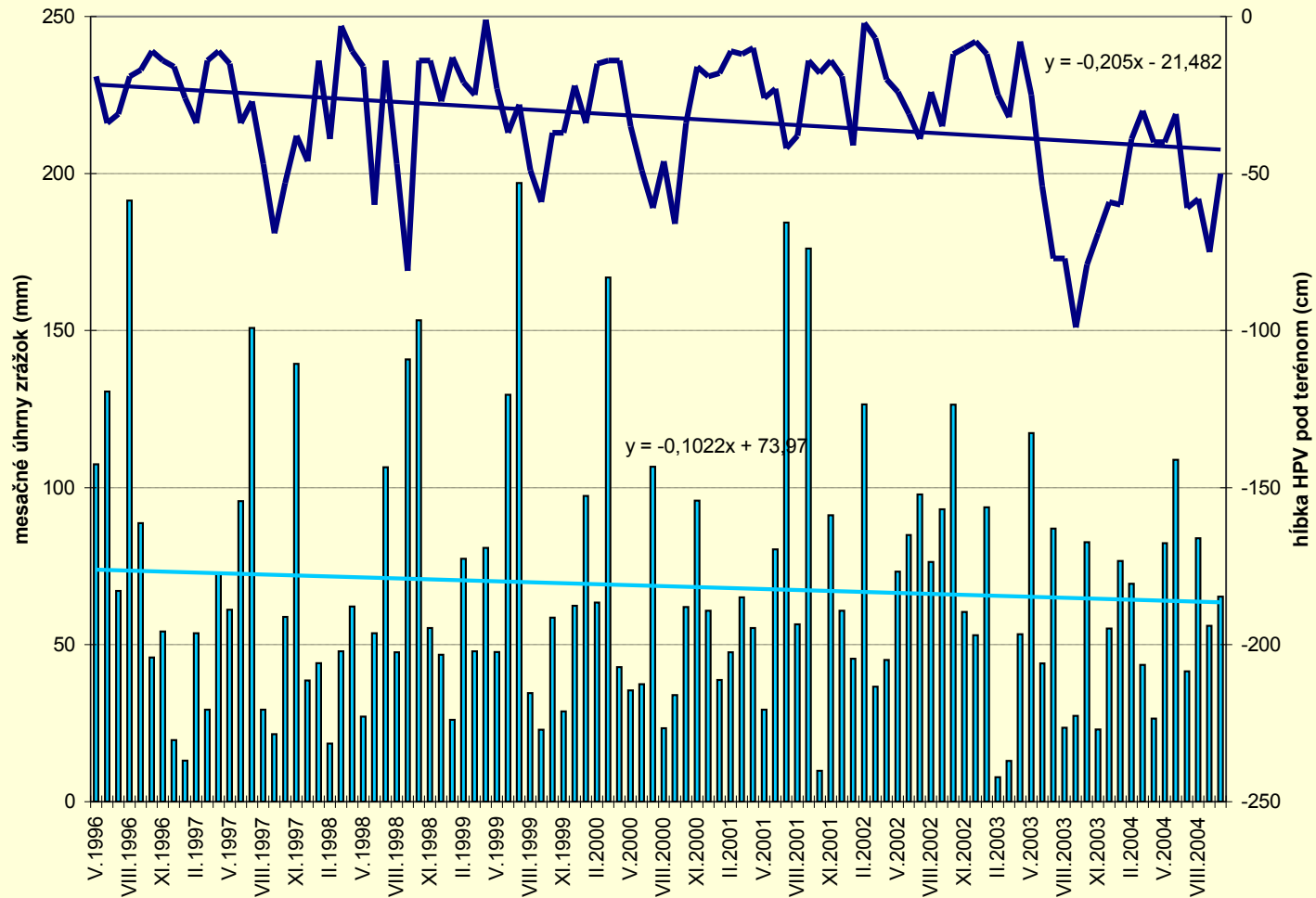
## Object 3: 1996-2004



## Object 4: 1996-2004

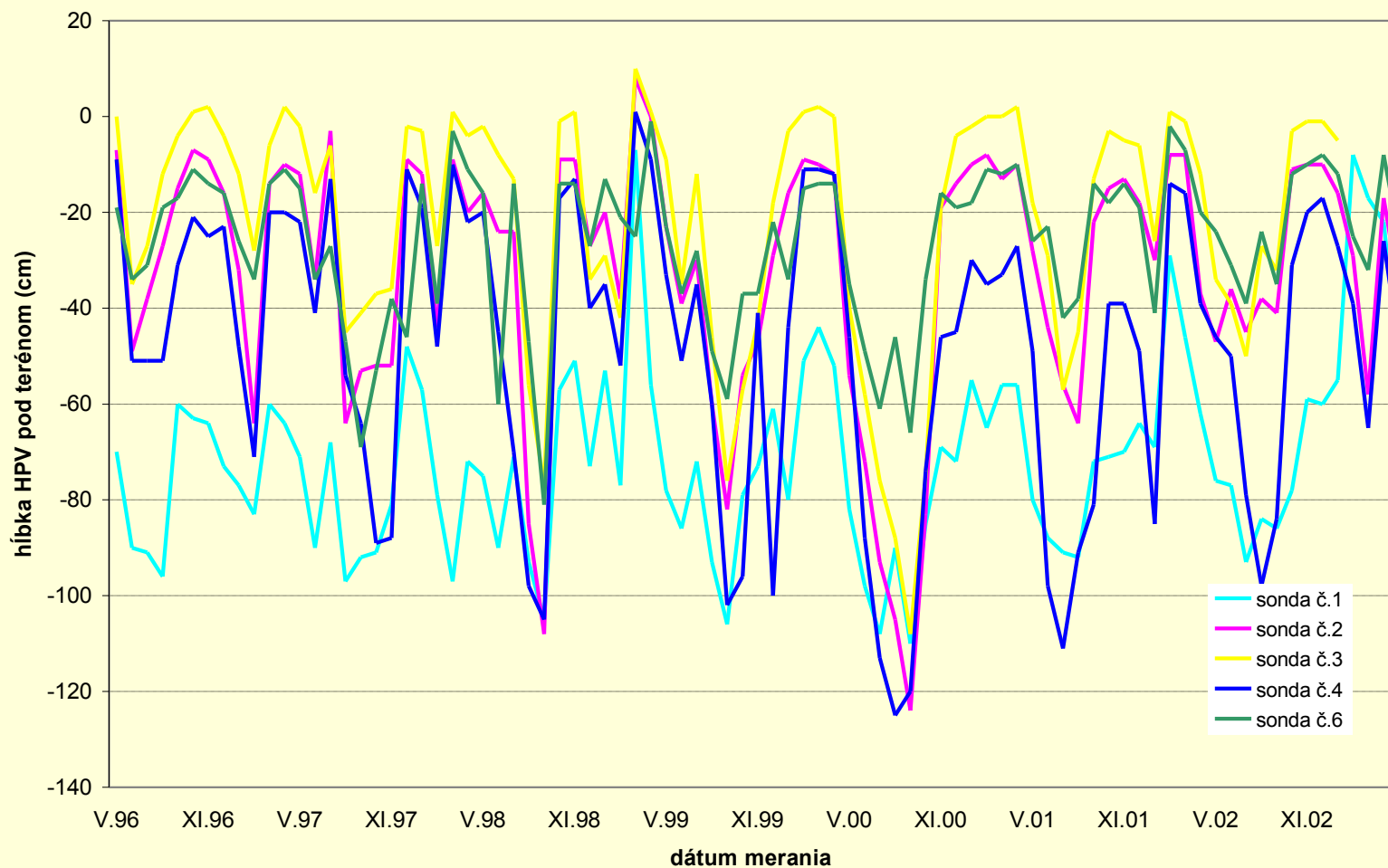


## Object 6: 1996-2004

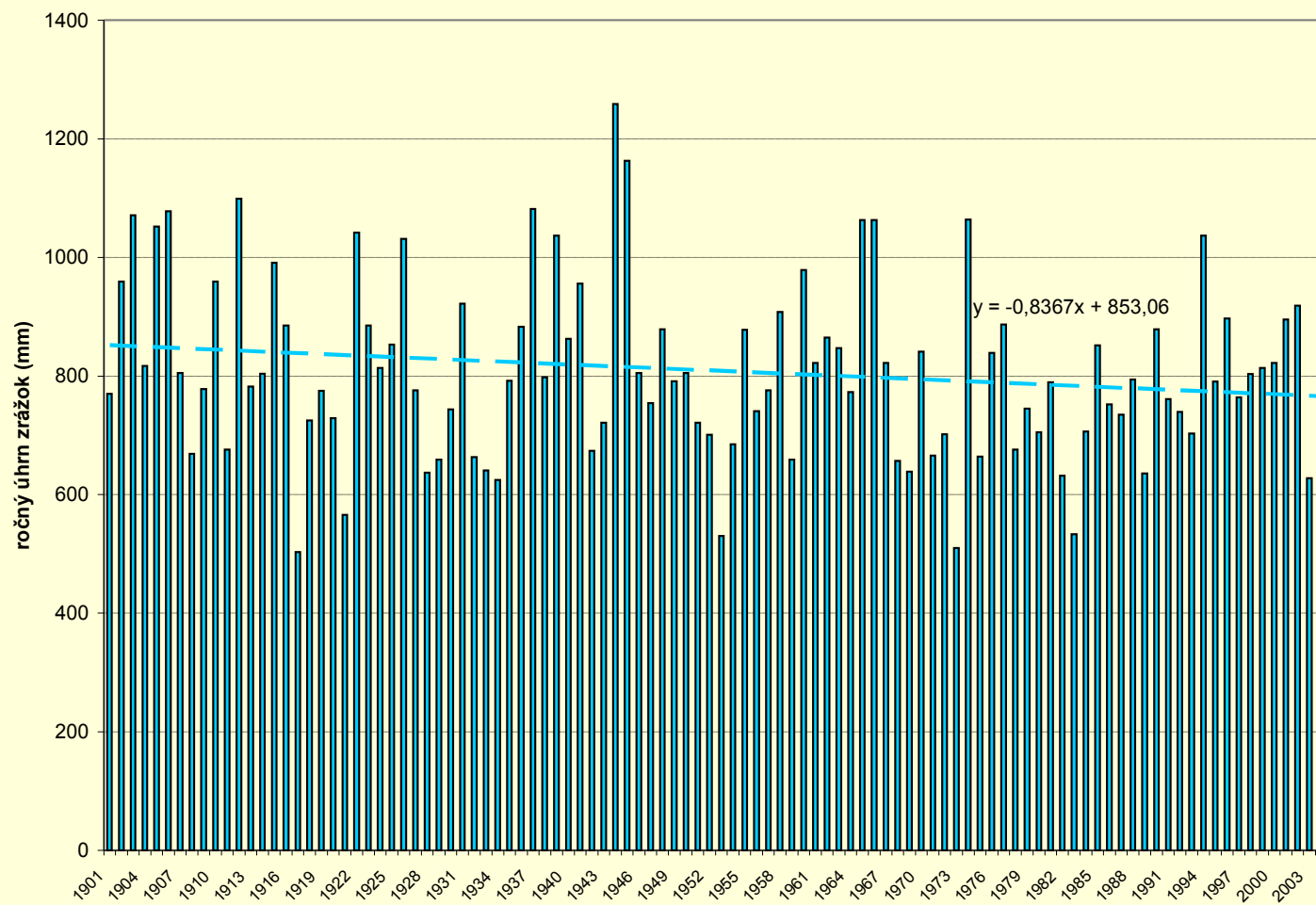




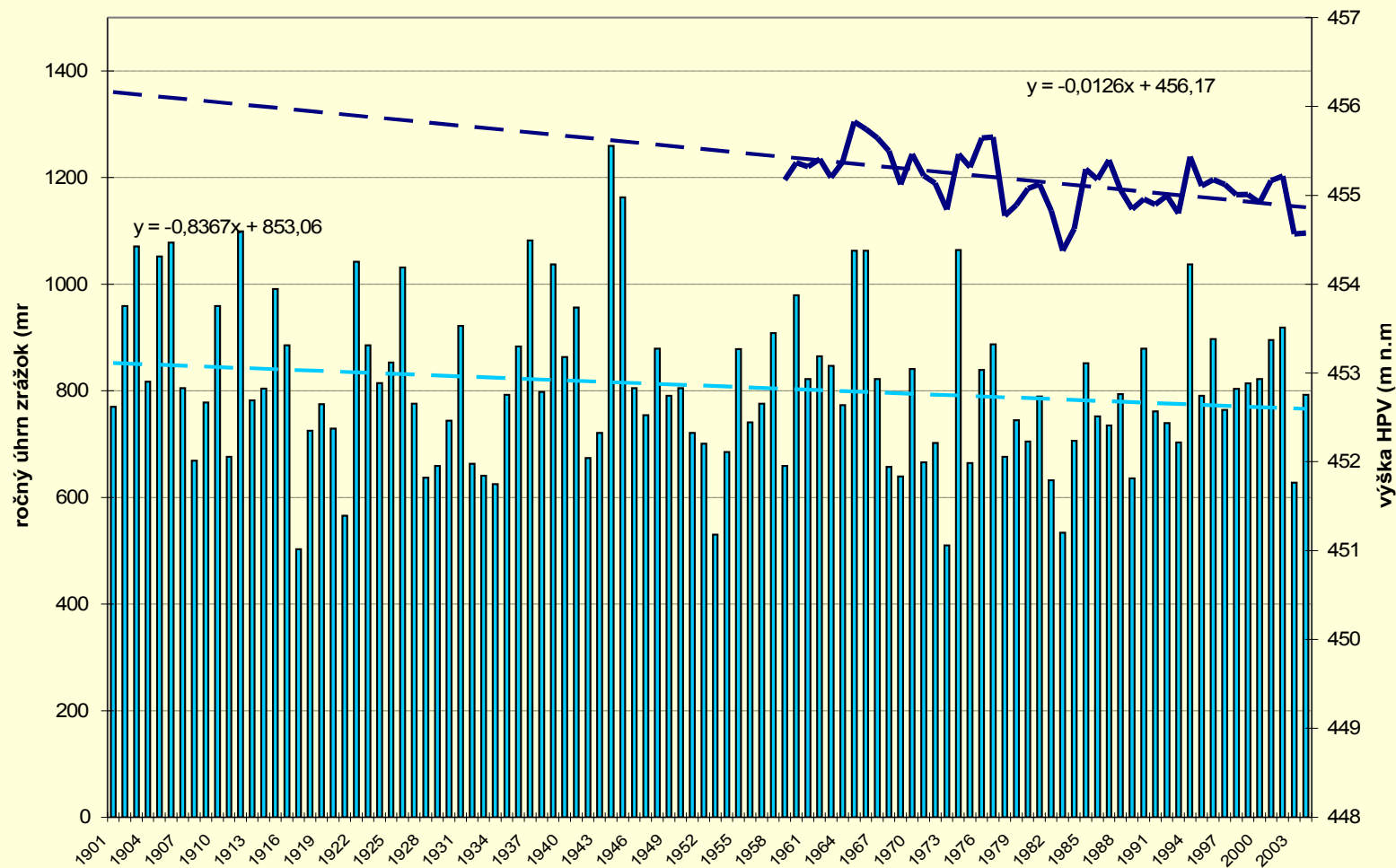
# Comparison of ground-water level in objects



# Annual precipitation totals in Kláštor pod Znievom: 1901-2004



# Ground-water level in 463: 1959-2004 and annual precipitation totals: 1901 -2004



# Conclusion

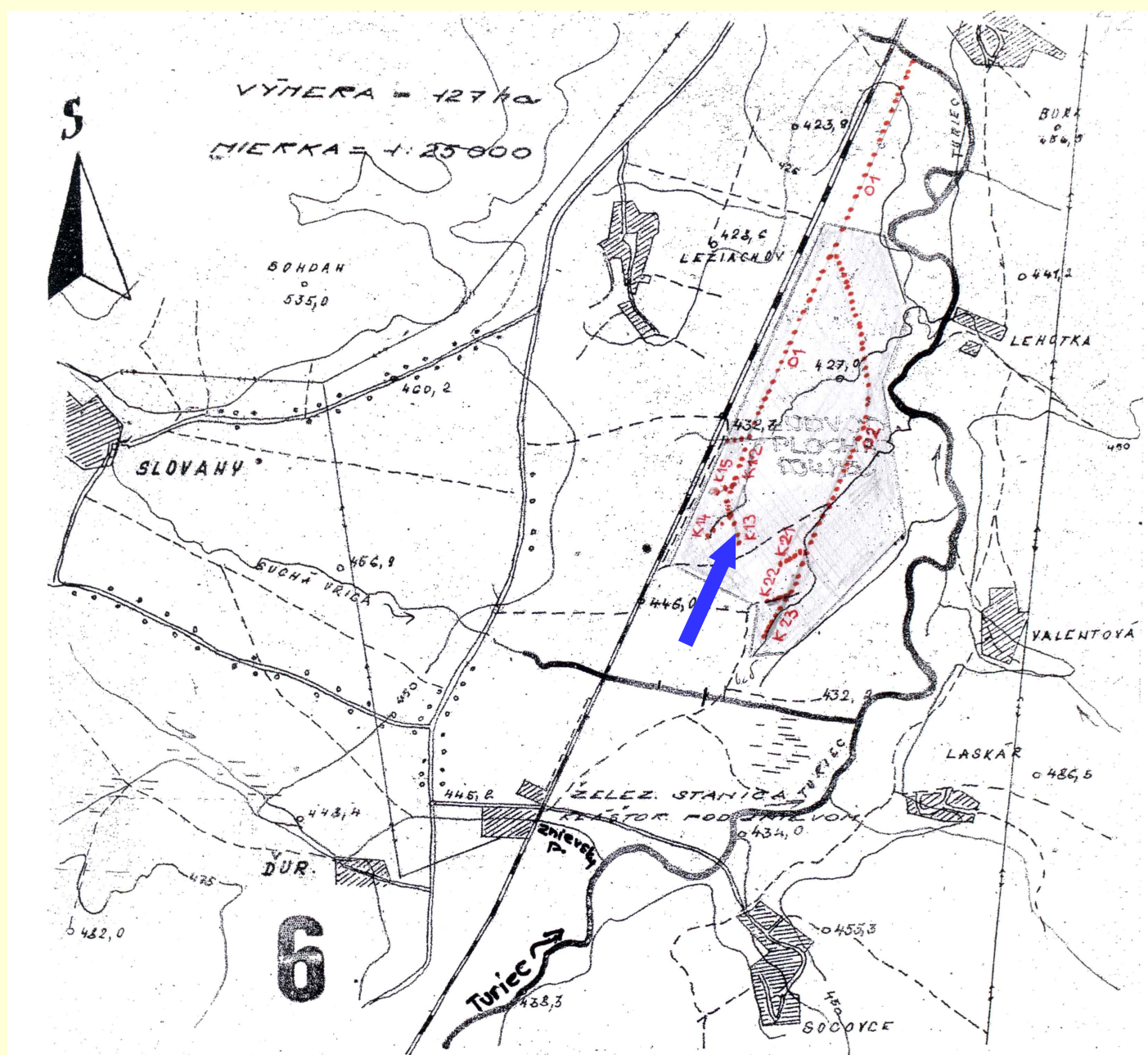
- In all observation objects the decreasing trend of ground-water level was indicated
- Only the object 1 indicated an increase in ground-water level - it was caused by the barrier built in the Valentová stream and increase in water level in the stream
- Minimum of ground-water levels occurred in August and October
- Maximum of ground-water levels occurred from February to April
- Ground-water regime highly depends on precipitation totals

### **3. Effect of hydro-melioration measures on the wetland system**

- **Drainage system**
- **Abstract of water from the Suchá Vřica river**

# Drainage system

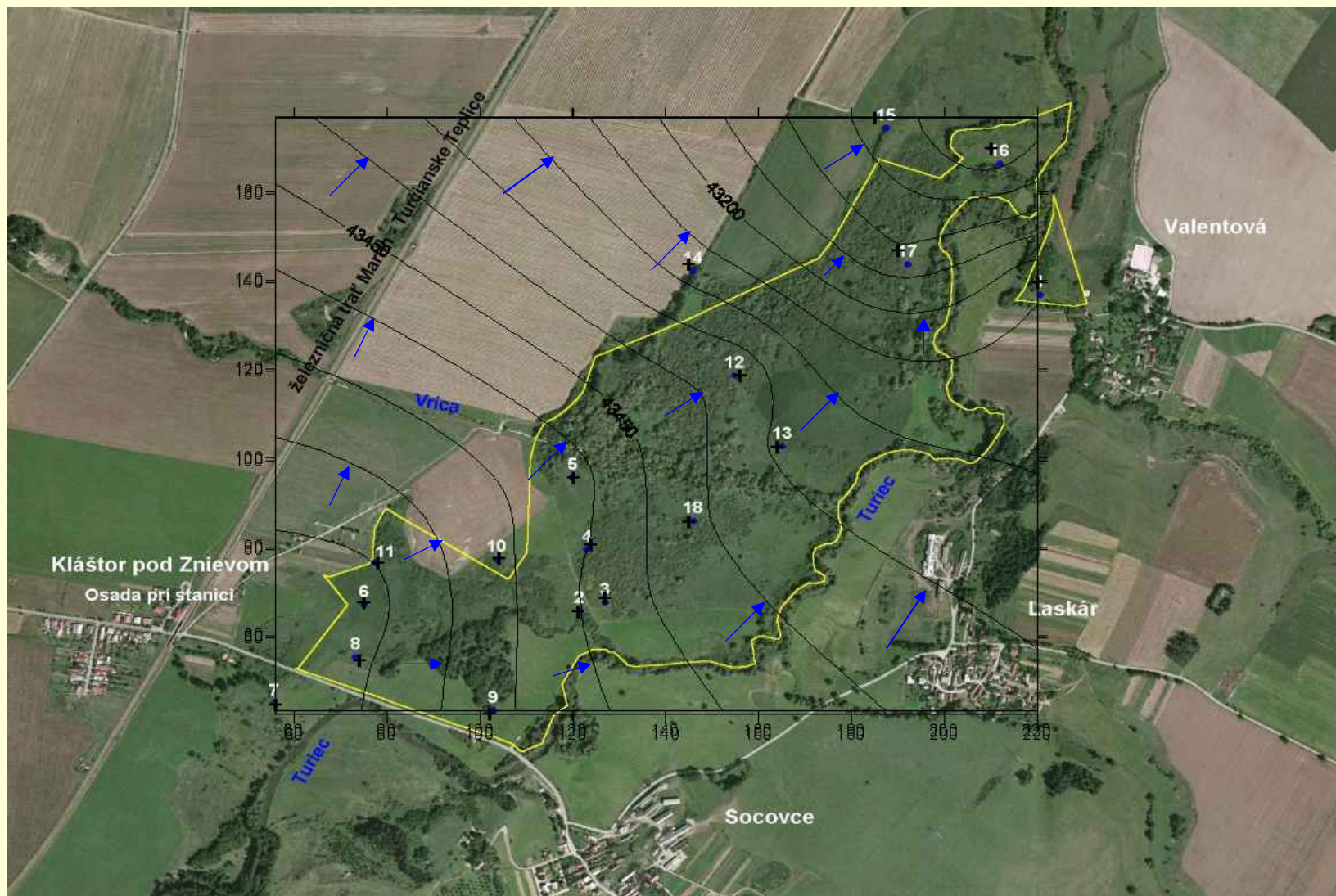
- built for the Slovany „agricultural farm“ (in 2 steps) in 1976
- 1. step - drainage skeleton:
  - subsurface drainage system (K11,K12,K13,K14,K21,K22 a K23) and 2 open channels (O1, O2)
- 2. step
  - detailed subsurface drainage system: 36 drainage groups (area of 0.44 - 2.46 ha), DS 36: area of 16.8 ha



O - open chanel, K - subsurface drainage



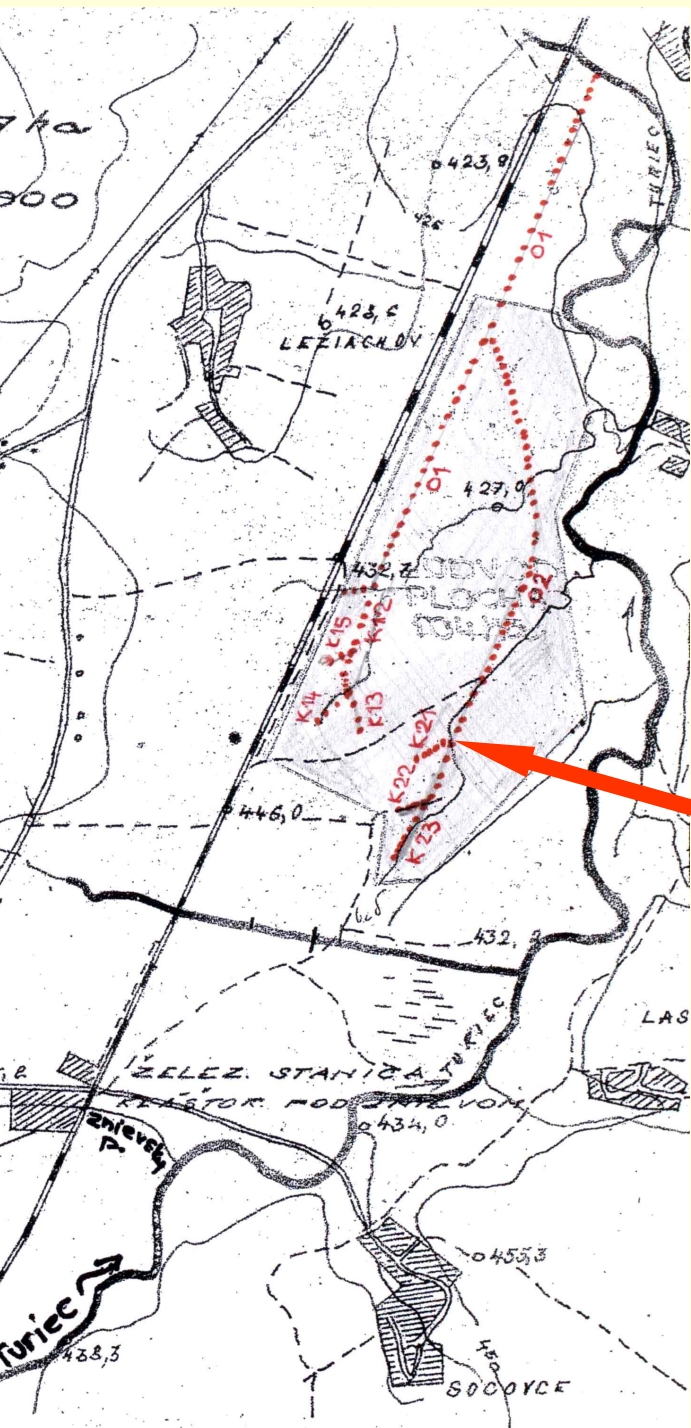
## Hydroisohyps of ground-water



# Conclusions

- Drainage system is out of the wetland area
- Direction of ground-water flow is parallel to the open drainage channel (and the Turiec river)
- Effect of drainage system can have only a small impact on the ground-water regime of the wetland
- It is not possible to transfer water from the open channel O2 to the wetland. The channel bottom is too low - 1.8 m below the terrain





20. októbra 2006



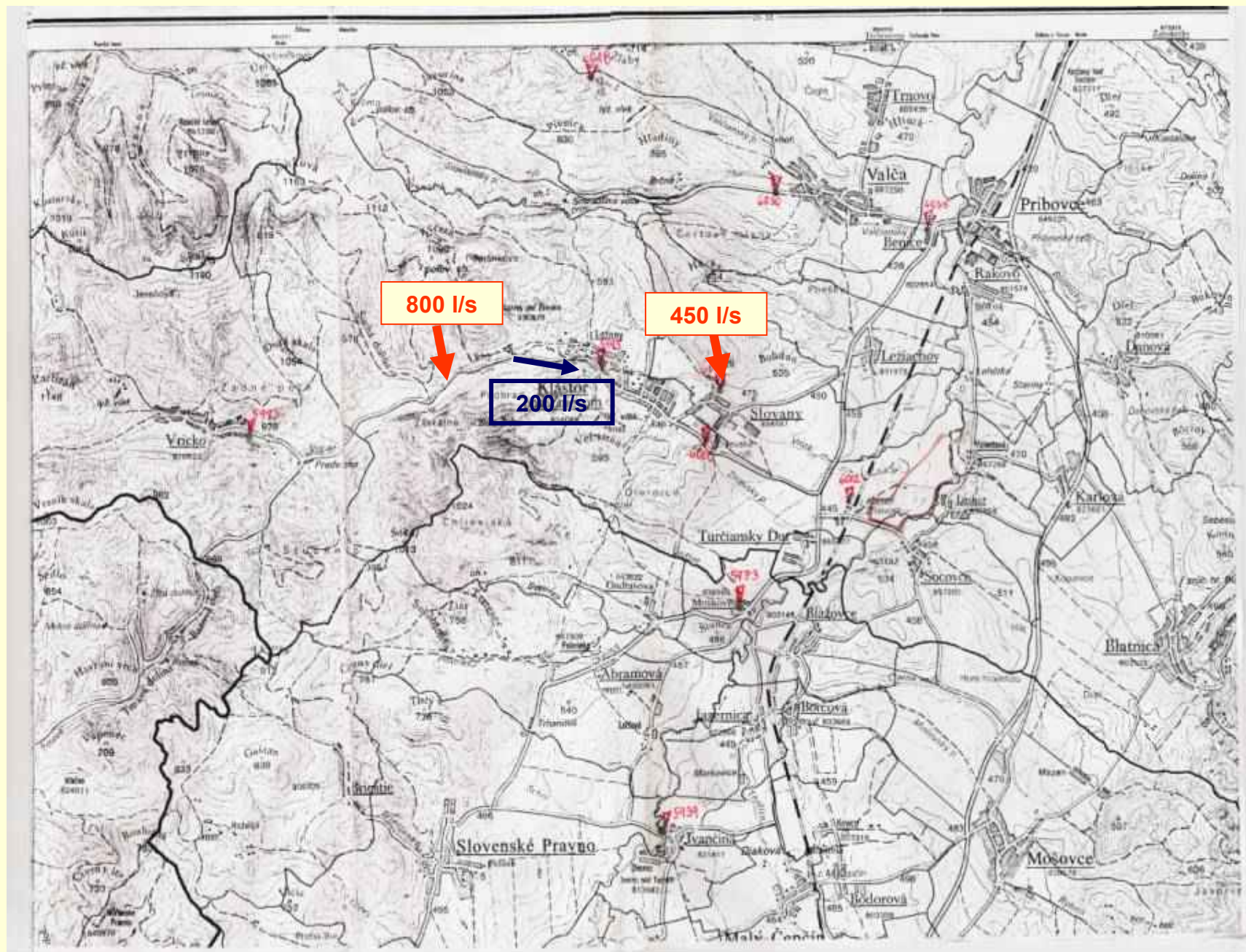


26. mája 2006



# Abstract of water from the Suchá Vřica river

- From 1964 there is an abstract of water from the Suchá Vřica river for the fishery in Kláštor pod Znievom
- It is about 200 l/s
- It has generally negative effect on the Suchá Vřica water regime
- 90 days of the year discharges in Suchá Vřica are less than 150 l/s, during this low flow period the lower part of the river is dry
- It can be supposed that the finish of the abstract will not improve the water regime of the Suchá Vřica





26. mája 2006



Suchá Vríca



29. júna 2006









## **4. Proposal of measures for revitalization of the wetland**

- Changes in management**
- Dams on the small stream in the west-southern part of the wetland**
- (Abstract of water from Znievsky potok)**

# KLÁŠTORSKÉ LÚKY

ŠTÁTNÁ PRÍRODNÁ REZERVÁCIA

INVENTARIZAČNÝ VÝSKUM

M-1:5000

Mapa č.3

Plošné rozloženie rastlinných spoločenstiev

STAV  
reality 12/96

- J jehličiny
- K krovinné formácie
- kosť lúky
- V zársť vysokých ostríc
- N zársť nízkych ostríc
- T trstiny a chrestnicové zársť

RNDr. Vladimír Druga  
EKOSPOL  
Baničská 18  
974 05 MALACHOV

MIESTO USTANOVENIA ŽADU  
RNDr. DRUGA  
OBRAT: STAVY  
MARTIN  
ELEKTROVÝ  
SAŽP COPK Banské Bystrice

MIESTO TECHNICKÝCH ČASTÍ  
ING. PŠENÁK

RNDr. VLADIMÍR DRUGA  
EKOSPOL  
BANIČSKÁ 18  
974 05 MALACHOV

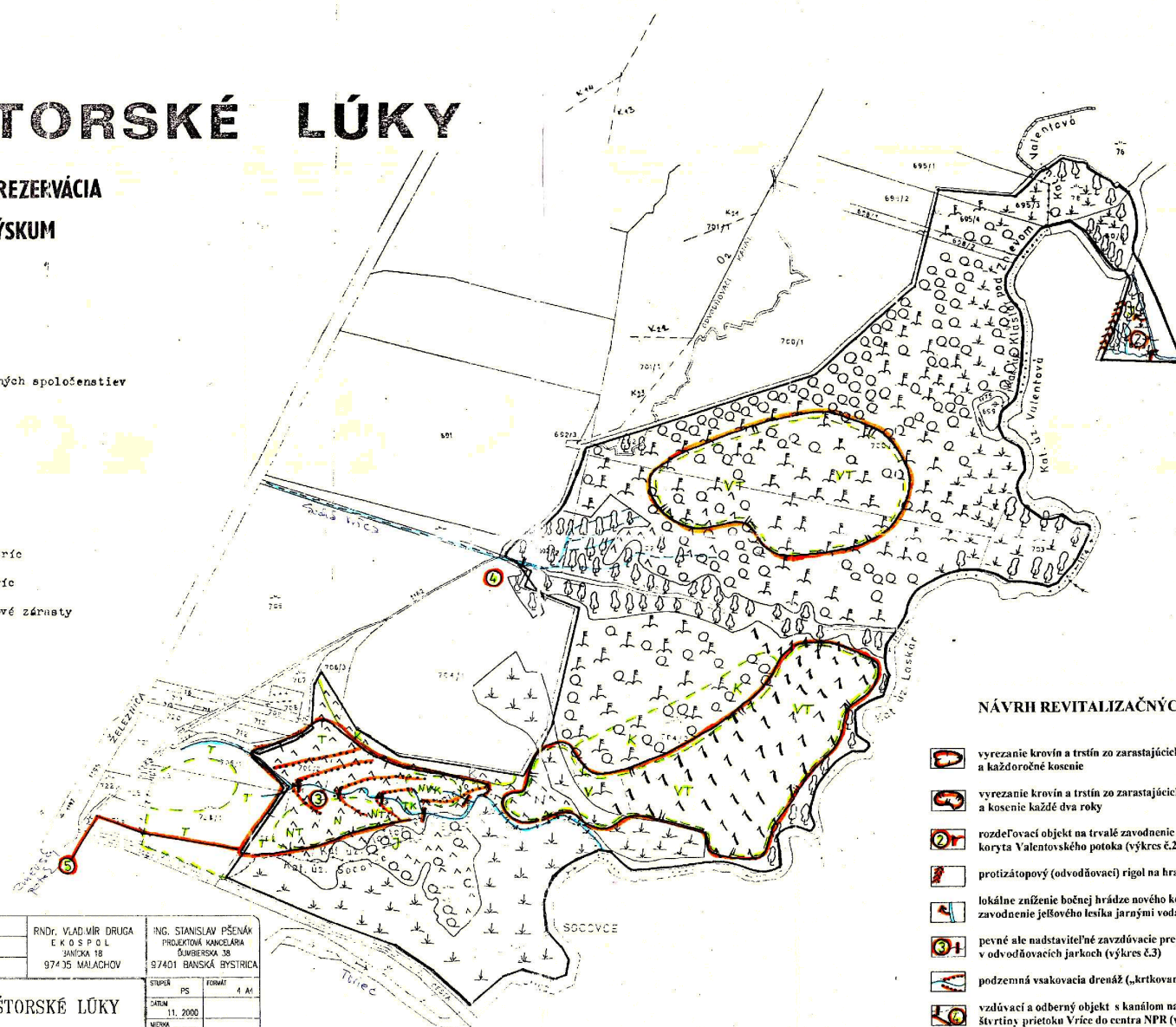
ING. STANISLAV PŠENÁK  
PROJEKTOVÁ KANCELÁRIA  
ŠUMPERSKÁ 38  
974 01 BANSKÁ BYSTRICA

ZAVODNENIE NPR KLÁŠTORSKÉ LÚKY

ROZKOT:

CELKOVÁ SITUÁCIA REVITALIZAČNÝCH OPATRENÍ

STUPEŇ	PS	FORMÁT	A4
DATUM	11. 2000		
MIETKA	1:5000		
ČÍSLO	1	ESKOPOL	



## NÁVRH REVITALIZAČNÝCH OPATRENÍ

- vyrezanie krovín a trstín zo zarastajúcich plôch a každoročné kosenie
- vyrezanie krovín a trstín zo zarastajúcich plôch a kosenie každé dva roky
- rozdeľovací objekt na trvalé zavodenie starého koryta Valentovského potoka (výkres č.2)
- protizátopový (odvodňovací) rigol na hranici NPR
- lokálne zníženie bočnej hrádze nového koryta - zavodenie jeľového lesika jarnými vodami
- pevné ale nadstaviteľné zavádzacie prepážky v odvodňovacích jarkoch (výkres č.3)
- podzemná vsakovacia drenáž („krtkovanie“)
- vzlúvaci a odberný objekt s kanálom na odvedenie štrtiny prítoku Vríce do centra NPR (výkres č. 4)
- dnový odber a úroveň prívodu vody zo Znievského potoka (výkres č.5)

























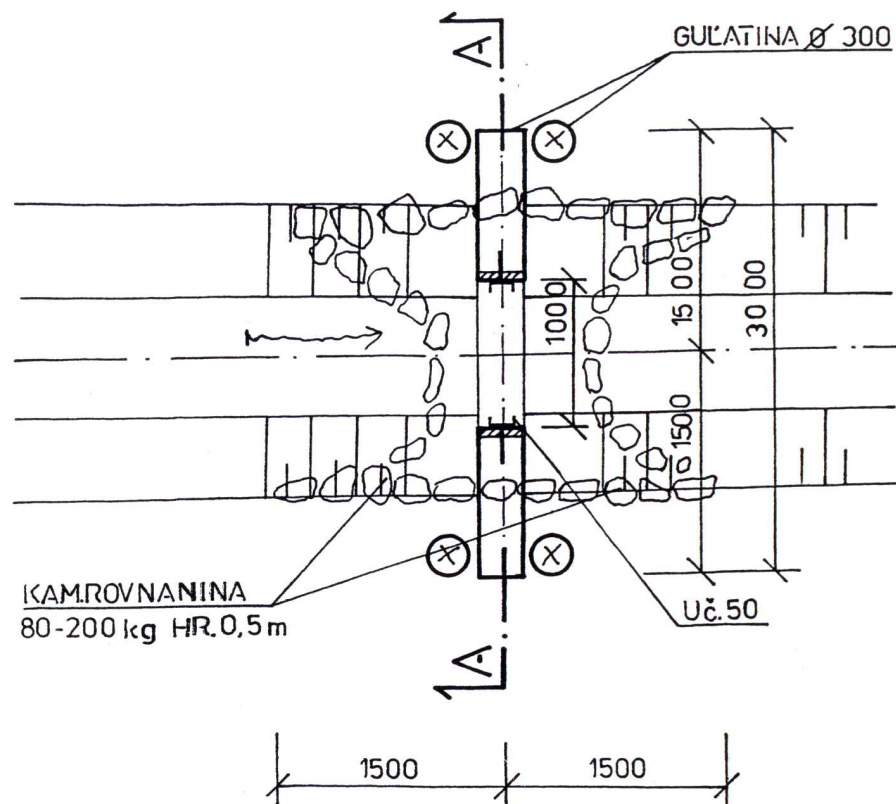




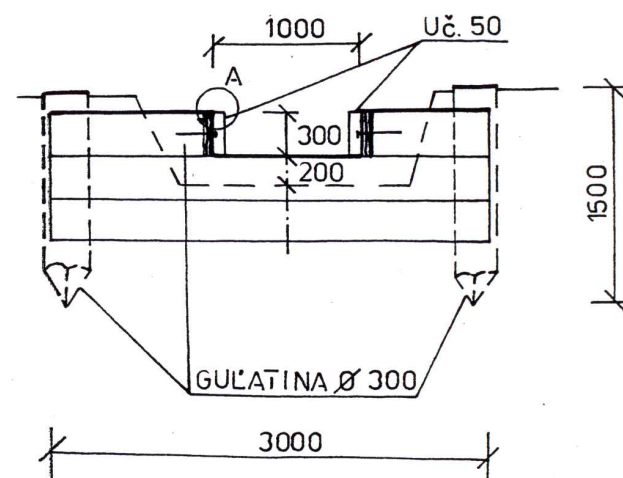


# Návrh prehrádzky na odvodňovacom jarku (EKOSPOL) - pôdorys a rez A - A'

PÔDORYS M=1:50

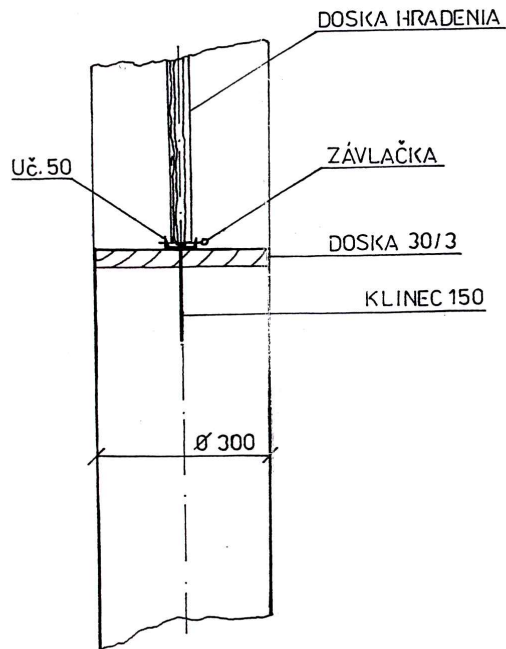


REZ A-A'

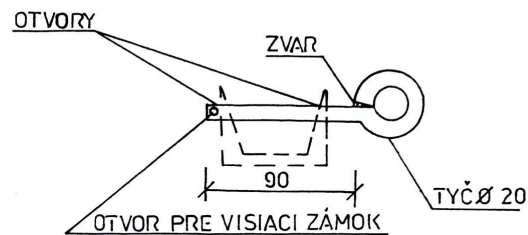


## Návrh prehrádzky na odvodňovacom jarku (EKOSPOL) - detail A a závlačka

DETAIL A  
M=1:10

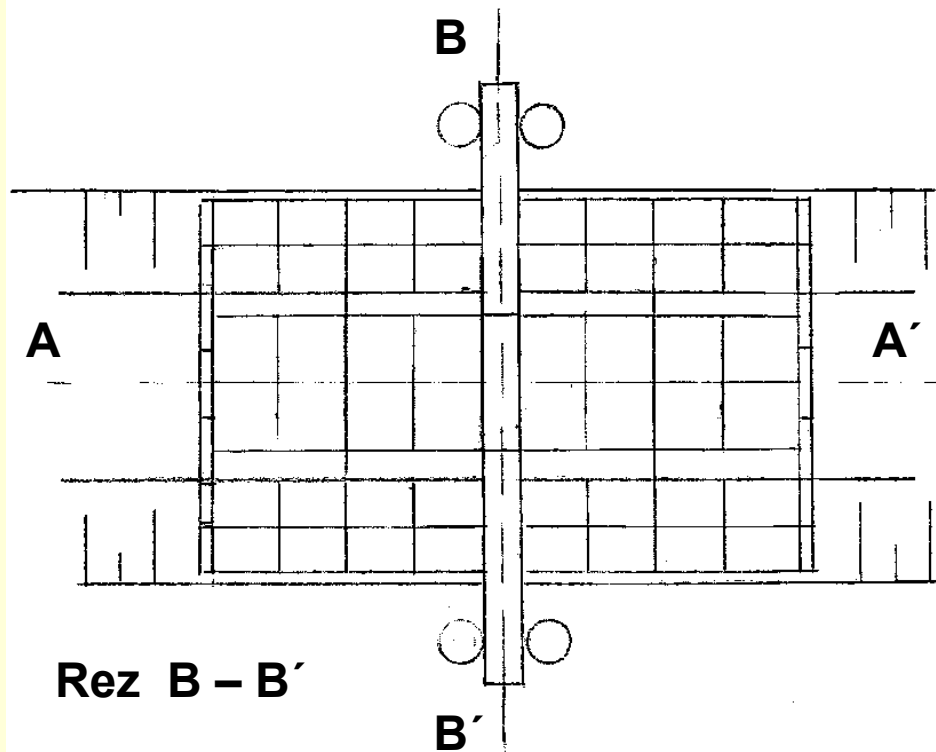


ZÁVLAČKA

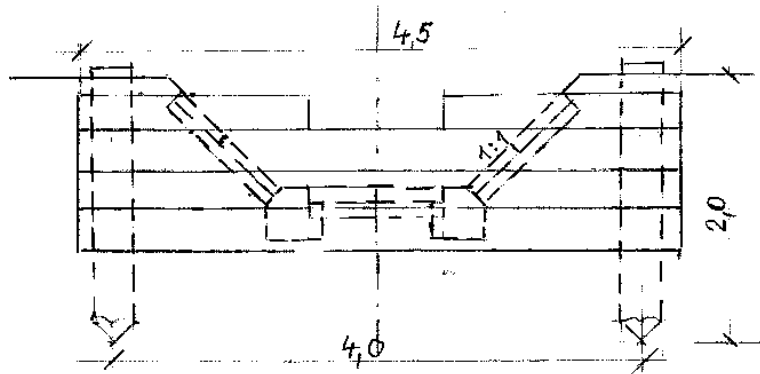




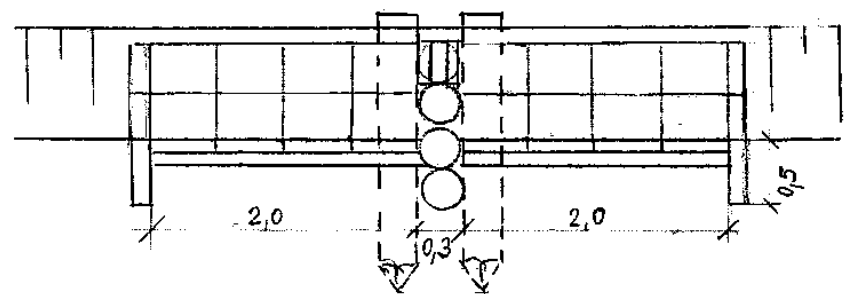
# Návrh prehrádzky na odvodňovacom jarku (KVHK)



Rez B – B'



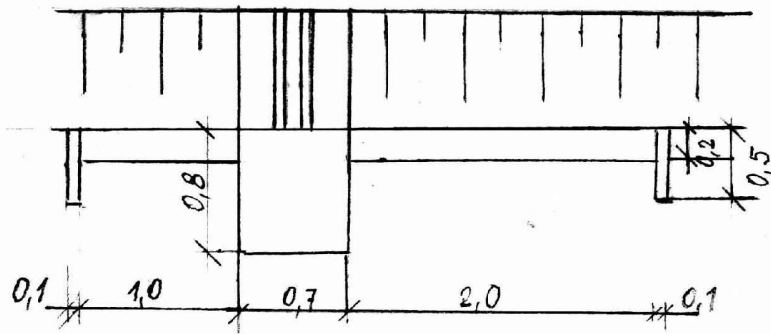
Rez A – A'



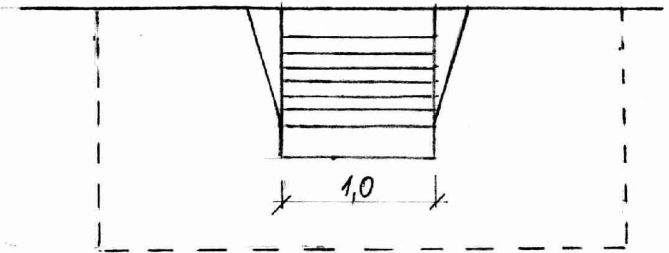
M 1:50

# Návrh prehrádzky na odvodňovacom jarku (KVHK) - pôdorys a rez A - A'

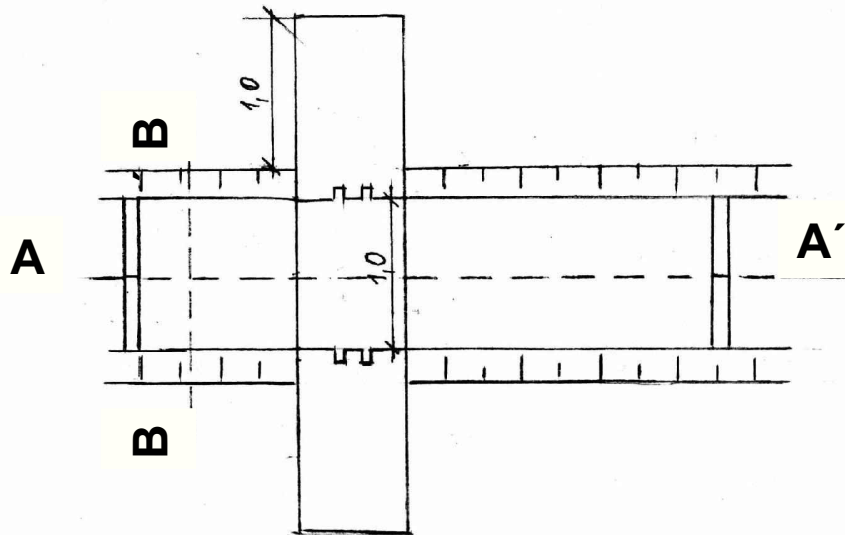
Rez A - A'



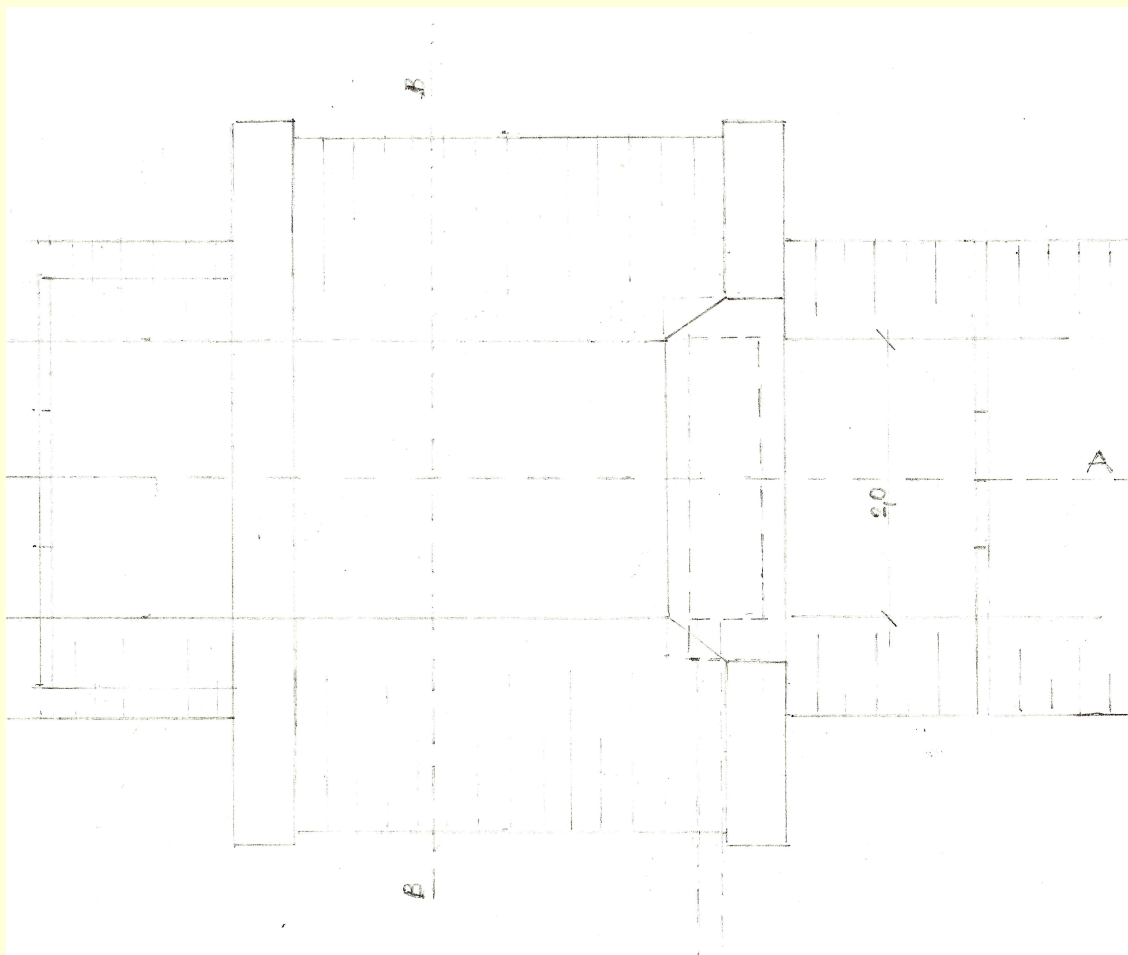
Rez B - B'



M 1 : 50



# Návrh odberného objektu na Znievskom potoku - pôdorys



## Návrh odberného objektu na Znievskom potoku – pozdĺžny rez A – A´



## Návrh odberného objektu na Znievskom potoku – priečny rez B – B´

