VELIKA VODA - REKA - A KARST RIVER

VELIKA VODA - REKA - KRAŠKA REKA

DANIEL ROJŠEK

Izvleček UDK 551.444.3(450+497.4)

Daniel Rojšek: Velika voda - Reka - kraška reka

Veliko vodo-Reko najdemo v naravoslovni in drugi literaturi od antike naprej. Reka je klasični primer kraške reke na otoku neprepustnih kamenin sredi obsežnega kraškega sveta. O Reki imajo na Inštitutu za raziskovanje krasa ZRC SAZU v Postojni obdelanih kar 399 bibliografskih enot (1*). Hidro-geografske značilnosti (2*) fluvialno kraškega porečja Velike vode-Reke smo v tem prispevku povzeli po objavljenih študijah, rečni režim 40-letnega obdobja (1953-1992) (3*) pa smo obdelali na novo.

Ključne besede: rečni režim, fluvialno-kraško porečje, Seznam svetovne dediščine pri UNESCO, Velika voda-Reka, Timav, matični Kras, Slovenija, Italija

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The Velika voda-Reka river is known in natural sciences and in literature since antiquity. The river is a classical representative of a karst river, isolated in a huge karst area. In the Postojna Karst Institute a rich bibliography containing 399 units exists (1*). Hydro-geographical features (2*) of the Velika voda-Reka fluviokarst basin have been studied, published and summarized in this paper. The river regime for a period of 40 years (1953-1992) (3*) is presented for this paper.

Key words: river regime, fluvio-karst drainage area, the World Heritage List by UNESCO, Velika voda-Reka, Timav - Il Timavo, Karst, Slovenia, Italy

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INTRODUCTION

The Velika Voda-Reka is a living name for the world famous karst river used by locals of the drainage area (Rojšek, 1992, 1993-2). Less adequate synonyms as the Notranjska Reka, Brkinska Reka, Timavo Superiore and similar can be found in the literature, too.

The Velika voda-Reka is narrowly linked by the the Škocjan Cave System. The Reka is one of the most interesting natural features of the Škocjan World Heritage Site by U.N.E.S.C.O. (Rojšek, 1995).

Sinking of the river into the Kras region, karst springs of Timav - Il Timavo and Brojnice - Sorgenti di Aurisina - Nabrežina and hydro-geographical properties of the Reka have been admired and studied since antiquity.

The Velika Voda-Reka is a classical representative of a karst river. The Reka drainage basin is caught between karst areas of the Snežnik massif, the upper Pivka fluvio-karstic drainage area, the Košansko-Slavinski ravnik karst plain and the Kras region (Fig. 1).

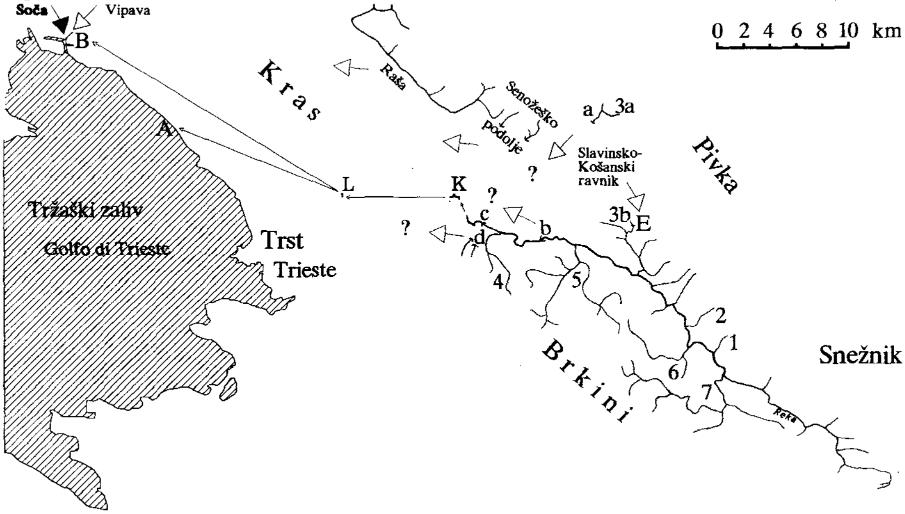
KARST RIVER

The karst river is a stream influenced by karst features. A surface karst river or its tributary can either spring out of a karst massif or the river sinks into it. The underground flow is either shallow or deep in the karst massif.

The Velika Voda-Reka is the widest known sinking stream of the classical Kras. The drainage basin lies on the Brkini sinkline Eocene flysch rocks, that are isolated in a huge Mezozoic karst area. There are four karst tributaries to the Reka drainage network: the Bistrica, Podstenjšek, and Rakulšca Sušica-Mrzlek are the right ones, and the Završka Sušica is the left one (Fig. 1).

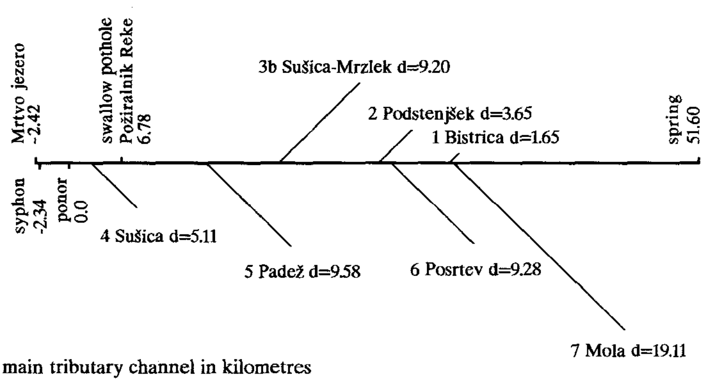
About one cubic meter per second of the Reka water sinks into the Požiralnik Reke and in other swallow-holes near Gornje Vreme at the contact of Eocene flysch and Paleocene limestones at the beggining of the Vremska dolina blind valley (Rojšek, 1984). Sinking conditions at the contact change. The pothole that had opened on the 14th September, 1982 was flooded by high waters on the 2nd October, 1982. Cavers descended 22 m, 26 m and 20 m into the pothole for three times and found different levels of the cave. Its entrance was 9.4 m long and 5.5 m wide in August 1983 later it was widened (10.3 x 7.1 m in October 1985), but it was filled up with gravel few years ago.

Fig. 1: The *Velika voda-Reka* drainage network and the *Kras* karst water junctions



KARST TRIBUTARIES:	PONOR CAVES:	KARST SPRINGS:	ESTAVELLE:
1 Bistrica	a Markov spodmol	A Brojnice - Sorgenti di Aurisina - Nabrežina	E Gabranca
2 Podstenjšek	b Požiralnik Reke	B Timav - Il Timavo	WATER CAVES:
3a Rakulšca - 3b Sušica	c Škocjanska jama		K Kačja jama
4 završka Sušica	d Mejame		L Lobodnica - Grotta di Trebiciano

Scheme of the main channel network



d=5.11 - lenght of the main tributary channel in kilometres

6.78 - distance from the ponor in kilometres

The main quantity of the water sinks into Škocjanska jama, the first cave of the Škocjan Cave System. Frequent floods make damages in the System's show part, and Šumeča jama is flooded up to the cave ceiling from Müllerjeva dvorana downwards. Waters of Senožeško Podolje, the Raša, Branica, Vipava and Soča rivers, sink in the Kras aquifer, too. Brojnice - Sorgenti di Aurisina - Nabrežina and Timav - Il Timavo springs represent direct outlets of the aquifer into the Adriatic Sea. The Brojnice submarine spring is the Reka's basic runoff outlet, but the Soča underground water prevails in Timav springs average discharge (Rojšek, 1987, 1993-3, Fig. 1).

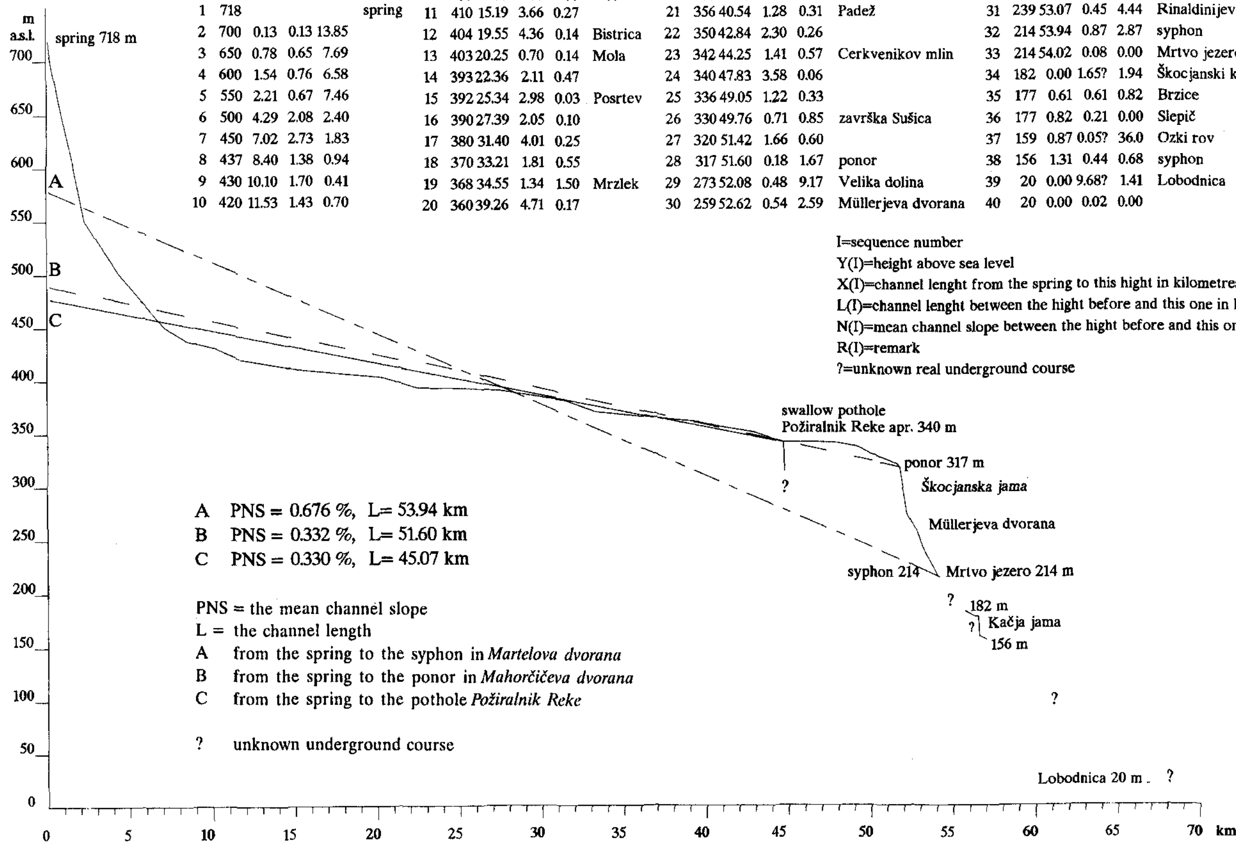
Basic hydro-geographic parameters of the basin:
* the basin surface = 335 km^2,
* the mean sea level = 570 m,
* the mean basin slope (without the Bistrica karst basin) = 26 %,
* the permeability coefficient = 0.40,
* the Velika voda-Reka length from the spring to
- the swallow pothole Požiralnik Reke = 45.07 km,
- the ponor Škocjanska jama = 51.60 km,
- the syphon in Marchesettijevo jezero = 53.94 km.
- the Mrtvo jezero underground lake = 54.02 km (Fig. 2),
* the Velika Voda-Reka mean channel slope from the spring to
- the swallow-hole Požiralnik Reke = 0.330 %,
- the ponor in Škocjanska Jama = 0.332 % and
- the syphon in Marchesettijevo Jezero = 0.676 % (Fig. 2).

Some authors divided the basin into three parts: the upper, the middle and the lower one, but from hydro-geographical point of view there are three main hydro-geographical units: the Velika Voda-Reka fluvio-karstic drainage area, the classical Kras aquifer and marshy basin of the Timav springs (the Potok river - Il Timavo) at the coast, where karst water drain into the Adriatic Sea. There are many drainage zones with different permeability in the Kras aquifer. The Reka underground course belongs to one zone of the aquifer, but the main affluent throughflow of the Timav belongs to the zone with underground water from the Soča drainage basin. The Kras aquifer surface of different limestones is estimated to 700 km^2, where about 70 km^2 belong to the Senožeško podolje and the Raša fluvio-karst drainage area and about 20 km^2 to other smaller areas. The aquifer permeability coefficient is estimated to 0.79 (Rojšek, 1981: 18).

Data for the Velika Voda-Reka longitudinal profile were read in the 1:25.000 scale map and in works of Mihevc (1984-1, 2)*1 and Rojšek (1981).

**1 Many thanks for the unpublished data to Mr A. Mihevc MSc from Inštitut za raziskovanje krasa ZRC SAZU in Postojna.*

Fig. 2: The *Velika voda-Reka* longitudinal channel profile and the mean channel slopes



I	Y(I)	X(I)	L(I)	N(I)	R(I)
1	718				spring
2	700	0.13	0.13	13.85	
3	650	0.78	0.65	7.69	
4	600	1.54	0.76	6.58	
5	550	2.21	0.67	7.46	
6	500	4.29	2.08	2.40	
7	450	7.02	2.73	1.83	
8	437	8.40	1.38	0.94	
9	430	10.10	1.70	0.41	
10	420	11.53	1.43	0.70	
11	410	15.19	3.66	0.27	
12	404	19.55	4.36	0.14	Bistrica
13	403	20.25	0.70	0.14	Mola
14	393	22.36	2.11	0.47	
15	392	25.34	2.98	0.03	Posrtev
16	390	27.39	2.05	0.10	
17	380	31.40	4.01	0.25	
18	370	33.21	1.81	0.55	
19	368	34.55	1.34	1.50	Mrzlek
20	360	39.26	4.71	0.17	
21	356	40.54	1.28	0.31	Padež
22	350	42.84	2.30	0.26	
23	342	44.25	1.41	0.57	Cerkvenikov mlin
24	340	47.83	3.58	0.06	
25	336	49.05	1.22	0.33	
26	330	49.76	0.71	0.85	završka Sušica
27	320	51.42	1.66	0.60	
28	317	51.60	0.18	1.67	ponor
29	273	52.08	0.48	9.17	Velika dolina
30	259	52.62	0.54	2.59	Müllerjeva dvorana
31	239	53.07	0.45	4.44	Rinaldinijeva dvorana
32	214	53.94	0.87	2.87	syphon
33	214	54.02	0.08	0.00	Mrtvo jezero
34	182	0.00	1.65?	1.94	Škocjanski kanal
35	177	0.61	0.61	0.82	Brzice
36	177	0.82	0.21	0.00	Slepič
37	159	0.87	0.05?	36.0	Ozki rov
38	156	1.31	0.44	0.68	syphon
39	20	0.00	9.68?	1.41	Lobodnica
40	20	0.00	0.02	0.00	

I=sequence number
Y(I)=height above sea level
X(I)=channel lenght from the spring to this hight in kilometres
L(I)=channel lenght between the hight before and this one in kilometres
N(I)=mean channel slope between the hight before and this one in %
R(I)=remark
?=unknown real underground course

A PNS = 0.676 %, L= 53.94 km
B PNS = 0.332 %, L= 51.60 km
C PNS = 0.330 %, L= 45.07 km

PNS = the mean channel slope
L = the channel length
A from the spring to the syphon in *Martelova dvorana*
B from the spring to the ponor in *Mahorčičeva dvorana*
C from the spring to the pothole *Požiralnik Reke*

? unknown underground course

The Bistrica stream is the strongest karst tributary of the river. Water springs out of the Snežnik massif and the Koritniška Kotlinica small relief basin in the hinterland. There are some registered, but not explored and surveyed caves in the spring area, which is dammed for the reginal water supply. Basic hydro-geographical parameters are published (Rojšek, 1987: 14, 16).

The Podstenjšek springs are located at the contact area of flysch and limestones. The highest water flows out of Kozja luknja, 85 m long and 20 m deep cave, where Proteus anguinus has been found.

The Stržen-Sušica-Mrzlek channels network is the most developed among the right tributaries. The network of 45 channels with total lenght of 43.17 km is located in the area of 49.25 km^2. Orographic watershed of this fluvio-karstic basin is uncertain and from the estavelle pothole Gabranca high waters of the Rakulšca stream from the other side of the Košansko-Slavinski ravnik flow off (Fig. 1). The Rakulšca karst water is accessible in the cave Vodna jama v Lozi between Markov spodmol and estavelle (F. Habe, F. Hribar, 1964).

The Završka Sušica stream is the tributary without permanent flow consisting of 24.90 km long channel network of 11.04 km^2 fluvio-karstic drainage basin.

THE VELIKA VODA - REKA RIVER REGIME

Ilešič (1947: 101-102) was the first who was studied the Velika Voda-Reka river regime for the period 1898-1913. He determined the regime as pluvio-nival with poor nival influence related only to water level at the gauging station Ilirska Bistrica.

Dukić (1968: 138-145) defined it as Mediteranean variant of the pluvial type regime with the highest average runoff in December and the lowest in August, but he used unrelevant data and his hydro-geographical study of the Reka is worthless.

Rojšek (1981, 1983, 1984, 1987, 1990) studied and published the regime of the limnigraph gauging station Cerkvenikov mlin (25 and 30 years period 1953-77 and 1953-1982). According to data of 40 years period 1953-92 the last average regime was ascertained, illustrated with histogram and runoff regimes of the lowest and the highest waters (Figs. 3-6).

Fig. 3: HISTOGRAM OF THE MEAN RUNOFF
Velika voda-Reka
gauging station Cerkvenikov mlin
period 1953-1992

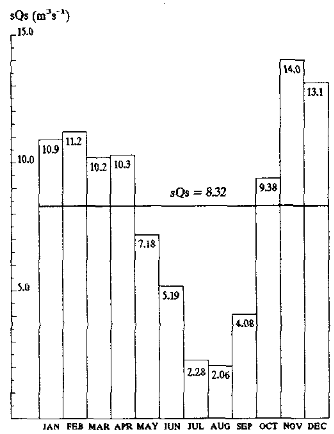


Fig. 4: Velika voda-Reka
runoff regime of the mean waters - **Qs** in m^3s^{-1}
gauging station Cerkvenikov mlin
period 1953-1992
sQs*[1] = 8.32 sQs(n)*[2] = 1.20 sQs(v)*[3] = 27.2

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
15.9	6.66	2.20	4.76	5.85	6.95	6.98	1.01	2.73	7.32	9.09	3.28	1953
6.47	4.84	10.7	3.49	12.4	4.78	2.24	0.50	1.33	3.16	9.56	12.7	1954
10.9	20.1	19.3	3.98	4.03	6.19	4.63	4.23	3.28	8.12	8.21	9.86	1955
10.9	11.6	3.98	15.1	11.2	6.98	2.31	0.64	0.48	4.09	14.3	2.00	1956
9.57	15.8	2.73	9.10	4.34	2.97	1.28	0.73	0.63	1.70	7.19	7.65	1957
13.9	14.7	11.8	9.01	1.96	2.88	1.36	0.69	0.62	3.13	8.45	23.8	1958
10.8	1.97	2.88	13.8	13.6	2.31	1.22	1.39	0.71	5.27	21.7	39.1	1959
13.7	26.8	20.8	4.10	1.21	1.31	2.47	3.90	19.1	41.7	24.6	39.3	1960
18.4	5.28	1.96	8.34	3.10	8.20	4.52	1.93	0.47	10.7	23.6	11.0	1961
19.8	4.39	15.6	16.8	9.70	2.94	4.06	0.51	0.60	0.45	29.2	10.8	1962
20.1	9.26	14.2	8.07	5.25	7.88	1.16	4.11	7.18	12.4	21.8	8.35	1963
6.27	3.76	15.1	10.6	3.34	1.27	1.00	1.01	2.37	37.1	7.00	19.6	1964
20.2	5.72	13.6	6.66	10.6	16.0	3.46	1.76	35.4	4.57	16.8	24.3	1965
5.79	15.0	4.77	10.7	3.93	2.78	3.33	6.63	3.16	17.1	25.6	20.0	1966
8.20	11.8	8.76	19.2	8.47	4.94	1.02	0.62	1.06	1.05	8.33	4.92	1967
7.11	32.6	5.76	2.90	6.94	4.96	1.32	4.05	5.96	2.17	22.8	9.88	1968
9.16	21.3	9.24	5.61	8.98	6.25	1.86	6.42	10.3	0.92	19.0	6.99	1969
17.1	7.51	24.6	32.8	6.23	3.13	2.35	2.15	2.02	1.07	8.19	8.76	1970
15.7	12.5	15.3	12.4	4.93	7.13	1.16	0.58	0.53	0.49	5.23	4.34	1971
6.47	11.8	13.2	8.08	25.4	3.66	1.59	1.15	2.66	1.74	16.6	12.2	1972
6.14	8.05	1.60	6.42	1.40	1.61	0.98	0.38	6.80	8.41	10.0	8.67	1973
7.26	10.6	6.17	5.42	11.3	11.5	2.80	0.91	3.34	25.4	7.70	4.35	1974
3.47	2.45	23.5	22.0	5.96	4.35	4.56	1.19	1.77	1.75	16.1	13.1	1975
1.20	14.1	6.90	9.50	2.93	1.96	0.83	1.77	9.91	8.20	19.5	31.0	1976
27.4	22.7	4.43	10.6	2.94	1.73	2.14	11.3	1.66	3.56	7.54	6.88	1977
17.7	14.5	12.0	15.5	12.4	3.00	0.97	1.53	1.70	12.2	2.46	14.2	1978
28.2	28.2	20.9	18.4	4.61	1.06	0.60	0.58	5.54	6.34	20.6	11.1	1979
8.59	6.85	5.76	5.56	3.50	9.39	5.46	1.60	3.03	23.4	25.9	11.7	1980
3.29	2.73	11.7	3.42	10.6	3.68	1.52	0.89	4.66	14.1	3.63	24.5	1981
15.4	1.84	6.17	4.42	8.53	7.26	1.50	1.82	0.92	18.7	14.7	20.7	1982
3.80	3.42	12.6	10.5	2.77	1.17	0.86	0.91	1.03	1.01	0.64	12.2	1983
9.21	11.2	7.29	12.1	6.74	6.10	2.49	1.54	4.91	25.0	6.85	14.1	1984
16.4	8.11	17.4	14.6	10.4	4.01	2.03	1.21	1.23	0.75	3.20	3.42	1985
8.57	6.67	10.0	11.7	3.62	8.77	1.19	1.15	1.29	1.11	3.69	4.84	1986
4.44	24.6	4.11	6.61	10.2	3.45	2.47	2.29	3.19	9.46	26.6	10.1	1987
12.0	17.5	12.3	12.3	4.69	9.25	1.19	1.76	2.51	5.43	0.91	3.49	1988
1.23	3.99	14.0	11.6	2.96	10.2	4.26	3.15	3.72	2.05	10.1	5.12	1989
4.18	3.44	2.11	10.7	1.99	5.51	1.52	1.75	2.54	11.1	22.3	18.1	1990
9.05	8.71	2.87	3.76	24.8	7.59	1.56	1.23	1.19	4.18	31.7	3.72	1991
1.84	4.27	11.2	11.5	3.37	2.32	2.98	1.33	1.49	28.6	18.3	24.2	1992
1.20	1.84	1.60	2.90	1.21	1.06	0.60	0.38	0.47	0.45	0.64	2.00	1.20
10.9	11.2	10.2	10.3	7.18	5.19	2.28	2.06	4.08	9.38	14.0	13.1	8.32
28.2	32.6	24.6	32.8	25.4	16.0	6.98	11.3	35.4	41.7	31.7	39.3	27.2

*[1] the mean water of the period
*[2] the lowest month mean water of the period
*[3] the highest month mean water of the period

Fig. 5: Velika voda-Reka
runoff regime of the lowest waters - **Qn(k)** in m^3s^{-1}
gauging station Cerkvenikov mlin
period 1953-1992
nQn(k)*[1] = 0.12 vQn(k)*[2] = 13.7

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
2.37	1.98	1.28	1.28	1.19	1.28	0.58	0.30	0.12	0.44	0.79	0.34	1953
2.65	1.28	2.65	0.56	1:28	1.28	0.51	0.20	0.16	1.00	1.75	2.49	1954
1.88	3.82	6.95	1.63	1.39	1.88	1.18	0.92	0.67	1.00	2.33	2.33	1955
3.00	3.40	1.27	3.20	2.60	2.60	0.80	0.36	0.29	0.36	3.62	1.05	1956
1.94	1.56	1.04	1.68	1.80	0.74	0.48	0.50	0.46	0.68	0.56	0.40	1957
2.22	3.22	6.32	3.58	0.80	0.62	0.68	0.37	0.43	0.50	1.12	1.12	1958
4.12	1.32	0.69	3.40	1.44	1.04	0.56	0.50	0.40	0.40	3.94	10.2	1959
2.50	4.40	6.32	1.68	0.74	0.56	0.96	1.20	1.04	12.2	5.84	9.04	1960
1.80	1.44	1.04	1.20	1.04	1.20	0.62	0.62	0.37	0.37	3.94	2.36	1961
4.83	2.52	2.85	3.34	1.93	1.30	0.80	0.28	0.28	0.19	0.53	2.52	1962
2.52	3.01	3.34	3.34	1.65	1.53	0.46	0.39	1.52	1.52	1.52	2.52	1963
2.95	1.20	2.62	3.97	1.41	0.86	0.53	0.53	0.48	0.78	1.65	1.89	1964
4.88	0.94	1.10	1.30	1.77	1.10	0.71	0.38	3.62	0.53	0.38	7.55	1965
2.84	4.11	2.84	3.25	2.47	1.94	1.87	2.00	1.94	3.25	8.76	4.47	1966
4.64	2.67	3.98	6.36	4.82	1.17	0.39	0.46	0.46	0.56	0.92	1.48	1967
2.50	2.50	2.85	1.70	2.04	1.56	1.03	1.03	1.27	1.07	1.17	1.96	1968
1.71	3.37	3.22	2.75	2.60	2.25	1.31	1.03	1.68	0.60	0.32	3.16	1969
0.90	2.79	3.28	13.7	2.70	1.71	0.42	0.30	0.67	0.80	0.92	1.88	1970
2.70	2.70	1.71	3.18	2.56	1.62	0.86	0.22	0.32	0.22	0.22	1.19	1971
1.66	1.10	2.29	1.80	2.95	0.80	0.65	0.57	0.52	0.57	1.66	1.80	1972
1.15	2.08	1.25	1.25	0.57	0.39	0.48	0.30	0.30	1.35	1.35	1.35	1973
1.75	1.75	1.75	1.05	2.41	2.41	0.75	0.48	0.70	3.78	2.10	1.80	1974
1.66	1.10	2.16	2.55	1.74	1.42	1.26	0.97	0.90	0.84	1.03	2.94	1975
0.78	0.91	1.70	2.11	1.18	0.68	0.49	0.63	1.11	0.97	2.11	2.00	1976
4.48	4.55	2.15	2.05	1.76	1.43	1.46	1.68	0.73	2.45	2.10	1.30	1977
2.20	5.49	5.29	2.80	4.10	0.80	0.68	0.52	0.64	0.80	0.56	1.30	1978
2.76	5.08	1.80	1.60	0.80	0.68	0.48	0.39	0.39	0.90	1.40	2.28	1979
2.30	2.00	1.90	2.30	1.90	2.30	1.80	1.30	1.30	1.20	5.05	2.90	1980
0.75	1.11	1.47	1.29	2.94	1.47	0.75	0.53	0.53	2.19	2.01	3.14	1981
2.37	1.35	1.07	1.69	1.35	1.52	0.55	0.64	0.28	0.37	2.55	3.07	1982
1.21	2.20	2.72	1.69	1.21	0.55	0.46	0.46	0.28	0.28	0.19	0.55	1983
1.75	1.26	2.10	1.26	0.83	1.58	0.83	0.83	0.70	4.85	3.21	3.78	1984
2.48	2.48	3.07	6.84	1.39	1.39	0.91	0.91	0.60	0.50	0.91	1.52	1985
2.29	1.79	2.64	2.82	0.96	1.08	0.35	0.44	0.28	0.28	0.62	1.08	1986
2.02	2.98	2.02	2.59	2.39	2.02	0.63	0.31	0.31	2.02	3.18	3.58	1987
4.31	5.31	4.56	3.34	2.44	2.23	0.47	0.18	0.97	0.97	0.58	0.82	1988
0.50	0.87	2.04	2.64	0.87	1.67	1.67	0.87	1.33	1.33	1.49	1.67	1989
1.34	1.50	1.03	3.30	1.18	1.18	1.03	0.88	1.18	1.68	2.65	5.26	1990
1.15	2.25	1.31	2.48	2.71	1.47	0.88	0.76	0.65	0.46	1.15	0.14	1991
1.32	1.57	1.32	2.45	1.40	1.25	1.40	0.74	1.11	1.11	3.03	2.45	1992
0.50	0.87	0.69	0.56	0.57	0.39	0.35	0.18	0.12	0.19	0.19	0.14	
4.88	5.49	6.95	13.7	4.82	2.60	1.87	2.00	3.62	12.2	8.76	10.2	

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*[1]the lowest recorded peak of the lowest waters
*[2]the highest recorded peak of the lowest waters

Fig. 6: Velika voda-Reka
runoff regime of the highest waters - **Qv(k)** in m^3s^{-1}
gauging station Cerkvenikov mlin
period 1953-1992
nQv(k)*[1] = 0.32   vQv(k)*[2] = 305

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
192	74.9	4.24	29.9	18.0	19.6	36.3	7.00	17.6	65.8	96.0	18.0	1953
25.4	24.2	36.4	28.6	63.3	20.3	10.4	0.61	28.2	13.4	129	54.3	1954
102	68.2	167	14.4	16.7	40.8	27.4	31.4	30.2	68.2	27.8	47.1	1955
63.7	49.9	12.8	81.2	48.6	25.4	17.0	1.16	3.40	56.7	92.6	12.2	1956
54.0	76.7	7.36	42.9	23.3	24.9	11.2	1.94	1.04	12.5	66.7	44.3	1957
115	136	40.0	39.4	4.88	29.7	4.40	3.58	1.32	41.2	57.3	203	1958
46.5	4.12	14.9	65.7	107	13.8	4.40	7.08	2.50	103	115	174	1959
69.7	147	128	11.2	1.80	15.6	6.56	21.5	182	235	85.1	186	1960
198	66.2	6.08	55.3	17.0	58.7	93.6	13.5	0.74	142	145	5.20	1961
88.9	14.9	84.5	62.1	67.6	12.4	47.8	0.80	3.88	1.08	109	62.6	1962
166	94.8	65.6	16.6	33.7	83.3	6.80	36.7	34.9	169	183	33.9	1963
31.1	26.6	81.5	44.5	9.56	5.65	2.62	5.45	30.7	248	30.7	109	1964
87.8	26.2	105	52.6	111	110	19.8	68.7	277	25.5	85.1	185	1965
36.6	49.8	12.2	49.8	24.0	18.9	14.2	61.2	26.3	93.0	195	204	1966
32.2	149	17.4	119	63.7	54.7	2.93	0.85	3.57	4.82	87.8	29.8	1967
48.7	147	18.3	26.3	96.0	56.1	4.69	61.7	59.6	8.61	231	276	1968
115	157	28.8	17.7	198	39.4	3.53	37.6	77.7	1.55	240	19.6	1969
109	16.8	174	123	19.0	12.4	9.15	42.2	14.3	3.56	72.7	131	1970
86.7	151	162	134	11.3	44.0	3.05	0.86	1.08	7.00	48.7	23.0	1971
77.4	61.5	126	19.1	305	23.4	25.6	6.31	14.2	16.6	101	68.8	1972
11.3	63.3	2.61	23.1	7.49	3.71	0.83	0.32	0.32	11.1	8.13	61.1	1973
39.3	116	94.8	65.1	58.6	97.2	21.1	8.10	34.2	172	41.9	13.6	1974
44.6	8.57	204	91.8	57.7	61.0	43.2	21.6	13.6	13.9	262	116	1975
2.11	174	23.1	39.4	10.9	8.00	1.51	26.3	151	188	77.7	178	1976
98.4	115	14.9	94.8	23.6	2.80	22.3	118	9.61	14.4	65.1	96.6	1977
224	56.2	36.2	93.0	63.5	22.1	2.44	50.0	11.1	104	54.7	94.2	1978
101	69.9	85.2	138	22.5	3.82	1.00	1.40	93.6	105	214	96.6	1979
101	48.2	26.7	46.4	15.7	67.8	23.9	25.3	73.2	119	119	84.0	1980
10.4	13.1	52.8	29.8	106	18.6	4.31	7.52	39.7	91.2	9.65	159	1981
104	2.72	65.1	21.0	75.3	65.6	5.20	12.0	2.90	97.2	157	73.2	1982
13.2	7.13	102	60.5	9.84	2.90	2.03	1.69	4.80	10.4	5.41	121	1983
94.0	81.4	62.1	112	47.7	23.6	16.8	4.15	45.2	233	53.7	150	1984
113	54.3	118	40.8	44.2	17.1	43.3	5.67	1.82	1.82	16.1	22.9	1985
56.1	54.6	49.2	79.8	30.1	83.3	6.95	8.39	9.35	5.09	61.4	34.5	1986
15.0	124	32.4	21.7	36.6	18.1	9.78	27.2	66.9	76.7	235	27.9	1987
53.9	77.5	101	68.9	18.0	75.7	4.56	12.8	38.1	68.9	2.44	16.0	1988
3.30	64.3	106	56.0	8.86	67.5	22.5	37.2	33.9	9.16	162	20.1	1989
16.0	7.72	7.72	47.0	6.33	30.9	6.33	10.7	8.86	73.1	168	229	1990
52.3	110	5.71	6.83	160	66.2	3.80	3.27	20.8	31.5	243	15.0	1991
4.01	20.8	117	59.3	23.0	12.0	23.8	3.42	8.54	175	84.4	259	1992
2.11	2.72	2.61	6.83	1.80	2.80	0.83	0.32	0.32	1.08	2.44	5.20	
102	115	105	79.8	63.7	61.0	22.5	31.4	39.7	105	162	159	
104	116	106	81.2	67.6	65.6	23.8	36.7	45.2	119	168	174	
109	124	117	91.8	75.3	66.2	23.9	37.2	59.6	142	183	178	
113	136	118	93.0	96.0	67.5	25.6	37.6	66.9	169	195	185	
115	147	126	94.8	106	67.8	27.4	42.2	73.2	172	214	186	
115	147	128	112	107	75.7	36.3	50.0	77.7	175	231	203	
166	149	162	119	111	83.3	43.2	61.2	93.6	188	235	204	
192	151	167	123	160	83.3	43.3	61.7	151	233	240	229	
198	157	174	134	198	97.2	47.8	68.7	182	235	243	259	
224	174	204	138	305	110	93.6	118	277	248	262	276	

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*[1] the lowest recorded peak of the highest waters
*[2] the highest recorded peak of the highest waters

The Velika Voda-Reka river regime of the 40 years period is determined as Submediteranean pluvio-nival with influence of karst retention. The average water level related to the period is 8.32 m^3s^{-1}. The highest mean water occurs in November, and the lowest in August. The highest mean monthly discharge belongs to the late autumn, winter and spring (Nov., Dec., Jan., Feb., Mar., Apr.). From November the average discharge decreases to January, it fluctuates from February to April and decreases again from May to August, to increase in November (Figs. 3, 4). Total subaverage discharge (20.79 m^3s^{-1}) does not reach one and the half of the highest average monthly discharge.

The runoff regime of the lowest waters shows that the lowest monthly peak of the period does not exceed one cubic meter per second, but one hundred and twenty liters per second (0.12 m^3s^{-1}) is the lowest recorded discharge. The highest monthly peaks of the lowest waters range from 1.87 to 13.7 m^3s^{-1} (Fig. 5).

Oscillating flood waves are characteristics of the highest runoff regime. The highest discharges have been not measured. The Cerkvenikov mlin gauging station discharge curve is uncertain in the upper part, thus the highest discharges displayed in the Fig. 6 are too low. The highest peak was recorded in September 1965 with discharge 277 m^3s^{-1}, but in the Fig. 6 the highest discharge of 305 m^3s^{-1} (May 1972) is shown. Hidrometeorološki zavod Slovenije - the Slovene hydrological institute processed the data of both flood waves (Rojšek, 1987: 19). The wave computation showed lower peak discharges. By the curve 222 m^3s^{-1} was computed as the 1972 wave's peak, but afterwards by the runoff and precipitation comparative analysis the peak of 305 m^3s^{-1} was estimated. The analysis of the 1965 wave has not yet been done.

In six months of the period (Jan., Feb., Mar., Oct., Nov. and Dec.) the highest peaks at least ten times expand beyond 100 m^3s^{-1}. The peak more than 100 m^3s^{-1} appeared every month of the period, except in July (93.6 m^3s^{-1}). In seven months of the period (Jan., Mar., May, Sep., Oct., Nov. and Dec.) 200 m^3s^{-1} appeared in November six times even (Fig. 6). A ratio between the lowest and the highest discharge is unknown, but it is more than 1:3.000.

DEGRADATION

The Velika Voda-Reka river was also known by overpollution of its waters from the Ilirska Bistrica town downwards. The river was degraded to sewer and the Cave System to sewage outlet of the town and regional agricultural, communal and industrial waste waters.

The basic river pollution parameters were published by Rojšek (1987, 21, 1990). From that time quality of the water improved, particulary after the independance of Slovenia in 1991. After that time the last big pollutant the Tovarna organskih kislin (Factory of organic acids) collapsed; Yugoslav army left barracks, and they are abandoned as military objects, however some pollutants still exist.

Building of projected communal water treatment plant for town, which should be built up in the year 1991 did not even started; also the validity of the plan location permission expired. The location procedure must start again, because inhabitants of Topolc village opposed to the plant location. The main reason of their discontent was the presumable plant stinking.

The water is no more overpolluted, but it is still in the 2nd to 3rd class, according to discharge. Diluting of communal waste water by fresh outlets from two accumulations in the Mola drainage basin is not appropriate and sufficient method to maintain the Velika Voda-Reka quality in the 2nd class. The functional communal cleaning plant is the only right way and a guarantee to maintain the river quality in the 2nd class.

CONCLUSION

A karst river is a stream influenced by karst features. A surface karst river or its tributaries either flow out of a karst massif or sink into it. The underground flows are shallow or deep in the karst massif.

The Velika Voda-Reka is a classical representative of a karst river. Its drainage basin lies mostly on the Brkini sinkline of the Eocen flysch rocks, which is isolated in a huge Mezozoic karst area. The Reka is narrowly linked by the Škocjan Cave System, the World Heritage Site. The river frequently floods the cave system (Figs. 1 and 2).

The Reka has a Submediteranean pluvio-nival river regime with influence of karst retention. The average water level for the period 1953-1992 is 8.32 m^3s^{-1}. The highest average water appears in November, the lowest in August. The runoff regime of the lowest waters shows that the lowest monthly peak of the period does not exceed one cubic meter per second, but one hundred and twenty liters per second (0.12 m^3s^{-1}) is the lowest recorded discharge. Oscillating flood waves are characteristics of the highest runoff regime. The highest discharges were not measured. The Cerkvenikov mlin gauging station discharge curve is uncertain in the upper part, thus the highest discharges in the figure 6 are too low. The highest discharge of the period was estimated to 305 m^3s^{-1}, however the peak was higher (Figs. 3-6).

A ratio between the lowest and the highest discharge is unknown, but it exceeds 1:3.000.

The water is no more overpolluted, but it is still in the 2nd to 3rd class, according to discharge. The water treatment plant of the Ilirska Bistrica town and industry is the only appropriate way to guarantee that the river quality remains in the 2nd class.

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VELIKA VODA - REKA - KRAŠKA REKA

Povzetek

Med domačini v porečju je Velika voda-Reka živo ime za svetovno znano kraško reko (D. Rojšek, 1992, 1993-2). V literaturi najdemo bolj ali manj neustrezne sinonime: Notranjska Reka, Brkinska Reka, Timavo Superiore in podobno, reka Reka pa je zagotovo med najbolj nesmiselnimi.

Ponikanje Reke v matični Kras, kraška izvira Timav in Brojnice pod Nabrežino ter druge hidro-geografske značilnosti Reke so občudovali in preučevali od antike dalje, kajti Velika voda je klasični primer kraške reke.

Kraško reko bistveno zaznamujejo vplivi krasa. Površinska kraška reka oziroma njen pritok lahko izvira iz krasa ali pa reka vanj ponika, podzemeljska se skozenj pretaka bolj ali manj globoko.

Porečje Velike vode se razteza na eocenskih flišnih kameninah brkinske sinklinale, ki tvori otok neprepustnih kamenin v obsežnem, večinoma mezozojskem kraškem svetu Snežniškega pogorja, Košansko-Slavinskega ravnika in matičnega Krasa ter fluvialno-kraškega porečja zgornje Pivke. Velika voda je del Škocjanskega jamskega spleta, kjer ima svoje mesto med zagotovo najbolj zanimivimi naravnimi pojavi v naravni in kulturni dediščini, ki je vpisana v Seznam svetovne dediščine pri UNESCO. Poplave v jamskem spletu so pogoste. Najvišje poplavne vode zalijejo Šumečo jamo do stropa od Müllerjeve dvorane navzdol. Reka ima štiri kraške pritoke: Bistrica, Podstenjšek in Sušica-Stržen-Mrzlek so desni, završka Sušica pa levi (sliki 1 in 2).

Reka ima pri Cerkvenikovem mlinu submediteranski pluvio-nivalni rečni režim z vplivi kraške retinence. Srednja voda obdobja 1953-1992 znaša 8.32 m^3s^{-1}. Najvišji poprečni odtok je novembra, najnižji pa avgusta (sliki 3 in 4). V odtočnem režimu najnižjih voda vidimo, da najnižja konica nikdar ne preseže kubičnega metra v sekundi, stodvajset litrov v sekundi (0.12 m^3s^{-1}) pa je najnižji opaženi pretok (slika 5). Temeljna značilnost odtočnega režima najvišjih voda je nihanje višine silovitih poplavnih valov. Najvišjih pretokov niso nikdar izmerili, temveč so jih izračunali. Pretočna krivulja vodomerske postaje Cerkvenikov mlin v zgornjem delu ni zanesljiva, tako da so konice iz slike 6 prenizke. Obdobna konica iz 305 m^3s^{-1} (maj 1972) je ocenjena, najvišja se je pojavila septembra 1965, vendar je nihče še ni na novo ovrednotil.

Razmerje med najnižjim in najvišjim pretokom ni znano, presega pa 1:3.000.

Voda Reke ni več tako onesnažena kot pred leti, vendar njena kakovost še vedno niha med 2. in 3. razredom, kar je večinoma odvisno od pretoka. Razredčevanje odplak v Reki s svežo vodo iz zadrževalnikov Klivnik in Mola ni pravi niti zadovoljivi način čiščenja Reke. Učinkovita komunalna čistilna naprava bi bila edino, kar bi nedvomno jamčilo da Reka ostane v drugem kakovostnem razredu.