



**Interreg**  
**Latvija-Lietuva**

European Regional Development Fund



EUROPEAN UNION

**Ecological flow estimation in Latvian – Lithuanian Transboundary river  
basins (ECOFLOW) LLI-249**

**Case study sites and hydrographs  
for Venta river basin district, in Latvia**

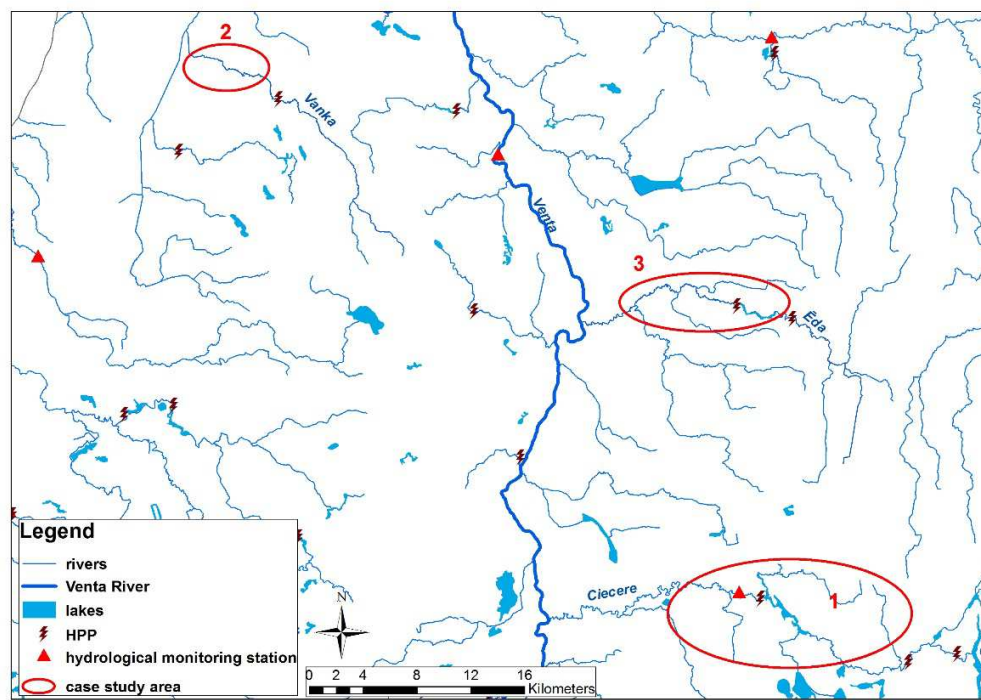
Riga, 2017



## 1 Selection of case studies

The case study of regulated rivers have been selected taking into account severity of hydrological regime' alterations or number of HPPs on the river, fish species existence and water body type.

In Venta RBD 3 type specific case studies were selected for assessment of HPP impact on river ecosystem and E-flow evaluation: Ciecere, Vanka and Eda rivers (Fig. 1).



**Figure 1. Case study territories in Venta RBD, Latvia**

## **2 Hydrographs for selected case study sites**

### **1.Ciecere River**

Ciecere River outflows from Ciecere Lake and inflows to Venta River. River basins is 539 km<sup>2</sup>. It is 51 km long, river bed gradient is 1.7 m/km in upper stretch and 1.0 m/km in down stretch. Elevation is 23 – 101 m LAS.

Ciecere River is classified as water body of 3-d type.

River has small U- and V- shaped (in upper reach) valley, 150 – 200 m width. Slopes are sandy loam, moderate, overgrown with brush. In some places, there are outcrops of bedrock.

Floodplain is also sandy loam, covered by brush and meadow vegetation, inundated.

Channel is sinuous, 10 m width in average and 0.3-0.6 m depth. There are bars and artificial riffles in the upper stretch near Saldus.

River bed substrate: boulders, cobbles, gravel and mud.

Fish: trout, roach, perch, pike, burbot and others.

3 hydropower plants are located in stream:

HPP Pakuli that was constructed in 1958 and operated until 1987. From 1988 to 1995 this HPP wasn't operated, but in 1996 has been renovated.

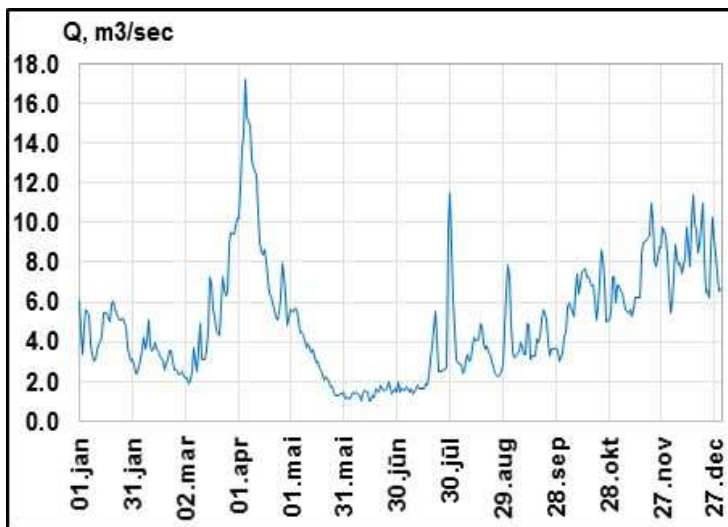
Ciecere HPP is operated from 1996, and

Dzirnavnieku HPP is operated from 1999.

The only HPP Pakuli has reservoir. All of 3 hydropower plants are working in inflow regime.

Hydrological regime is characterised by spring flood, summer low flow and rain flood during winter and autumn seasons. Water runoff data of Ciecere – Pakuli HPP for period of 1961-1987 were analysed taking into consideration lack of data for period 1988-2007 and construction of two additional hydropower plants upstream Pakuli HPP.

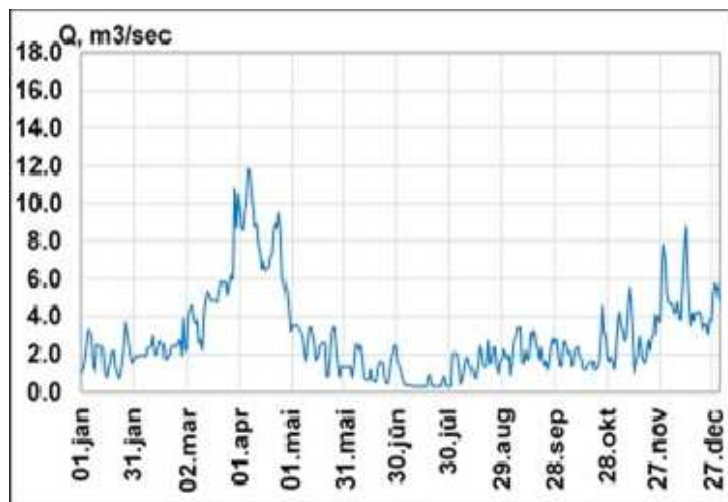
Hydrological regime is regulated by Ciecere Lake and hydropower plants. Hence water hydrographs shows both runoff fluctuations from frequent rains and HPP operations. There is no possible to find river-analogue with long data series and reference conditions for Ciecere River due to lake regulations.



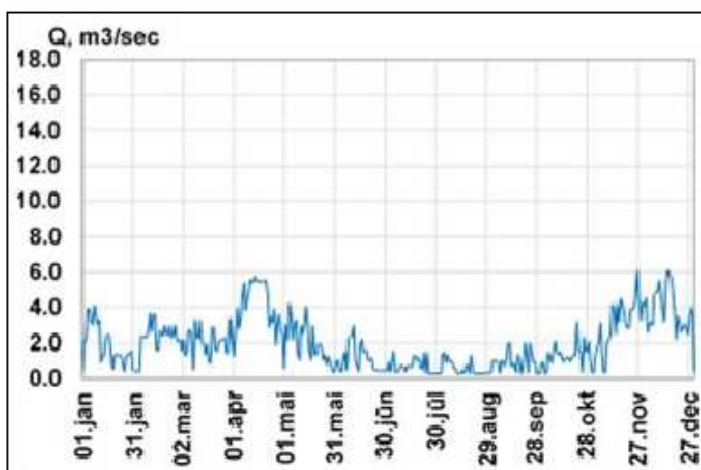
**Figure 2. Hydrograph of Wet Year, Ciecere River**

Hydrograph of Wet Year (Fig. 2, Table 1 in Annex) was created on the base of daily discharge for 8 wet years with module coefficient higher than 1.30. There are high spring flood from the beginning of March to the end of May and high rain floods from July to December.

Hydrograph of Normal Year (Fig. 3, Table 2 in Annex) is based on daily discharge data of 5 years with runoff module coefficient 0.85-1.15. The spring flood in normal year starts in the beginning of March and usually lasts 2-2.5 months. It has not many rains during summer season but quite high rain floods in late autumn and in winter season.



**Figure 3. Hydrograph of Normal Year, Ciecere River**



**Figure 4. Hydrograph of Dry Year, Ciecere River**

Data of 3 dry years with runoff module coefficient from 0.56 to 0.65 were used for creating of Dry Year Hydrograph of Ciecere River (Fig. 4, Table 3 in Annex). A spring flood in dry years is not higher than rain flood in winter, and a low flow period lasts until late

autumn almost without rains.

## **2. Vanka River**

Vanka is a right tributary of Užava River. Basin area of Vanka River is 96.85 km<sup>2</sup>, length – 30 km. Elevation of river basin is 11 – 93 m. River bed average gradient is 2.7 m/km, in upper stretch – 4.9 m/km.

Vanka River is classified as water body of 1-st type.

River has small U- and V- shaped (in upper reach) valley.

Slopes are sandy, moderate, overgrown with conifer forest.

Floodplain is also sandy, covered by meadow vegetation.

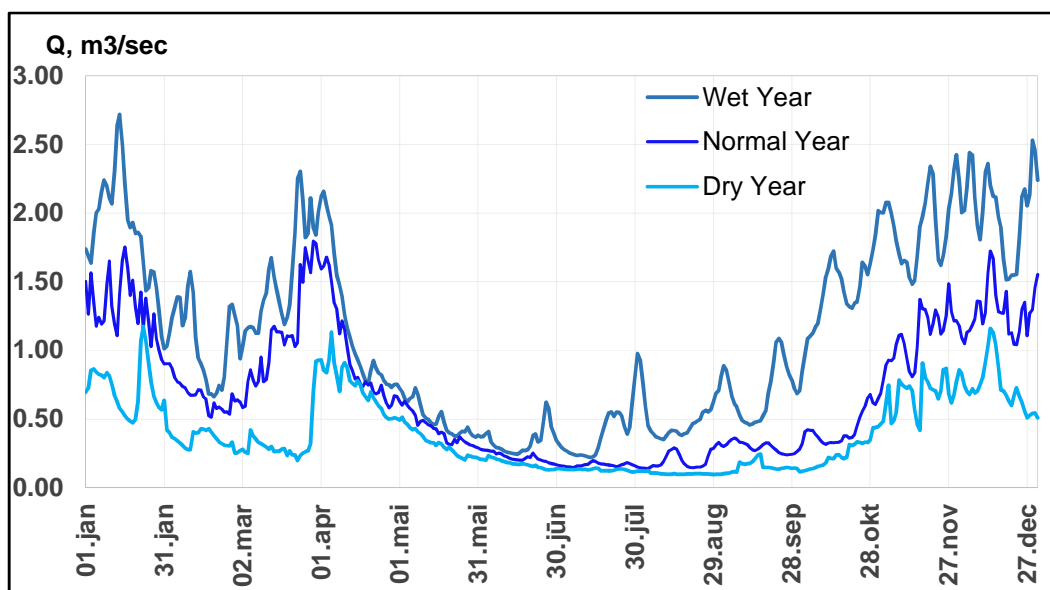
Channel is sinuous, 30% of river length are shortened.

River bed substrate: gravel, sand and mud.

Fish: trout and others.

Edole HPP is located in the middle stretch of Vanka River. HPP was constructed in 1999.

Hydrological regime is characterised by spring flood, summer low flow and rain flood during winter and autumn seasons. Water runoff data of Riva-Pieviki monitoring station for period of 1961-2015 were analysed for preparing of Vanka River hydrographs upstream Edole HPP (Fig. 5).



**Figure 5. Wet, Normal and Dry Years Hydrographs of Vanka River**

For Hydrograph of Wet Year daily discharge data of 11 years with runoff module coefficient 1.27 – 1.65 were averaged. For calculation of Normal Year' Hydrograph data of 7 years with water runoff module coefficient 0.91-1.07 was taken into account, but for Dry Year' Hydrograph – data of 6 years with water runoff module coefficients 0.51-0.60. Data tables in Annex include daily discharge of Wet (Table 4), Normal (Table 5) and Dry (Table 6) Years.

### **3. Ēda River.**

The Ēda River (in the middle and upper course also known as *Šķēde River*) originates in the western slopes of Eastern Kurzeme Upland and flows into the Venta River.

Catchment area of the Ēda River is 303 km<sup>2</sup>. River length is 46 km; stream gradient varies from 1.46 m/km in lower reach to 1.75 m/km in upper reach. Elevation is 16.4 – 92.0 m above sea level.

Forests cover about 43%, lakes 0.2% and swamps 1.9% of the catchment area.

Water body *Ēda* V046 is classified as a river of the 3-d (third) type (medium ritral-type river).

Channel is mainly sinuous, only in upper course it is straight. Average width of the Ēda River is 5-8 m and average depth 0.4-0.8 m. There are riffles downstream of HPP *Šķēde*.

Reclamation works were carried out on the floodplain of upper reach, therefore river valley is weakly expressed here, while in middle and lower reaches of the Ēda River slopes of riverbanks are moderate steep to steep, overgrown with shrubs, broad-leaved forest and mixed forest.

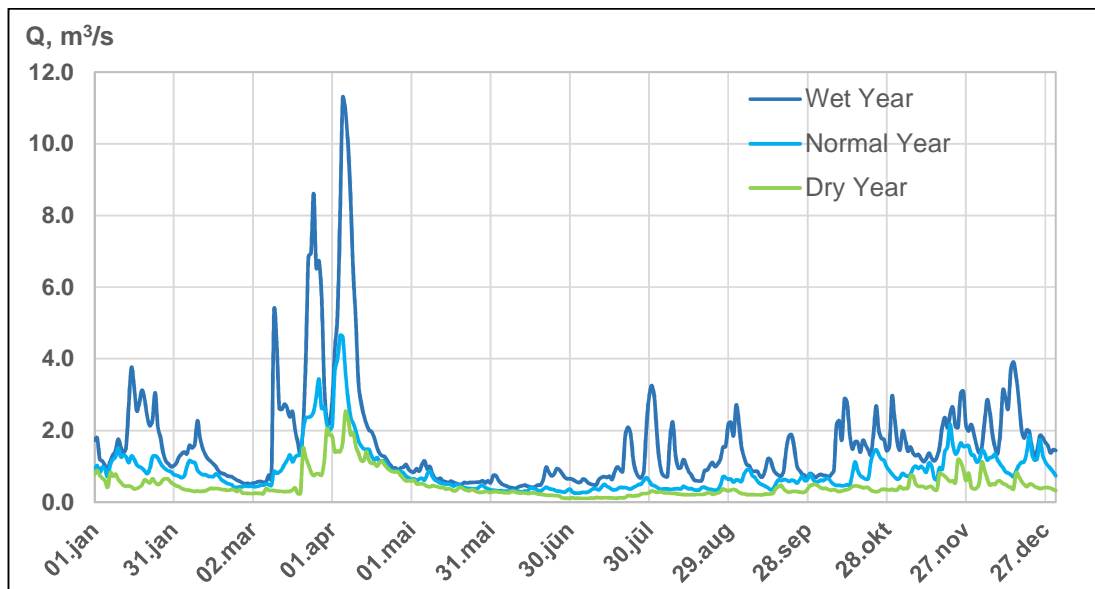
Underlying bedrock of the Ēda River catchment is mainly comprised of clay loam, sand clay and sand.

Riverbed substrate: cobbles, gravel and sand.

Fish: trout, grayling, pike, perch, roach and others.

There are 2 hydropower plants located in a stream: *Spīķu* HPP and *Šķēdes* HPP. *Spīķu* HPP is operated from 1997, it was constructed on already created reservoir. *Šķēdes* HPP is operated from 1999.

Hydrological regime of the Ēda River is characterized by spring flood, summer low flow and rainfall flood during autumn and winter seasons. Water runoff data of hydrological monitoring station 'Imula River, nearby Pilskalni' (catchment area 207 km<sup>2</sup>) for the periods 1961-1994 and 2009-2015 were used and analysed in creating hydrographs of the Ēda River upstream from *Spīķu* HPP (Fig. 6). During the period of 1995 to 2008 no monitoring was done.



**Figure 6. Hydrographs of Wet, Normal and Dry Years, Ēda River**

Hydrograph of Wet Year for Ēda River was prepared on the base of daily discharge data for 5 years with water runoff module coefficient 1.37-1.78. There are high spring floods from the beginning of March till early-May and rainfall floods from the end of July till December.

Hydrograph of Normal Year was created using daily discharge data for 9 years with runoff module coefficient 0.85-1.17. Spring flood in normal years lasts about 2 months (as in wet years) but rain floods are not so frequent - from mid-October till December.

Hydrograph of Dry Year is based on daily discharge data of 4 years with runoff module coefficient 0.48-0.75. The Dry Year is characterized by spring flood from the end of March till May, followed by low flow period, which in turn continues until late autumn almost without rains.

Data tables in Annex include daily discharge of Wet (Table 7), Normal (Table 8) and Dry (Table 9) Years for Ēda River.





**Table 2. Normal Year daily discharge (m<sup>3</sup>/s), Ciecere River – Pakuli HPP**

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	1.10	1.92	2.23	9.65	3.51	1.32	1.54	2.03	1.76	1.36	1.17	5.27
2	1.13	1.89	2.17	8.71	3.43	1.32	1.44	2.06	1.99	1.35	1.96	4.72
3	1.66	1.92	4.30	8.58	3.57	1.35	1.09	2.02	0.94	2.62	3.69	4.68
4	2.41	1.93	4.40	9.47	3.47	0.81	0.73	2.02	1.46	2.73	4.27	4.66
5	3.28	1.96	4.61	10.3	3.32	1.34	0.39	1.28	2.73	2.32	3.37	4.24
6	3.23	1.95	3.95	11.8	3.20	2.53	0.39	0.42	2.80	2.04	3.31	4.26
7	2.99	1.92	3.62	11.8	2.90	2.53	0.38	0.73	3.33	2.13	2.69	4.80
8	1.42	2.34	3.83	10.8	2.06	2.20	0.35	1.21	3.39	1.34	2.95	3.94
9	1.09	2.35	2.59	9.75	1.63	2.47	0.32	1.84	3.44	1.42	4.55	3.79
10	2.50	2.43	2.79	8.77	2.56	1.71	0.32	1.82	1.60	2.14	5.59	5.65
11	2.48	3.05	2.22	8.95	3.38	0.79	0.32	1.31	1.49	2.36	4.83	7.52
12	2.45	2.02	4.07	7.88	3.43	0.72	0.32	1.17	2.19	2.38	3.02	8.85
13	2.21	1.98	4.91	7.44	3.08	0.68	0.31	0.80	1.75	1.84	1.05	6.32
14	1.14	2.24	5.35	6.53	2.45	0.66	0.31	0.78	1.72	1.77	1.72	4.39
15	0.80	2.68	5.15	6.84	1.66	1.20	0.31	1.50	3.13	1.20	1.82	3.48
16	1.10	2.67	4.82	6.46	1.84	0.64	0.30	2.45	3.24	1.15	2.98	4.23
17	1.63	2.42	4.85	6.59	2.35	0.60	0.30	2.07	2.53	1.30	2.35	3.75
18	2.13	1.69	4.87	6.65	2.59	0.57	0.90	1.37	2.21	1.57	1.71	4.21
19	2.18	1.90	4.83	7.21	2.60	1.11	0.93	1.30	1.67	1.55	1.51	4.17
20	1.28	1.97	4.75	7.23	2.59	1.58	0.35	1.38	2.40	1.63	1.89	4.31
21	1.03	2.45	5.31	8.61	0.88	1.57	0.31	2.78	1.75	1.14	2.75	4.08
22	0.75	2.44	5.85	9.00	0.83	1.57	0.31	1.52	1.38	1.28	2.21	3.36
23	0.99	2.41	5.80	8.69	1.85	0.78	0.30	1.55	1.64	1.54	2.84	3.58
24	1.62	2.39	5.80	9.51	3.18	0.47	0.31	2.33	1.15	2.81	3.10	3.56
25	2.54	2.76	5.14	8.83	3.46	0.46	0.30	2.38	1.77	4.55	4.12	3.07
26	3.71	2.74	5.78	6.13	3.42	1.04	0.63	1.34	2.43	3.12	3.79	3.80
27	3.14	1.93	6.20	5.74	2.19	1.78	0.88	0.99	2.87	3.09	3.68	3.74
28	2.60	3.93	5.99	5.40	1.37	2.08	0.35	1.65	2.59	1.86	6.69	5.19
29	1.88		10.8	4.67	0.80	2.48	0.32	1.75	2.83	1.59	7.84	5.77
30	1.52		8.74	3.25	1.36	2.44	0.32	2.27	2.15	1.87	6.95	5.51
31	1.68		10.5		1.34		0.31	1.94		1.64		4.85



**Table 4. Wet Year daily discharge (m<sup>3</sup>/s), Vanka River – upstream Edole HPP**

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	1.74	1.03	0.94	2.12	0.72	0.37	0.32	0.93	0.81	0.71	2.00	2.23
2	1.68	1.13	1.03	2.16	0.70	0.37	0.29	0.78	0.89	0.85	2.00	2.00
3	1.64	1.23	1.14	2.06	0.65	0.40	0.28	0.59	0.85	0.97	2.08	2.02
4	1.86	1.32	1.17	1.98	0.63	0.41	0.27	0.45	0.77	1.09	2.08	2.19
5	2.00	1.39	1.17	1.91	0.65	0.33	0.25	0.42	0.67	1.10	2.00	2.44
6	2.03	1.39	1.17	1.71	0.66	0.31	0.25	0.39	0.61	1.13	1.91	2.42
7	2.15	1.18	1.13	1.55	0.73	0.29	0.24	0.37	0.59	1.17	1.80	2.11
8	2.24	1.23	1.13	1.48	0.68	0.29	0.23	0.36	0.53	1.20	1.70	1.91
9	2.20	1.47	1.29	1.39	0.60	0.28	0.24	0.36	0.49	1.30	1.63	1.81
10	2.11	1.57	1.37	1.26	0.53	0.27	0.24	0.35	0.48	1.41	1.66	2.01
11	2.07	1.42	1.42	1.16	0.51	0.26	0.23	0.38	0.47	1.54	1.64	2.30
12	2.31	1.10	1.59	1.10	0.50	0.25	0.22	0.40	0.46	1.60	1.53	2.36
13	2.63	0.95	1.67	1.03	0.48	0.25	0.22	0.42	0.47	1.69	1.48	2.20
14	2.72	0.90	1.53	0.98	0.46	0.25	0.22	0.42	0.48	1.72	1.51	2.12
15	2.49	0.86	1.44	0.93	0.46	0.24	0.24	0.41	0.48	1.60	1.68	2.11
16	2.21	0.79	1.36	0.88	0.52	0.26	0.29	0.39	0.49	1.57	1.91	1.97
17	1.95	0.68	1.26	0.83	0.55	0.27	0.37	0.38	0.52	1.52	1.97	1.89
18	1.90	0.68	1.19	0.78	0.48	0.27	0.43	0.39	0.56	1.43	2.07	1.67
19	1.93	0.66	1.24	0.76	0.42	0.28	0.50	0.40	0.69	1.34	2.22	1.52
20	1.85	0.69	1.33	0.85	0.40	0.30	0.54	0.43	0.77	1.32	2.34	1.52
21	1.86	0.74	1.58	0.93	0.39	0.38	0.55	0.47	0.91	1.31	2.28	1.55
22	1.83	0.71	1.86	0.87	0.38	0.39	0.52	0.47	1.06	1.34	1.95	1.55
23	1.65	0.80	2.25	0.84	0.37	0.34	0.55	0.49	1.09	1.35	1.66	1.56
24	1.43	1.09	2.30	0.82	0.40	0.35	0.55	0.50	1.06	1.47	1.62	1.83
25	1.46	1.32	2.10	0.78	0.41	0.48	0.52	0.55	0.97	1.64	1.69	2.12
26	1.58	1.33	1.82	0.75	0.41	0.62	0.45	0.56	0.88	1.61	1.83	2.17
27	1.57	1.25	1.85	0.75	0.44	0.58	0.39	0.55	0.82	1.55	2.03	2.05
28	1.46	1.18	2.11	0.73	0.40	0.45	0.44	0.57	0.78	1.63	2.14	2.13
29	1.30		1.89	0.75	0.38	0.39	0.64	0.62	0.72	1.73	2.32	2.53
30	1.10		1.84	0.76	0.37	0.34	0.81	0.69	0.69	1.84	2.42	2.46
31	1.01		2.01		0.38		0.98	0.71		2.02		2.24







**Table 8. Normal Year daily discharge (m<sup>3</sup>/s), Ēda River – upstream from Spīķu HPP**

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1	0.90	0.75	0.45	2.13	0.62	0.34	0.28	0.46	0.62	0.57	0.64	1.13
2	1.02	0.72	0.44	3.65	0.65	0.33	0.26	0.42	0.61	0.57	0.69	1.17
3	0.83	0.69	0.44	3.98	0.60	0.31	0.25	0.37	0.58	0.62	0.80	1.45
4	0.99	0.74	0.45	4.65	0.65	0.33	0.26	0.37	0.79	0.60	0.75	1.38
5	0.91	0.99	0.47	4.61	0.67	0.31	0.28	0.37	0.89	0.66	0.73	1.18
6	0.71	1.16	0.48	3.69	0.62	0.31	0.27	0.37	0.92	0.66	0.78	1.24
7	1.05	1.12	0.51	2.89	0.78	0.31	0.29	0.36	0.75	0.56	0.95	1.26
8	1.19	1.10	0.49	2.37	0.87	0.33	0.33	0.37	0.70	0.50	1.01	1.34
9	1.27	0.90	0.47	2.20	0.72	0.33	0.38	0.37	0.60	0.47	0.95	1.17
10	1.51	0.82	0.86	1.98	0.62	0.31	0.37	0.38	0.52	0.48	1.00	1.06
11	1.26	0.77	0.81	1.71	0.58	0.30	0.35	0.37	0.49	0.46	0.93	0.96
12	1.32	0.77	0.84	1.57	0.53	0.28	0.42	0.44	0.45	0.47	0.84	0.85
13	1.27	0.73	0.93	1.49	0.52	0.31	0.50	0.41	0.40	0.49	1.10	0.81
14	1.11	0.72	1.06	1.47	0.50	0.31	0.45	0.37	0.35	0.48	1.01	0.77
15	1.29	0.72	1.18	1.47	0.51	0.40	0.41	0.38	0.38	0.78	0.67	0.72
16	1.21	0.79	1.32	1.29	0.49	0.39	0.35	0.35	0.51	1.12	0.64	0.88
17	1.05	0.74	1.13	1.18	0.45	0.38	0.34	0.34	0.62	0.88	0.96	1.03
18	0.99	0.63	1.26	1.24	0.49	0.32	0.37	0.34	0.60	0.74	0.92	1.11
19	0.95	0.58	1.31	1.14	0.49	0.31	0.41	0.41	0.63	0.69	1.41	1.13
20	0.87	0.54	1.33	1.15	0.44	0.37	0.41	0.42	0.62	0.65	1.55	1.40
21	0.80	0.51	1.99	1.14	0.41	0.42	0.41	0.38	0.58	0.66	2.17	1.85
22	0.95	0.49	2.35	1.02	0.40	0.38	0.38	0.36	0.62	1.13	1.62	1.34
23	1.27	0.41	2.37	0.91	0.38	0.36	0.37	0.35	0.60	1.37	1.35	1.18
24	1.30	0.42	2.40	0.88	0.38	0.35	0.41	0.34	0.53	1.47	1.44	1.22
25	1.24	0.42	2.54	0.88	0.37	0.31	0.45	0.35	0.62	1.33	1.65	1.74
26	1.09	0.43	2.93	0.87	0.38	0.31	0.49	0.48	0.73	1.20	1.56	1.34
27	0.98	0.46	3.43	0.86	0.45	0.29	0.51	0.71	0.60	1.16	1.57	1.14
28	0.92	0.44	2.62	0.81	0.47	0.28	0.61	0.68	0.64	0.98	1.57	1.02
29	0.87		2.66	0.72	0.41	0.33	0.69	0.64	0.79	0.88	1.33	0.95
30	0.86		2.18	0.68	0.37	0.37	0.60	0.65	0.65	0.79	1.31	0.85
31	0.77		2.01		0.34		0.49	0.56		0.71		0.74

