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TECHNICAL PLAN FOR THE CONSTRUCTION OF A WATER RESERVOIR ON THE RIVER TUR BEFORE THE FIRST WORLD WAR AND ESTABLISHMENT OF A HYDROMETRIC NETWORK FOR HYDROLOGICAL STUDIES

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ABSTRACT. In the middle of the 19th century, comprehensive river regulation and flood control works began on the entire lowland section of the Tisza/Tisa River. Soon, a number of water development plans were made for the catchment area of one of the tributaries, the River Túr/Tur. Plans outlining several technical alternatives have been prepared for the purpose of flood drainage, inland water drainage and water utilization. The implementation of the plans took place over decades, with construction started in 1914 interrupted due to the outbreak of World War I (Túr-Tisza branch channel). Most of the water facilities in the lower Hungarian section of the Túr River were built between 1926 and 1930 according to revised plans. The flood defense embankments on the Romanian river section were built in 1956-1957 and were further developed after the catastrophic floods of 1970, with half a dozen pumping stations set up to transfer the inland waters to the receiving area. Between 1972 and 1974, the Călinești-Oaș dam and water reservoir were built. In our paper we describe the technical plans developed by the River Engineering Office in Szatmárnémeti (Satu Mare) at the end of the 19th century and the beginning of the 20th century for the regulation of the Túr river. We present the findings of the technical review of the plan and the calculations made for the water supply of the reservoir. We describe the development of the hydrometric network necessary for the foundation of hydrological calculations. When writing the paper, we used the technical documentation in the Upper Tisza Region Water Historical Collection in Nyíregyháza, which has not been published so far.

Keywords: river regulation planning, flood control, inland water management, water reservoir, hydrometric network.

1. INTRODUCTION

The inland water bay of the Tisza-Szamosköz/the area between Tisa and Somes (5,250 km^2) stretched from the ridge of the Avas/Oaș Mountains to the floodplain of the rivers Tisza and Szamos/Someș, with the valley of the river Túr/Tur in the middle. Until 1920, the Túr flowed into the Tisza near Olcsvaapáti, winding through extensive

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forests, with a further branch reaching the Tisza at Nagyar. In this time, floodwaters covered a significant part of the floodplain several times almost every year.

The floods in the Tisza-Szamosköz area came not only from the Túr river, but also from the Tisza and Szamos, and even from the Tisza in Batár/Batar, where there was also no embankment (Nyárády, 1908).

There was a period when the river Túr flooded 30 times in 12 months and oxen caught in a boat in the Palád area were used for transport (Schick, 1932).

Without technical interventions, the development of agriculture, traffic and transportation of freight could not be achieved.

2. THE FIRST WATER WORKS AND WATER REGULATION PLANS

The water conditions of the Tisza-Szamosköz were affected by the construction of embankments between 1770 and 1774, when the unconnected dams were linked from Tiszabecs to Szatmárcseke and from Berence/Băbăşeşti to Szamossályi.

However, these embankments, with their low height, did not provide protection even against moderate floods and ruptured in several places during floods. Between 1864 and 1896, 19 floods on the right bank of the Szamos caused dam ruptures in 62 places (Vázsonyi, 1959).

Founded in 1871, the area of operation of the Szatmár Hungarian Royal River Engineering Office was the section of the Upper Tisza above Eszeny-Zsurk (138.5 km), as well as the lower section of the rivers Szamos (206 km) and Kraszna/Crasna (78 km), Latorca/Latorița (57 km), within Szatmár, Bereg, Ugocsa counties covered. The Szatmárnémeti/Satu Mare head office moved to Vásárosnamény from 1878, where it remained for 11 years, then between 1889 - 1920 again back in Szatmárnémeti (Konecsny, 2021a). The first version of the regulatory plan for Szatmár County was prepared at the office in 1879, but this did not include the quantities of water to be discharged.

The general plan developed in 1885 included the regulation of the Túr, Turc/Turț and Batár riverbeds, the construction of embankments and the management of inland waterways, but due to the high costs the landowners effected in the area did not undertake the transformation into a company and the execution of works (Nyárády, 1908).

It was then that the idea of building a flood emergency reservoir to be built in Túr was first raised above the Sárköz/Livada – Adorján/Adrian line (Fazekas, 2016).

3. THE 1907 PLAN PREPARED BY THE SZATMÁR OFFICE OF RIVER ENGINEERING FOR THE WATER MANAGEMENT OF TISZA-SZAMOSKÖZ

In May 1907, László Nyárády (1854-1927) royal chief engineer, who was between 1899-1910 head of the Szatmár River Engineering Office, prepared the technical design documentation of the regulation of the Tisza-Szamosközi (Konecsny, 2021b)

assisted by royal engineer Győző Kövessy (1861-1938). The plan included technical descriptions, site drawings, longitudinal sections and cross sections. The 119 page technical description is divided into the following chapters: Introduction, I Regulation of external waters, II Inland water management and III Flood control.

According to Chapter I on the regulation of external waters (pages 6-38), the Túr and Batár riverbeds feeding the Tisza-Szamosköz must be regulated so that they pass through the area without spillage. Three plan variants have been developed to reduce the flood runoff of the Túr: A.) Construction of the Szamos-Túr canal (water transport 164 m^3s^{-1}); B.) Construction of the Tisza-Túr canal (water transport 193 m^3s^{-1}); C.) Construction of a valley dam and reservoir (250 million m^3) under the mouth of the Túr Tálna/Talna to regulate the amount of runoff (Fig. 1.).

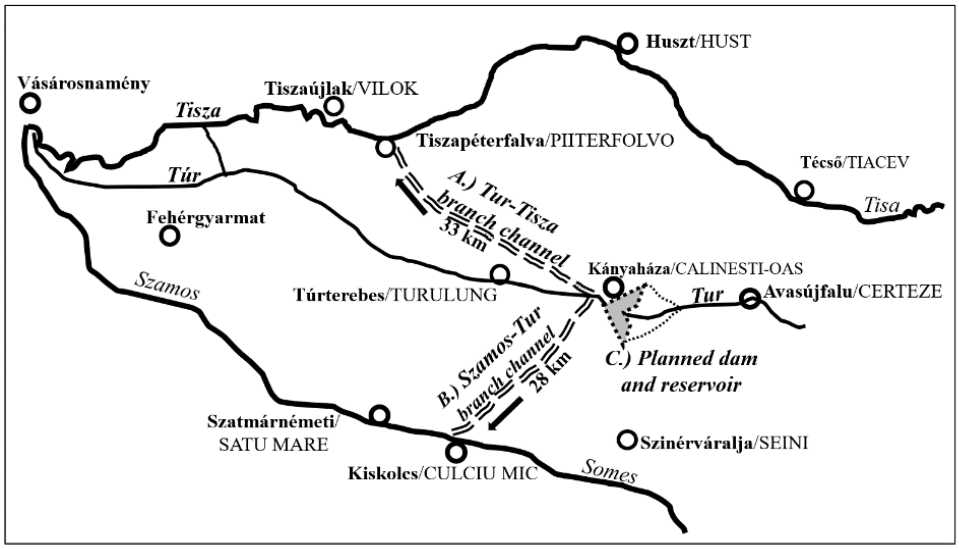

Fig. 1. Three versions of the 1907 Tisza-Szamosköz water management plan of the Szatmár River Engineering Office (A, B. C)

A II. The chapter entitled Inland Water Management - the largest part of the technical description, nearly 50 pages (pages 38-86) - deals with inland water management, which is planned to be solved with three sewer systems using existing valleys and the construction of the Sonkád water distribution plant. In the case of the construction of the Tisza-Túr canal, the main canals, the Szamos-Túrközi main canal, the Túrvölgy main canal, the Tisza-Szamoszugi main canal.

A III. The flood control chapter (pages 87-111) bases the flood control of the Tisza-Szamosköz on the construction of the Szamos right bank and the Tisza left bank embankment. It planned to improve water conditions through the coordinated management of external and inland waters after the construction of these facilities.

The following sequence is proposed for the execution of the plans: 1.) Construction of the Tisza-Túr canal; 2.) Construction of flood relief embankments at the Tisza estuary; 3.) Construction of the Szamos-Túr interfluvial main canal and the Túrvölgy main canal; 4.) Construction of an estuary lock in the Tisza-Szamos-

zugi system, finally the construction of tributary canals (Nyárády, 1907, in Konecsny, 2021b).

According to the plan variant marked I. C.), the elimination of the damage caused by external waters by valley dams can only be considered in the valley of Túr, because there are no valley sections suitable for storage along the other watercourses. A dam can be built a few km below the confluence of the Tálna and Túr, the height of which must be determined in such a way that it does not reach the inner area of the village of Avasújváros/Orașu Nou, which is 148 m high in the Tálna Valley. The section of the valley northeast of the village of Adorján (Pusztahegy) was considered suitable for the construction of a barrier. In this case, the reservoir area would have been 7,000 acres (40,000,000 m^2).

The designers used precipitation data to calculate the amount of water entering the reservoir. The relevant meteorological station of Nagybánya/Baia Mare, recorded a 10-year average precipitation of 1015 mm for 1895-1904. It is 331 mm larger then the average in 1895 and 248 mm smaller in 1904. Assuming that 2/3 of the 1015 mm precipitation flows from the catchment, the average water flow is 14 m^3s^{-1}, which increases to 18 m^3s^{-1} (30% up) in a rainy year and to 11 m^3s^{-1} in a dry year. (24% down). These discharges can be drained to the Túr riverbed without damage.

In an unfavorable case, 664 mm of precipitation may fall in the December-April period, and 280 million m^3 of water may flow out of this catchment area. After deducting the 31 million m^3 of water flowing in the December-February period, 250 million m^3 of water must be stored in the reservoir in April. For this a water height of 15 m must be ensured, so a 15 m high, 6 m wide crown dam must be built. 250 million m^3 of water must be stored in the storage area in April. The dam requires the installation of 2.33 million m^3 of material. The plan includes a calculation of the cost of building the dam and compensating landowners for 7,000 acres. The total amount of the investment is estimated at 14 million crowns. Due to the high cost, it is concluded that the interested party cannot afford this, it is more favorable to build a canal to the excess water on the Adorján-Berence/Băbășești line towards Szamos or towards Gyula/Diula-Péterfalva/Piiterfolvo towards the Tisza (Nyárády, 1907, in Konecsny, 2021b).

4. TECHNICAL OPINION OF THE NATIONAL HYDRAULIC ENGINERING DIRECTORATE (1907)

The regulatory plan of the Tisza-Szamosköz was submitted by the Szatmárnémeti River Engineering Office to the National Hydraulic Engineering Directorate (Országos Vízépítési Igazgatóság / OVI) on June 30, 1907 for approval. Here, renowned experts, engineers Ödön Bogdánfy and Ede Viczián commented. The original handwritten expert opinions can be found in the Historical Collection of Water Management in the Upper Tisza Region Nyíregyháza (Konecsny, 2021b)

On October 1, 1907, Ödön Bogdánfy (1863-1944) examined the regulatory plan of Tisza-Szamosköz and gave a positive opinion on it. He stated that the plan fully examined the water management of the Tisza-Szamosköz, covering all modes of water management. According to him, the regulation of external waters by storage, which is very expensive, should be abandoned. He recommended the drainage of the outer waters of the area into the Tisza at the foot of the mountains, separating them from the inland waters, which should be drained in old riverbeds and small watercourse vessels (Konecsny, 2021b).

Ede Viczián (1872-1931) attached technical calculations, tables, graphs, site drawings a virtual engineering study to his professional opinion supporting the storage on December 21, 1907, and suggested that further investigations are to be done (Konecsny, 2021b).

Viczián considered the calculation that 250 million m^3 of water would be needed to contain the floods to be excessive. He thought it likely that a storage capacity of 60-80 million m^3 is sufficient. If, in the absence of detection data, the most unfavorable version of the water to be stored is used as a precaution, this will result in the calculation of more water than necessary and thus the cost estimate will be higher than necessary. In his view, "Floods are cheaper to drain but barren, flood retention is more expensive but profitable. Despite the higher investment, storage seems to be more advantageous." (Viczián, 1907).

He endorsed the designer's assumption that major floods are caused by the sudden melting of solid precipitation that accumulates during the winter. Snow accumulation begins as early as December and may even last in March. In order to determine the approximate amount of water to be stored, it is necessary to know the amount of precipitation in the months of December-April and the runoff.

In the upper part of the Túr catchment, in the Avas Mountains, in 1907 there were 3 precipitation measuring stations: Tartolc/Târșolț, Avasújfalu/Certeze, and Avasújváros. To replace the short 3-year data sets, he established a correlation between these and the nearby Huszt/Hust (25 years) and Nagybánya (33 years) stations with longer time series. Thus, he estimated the 25-year annual mean at 1,042 mm and the December-April mean at 359 mm.

Based on the measured data, it appeared that the precipitation in the upper catchment of the Túr was on average lower than in Huszt and Nagybánya, but from a safety point of view accepted the average values formed from the data of Huszt and Nagybánya for the Upper Túr (Table 1.). The highest precipitation in December-April occurred in 1888/1889, when the average value of Huszt-Nagybánya was 546 mm. Thus, as a maximum of 33 years, 546 mm was also taken into account for the Upper Túr (Viczián, 1907).

The daily water flow data required for the calculation of the runoff for the Tur were not yet available at that time. Thus, he determined the runoff rate characteristic of the winter-spring period by analogy, based on the data of the nearby Szernye/Serne stream, which has been studied by the OVI Hydrographic Department for years. Here snowmelt accounted for 55% of the December-April volume.

Table 1. Mean value of precipitation amounts (mm) in December-April at the upper catchment of the Tur and at the Nagybánya/Baia Mare and Huszt stations (Viczián, 1907)

Precipitation stations	1904/1905	1905/1906	1906/1907
Tartolc, Avasújfalu, Avasújváros average	247	266	402
Huszt, Nagybánya average	333	327	400
Ratio number	74 %	81%	100%

The 10 km long valley dam in the plan of the Szatmár River Engineering Office was drawn between the Pusztahegy and Muzsdaly mountains. Inspecting the catchment area above the valley dam, Ede Viczián found that it was 596 km^2 above the planned dam, less than the 650 km^2 in the Technical Description. according to the calculation in the case of the maximum winter-spring precipitation of 33 years, the spring flood wave of the Túr would have brought 179 million m^3 of water that must be accommodated in the reservoir.

He suggested relocating the location of the valley dam to the 450 m long line between the highlands above the mouth of the Túr Tálna, north of Kőszegremete/Remetea Oașului. The water of the Talna would have been led to the reservoir west of Vámfalu/Vama (Fig. 2.). Thus, the catchment area above the dam and diversion will be changed to 470 km^2, the volume of water to be stored to 142 million m^3 and 15 km^2 will be submerged at a water level of 162.60 mAf. In order to provide protection against surges, it was proposed to build the crown of the valley dam at a height of 164.00 mAf. The construction height of the dam must be 25 m on average. His proposal includes a 5 km long service water canal, at the end of which he planned to build a hydropower plant (Viczián, 1907).

Table 2 for the comparison of the design versions contains the data calculated by the Office, the data corrected by the OVI Hydrographic Department and the data of the design version of the Hydrographic Department.

Table 2. The layout and dimensions of the reservoir proposed by the Office of River Engineering and the OVI Department of Hydrography (Viczián, 1907, Kövessy 1912, in: Konecsny 2021)

Designer office	Dam closing the valley			Flooded area		Maximum water volume million m^3	Catchment area km^2	Comment
	hossza	magasság	térfogata					
	m	m	mill. m^3	km^2	k.hold			
Szatmár Office of River Engineering	9 900	3-15	3,33	40	7 000	250	650	Original data
	9 900	2-14	2,70	37	6 400	186	596	Corrected
OVI Hydr. Dep.	450	21	0,48	15	2 600	142	470	

According to the expert opinion of Ede Viczián, 69 m^3 of water storage would have been installed per 1 cubic meter of the dam designed by the Office, and 296 m^3 of water would have been allowed by the OVI, so the latter is 4 times more efficient. The catchment area of the Tisza-Túr canal is 992 km^2, of which the impact of the dam would be 470 km^2, the flooding of the 522 km^2 catchment area must be handled by a canal. The Office scaled the Tisza-Túr canal to a water flow of 193 m^{3}s^{-1}, but in the case of storage, a conductivity of 101 m^{3}s^{-1} is sufficient. He considered it necessary to carry out further hydrological and technical studies in order to prepare

reliable, detailed plans. He summarized the technical questions to be answered in 14 points. He considered it necessary to develop a network of precipitation meters, water meters and communications necessary for a more thorough exploration of the runoff, and to perform water flow measurements. Based on the results of the studies, it may be necessary to revise the plan (Viczián, 1907).

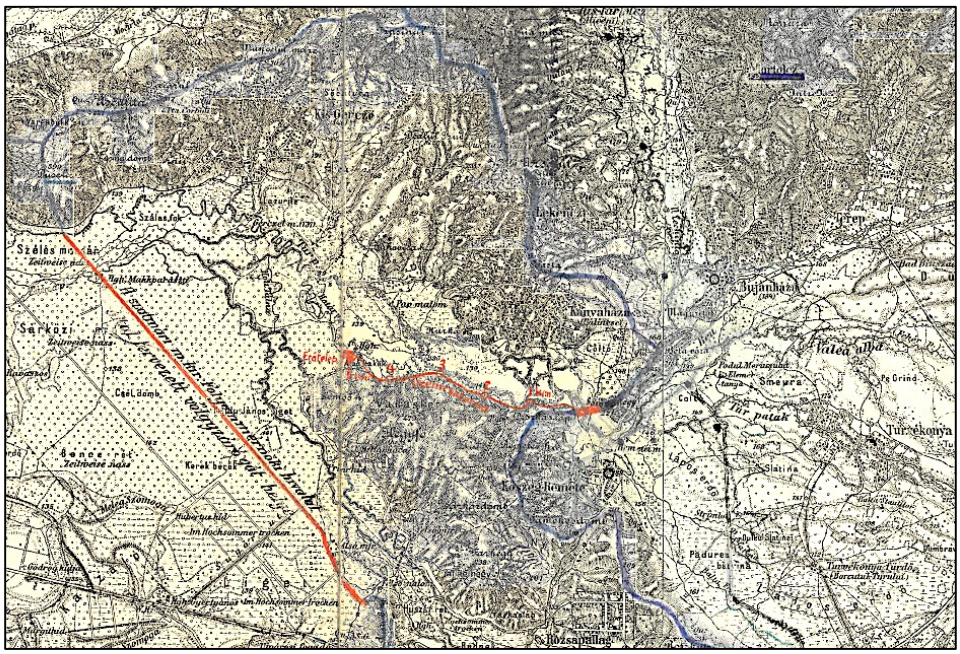

Fig. 2. Topography map with the two versions of the valley dam planned on Túr and the line of the service water canal, the location of the power plant (Viczián, 1907) it must be included in the reservoir space.

Outline of the valley dam in the draft of the Office of River Engineering (thin red line on the left); in the proposal of the OVI (short thick red line on the right); the service water channel (red line with 1-5 digits) and the location of the power plant (red inscription); watershed (blue line)

5. DEVELOPMENT AND MEASUREMENT RESULTS OF THE HYDRAULIC OBSERVATION NETWORK SINCE 1908

In 1900, there were only two regular rainfall monitoring stations in the Upper River catchment area, one at Avasújváros and another at Turc. At that time, no hydrographic observations had been made. In the adjacent catchments, at a relatively short distance from the Túr valley, a further 5 stations collected precipitation data, of which Szinyérváralja/Seini and Bustyaháza/Bustino are located very close to the catchment. The latter and three more distant stations (Huszt, Nagybánya, Szatmárnémeti/Satu Mare) were daily telegraph stations. In 1904, the

Avasújfalu/Certeze and Tartolc precipitation measuring stations began work, joined in 1905 by the Túrterebes/Turulung precipitation measuring station. The plans for 1907 performed the runoff calculations on the basis of the three-year (1904-1906) precipitation data of Avasújváros, Avasújfalu and Tartolc, as well as the data of the Huszt and Nagybánya stations with a long data series. Before the finalization of the technical plans, in 1911, two more precipitation measuring stations started operating in the catchment area, Vámfalu/Vama and Kányaháza/Călinești Oaș, and adjacent to the Batarcs/Bătarci catchment area (Table 3.).

It was important for the design that in the years after 1907, until the work started in 1914, much higher than average (700-950 mm) precipitation was measured in 1912, around 1100-1300 mm. Thus e.g. 1272 mm in Avasújváros, 1321 mm in Avasújfalu and 1316 mm in Tartolc. The spring-early months were rainy, but so was the autumn. In 1913, the annual precipitation was lower (950-1150 mm), but July, had 4-5 times more than the annual average (Turc 415 mm, Avasújfalu 372 mm, Tartolc 363 mm). On July 26, the water level of the Tur River caused a peak.

At the Túr Túrterebes hydrographic station, the regular twice-daily water level observation was started in April 1909 at the water level installed at the 136.466 mAf "0" level. Observations were made in January-March and October-December at 8 am, then in the afternoon at 4 pm, in April-September at 7 am, and at 5 pm (Hydrographic Yearbooks, 1917-1919).

Table 3. In the Túr catchment area and nearby precipitation measuring stations (Hydrographic Yearbooks 1900-1916)

Station name 1907 / current	Geographical coordinates	Altitude (mAf)	County	Start of observations
Avasújváros/Orașu Nou	48°50' 23°17'	160	Szatmár	1900
Turc/Turț	48°00' 23°13'	171	Ugocsa	1900
Bustyaháza/Bustino	48°03' 23°28'	275	Máramaros	1900
Huszt/Hust	48°10' 23°18'	168	Máramaros	1900
Nagybánya/Baia Mare	47°38' 23°35'	227	Szatmár	1900
Szatmárnémeti/Satu Mare	47°48' 22°53'	123	Szatmár	1900
Szinyérváralja/Seini	47°45' 23°17'	145	Szatmár	1900
Halmi/Halmeu	47°59' 23°01'	128	Ugocsa	1903
Avasújfalu/Certeze	48°54' 23°28'	246	Szatmár	1904
Tartolc/Târșolț	47°57' 23°21'	172	Szatmár	1904
Turterebes/Turulung	47°56' 23°05'	133	Ugocsa	1905
Vámfalu/Vama	47°50' 23°24'	189	Szatmár	1911
Kányaháza/Călinești Oaș	47°55' 23°17'	202	Szatmár	1911
Batarcs/Bătarci	48°02' 23°09'	173	Ugocsa	1911

Until 1916 the OVI, published independent annual hydrographic yearbooks, however data of stations for 1917-1923 were published in a volume in 1924. Unfortunately, the data of the Túr Túrterebes water meter were not published in this book – similarly to the other stations that were now over the new state border. Therefore the 1917-1919 data was collected on the basis of the original monthly water level reports filled in by the observers found in the Budapest Archives of Environment and Water Management (Water level reports, 1917-1919).

Table 4. Monthly and annual multi-year water levels of the Túr Túrterebes in the years 1909-1919 (Hydrographic Yearbooks 1900-1916, Water level reports, 1917-1919)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
H_{min}	28	26	28	30	26	24	21	18	23	23	22	23	18
Dátum	1918	1917	1910	1914	1915	1915	1917	1914	1913	1917	1911	1914	1914
H_{med}	**103**	**89**	**135**	**108**	**70**	**48**	**76**	**58**	**57**	**52**	**84**	**111**	**81**
H_{max}	336	342	340	367	335	332	400	307	323	320	322	350	400
Dátum	1915	1912	1915	1912	1912	1912	1913	1913	1912	1915	1912	1915	1913

H_{min} – minimum water level; H_{med} - medium water level; H_{max} - maximum water level

Based on the data series, the average water level for many years (1909-1919) is 81 cm, the maximum is 400 cm on November 11, 1913, and the minimum is 18 cm on July 7, 1914. So in 10 years, the biggest difference between the maximum and many years of minimum water level was 382 cm (Table 4., Fig. 3., Fig. 4.).

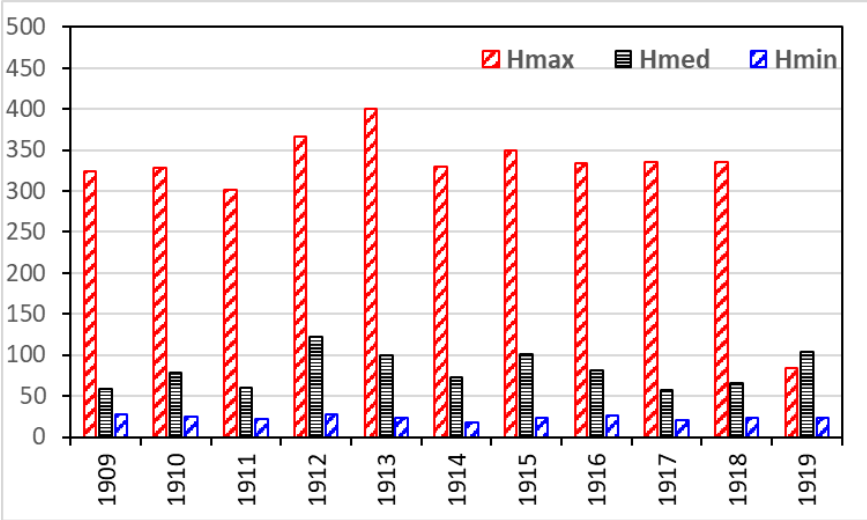

Fig. 3. Túr Túrterebes hydrographic station annual characteristic perennial water levels in 1909-1919 (data from hydrographic yearbooks and water level reports)

The Szatmár Office of the River Engineer carried out four water discharge measurements at the road bridge at Túr Túrterebes in May 1902 (19th, 20th, 21st and 22nd). At the maximum water level observed at that time, a water flow of 102 m^3s^{-1} was measured. The small water flow of the Túr was 0.5 m^3s^{-1} on August 5, 1905, and its high water discharge in the month of June 1884 reached 130 m^3/s at the confluence of the Túr and Tálna.

Based on the rainfall and water level data of 1907-1912, the Hydrographic Department of the OVI prepared a runoff study to establish the possibility of storage. The 1912 plan for the reservoir already contains a much smaller value of 250 million m^3 calculated in 1907 by the Office and 142 million m^3, according to Ede Viczián's conservative estimate.

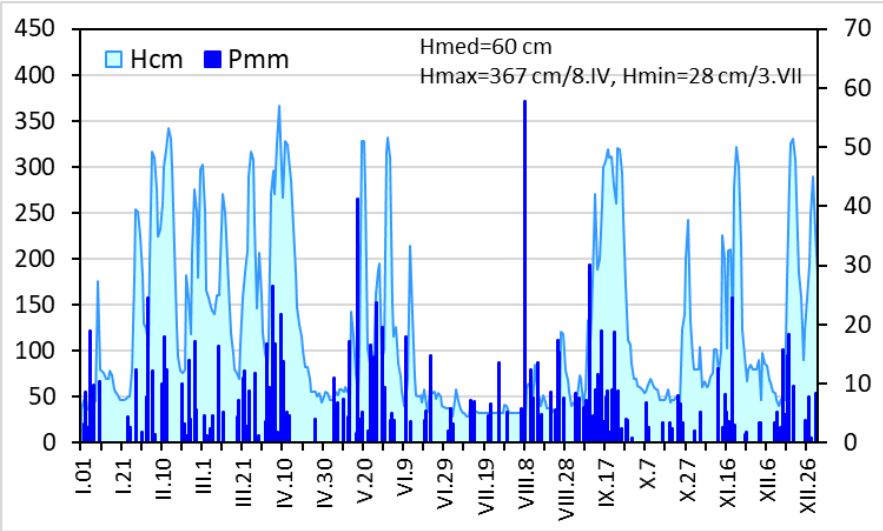

Fig. 4. Daily water levels of Túr Túrterebes/Turulung in the typically high water year of 1912 and daily precipitation at Avasújfalu (own compilation based on the data of the 1912 hydrographic yearbook)

6. THE TISZA-SZAMOSKÖZ PLAN ADOPTED IN 1912

An amended version of the 1907 plan containing three alternative proposals was prepared by the Szatmár River Engineering Office in 1912, and the National Hydraulic Engineering Directorate (OVI) of Budapest found this plan suitable for implementation.

Győző Kövessy, representing the Szatmár River Engineering Office, summarized the content of the last version of the plan for the water management of the area on page 9 under the title "Description of the water management project of the Tisza-Szamosköz" in 1912. They were looking for a solution that would ensure the free flow of inland waters into the Túr Valley without damage, in addition to excluding floods. They were looking for a solution that would ensure the free flow of inland waters into the Túr Valley without damage, in addition to excluding floods. The design variants already described above are: I. the Szamos Túr canal; a II. Tisza Túr canal; III. Storage system. Regarding the storage plans, he mentions that a reservoir capable of receiving 50 million m^3 of water would be built in the upper section of the Tur, or alternatively, a storage capacity of 90 million m^3, which would also make it possible to provide irrigation water. Analyzing the advantages and disadvantages, he concludes that the construction of the reservoir is not recommended. According to his reasoning, on the one hand, this does not completely solve the flood reduction and thus an embankment must be built along the Túr, which hinders the free introduction of inland waters. On the other hand, it does not allow the floods of the Turc and Hodos streams to be drained. Thirdly, the costs of reservoir construction are higher than I and II. version construction costs. It is also a problem for him that

the dam will have to be built on a gravel subsoil in the absence of a rock foundation, which is unsafe at a pressure of a 13 m high water column. However, he finds that drainage of external waters alone is not efficient without inland water management. In both cases, the Office has planned 3 main canals for the drainage of inland waters, while the route of the secondary canals can be determined after the exact topography. It also estimates the construction costs of each design variant and states that securing the costs of the works can be done by establishing a company (Kövessy, 1912, in Konecsny, 2021).

7. MAINTENACE SOCIETY TO REGULATORY ASSOCIATION IN TISZA-SZAMOSKÖZ

After the floods of 1912 and 1913, the Szamos-right and Tisza-left bank Embankment Maintenance Society realized that the solution of the flood relief could not be delayed any longer. The Minister of Agriculture granted discounts to the company that might be formed. He submitted a legislative proposal, the aim of which, in addition to flood control and the regulation of inland waters, was to provide income for the population affected by the floods (Fejér, 2010)

On January 11, 1914, the Tisza-Szamosközi Flood Control and Inland Water Regulatory Association (Tisza-Szamosközi Ármentesítő és Belvízszabályozó Társulat), operating over an area of 273,000 acres (118,000 hectare), was established in Szatmárnémeti as the legal successor of the Szamos right and Tisza-left bank Embankment Maintenance Society. Its task was to unify the floodplain of the Tisza-Szamos-köz, to regulate the rivers Túr, Batár and Turc flowing into the floodplain and to drain the inland waters. It intended to complete the implementation of the floodplain development and the construction of the main canals by the end of 1917. Landowner Baron Zsigmond Kende, was elected president of the association, and László Nyárády, ministerial department councillor, was invited as director.

8. WATER WORK CARRIED OUT UNTIL THE END OF WORLD WAR I

The Tisza-Szamosközi Flood Removal and Inland Water Regulatory Association started the construction works ont he Tiszai-Túr canal in the summer of 1914 under the direction of the construction manager Károly Bodnár.

As a result of the outbreak of World War I on July 28, 1914, the association had considerable financial difficulties and some of its employees were assigned to military service from the autumn of 1914. In order to alleviate the labor shortage, on January 29, 1915, the government arranged for the transfer of 4,000 Russian prisoners of war to continue the work begun by the association. Prisoners of war were employed on constructions started on the 0-4260 m section of the Tisza-Túr canal, on the route of the canal with a bottom width of 13 m and a depth of 5.5 m (Fejér, 2010). Prisoners were paid for their work (Fazekas, 2016).

In 1917, they also worked on the embankments between Panyola and Olcsvaapáti and on the border sections of Szamosszeg, as well as on the Gőgő-Szenke canal. The prisoners of war left the company camps on April 23, 1918, according to the minutes of the Association Electoral and General Assembly of June 5, 1918.

At the final liquidation made on April 30, 1918, the association recorded a result of 475,426 m^3 work versus 1,270,823 crowns wages to prisoners.

Following the Treaty of Trianon, which came into force on July 31, 1921, and the establishment of new borders, the Society's area of operation was divided between three countries (Hungary 56%, Romania 34%, and Czechoslovakia 10%) (Vázsonyi, 1959). The lower 4.5 km long section of the Tisza-Túr canal, built during the war years, now belonged to Czechoslovakia (currently Ukrainian territory).

The water regulation works carried out between 1926 and 1930 covered the Hungarian section of the Túr. The Túr, formed after the regulation, flows into the Tisza in a new dug canal from the Sonkád divider. An 11.5 km long new riverbed was built from Sonkád to the new Tisza entrance, the shortening here is 52 km. The section of the river above the Sonkád was shortened by 12 cuts to 18.5 km (Schick, 1932, Slavik, 2014).

In 1957 the embankment on the Romanian stretch of the River Tur was completed, which prevented flooding. The Călineşti-Oaş dam and reservoir were built between 1971 and 1973 (completed in 1979) according to the plans of the Institute for Studies and Design for Land Improvoment (ISPIF) in Bucharest. The water facilities on the Tur River were built higher up than in the plans of 1907 and 1912, respectively, so the reservoir also had a smaller catchment area (359 km^2) and a storage capacity (30 million m^3). The length of the valley dam is 798 m, its height is 9.5 m, and the flooded area is 3.51 km^2.
(https://www.scrigroup.com/geografie/hidrologie/Acumulare-permanenta-Calinesti71532.php).

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