# River Rioni and sediment management process of reservoir Rion Hpp

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**DOI: https://doi.org/10.52340/building.2025.71.07**

**Abstract.** In 1927, construction of the Rioni Hydroelectric Power Plant began on the Rioni River near Kutaisi.The article discusses the construction processes of the Rioni hydroelectric dam and hydropower station, as well as the problems associated with it. The processes of sediment formation at the Rioni hydroelectric power station and the associated problems of hydroelectric power station operation are studied. The paper presents data from field observations and measurements during the process of dredging and flushing of the reservoir.

**Key words:** Low-threshold reinforced concrete dam, Output channel, sediment management of reservoir, Washing the reservoir.

## 1. Introduction

The program for the construction of the Rion Hydroelectric Power Station was extremely difficult for Georgia at that time, but feasible, since Georgian engineers had the necessary education for the construction of the Hydroelectric Power Plant. Today, the Rioni Hydroelectric Power Plant is truly a unique structure in all respects. The Rioni Hydroelectric Power Station on the Rioni River is a well-designed and technically reliable station. The construction of this complex was carried out under very difficult and challenging conditions. On September 30, 1933, the Rioni Hydroelectric Power Station provided our republic with its first electric power, and on July 30, 1934, all four hydroelectric generators of the Rioni Hydroelectric Power Station began operating at full capacity.

## Main part

Rioni is a river in western Georgia. Length 327 km, river basin area 13400 km2. It has its source on the southern slope of the Caucasus on Mount Fasi, 2960 m above sea level. It flows into the Black Sea. Below Kutaisi the river enters the Colchis plain, forms a transverse channel, swells and forms islands. The Figure 1 shows the average annual discharge of the Rioni River.

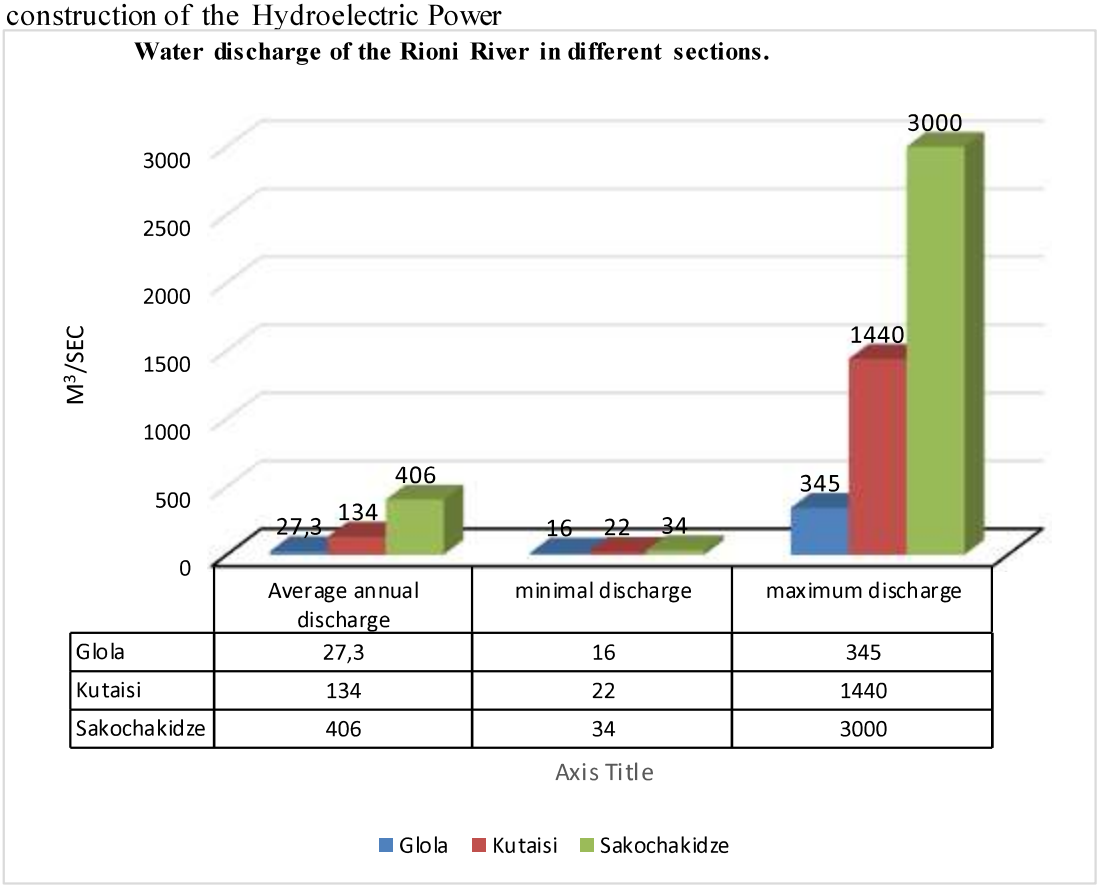


**Fig. 1 average annual discharge of the Rioni River.**

The Figure 2 shows the water discharge of the Rioni river to seasonality of the year

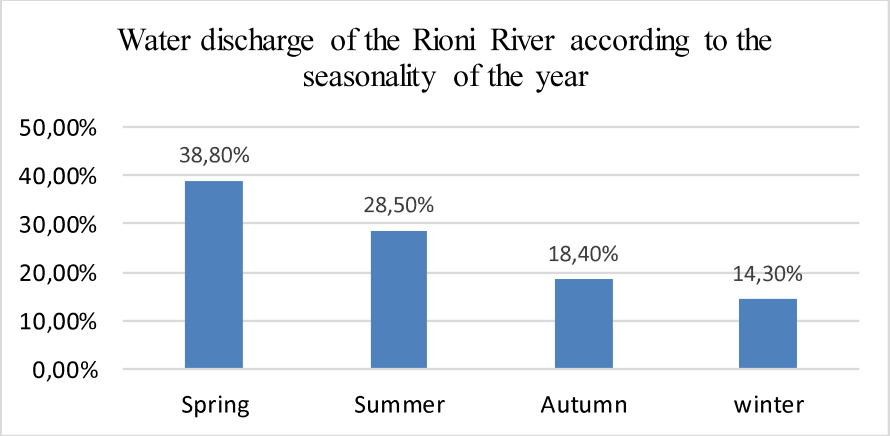


**Fig. 2 discharge of the Rioni river to seasonality of the year**

The Figure 3 shows the water discharge of the Rioni river to nutrient sources components.

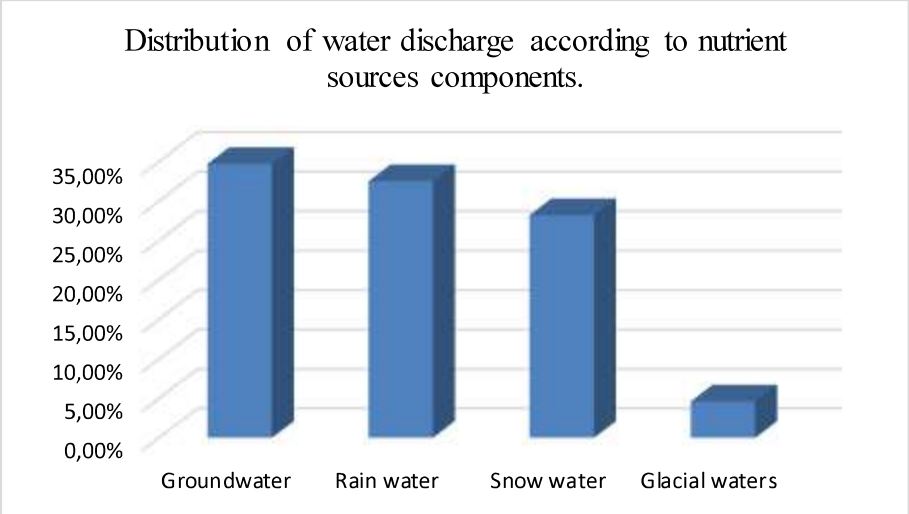


**Fig. 3 Distribution of water discharge according to nutrient sources components.**

Rioni annually discharges 12.9 km3 of water and a large amount of solid runoff into the Black Sea. The average annual amount of solid runoff increases from the source to the confluence: at the village of Ghebi it is 96 thousand tons, at Khidikar — 2.2 million tons, at the village of Namakhvani — 4.9 million tons, at Sakochakidze — 6.9 million tons.

In table 1 shows Rioni River bottom and floating sediment data for 1985.

**Table 1.**

| № | Year of observation | water metering station of River Rioni | Catchment area, F km² | transported material, thousand tons | The module of transported material, t/m³ |
|---|---|---|---|---|---|
| 1 | 1985 | Village Utsera | 707 | 190 | 270 |
| | | City Oni | 1060 | 310 | 1060 |
| | | Village Khidikari | 2010 | 850 | 420 |
| | | Village Alpana | 2830 | 910 | 320 |
| | | Village Namakhvani | 3450 | 1900 | 550 |
| | | Village Sakochakidze | 13300 | 4700 | 350 |
| | | City Poti Northern Branch | 13400 | 6600 | 490 |
| | | City Poti Southern Branch | 13400 | - | - |

| | | | | | |
|---|---|---|---|---|---|
| | | River Lajanuri Village Orbeli | 231 | 91 | 390 |
| | | River Kvirila city Zestaponi | 2490 | 600 | 240 |
| | | River Dzirula | 1190 | 230 | 190 |

Rioni Hydroelectric Power Plant (Rioni HPP) is a hydroelectric power plant in Georgia, on the Rioni River, near the city of Kutaisi. It is part of the Rioni Hydroelectric Power Plant Cascade and is its fourth stage.

Structurally, it is a typical diversion hydroelectric power plant with a head reservoir and a non-pressure diversion. The hydraulic scheme is based on the diversion of part of the Rioni River flow into the lower reaches of its tributary, the Kvirila River.

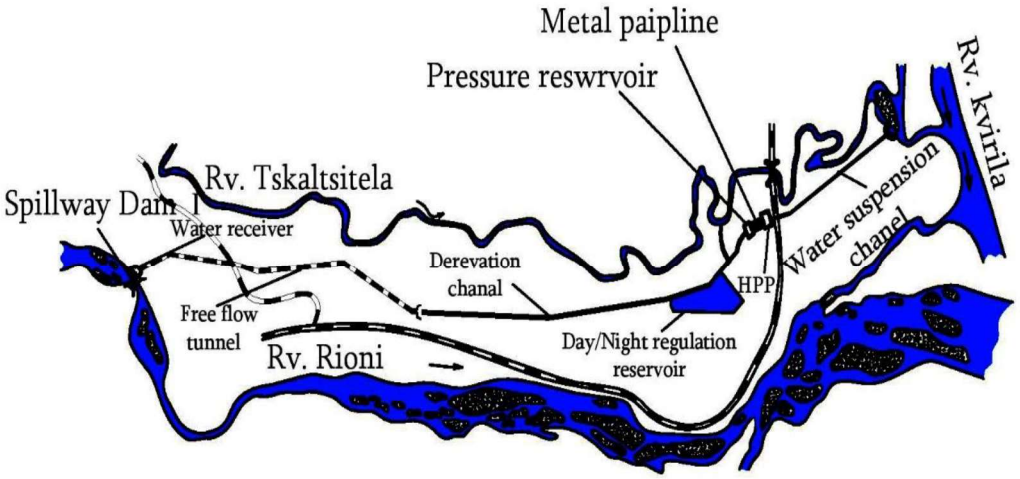


**Fig. 4. Scheme of the hydropower node of the Rioni River of hydroelectric power station.**

Embankment Water intake.

Diversion structure with a total length of approximately 9 km, including:

Gravity diversion tunnel with a length of 3927 m;

Diversion channel with a length of 5131 m.

Station node, including:

Pressure basin;

Four-thread pressure turbine water pipeline;

Hydropower plant building;

2.1 km long outlet channel into the Kvirila River;

35/110 kV switchgear.

Fig. 5. The upper reaches of the Rioni River are shown, which include: a concrete spillway dam with a siphon spillway, pontoon and flushing sluices, with a total length of 92.5 m. The dam is designed to pass 2600 m³/s of water and is equipped with four spillways, each 10.2 m wide, covered with flat gates. The siphon spillway has five main and one auxiliary spillways and is designed for a flow rate of up to 80 m³/s.

**Fig. 5. Dam at the head node of the Rioni River**

The dam creates a small reservoir with a total volume of 3 million m³ and a useful volume of 0.5 million m³.

Fig. 6 shows the Rioni River Reservoir during the repair and washing works. During the washing of the reservoir in 2024, an island (mesoform) is visible in the riverbed, which gradually decreases during the washing process and the volume of the reservoir increases and approaches the design data. As the volume of the reservoir increases, the water supply in the reservoir increases, which allows for the improvement of peak electric energy consumption.

**Fig. 6. The reservoir of the Rioni River Hydroelectric Power Plant on August 21, 2024 at 12:19 am during maintenance and cleaning.**

The capacity of the hydroelectric power plant is 48 megawatts, the average annual output is 317 million kWh. The hydroelectric power plant building is equipped with 4 hydropower units with vertical radial-axial turbines RO-VM-190 (the working diameter of the hydropower unit is 1.9 m), operating at a design head of 60 m (maximum pressure - 65.4 m), the maximum water flow in each turbine is 25 m³/s. The turbines are driven by BB-7442-300 hydrogenerators, the capacity of which is 12 MW each.

Fig. 7. The lower reaches of the Rioni River Hydroelectric Power Plant reservoir dam are presented on August 20, 2024 at 11:56 am. The process of regulating the flow of floods and waterlogging in the Rioni River bed with artificial structures in order to ensure the protection of the population.

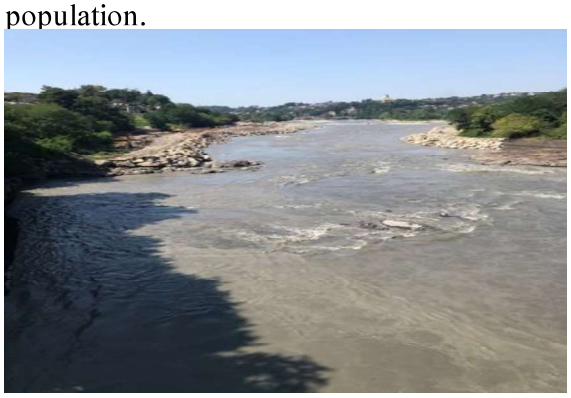

**Fig. 7. The lower reaches of the Rioni River hydroelectric power station reservoir dam on August 20, 2024 at 11:56 a.m.**

The Rioni Hydroelectric Power Station, with its technical and architectural design, represents a safe, environmentally friendly source of energy that provides the homeland and its people with the necessary energy. Today's living conditions are unimaginable without electricity.

### 3. Conclusion

1. The Rioni River is a mountain river characterized by abundant liquid and solid runoff, playing a special role in replenishing the Rioni hydroelectric power plants with sediment.
2. Despite the barriers (in the form of reservoirs) created by the stations on the Rioni River: Gumati I, Gumati II, the headwater dam of the Rioni HPP, the Somashveli headwater dam, the Vartsikhe Dam, the Vartsikhe Cascade, Vartsikhe I, Vartsikhe II, Vartsikhe III, and Vartsikhe IV, a large amount of sedimentary material continues to move to the Black Sea. The average annual amount of solid runoff of the Rioni at Sakochakidze is 6.9 million tons, and on average 7.0 million tons of solid sedimentary material enters the Black Sea.

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