



JUSTIFICATION OF THE SCHEME FOR DIVERTING CHIRCHIK–BOZSUV DERIVATION CANAL WATER RESOURCES TO THE SYRDARYA REGION

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Abstract: This article presents the justification for a canal scheme to transfer the water resources of the **Chirchik–Bozsuv derivation canal** to the **Syrdarya region**. The general equations of the water management balance and the operational conditions are provided.

Keywords: Chirchik–Bozsuv, derivation, canal scheme, balance equation, basin.

Introduction

Due to existing scientific and technical issues within the **Chirchik–Bozsuv derivation canal hydropower system**, it has been determined that on average **1.2–1.3 km³/year** of water resources (within the limits of the Republic of Uzbekistan) are being discharged into the **Republic of Kazakhstan** through the **Syrdarya River**.

It is therefore advisable to conduct scientific research aimed at **justifying the design, hydraulic efficiency, and reliability** of a canal system that would transfer these **1.2–1.3 km³/year** of water resources from the derivation canal to the **Mirzachul (Golodnaya Steppe) region** instead of releasing them into the Syrdarya River [2].

There are several practical forms of **inter-basin water transfer systems**, differing in their length, functional significance, and operational parameters. These include:

- **Inter-basin water transfer systems,**

- **Intra-basin water transfer systems, and**
- **Local water distribution systems.**

Since the water facilities under study are located in the **middle reaches of the Syrdarya River**, hydraulic calculations are carried out based on the **intra-basin water transfer system model**.

This type of water transfer system would make it possible to redirect a significant portion of the water resources currently discharged from the **Chirchik–Bozsuv derivation canal** into the **Syrdarya River**, instead supplying these waters to the **Syrdarya region**, thereby significantly improving its **water supply conditions**.

For the intra-basin water transfer scheme, the **water management balance equation** can be expressed as follows [1,3]:

$$\Delta W = W_{\text{чбдк}} + W_{\text{таш.суб}} - \sum_{i=1}^n W_{\text{ист.с.х.и}} - \pm \Delta V - V_{\text{ф.п}}; \quad (1)$$

Explanation of the Water Balance Equation Parameters

Where:

- ΔW — surplus () or deficit () of water resources in the **water management balance**;
- W_{ChBDK} — volume of water in the **Chirchik–Bozsuv derivation canal**;
- $W_{\text{transferred water}}$ — volume of water **discharged or transferred to another basin**;
- $W_{\text{agric. use}}$ — total volume of water **consumed within the region**;
- ΔV — **adjustable volume of water regulated from the Chirchik River** (positive or negative);
- V_{losses} — amount of water **lost due to filtration and evaporation**.

The **main parameters** of the water transfer system are:

- the **volume of water transported** (W), and
- the **transfer distance** (L).

Therefore, it is considered appropriate to classify the water transfer systems (inter-basin transfers) according to the **indicator obtained by multiplying the annual water transfer volume (m³/year) by the length of the transfer canal (km)**.

Within the framework of this project, the values of these parameters are presented in **Table 1**.

Indicators of Water Transfer from the Chirchik–Bozsuv Derivation Canal to the Mirzachul Region

Drainage channel	Volume of discharged water W, million m ³ /year	The design length of the drainage channel, km	Discharge category of water flow (by scale)
Project channel	800,0	86,2	Medium

The main objective of this study is to **provide a hydrological justification** for transferring the water resources of the **Chirchik–Bozsuv derivation canal** to the **Mirzachul region**.

The **intra-basin water transfer scheme** is shown in **Figure 1**, where the **donor water source** is represented by the **Chirchik–Bozsuv derivation canal**.

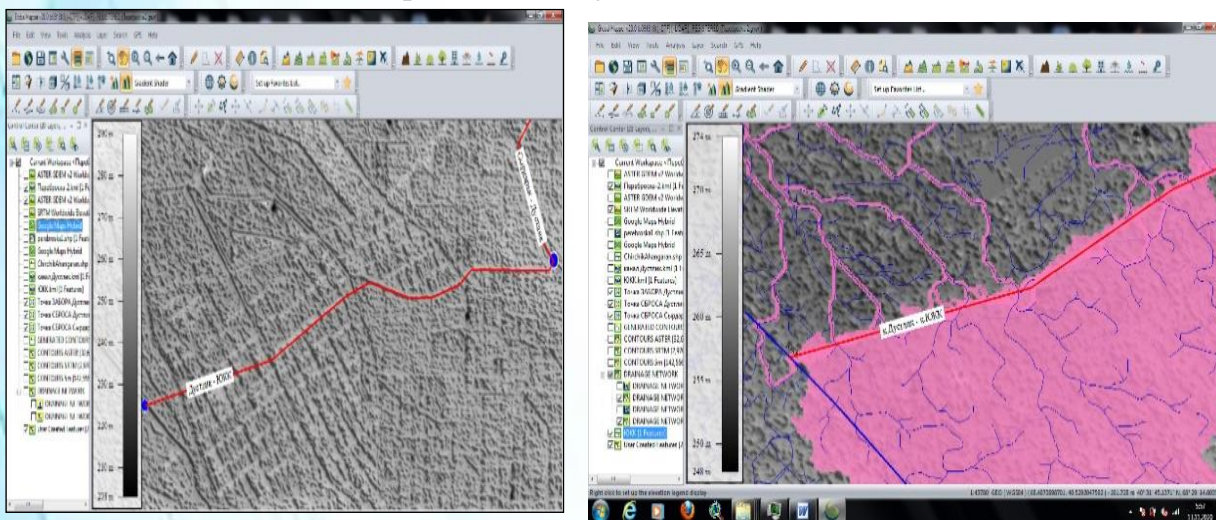


Figure 1. Scheme of the Canal for Transferring Water Resources from the Chirchik–Bozsuv Derivation Canal to the Mirzachul Region

Next, we carry out the **calculation of the water management balance** using **equation (1)**.

Table 2 presents the **input components** of the water management balance corresponding to the **water flow diverted under 95% water supply reliability**.

Taking into account the **hydrological parameters**, it is possible to formulate the **general operating conditions** of the water transfer system. For the **intra-basin water transfer scheme** to function under **normal operating conditions**, the following parameters are considered essential (Table 2).

Table 2.

Indicators Forming the Input Part of the Annual Water Management Balance of the Water Resources Flowing from the Chirchik River into the Derivation Canal

Indicators that make up the balance	Volume, million m3
Water resources coming from the Chirchik river to the derivation channel	800,0
Other organizers	0

a) By the volume transferred (diverted) within the system:

$$\sum W_{\text{ТПСр-д}} \geq \sum_{i=1}^N W_{\text{потр}i} - W_{\text{р-рц}} - W_{\text{ПОТ}_{\text{ТПС}}} \quad (2)$$

Where:

$W_{\text{TPSr-d}}$ – total annual volume received from the donor river;
 $W_{\text{р-рц}}$ – total consumption volume within the area of water transfer;
 $W_{\text{р-рц}}$ – volume of water resources in the recipient water body;
 $\sum W_{\text{ПОТ}_{\text{TPS}}}$ – total water losses due to evaporation and filtration during transportation within the water transfer system.

b) **By the water-carrying capacity of the intra-basin water transfer system:**

$$\begin{aligned} \frac{\sum_{i=1}^N W_{\text{потр}i}}{T_{\text{год}}} &\leq Q_{\text{мбТПСр-д1}} = \frac{W_{\text{мбТПСр-д1}}}{T_{\text{год}}} \\ \frac{\sum_{k=1}^k W_{\text{потр}i}}{T_{\text{год}}} &\leq Q_{\text{вбТПСр-д2}} = \frac{W_{\text{вбТПСр-д2}}}{T_{\text{год}}} \\ \frac{\sum_{k=1}^k W_{\text{потр}i}}{T_{\text{год}}} &\leq Q_{\text{лкТПСр-рц}} = \frac{W_{\text{лкТПСр-рц}}}{T_{\text{год}}} \end{aligned} \quad (3)$$

Where:

$Q_{\text{мбTPSr-d1}}$, $W_{\text{бTPSr-d2}}$ – water discharge and volume diverted from the donor water body into the water transfer system;

$Q_{\text{лкTPSr-пу}}$ – water discharge of the local water distribution system from the recipient water body;

$T_{\text{зод}}$ – annual operating period of the regional water distribution system.

The possible limit volume of water intake is determined by the natural flow rate (design water supply) and the difference between the flow in the downstream reach of the hydraulic unit and the reserve (remaining) water volume:

$$Q_{\text{нду}} = Q_{\text{kr}} - Q_{\text{ist}}$$

$$Q_{\text{нди}} = Q_{\text{kr}} - Q_{\text{ist}} \quad (4)$$

Where:

Q_{kr} – water discharge during water-deficient years;

Q_{ist} – minimum water discharge observed during the observation period.



Chatkal River; Pskem River; Chirchik River

Based on research conducted in the Chirchik–Ohangaron irrigation basin, we will examine the determination of the boundary water discharge taken from the Chirchik–Bozsuv Derivation Canal. Figure 2 shows the hydrograph of the minimum flow in the Chirchik River and the Chirchik–Bozsuv Derivation Canal under 95% water supply conditions.

The boundary monthly water discharge taken from the derivation canal is **23.5 m³/s** for the **summer–autumn period** and **25 m³/s** for the **winter–spring period**.

At the possible boundary water intake (800.0 million m³ per year), the average water consumption in the discharge area is **20 m³/s**, which allows us to conclude that even during water shortage periods, these indicators do not exceed the boundary values.

This, in turn, indicates the preservation of the water ecosystem in both the derivation canal and the Chirchik River, as well as the reliable operation of the hydraulic structures within the derivation canal.

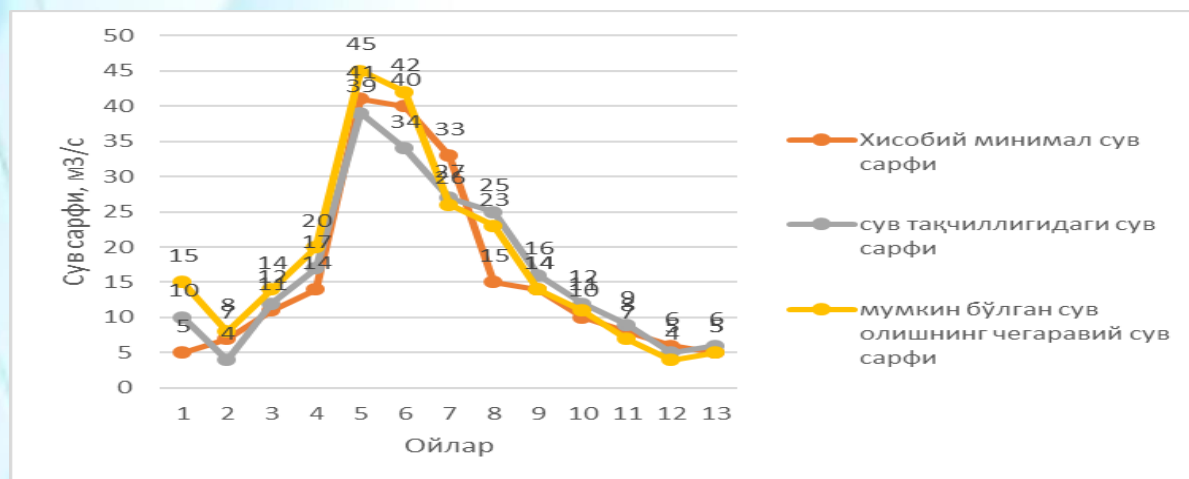


Figure 2. Hydrograph of the minimum flow in the Chirchik River and the Chirchik-Bozsuv Derivation Canal under 95% water supply conditions.

Conclusion.

A water management balance equation has been proposed to justify the scheme of transferring water from the Chirchik-Bozsuv Derivation Canal to the Mirzachul region. Using these equations, the water management balance of the water transfer system was calculated. Based on the canal's water-carrying capacity and the total volume of transferred water, the conditions for the efficient operation of the inter-basin water transfer system were substantiated.

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