NO.

# THE STUDY ON RESTRUCTURING OF WATER SUPPLY SYSTEM OF TASHKENT CITY IN THE REPUBLIC OF UZBEKISTAN

## FINAL REPORT
## VOLUME 3
## SUPPORTING REPORT

MARCH 2006


**Japan International Cooperation Agency**
**Global Environment Department**

JAPAN INTERNATIONAL COOPERATION AGENCY

TASHKENT CITY MUNICIPALITY
THE REGIONAL COMMUNAL SERVICE ASSOCIATIONS (TKEO)
TASHKENT VODOKANAL (SUVSOZ)
THE REPUBLIC OF UZBEKISTAN

# THE STUDY ON RESTRUCTURING OF WATER SUPPLY SYSTEM OF TASHKENT CITY IN THE REPUBLIC OF UZBEKISTAN

## VOLUME 3

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ERNST & YOUNG SHINNIHON

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VOLUMES OF

FINAL REPORT

"THE STUDY ON RESTRUCTURING OF WATER SUPPLY SYSTEM

OF TASHKENT CITY IN THE REPUBLIC OF UZBEKISTAN"

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Volume 2 MAIN REPORT

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Volume 4 DATA REPORT

**The Study Report**
**On Restructuring of Water Supply System**
**Of Tashkent City**
**in the Republic of Uzbekistan**

**Final Report**

# Supporting Report

## Long-Term Development Plan

**Chapter 1 Introduction**

(No additional Supporting Information)

**Chapter 2 Conditions of the Water Supply System**



**Chapter 3 Current Issues of the Water Supply System**



**Chapter 4 Planning Fundamentals for Development Plan**

## B. Questionnaires Survey



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# Chapter 2 Conditions of the Water Supply System

# S 2.1 Natural Conditions of the Chirchik River Basin

## S 2.1.1 Topography, Geology and Meteorology of Tashkent City and the Surrounding Area

### (1) Geomorphologic Characteristics of the Basin

Charvak Dam is constructed in the Chirchik River Basin. This basin lies to the northeast from Tashkent City and extends to the southwest. The Talass Ridge of Tyan-Shan mountain system and its Karjantau Ridge are borders of the basin on the northwest. The basin is closed by Talass Ridge from the north,, and it extends from the southeast to the Chatkal Ridge. The basin is opened from the southwest, and the Sirdarya River serves as the border. From the orographic viewpoint, the basin is a quite complicated mountain system, and this defines drainage network and the system of its rivers runoff. The basin is divided into the range of the independent river basins by the Talass Ridge. The main spur of the Talass and Pskem Ridge divides the basin into two different parts: basins of the Chatkal and the Pskem Rivers. The Djettisandal Ridge separates the Sandalash River basin from the Chatkal River; the Chatkal and Kumbel Ridges make an orographic enclosure of the Ters River Basin, which is the left inflow of the Chatkal River Similarly two spurs of the Chatkal Ridge make closed basin of another left inflow of the Chatkal and Akbulak River. The Pskem Ridge and its spur of the Keksuus Ridge create a Valley of the Koksu River, former the inflow of the Chatkal River, which now flows directly into Charvak Dam. The Koksu valley is opened to the southwest.

The spur of Talass Ridge - Maydantal and Oygaing - create a closed basin of the Maydantal River, and the Talass, Ugam and Karjantau Ridges enclose the Ugam River Basin, the left inflow of the Chirchik River.

Chirchik River is formed by connected the Chatkal and Pskem Rivers. Charvak Dam is built in the junction, where some rivers and streams, such as Chatkal, Koksu, Pskem, Yangikurgan, Chimgansay, and others flow.

The elevation grade of the Talass Ridge is over 3,500 m and some mountaintops exceed 4000 m. The highest point of the ridge is Manas Mountain (4,488 m). The height of the ridge spurs, stretching mainly toward southwest, such as Chatkal, Djettisandal and Pskem, also exceed 3,500 m, where there are some mountaintops with height of over 4,000 m. The height of the Ugam Ridge is lower than 3,500 m., except for some mountaintops.

Because the height of ridges in this basin is not enough in order to form glaciers compared to the frozen border (3,300-4,000 m), freezing zoon is relatively small. According to the data issued by Shultz V.L. [ 1 ] in 1963 in the Chatkal and Pskem Rivers basin, 82 and 118 glaciers with the total area of 44.2 and 153.9 km$^2$ was observed. According to precise data of Schetinnikov A.S. and Podkopaeva L.D. [ 3, 4 ] , there were 119 and 250 glaciers with the total freezing area of 51.0 and 127.8 km$^2$ respectively in the basins of these rivers. Finally, according to the latest data of Schetinnikov A.S. [ 5 ] in Pskem basin, there were 251 glaciers with the total area of 121.2 km$^2$. In the winter, seasonable snowfields are widely spread in the basin.

The main flow of the basin, as aforementioned, is the Chirchik River, which discharges from Charvak Dam. Large two tributaries join the Chirchik River before the river flows into the Sirdarya River, which are the Ugam River from right bank of it, and the Aksakatasay River from left bank. The other inflows are small rivers or streams, which flow into in only flood periods. The relatively large inflows are Aktash, Shurabsay, Tavaksay and Azatbash inflowing from the right bank, and Karankulsay, Galvasay, Galibasay, Parkentsay and Bashkizilsay from the left bank.

In the flatland, the flowing water of the Chirchik River is intensively taken by the canals network.

**(2) Meteorological Data**

Currently five meteorological stations are functioning in the Chirchik basin within the boundary of Uzbekistan. These are Tashkent (Height above sea level = 477 m., № 1), Sukok (H = 1351 m., № 2), Chimgan (H = 1670 m., № 3), Pskem (H = 1256 m., № 5) and Oygaing (H = 2151 m., № 6) and Charvak Dam (H = 975m., № 4) Stations. The Charvak Dam Station was located on the bank of the reservoir, closed in 1987. The locations of Meteorological stations are shown on Figure S 2.1.1.

Monthly average of temperature according to the data taken from the mentioned stations from 1980 to 2002 are sown in Table S 2.1.1(1) –(6) and Figure S 2.1.2.

Monthly amount of precipitation is shown in Table S 2.1.2 and Figure S 2.1.3. The blank spaces in the columns mean that there is no precipitation.

Data of the monthly maximum snow depth is given in Table S 2.1.3 and Figure S 2.1.4. The blank spaces in the columns mean that there is no snow cover, and zeros show that snow depth was less than 1cm thickness. Unfortunately, there is no data of snow cover in some observation years.

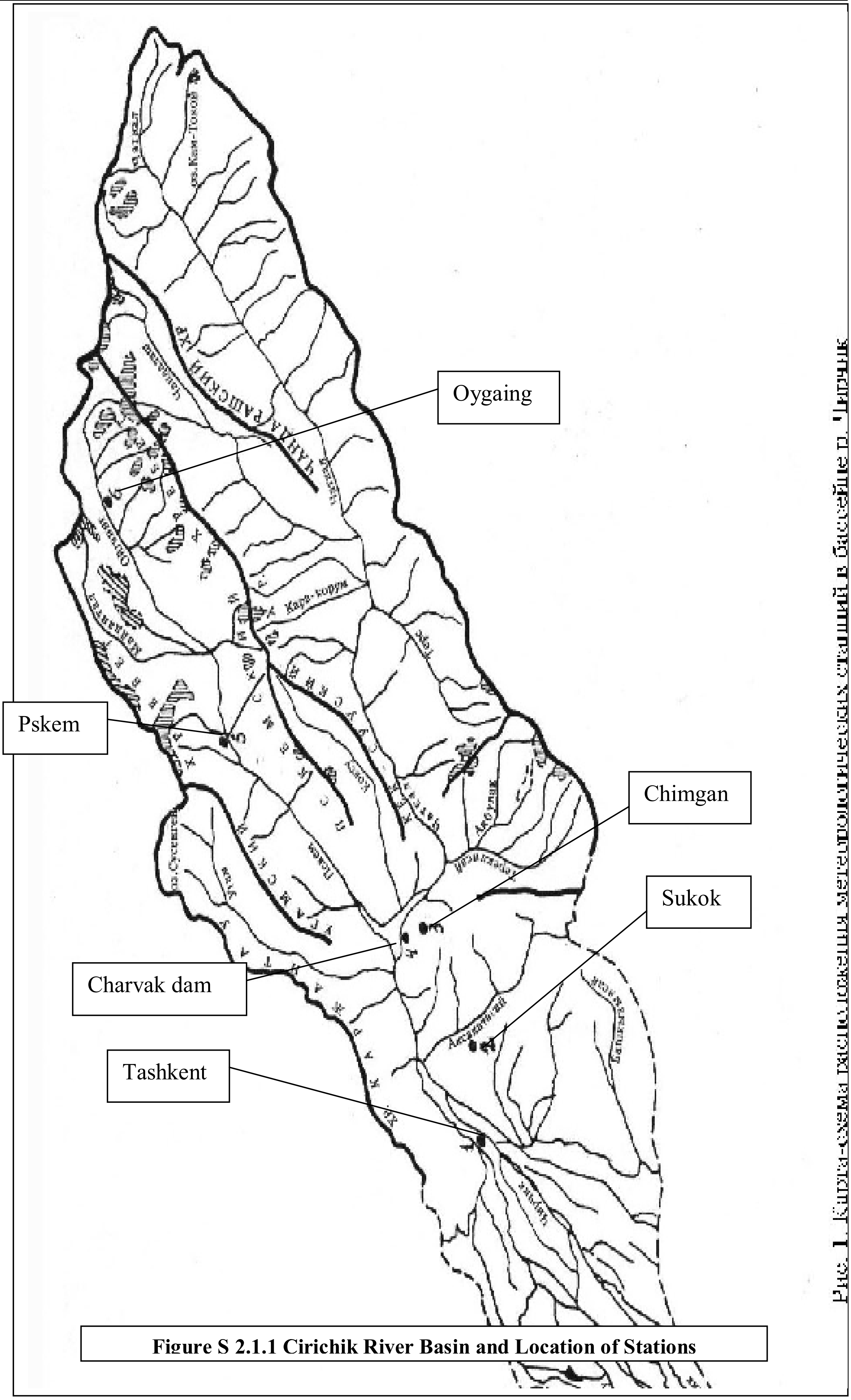



**Figure S 2.1.1 Cirichik River Basin and Location of Stations**

## Table S 2.1.1 (1) Temperature Data of Tashkent Station

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Ave |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 0.8 | -0.2 | 7.3 | 17.6 | 21.3 | 25.5 | 28.4 | 25.4 | 20.4 | 13.5 | 11.5 | 8.2 | 15.0 |
| 1981 | 4.7 | 4.5 | 10.9 | 15.1 | 20.0 | 24.2 | 27.5 | 25.1 | 20.0 | 11.8 | 8.9 | 5.5 | 14.9 |
| 1982 | 2.0 | 1.2 | 7.2 | 17.3 | 21.5 | 25.4 | 26.9 | 25.4 | 19.5 | 13.2 | 2.9 | 1.0 | 13.6 |
| 1983 | 2.2 | 6.7 | 8.0 | 16.2 | 20.3 | 25.9 | 29.3 | 27.1 | 20.4 | 13.3 | 10.8 | 2.9 | 15.3 |
| 1984 | 0.1 | -5.1 | 8.1 | 14.9 | 20.8 | 26.0 | 29.0 | 27.6 | 19.2 | 13.2 | 8.4 | -6.8 | 13.0 |
| 1985 | -0.1 | 6.0 | 6.3 | 17.1 | 20.6 | 26.5 | 28.6 | 25.0 | 21.0 | 12.2 | 6.1 | 4.3 | 14.5 |
| 1986 | 4.6 | 4.9 | 5.4 | 15.0 | 21.8 | 25.0 | 27.8 | 25.5 | 21.9 | 14.1 | 6.7 | 3.0 | 14.6 |
| 1987 | 5.1 | 5.9 | 10.0 | 12.9 | 20.3 | 24.3 | 26.2 | 27.3 | 19.9 | 9.4 | 7.0 | 8.7 | 14.8 |
| 1988 | 2.2 | -3.5 | 8.2 | 17.4 | 18.8 | 27.2 | 28.9 | 25.4 | 20.6 | 13.0 | 11.6 | 6.6 | 14.7 |
| 1989 | -0.9 | -0.9 | 10.1 | 12.8 | 19.0 | 25.6 | 28.1 | 26.2 | 19.2 | 15.3 | 7.4 | 6.5 | 14.0 |
| 1990 | -0.4 | 4.2 | 9.1 | 14.5 | 21.3 | 28.1 | 27.1 | 26.3 | 21.4 | 13.2 | 9.8 | 2.9 | 14.8 |
| 1991 | 0.1 | 3.5 | 8.1 | 16.3 | 19.6 | 24.4 | 28.0 | 25.5 | 20.5 | 14.6 | 7.5 | 4.1 | 14.4 |
| 1992 | 2.9 | 6.1 | 7.1 | 15.7 | 17.1 | 24.2 | 27.0 | 24.1 | 18.9 | 13.0 | 10.7 | 6.0 | 14.4 |
| 1993 | 1.7 | 3.8 | 7.6 | 15.0 | 17.6 | 24.8 | 27.4 | 24.5 | 19.9 | 12.1 | 4.5 | 1.3 | 13.4 |
| 1994 | 0.9 | -0.5 | 10.5 | 12.7 | 21.1 | 26.8 | 27.5 | 26.5 | 17.5 | 14.2 | 11.7 | 3.0 | 14.3 |
| 1995 | 1.5 | 4.8 | 9.0 | 16.2 | 20.7 | 26.2 | 28.4 | 26.6 | 20.4 | 13.0 | 11.1 | 2.0 | 15.0 |
| 1996 | -0.1 | 1.7 | 6.6 | 13.6 | 19.7 | 25.7 | 27.5 | 25.3 | 12.2 | 13.4 | 6.3 | 6.8 | 13.2 |
| 1997 | 3.8 | 2.3 | 9.8 | 16.5 | 19.7 | 26.6 | 29.0 | 26.0 | 21.2 | 17.2 | 5.7 | 3.8 | 15.1 |
| 1998 | 1.5 | 1.5 | 7.6 | 16.9 | 18.9 | 24.5 | 27.8 | 26.6 | 21.6 | 13.5 | 9.3 | 5.8 | 14.6 |
| 1999 | 2.6 | 8.6 | 7.6 | 13.8 | 21.0 | 24.8 | 26.3 | 27.7 | 21.1 | 15.7 | 6.9 | 5.1 | 15.1 |
| 2000 | 4.0 | 3.5 | 9.8 | 18.4 | 22.3 | 25.9 | 28.4 | 27.5 | 21.4 | 11.7 | 7.0 | 4.9 | 15.4 |
| 2001 | -0.3 | 5.3 | 11.9 | 17.2 | 24.9 | 28.2 | 27.2 | 25.8 | 19.7 | 12.8 | 10.6 | 4.7 | 15.7 |
| 2002 | 4.5 | 5.5 | 11.5 | 14.5 | 19.0 | 24.7 | 27.2 | 27.2 | 21.6 | 17.0 | 10.4 | -0.9 | 15.2 |
| Ave. | 1.9 | 3.0 | 8.6 | 15.5 | 20.3 | 25.7 | 27.8 | 26.1 | 20.0 | 13.5 | 8.4 | 3.9 | 14.6 |

## Table S 2.1.1 (2) Temperature Data Sukok Station

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Ave |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | -1.2 | -2.6 | 3.4 | 13.6 | 16.7 | 21.1 | 25.0 | 22.1 | 18.1 | 11.5 | 9.6 | 5.6 | 11.9 |
| 1981 | 1.5 | 0.9 | 6.9 | 11.3 | 15.7 | 19.4 | 22.7 | 21.0 | 17.2 | 8.7 | 6.7 | 3.0 | 11.3 |
| 1982 | 1.2 | -0.8 | 3.2 | 13.3 | 17.1 | 20.3 | 22.6 | 21.9 | 16.6 | 10.8 | 1.5 | 1.2 | 10.7 |
| 1983 | 0.4 | 3.4 | 3.4 | 11.3 | 15.8 | 20.8 | 25.3 | 24.1 | 17.7 | 11.1 | 9.3 | 1.5 | 12.0 |
| 1984 | -2.0 | -7.0 | 4.9 | 10.5 | 15.8 | 21.8 | 25.6 | 25.2 | 16.6 | 10.8 | 6.0 | -6.1 | 10.2 |
| 1985 | -0.2 | 3.8 | 1.6 | 12.9 | 15.7 | 22.2 | 24.3 | 21.0 | 18.8 | 9.9 | 5.0 | 2.6 | 11.5 |
| 1986 | 2.1 | 1.9 | 0.8 | 10.2 | 16.8 | 20.1 | 23.8 | 22.2 | 19.5 | 12.2 | 4.6 | 1.0 | 11.3 |
| 1987 | 2.9 | 2.8 | 6.3 | 8.8 | 15.6 | 19.2 | 17.2 | 23.9 | 17.2 | 6.3 | 6.1 | 6.0 | 11.0 |
| 1988 | 0.9 | 1.0 | 3.6 | 13.1 | 14.2 | 22.5 | 24.5 | 21.5 | 17.6 | 10.7 | 10.3 | 5.0 | 12.1 |
| 1989 | -2.6 | -3.9 | 5.7 | 8.2 | 13.8 | 20.5 | 23.6 | 22.6 | 16.6 | 13.2 | 5.1 | 5.1 | 10.7 |
| 1990 | -1.3 | 0.2 | 4.6 | 9.6 | 17.1 | 23.5 | 22.5 | 22.9 | 19.4 | 11.1 | 8.8 | 0.6 | 11.6 |
| 1991 | -1.0 | -0.2 | 3.7 | 11.6 | 14.6 | 19.6 | 23.2 | 21.8 | 17.7 | 12.0 | 6.4 | 2.3 | 11.0 |
| 1992 | 0.6 | 2.2 | 1.8 | 11.2 | 11.9 | 19.5 | 22.7 | 20.0 | 15.7 | 11.2 | 9.8 | 4.1 | 10.9 |
| 1993 | -1.3 | 0.9 | 2.9 | 10.8 | 13.0 | 20.2 | 22.7 | 20.3 | 17.4 | 9.3 | 3.3 | 2.5 | 10.2 |
| 1994 | -0.3 | -2.5 | 6.7 | 8.1 | 16.4 | 21.7 | 22.6 | 22.6 | 14.1 | 11.4 | 9.9 | 0.8 | 11.0 |
| 1995 | -0.2 | 1.2 | 4.4 | 11.3 | 15.9 | 21.2 | 24.0 | 22.9 | 17.6 | 10.5 | 9.1 | 0.6 | 11.5 |
| 1996 | -2.0 | 0.1 | 2.5 | 8.7 | 14.8 | 20.5 | 22.7 | 21.4 | 18.7 | 10.9 | 4.1 | 5.3 | 10.6 |
| 1997 | 2.0 | 0.0 | 4.9 | 12.0 | 14.6 | 21.6 | 24.5 | 22.3 | 18.4 | 15.0 | 4.6 | 2.1 | 11.8 |
| 1998 | -0.3 | -0.3 | 4.1 | 12.8 | 14.2 | 19.5 | 23.3 | 22.4 | 18.5 | 11.5 | 8.4 | 5.5 | 11.6 |
| 1999 | 0.8 | 5.5 | 3.0 | 9.4 | 16.3 | 19.8 | 21.2 | 23.7 | 17.7 | 13.3 | 4.5 | 5.0 | 11.7 |
| 2000 | 1.3 | 0.4 | 5.0 | 14.1 | 18.2 | 21.1 | 23.5 | 23.5 | 18.5 | 9.1 | 3.8 | 3.7 | 11.9 |
| 2001 | -1.4 | 2.5 | 8.2 | 13.3 | 20.3 | 23.4 | 22.1 | 21.3 | 16.5 | 10.7 | 8.3 | 3.0 | 12.4 |
| 2002 | 1.9 | 2.5 | 7.9 | 10.9 | 14.6 | 20.2 | 22.6 | 23.4 | 18.6 | 14.8 | 8.2 | -0.6 | 12.1 |
| Ave. | 0.1 | 0.5 | 4.3 | 11.2 | 15.6 | 20.9 | 23.1 | 22.3 | 17.6 | 11.1 | 6.7 | 2.6 | 11.3 |

**Table S 2.1.1 (3) Temperature Data Chimgan Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Ave |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1984 | -4.9 | -8.9 | 1.6 | 7.7 | 13.0 | 19.3 | 23.6 | 23.5 | 14.0 | 8.1 | 2.8 | -7.8 | 7.7 |
| 1985 | -2.7 | -0.1 | -1.2 | 10.6 | 13.1 | 19.2 | 22.1 | 18.8 | 16.5 | 7.4 | 2.3 | -0.5 | 8.8 |
| 1986 | -1.4 | -0.8 | -1.6 | 7.6 | 13.7 | 17.6 | 21.7 | 20.2 | 17.4 | 9.4 | 4.3 | -1.8 | 8.9 |
| 1987 | -0.3 | -0.5 | 3.1 | 6.0 | 13.0 | 16.5 | 18.5 | 21.7 | 14.9 | 4.0 | 3.7 | 2.4 | 8.6 |
| 1988 | -1.9 | -1.1 | 0.5 | 10.1 | 11.4 | 19.5 | 22.1 | 19.1 | 15.4 | 8.0 | 7.4 | 1.8 | 9.4 |
| 1989 | -5.2 | -6.5 | 2.4 | 5.6 | 11.2 | 17.5 | 20.7 | 20.4 | 14.3 | 10.5 | 1.8 | 1.7 | 7.9 |
| 1990 | -3.8 | -2.4 | 4.0 | 6.7 | 14.5 | 21.0 | 19.7 | 20.7 | 17.3 | 8.6 | 5.5 | -1.8 | 9.2 |
| 1991 | -3.5 | -3.2 | 1.1 | 8.9 | 11.9 | 16.6 | 20.5 | 19.8 | 15.3 | 9.5 | 4.0 | -1.2 | 8.3 |
| 1992 | -2.5 | -1.4 | -1.6 | 8.4 | 9.5 | 16.5 | 20.2 | 17.9 | 13.5 | 9.0 | 7.0 | 0.9 | 8.1 |
| 1993 | -4.2 | -2.0 | -0.3 | 7.3 | 10.3 | 17.7 | 20.2 | 18.0 | 15.5 | 7.0 | 0.8 | -0.5 | 7.5 |
| 1994 | -3.2 | -5.7 | 3.3 | 4.9 | 13.9 | 18.7 | 20.8 | 21.1 | 11.9 | 9.4 | 6.4 | -2.2 | 8.3 |
| 1995 | -3.1 | -1.8 | 1.5 | 9.0 | 13.7 | 18.5 | - | - | 15.7 | 7.9 | 6.3 | -2.0 | 5.5 |
| 1996 | -5.0 | -3.2 | -0.4 | 5.0 | 11.9 | 17.7 | 20.3 | 19.7 | 16.6 | 8.2 | 2.1 | 2.0 | 7.9 |
| 1997 | -1.5 | -3.3 | 2.0 | 9.8 | 12.0 | 18.6 | 22.7 | 20.4 | 16.3 | 12.8 | 2.1 | -1.2 | 9.2 |
| 1998 | -3.8 | -2.8 | 0.6 | 9.9 | 11.7 | 16.6 | 20.6 | 20.2 | 16.3 | 9.9 | 6.4 | 1.9 | 9.0 |
| 1999 | -1.7 | 1.9 | 0.5 | 6.4 | 14.0 | 16.8 | 18.2 | 22.1 | 15.8 | 11.1 | 1.6 | 1.9 | 9.1 |
| 2000 | -1.7 | -2.8 | 1.8 | 11.0 | 15.4 | 18.6 | 21.6 | 21.7 | 16.2 | 6.3 | 1.4 | 0.4 | 9.2 |
| 2001 | -4.2 | -1.1 | 4.7 | 10.4 | 17.1 | 20.9 | 20.0 | 18.6 | 13.8 | 8.0 | 5.2 | -1.2 | 9.4 |
| 2002 | -1.3 | -0.8 | 4.1 | 8.1 | 11.7 | 17.1 | 19.9 | 21.1 | 16.3 | 12.1 | 5.6 | -3.7 | 9.2 |
| Ave. | -2.9 | -2.4 | 1.4 | 8.1 | 12.8 | 18.2 | 19.7 | 19.2 | 15.4 | 8.8 | 4.0 | -0.6 | 8.5 |

**Table S 2.1.1 (4) Temperature Data Charvak Dam Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Ave |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | -2.0 | -2.8 | 3.5 | 13.7 | 17.2 | 21.1 | 25.7 | 23.1 | 18.8 | 12.8 | 9.3 | 8.9 | 12.4 |
| 1981 | 1.3 | 0.9 | 6.9 | 12.2 | 16.4 | 19.7 | 23.4 | 21.3 | 17.4 | 10.1 | 6.5 | 1.6 | 11.5 |
| 1982 | 0.8 | -0.8 | 4.2 | 14.4 | 18.1 | 21.8 | 23.8 | 23.0 | 17.1 | 11.4 | 1.5 | 0.4 | 11.3 |
| 1983 | -1.3 | 2.5 | 4.5 | 13.0 | 16.3 | 20.8 | 25.9 | 25.2 | 18.5 | 11.2 | 8.6 | 1.3 | 12.2 |
| 1984 | -2.7 | -7.5 | 4.6 | 11.8 | 16.6 | 22.9 | 26.9 | 26.2 | 17.5 | 11.2 | 5.8 | -6.9 | 10.5 |
| 1985 | -1.7 | 1.5 | 2.2 | 14.4 | 16.6 | 22.6 | 25.4 | 22.5 | 19.4 | 10.4 | 4.9 | 2.2 | 11.7 |
| 1986 | 0.7 | 1.4 | 2.4 | 11.9 | 17.4 | 21.2 | 25.4 | 23.6 | 20.6 | 12.3 | 5.3 | -0.4 | 11.8 |
| 1987 | 0.6 | 2.0 | 6.9 | 9.8 | 16.6 | 20.5 | 22.7 | 25.1 | 18.1 | 8.0 | 6.0 | 5.3 | 11.8 |
| Ave. | -0.5 | -0.4 | 4.4 | 12.7 | 16.9 | 21.3 | 24.9 | 23.8 | 18.4 | 10.9 | 6.0 | 1.6 | 11.7 |

**Table S 2.1.1 (5) Temperature Data Pskem Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Ave |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | -3.8 | -4.0 | 1.5 | 11.5 | 15.1 | 18.4 | 23.8 | 21.5 | 17.1 | 10.3 | 7.1 | 3.1 | 10.1 |
| 1981 | -1.0 | -1.0 | 4.8 | 10.4 | 14.8 | 17.2 | 20.7 | 19.4 | 15.7 | 8.2 | 4.6 | -0.8 | 9.4 |
| 1982 | -1.7 | -3.0 | 2.0 | 12.1 | 15.9 | 19.0 | 21.8 | 21.4 | 15.4 | 9.6 | -0.2 | -1.6 | 9.2 |
| 1983 | -2.7 | 0.5 | 2.8 | 11.1 | 13.9 | 17.6 | 22.5 | 17.7 | 16.9 | 9.6 | 5.9 | -0.8 | 9.6 |
| 1984 | -5.1 | -8.4 | 2.4 | 9.7 | 14.1 | 19.9 | 25.0 | 19.7 | 15.5 | 9.3 | 3.4 | -8.1 | 8.1 |
| 1985 | -3.3 | -0.1 | -0.1 | 11.6 | 14.0 | 19.3 | 23.2 | 20.6 | 18.0 | 8.7 | 2.3 | -0.1 | 9.5 |
| 1986 | -1.4 | -0.1 | 0.7 | 10.0 | 14.7 | 18.5 | 23.1 | 21.7 | 18.9 | 10.4 | 2.7 | -0.2 | 9.9 |
| 1987 | -1.4 | -0.1 | 4.6 | 7.7 | 14.0 | 17.6 | 19.9 | 30.5 | 12.2 | 6.1 | 4.0 | 2.6 | 9.8 |
| 1988 | -1.6 | -1.2 | 2.1 | 11.2 | 12.6 | 19.7 | 23.1 | 20.8 | 17.1 | 9.1 | 2.0 | 7.9 | 10.2 |
| 1989 | -5.1 | -5.7 | 2.9 | 7.3 | 12.9 | 17.9 | 21.8 | 21.9 | 15.7 | 11.3 | 1.9 | 1.8 | 8.7 |
| 1990 | -4.2 | -1.2 | 2.1 | 8.8 | 15.9 | 21.5 | 20.8 | 22.2 | 18.5 | 9.7 | 6.2 | -1.3 | 9.9 |
| 1991 | -3.3 | -2.1 | 2.8 | 10.9 | 13.4 | 17.7 | 21.5 | 21.6 | 17.2 | 10.5 | 5.4 | -1.0 | 9.6 |
| 1992 | -2.3 | -1.0 | -0.2 | 10.3 | 11.9 | 16.8 | 20.9 | 19.4 | 15.3 | 10.0 | 7.5 | 1.6 | 9.2 |
| 1993 | -3.6 | -1.3 | 1.2 | 8.2 | 12.2 | 18.3 | 21.0 | 19.6 | 16.7 | 8.4 | 1.6 | -0.9 | 8.5 |
| 1994 | -3.5 | -5.2 | 3.7 | 7.0 | 15.4 | 19.7 | 22.5 | 22.9 | 13.9 | 10.7 | 6.5 | -1.7 | 9.3 |
| 1995 | -3.8 | -1.1 | 3.4 | 11.4 | 15.0 | 19.6 | 22.3 | 22.4 | 17.1 | 9.2 | 6.8 | -2.2 | 10.0 |
| 1996 | -4.4 | -2.3 | 1.2 | 6.6 | 13.3 | 18.3 | 21.1 | 21.1 | 17.5 | 9.5 | 3.1 | 2.1 | 8.9 |
| 1997 | -1.6 | -3.0 | 3.6 | 12.0 | 13.4 | 18.8 | 23.8 | 21.8 | 17.6 | 13.5 | 3.0 | -0.9 | 10.2 |
| 1998 | -3.4 | -2.6 | 1.1 | 10.4 | 13.4 | 17.6 | 21.2 | 20.9 | 17.5 | 10.7 | 6.5 | 1.1 | 9.5 |
| 1999 | -2.0 | 1.8 | 2.6 | 8.6 | 15.0 | 17.2 | 19.0 | 22.8 | 17.0 | 11.8 | 1.5 | 1.1 | 9.7 |
| 2000 | -2.3 | -2.3 | 3.2 | 12.5 | 15.8 | 19.4 | 22.4 | 22.9 | 17.6 | 7.5 | 2.7 | -0.1 | 9.9 |
| 2001 | -4.1 | -0.9 | 5.7 | 11.9 | 17.3 | 21.5 | 21.3 | 20.1 | 14.9 | 8.5 | 5.9 | -1.3 | 10.1 |
| 2002 | -1.2 | -0.5 | 5.2 | 9.7 | 12.8 | 17.4 | 20.8 | 22.4 | 17.7 | 12.8 | 6.5 | -3.3 | 10.0 |
| Ave. | -2.9 | -1.9 | 2.6 | 10.0 | 14.2 | 18.6 | 21.9 | 21.5 | 16.6 | 9.8 | 4.2 | -0.1 | 9.5 |

**Table S 2.1.1 (6) Temperature Data Oygaing Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Ave |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | -10.5 | -10.0 | -5.3 | 3.1 | 9.0 | 11.9 | 17.2 | 15.6 | 11.0 | 4.1 | 0.1 | -5.9 | 3.4 |
| 1981 | -9.3 | -8.2 | -2.8 | 2.1 | 9.4 | 10.8 | 13.8 | 12.7 | 9.4 | 2.7 | -2.4 | -7.8 | 2.5 |
| 1982 | -8.8 | -9.9 | -4.9 | 3.4 | 9.9 | 12.3 | 14.5 | 15.0 | 8.5 | 2.6 | -6.9 | -8.5 | 2.3 |
| 1983 | -9.4 | -8.5 | -5.6 | 4.2 | 8.2 | 11.0 | 14.9 | 17.7 | 10.7 | 3.3 | -3.3 | -8.7 | 2.9 |
| 1984 | -13.5 | -14.4 | -4.4 | -0.1 | 7.2 | 13.0 | 18.2 | 19.7 | 9.0 | 2.1 | -4.0 | -14.8 | 1.5 |
| 1985 | -10.0 | -6.8 | -7.5 | 1.9 | 7.4 | 11.5 | 15.5 | 14.3 | 11.2 | 2.1 | -5.9 | -7.5 | 2.2 |
| 1986 | -10.1 | -9.9 | -7.1 | 0.9 | 7.1 | 10.0 | 15.0 | 15.5 | 12.9 | 3.2 | 3.7 | -8.7 | 2.7 |
| 1987 | -8.0 | -7.1 | -2.5 | -0.6 | 4.3 | 10.5 | 13.2 | 16.0 | 10.0 | 0.3 | -3.3 | -4.8 | 2.3 |
| 1988 | -8.3 | -9.3 | -5.3 | 0.8 | 6.0 | 12.9 | 16.3 | 14.4 | 10.7 | 1.4 | 0.1 | -5.7 | 2.8 |
| 1989 | -11.8 | -12.6 | -5.1 | -1.4 | 6.6 | 11.0 | 14.5 | 15.1 | 9.5 | 4.6 | -7.0 | -6.0 | 1.5 |
| 1990 | -10.3 | -9.1 | -5.5 | 0.1 | 7.3 | 14.5 | 13.8 | 15.4 | 12.2 | 3.5 | - | - | - |
| 1991 | -10.2 | -10.1 | -4.5 | 3.3 | 7.4 | 11.0 | 14.2 | 14.8 | 11.2 | 3.6 | -1.3 | -7.8 | 2.6 |
| 1992 | -8.6 | -8.3 | -7.9 | 1.5 | 5.8 | 10.8 | 14.7 | 13.2 | 9.4 | 3.5 | -0.2 | -5.2 | 2.4 |
| 1993 | -10.6 | -7.6 | -5.8 | -1.1 | 4.3 | 12.3 | 14.5 | 13.2 | 11.2 | 2.2 | -4.0 | -8.2 | 1.7 |
| 1994 | -11.1 | -11.0 | -4.1 | -1.5 | 6.8 | 13.2 | 16.4 | 16.8 | 8.4 | 4.5 | -1.0 | -9.0 | 2.4 |
| 1995 | -11.4 | -8.9 | -4.9 | 0.7 | 8.5 | 12.5 | 15.4 | 15.9 | 10.9 | 2.4 | -0.8 | -8.7 | 2.6 |
| 1996 | -11.7 | -9.1 | -5.2 | -2.0 | 5.4 | 11.7 | 13.9 | 14.4 | 11.4 | 3.2 | -3.6 | -5.2 | 1.9 |
| 1997 | -7.8 | -10.8 | -3.5 | 4.5 | 8.2 | 12.6 | 16.9 | 16.0 | 12.0 | 7.0 | -3.5 | -7.0 | 3.7 |
| 1998 | -9.7 | -8.5 | -5.7 | 1.9 | 7.0 | 11.7 | 14.7 | 14.6 | 11.5 | 5.1 | -0.5 | -5.8 | 3.0 |
| 1999 | -9.1 | -5.7 | -5.2 | 0.4 | 8.3 | 10.7 | 12.9 | 16.1 | 11.3 | 5.5 | -3.9 | -6.5 | 2.9 |
| 2000 | -9.1 | -10.5 | -5.3 | 4.8 | 10.4 | 13.4 | 15.5 | 16.9 | 11.3 | 0.0 | -9.3 | -6.4 | 2.6 |
| 2001 | -10.5 | -7.0 | -2.6 | 2.0 | 6.8 | 10.9 | 13.7 | 16.1 | 11.1 | 6.6 | -0.5 | -9.0 | 3.1 |
| 2002 | -8.4 | -7.0 | -2.6 | 2.0 | 6.8 | 10.9 | 13.4 | 16.1 | 11.1 | 6.6 | -0.5 | -9.0 | 3.3 |
| Ave. | -9.9 | -9.1 | -4.9 | 1.3 | 7.3 | 11.8 | 14.9 | 15.5 | 10.7 | 3.5 | -2.6 | -7.6 | 2.6 |

**Table S 2.1.2 (1) Precipitation Data of Tashkent Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 40.4 | 80.2 | 60.3 | 50.5 | 34.7 | 8.6 | | 8.1 | 0.0 | 34.9 | 40.6 | 19.0 | 377.3 |
| 1981 | 53.0. | 27.3 | 94.1 | 50.0 | 52.4 | 13.8 | 15.7 | 1.1 | 9.0 | 3.1 | 44.2 | 26.1 | 336.8 |
| 1982 | 35.9 | 31.4 | 102.4 | 20.9 | 16.5 | 16.8 | 1.7 | 0.3 | 17.5 | 77.1 | 67.8 | 27.6 | 415.9 |
| 1983 | 49.6 | 42.7 | 26.7 | 18.3 | 50.4 | 10.5 | 0.0 | 0.0 | 0.0 | 0.0 | 86.5 | 43.3 | 328.0 |
| 1984 | 18.3 | 43.5 | 111.7 | 23.7 | 12.0 | 8.6 | | | 0.3 | 37.0 | 77.4 | 30.6 | 363.1 |
| 1985 | 66.1 | 63.5 | 82.0 | 44.5 | 33.0 | 2.9 | 0.0 | 0.0 | | 25.7 | 6.1 | 41.2 | 365.0 |
| 1986 | 42.5 | 21.9 | 46.7 | 32.8 | 19.5 | 5.8 | 4.8 | | 13.5 | 40.1 | 17.3 | 98.8 | 343.7 |
| 1987 | 44.5 | 24.9 | 158.1 | 129.0 | 20.8 | 4.6 | 17.8 | 0.0 | 10.5 | 49.3 | 25.8 | 47.3 | 532.6 |
| 1988 | 66.6 | 42.2 | 65.1 | 44.1 | 34.2 | 0.6 | 0.0 | 0.9 | 10.1 | 14.9 | 22.9 | 40.5 | 342.1 |
| 1989 | 58.9 | 32.8 | 59.8 | 47.9 | 37.1 | 0.7 | 2.4 | | 5.2 | 16.5 | 70.1 | 86.2 | 417.6 |
| 1990 | 76.7 | 56.1 | 34.1 | 179.1 | 20.8 | 0.8 | 3.1 | | 0.0 | 64.0 | 22.8 | 51.0 | 508.5 |
| 1991 | 67.6 | 30.3 | 64.7 | 56.1 | 64.8 | 17.9 | 3.0 | | 3.8 | 4.3 | 27.7 | 135.8 | 476.0 |
| 1992 | 56.3 | 70.7 | 46.3 | 69.8 | 83.3 | 29.0 | | 1.8 | 3.3 | 20.8 | 7.5 | 18.8 | 407.6 |
| 1993 | 22.5 | 182.8 | 92.9 | 103.2 | 93.8 | 21.4 | 3.0 | 4.0 | 10.4 | 36.0 | 105.7 | 72.1 | 747.8 |
| 1994 | 50.5 | 57.6 | 41.3 | 78.1 | 77.6 | 11.2 | | | 12.9 | 3.2 | 95.3 | 83.2 | 510.9 |
| 1995 | 45.0 | 38.1 | 32.5 | 13.6 | 15.9 | 10.5 | 6.5 | 0.3 | 0.4 | 28.4 | 8.0 | 33.9 | 233.1 |
| 1996 | 17.7 | 108.8 | 37.0 | 66.1 | 6.4 | 1.7 | 11.7 | 0.0 | 20.2 | 9.3 | 6.5 | 6.3 | 291.7 |
| 1997 | 81.2 | 53.3 | 32.0 | 54.6 | 57.9 | 23.9 | | 0.3 | 0.0 | 12.0 | 36.0 | 54.0 | 405.2 |
| 1998 | 94.9 | 117.5 | 122.7 | 67.6 | 100.2 | 41.6 | 17.2 | 0.3 | 12.1 | 31.0 | 25.0 | 53.9 | 684.0 |
| 1999 | 83.0 | 90.6 | 63.5 | 44.6 | 53.6 | 52.3 | 12.2 | 5.1 | 10.6 | 10.7 | 84.9 | 14.2 | 525.3 |
| 2000 | 68.7 | 24.1 | 42.1 | 35.4 | 3.0 | 14.8 | 1.0 | | 9.6 | 50.7 | 37.3 | 53.0 | 339.7 |
| 2001 | 21.7 | 61.0 | 56.6 | 32.1 | 2.2 | 0.0 | 0.6 | 4.5 | 0.4 | 65.5 | 32.0 | 88.6 | 365.2 |
| 2002 | 57.3 | 95.4 | 117.8 | 123.5 | 72.9 | 10.3 | 1.6 | 1.0 | 0.0 | 0.0 | 7.9 | 98.2 | 585.9 |
| Ave. | 50.7 | 60.7 | 69.1 | 60.2 | 41.9 | 13.4 | 4.4 | 1.2 | 6.5 | 27.6 | 41.5 | 53.2 | 430.6 |

**Table S 2.1.2 (2) Precipitation Data of Sukok Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 59.0 | 133.5 | 114.4 | 185.1 | 58.6 | 17.3 | | 11.2 | 0.7 | 70.8 | 83.2 | 34.3 | 768.1 |
| 1981 | 4.2 | 88.9 | 163.4 | 105.2 | 166.4 | 24.5 | 18.5 | 14.8 | 52.0 | 16.6 | 96.9 | 35.2 | 786.6 |
| 1982 | 54.8 | 70.1 | 169.1 | 33.5 | 33.1 | 68.1 | 4.6 | 0.5 | 61.0 | 175.4 | 73.9 | 44.6 | 788.7 |
| 1983 | 106.8 | 50.5 | 82.8 | 142.3 | 108.4 | 14.6 | | 0.0 | 0.3 | 2.2 | 86.8 | 84.6 | 679.3 |
| 1984 | 31.1 | 74.4 | 163.0 | 79.7 | 62.1 | 2.6 | 2.4 | | 2.5 | 97.3 | 186.8 | 53.8 | 755.7 |
| 1985 | 116.5 | 94.3 | 133.2 | 109.9 | 74.5 | 10.5 | 0.4 | 3.9 | | 63.8 | 31.4 | 59.2 | 697.6 |
| 1986 | 69.3 | 29.4 | 97.2 | 87.1 | 40.1 | 16.6 | 5.4 | 0.0 | 50.5 | 65.3 | 59.2 | 194.6 | 714.7 |
| 1987 | 84.2 | 92.3 | 246.4 | 274.7 | 49.6 | 8.2 | 55.4 | 0.8 | 14.7 | 95.5 | 73.3 | 69.4 | 1,064.5 |
| 1988 | 103.2 | 56.2 | 158.7 | 68.5 | 86.3 | 3.8 | 0.5 | 0.5 | 12.4 | 43.6 | 54.2 | 118.1 | 706.0 |
| 1989 | 92.7 | 84.6 | 106.7 | 107.7 | 50.3 | 2.4 | 4.2 | 0.0 | 19.1 | 30.6 | 84.6 | 182.9 | 765.8 |
| 1990 | 100.0 | 68.5 | 137.5 | 276.0 | 28.6 | 11.4 | 14.0 | 0.3 | | 45.5 | 12.5 | 65.2 | 759.5 |
| 1991 | 84.5 | 55.0 | 127.9 | 160.0 | 156.2 | 40.3 | 8.3 | 0.3 | 17.7 | 7.6 | 28.1 | 267.1 | 953.0 |
| 1992 | 99.4 | 120.2 | 84.4 | 131.2 | 190.0 | 25.4 | 2.2 | 6.4 | 3.1 | 19.0 | 27.2 | 104.1 | 812.6 |
| 1993 | 55.3 | 228.3 | 210.3 | 169.6 | 149.4 | 41.8 | 0.0 | 10.0 | 8.7 | 43.4 | 173.8 | 136.1 | 1,226.7 |
| 1994 | 90.7 | 98.5 | 110.6 | 166.4 | 153.7 | 51.1 | 0.0 | 0.0 | 12.3 | 9.3 | 240.0 | 135.2 | 1,067.8 |
| 1995 | 68.1 | 64.0 | 113.7 | 41.5 | 57.9 | 17.8 | 5.1 | 0.3 | 0.2 | 73.1 | 43.8 | 55.0 | 540.5 |
| 1996 | 48.5 | 138.1 | 114.4 | 168.2 | 12.2 | 51.8 | 18.9 | 0.0 | 30.6 | 28.3 | 32.8 | 14.3 | 658.1 |
| 1997 | 119.0 | 117.3 | 106.8 | 160.3 | 196.4 | 23.2 | 0.0 | 2.9 | 0.0 | 28.6 | 80.2 | 98.9 | 933.6 |
| 1998 | 138.7 | 178.3 | 209.0 | 150.3 | 179.5 | 63.6 | 45.0 | 2.3 | 15.2 | 29.3 | 60.7 | 107.1 | 1,179.0 |
| 1999 | 124.3 | 111.4 | 141.7 | 114.5 | 153.4 | 29.0 | 76.1 | 7.0 | 22.1 | 15.3 | 220.1 | 26.9 | 1,041.8 |
| 2000 | 102.3 | 42.6 | 74.6 | 86.5 | 8.5 | 19.2 | 8.8 | 3.0 | 9.1 | 158.6 | 93.3 | 107.7 | 714.2 |
| 2001 | 58.3 | 97.7 | 85.3 | 85.3 | 4.0 | 5.5 | 6.0 | 18.6 | 0.3 | 132.4 | 76.7 | 128.6 | 698.7 |
| 2002 | 77.1 | 152.4 | 227.0 | 269.0 | 156.1 | 40.0 | 1.2 | 1.3 | 3.1 | 5.0 | 63.5 | 155.0 | 1,150.7 |
| Ave. | 82.1 | 97.7 | 138.2 | 137.9 | 94.6 | 25.6 | 12.0 | 3.7 | 14.6 | 54.6 | 86.2 | 99.0 | 846.2 |

**Table S 2.1.2 (3) Precipitation Data of Chimgan Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | - | 157.3 | 88.6 | 218.9 | 136.9 | 28.1 | | 15.0 | 4.1 | 70.1 | 141.9 | 35.1 | - |
| 1982 | 69.6 | 97.3 | 139.0 | 43.3 | 45.9 | 13.6 | 49.2 | 1.0 | 34.7 | 178.0 | 62.3 | 58.2 | 792.1 |
| 1983 | 75.1 | 37.5 | 73.0 | 82.7 | 135.5 | 22.7 | 1.0 | | 0.5 | 26.2 | 92.4 | 79.1 | 625.7 |
| 1984 | 29.5 | 75.3 | 164.4 | 84.7 | 80.4 | 6.3 | | | 4.6 | 107.2 | 213.6 | 46.4 | 812.4 |
| 1985 | 135.2 | 106.1 | 124.9 | 115.2 | 54.3 | 25.5 | 1.3 | 3.3 | | 102.4 | 54.6 | 71.8 | 794.6 |
| 1986 | 64.1 | 23.9 | 81.4 | 103.2 | 64.2 | 9.8 | 14.9 | 0.4 | 58.8 | 98.3 | 82.9 | 213.5 | 815.4 |
| 1987 | 111.1 | 89.9 | 204.9 | 325.1 | 51.0 | 7.6 | 76.0 | 2.1 | 32.5 | 112.9 | 95.5 | 84.6 | 1,193.2 |
| 1988 | 64.1 | 82.0 | 133.2 | 68.5 | 98.7 | 0.9 | 0.1 | 5.7 | 23.4 | 76.6 | 83.0 | 136.4 | 772.6 |
| 1989 | 101.8 | 72.1 | 84.9 | 115.9 | 74.7 | 18.7 | 7.2 | 0.0 | 55.5 | 54.5 | 90.2 | 256.5 | 932.0 |
| 1990 | 102.0 | 74.8 | 164.8 | 249.9 | 52.9 | 17.5 | 28.3 | 0.0 | 0.9 | 132.6 | 35.4 | 65.0 | 924.1 |
| 1991 | 78.5 | 39.8 | 78.9 | 127.4 | 157.1 | 67.2 | 17.9 | | 13.3 | 22.6+ | 25.0 | 256.6 | 861.7 |
| 1992 | 90.6 | 119.3 | 60.3 | 137.7 | 124.4 | 51.4 | 28.2 | 14.9 | 8.3 | 36.0 | 22.1 | 107.7 | 800.9 |
| 1993 | 60.9 | 277.4 | 198.5 | 127.0 | 211.0 | 48.5 | 5.6 | 38.0 | 17.0 | 80.3 | 217.5 | 110.8 | 1,392.5 |
| 1994 | 63.4 | 97.7 | 99.5 | 198.9 | 194.7 | 29.1 | 0.0 | | 21.0 | 10.5 | 301.0 | 135.2 | 1,151.0 |
| 1995 | 90.2 | 45.1 | 66.5 | 16.3 | 29.4 | 63.4 | | | 0.0 | 53.4 | 31.7 | 46.7 | 442.7 |
| 1996 | 41.1 | 135.5 | 111.7 | 158.2 | 52.0 | 12.0 | 15.7 | 0.3 | 30.9 | 58.8 | 36.5 | 16.8 | 669.5 |
| 1997 | 103.1 | 62.9 | 49.4 | 85.5 | 151.2 | 81.7 | 0.0 | 6.3 | | 35.6 | 86.5 | 90.4 | 752.6 |
| 1998 | 134.5 | 166.8 | 204.8 | 137.4 | 282.6 | 116.3 | 98.2 | 10.0 | 9.6 | 22.4 | 30.9 | 73.2 | 1,286.7 |
| 1999 | 87.9 | 105.8 | 129.4 | 137.0 | 100.1 | 40.5 | 92.0 | 3.3 | 47.2 | 15.2 | 234.8 | 20.2 | 1,013.4 |
| 2000 | 80.9 | 31.9 | 41.7 | 90.5 | 23.0 | 22.7 | 17.0 | 4.8 | 34.6 | 188.0 | 83.2 | 93.1 | 711.4 |
| 2001 | 57.3 | 74.0 | 59.5 | 95.6 | 16.8 | 4.7 | 32.3 | 55.5 | 7.6 | 209.8 | 58.0 | 113.0 | 784.1 |
| 2002 | 68.6 | 150.0 | 176.6 | 278.9 | 177.7 | 46.0 | 5.8 | 7.6 | 0.7 | 26.5 | 39.4 | 128.5 | 1,106.3 |
| Ave. | 77.7 | 92.3 | 110.3 | 130.3 | 100.6 | 31.9 | 21.3 | 7.3 | 17.6 | 73.7 | 92.1 | 97.3 | 847.0 |

**Table S 2.1.2 (4) Precipitation Data of Charvak Dam Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 58.1 | 132.6 | 99.8 | 183.8 | 71.1 | 27.4 | | 8.3 | 0.3 | 53.3 | 135.0 | 29.8 | 799.5 |
| 1981 | 97.0 | 94.1 | 132.0 | 85.8 | 115.4 | 29.2 | 24.2 | 35.6 | 43.9 | 14.5 | 122.9 | 24.8 | 819.4 |
| 1982 | 68.0 | 58.9 | 126.3 | 25.6 | 31.5 | 13.9 | 9.6 | 1.7 | 60.6 | 157.5 | 27.8 | 47.0 | 628.4 |
| 1983 | 84.9 | 37.2 | 60.4 | 51.9 | 110.6 | 39.5 | 1.5 | | 0.6 | 18.6 | 71.3 | 67.7 | 544.2 |
| 1984 | 34.4 | 77.4 | 172.0 | 47.9 | 60.6 | 11.6 | | | 1.9 | 70.9 | 184.9 | 47.9 | 709.5 |
| 1985 | 116.5 | 96.1 | 105.3 | 74.2 | 56.4 | 19.0 | 0.0 | 1.5 | | 79.4 | 55.5 | 77.8 | 681.7 |
| 1986 | 46.9 | 26.9 | 65.9 | 72.9 | 42.1 | 8.0 | 9.0 | | 50.7 | 97.5 | 78.2 | 194.3 | 692.4 |
| 1987 | 109.0 | 105.8 | 189.9 | 275.7 | 34.4 | 7.2 | 48.4 | 0.6 | 21.9 | 103.5 | 71.9 | 85.3 | 1,053.6 |
| Ave. | 76.9 | 78.6 | 119.0 | 102.2 | 65.3 | 19.5 | 11.6 | 6.0 | 22.5 | 74.4 | 93.4 | 71.8 | 741.1 |

**Table S 2.1.2 (5) Precipitation Data of Pskem Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 69.2 | 127.6 | 85.9 | 208.9 | 56.3 | 65.7 | 0.0 | 5.6 | 8.4 | 45.3 | 158.3 | 18.3 | 849.5 |
| 1981 | 73.9 | 86.0 | 11.3 | 87.7 | 94.8 | 55.3 | 52.0 | 28.8 | 42.7 | 15.5 | 101.2 | 40.6 | 689.8 |
| 1982 | 62.5 | 37.9 | 106.8 | 39.3 | 35.2 | 28.6 | 13.1 | 2.4 | 59.0 | 143.6 | 85.6 | 38.4 | 652.4 |
| 1983 | 64.4 | 19.6 | 40.2 | 41.1 | 113.1 | 62.7 | 9.5 | 5.9 | 1.1 | 30.0 | 111.3 | 72.2 | 571.1 |
| 1984 | 19.7 | 96.3 | 175.0 | 75.2 | 51.6 | 11.1 | | | 3.7 | 57.2 | 212.3 | 44.5 | 746.6 |
| 1985 | 166.5 | 106.4 | 95.6 | 63.5 | 59.6 | 43.2. | 1.1 | 9.1 | | 95.8 | 71.7 | 99.8 | 769.1 |
| 1986 | 70.7 | 37.2 | 37.3 | 94.0 | 47.5 | 6.9 | 15.7 | 1.3 | 19.9 | 92.7 | 70.1 | 208.3 | 701.6 |
| 1987 | 107.3 | 92.9 | 200.8 | 259.9 | 45.0 | 12.1 | 42.8 | 5.5 | 24.6 | 126.6 | 93.0 | 115.9 | 1,126.4 |
| 1988 | 71.6 | 119.6 | 120.2 | 95.7 | 111.1 | 11.0 | 0.9 | 18.9 | 7.8 | 80.3 | 33.0 | 132.0 | 802.1 |
| 1989 | 102.6 | 57.6 | 79.8 | 87.2 | 54.0 | 13.0 | 7.1 | 0.0 | 63.1 | 59.4 | 109.1 | 269.1 | 902.0 |
| 1990 | 118.9 | 75.7 | 133.2 | 152.2 | 57.1 | 22.7 | 64.0 | 7.9 | 5.0 | 101.1 | 35.3 | 76.7 | 849.8 |
| 1991 | 115.1 | 34.9 | 82.1 | 57.3 | 67.1 | 52.0 | 18.5 | 0.4 | 83.6 | 20.5 | 21.4 | 283.7 | 836.6 |
| 1992 | 91.1 | 109.1 | 61.3 | 119.3 | 112.4 | 76.0 | 23.6 | 28.7 | 7.2 | 36.4 | 32.0 | 123.6 | 820.7 |
| 1993 | 69.7 | 261.9 | 162.9 | 116.6 | 177.4 | 35.8 | 32.1 | 41.4 | 13.3 | 85.4 | 283.2 | 108.3 | 1,388.0 |
| 1994 | 76.4 | 150.5 | 81.9 | 177.7 | 59.8 | 29.3 | | | 21.3 | 14.7 | 342.9 | 158.0 | 1,112.5 |
| 1995 | 74.9 | 37.3 | 53.3 | 9.3 | 48.3 | 27.4 | 46.3 | 7.9 | 2.0 | 76.7 | 14.5 | 54.6 | 452.5 |
| 1996 | 53.6 | 151.1 | 107.7 | 239.0 | 63.0 | 20.4 | 31.6 | 1.7 | 35.9 | 56.4 | 27.6 | 58.6 | 846.6 |
| 1997 | 169.5 | 48.7 | 44.3 | 73.2 | 85.7 | 67.0 | 0.3 | 17.8 | 0.4 | 26.7 | 72.9 | 118.9 | 725.4 |
| 1998 | 175.3 | 187.5 | 188.4 | 121.4 | 182.2 | 76.0 | 62.5 | 7.5 | 32.3 | 32.5 | 67.7 | 93.1 | 1,226.4 |
| 1999 | 70.7 | 105.5 | 104.3 | 102.7 | 79.9 | 72.0 | 87.7 | 6.3 | 43.8 | 23.7 | 192.9 | 26.8 | 916.3 |
| 2000 | 98.6 | 20.5 | 27.5 | 51.7 | 45.9 | 11.1 | 31.3 | 1.2 | 54.8 | 197.2 | 48.8 | 110.2 | 698.8 |
| 2001 | 37.8 | 114.1 | 50.0 | 75.3 | 14.1 | 0.0 | 22.5 | 65.8 | 0.0 | 252.6 | 60.8 | 122.3 | 815.3 |
| 2002 | 58.9 | 142.0 | 143.1 | 238.2 | 115.3 | 66.1 | 5.9 | 3.4 | 0.3 | 45.2 | 28.9 | 179.8 | 1,027.1 |
| Ave. | 87.8 | 96.5 | 95.3 | 112.5 | 77.2 | 35.7 | 24.7 | 11.6 | 23.1 | 74.6 | 98.9 | 111.0 | 849.0 |

**Table S 2.1.2 (6) Precipitation Data of Oygaing Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 48.4 | 72.2 | 61.7 | 153.6 | 61.0 | 65.9 | 0.5 | 9.8 | 28.6 | 55.9 | 122.0 | 10.6 | 690.2 |
| 1981 | 82.0 | 65.6 | 78.7 | 82.7 | 67.7 | 45.6 | 67.3 | 64.0 | 23.1 | 13.1 | 68.6 | 34.0 | 692.4 |
| 1982 | 37.4 | 23.2 | 73.8 | 23.5 | 21.9 | 20.4 | 33.9 | 11.6. | 61.3 | 128.5 | 65.8 | 22.9 | 512.6 |
| 1983 | 47.6 | 13.0 | 25.0 | 28.1 | 129.8 | 62.7 | 26.0 | 5.9 | 10.1 | 12.5 | 110.7 | 52.4 | 523.8 |
| 1984 | 10.1 | 87.5 | 198.4 | 98.0 | 56.4 | 15.1 | 0.0 | | 23.9 | 49.1 | 155.0 | 48.4 | 741.9 |
| 1985 | 84.6 | 74.3 | 72.7 | 59.3 | | 42.8 | 5.0 | 13.6 | 0.6 | 68.2 | 36.8 | 98.4 | 556.3 |
| 1986 | 59.2 | 22.5 | 25.3 | 96.5 | 85.9 | 20.5 | 13.7 | 3.7 | 28.6 | 88.2 | 41.3 | 152.2 | 637.6 |
| 1987 | 75.8 | 87.2 | 173.5 | 197.1 | 64.5 | 52.1 | 59.9 | 22.4 | 57.6 | 101.2 | 65.2 | 86.3 | 1,042.8 |
| 1988 | 45.2 | 105.9 | 67.3 | 72.2 | 99.1 | 26.4 | 12.7 | 39.6 | 12.1 | 90.9 | 24.0 | 80.8 | 676.2 |
| 1989 | 52.9 | 28.6 | 35.0 | 59.0 | 59.8 | 14.0 | 13.9 | 6.0 | 65.5 | 42.7 | 52.5 | 202.2 | 632.1 |
| 1990 | 119.0 | 49.5 | 34.0 | 73.4 | 73.4 | 21.3 | 95.4 | 10.8 | 10.4 | 91.2 | - | - | - |
| 1991 | 63.7 | 21.3 | 32.7 | 36.0 | 58.1 | 86.1 | 40.4 | 3.7 | 9.7 | 24.6 | 18.0 | 151.0 | 545.3 |
| 1992 | 74.3 | 67.6 | 52.5 | 85.2 | 68.3 | 64.4 | 35.9 | 75.6 | 20.2 | 28.9 | 27.6 | 117.5 | 718.0 |
| 1993 | 36.6 | 174.1 | 101.2 | 100.7 | 133.2 | 50.8 | 11.3 | 35.1 | 16.9 | 66.7 | 271.7 | 79.3 | 1,077.6 |
| 1994 | 37.3 | 98.7 | 72.9 | 115.1 | 38.5 | 24.4 | 0.0 | 0.0 | 20.6 | 24.5 | 314.6 | 119.8 | 866.4 |
| 1995 | 38.5 | 30.4 | 33.1 | 13.5 | 49.6 | 43.5 | 62.8 | 16.4 | 5.3 | 96.1 | 19.2 | 34.0 | 442.4 |
| 1996 | 35.1 | 99.7 | 107.7 | 229.2 | 75.8 | 31.7 | 64.4 | 3.0 | 27.0 | 100.3 | 18.8 | 47.1 | 839.8 |
| 1997 | 160.6 | 46.0 | 50.6 | 66.0 | 58.4 | 76.6 | 4.2 | 17.9 | 1.9 | 8.6 | 78.2 | 70.8 | 639.8 |
| 1998 | 129.4 | 203.6 | 140.7 | 115.3 | 141.7 | 102.6 | 67.1 | 19.5 | 31.5 | 39.6 | 43.7 | 79.0 | 1,113.7 |
| 1999 | 42.1 | 62.9 | 71.8 | 68.7 | 62.9 | 97.7 | 101.6 | 25.8 | 39.9 | 29.5 | 113.1 | 31.5 | 747.5 |
| 2000 | 55.8 | 8.2 | 15.7 | 56.2 | 104.6 | 15.8 | 28.1 | 7.2 | 46.8 | 203.3 | 47.2 | 78.6 | 667.5 |
| 2001 | 35.2 | 62.8 | 35.4 | 66.0 | 28.8 | 8.7 | 35.1 | 98.2 | 17.3 | 232.4 | 46.1 | 94.5 | 760.5 |
| 2002 | 45.7 | 109.6 | 94.5 | 218.1 | 123.5 | 71.6 | 25.1 | 15.8 | 6.9 | 70.9 | 32.8 | 118.5 | 933.0 |
| Ave. | 61.6 | 70.2 | 71.9 | 91.9 | 72.3 | 46.1 | 35.0 | 21.5 | 24.6 | 72.5 | 80.6 | 82.3 | 729.9 |

**Table S 2.1.3 (1) Snow Depth Data of Tashkent Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 2 | 14 | | | | | | | | | | |
| 1981 | | 5 | | | | | | | | | | 6 |
| 1982 | 6 | 8 | 0 | 0 | | | | | | | 1 | 9 |
| 1983 | 5 | 0 | 0 | | | | | | | | 0 | 2 |
| 1984 | 3 | 19 | 8 | | | | | | | | | 13 |
| 1985 | 12 | 4 | 6 | | | | | | | | | |
| 1986 | 2 | 1 | 6 | | | | | | | | | |
| 1987 | 10 | 2 | | | | | | | | | | |
| 1988 | 6 | 4 | 1 | | | | | | | | 2 | 3 |
| 1989 | 16 | 13 | | | | | | | | | 1 | |
| 1990 | 16 | 2 | | | | | | | | | | 7 |
| Ave. | 7 | 7 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |

**Table S 2.1.3 (2) Snow Depth Data of Sukok Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 24 | 30 | 17 | 0 | | | | | | | | 0 |
| 1981 | 6 | 13 | 0 | | | | | | | | 17 | 12 |
| 1982 | 15 | 30 | 15 | 0 | | | | | | 0 | 7 | 24 |
| 1983 | 32 | 7 | 0 | | | | | | | | 0 | 10 |
| 1984 | 26 | 71 | 58 | | | | | | | | 1 | 32 |
| 1985 | 47 | 30 | 16 | | | | | | | | | |
| 1986 | 10 | 6 | 10 | | | | | | | | | |
| 1987 | 24 | 7 | 2 | 10 | | | | | | | | |
| 1988 | 28 | 23 | 8 | 2 | | | | | | | 5 | 13 |
| 1989 | 43 | 59 | 46 | 11 | 4 | | | | | | 9 | 14 |
| 1990 | 43 | 30 | | | | | | | | 6 | | 18 |
| Ave. | 27 | 28 | 16 | 2 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 11 |

**Table S 2.1.3 (3) Snow Depth Data of Chimgan Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1982 | 47 | 72 | 58 | 0 | | | | | | | 20 | 51 |
| 1983 | 34 | 77 | 101 | | | | | | | | | |
| 1984 | --- | --- | --- | --- | | | | | | | 19 | |
| 1985 | 108 | 95 | 108 | 19 | | | | | | | | |
| 1986 | 38 | 42 | 42 | 22 | | | | | | | | |
| 1987 | 65 | 61 | 37 | | | | | | | | | |
| 1988 | 46 | 47 | 42 | 41 | | | | | | | 4 | 30 |
| 1989 | 71 | 94 | 85 | 27 | 6 | | | | | | 12 | 16 |
| 1990 | 50 | 73 | 64 | 8 | | | | | | 9 | 4 | 28 |
| Ave. | 57 | 70 | 67 | 15 | 1 | 0 | 0 | 0 | 0 | 1 | 7 | 14 |

**Table S 2.1.3 (4) Snow Depth Data of Charvak Dam Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 12 | 28 | 12 | | | | | | | | | 0 |
| 1981 | 4 | 13 | 0 | | | | | | | | 8 | 5 |
| 1982 | 10 | 6 | 0 | 0 | | | | | | 0 | 5 | 11 |
| 1983 | 20 | 7 | 0 | | | | | | | | 0 | 3 |
| 1984 | 2 | 48 | 37 | | | | | | | | 0 | 15 |
| 1985 | 34 | 18 | 4 | | | | | | | | | |
| 1986 | 13 | 6 | 9 | | | | | | | | | |
| 1987 | 19 | 4 | 2 | 6 | | | | | | | | |
| 1988 | - | - | - | - | - | | | | | - | - | - |
| 1989 | 23 | 33 | 20 | 1 | 3 | | | | | | | |
| 1990 | - | - | - | - | - | | | | | 3 | - | - |
| Ave. | 14 | 16 | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 |

**Table S 2.1.3 (5) Snow Depth Data of Pskem Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 60 | 100 | 94 | 0 | | | | | | 0 | | 5 |
| 1981 | 15 | 54 | 49 | 0 | | | | | | | 48 | 50 |
| 1982 | 60 | 75 | 55 | 0 | | | | | | 0 | 17 | 47 |
| 1983 | 58 | 47 | 39 | | | | | | | | 1 | 54 |
| 1984 | 44 | 105 | 105 | 0 | | | | | | | 12 | 35 |
| 1985 | 116 | 111 | 95 | 18 | | | | | | | -- | -- |
| 1986 | 38 | 45 | 38 | 8 | | | | | | | -- | -- |
| 1987 | 82 | 71 | 53 | 3 | | | | | | | -- | -- |
| 1988 | 45 | 63 | 40 | 5 | | | | | | | | 13 |
| 1989 | 64 | 87 | 81 | 5 | | | | | | 5 | 6 | 39 |
| 1990 | 76 | 84 | 76 | 10 | | | | | | | | 18 |
| Ave. | 60 | 77 | 66 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 33 |

**Table S 2.1.3 (6) Snow Depth Data of Oygaing Station**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 72 | 105 | 128 | 91 | | | | | | | 35 | 35 |
| 1981 | 91 | 101 | 106 | 89 | | | | | | | 39 | 57 |
| 1982 | 66 | 75 | 105 | 91 | | | | | | 0 | 40 | 46 |
| 1983 | 71 | 76 | 85 | 27 | | | | | | 2 | 56 | 71 |
| 1984 | 68 | 119 | 152 | 139 | 0 | | | | | 11 | 88 | 118 |
| 1985 | 141 | 168 | 166 | 15 | | | | | | | -- | -- |
| 1986 | 112 | 118 | 127 | 113 | 8 | | | | | | | 81 |
| 1987 | 120 | 162 | 188 | 189 | 126 | | | | | 22 | 20 | 51 |
| 1988 | 96 | 173 | 148 | 151 | 19 | | | | | 15 | 4 | 60 |
| 1989 | 99 | 109 | 110 | 100 | 32 | | | | 4 | 12 | 58 | 115 |
| 1990 | 188 | 180 | 237 | 177 | 95 | | | | | 5 | 5 | - |
| Ave. | 102 | 126 | 141 | 107 | 25 | 0 | 0 | 0 | 0 | 6 | 35 | 63 |

Figure S 2.1.2 to 4 shows monthly average of temperature, precipitation and maximum snow depth for each station, respectively.

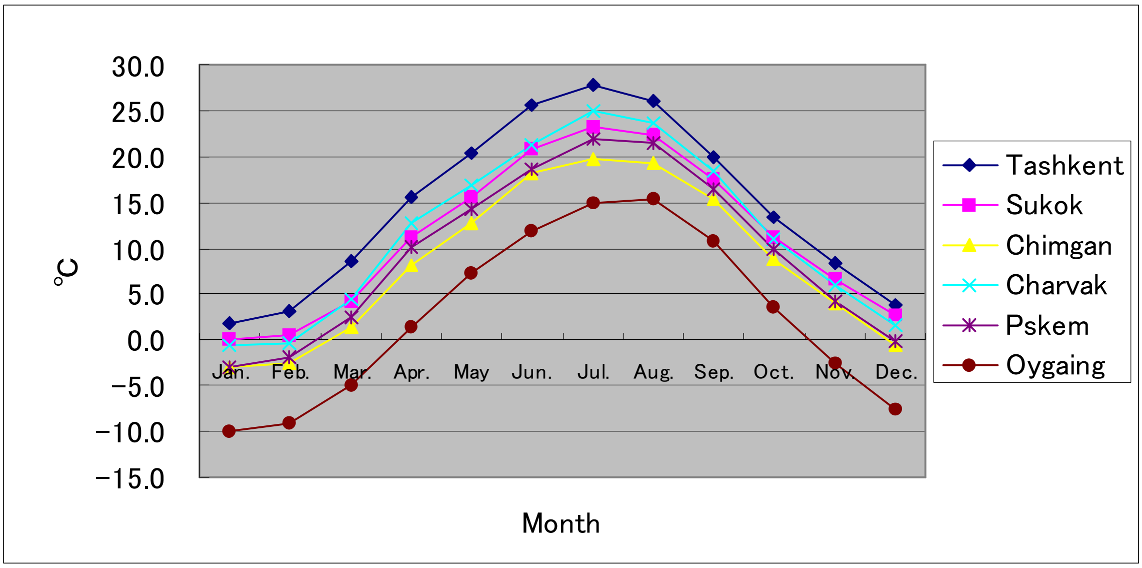



**Figure S 2.1.2Monthly Average of Temperature**

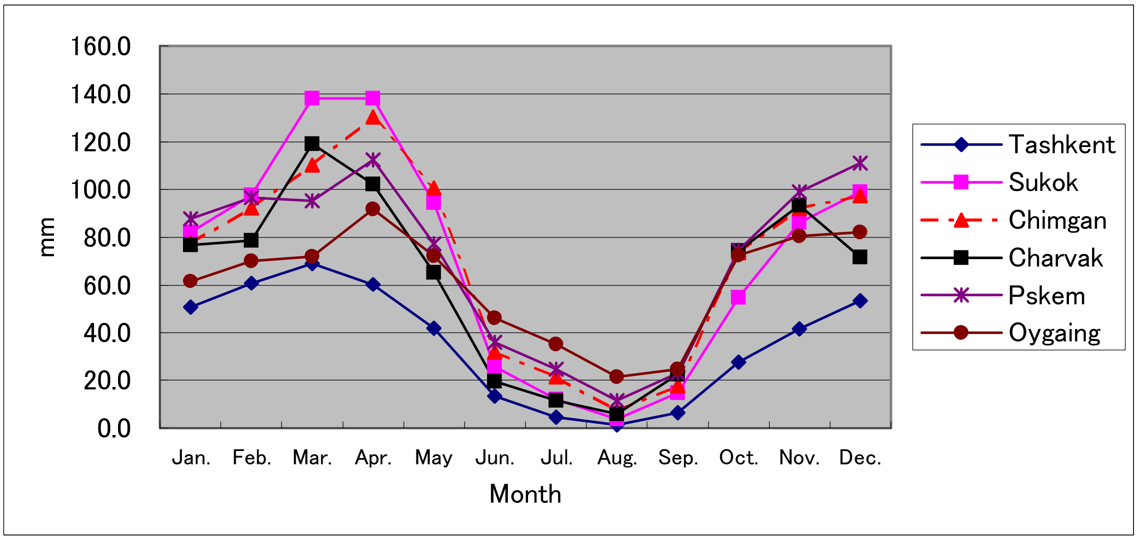



**Figure S 2.1.3 Monthly Average of Precipitation**

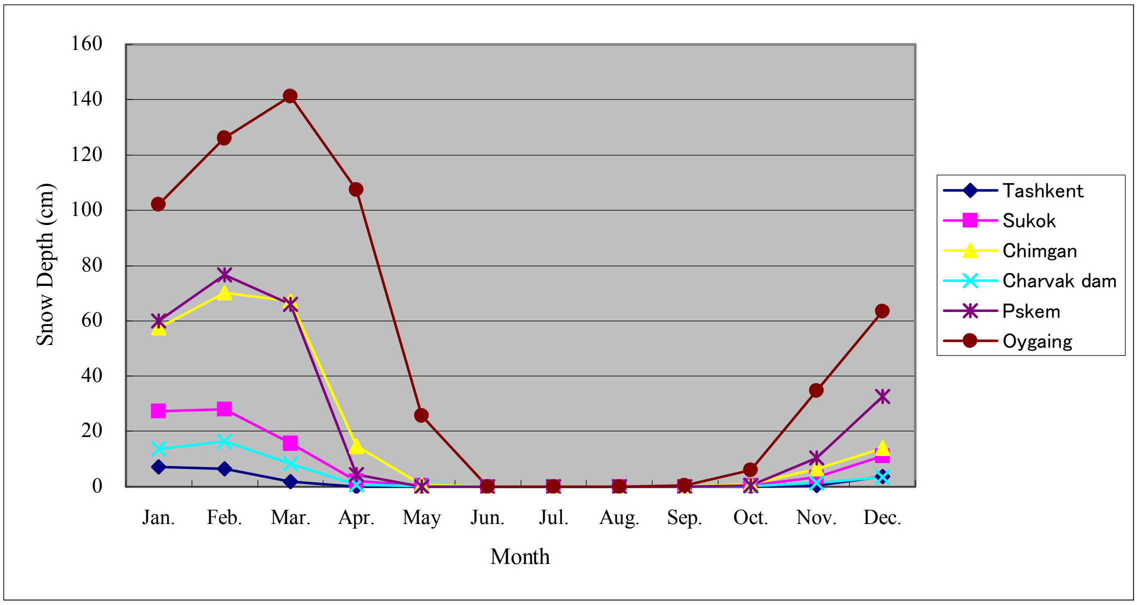



**Figure S 2.1.4 Monthly Average of Maximum Snow Depth**

# S 2.1.2 Water Source for Tashkent City

### (1) Water Flow Monitoring Stations in the Chirchik River Basin

There are 166 rivers/streams with length less than 10km and 27 rivers with length over 10km in the Chirchik River Basin, excluding concentrated network of irrigation and drainage canals. The water flow rates of the rivers were observed for 55 points of 25 rivers. The locations of observation stations are shown in Figure 2.1.5, and the tributary rivers with length more than 10km are listed in Table S 2.1.4.

The first water flow observations were started in the Chirchik Basin at Khodjikent Village in 1900 and it had been continued without any break until 1976, when the post was carried away by a flood during the construction of the dam for the Khodjikent hydroelectric power station. In 1915, the following posts began to function: 1) the Chirchik River, directly below the point where the Chatkal River flows into, 2) the Chirchik River Mouth, 3) the Chatkal River above the Ters River mouth, 4) the Ters River Mouth and 5) the Pskem River Mouth. Unfortunately, these posts had not worked for long time. The number of the posts reached its peak in the period of 1965-1985s and then the number was gradually decreased. The observations on some posts had lasted for 60 or more years, however, interruptions of observation have frequently been taken place. There were any observation flow post in some districts, although there were/ are flow posts at major points in the basin.

Total number of years of observations for all 55 posts is 1475, among them observations of 1267 full calendar years was carried out and it is 86% out of total number of observation years. The lists of rivers posts with distance from the river mouth connecting with the Sirdarya River, basin areas, basin average heights and survey period are shown in Table S 2.1.5.
As shown in Table S 2.1.5 and Figure S 2.1.5, since water flow observations had been carried out on various rivers (large and small), an abundant flow data in the Chirchik Rive Basin could be obtained. However observation conducted for almost all small waterways either too short duration, or intermittent execution, which makes water flow analysis using the data difficult.

Based on the study conducted by Shultz V.L. [ 1 ] and the analysis of obtained data, it may be assumed that any thirty-year period of the 20th century practically enables to define average long-term discharge at the precision of no more than ± 5% for the Chirchik Basin.

## Table S 2.1.4 Characteristics of Rivers in Chirchik Basin With Observation Posts

| Name of River | | Length, km | Basin area, $km^2$ | Posts Number |
|---|---|---|---|---|
| 1 | Chirchik (Sirdarya) | 161 | 14,900.0 | 16 |
| 2 | Chatkal (Charvak dam) | 217 | 7,110.0 | 6 |
| 3 | Aksu (Chatkal) | 18 | 90.0 | 1 |
| 4 | Sandalash (Chatkal) | 94 | 1,150.0 | 1 |
| 5 | Nayza (Chatkal) | 17 | 109.0 | 1 |
| 6 | Ters (Chatkal) | 40 | 549.0 | 1 |
| 7 | Italgi (Chatkal) | 10 | 10.0 | 1 |
| 8 | Akbulak (Chatkal) | 39 | 886.0 | 1 |
| 9 | Yangikurgan (Charvak dam) | | 190.0 | 2 |
| 10 | Koksu (Charvak dam) | 60 | 398.0 | 2 |
| 11 | Pskem (Charvak dam) | 73 | 2,840.0 | 2 |
| 12 | Oygaing (Chirchik) | 72 | 1,100.0 | 2 |
| 13 | Koksu (Pskem) | 20 | 188.0 | 1 |
| 14 | Chiralma (Pskem ) | 15 | 103.0 | 1 |
| 15 | Maydantal (Pskem) | 50 | 477.0 | 2 |
| 16 | Urungach (Pskem) | 10 | 46.9 | 1 |
| 17 | Nauvalisay (Pskem) | 17 | 98.0 | 1 |
| 18 | Chimgansay (Charvak dam) | 17 | 393.0 | 2 |
| 19 | Ugam (Chirchik) | 68 | 870.0 | 1 |
| 20 | Karankulsay (Chirchik) | 9.2 | 17.0 | 1 |
| 21 | Aktashsay (Chirchik) | 14 | 31.3 | 1 |
| 22 | Aksakatasay (Chirchik) | 48 | 501.0 | 1 |
| 23 | Parkentsay (Chirchik) | 40 | 198.0 | 3 |
| 24 | Galvasay (Chirchik) | 20 | 56.7 | 1 |
| 25 | Altinbelsay (Parkentsay) | 12.0 | 39.8 | 1 |
| 26 | Zarkentsay (Parkentsay) | 18 | 32.0 | 1 |
| 27 | Bashkizilsay (Chirchik) | 54 | 363.0 | 1 |
| | | | | |

**Figure S 2.1.5 Locations of Observation Post**

## Table S 2.1.5 List of Observation Post

| River - post | Distance from mouth km | Basin area, $km^2$ | Basin average height, km | Survey period | Times full year survey |
|---|---|---|---|---|---|
| 1. Chirchik – Charvak village | 157.4 | 9,990 | 2.62 | 1915-1919, ‘42-‘47, ‘53-‘58 | 12 |
| 2. Chirchik - Razlomnaya | 154.5 | 10,000 | - | 1955-1956 | 1 |
| 3. Chirchik – Charvak Hydroelectric Power Station dam | - | 10,000 | - | 1976-1999 | 24 |
| 4. Chirchik – below Ugam river mouth | - | 10,650 | - | 1930-1935 | 4 |
| 5. Chirchik – Khodjikent village | 151 | 10,900 | 2.57 | 1900-1976 | 76 |
| 6. Chirchik - Karankul | 143 | 10,900 | - | 1956-1957 | 0 |
| 7. Chirchik – Gazalkent village | 136 | 11,100 | - | 1929-1931, ‘56-‘57 | 2 |
| 8. Chirchik – Gazalkent village | 135 | 11,200 | - | 1964-1979, ‘84-‘99 | 31 |
| 9. Chirchik – Gazalkent dam location | 133 | 11,200 | - | 1960-1999 | 40 |
| 10. Chirchik - 1km below Gazalkent dam | 132 | 11,200 | - | 1955-1957 | 2 |
| 11. Chirchik – 1km below Gazalkent dam | - | 12,000 | - | 1983-1986 | 3 |
| 12. Chirchik – Troitskoye village | 108 | 12,100 | - | 1955-1959 | 0 |
| 13. Chirchik - Troitskoye village (below the dam) | 107.7 | - | - | 1955-1957 | 0 |
| 14. Chirchik – Kuyluk village | 75 | 12,600 | - | 1955-1957 | 2 |
| 15. Chirchik - Chinaz | 3.2 | 14,900 | - | 1915,1917, ‘23-‘67, ‘69-‘71, ‘75-‘99 | 68 |
| 16. Chirchik (Kalgan-Chirchik armlet) Tashlak village | 3.4 | - | - | 1925-1935 | 10 |
| 17. Chatkal – above Ters river mouth | 89 | 4,090 | 2.78 | 1964-1986 | 21 |
| 18. Chatkal – above Ters river mouth | 85 | 4,285 | 2.78 | 1915-1916, 1932-1963 | 27 |
| 19. Chatkal – below Nayz river mouth | 42 | 5,520 | 2.72 | 1932-1958, 1960-1964 | 26 |
| 20. Chatkal – 1km above Pegek river mouth | 27 | 5,650 | - | 1933-1934 | 1 |
| 21. Chatkal – above Hudaydotsay river mouth | 20.0. | 6,580 | 2.64 | 1965-2002 | 35 |
| 22. Chatkal – Charvak village | 2.2 | 7,110 | 2.61 | 1915-1916, ‘18-‘19, ‘31-‘67 | 36 |
| 23. Sandalash – the mouth | 3.5 | 1,160 | 2.9 | 1963-1968, 1970-1971 | 7 |
| 24. Aksu – the mouth | 0.4 | 51 | 3.07 | 1947-1953 | 5 |
| 25. Ters – the mouth | 1.1 | 547 | 2.71 | 1915-1916, 1932-1971 | 34 |
| 26. Italgi – 7km from the mouth | 7 | 10 | 2.77 | 1963-1964 | 1 |
| 27. Nayza - the mouth | 0.1 | 109 | 2?84 | 1956-1958, 1960-1964 | 3 |
| 28. Akbulak - the mouth | 0.3 | 886 | 2.4 | 1975-2002 | 22 |
| 29. Yangikurgan – above Kuyluk river mouth | 4.5 | 14 | 2.2 | 1946-1964 | 17 |
| 30. Yangikurgan – Yangikurgan villlage | 2.6 | 34 | 1.79 | 1965-1999 | 32 |
| 31. Koksu – Ayrik village | 24 | 238 | 2.71 | 1956-1957 | 1 |
| 32. Koksu – Burchmulla village | 2.7 | 3,720 | 2.48 | 1931-1944, 1949-1978 | 39 |
| 33. Pskem – above Teparsay river mouth | - | - | - | 1978 | 0 |
| 34 Pskem – Mullala village | 21 | 2,540 | 2.74 | 1965-2002 | 35 |
| 35. Pskem – the mouth | 1.6 | 2,830 | 2.69 | 1915, 1932-1967 | 32 |
| 36. Oygaing - above Koksu river mouth | 31 | 4,660 | 3.35 | 1963-2002 | 36 |
| 37. Oygaing – the mouth | 0.4. | 1,010 | 3.01 | 1933-1999 | 65 |
| 38. Koksu - 1,3km above the mouth | 1.3 | 188 | 3.14 | 1963-1999 | 35 |
| 39. Chiralma – the mouth | 0.2 | 103 | 2.7 | 1934-1999 | 62 |
| 40. Maydantal – the mouth | 1 | 471 | 3.13 | 1933-1999 | 66 |
| 41. Urungach – Pskem village | 1 | 47 | 2.33 | 1962-1964 | 2 |
| 42. Nauvalisay – Sidjak village | 1.6 | 98 | 1.65 | 1964-1968, 1971, 1973-1999 | 31 |
| 43. Chimgan – Chimgan resort | | 17 | 1.58 | 1963-1966 | 3 |
| 44. Chimgansay – Chimgan resort | 9.9 | 23 | 1.53 | 1967-2002 | 34 |
| 45. Ugam – Khodjikent village | 2.7 | 869 | 2.03 | 1932-2002. | 67 |
| 46. Karankulsay – Karankul tract | 2 | 16 | 1.38 | 1947-1987 | 39 |
| 47. Aktashsay – Aktash resort | 8 | 19 | 1.67 | 1947-2002 | 54 |
| 48. Galvasay – Galvasay village | 5.5 | 57 | 1.26 | 1980-1990 | 10 |
| 49. Aksakatasay – Karamazar village | 12 | 453 | 1.84 | 1941-1987 | 18 |
| 50. Parkentsay – Kirgiz village | 27 | 40 | 1.97 | 1950-1988 | 27 |
| 51. Parkentsay – Sumcha village | 25 | 80 | 1.68 | 1988-2002 | 15 |
| 52. Parkentsay – Karlik village | 25 | 87 | 1941 | 1944-1945 | 0 |
| 53. Altinbelsay – Kirgiz village | 0.3 | 39 | 1.66 | 1950-1987 | 31 |
| 54. Zarkentsay – Zarkent village | 12 | 19 | 2 | 1952-1959 | 6 |
| 55. Bashkizilsay – Nevich village | 31 | 123 | 1.94 | 1977-1988, 12990 | 10 |

**(2) Charvak Dam**

Charvak Dam is constructed in Brichmulla hollow where is the junction of the Chatkal and Pskem Rivers. It is a compound reservoir on valley bed and works to regulate the discharge water flow. The basic function of the dam is to store the inflow water and to discharge the water coping with the multiple demands in the Chirchik River Basin. Thus it increases water supply for the irrigated territories of the Tashkent Region with the area of 164 thousand hectares and Tashkent City and Chirchik City. The water discharged from the dam is also used for hydropower purposes with many power stations along the river and Boz-su channel as shown in Figure S 2.1.15. Charvak Dam Lake is used as recreational area, which plays an important role in the Regtion.

The maximum height of rock-fill dam embankment is 168m. The construction work was commenced in 1963 and completed in 1977. A hydroelectric power station with the capacity of 600 thousand kW is constructed connecting the discharge spillway, which is also used for flood flow discharge. The dam was started its normal operation in 1978.

Its major dimension according to the surveys conducted in 1985 year are as follows:

| | | | |
|---|---|---|---|
| Normal Pool Level (NPL) grade | - | 890.00 | m, |
| Year of started operation | - | 1978, | |
| Catchment area | - | 10 000 | $km^2$, |
| Full water storage | - | 1 991 | mil. $m^3$, |
| Conservation zone | - | 1 690 | mil. $m^3$, |
| Reservoir area by NPL | - | 40.3 | $km^2$, |
| Length by NPL | - | 22.0 | km, |
| Reservoir average width | - | 1.8 | km, |
| Overall width | - | 10.0 | km, |
| Average depth | - | 49.4 | m, |
| Overall depth | - | 148 | m, |
| Length of shore line by NPL | - | 69.0 | km. |

The location of Charvak Dam with the hydrological observation points is shown in Figure S 2.1.6(1), and the picture taken from satellite is shown in Figure S 2.1.6(2). The list of the hydrological observation points surrounding the dam is shown in Table S 2.1.6.

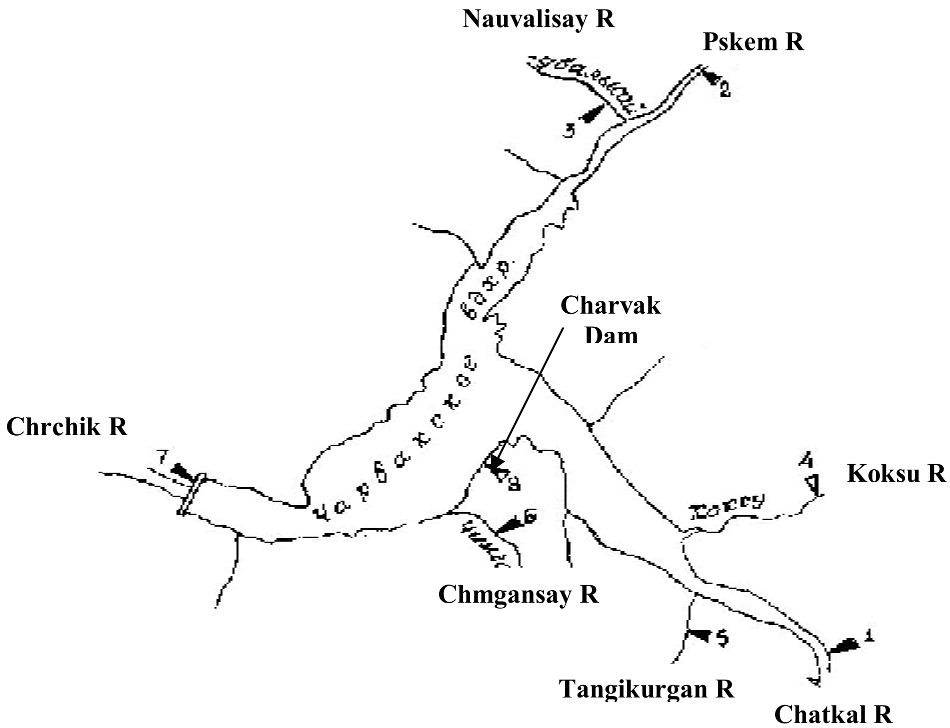



**Figure S 2.1.6 (1) Location of Charvak Dam with Hydrological Observation Points**

**Figure S 2.1.6(2) Picture of Charvak Dam taken from Satellite**

**Table S 2.1.6 List of Hydrological Observation Points**.

| Number on the layout | Object | Type of observation | Note |
|---|---|---|---|
| 1 | Chatkal River – Hudaydotsay River mouth | Inflow measurement | Functioning |
| 2 | Pskem River – Mullala Village | Inflow measurement | Functioning |
| 3 | Nauvalisay River – Sidjak Village | Inflow measurement | Functioning |
| 4 | Koksu River – the mouth | Inflow measurement | Closed |
| 5 | Yangikurgan River – Yangikurgan Village | Inflow measurement | Functioning |
| 6 | Chimgansay River – Chimgan Resort | Inflow measurement | |
| 7 | Chirchik River – Charvak hydroelectric Dam | Inflow measurement | Functioning |
| 8 | Charvak Dam – Yusuphana Village | Measurement of fluctuation of levels in the dam | Functioning |

Table S 2.1.7 shows the relation between the water level, the surface area and the volume of the dam lake. The curves of the relations of the dam lake in 1985, are shown in Figure S 2.1.7.

**Table S 2.1.7 Relations of Water Level Grade, Surface Area and Capacity**

| Level, m | Area, $km^2$ | Capacity, mil.$m^3$ |
|---|---|---|
| 790 | 2.15 | 20.3 |
| 800 | 4.78 | 55.2 |
| 810 | 7.16 | 113.8 |
| 820 | 11.01 | 204.3 |
| 830 | 16.09 | 334.9 |
| 840 | 18.99 | 505.0 |
| 850 | 23.18 | 716.0 |
| 860 | 27.18 | 967.7 |
| 870 | 31.34 | 1 259.0 |
| 880 | 37.00 | 1 602.7 |
| 890 | 40.29 | 1 991.1 |

The dam water level are measured by Yusuphana Post (point 8 in Figure S 2.1.6(1), which is located on the left shore of the lake. Monthly average dam water level, water storage volume on the first day of each month and monthly average inflow of the dam from 1978 to 2002 are shown in Table S 2.1.8, Table S 2.1.9, and Table S 2.1.10, respectively.

The fluctuation of the dam level, dam storage volume and inflow from 1999 to 2002 are shown in Figure S 2.1.8 to 10.

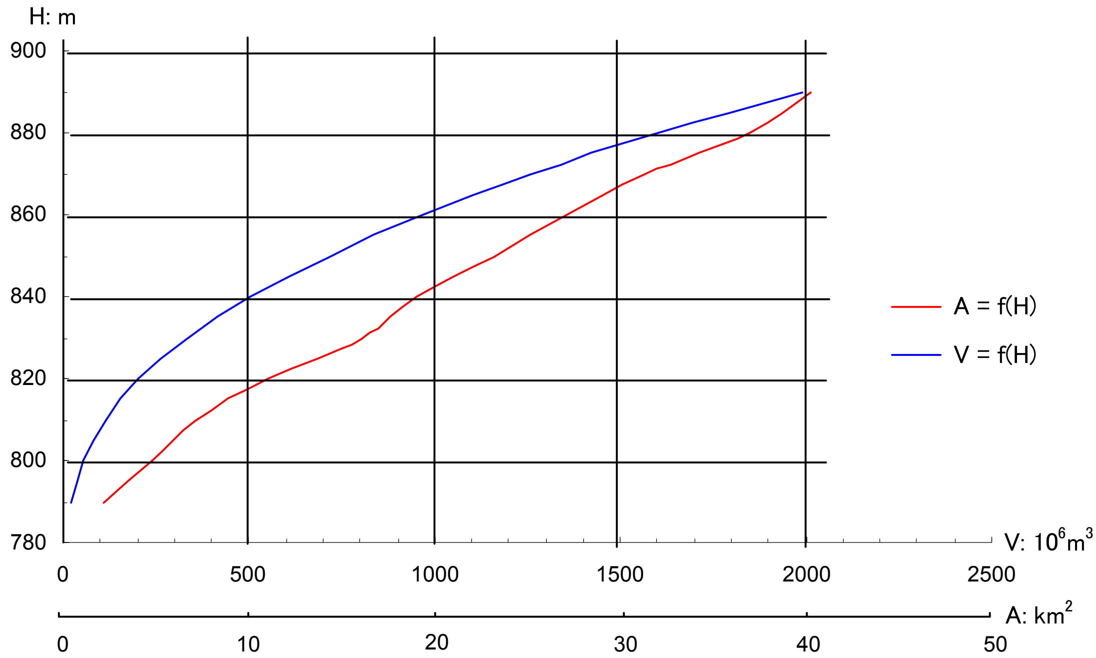



**Figure S 2.1.7 AH and VH Curves for Charvak Dam**

**Table S 2.1.8 Monthly Average Levels of Charvak Dam (m above zero of post)**

Zero Post H=800m.

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | End of Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1978 | 34.48 | 30.42 | 20.78 | 42.01 | 71.31 | 86.46 | 89.30 | 82.65 | 75.80 | 74.56 | 75.20 | 76.06 | 64.00 |
| 1979 | 73.32 | 63.56 | 51.73 | 56.27 | 78.93 | 81.49 | 89.27 | 95.51 | 77.65 | 77.30 | 78.30 | 75.63 | 74.08 |
| 1980 | 71.57 | 68.23 | 64.56 | 71.93 | 83.31 | 86.09 | 86.01 | 65.29 | 57.15 | 55.84 | 57.10 | 58.57 | 68.80 |
| 1981 | 58.66 | 59.36 | 60.12 | 64.99 | 82.11 | 87.58 | 87.37 | 72.13 | 64.61 | 63.02 | 62.12 | 61.17 | 68.60 |
| 1982 | 59.82 | 55.98 | 50.83 | 49.78 | 55.28 | 50.50 | 36.50 | 19.21 | 15.60 | 18.37 | 24.43 | 24.44 | 38.30 |
| 1983 | 22.01 | 22.98 | 23.30 | 28.57 | 39.60 | 54.67 | 55.72 | 39.71 | 28.86 | 23.79 | 23.18 | 23.32 | 32.22 |
| 1984 | 25.27 | 26.11 | 27.22 | 41.47 | 53.90 | 70.12 | 74.10 | 54.40 | 41.64 | 39.61 | 39.60 | 40.73 | 44.48 |
| 1985 | 38.01 | 35.58 | 34.06 | 42.27 | 67.17 | 84.99 | 87.65 | 74.64 | 68.32 | 64.44 | 66.37 | 65.45 | 60.91 |
| 1986 | 63.98 | 62.92 | 60.59 | 58.94 | 62.17 | 63.05 | 60.57 | 37.71 | 21.80 | 23.21 | 26.41 | 29.24 | 47.56 |
| 1987 | 31.16 | 33.01 | 38.43 | 50.91 | 19.64 | 81.22 | 87.73 | 88.16 | 83.49 | 83.62 | 84.20 | 83.71 | 67.94 |
| 1988 | 81.15 | 75.48 | 72.97 | 66.59 | 77.44 | 85.28 | 89.24 | 81.16 | 76.30 | 75.61 | 75.77 | 75.87 | 77.74 |
| 1989 | 75.48 | 73.45 | 71.97 | 72.51 | 73.13 | 81.83 | 80.27 | 65.96 | 54.82 | 51.88 | 51.87 | 84.07 | 67.27 |
| 1990 | 55.00 | 54.02 | 52.50 | 51.16 | 69.73 | 86.17 | 87.93 | 80.81 | 74.31 | 71.73 | 70.42 | 67.72 | 68.38 |
| 1991 | 63.07 | 57.67 | 54.65 | 58.63 | 63.17 | 75.47 | 78.75 | 69.40 | 58.32 | 54.93 | 53.36 | 53.56 | 61.57 |
| 1992 | 51.26 | 49.81 | 49.69 | 53.31 | 69.99 | 91.91 | 85.95 | 81.35 | 75.70 | 75.62 | 76.51 | 76.80 | 68.99 |
| 1993 | 75.45 | 75.18 | 73.19 | 67.36 | 74.04 | 83.12 | 89.00 | 85.75 | 79.82 | 77.39 | 80.01 | 79.70 | 78.33 |
| 1994 | 76.74 | 68.61 | 56.24 | 46.74 | 57.78 | 79.67 | 88.83 | 85.75 | 81.68 | 80.10 | 79.75 | 79.70 | 73.47 |
| 1995 | 74.03 | 71.74 | 66.50 | 63.13 | 73.30 | 81.21 | 83.12 | 76.57 | 70.47 | 69.42 | 68.91 | 67.03 | 71.88 |
| 1996 | 65.62 | 65.02 | 64.89 | 69.15 | 83.96 | 88.21 | 89.84 | 87.28 | 81.47 | 78.88 | 76.22 | 71.27 | 76.83 |
| 1997 | 67.21 | 64.49 | 61.90 | 63.87 | 80.07 | 87.57 | 88.60 | 79.97 | 72.12 | 66.87 | 61.85 | 59.65 | 71.18 |
| 1998 | 57.50 | 55.62 | 48.87 | 78.84 | 69.65 | 81.02 | 89.31 | 89.47 | 87.76 | 85.29 | 81.72 | 76.59 | 72.64 |
| 1999 | 68.67 | 62.12 | 55.98 | 53.37 | 65.96 | 77.35 | 86.52 | 82.82 | 77.26 | 72.80 | 69.02 | 69.10 | 70.08 |
| 2000 | 66.89 | 61.83 | 53.14 | 49.48 | 61.76 | 69.07 | 63.28 | 48.34 | 39.12 | 37.79 | 44.51 | 47.50 | 53.73 |
| 2001 | 48.05 | 46.61 | 47.03 | 54.85 | 67.51 | 82.64 | 83.51 | 73.30 | 66.82 | 60.21 | 58.18 | 54.85 | 62.00 |
| 2002 | 50.00 | 45.35 | 41.74 | 55.75 | 80.69 | 87.42 | 89.57 | 89.90 | 89.54 | 87.07 | 82.48 | 76.04 | 72.96 |

**Table S 2.1.9 Storage Volume of Charvak Dam on the first Day of Months** ($10^3m^3$)

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1978 | 410 | 408 | 328 | 335 | 923 | 1699 | 1927 | 1900 | 1517 | 1418 | 1425 | 1444 |
| 1979 | 1471 | 1209 | 931 | 676 | 1349 | 1643 | 1840 | 1972 | 1605 | 1492 | 1541 | 1511 |
| 1980 | 1313 | 1207 | 1101 | 1325 | 1731 | 1839 | 1836 | 1122 | 896 | 863 | 895 | 932 |
| 1981 | 933 | 946 | 962 | 992 | 1313 | 1868 | 1983 | 1549 | 1165 | 1064 | 1053 | 1018 |
| 1982 | 971 | 911 | 795 | 670 | 823 | 832 | 608 | 289 | 164 | 164 | 238 | 270 |
| 1983 | 241 | 247 | 242 | 265 | 331 | 754 | 935 | 691 | 354 | 276 | 244 | 242 |
| 1984 | 255 | 283 | 284 | 397 | 715 | 967 | 1492 | 1160 | 573 | 517 | 494 | 510 |
| 1985 | 489 | 448 | 421 | 389 | 870 | 1544 | 1991 | 1645 | 1244 | 1158 | 1161 | 1142 |
| 1986 | 1133 | 1061 | 1031 | 936 | 1005 | 1017 | 1117 | 734 | 263 | 213 | 273 | 300 |
| 1987 | 341 | 367 | 396 | 560 | 1073 | 1486 | 1737 | 1694 | 1788 | 1730 | 1762 | 1775 |
| 1988 | 1734 | 1526 | 1417 | 1214 | 1351 | 1621 | 1964 | 1848 | 1570 | 1458 | 1453 | 1460 |
| 1989 | 1462 | 1428 | 1349 | 1337 | 1329 | 1515 | 1765 | 1386 | 916 | 791 | 754 | 774 |
| 1990 | 843 | 834 | 800 | 727 | 853 | 1609 | 1924 | 1818 | 1462 | 1359 | 1281 | 1216 |
| 1991 | 1135 | 959 | 859 | 833 | 998 | 1207 | 1584 | 1437 | 1013 | 859 | 811 | 789 |
| 1992 | 770 | 727 | 719 | 689 | 1039 | 1518 | 1783 | 1821 | 1494 | 1436 | 1475 | 1497 |
| 1993 | 1471 | 1418 | 1422 | 1239 | 1224 | 1589 | 1840 | 1950 | 1691 | 1528 | 1500 | 1686 |
| 1994 | 1553 | 1363 | 1041 | 721 | 714 | 1211 | 1904 | 1930 | 1717 | 1639 | 1567 | 1636 |
| 1995 | 1514 | 1318 | 1294 | 1068 | 1106 | 1568 | 1791 | 1537 | 1332 | 1216 | 1258 | 1195 |
| 1996 | 1152 | 1111 | 1111 | 1125 | 1586 | 1874 | 1957 | 1990 | 1741 | 1596 | 1527 | 1397 |
| 1997 | 1224 | 1136 | 1064 | 997 | 1322 | 1824 | 1984 | 1796 | 1422 | 1273 | 1057 | 1057 |
| 1998 | 933 | 869 | 822 | 555 | 1038 | 1550 | 1850 | 1992 | 1927 | 1880 | 1730 | 1609 |
| 1999 | 1220 | 1029 | 867 | 801 | 1141 | 1512 | 1856 | 1712 | 1509 | 1355 | 1230 | 1233 |
| 2000 | 1168 | 1021 | 798 | 705 | 1019 | 1232 | 1063 | 681 | 490 | 467 | 600 | 663 |
| 2001 | 678 | 661 | 633 | 697 | 975 | 1478 | 1847 | 1592 | 1230 | 1064 | 933 | 897 |
| 2002 | 774 | 661 | 559 | 598 | 1360 | 1823 | 1954 | 1990 | 1987 | 1934 | 1810 | 1598 |

**Table S 2.1.10 Monthly Average Inflow into Charvak Dam** ($m^3$/sec)

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1978 | 64.8 | 60.3 | 73.1 | 274 | 438 | 564 | 473 | 229 | 145 | 92.0 | 96.0 | 78.0 | 216 |
| 1979 | 58.9 | 66.6 | 77.4 | 346 | 477 | 725 | 591 | 279 | 137 | 97.1 | 79.5 | 68.7 | 251 |
| 1980 | 62.3 | 61.2 | 69.9 | 245 | 419 | 488 | 346 | 193 | 125 | 88.0 | 79.6 | 66.3 | 187 |
| 1981 | 60.8 | 55.8 | 79.9 | 187 | 437 | 403 | 411 | 207 | 126 | 90.7 | 71.3 | 61.0 | 183 |
| 1982 | 55.5 | 52.8 | 58.9 | 178 | 304 | 240 | 197 | 151 | 92.8 | 84.5 | 76.1 | 64.0 | 130 |
| 1983 | 58.3 | 54.6 | 60.0 | 136 | 275 | 376 | 330 | 209 | 114 | 81.0 | 72.1 | 62.9 | 161 |
| 1984 | 52.4 | 49.2 | 71.7 | 188 | 335 | 614 | 375 | 209 | 113 | 81.6 | 73.0 | 64.0 | 185 |
| 1985 | 57.6 | 65.0 | 76.4 | 257 | 492 | 610 | 389 | 194 | 113 | 85.3 | 70.6 | 63.9 | 206 |
| 1986 | 55.5 | 52.2 | 55.6 | 140 | 269 | 378 | 290 | 162 | 107 | 85.0 | 69.6 | 67.4 | 144 |
| 1987 | 58.3 | 60.9 | 92.5 | 265 | 528 | 673 | 588 | 322 | 159 | 111 | 93.0 | 72.1 | 252 |
| 1988 | 59.9 | 57.7 | 67.0 | 217 | 396 | 606 | 414 | 210 | 131 | 89.5 | 77.7 | 66.2 | 199 |
| 1989 | 59.6 | 53.9 | 65.3 | 116 | 259 | 450 | 326 | 186 | 117 | 91.1 | 76.9 | 83.3 | 157 |
| 1990 | 62.1 | 59.5 | 89.7 | 210 | 613 | 769 | 403 | 237 | 141 | 105 | 91.1 | 71.7 | 238 |
| 1991 | 63.5 | 58.3 | 68.7 | 162 | 243 | 444 | 350 | 192 | 124 | 89.1 | 68.6 | 59.3 | 160 |
| 1992 | 50.8 | 50.3 | 56.2 | 202 | 372 | 504 | 451 | 201 | 133 | 94.6 | 77.8 | 66.6 | 188 |
| 1993 | 50.2 | 66.8 | 72.3 | 215 | 498 | 712 | 517 | 233 | 143 | 91.5 | 112 | 80.2 | 233 |
| 1994 | 68.9 | 60.5 | 93.5 | 242 | 599 | 459 | 333 | 263 | 151 | 110 | 122 | 114 | 243 |
| 1995 | 85.1 | 78.5 | 90.9 | 173 | 396 | 420 | 336 | 213 | 132 | 95.7 | 82.0 | 68.7 | 181 |
| 1996 | 69.1 | 59.6 | 65.1 | 196 | 345 | 597 | 432 | 256 | 131 | 101 | 82.2 | 68.2 | 108 |
| 1997 | 64.7 | 62.3 | 74.2 | 230 | 385 | 508 | 337 | 188 | 122 | 86.0 | 72.0 | 62.9 | 181 |
| 1998 | 59.4 | 62.6 | 84.6 | 354 | 536 | 692 | 615 | 317 | 182 | 120 | 89.4 | 78.7 | 265 |
| 1999 | 71.1 | 72.5 | 80.4 | 164 | 494 | 515 | 470 | 265 | 151 | 108 | 95.6 | 82.9 | 213 |
| 2000 | 73.7 | 67.8 | 79.2 | 194 | 411 | 556 | 233 | 171 | 121 | 121 | 105 | 87.7 | 166 |
| 2001 | 79.4 | 73.7 | 118 | 270 | 490 | 540 | 483 | 186 | 132 | 112 | 109 | 81.2 | 205 |
| 2002 | 80.0 | 72.6 | 118 | 235 | 436 | 565 | 349 | 203 | 163 | 123 | 109 | 89.6 | 206 |

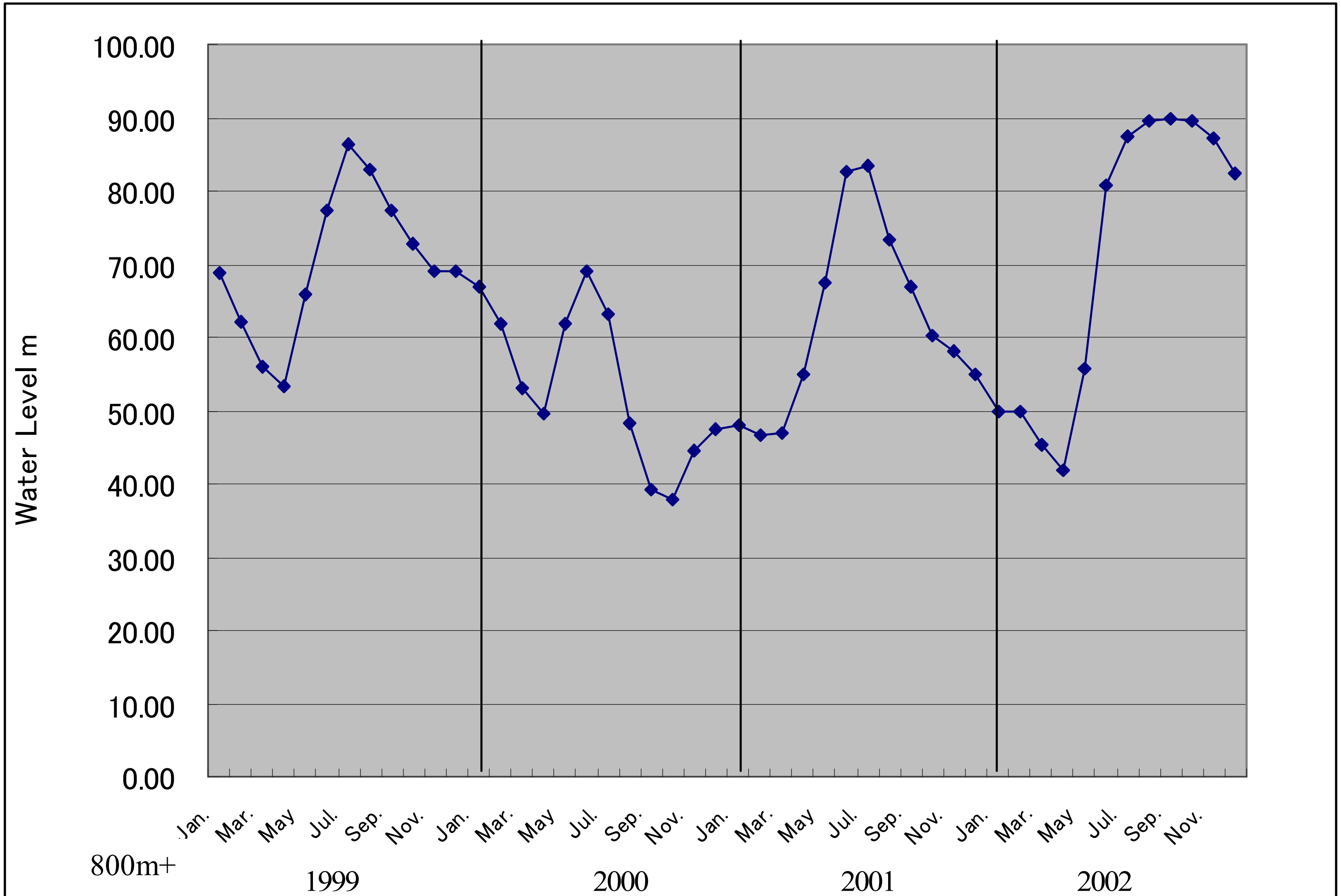



**Figure S 2.1.8 Water Level Fluctuation of Charvak Dam**

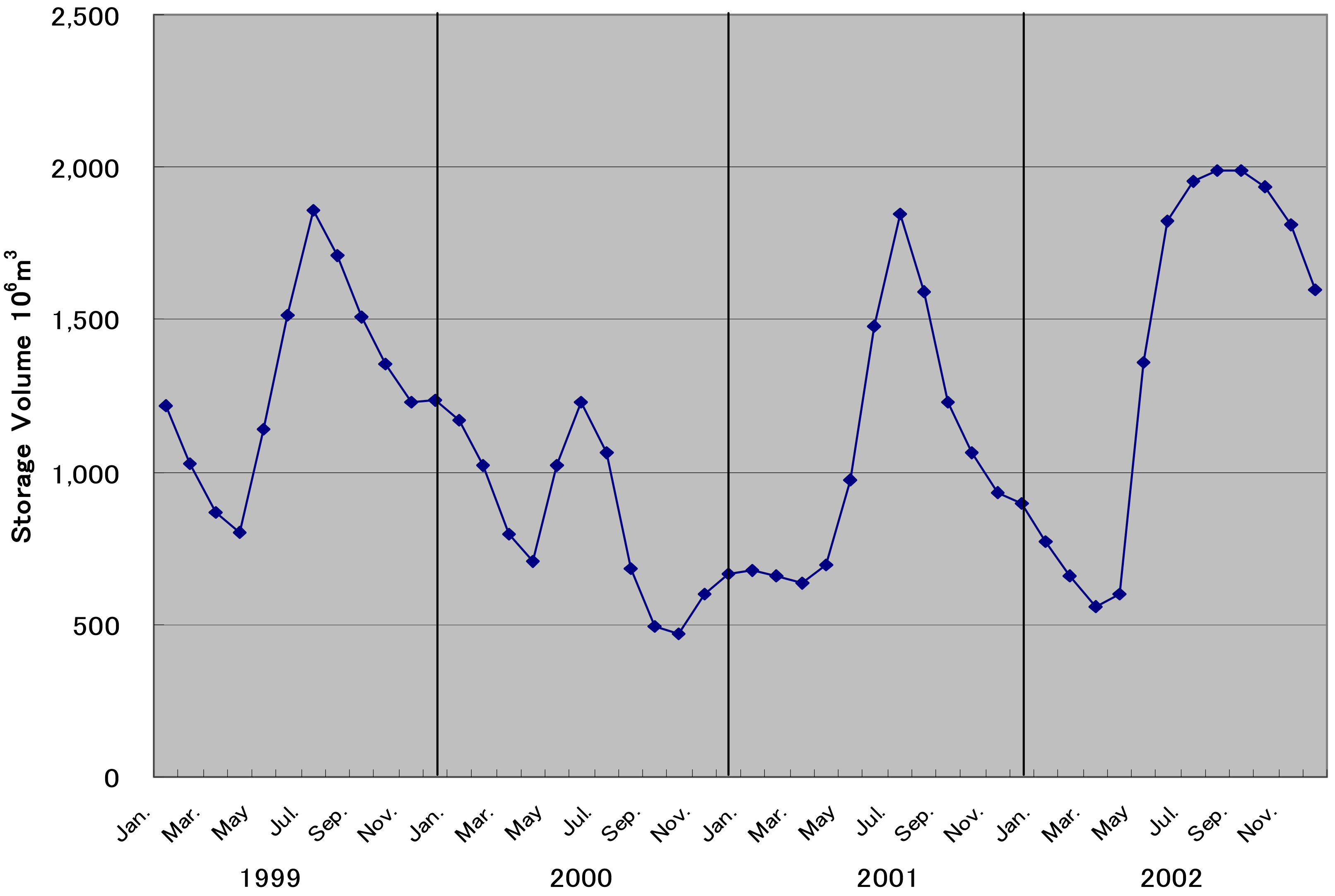



**Figure S 2.1.9 Storage Volume Fluctuation of Charvak Dam**

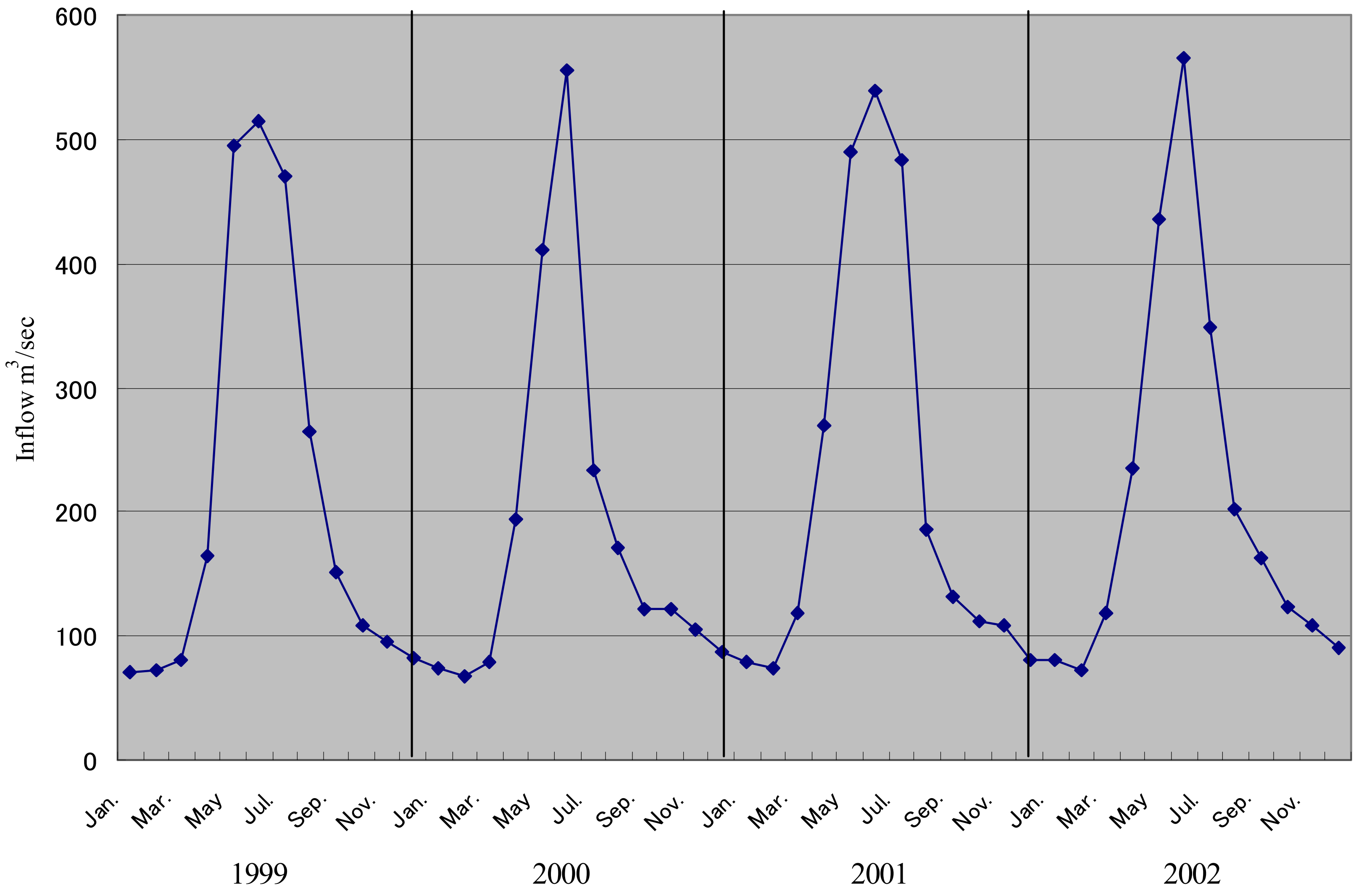



**Figure S 2.1.10 Total Inflow Volume Fluctuation of Charvak Dam**

### (3) Water Source of Charvak Dam

1) Precipitation of the Basin and Inflow Water Quantity of the Dam

The catchments area discharging to Charvak Dam is 10,000 $km^2$. Inflow water to the dam is derived from major rivers of the Chatkal, Pskem and Koksu, flowing into. The major part of inflow water is derived from melted water of snow, which falls and is accumulated in mountain area.

As aforementioned, the meteorological stations in the Chirchik River Basin are five, and three of these are located in the basin of Charvak Dam. Probable rainfall plotting for each station by Hazen Method is shown in Figure S 2.1.11 (1) to (5). Resulted in these calculations, major hydrological standard years and annual precipitation of each year are shown in Table S 2.1.11.

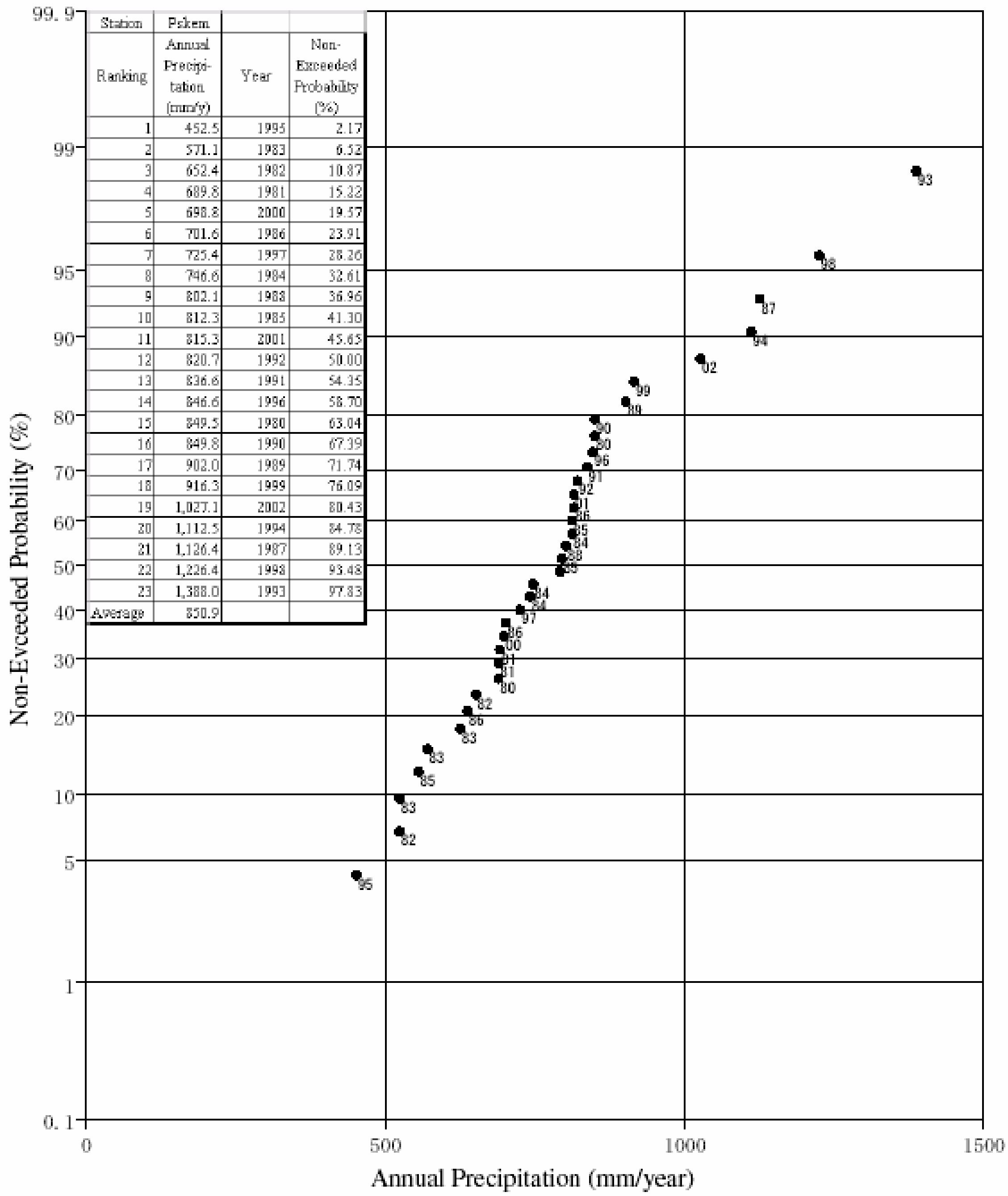
**Table S 2.1.11 Annual Precipitation according to Hydrological Standard Year**

| Station | Chimgan | | Oygaing | | Pskem | | Sukok | | Tashkent | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Annual Precipitation (mm/y) | Year | Annual Precipitation (mm/y) | Year | Annual Precipitation (mm/y) | Year | Annual Precipitation (mm/y) | Year | Annual Precipitation (mm/y) | Year |
| Average Year | 812.4 | 1984 | 690.2 | 1980 | 820.7 | 1992 | 768.1 | 1980 | 405.2 | 1997 |
| 1/5 Draught Year | 752.6 | 1997 | 556.3 | 1985 | 698.8 | 2000 | 698.7 | 2001 | 342.1 | 1988 |
| 1/10 Draught Year | 669.5 | 1996 | 524.2 | 1982 | 652.4 | 1982 | 679.3 | 1983 | 328.0 | 1983 |
| 1/20 Draught Year | 625.7 | 1983 | 523.8 | 1983 | 571.1 | 1983 | 658.1 | 1996 | 291.7 | 1996 |
| 1/50 Draught Year | 442.7 | 1995 | 442.4 | 1995 | 452.5 | 1995 | 540.5 | 1995 | 233.1 | 1995 |
| Annual Average | 888.5 | | 723.8 | | 850.9 | | 846.2 | | 432.9 | |

At the present time, the water flow measurement is conducted on the Pskem and Chatkal Rivers by Glavgidromet Authorities of the Republic of Uzbekistan. The catchments area of these two rivers account for 91% of that of the dam. According to probability analysis of long-term period observation, it may be assumed that the error/failure of flow measurement on pointed rivers account for 3-4% of annual inflow amount.

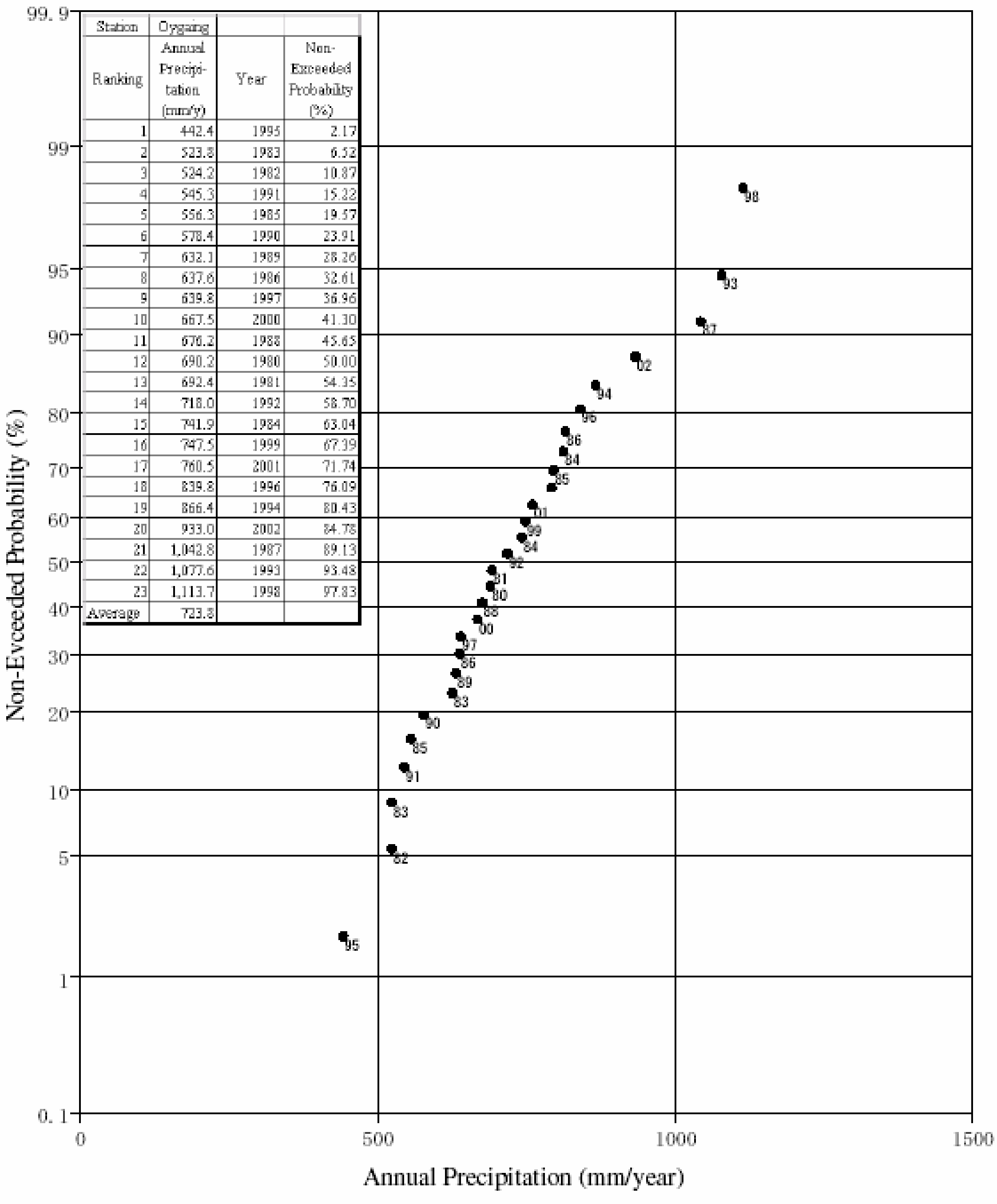
The measurement of water flow in Koksu River Basin was conducted for from 1932 to 1977 years except for 1945-1948 on Burchmulla Post, however because of the construction of Charvak Dam the post was washed away. Currently water flow through this post is estimated by analogical analysis according to the flow of the Chatkal, Pskem and Ahangaran Rivers.

Besides main waterways, some small rivers and streams with total catchments area of 510 $km^2$ flow into the dam. The major rivers/streams are Avliyansay, Shakramsay, Kaynarsay, Sidjaksay, Nauvalisay, Bogustansay, Yangikurgan and Chimgansay. These rivers/streams flow out from the low mountain watersheds ($H_{aver.}$ = 1500-1700m. ), of which water source is fed by seasonal snow melting and drainage from groundwater.



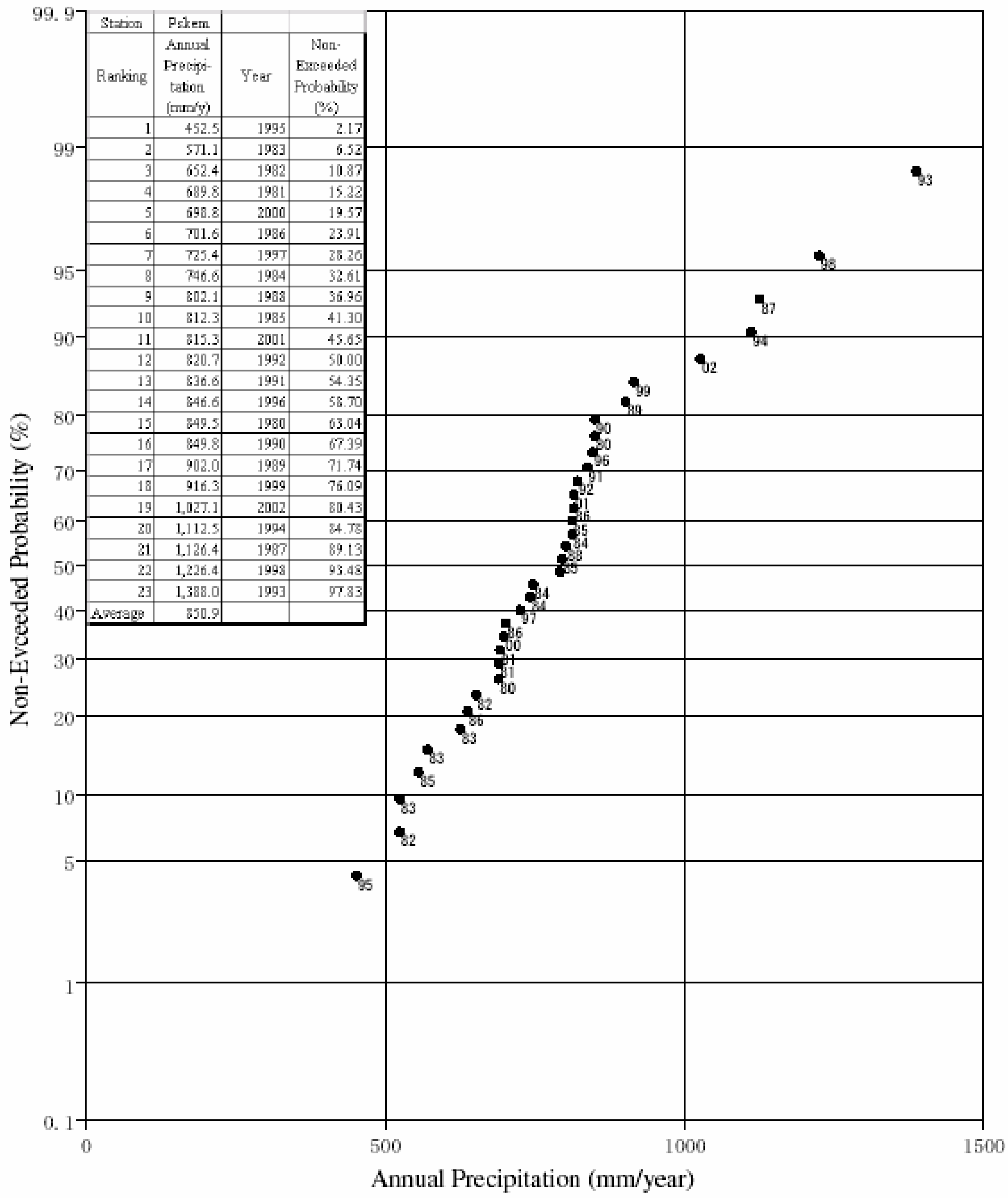

| Station | Pskem | | |
|---|---|---|---|
| Ranking | Annual Precipi-tation (mm/y) | Year | Non-Exceeded Probabilty (%) |
| 1 | 452.5 | 1995 | 2.17 |
| 2 | 571.1 | 1983 | 6.52 |
| 3 | 652.4 | 1982 | 10.87 |
| 4 | 689.8 | 1981 | 15.22 |
| 5 | 698.8 | 2000 | 19.57 |
| 6 | 701.6 | 1986 | 23.91 |
| 7 | 725.4 | 1997 | 28.26 |
| 8 | 746.6 | 1984 | 32.61 |
| 9 | 802.1 | 1988 | 36.96 |
| 10 | 812.3 | 1985 | 41.30 |
| 11 | 815.3 | 2001 | 45.65 |
| 12 | 820.7 | 1992 | 50.00 |
| 13 | 836.6 | 1991 | 54.35 |
| 14 | 846.6 | 1996 | 58.70 |
| 15 | 849.5 | 1980 | 63.04 |
| 16 | 849.8 | 1990 | 67.39 |
| 17 | 902.0 | 1989 | 71.74 |
| 18 | 916.3 | 1999 | 76.09 |
| 19 | 1,027.1 | 2002 | 80.43 |
| 20 | 1,112.5 | 1994 | 84.78 |
| 21 | 1,126.4 | 1987 | 89.13 |
| 22 | 1,226.4 | 1998 | 93.48 |
| 23 | 1,388.0 | 1993 | 97.83 |
| Average | 850.9 | | |

**Figure S 2.1.11 (1) Probability Plotting of Precipitation (Chimgan)**



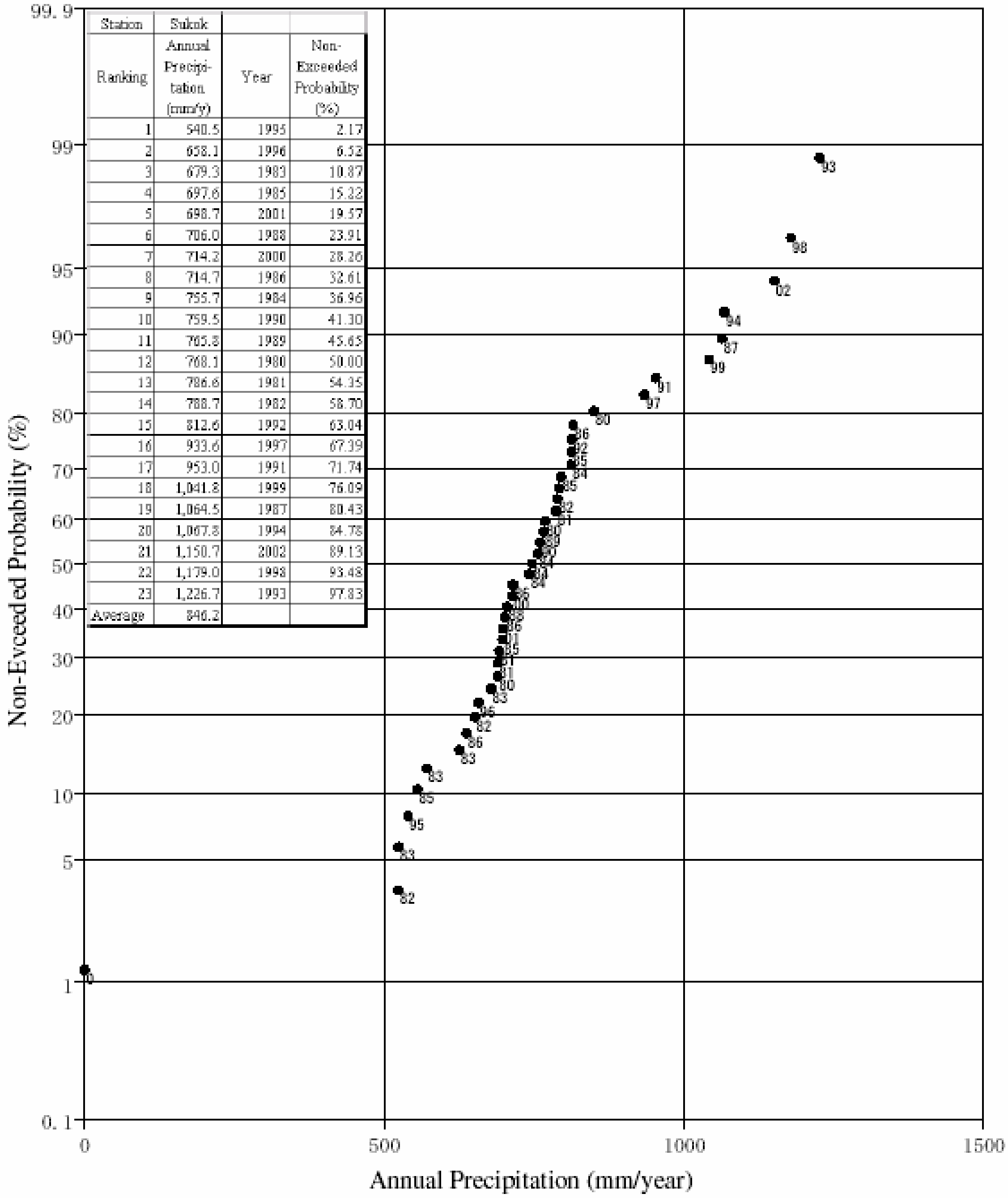

| Station | Oygaing | | |
|---|---|---|---|
| Ranking | Annual Precipi-tation (mm/y) | Year | Non-Exceeded Probability (%) |
| 1 | 442.4 | 1995 | 2.17 |
| 2 | 523.8 | 1983 | 6.52 |
| 3 | 524.2 | 1982 | 10.87 |
| 4 | 545.3 | 1991 | 15.22 |
| 5 | 556.3 | 1985 | 19.57 |
| 6 | 578.4 | 1990 | 23.91 |
| 7 | 632.1 | 1989 | 28.26 |
| 8 | 637.6 | 1986 | 32.61 |
| 9 | 639.8 | 1997 | 36.96 |
| 10 | 667.5 | 2000 | 41.30 |
| 11 | 676.2 | 1988 | 45.65 |
| 12 | 690.2 | 1980 | 50.00 |
| 13 | 692.4 | 1981 | 54.35 |
| 14 | 718.0 | 1992 | 58.70 |
| 15 | 741.9 | 1984 | 63.04 |
| 16 | 747.5 | 1999 | 67.39 |
| 17 | 760.5 | 2001 | 71.74 |
| 18 | 839.8 | 1996 | 76.09 |
| 19 | 866.4 | 1994 | 80.43 |
| 20 | 933.0 | 2002 | 84.78 |
| 21 | 1,042.8 | 1987 | 89.13 |
| 22 | 1,077.6 | 1993 | 93.48 |
| 23 | 1,113.7 | 1998 | 97.83 |
| Average | 723.8 | | |

**Figure S 2.1.11 (2) Probability Plotting of Precipitation (Oygaing)**



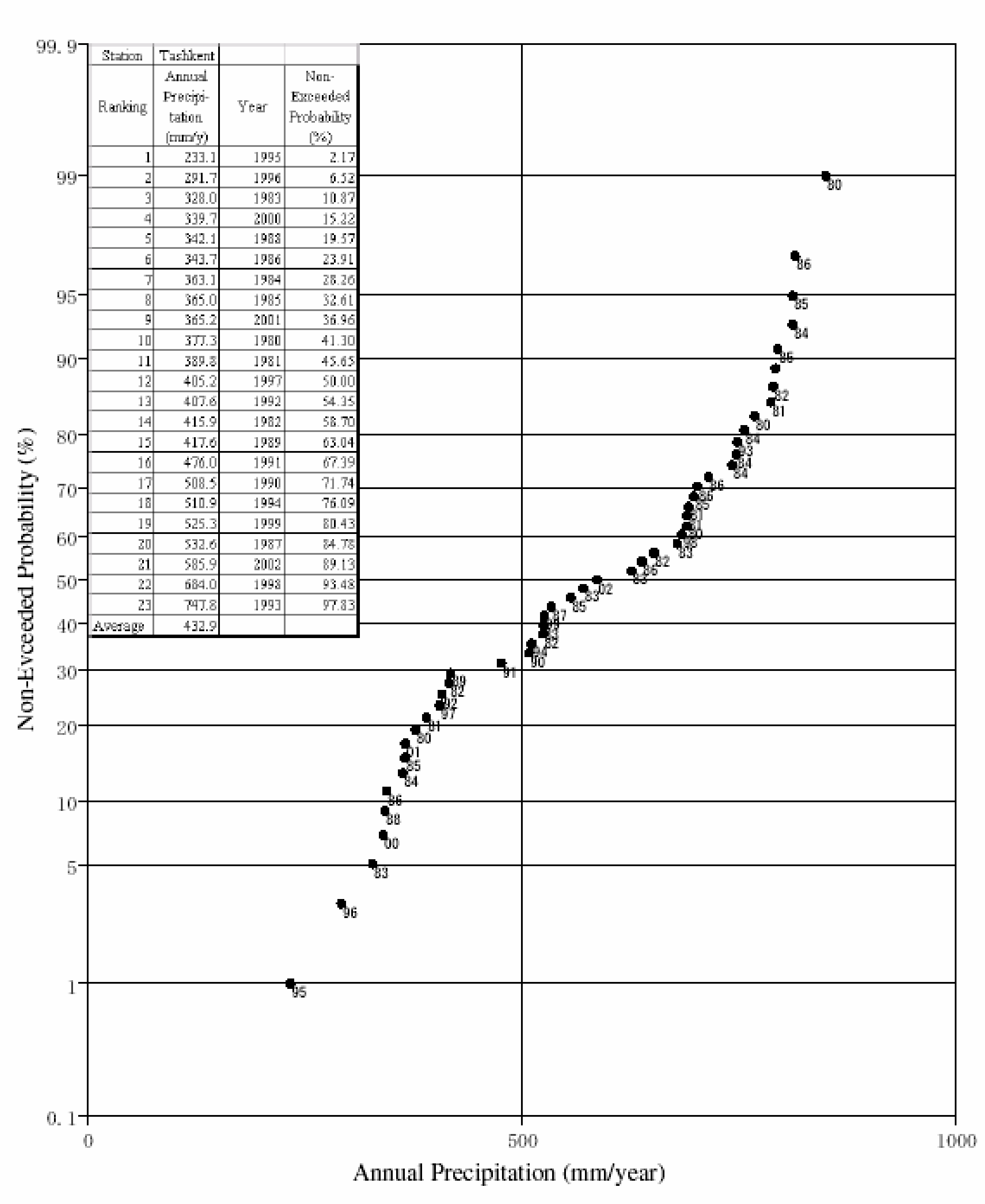

| Station | Pskem | | |
|---|---|---|---|
| Ranking | Annual Precipi-tation (mm/y) | Year | Non-Exceeded Probability (%) |
| 1 | 452.5 | 1995 | 2.17 |
| 2 | 571.1 | 1983 | 6.52 |
| 3 | 652.4 | 1982 | 10.87 |
| 4 | 689.8 | 1981 | 15.22 |
| 5 | 698.8 | 2000 | 19.57 |
| 6 | 701.6 | 1986 | 23.91 |
| 7 | 725.4 | 1997 | 28.26 |
| 8 | 746.6 | 1984 | 32.61 |
| 9 | 802.1 | 1988 | 36.96 |
| 10 | 812.3 | 1985 | 41.30 |
| 11 | 815.3 | 2001 | 45.65 |
| 12 | 820.7 | 1992 | 50.00 |
| 13 | 836.6 | 1991 | 54.35 |
| 14 | 846.6 | 1996 | 58.70 |
| 15 | 849.5 | 1980 | 63.04 |
| 16 | 849.8 | 1990 | 67.39 |
| 17 | 902.0 | 1989 | 71.74 |
| 18 | 916.3 | 1999 | 76.09 |
| 19 | 1,027.1 | 2002 | 80.43 |
| 20 | 1,112.5 | 1994 | 84.78 |
| 21 | 1,126.4 | 1987 | 89.13 |
| 22 | 1,226.4 | 1998 | 93.48 |
| 23 | 1,388.0 | 1993 | 97.83 |
| Average | 850.9 | | |

**Figure S 2.1.11 (3) Probability Plotting of Precipitation (Pskem)**




| Station | Sukok | | |
|---|---|---|---|
| Ranking | Annual Precipi-tation (mm/y) | Year | Non-Exceeded Probabilty (%) |
| 1 | 540.5 | 1995 | 2.17 |
| 2 | 658.1 | 1996 | 6.52 |
| 3 | 679.3 | 1983 | 10.87 |
| 4 | 697.6 | 1985 | 15.22 |
| 5 | 698.7 | 2001 | 19.57 |
| 6 | 706.0 | 1988 | 23.91 |
| 7 | 714.2 | 2000 | 28.26 |
| 8 | 714.7 | 1986 | 32.61 |
| 9 | 755.7 | 1984 | 36.96 |
| 10 | 759.5 | 1990 | 41.30 |
| 11 | 765.8 | 1989 | 45.65 |
| 12 | 768.1 | 1980 | 50.00 |
| 13 | 786.6 | 1981 | 54.35 |
| 14 | 788.7 | 1982 | 58.70 |
| 15 | 812.6 | 1992 | 63.04 |
| 16 | 933.6 | 1997 | 67.39 |
| 17 | 953.0 | 1991 | 71.74 |
| 18 | 1,041.8 | 1999 | 76.09 |
| 19 | 1,064.5 | 1987 | 80.43 |
| 20 | 1,067.8 | 1994 | 84.78 |
| 21 | 1,150.7 | 2002 | 89.13 |
| 22 | 1,179.0 | 1998 | 93.48 |
| 23 | 1,226.7 | 1993 | 97.83 |
| Average | 846.2 | | |

**Figure S 2.1.11 (4) Probability Plotting of Precipitation (Sukok)**




| Station | Tashkent | | |
|---|---|---|---|
| Ranking | Annual Precipi-tation (mm/y) | Year | Non-Exceeded Probability (%) |
| 1 | 233.1 | 1995 | 2.17 |
| 2 | 291.7 | 1996 | 6.52 |
| 3 | 328.0 | 1983 | 10.87 |
| 4 | 339.7 | 2000 | 15.22 |
| 5 | 342.1 | 1988 | 19.57 |
| 6 | 343.7 | 1986 | 23.91 |
| 7 | 363.1 | 1984 | 28.26 |
| 8 | 365.0 | 1985 | 32.61 |
| 9 | 365.2 | 2001 | 36.96 |
| 10 | 377.3 | 1980 | 41.30 |
| 11 | 389.8 | 1981 | 45.65 |
| 12 | 405.2 | 1997 | 50.00 |
| 13 | 407.6 | 1992 | 54.35 |
| 14 | 415.9 | 1982 | 58.70 |
| 15 | 417.6 | 1989 | 63.04 |
| 16 | 476.0 | 1991 | 67.39 |
| 17 | 508.5 | 1990 | 71.74 |
| 18 | 510.9 | 1994 | 76.09 |
| 19 | 525.3 | 1999 | 80.43 |
| 20 | 532.6 | 1987 | 84.78 |
| 21 | 585.9 | 2002 | 89.13 |
| 22 | 684.0 | 1998 | 93.48 |
| 23 | 747.8 | 1993 | 97.83 |
| Average | 432.9 | | |

**Figure S 2.1.11 (5) Probability Plotting of Precipitation (Tashkent)**

The dam inflow is hydrometrically taken into account discharge water from the Yangikurgan, Nauvalisay and Chimgansay Rivers with 155 $km^2$ total catchments area. The flow from the rest area of 345 $km^2$ is not taken into account. According to Alimuhamedova I.R. developmental works, the flow is less than 167 $x10^6$ $m^3$/year or 5.3 $m^3$/s.

In these studies, the dam inflow is estimated based on the data of six posts: No.1, the Chatkal River – Hudaydotsay River Mouth, Figure S 2.2.6(1), survey period from 1965 to 2002, :No.2, the Pskem river – Mullalla village, survey period from 1965 to 2002, :No.3, the Nauvalisay River – Sidjak Village, functions from 1964 to 2002, :No.4, the Koksu River – Burchmulla Village, survey period from 1931 to 1978, :No.5, the Yangikurgan River – Yangikurgan Village, survey period from 1965 to 2002, and :No.6, the Chimgansay River – Chimgan Resort, survey period from 1967 to 2002. The Chatkal and Pskem Rivers are major ones in these six rivers, and they supply 92% of inflow to the dam. The flow through the Koksu River is 6% of total inflow into the Dam Lake, and the total of other three rivers flow into only 2%.

Monthly inflow data on all mentioned posts are shown in Table S 2.1.12 (1) to (6). Good correlation is observed during the observation years in the data of these tables, therefore the lack data for inflow to the dam can be made up based on the pattern of the measured data. The results of these made up calculations are given in Table S 2.1.13 (1) to (4).

Results in the calculations, the monthly average inflow to the dam lake during from 1932 to 2002 are shown in Table S 2.1.14. Figure 2.1.12 (1) to (3) shows the inflow quantities from each flow measurement station into the dam from 1999 to 2001.

**Table S 2.1.12 (1) Monthly Average Water Discharge Flow (1) ($m^3$/sec)**
**021 Chatkal – above Hudaydotsay river mouth**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Ave. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965 | 31.0 | 28.4 | 31.5 | 57.3 | 165.0 | 146.0 | 94.3 | 67.3 | 44.8 | 48.9 | 62.0 | 40.4 | 68.1 |
| 1966 | 34.4 | 34.5 | 55.1 | 133.0 | 250.0 | 378.0 | 232.0 | 126.0 | 77.4 | 58.5 | 43.6 | 37.1 | 122.0 |
| 1967 | 32.2 | 31.5 | 40.1 | 100.0 | 172.0 | 273.0 | 153.0 | 84.0 | 52.9 | 45.2 | 38.1 | 32.8 | 87.9 |
| 1968 | 28.6 | 26.8 | 43.6 | 133.0 | 231.0 | 377.0 | 287.0 | 134.0 | 64.8 | 47.6 | 44.4 | 37.5 | 121.0 |
| 1969 | 29.6 | 25.7 | 74.8 | 224.0 | 569.0 | 675.0 | 512.0 | 257.0 | 129.0 | 95.6 | 87.3 | 67.0 | 229.0 |
| 1970 | 71.9 | 61.4 | 57.1 | 135.0 | 231.0 | 290.0 | 168.0 | 110.0 | 67.6 | 48.9 | 43.0 | 40.0 | 110.0 |
| 1971 | 35.4 | 31.8 | 52.8 | 122.0 | 199.0 | 322.0 | 153.0 | 87.1 | 54.3 | 40.7 | 38.6 | 32.0 | 97.4 |
| 1972 | 29.5 | 28.8 | 33.3 | 91.3 | 208.0 | 315.0 | 232.0 | 113.0 | 67.3 | 49.1 | 43.1 | 35.2 | 104.0 |
| 1973 | 27.7 | 35.7 | 36.5 | 128.0 | 251.0 | 410.0 | 174.0 | 92.9 | 53.6 | 43.0 | 38.0 | 32.1 | 110.0 |
| 1974 | 30.2 | 30.0 | 31.6 | 56.1 | 126.0 | 187.0 | 107.0 | 63.3 | 42.0 | 35.2 | 30.4 | 23.8 | 63.6 |
| 1975 | 23.2 | 22.4 | 28.5 | 101.0 | 127.0 | 191.0 | 108.0 | 60.9 | 40.1 | 32.6 | 29.2 | 27.0 | 65.9 |
| 1976 | 24.6 | 22.4 | 23.8 | 102.0 | 195.0 | 215.0 | 119.0 | 75.5 | 46.0 | 40.8 | 36.2 | 29.0 | 77.4 |
| 1977 | 26.2 | 25.5 | 39.1 | 103.0 | 143.0 | 252.0 | 131.0 | 68.1 | 53.2 | 49.6 | 47.2 | 37.1 | 81.3 |
| 1978 | 32.6 | 31.1 | 38.9 | 170.0 | 262.0 | 318.0 | 238.0 | 102.0 | 55.6 | 44.6 | 38.7 | 40.8 | 114.0 |
| 1979 | 36.4 | 35.5 | 42.4 | 234.0 | 298.0 | 448.0 | 333.0 | 133.0 | 71.6 | 54.3 | 45.2 | 40.2 | 148.0 |
| 1980 | 34.0 | 32.2 | 35.6 | 138.0 | 243.0 | 265.0 | 163.0 | 81.2 | 55.1 | 42.2 | 39.8 | 31.5 | 96.7 |
| 1981 | 29.8 | 28.0 | 39.9 | 99.1 | 246.0 | 205.0 | 194.0 | 89.7 | 55.4 | 42.7 | 35.3 | 31.2 | 91.3 |
| 1982 | 29.4 | 27.3 | 29.1 | 92.3 | 154.0 | 112.0 | 82.5 | 59.4 | 40.2 | 42.5 | 38.8 | 33.9 | 61.8 |
| 1983 | 31.0 | 29.8 | 31.6 | 76.4 | 163.0 | 214.0 | 168.0 | 88.0 | 53.1 | 41.2 | 38.9 | 34.1 | 80.8 |
| 1984 | 28.9 | 27.5 | 38.8 | 112.0 | 205.0 | 355.0 | 188.0 | 92.2 | 56.7 | 44.5 | 41.1 | 35.8 | 102.0 |
| 1985 | 33.2 | 39.2 | 44.3 | 163.0 | 307.0 | 352.0 | 194.0 | 89.2 | 53.5 | 44.1 | 38.4 | 34.9 | 116.0 |
| 1986 | 30.8 | 29.3 | 30.0 | 78.5 | 152.0 | 213.0 | 136.0 | 67.7 | 47.2 | 42.9 | 36.3 | 34.7 | 74.9 |
| 1987 | 30.5 | 32.3 | 48.6 | 156.0 | 319.0 | 371.0 | 293.0 | 144.0 | 72.4 | 54.4 | 46.8 | 36.9 | 134.0 |
| 1988 | 30.3 | 29.3 | 32.2 | 129.0 | 223.0 | 330.0 | 192.0 | 90.5 | 60.6 | 44.8 | 42.5 | 35.9 | 103.0 |
| 1989 | 33.1 | 30.5 | 35.5 | 65.1 | 148.0 | 258.0 | 161.0 | 82.9 | 55.4 | 48.8 | 43.5 | 42.9 | 83.7 |
| 1990 | 35.9 | 34.1 | 47.4 | 122.0 | 367.0 | 412.0 | 196.0 | 108.0 | 66.6 | 55.2 | 49.6 | 38.7 | 128.0 |
| 1991 | 35.1 | 31.4 | 37.4 | 93.7 | 136.0 | 263.0 | 191.0 | 91.6 | 61.7 | 48.4 | 39.2 | 35.0 | 88.6 |
| 1992 | 28.0 | 26.7 | 32.3 | 126.0 | 234.0 | 309.0 | 247.0 | 101.0 | 71.9 | 55.0 | 47.0 | 40.2 | 110.0 |
| 1993 | 27.4 | 38.2 | 40.9 | 132.0 | 318.0 | 418.0 | 273.0 | 123.0 | 74.7 | 49.6 | 62.1 | 44.7 | 133.0 |
| 1994 | 41.1 | 35.2 | 51.0 | 143.0 | 319.0 | 342.0 | 220.0 | 121.0 | 78.5 | 57.6 | 70.2 | 60.5 | 128.0 |
| 1995 | 46.4 | 44.1 | 50.8 | 94.3 | 226.0 | 226.0 | 148.0 | 93.5 | 62.1 | 52.7 | 44.6 | 40.5 | 94.1 |
| 1996 | 33.5 | 33.2 | 34.1 | 99.4 | 176.0 | 331.0 | 225.0 | 115.0 | 65.0 | 55.5 | 46.0 | 38.7 | 104.0 |
| 1997 | 36.9 | 34.6 | 38.7 | 130.0 | 204.0 | 253.0 | 147.0 | 79.1 | 52.7 | 40.9 | 36.0 | 33.7 | 90.5 |
| 1998 | 31.7 | 32.8 | 44.0 | 208.0 | 295.0 | 383.0 | 314.0 | 161.0 | 95.1 | 65.7 | 47.9 | 42.5 | 143.0 |
| 1999 | 38.5 | 38.6 | 42.5 | 81.6 | 297.0 | 286.0 | 243.0 | 127.0 | 73.4 | 59.5 | 53.8 | 46.3 | 116.0 |
| 2000 | 41.4 | 37.9 | 43.9 | 109.0 | 236.0 | 159.0 | 100.0 | 73.0 | 55.4 | 67.5 | 57.3 | 47.6 | 85.7 |
| 2001 | 44.2 | 40.9 | 67.6 | 161.0 | 294.0 | 284.0 | 132.0 | 86.4 | 66.0 | 61.4 | 59.1 | 44.5 | 112.0 |
| 2002 | 43.0 | 39.9 | 65.6 | 216.0 | 242.0 | 354.0 | 287.0 | 172.0 | 96.1 | 74.0 | 61.5 | 53.1 | 142.0 |
| Aver. | 33.9 | 32.8 | 41.9 | 124.0 | 235.0 | 302.0 | 198.0 | 103.0 | 62.9 | 50.7 | 45.8 | 38.7 | 106.0 |
| | | | | | | | | | | | | | 106.0 |
| Max. | 71.9 | 61.4 | 74.8 | 234.0 | 569.0 | 675.0 | 512.0 | 257.0 | 129.0 | 95.6 | 87.3 | 67.0 | |
| Min. | 23.2 | 22.4 | 23.8 | 56.1 | 126.0 | 112.0 | 82.5 | 59.4 | 40.1 | 32.6 | 29.2 | 23.8 | |

**Table S 2.1.12 (2) Monthly Average Water Discharge Flow (2) ($m^3$/sec)**
**033 Koksu – Burchmulla village**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Ave. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1931 | | | | 23.4 | 29.9 | 32.3 | 27.1 | 12.9 | 7.1 | 6.0 | 6.0 | 5.2 | - |
| 1932 | 4.3 | 4.4 | 7.0 | 18.2 | 25.4 | 24.9 | 14.8 | 8.3 | 6.0 | 5.0 | 4.4 | 3.4 | 10.5 |
| 1933 | 2.6 | 2.8 | 5.1 | 11.5 | 29.1 | 26.7 | 15.2 | 7.4 | 4.9 | 3.7 | 3.0 | 4.3 | 9.7 |
| 1934 | 3.3 | 4.8 | 5.5 | 19.3 | 26.3 | 58.8 | 31.3 | 18.9 | 10.5 | 6.4 | 5.7 | 4.5 | 16.3 |
| 1935 | 5.0 | 3.5 | 7.5 | 11.8 | 27.0 | 25.0 | 20.4 | 11.1 | 7.1 | 5.8 | 5.6 | 4.9 | 11.2 |
| 1936 | 3.9 | 3.9 | 4.5 | 13.0 | 26.3 | 24.5 | 12.9 | 8.0 | 6.3 | 5.1 | 4.2 | 3.6 | 9.7 |
| 1937 | 3.2 | 3.2 | 3.7 | 8.5 | 21.7 | 21.1 | 11.1 | 5.9 | 4.8 | 3.9 | 4.4 | 3.1 | 7.9 |
| 1938 | 3.4 | 4.1 | 4.9 | 13.4 | 25.1 | 14.3 | 10.0 | 6.8 | 5.2 | 3.8 | 3.7 | 3.2 | 8.2 |
| 1939 | 3.5 | 3.4 | 5.0 | 8.3 | 26.3 | 21.4 | 10.4 | 6.0 | 4.6 | 3.3 | 3.6 | 3.3 | 8.3 |
| 1940 | 3.4 | 4.5 | 5.1 | 13.7 | 20.6 | 22.3 | 12.2 | 6.7 | 4.8 | 5.6 | 5.7 | 4.8 | 9.1 |
| 1941 | 4.3 | 4.9 | 10.1 | 20.4 | 44.6 | 32.4 | 17.6 | 10.7 | 7.3 | 6.3 | 5.5 | 5.3 | 14.1 |
| 1942 | 4.6 | 4.2 | 12.2 | 18.9 | 47.4 | 37.4 | 22.3 | 11.2 | 6.8 | 5.7 | 4.3 | 5.7 | 15.0 |
| 1943 | 5.1 | 4.9 | 9.2 | 18.0 | 28.4 | 30.4 | - | - | - | - | - | - | - |
| 1944 | 8.7 | 5.5 | 11.3 | 23.7 | 33.8 | 27.1 | 17.9 | 8.0 | - | - | - | - | - |
| 1945 | - | - | - | - | - | 40.2 | 26.1 | 11.8 | 6.9 | 5.1 | 4.2 | 3.5 | - |
| 1950 | 3.4 | 3.0 | 5.0 | 7.6 | 24.6 | 24.8 | 13.4 | 7.9 | 5.2 | 4.4 | 3.8 | 3.5 | 8.9 |
| 1951 | 3.3 | 3.1 | 4.9 | 11.2 | 24.6 | 19.1 | 15.1 | 8.4 | 5.3 | 8.3 | 10.7 | 6.2 | 10.0 |
| 1952 | 4.8 | 5.0 | 6.9 | 26.6 | 37.7 | 41.4 | 30.3 | 16.2 | 9.2 | 6.3 | 5.1 | 4.6 | 16.2 |
| 1953 | 3.9 | 4.5 | 10.8 | 14.3 | 42.2 | 40.1 | 19.9 | 9.9 | 7.0 | 7.4 | 7.5 | 6.6 | 14.5 |
| 1954 | 5.7 | 4.9 | 8.4 | 22.1 | 34.5 | 31.0 | 24.8 | 15.1 | 8.2 | 5.5 | 4.3 | 3.6 | 14.0 |
| 1955 | 3.1 | 3.0 | 5.2 | 10.9 | 23.7 | 25.6 | 12.0 | 6.7 | 3.9 | 3.5 | 3.8 | 3.7 | 8.8 |
| 1956 | 3.3 | 3.3 | 4.3 | 17.2 | 32.2 | 23.2 | 16.5 | 8.0 | 5.5 | 4.7 | 3.7 | 3.2 | 10.4 |
| 1957 | 3.0 | 2.8 | 5.0 | 7.8 | 13.9 | 19.1 | 11.2 | 6.7 | 4.8 | 4.3 | 4.1 | 4.0 | 7.2 |
| 1958 | 3.7 | 3.6 | 7.6 | 29.2 | 34.5 | 41.5 | 30.5 | 14.3 | 8.3 | 5.7 | 4.5 | 4.5 | 15.7 |
| 1959 | 3.6 | 3.2 | 7.0 | 25.5 | 30.7 | 34.6 | 23.8 | 11.8 | 8.1 | 6.2 | 6.5 | 5.9 | 13.9 |
| 1960 | 5.6 | 6.7 | 6.6 | 15.2 | 39.5 | 46.5 | 34.9 | 16.3 | 10.1 | 7.5 | 6.3 | 5.0 | 16.7 |
| 1961 | 4.2 | 3.9 | 6.0 | 13.8 | 21.4 | 15.6 | 10.6 | 7.6 | 6.3 | 5.1 | 4.6 | 4.3 | 8.6 |
| 1962 | 3.9 | 4.2 | 6.7 | 14.2 | 21.6 | 23.1 | 15.6 | 9.1 | 6.4 | 5.7 | 7.8 | 6.1 | 10.4 |
| 1963 | 5.0 | 5.3 | 7.9 | 24.8 | 32.9 | 32.0 | 17.2 | 10.1 | 7.0 | 5.9 | 6.2 | 5.9 | 13.3 |
| 1964 | 5.3 | 4.9 | 9.4 | 19.8 | 32.0 | 35.9 | 24.5 | 13.3 | 9.3 | 7.0 | 5.7 | 4.8 | 14.3 |
| 1965 | 4.2 | 4.0 | 5.4 | 10.0 | 22.6 | 17.7 | 11.5 | 8.5 | 6.7 | 7.8 | 11.5 | 6.1 | 9.7 |
| 1966 | 4.3 | 5.5 | 11.4 | 23.3 | 33.0 | 37.7 | 18.4 | 12.6 | 7.8 | 6.2 | 5.0 | 4.7 | 14.2 |
| 1967 | 6.5 | 6.5 | 7.2 | 12.5 | 19.0 | 28.4 | 17.2 | 10.9 | 7.7 | 7.5 | 7.0 | 6.2 | 11.4 |
| 1968 | 5.5 | 5.0 | 12.0 | 24.2 | 32.4 | 35.0 | 23.5 | 13.5 | 8.2 | 6.6 | 8.0 | 7.9 | 15.1 |
| 1969 | 6.0 | 5.3 | 19.3 | 31.2 | 52.4 | 62.0 | 48.1 | 29.1 | 15.2 | 14.9 | 12.9 | 7.6 | 25.3 |
| 1970 | 7.0 | 7.1 | 7.5 | 17.7 | 23.5 | 22.3 | 14.4 | 9.9 | 7.4 | 5.7 | 5.5 | 7.0 | 11.2 |
| 1971 | 4.5 | 4.4 | 8.2 | 21.2 | 28.7 | 27.5 | 14.1 | 9.0 | 6.4 | 4.3 | 3.3 | 3.3 | 11.2 |
| 1972 | 3.4 | 2.9 | 4.8 | 14.5 | 33.1 | 38.4 | 25.8 | 12.0 | 7.7 | 6.3 | 7.7 | 5.8 | 13.5 |
| 1973 | 4.4 | 5.1 | 6.4 | 17.4 | 33.7 | 33.5 | 18.0 | 12.2 | 7.9 | 6.8 | 5.4 | 4.4 | 12.9 |
| 1974 | 3.9 | 3.9 | 5.0 | 11.5 | 17.9 | 17.0 | 10.3 | 7.2 | 5.4 | 4.3 | 3.0 | 2.8 | 7.7 |
| 1975 | 2.3 | 2.2 | 4.8 | 18.1 | 21.9 | 22.5 | 14.3 | 8.3 | 5.8 | 4.4 | 3.8 | 3.3 | 9.3 |
| 1976 | 2.8 | 3.4 | 3.5 | 18.0 | 35.1 | 26.8 | 14.3 | 8.4 | 5.7 | 6.5 | 7.2 | 5.2 | 11.4 |
| 1977 | 4.1 | 3.4 | 6.8 | 16.8 | 19.0 | 21.3 | 11.9 | 6.7 | 5.1 | 6.5 | 7.6 | 6.3 | 9.6 |
| 1978 | 5.3 | 4.8 | 5.8 | 23.0 | | | | | | | | | - |
| Aver. | 4.3 | 4.3 | 7.2 | 17.2 | 29.3 | 29.8 | 18.4 | 10.3 | 6.6 | 5.6 | 5.4 | 4.6 | 10.6 |
| | | | | | | | | | | | | | 11.9 |
| Max. | 8.7 | 7.1 | 19.3 | 31.2 | 52.4 | 62.0 | 48.1 | 29.1 | 15.2 | 14.9 | 12.9 | 7.9 | |
| Min. | 2.3 | 2.2 | 3.5 | 7.6 | 13.9 | 14.3 | 10.0 | 5.9 | 3.9 | 3.3 | 3.0 | 2.8 | |

**Table S 2.1.12 (3) Monthly Average Water Discharge Flow (3) ($m^3$/sec)**
**034 Pskem – Mulalla village**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Ave. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965 | 21.9 | 19.5 | 21.8 | 36.8 | 110.0 | 131.0 | 110.0 | 87.7 | 43.0 | 39.8 | 44.9 | 33.0 | 58.3 |
| 1966 | 26.8 | 26.6 | 37.7 | 66.7 | 139.0 | 257.0 | 200.0 | 124.0 | 75.8 | 53.9 | 38.0 | 32.7 | 89.9 |
| 1967 | 22.8 | 20.5 | 33.3 | 78.9 | 131.0 | 192.0 | 146.0 | 117.0 | 71.0 | 51.5 | 41.0 | 33.7 | 78.2 |
| 1968 | 30.2 | 27.4 | 44.0 | 98.8 | 152.0 | 234.0 | 229.0 | 136.0 | 65.4 | 44.7 | 39.1 | 33.8 | 94.5 |
| 1969 | 29.7 | 27.9 | 52.4 | 110.0 | 209.0 | 382.0 | 339.0 | 184.0 | 102.0 | 80.4 | 69.4 | 50.4 | 136.0 |
| 1970 | 39.4 | 35.2 | 35.1 | 86.0 | 137.0 | 197.0 | 157.0 | 120.0 | 80.3 | 52.5 | 38.7 | 24.9 | 83.6 |
| 1971 | 23.4 | 24.2 | 38.4 | 93.1 | 144.0 | 241.0 | 165.0 | 117.0 | 63.1 | 35.7 | 27.2 | 23.0 | 82.9 |
| 1972 | 19.5 | 18.2 | 22.2 | 60.9 | 135.0 | 195.0 | 208.0 | 121.0 | 66.1 | 44.1 | 36.8 | 30.6 | 79.8 |
| 1973 | 26.7 | 25.2 | 28.2 | 70.4 | 154.0 | 290.0 | 195.0 | 119.0 | 60.4 | 37.8 | 29.7 | 25.4 | 88.5 |
| 1974 | 22.5 | 20.5 | 23.8 | 46.7 | 94.3 | 144.0 | 121.0 | 75.3 | 43.2 | 32.1 | 24.8 | 22.3 | 55.9 |
| 1975 | 21.2 | 19.6 | 22.4 | 64.7 | 95.5 | 156.0 | 129.0 | 94.4 | 53.3 | 32.4 | 23.7 | 20.2 | 61.0 |
| 1976 | 17.7 | 15.6 | 16.0 | 55.0 | 131.0 | 182.0 | 154.0 | 99.8 | 59.4 | 40.2 | 35.8 | 27.6 | 69.5 |
| 1977 | 22.9 | 21.5 | 29.1 | 68.9 | 102.0 | 192.0 | 149.0 | 88.7 | 58.1 | 42.2 | 39.9 | 31.8 | 70.5 |
| 1978 | 27.9 | 24.9 | 27.0 | 86.3 | 147.0 | 216.0 | 216.0 | 116.0 | 60.0 | 41.5 | 51.6 | 32.4 | 87.2 |
| 1979 | 28.2 | 26.8 | 27.8 | 94.7 | 150.0 | 247.0 | 239.0 | 135.0 | 58.8 | 36.9 | 28.6 | 23.7 | 91.4 |
| 1980 | 22.4 | 22.7 | 24.5 | 81.3 | 139.0 | 189.0 | 161.0 | 98.5 | 60.9 | 38.0 | 32.2 | 28.1 | 74.8 |
| 1981 | 25.0 | 21.9 | 29.4 | 65.6 | 154.0 | 163.0 | 195.0 | 104.0 | 62.2 | 40.4 | 28.6 | 23.8 | 76.1 |
| 1982 | 20.4 | 19.8 | 20.9 | 63.0 | 115.0 | 95.4 | 93.3 | 79.0 | 44.1 | 34.6 | 30.2 | 23.8 | 53.3 |
| 1983 | 21.7 | 19.2 | 19.4 | 39.5 | 79.3 | 130.0 | 141.0 | 109.0 | 53.0 | 32.5 | 26.2 | 22.3 | 57.8 |
| 1984 | 19.0 | 17.4 | 24.7 | 56.1 | 102.0 | 222.0 | 168.0 | 106.0 | 48.7 | 30.6 | 25.2 | 22.0 | 70.1 |
| 1985 | 18.9 | 18.7 | 21.8 | 67.3 | 142.0 | 220.0 | 175.0 | 94.1 | 51.9 | 34.2 | 25.8 | 22.8 | 74.4 |
| 1986 | 19.4 | 17.8 | 19.3 | 48.4 | 95.1 | 143.0 | 141.0 | 86.4 | 53.4 | 35.9 | 27.5 | 26.5 | 59.5 |
| 1987 | 22.3 | 22.5 | 32.0 | 80.8 | 167.0 | 261.0 | 263.0 | 159.0 | 76.0 | 49.1 | 38.8 | 29.0 | 100.0 |
| 1988 | 24.2 | 23.1 | 27.5 | 67.3 | 140.0 | 242.0 | 199.0 | 108.0 | 62.2 | 38.4 | 28.8 | 24.6 | 82.1 |
| 1989 | 21.1 | 18.8 | 22.3 | 37.5 | 87.4 | 163.0 | 146.0 | 92.9 | 54.8 | 35.4 | 27.2 | 30.1 | 61.4 |
| 1990 | 20.6 | 19.6 | 30.0 | 63.0 | 195.0 | 306.0 | 179.0 | 115.0 | 64.6 | 41.9 | 32.7 | 26.2 | 91.1 |
| 1991 | 22.7 | 21.2 | 23.0 | 49.7 | 78.4 | 151.0 | 141.0 | 89.7 | 54.6 | 34.0 | 23.9 | 18.5 | 59.0 |
| 1992 | 17.6 | 17.2 | 17.6 | 53.0 | 99.8 | 157.0 | 174.0 | 85.7 | 51.0 | 31.4 | 24.1 | 20.5 | 62.4 |
| 1993 | 18.0 | 19.5 | 21.0 | 56.8 | 131.0 | 242.0 | 205.0 | 92.3 | 57.1 | 33.0 | 37.7 | 26.5 | 78.3 |
| 1994 | 22.4 | 19.1 | 28.4 | 66.1 | 169.0 | 288.0 | 239.0 | 121.0 | 63.7 | 40.2 | 47.4 | 41.4 | 95.5 |
| 1995 | 29.3 | 25.4 | 28.8 | 57.7 | 154.0 | 173.0 | 162.0 | 106.0 | 58.0 | 39.4 | 29.6 | 23.0 | 73.8 |
| 1996 | 19.4 | 20.1 | 20.5 | 68.2 | 127.0 | 227.0 | 182.0 | 125.0 | 54.5 | 36.1 | 27.8 | 22.6 | 77.5 |
| 1997 | 20.9 | 20.7 | 23.9 | 71.8 | 137.0 | 215.0 | 166.0 | 93.7 | 58.4 | 36.4 | 27.8 | 23.2 | 74.6 |
| 1998 | 21.0 | 22.4 | 27.6 | 111.0 | 190.0 | 264.0 | 273.0 | 139.0 | 75.5 | 45.7 | 32.2 | 28.2 | 102.0 |
| 1999 | 24.7 | 24.2 | 25.3 | 55.7 | 152.0 | 190.0 | 202.0 | 122.0 | 66.6 | 39.8 | 32.5 | 28.5 | 80.3 |
| 2000 | 24.3 | 22.0 | 24.2 | 59.5 | 149.0 | 145.0 | 111.0 | 85.3 | 55.1 | 46.2 | 38.9 | 31.8 | 66.0 |
| 2001 | 27.3 | 24.9 | 38.6 | 84.0 | 159.0 | 221.0 | 128.0 | 85.9 | 55.8 | 41.2 | 39.4 | 29.0 | 77.8 |
| 2002 | 28.1 | 25.3 | 43.2 | 139.0 | 155.0 | 258.0 | 270.0 | 152.0 | 75.1 | 53.4 | 35.0 | 27.8 | 105.0 |
| Aver. | 23.5 | 22.0 | 27.7 | 70.0 | 135.0 | 208.0 | 181.0 | 110.0 | 61.0 | 40.9 | 33.9 | 27.5 | 78.4 |
| | | | | | | | | | | | | | 78.4 |
| Max. | 39.4 | 35.2 | 52.4 | 139.0 | 209.0 | 382.0 | 339.0 | 184.0 | 102.0 | 80.4 | 69.4 | 50.4 | |
| Min. | 17.6 | 15.6 | 16.0 | 36.8 | | | | | | | | | |

**Table S 2.1.12 (4) Monthly Average Water Discharge Flow (4) ($m^3$/sec)**

**Nauvalisay – Sidjak village**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Ave. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1964 | 1.92 | 1.87 | 3.60 | 6.84 | 8.65 | 6.72 | 4.13 | 2.93 | 2.29 | 1.83 | 1.57 | 1.41 | 3.65 |
| 1965 | 1.29 | 1.38 | 2.24 | 3.29 | 3.57 | 2.13 | 1.43 | 1.15 | 0.99 | 1.33 | 2.70 | 1.67 | 1.93 |
| 1966 | 1.31 | 2.24 | 3.40 | 4.15 | 5.92 | 4.13 | 2.52 | 2.03 | 1.54 | 1.42 | 1.17 | 1.41 | 2.60 |
| 1967 | 1.18 | 1.12 | 1.91 | 4.01 | 4.75 | 2.96 | 2.02 | 1.53 | 1.38 | 1.68 | 1.32 | 1.31 | 2.10 |
| 1968 | 1.18 | 1.06 | 3.66 | 6.01 | 7.34 | 5.84 | 3.32 | 2.43 | 1.85 | 1.49 | 1.77 | 2.08 | 3.17 |
| 1971 | 1.86 | 1.89 | 3.76 | 7.78 | 8.48 | 5.44 | 3.17 | 2.78 | 2.22 | | | | - |
| 1973 | | | | | | | 3.27 | 2.70 | 2.39 | 2.15 | 1.88 | 1.68 | - |
| 1974 | 1.48 | 1.54 | 2.20 | 4.34 | 4.20 | 2.75 | 1.93 | 1.45 | 1.23 | 1.18 | 1.15 | 1.05 | 2.04 |
| 1975 | 1.15 | 1.08 | 2.87 | 6.66 | 5.23 | 4.20 | 2.11 | 1.75 | 1.40 | 1.31 | 1.68 | 1.58 | 2.59 |
| 1976 | 1.27 | 1.68 | 1.58 | 7.36 | 7.46 | 4.61 | 3.13 | 2.05 | 1.60 | 1.56 | 1.77 | 1.44 | 2.96 |
| 1977 | 1.25 | 1.61 | 3.27 | 4.11 | 3.04 | 2.48 | 2.00 | 1.65 | 1.30 | 1.48 | 2.02 | 1.77 | 2.16 |
| 1978 | 1.64 | 1.75 | 3.20 | 7.89 | 7.03 | 5.44 | 3.70 | 2.80 | 2.51 | 1.75 | 1.55 | 2.82 | 3.51 |
| 1979 | 1.97 | 2.63 | 3.24 | 9.06 | 8.40 | 5.87 | 4.38 | 3.44 | 2.91 | 2.28 | 0.17 | 1.74 | 3.84 |
| 1980 | 1.60 | 2.00 | 2.63 | 8.16 | 8.11 | 4.73 | 3.68 | 2.73 | 1.90 | 1.97 | 1.95 | 1.90 | 3.45 |
| 1981 | 1.73 | 1.65 | 3.27 | 5.52 | 7.28 | 5.24 | 2.80 | 2.32 | 1.97 | 1.73 | 1.72 | 1.27 | 3.04 |
| 1982 | 1.40 | 1.41 | 1.78 | 5.05 | 5.35 | 2.99 | 2.04 | 1.80 | 1.54 | 1.57 | 1.39 | 1.28 | 2.30 |
| 1983 | 1.33 | 1.37 | 1.84 | 3.10 | 3.29 | 2.12 | 1.68 | 1.49 | 1.37 | 1.46 | 1.35 | 1.71 | 1.84 |
| 1984 | 1.25 | 1.03 | 2.52 | 6.03 | 5.59 | 4.31 | 2.99 | 1.99 | 1.96 | 1.71 | 1.88 | 2.01 | 2.77 |
| 1985 | 1.59 | 2.43 | 3.77 | 7.56 | 9.10 | 5.78 | 3.69 | 3.00 | 2.49 | 2.14 | 1.85 | 2.11 | 3.79 |
| 1986 | 1.71 | 1.59 | 1.83 | 4.03 | 4.17 | 2.65 | 2.00 | 1.64 | 1.58 | 1.52 | 1.46 | 2.08 | 2.19 |
| 1987 | 1.89 | 2.30 | 4.46 | 8.76 | 8.60 | 7.53 | 3.11 | 3.56 | 3.02 | 1.99 | 1.90 | 1.83 | 4.08 |
| 1988 | 1.81 | 1.92 | 2.33 | 5.38 | 6.68 | 5.23 | 3.12 | 2.12 | 1.77 | 1.48 | 1.39 | 1.36 | 2.88 |
| 1989 | 1.37 | 1.23 | 2.42 | 4.25 | 5.55 | 4.89 | 2.68 | 2.07 | 1.71 | 1.44 | 1.33 | 2.81 | 2.65 |
| 1990 | 1.62 | 1.50 | 4.27 | 6.88 | 9.48 | 7.01 | 3.90 | 2.79 | 2.25 | 2.04 | 2.08 | 1.82 | 3.80 |
| 1991 | 1.71 | 1.77 | 2.64 | 5.35 | 5.44 | 4.48 | 3.06 | 2.43 | 1.98 | 1.70 | 1.54 | 1.79 | 2.82 |
| 1992 | 1.54 | 1.86 | 2.24 | 6.83 | 9.41 | 6.66 | 4.66 | 3.23 | 2.58 | 1.91 | 1.59 | 1.38 | 3.66 |
| 1993 | 1.27 | 3.56 | 3.15 | 8.00 | 11.10 | 8.66 | 5.82 | 3.62 | 2.86 | 2.26 | 2.44 | 2.40 | 4.60 |
| 1994 | 2.23 | 1.67 | 4.29 | 8.12 | 14.20 | 8.19 | 4.90 | 3.67 | 2.59 | 2.03 | 3.61 | 1.05 | 4.71 |
| 1995 | 2.59 | 2.41 | 2.84 | 3.99 | 5.44 | 3.24 | 2.61 | 2.21 | 2.16 | 2.03 | 1.60 | 1.51 | 2.72 |
| 1996 | 1.57 | 1.67 | 2.63 | 8.42 | 9.96 | 7.12 | 5.49 | 4.61 | 3.64 | 2.76 | 2.37 | 1.97 | 4.35 |
| 1997 | 2.09 | 2.03 | 3.39 | 9.31 | 12.10 | 8.53 | 5.02 | 4.24 | 3.35 | 2.61 | 2.20 | 1.87 | 4.73 |
| 1998 | 1.87 | 2.50 | 4.20 | 15.60 | 16.80 | 11.60 | 8.00 | 5.77 | 4.15 | 3.26 | 2.87 | 2.80 | 6.62 |
| 1999 | 2.99 | 4.57 | 4.43 | 7.19 | 12.60 | 7.96 | 5.69 | 4.75 | 3.32 | 2.88 | 3.15 | 2.91 | 5.20 |
| 2000 | 2.96 | 2.97 | 3.25 | 6.62 | 6.06 | 3.66 | 2.76 | 2.06 | 2.00 | 2.02 | 2.77 | 2.91 | 3.34 |
| 2001 | 2.82 | 2.86 | 3.92 | 6.26 | 6.22 | 4.53 | 3.38 | 3.09 | 2.80 | 3.27 | 4.16 | 2.25 | 3.80 |
| 2002 | 2.86 | 2.62 | 5.82 | 13.20 | 10.50 | 10.40 | 6.17 | 4.63 | 4.02 | 3.18 | 2.52 | 2.34 | 5.69 |
| Aver. | 1.75 | 1.96 | 3.11 | 6.72 | 7.63 | 5.43 | 3.51 | 2.74 | 2.24 | 1.95 | 1.94 | 1.87 | 3.21 |
| | | | | | | | | | | | | | 3.40 |
| Max. | 2.99 | 4.57 | 5.82 | 15.60 | 16.80 | 11.60 | 8.00 | 5.77 | 4.15 | 3.27 | 4.16 | 2.91 | |
| Min. | 1.15 | 1.03 | 1.58 | 3.10 | 3.04 | 2.12 | | | | | | | |

**Table S 2.1.12 (5) Monthly Average Water Discharge Flow (5) ($m^3$/sec)**

**044 Chimgansay – Chimgan resort**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Ave. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1967 | 0.16 | 0.14 | 0.18 | - | 0.59 | 0.34 | 0.27 | 0.20 | 0.16 | 0.19 | 0.17 | 0.17 | - |
| 1968 | 0.15 | 0.14 | 0.35 | 0.69 | 0.81 | 0.69 | 0.40 | 0.26 | 0.20 | 0.17 | 0.16 | 0.16 | 0.35 |
| 1969 | 0.15 | 0.15 | 1.16 | - | - | - | 0.66 | 0.52 | 0.39 | 0.39 | 0.37 | 0.31 | - |
| 1970 | 0.26 | 0.22 | 0.25 | 0.60 | 0.57 | 0.42 | 0.35 | 0.28 | 0.19 | 0.14 | 0.14 | 0.14 | 0.30 |
| 1971 | 0.12 | 0.12 | 0.15 | 0.42 | 0.41 | 0.30 | 0.27 | 0.22 | 0.14 | 0.13 | 0.13 | 0.12 | 0.21 |
| 1972 | 0.12 | 0.10 | 0.15 | 0.71 | 1.01 | 0.73 | 0.38 | 0.26 | 0.19 | 0.19 | 0.23 | 0.16 | 0.35 |
| 1973 | 0.15 | 0.14 | 0.20 | 0.72 | 0.74 | 0.50 | 0.35 | 0.25 | 0.20 | 0.16 | 0.15 | 0.14 | 0.31 |
| 1974 | 0.12 | 0.11 | 0.12 | 0.19 | 0.28 | 0.17 | 0.14 | 0.12 | 0.10 | 0.09 | 0.93 | 0.08 | 0.20 |
| 1975 | 0.08 | 0.08 | 0.15 | 0.30 | 0.27 | 0.28 | 0.23 | 0.16 | 0.12 | 0.12 | 0.12 | 0.10 | 0.17 |
| 1976 | 0.08 | 0.11 | 0.12 | 0.53 | 0.56 | 0.32 | 0.25 | 0.18 | 0.14 | 0.15 | 0.15 | 0.14 | 0.23 |
| 1977 | 0.13 | 0.11 | 0.15 | 0.16 | 0.22 | 0.30 | 0.21 | 0.15 | 0.11 | 0.22 | 0.19 | 0.21 | 0.18 |
| 1978 | 0.21 | 0.17 | 0.21 | 1.01 | 0.99 | 0.91 | 0.42 | 0.30 | 0.21 | 0.20 | 0.20 | 0.42 | 0.44 |
| 1979 | 0.30 | 0.29 | 0.45 | 1.40 | 1.28 | 0.89 | 0.43 | 0.35 | 0.31 | 0.29 | 0.24 | 0.24 | 0.54 |
| 1980 | 0.14 | 0.15 | 0.18 | 0.70 | 0.79 | 0.53 | 0.35 | 0.23 | 0.17 | 0.15 | 0.22 | 0.14 | 0.31 |
| 1981 | 0.14 | 0.13 | 0.27 | 0.51 | 0.65 | 0.52 | 0.33 | 0.26 | 0.20 | 0.19 | 0.16 | 0.14 | 0.29 |
| 1982 | 0.12 | 0.12 | 0.16 | 0.36 | 0.41 | 0.27 | 0.21 | 0.18 | 0.16 | 0.20 | 0.18 | 0.17 | 0.21 |
| 1983 | 0.17 | 0.17 | 0.17 | 0.29 | 0.60 | 0.37 | 0.26 | 0.23 | 0.17 | 0.14 | 0.14 | 0.14 | 0.24 |
| 1984 | 0.11 | 0.11 | 0.25 | 0.36 | 0.43 | 0.31 | 0.20 | 0.17 | 0.14 | 0.13 | 0.14 | 0.13 | 0.21 |
| 1985 | 0.12 | 0.12 | 0.20 | 0.65 | 0.72 | 0.45 | 0.31 | 0.21 | 0.16 | 0.14 | 0.12 | 0.11 | 0.28 |
| 1986 | 0.10 | 0.09 | 0.11 | 0.16 | 0.20 | 0.15 | 0.11 | 0.09 | 0.09 | 0.09 | 0.08 | 0.10 | 0.12 |
| 1987 | 0.14 | 0.16 | 0.43 | 1.61 | 1.39 | 0.88 | 0.56 | 0.26 | 0.17 | 0.18 | 0.20 | 0.18 | 0.51 |
| 1988 | 0.16 | 0.16 | 0.19 | 0.30 | 0.51 | 0.29 | 0.22 | 0.17 | 0.13 | 0.12 | 0.13 | 0.12 | 0.21 |
| 1989 | 0.10 | 0.10 | 0.16 | 0.26 | 0.48 | 0.34 | 0.24 | 0.18 | 0.14 | 0.14 | 0.11 | 0.19 | 0.20 |
| 1990 | 0.16 | 0.16 | 0.28 | 0.62 | 1.16 | 0.81 | 0.47 | 0.27 | 0.20 | 0.20 | 0.17 | 0.14 | 0.39 |
| 1991 | 0.13 | 0.13 | 0.17 | 0.31 | 0.48 | 0.46 | 0.25 | 0.20 | 0.15 | 0.14 | 0.12 | 0.13 | 0.22 |
| 1992 | 0.11 | 0.14 | 0.19 | 0.73 | 1.07 | 0.90 | 0.47 | 0.37 | 0.28 | 0.24 | 0.20 | 0.15 | 0.40 |
| 1993 | 0.15 | 0.19 | 0.22 | 0.78 | 1.53 | 1.23 | 0.59 | 0.39 | 0.27 | 0.23 | 0.35 | 0.27 | 0.52 |
| 1994 | 0.26 | 0.23 | 0.39 | 1.01 | 1.27 | 0.84 | 0.46 | 0.29 | 0.22 | 0.22 | 0.23 | 0.26 | 0.47 |
| 1995 | 0.27 | 0.28 | 0.29 | 0.37 | 0.40 | 0.28 | 0.26 | 0.21 | 0.18 | 0.19 | 0.15 | 0.13 | 0.25 |
| 1996 | 0.13 | 0.15 | 0.16 | 0.70 | 0.79 | 0.59 | 0.36 | 0.22 | 0.19 | 0.21 | 0.15 | 0.13 | 0.32 |
| 1997 | 0.14 | 0.15 | 0.20 | 0.31 | 0.68 | 0.54 | 0.24 | 0.15 | 0.14 | 0.15 | 0.22 | 0.14 | 0.26 |
| 1998 | 0.15 | 0.22 | 0.32 | 1.09 | 1.26 | 0.87 | 0.29 | 0.40 | 0.28 | 0.30 | 0.26 | 0.19 | 0.47 |
| 1999 | 0.16 | 0.19 | 0.27 | 0.74 | 1.00 | 0.51 | 0.36 | 0.19 | 0.23 | 0.27 | 0.22 | 0.19 | 0.36 |
| 2000 | 0.23 | 0.22 | 0.23 | 0.24 | 0.25 | 0.22 | 0.26 | 0.18 | 0.18 | 0.17 | 0.19 | 0.20 | 0.21 |
| 2001 | 0.23 | 0.22 | 0.23 | 0.24 | 0.25 | 0.22 | 0.26 | 0.18 | 0.18 | 0.17 | 0.19 | 0.20 | 0.21 |
| 2002 | 0.21 | 0.21 | 0.26 | 0.31 | 0.35 | 0.29 | 0.26 | 0.21 | 0.21 | 0.25 | 0.26 | 0.25 | 0.26 |
| Aver. | 0.16 | 0.16 | 0.25 | 0.57 | 0.70 | 0.51 | 0.32 | 0.24 | 0.19 | 0.19 | 0.21 | 0.17 | 0.28 |
| | | | | | | | | | | | | | 0.30 |
| Max. | 0.30 | 0.29 | 1.16 | 1.61 | 1.53 | 1.23 | 0.66 | 0.52 | 0.39 | 0.39 | 0.93 | 0.42 | |
| Min. | 0.08 | 0.08 | 0.11 | 0.16 | 0.20 | 0.15 | 0.11 | 0.09 | 0.09 | 0.09 | 0.08 | 0.08 | |

**Table S 2.1.12 (6) Monthly Average Water Discharge Flow (6) ($m^3$/sec)**

**Yangikurgan - Yangikurgan village**

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Ave. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1965 | | | | | | | 0.73 | 0.67 | 0.36 | 0.44 | 1.07 | 0.41 | - |
| 1966 | 0.32 | 0.43 | 0.94 | 1.03 | 1.92 | 1.67 | 0.73 | 0.39 | 0.25 | 0.41 | 0.32 | 0.36 | 0.73 |
| 1967 | 0.30 | 0.27 | 0.42 | 1.27 | 1.45 | 1.01 | 0.42 | 0.23 | 0.18 | 0.38 | 0.36 | 0.31 | 0.55 |
| 1968 | 0.27 | 0.26 | 0.95 | 1.24 | 1.74 | 1.54 | 0.81 | 0.44 | 0.43 | 0.40 | 0.43 | 0.41 | 0.74 |
| 1970 | | | | | | | 0.69 | 0.58 | 0.48 | 0.43 | 0.51 | 0.61 | - |
| 1971 | 0.48 | 0.33 | 0.77 | 1.52 | 1.53 | 1.18 | 0.79 | 0.59 | 0.49 | 0.42 | 0.28 | 0.25 | 0.72 |
| 1972 | 0.23 | 0.22 | 0.46 | 1.55 | 1.69 | 1.48 | 1.23 | 0.77 | 0.48 | 0.40 | 0.42 | 0.28 | 0.77 |
| 1973 | 0.26 | 0.32 | 0.52 | 1.67 | 1.74 | 1.10 | 0.72 | 0.46 | 0.31 | 0.32 | 0.28 | 0.21 | 0.66 |
| 1974 | 0.19 | 0.19 | 0.28 | 0.67 | 0.71 | 0.40 | 0.24 | 0.22 | 0.21 | 0.21 | 0.20 | 0.20 | 0.31 |
| 1975 | 0.16 | 0.15 | 0.38 | 1.07 | 1.02 | 0.84 | 0.48 | 0.32 | 0.25 | 0.24 | 0.23 | 0.22 | 0.45 |
| 1976 | 0.19 | 0.23 | 0.25 | 1.70 | 1.30 | 0.88 | 0.68 | 0.35 | 0.26 | 0.35 | 0.36 | 0.26 | 0.57 |
| 1977 | 0.22 | 0.24 | 0.40 | 0.74 | 0.61 | 0.67 | 0.34 | 0.28 | 0.22 | 0.41 | 0.48 | 0.45 | 0.42 |
| 1978 | 0.42 | 0.33 | 0.51 | 2.46 | 2.17 | 1.51 | 0.92 | 0.53 | 0.44 | 0.38 | 0.30 | 0.47 | 0.87 |
| 1979 | 0.42 | 0.45 | 0.52 | 3.57 | 2.42 | 2.04 | 1.18 | 0.85 | 0.52 | 0.38 | 0.33 | 0.33 | 1.08 |
| 1980 | 0.28 | 0.30 | 0.36 | 1.93 | 1.90 | 1.05 | 0.72 | 0.45 | 0.34 | 0.29 | 0.35 | 0.27 | 0.69 |
| 1981 | 0.25 | 0.24 | 0.58 | 1.17 | 1.64 | 1.52 | 0.88 | 0.89 | 0.58 | 0.36 | 0.27 | 0.29 | 0.72 |
| 1982 | 0.26 | 0.20 | 0.33 | 0.89 | 0.85 | 0.53 | 0.27 | 0.20 | 0.22 | 0.43 | 0.46 | 0.34 | 0.42 |
| 1983 | 0.29 | 0.27 | 0.33 | 0.75 | 1.10 | 0.70 | 0.54 | 0.35 | 0.26 | 0.27 | 0.25 | 0.21 | 0.44 |
| 1984 | 0.24 | 0.18 | 0.75 | 1.01 | 1.04 | 0.73 | 0.46 | 0.33 | 0.30 | 0.29 | 0.35 | 0.36 | 0.50 |
| 1985 | 0.26 | 0.31 | 0.68 | 1.69 | 1.64 | 1.25 | 0.81 | 0.48 | 0.35 | 0.32 | 0.32 | 0.29 | 0.70 |
| 1986 | 0.25 | 0.23 | 0.27 | 0.71 | 0.82 | 0.50 | 0.30 | 0.23 | 0.21 | 0.26 | 0.26 | 0.43 | 0.37 |
| 1987 | 0.30 | 0.35 | 1.06 | 2.53 | 2.81 | 2.25 | 1.83 | 0.87 | 0.40 | 0.39 | 0.47 | 0.31 | 1.13 |
| 1988 | 0.24 | 0.33 | 0.36 | 1.16 | 1.29 | 0.78 | 0.48 | 0.35 | 0.32 | 0.32 | 0.28 | 0.29 | 0.52 |
| 1989 | 0.26 | 0.20 | 0.36 | 0.74 | 1.24 | 0.97 | 0.50 | 0.34 | 0.29 | 0.28 | 0.26 | 0.86 | 0.53 |
| 1990 | 0.29 | 0.25 | 0.88 | 1.66 | 2.38 | 1.86 | 1.11 | 0.55 | 0.41 | 0.46 | 0.37 | 0.34 | 0.88 |
| 1991 | 0.35 | 0.37 | 0.43 | 0.94 | 1.09 | 0.73 | 0.51 | 0.30 | 0.25 | 0.26 | 0.25 | 0.39 | 0.49 |
| 1992 | 0.30 | 0.47 | 0.47 | 1.36 | 2.24 | 1.96 | 0.93 | 0.68 | 0.39 | 0.37 | 0.35 | 0.35 | 0.82 |
| 1993 | 0.34 | 0.54 | 0.83 | 1.51 | 2.61 | 2.23 | 1.47 | 0.75 | 0.68 | 0.65 | 1.03 | 0.64 | 1.11 |
| 1994 | 0.55 | 0.48 | 1.36 | 2.05 | 3.32 | 1.89 | 0.93 | 0.59 | 0.33 | 0.27 | 1.04 | 0.83 | 1.14 |
| 1995 | 0.56 | 0.53 | 0.58 | 0.79 | 1.40 | 0.71 | 0.40 | 0.30 | 0.26 | 0.29 | 0.28 | 0.28 | 0.53 |
| 1996 | 0.27 | 0.25 | 0.38 | 3.01 | 1.78 | 1.37 | 1.06 | 0.72 | 0.56 | 0.53 | 0.52 | 0.56 | 0.92 |
| 1997 | 0.42 | 0.56 | 0.81 | 1.50 | 1.54 | 0.90 | 0.54 | 0.40 | 0.31 | 0.33 | 0.40 | 0.38 | 0.67 |
| 1998 | 0.37 | 0.37 | 1.46 | 3.20 | 3.54 | 2.24 | 1.39 | 0.67 | 0.64 | 0.50 | 0.44 | 0.41 | 1.27 |
| 1999 | 0.42 | 0.71 | 0.75 | 1.37 | 1.82 | 1.03 | 1.05 | 0.55 | 0.44 | 0.45 | 0.54 | 0.47 | 0.80 |
| 2000 | 0.47 | 0.42 | 0.45 | 1.17 | 0.89 | 0.50 | 0.35 | 0.25 | 0.29 | 0.77 | 0.68 | 0.65 | 0.58 |
| 2001 | 0.61 | 0.61 | 0.52 | 1.55 | 1.53 | 0.70 | 0.47 | 0.25 | 0.29 | 0.53 | 0.62 | 0.63 | 0.69 |
| 2002 | 0.63 | 0.73 | 1.03 | 2.53 | 2.79 | 1.90 | 1.01 | 0.47 | 0.33 | 0.27 | 0.31 | 0.32 | 1.03 |
| Aver. | 0.33 | 0.35 | 0.61 | 1.53 | 1.70 | 1.22 | 0.76 | 0.48 | 0.36 | 0.38 | 0.42 | 0.40 | 0.67 |
| | | | | | | | | | | | | | 0.71 |
| Max. | 0.63 | 0.73 | 1.46 | 3.57 | 3.54 | 2.25 | 1.83 | 0.89 | 0.68 | 0.77 | 1.07 | 0.86 | |
| Min. | 0.16 | 0.15 | 0.25 | 0.67 | 0.61 | 0.40 | 0.24 | 0.20 | 0.18 | 0.21 | 0.20 | 0.20 | |

# Table S 2.1.13 (1) Charvak Dam Inflow Calculation (1) ($m^3$/sec)

103 7 12 7 25

**Chirchik – Khodjikent village**
**Chatkal – above Hudaydotsay river mouth**

| | Q1 | Q2 | Q1 | Q2 |
|---|---|---|---|---|
| 1900 | - | | - | |
| 1901 | 231 | | 231 | 109.145 |
| 1902 | 326 | | 326 | 161.483 |
| 1903 | 309 | | 309 | 152.117 |
| 1904 | 194 | | 194 | 88.761 |
| 1905 | 222 | | 222 | 104.187 |
| 1906 | 191 | | 191 | 87.108 |
| 1907 | 288 | | 288 | 140.548 |
| 1908 | 359 | | 359 | 179.663 |
| 1909 | 209 | | 209 | 97.025 |
| 1910 | 208 | | 208 | 96.474 |
| 1911 | 194 | | 194 | 88.761 |
| 1912 | 239 | | 239 | 113.552 |
| 1913 | 210 | | 210 | 97.576 |
| 1914 | 284 | | 284 | 138.344 |
| 1915 | 248 | | 248 | 118.511 |
| 1916 | 183 | | 183 | 82.701 |
| 1917 | 132 | | 132 | 54.604 |
| 1918 | 208 | | 208 | 96.474 |
| 1919 | 219 | | 219 | 102.534 |
| 1920 | 195 | | 195 | 89.312 |
| 1921 | 348 | | 348 | 173.603 |
| 1922 | 265 | | 265 | 127.876 |
| 1923 | 239 | | 239 | 113.552 |
| 1924 | 242 | | 242 | 115.205 |
| 1925 | 180 | | 180 | 81.048 |
| 1926 | 179 | | 179 | 80.497 |
| 1927 | 139 | | 139 | 58.460 |
| 1928 | 265 | | 265 | 127.876 |
| 1929 | 244 | | 244 | 116.307 |
| 1930 | 221 | | 221 | 103.636 |
| 1931 | 278 | | 278 | 135.038 |
| 1932 | 206 | | 206 | 95.372 |
| 1933 | 212 | | 212 | 98.677 |
| 1934 | 305 | | 305 | 149.913 |
| 1935 | 232 | | 232 | 109.696 |
| 1936 | 196 | | 196 | 89.863 |
| 1937 | 171 | | 171 | 76.090 |
| 1938 | 159 | | 159 | 69.478 |
| 1939 | 173 | | 173 | 77.191 |
| 1940 | 183 | | 183 | 82.701 |
| 1941 | 265 | | 265 | 127.876 |
| 1942 | 268 | | 268 | 129.529 |
| 1943 | 217 | | 217 | 101.432 |
| 1944 | 170 | | 170 | 75.539 |
| 1945 | 206 | | 206 | 95.372 |
| 1946 | 229 | | 229 | 108.043 |
| 1947 | 178 | | 178 | 79.946 |
| 1948 | 249 | | 249 | 119.062 |
| 1949 | 256 | | 256 | 122.918 |
| 1950 | 166 | | 166 | 73.335 |
| 1951 | 179 | | 179 | 80.497 |
| 1952 | 294 | | 294 | 143.853 |
| 1953 | 245 | | 245 | 116.858 |
| 1954 | 242 | | 242 | 115.205 |
| 1955 | 190 | | 190 | 86.557 |
| 1956 | 202 | | 202 | 93.168 |
| 1957 | 141 | | 141 | 59.562 |
| 1958 | 311 | | 311 | 153.219 |
| 1959 | 306 | | 306 | 150.464 |
| 1960 | 317 | | 317 | 156.524 |

**Chirchik – Khodjikent village**
**Chatkal – above Hudaydotsay river mouth**

| | Q1 | Q2 | Q1 | Q2 |
|---|---|---|---|---|
| 1961 | 164 | | 164 | 72.233 |
| 1962 | 191 | | 191 | 87.108 |
| 1963 | 234 | | 234 | 110.798 |
| 1964 | 242 | | 242 | 115.205 |
| 1965 | 153 | 68.1 | 153 | 68.100 |
| 1966 | 251 | 122 | 251 | 122.000 |
| 1967 | 190 | 87.9 | 190 | 87.900 |
| 1968 | 257 | 121 | 257 | 121.000 |
| 1969 | 448 | 229 | 448 | 229.000 |
| 1970 | 218 | 110 | 218 | 110.000 |
| 1971 | 211 | 97.4 | 211 | 97.400 |
| 1972 | 234 | 104 | 234 | 104.000 |
| 1973 | 235 | 110 | 235 | 110.000 |
| 1974 | 142 | 63.6 | 142 | 63.600 |
| 1975 | 154 | 65.9 | 154 | 65.900 |
| 1976 | 182 | 77.4 | 182 | 77.400 |
| 1977 | | 81.2 | 180.276 | 81.200 |
| 1978 | | 114 | 239.813 | 114.000 |
| 1979 | | 148 | 301.527 | 148.000 |
| 1980 | | 96.7 | 208.411 | 96.700 |
| 1981 | | 91.3 | 198.609 | 91.300 |
| 1982 | | 61.8 | 145.063 | 61.800 |
| 1983 | | 80.8 | 179.550 | 80.800 |
| 1984 | | 102 | 218.031 | 102.000 |
| 1985 | | 116 | 243.443 | 116.000 |
| 1986 | | 74.9 | 168.841 | 74.900 |
| 1987 | | 134 | 276.115 | 134.000 |
| 1988 | | 103 | 219.846 | 103.000 |
| 1989 | | 83.7 | 184.814 | 83.700 |
| 1990 | | 128 | 265.224 | 128.000 |
| 1991 | | 88.6 | 193.708 | 88.600 |
| 1992 | | 110 | 232.552 | 110.000 |
| 1993 | | 133 | 274.300 | 133.000 |
| 1994 | | 128 | 265.224 | 128.000 |
| 1995 | | 94.1 | 203.691 | 94.100 |
| 1996 | | 105 | 223.476 | 105.000 |
| 1997 | | 90.6 | 197.338 | 90.600 |
| 1998 | | 143 | 292.451 | 143.000 |
| 1999 | | 116 | 243.443 | 116.000 |
| 2000 | | 84.5 | 186.266 | 84.500 |
| 2001 | | 112 | 236.182 | 112.000 |
| 2002 | | 142 | 290.636 | 142.000 |
| | 76 | 38 | 102 | 102 |

Number of years of consistent observations = 12
Averag 76 38 102 102
222.917 104.692
Average figures for the renewal period
226.391 106.605
Index of correlation = 0.996
Its probable error = 0.001
Probable value of correlation index 0.998 0.995
Limit value of correlation index 1.002 0.990
Regression equation on Q1 Q2 = -18.118 + 0.551 * Q1
Regression equation on Q2 Q1 = 32.887 + 1.815 * Q2
Equation errors on Q1 2.717
on Q2 4.950

## Table S 2.1.13 (2) Charvak Dam Inflow Calculation (2) ($m^3$/sec)

**Chatkal – above Hudaydotsay river mouth**
**Pskem – Mullala village**

| | Q1 | Q2 | Q1 | Q2 |
|---|---|---|---|---|
| 1900 | | | | |
| 1901 | 109 | | 109 | 80.395 |
| 1902 | 161 | | 161 | 111.346 |
| 1903 | 152 | | 152 | 105.989 |
| 1904 | 88.8 | | 88.8 | 68.372 |
| 1905 | 104 | | 104 | 77.419 |
| 1906 | 87.1 | | 87.1 | 67.360 |
| 1907 | 141 | | 141 | 99.442 |
| 1908 | 180 | | 180 | 122.655 |
| 1909 | 97 | | 97 | 73.252 |
| 1910 | 96.5 | | 96.5 | 72.955 |
| 1911 | 88.8 | | 88.8 | 68.372 |
| 1912 | 114 | | 114 | 83.371 |
| 1913 | 97.6 | | 97.6 | 73.610 |
| 1914 | 138 | | 138 | 97.656 |
| 1915 | 119 | | 119 | 86.347 |
| 1916 | 82.7 | | 82.7 | 64.741 |
| 1917 | 54.6 | | 54.6 | 48.016 |
| 1918 | 96.5 | | 96.5 | 72.955 |
| 1919 | 103 | | 103 | 76.824 |
| 1920 | 89.3 | | 89.3 | 68.669 |
| 1921 | 174 | | 174 | 119.083 |
| 1922 | 128 | | 128 | 91.704 |
| 1923 | 114 | | 114 | 83.371 |
| 1924 | 115 | | 115 | 83.966 |
| 1925 | 81 | | 81 | 63.729 |
| 1926 | 90.5 | | 90.5 | 69.384 |
| 1927 | 58.5 | | 58.5 | 50.337 |
| 1928 | 128 | | 128 | 91.704 |
| 1929 | 116 | | 116 | 84.561 |
| 1930 | 104 | | 104 | 77.419 |
| 1931 | 135 | | 135 | 95.87 |
| 1932 | 95.4 | | 95.4 | 72.3 |
| 1933 | 98.7 | | 98.7 | 74.264 |
| 1934 | 150 | | 150 | 104.798 |
| 1935 | 110 | | 110 | 80.99 |
| 1936 | 89.9 | | 89.9 | 69.026 |
| 1937 | 76.1 | | 76.1 | 60.813 |
| 1938 | 69.5 | | 69.5 | 56.884 |
| 1939 | 77.2 | | 77.2 | 61.467 |
| 1940 | 82.7 | | 82.7 | 64.741 |
| 1941 | 128 | | 128 | 91.704 |
| 1942 | 130 | | 130 | 92.894 |
| 1943 | 101 | | 101 | 75.633 |
| 1944 | 75.5 | | 75.5 | 60.456 |
| 1945 | 95.4 | | 95.4 | 72.3 |
| 1946 | 108 | | 108 | 79.8 |
| 1947 | 79.9 | | 79.9 | 63.074 |
| 1948 | 119 | | 119 | 86.347 |
| 1949 | 123 | | 123 | 88.728 |
| 1950 | 73.3 | | 73.3 | 59.146 |
| 1951 | 80.5 | | 80.5 | 63.432 |
| 1952 | 144 | | 144 | 101.227 |
| 1953 | 117 | | 117 | 85.157 |
| 1954 | 115 | | 115 | 83.966 |
| 1955 | 86.6 | | 86.6 | 67.062 |
| 1956 | 93.2 | | 93.2 | 70.991 |
| 1957 | 59.6 | | 59.6 | 50.992 |
| 1958 | 153 | | 153 | 106.584 |
| 1959 | 150 | | 150 | 104.798 |
| 1960 | 157 | | 157 | 108.965 |

**Chatkal – above Hudaydotsay river mouth**
**Pskem – Mullala village**

| | Q1 | Q2 | Q1 | Q2 |
|---|---|---|---|---|
| 1961 | 72.2 | | 72.2 | 58.491 |
| 1962 | 87.1 | | 87.1 | 67.36 |
| 1963 | 111 | | 111 | 81.585 |
| 1964 | 115 | | 115 | 83.966 |
| 1965 | 68.1 | 58.3 | 68.1 | 58.3 |
| 1966 | 122 | 89.8 | 122 | 89.8 |
| 1967 | 87.9 | 78.2 | 87.9 | 78.2 |
| 1968 | 121 | 94.5 | 121 | 94.5 |
| 1969 | 229 | 137 | 229 | 137 |
| 1970 | 110 | 83.6 | 110 | 83.6 |
| 1971 | 97.4 | 82.9 | 97.4 | 82.9 |
| 1972 | 104 | 79.8 | 104 | 79.8 |
| 1973 | 110 | 88.5 | 110 | 88.5 |
| 1974 | 63.6 | 55.9 | 63.6 | 55.9 |
| 1975 | 65.9 | 61 | 65.9 | 61 |
| 1976 | 77.4 | 69.5 | 77.4 | 69.5 |
| 1977 | 81.2 | 70.5 | 81.2 | 70.5 |
| 1978 | 114 | 87.2 | 114 | 87.2 |
| 1979 | 148 | 91.4 | 148 | 91.4 |
| 1980 | 96.7 | 74.8 | 96.7 | 74.8 |
| 1981 | 91.3 | 76.1 | 91.3 | 76.1 |
| 1982 | 61.8 | 53.3 | 61.8 | 53.3 |
| 1983 | 80.8 | 57.8 | 80.8 | 57.8 |
| 1984 | 102 | 70.1 | 102 | 70.1 |
| 1985 | 116 | 74.4 | 116 | 74.4 |
| 1986 | 74.9 | 59.5 | 74.9 | 59.5 |
| 1987 | 134 | 100 | 134 | 100 |
| 1988 | 103 | 82.1 | 103 | 82.1 |
| 1989 | 83.7 | 61.4 | 83.7 | 61.4 |
| 1990 | 128 | 91.1 | 128 | 91.1 |
| 1991 | 88.6 | 59 | 88.6 | 59 |
| 1992 | 110 | 62.4 | 110 | 62.4 |
| 1993 | 133 | 78.3 | 133 | 78.3 |
| 1994 | 128 | 95.6 | 128 | 95.6 |
| 1995 | 94.1 | 73.9 | 94.1 | 73.9 |
| 1996 | 105 | 75.9 | 105 | 75.9 |
| 1997 | 90.6 | 74.8 | 90.6 | 74.8 |
| 1998 | 143 | 102 | 143 | 102 |
| 1999 | 116 | 80.6 | 116 | 80.6 |
| 2000 | 84.5 | 66.2 | 84.5 | 66.2 |
| 2001 | 112 | 78.1 | 112 | 78.1 |
| 2002 | 142 | 106 | 142 | 106 |
| | 102 | 38 | 102 | 102 |

Number of years of consistent observations = 38
Average figures for the period of consistent observations
105.750 78.461
Average figures for the renewal period
106.727 79.042
Index of correlation = 0.918
Its probable error = 0.017
Probable value of correlation index 0.935 0.900
Limit value of correlation index 0.987 0.848
Regression equation on Q1 Q2 = 15.517 + 0.595 * Q1
Regression equation on Q2 Q1 = -26.071 + 1.680 * Q2
Equation errors on Q1 4.828
on Q2 8.840

## Table S 2.1.13 (3) Charvak Dam Inflow Calculation (3) ($m^3$/sec)

102 11 12 7 25

**Nauvalisay – Sidjak village**
**Chatkal – above Hudaydotsay river mouth**

| | Q1 | Q2 | Q1 | Q2 |
|---|---|---|---|---|
| 1900 | | | | |
| 1901 | | 109 | 3.649 | 109 |
| 1902 | | 161 | 5.512 | 161 |
| 1903 | | 152 | 5.189 | 152 |
| 1904 | | 88.8 | 2.926 | 88.8 |
| 1905 | | 104 | 3.47 | 104 |
| 1906 | | 87.1 | 2.865 | 87.1 |
| 1907 | | 141 | 4.795 | 141 |
| 1908 | | 180 | 6.192 | 180 |
| 1909 | | 97 | 3.22 | 97 |
| 1910 | | 96.5 | 3.202 | 96.5 |
| 1911 | | 88.8 | 2.926 | 88.8 |
| 1912 | | 114 | 3.829 | 114 |
| 1913 | | 97.6 | 3.241 | 97.6 |
| 1914 | | 138 | 4.688 | 138 |
| 1915 | | 119 | 4.008 | 119 |
| 1916 | | 82.7 | 2.708 | 82.7 |
| 1917 | | 54.6 | 1.701 | 54.6 |
| 1918 | | 96.5 | 3.202 | 96.5 |
| 1919 | | 103 | 3.435 | 103 |
| 1920 | | 89.3 | 2.944 | 89.3 |
| 1921 | | 174 | 5.977 | 174 |
| 1922 | | 128 | 4.33 | 128 |
| 1923 | | 114 | 3.829 | 114 |
| 1924 | | 115 | 3.864 | 115 |
| 1925 | | 81 | 2.647 | 81 |
| 1926 | | 90.5 | 2.987 | 90.5 |
| 1927 | | 58.5 | 1.841 | 58.5 |
| 1928 | | 128 | 4.33 | 128 |
| 1929 | | 116 | 3.9 | 116 |
| 1930 | | 104 | 3.47 | 104 |
| 1931 | | 135 | 4.581 | 135 |
| 1932 | | 95.4 | 3.162 | 95.4 |
| 1933 | | 98.7 | 3.281 | 98.7 |
| 1934 | | 150 | 5.118 | 150 |
| 1935 | | 110 | 3.685 | 110 |
| 1936 | | 89.9 | 2.966 | 89.9 |
| 1937 | | 76.1 | 2.471 | 76.1 |
| 1938 | | 69.5 | 2.235 | 69.5 |
| 1939 | | 77.2 | 2.511 | 77.2 |
| 1940 | | 82.7 | 2.708 | 82.7 |
| 1941 | | 128 | 4.33 | 128 |
| 1942 | | 130 | 4.401 | 130 |
| 1943 | | 101 | 3.363 | 101 |
| 1944 | | 75.5 | 2.45 | 75.5 |
| 1945 | | 95.4 | 3.162 | 95.4 |
| 1946 | | 108 | 3.614 | 108 |
| 1947 | | 79.9 | 2.607 | 79.9 |
| 1948 | | 119 | 4.008 | 119 |
| 1949 | | 123 | 4.151 | 123 |
| 1950 | | 73.3 | 2.371 | 73.3 |
| 1951 | | 80.5 | 2.629 | 80.5 |
| 1952 | | 144 | 4.903 | 144 |
| 1953 | | 117 | 3.936 | 117 |
| 1954 | | 115 | 3.864 | 115 |
| 1955 | | 86.6 | 2.847 | 86.6 |
| 1956 | | 93.2 | 3.084 | 93.2 |
| 1957 | | 59.6 | 1.88 | 59.6 |
| 1958 | | 153 | 5.225 | 153 |
| 1959 | | 150 | 5.118 | 150 |
| 1960 | | 157 | 5.368 | 157 |

**Nauvalisay – Sidjak village**
**Chatkal – above Hudaydotsay river mouth**

| | Q1 | Q2 | Q1 | Q2 |
|---|---|---|---|---|
| 1961 | | 72.2 | 2.332 | 72.2 |
| 1962 | | 87.1 | 2.865 | 87.1 |
| 1963 | | 111 | 3.721 | 111 |
| 1964 | 3.65 | 115 | 3.65 | 115 |
| 1965 | 1.93 | 68.1 | 1.93 | 68.1 |
| 1966 | 2.6 | 122 | 2.6 | 122 |
| 1967 | 2.1 | 87.9 | 2.1 | 87.9 |
| 1968 | 3.17 | 121 | 3.17 | 121 |
| 1969 | | 229 | 7.947 | 229 |
| 1970 | | 110 | 3.685 | 110 |
| 1971 | - | 97.4 | 3.234 | 97.4 |
| 1972 | | 104 | 3.47 | 104 |
| 1973 | - | 110 | 3.685 | 110 |
| 1974 | 2.04 | 63.6 | 2.04 | 63.6 |
| 1975 | 2.58 | 65.9 | 2.58 | 65.9 |
| 1976 | 2.96 | 77.4 | 2.96 | 77.4 |
| 1977 | 2.16 | 81.2 | 2.16 | 81.2 |
| 1978 | 3.51 | 114 | 3.51 | 114 |
| 1979 | 3.97 | 148 | 3.97 | 148 |
| 1980 | 3.45 | 96.7 | 3.45 | 96.7 |
| 1981 | 3.04 | 91.3 | 3.04 | 91.3 |
| 1982 | 2.3 | 61.8 | 2.3 | 61.8 |
| 1983 | 1.84 | 80.8 | 1.84 | 80.8 |
| 1984 | 2.77 | 102 | 2.77 | 102 |
| 1985 | 3.79 | 116 | 3.79 | 116 |
| 1986 | 2.19 | 74.9 | 2.19 | 74.9 |
| 1987 | 4.25 | 134 | 4.25 | 134 |
| 1988 | 2.88 | 103 | 2.88 | 103 |
| 1989 | 2.65 | 83.7 | 2.65 | 83.7 |
| 1990 | 3.8 | 128 | 3.8 | 128 |
| 1991 | 2.82 | 88.6 | 2.82 | 88.6 |
| 1992 | 3.66 | 110 | 3.66 | 110 |
| 1993 | 4.6 | 133 | 4.6 | 133 |
| 1994 | 4.85 | 128 | 4.85 | 128 |
| 1995 | 2.82 | 94.1 | 2.82 | 94.1 |
| 1996 | 4.35 | 105 | 4.35 | 105 |
| 1997 | 4.73 | 90.6 | 4.73 | 90.6 |
| 1998 | 6.62 | 143 | 6.62 | 143 |
| 1999 | 5.2 | 116 | 5.2 | 116 |
| 2000 | 3.33 | 84.5 | 3.33 | 84.5 |
| 2001 | 3.8 | 112 | 3.8 | 112 |
| 2002 | 5.69 | 142 | 5.69 | 142 |
| | 34 | 102 | 102 | 102 |

Number of years of consistent observations = 34
Average figures for the period of consistent observations
3.415 102.444
Average figures for the renewal period
3.568 106.727
Index of correlation = 0.765
Its probable error = 0.048
Probable value of correlation index 0.813 0.717
Limit value of correlation index 0.957 0.574
Regression equation on Q1 Q2 = 7.087 + 27.925 * Q1
Regression equation on Q2 Q1 = -0.254 + 0.036 * Q2
Equation errors on Q1 11.772
on Q2 0.551

## Table S 2.1.13 (4) Charvak Dam Inflow Calculation (4) ($m^3$/sec)

72 7 25 6 12

**Chatkal – above Hudaydotsay river mouth**
**Koksu – Burchmulla village**

| | Q1 | Q2 | Q1 | Q2 |
|---|---|---|---|---|
| 1931 | | - | | - |
| 1932 | | 10.5 | 83.717 | 10.5 |
| 1933 | | 9.69 | 75.945 | 9.69 |
| 1934 | | 16.3 | 139.37 | 16.3 |
| 1935 | | 11.2 | 90.434 | 11.2 |
| 1936 | | 9.68 | 75.849 | 9.68 |
| 1937 | | 7.87 | 58.483 | 7.87 |
| 1938 | | 8.1 | 60.69 | 8.1 |
| 1939 | | 8.26 | 62.225 | 8.26 |
| 1940 | | 9.11 | 70.38 | 9.11 |
| 1941 | | 14.1 | 118.26 | 14.1 |
| 1942 | | 15 | 126.89 | 15 |
| 1943 | | - | | - |
| 1944 | | - | | - |
| 1945 | | | | |
| 1946 | | | | |
| 1947 | | | | |
| 1948 | | | | |
| 1949 | | - | | - |
| 1950 | | 8.88 | 68.174 | 8.88 |
| 1951 | | 10 | 78.92 | 10 |
| 1952 | | 16.2 | 138.41 | 16.2 |
| 1953 | | 14.5 | 122.1 | 14.5 |
| 1954 | | 14 | 117.3 | 14 |
| 1955 | | 8.75 | 66.926 | 8.75 |
| 1956 | | 10.4 | 82.758 | 10.4 |
| 1957 | | 7.22 | 52.246 | 7.22 |
| 1958 | | 15.7 | 133.61 | 15.7 |
| 1959 | | 13.9 | 116.34 | 13.9 |
| 1960 | | 16.7 | 143.21 | 16.7 |
| 1961 | | 8.61 | 65.583 | 8.61 |
| 1962 | | 10.4 | 82.758 | 10.4 |
| 1963 | | 13.3 | 110.58 | 13.3 |
| 1964 | | 14.3 | 120.18 | 14.3 |
| 1965 | 68.1 | 9.66 | 68.1 | 9.66 |
| 1966 | 122 | 14.2 | 122 | 14.2 |
| 1967 | 87.9 | 11.4 | 87.9 | 11.4 |
| 1968 | 121 | 15.1 | 121 | 15.1 |
| 1969 | 229 | 25.3 | 229 | 25.3 |
| 1970 | 110 | 11.2 | 110 | 11.2 |
| 1971 | 97.4 | 11.2 | 97.4 | 11.2 |
| 1972 | 104 | 13.5 | 104 | 13.5 |
| 1973 | 110 | 12.9 | 110 | 12.9 |
| 1974 | 63.6 | 7.68 | 63.6 | 7.68 |
| 1975 | 65.9 | 9.3 | 65.9 | 9.3 |
| 1976 | 77.4 | 11.4 | 77.4 | 11.4 |
| 1977 | 81.2 | 9.63 | 81.2 | 9.63 |
| 1978 | 114 | - | 114 | 13.656 |
| 1979 | 148 | | 148 | 17.2 |
| 1980 | 96.7 | | 96.7 | 11.853 |

**Chatkal – above Hudaydotsay river mouth**
**Koksu – Burchmulla village**

| | Q1 | Q2 | Q1 | Q2 |
|---|---|---|---|---|
| 1981 | 91.3 | | 91.3 | 11.29 |
| 1982 | 61.8 | | 61.8 | 8.216 |
| 1983 | 80.8 | | 80.8 | 10.196 |
| 1984 | 102 | | 102 | 12.405 |
| 1985 | 116 | | 116 | 13.865 |
| 1986 | 74.9 | | 74.9 | 9.581 |
| 1987 | 134 | | 134 | 15.741 |
| 1988 | 103 | | 103 | 12.51 |
| 1989 | 83.7 | | 83.7 | 10.498 |
| 1990 | 128 | | 128 | 15.115 |
| 1991 | 88.6 | | 88.6 | 11.009 |
| 1992 | 110 | | 110 | 13.239 |
| 1993 | 133 | | 133 | 15.636 |
| 1994 | 128 | | 128 | 15.115 |
| 1995 | 94.1 | | 94.1 | 11.582 |
| 1996 | 105 | | 105 | 12.718 |
| 1997 | 90.6 | | 90.6 | 11.217 |
| 1998 | 143 | | 143 | 16.679 |
| 1999 | 116 | | 116 | 13.865 |
| 2000 | 84.5 | | 84.5 | 10.582 |
| 2001 | 112 | | 112 | 13.448 |
| 2002 | 142 | | 142 | 16.574 |
| | 38 | 39 | 64 | 64 |

Number of years of consistent observations = 13
Average figures for the period of consistent observations
102.885 12.498
Average figures for the renewal period
101.247 12.327
Index of correlation = 0.977
Its probable error = 0.008
Probable value of correlation index 0.986 0.969
Limit value of correlation index 1.011 0.943
Regression equation on Q1 Q2 = 1.775 + 0.104 * Q1
Regression equation on Q2 Q1 = -17.028 + 9.595 * Q2
Equation errors on Q1 0.662
on Q2 6.499

# Table S 2.1.14 Monthly Average Inflow into Charvak Dam ($m^3$/sec)

| Year | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Ave | Min |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1932 | 83.7 | 80.9 | 129 | 262 | 387 | 511 | 373 | 206 | 135 | 99.6 | 91.9 | 70.8 | 202.5 | 70.8 |
| 1933 | 63.1 | 62.5 | 78.4 | 173 | 423 | 549 | 370 | 232 | 144 | 94.1 | 80 | 83.7 | 196.1 | 62.5 |
| 1934 | 65.3 | 80.9 | 94.8 | 253 | 444 | 873 | 674 | 372 | 177 | 119 | 91.2 | 822 | 338.9 | 65.3 |
| 1935 | 68.4 | 66.1 | 88.2 | 170 | 401 | 572 | 516 | 295 | 145 | 103 | 85.5 | 73.4 | 215.3 | 66.1 |
| 1936 | 63.9 | 60 | 61.1 | 163 | 396 | 488 | 291 | 166 | 112 | 81.7 | 71.7 | 59.4 | 167.8 | 59.4 |
| 1937 | 53 | 52.7 | 56.1 | 106 | 284 | 351 | 264 | 148 | 106 | 69.8 | 59.2 | 49.4 | 133.3 | 49.4 |
| 1938 | 54.6 | 58.1 | 57.4 | 177 | 373 | 262 | 212 | 155 | 87.3 | 67.8 | 51.1 | 45.2 | 133.4 | 45.2 |
| 1939 | 44 | 45.4 | 55.6 | 112 | 387 | 407 | 276 | 169 | 99.4 | 72.2 | 64.2 | 51.7 | 148.6 | 44 |
| 1940 | 48.9 | 51.6 | 58.7 | 149 | 265 | 473 | 287 | 176 | 104 | 89.7 | 80.9 | 61.8 | 153.8 | 48.9 |
| 1941 | 58.5 | 60.4 | 119 | 309 | 622 | 622 | 331 | 206 | 122 | 95.4 | 87.6 | 79.7 | 226.1 | 58.5 |
| 1942 | 63.8 | 55.6 | 112 | 241 | 512 | 634 | 457 | 228 | 130 | 84.6 | 69.1 | 51.9 | 219.9 | 51.9 |
| 1943 | 63.9 | 61 | 63.3 | 137 | 327 | 543 | 434 | 201 | 120 | 101 | 84.8 | 76.8 | 184.4 | 61 |
| 1944 | 72.7 | 66.3 | 91.4 | 170 | 344 | 364 | 305 | 189 | 113 | 81.6 | 72.1 | 66.4 | 161.3 | 66.3 |
| 1945 | 62 | 56.2 | 72.6 | 210 | 370 | 533 | 409 | 226 | 133 | 96.9 | 84.3 | 74.8 | 194 | 56.2 |
| 1946 | 68 | 69.7 | 85.8 | 368 | 537 | 534 | 382 | 232 | 140 | 102 | 97.9 | 87.4 | 225.3 | 68 |
| 1947 | 78.3 | 70.2 | 92.3 | 181 | 316 | 421 | 341 | 204 | 130 | 89.4 | 104 | 77.6 | 175.4 | 70.2 |
| 1948 | 71.5 | 65.5 | 77.6 | 247 | 581 | 653 | 624 | 299 | 156 | 105 | 83.2 | 73.6 | 253 | 65.5 |
| 1949 | 66.2 | 61.7 | 76.5 | 216 | 579 | 703 | 591 | 291 | 161 | 112 | 89.8 | 70.9 | 251.5 | 61.7 |
| 1950 | 66.6 | 60.8 | 75.4 | 114 | 358 | 461 | 309 | 203 | 119 | 84.8 | 72.4 | 62.3 | 165.5 | 60.8 |
| 1951 | 54.2 | 50.4 | 68.3 | 154 | 338 | 359 | 366 | 221 | 117 | 135 | 147 | 97.7 | 175.6 | 50.4 |
| 1952 | 78.9 | 77.9 | 90.7 | 366 | 548 | 737 | 675 | 385 | 184 | 117 | 89.8 | 75.9 | 285.4 | 75.9 |
| 1953 | 66.3 | 65.6 | 116 | 187 | 583 | 704 | 466 | 236 | 150 | 111 | 98.5 | 87.6 | 239.3 | 65.6 |
| 1954 | 77.3 | 71.2 | 99.1 | 297 | 464 | 544 | 536 | 364 | 176 | 111 | 84.4 | 69.8 | 241.2 | 69.8 |
| 1955 | 61.4 | 58.1 | 74.4 | 139 | 340 | 528 | 322 | 238 | 121 | 84.4 | 72 | 64.5 | 175.2 | 58.1 |
| 1956 | 54.5 | 49.8 | 66.7 | 220 | 446 | 433 | 444 | 215 | 133 | 88.5 | 70.3 | 57.5 | 189.9 | 49.8 |
| 1957 | 52.7 | 46.4 | 60.5 | 100 | 180 | 368 | 257 | 166 | 100 | 79.9 | 70 | 61.1 | 128.5 | 46.4 |
| 1958 | 55.3 | 54.6 | 94.4 | 349 | 491 | 764 | 713 | 324 | 172 | 110 | 84.7 | 76.1 | 274 | 54.6 |
| 1959 | 65.6 | 59.9 | 82.1 | 427 | 564 | 688 | 568 | 343 | 204 | 130 | 108 | 91.7 | 277.6 | 59.9 |
| 1960 | 79.8 | 84.1 | 94.4 | 211 | 614 | 836 | 683 | 331 | 186 | 122 | 97.1 | 79.3 | 284.8 | 79.3 |
| 1961 | 67 | 60 | 72 | 143 | 336 | 317 | 249 | 186 | 120 | 85.3 | 70.7 | 62.9 | 147.4 | 60 |
| 1962 | 59.5 | 56.8 | 80.6 | 152 | 269 | 472 | 387 | 215 | 132 | 91 | 87.3 | 72.4 | 172.9 | 56.8 |
| 1963 | 66.6 | 70.1 | 91.9 | 282 | 380 | 627 | 403 | 225 | 135 | 97.4 | 88.7 | 78.6 | 212.1 | 66.6 |
| 1964 | 69.8 | 62.4 | 103 | 220 | 428 | 607 | 503 | 262 | 147 | 101 | 82.2 | 69.8 | 221.3 | 62.4 |
| 1965 | 60.1 | 56.2 | 63.8 | 111 | 312 | 302 | 223 | 164 | 94.7 | 98.6 | 122 | 83.6 | 140.9 | 56.2 |
| 1966 | 70.1 | 74.2 | 113 | 236 | 457 | 713 | 446 | 265 | 154 | 103 | 75.8 | 69.6 | 231.4 | 69.6 |
| 1967 | 61.2 | 55.8 | 71.8 | 179 | 334 | 517 | 331 | 206 | 132 | 104 | 86.1 | 72.7 | 179.2 | 55.8 |
| 1968 | 64.3 | 59.2 | 99.6 | 256 | 415 | 646 | 540 | 284 | 138 | 98.9 | 91.5 | 79.2 | 231 | 59.2 |
| 1969 | 65.3 | 58.9 | 146 | 365 | 830 | 1120 | 899 | 470 | 245 | 184 | 169 | 125 | 389.8 | 58.9 |
| 1970 | 118 | 104 | 99.7 | 239 | 392 | 509 | 339 | 240 | 155 | 107 | 87.2 | 70.9 | 205.1 | 70.9 |
| 1971 | 63.3 | 60.4 | 99.4 | 236 | 372 | 590 | 332 | 213 | 124 | 80.7 | 69.1 | 58.3 | 191.5 | 58.3 |
| 1972 | 52.4 | 49.9 | 60.3 | 166 | 376 | 548 | 466 | 246 | 141 | 99.5 | 87.6 | 71.6 | 197 | 49.9 |
| 1973 | 58.8 | 56 | 71.1 | 216 | 439 | 733 | 387 | 224 | 122 | 87.6 | 73.1 | 61.9 | 210.8 | 56 |
| 1974 | 56.6 | 54.4 | 60.4 | 114 | 238 | 348 | 238 | 146 | 90.6 | 71.6 | 58.2 | 48.9 | 127.1 | 48.9 |
| 1975 | 46.7 | 44.2 | 55.7 | 184 | 244 | 370 | 251 | 164 | 99.2 | 69.4 | 56.7 | 50.5 | 136.3 | 44.2 |
| 1976 | 45 | 41.4 | 43.3 | 175 | 361 | 424 | 287 | 184 | 111 | 87.5 | 79.2 | 61.8 | 158.4 | 41.4 |
| 1977 | 53.2 | 50.4 | 75 | 188 | 264 | 465 | 292 | 164 | 116 | 98.3 | 94.7 | 75.2 | 161.3 | 50.4 |
| 1978 | 64.8 | 60.3 | 73.1 | 274 | 438 | 564 | 473 | 229 | 145 | 92 | 96 | 78 | 215.6 | 60.3 |
| 1979 | 58.9 | 66.6 | 77.4 | 346 | 477 | 725 | 591 | 279 | 137 | 97.1 | 79.5 | 68.7 | 250.3 | 58.9 |
| 1980 | 62.3 | 61.2 | 69.9 | 245 | 419 | 488 | 346 | 193 | 125 | 88 | 79.6 | 66.3 | 186.9 | 61.2 |
| 1981 | 60.8 | 55.8 | 79.7 | 187 | 437 | 403 | 411 | 207 | 126 | 90.7 | 71.3 | 61 | 182.5 | 55.8 |
| 1982 | 55.5 | 52.8 | 58.9 | 178 | 304 | 240 | 197 | 151 | 92.8 | 84.5 | 76.1 | 64 | 129.6 | 52.8 |
| 1985 | 58.3 | 54.6 | 60 | 136 | 275 | 376 | 330 | 209 | 114 | 81 | 72.1 | 62.9 | 152.4 | 54.6 |
| 1984 | 52.4 | 49.2 | 71.7 | 188 | 335 | 614 | 375 | 209 | 113 | 81.6 | 73 | 64 | 185.5 | 49.2 |
| 1985 | 57.6 | 65 | 76.4 | 257 | 492 | 610 | 389 | 194 | 113 | 85.3 | 70.6 | 63.9 | 206.2 | 57.6 |
| 1986 | 55.5 | 52.2 | 55.6 | 140 | 269 | 378 | 290 | 162 | 107 | 85 | 69.6 | 67.4 | 144.3 | 52.2 |
| 1987 | 58.3 | 60.9 | 92.5 | 265 | 528 | 673 | 588 | 322 | 159 | 111 | 93 | 72.1 | 251.9 | 58.3 |
| 1988 | 59.9 | 57.7 | 67 | 217 | 396 | 606 | 414 | 210 | 131 | 89.5 | 77.7 | 66.2 | 199.3 | 57.7 |
| 1989 | 59.6 | 53.9 | 65.3 | 116 | 259 | 450 | 326 | 186 | 117 | 91.1 | 76.9 | 83.3 | 157 | 53.9 |
| 1990 | 62.1 | 59.5 | 89.7 | 210 | 613 | 769 | 403 | 237 | 141 | 105 | 91.1 | 71.7 | 237.7 | 59.5 |
| 1991 | 63.5 | 58.3 | 68.7 | 162 | 243 | 444 | 350 | 192 | 124 | 89.1 | 68.6 | 59.3 | 160.2 | 58.3 |
| 1992 | 50.8 | 50.3 | 56.2 | 202 | 372 | 504 | 451 | 201 | 133 | 94.6 | 77.8 | 66.6 | 188.3 | 50.3 |
| 1993 | 50.2 | 66.8 | 72.3 | 215 | 498 | 712 | 517 | 233 | 143 | 91.5 | 112 | 80.2 | 232.6 | 50.2 |
| 1994 | 68.9 | 60.5 | 93.5 | 242 | 599 | 459 | 333 | 263 | 151 | 110 | 122 | 114 | 218 | 60.5 |
| 1995 | 85.1 | 78.5 | 90.9 | 173 | 396 | 420 | 336 | 213 | 132 | 95.7 | 82 | 68.7 | 180.9 | 68.7 |
| 1996 | 69.1 | 59.6 | 65.1 | 196 | 345 | 597 | 432 | 256 | 131 | 101 | 82.2 | 68.2 | 200.2 | 59.6 |
| 1997 | 64.7 | 62.3 | 74.2 | 230 | 385 | 508 | 337 | 188 | 122 | 86 | 72 | 62.9 | 182.7 | 62.3 |
| 1998 | 59.4 | 62.6 | 84.6 | 354 | 536 | 692 | 615 | 317 | 182 | 120 | 89.4 | 78.7 | 265.9 | 59.4 |
| 1999 | 71.1 | 72.5 | 80.4 | 164 | 494 | 515 | 470 | 265 | 151 | 108 | 95.6 | 82.9 | 214.1 | 71.1 |
| 2000 | 73.7 | 67.8 | 79.2 | 194 | 411 | 556 | 233 | 171 | 121 | 121 | 105 | 87.7 | 185 | 67.8 |
| 2001 | 79.4 | 73.7 | 118 | 270 | 490 | 540 | 483 | 186 | 132 | 112 | 109 | 81.2 | 222.9 | 73.7 |
| 2002 | 80 | 72.6 | 118 | 235 | 436 | 565 | 349 | 203 | 163 | 123 | 109 | 89.6 | 211.9 | 72.6 |
| Ave. | 63.6 | 61.2 | 80.5 | 210.8 | 411.2 | 541.4 | 407.3 | 229.2 | 133.7 | 97.3 | 85.2 | 81.8 | 200.3 | 59.1 |

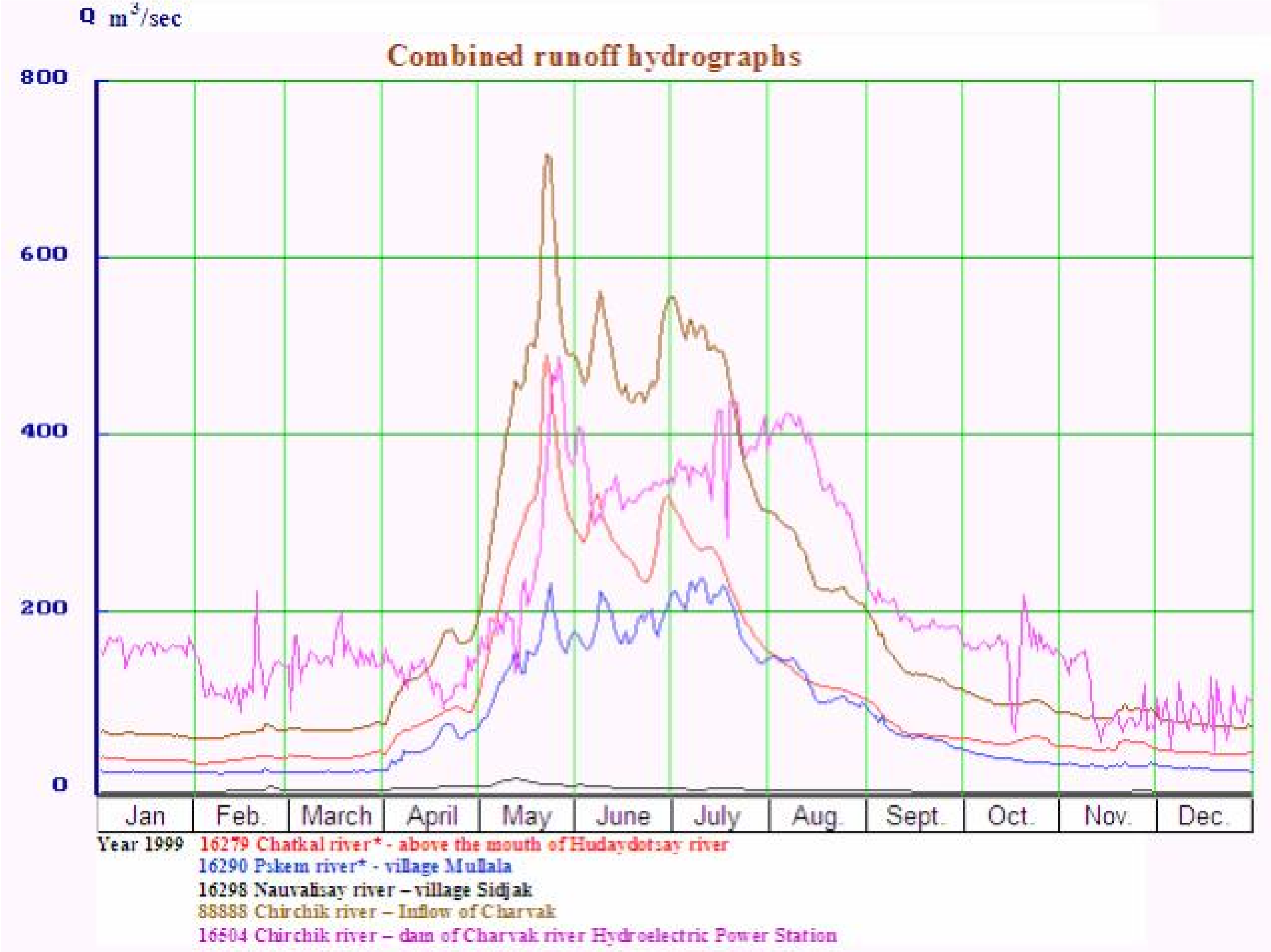



**Figure S 2.1.12 (1) Water Inflow Quantities for Charvak Dam**

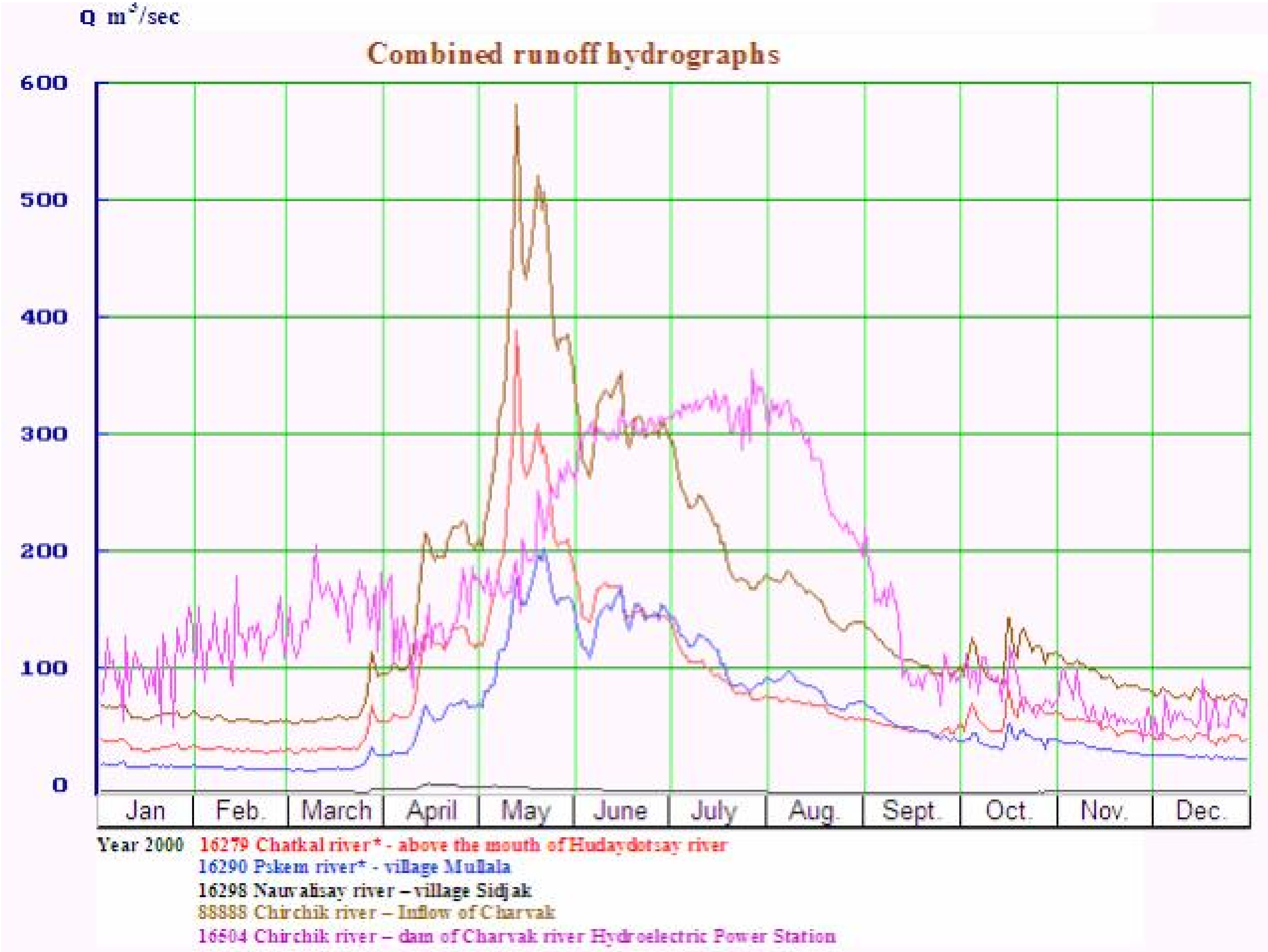



**Figure S 2.1.12 (2) Water Inflow Quantities for Charvak Dam**

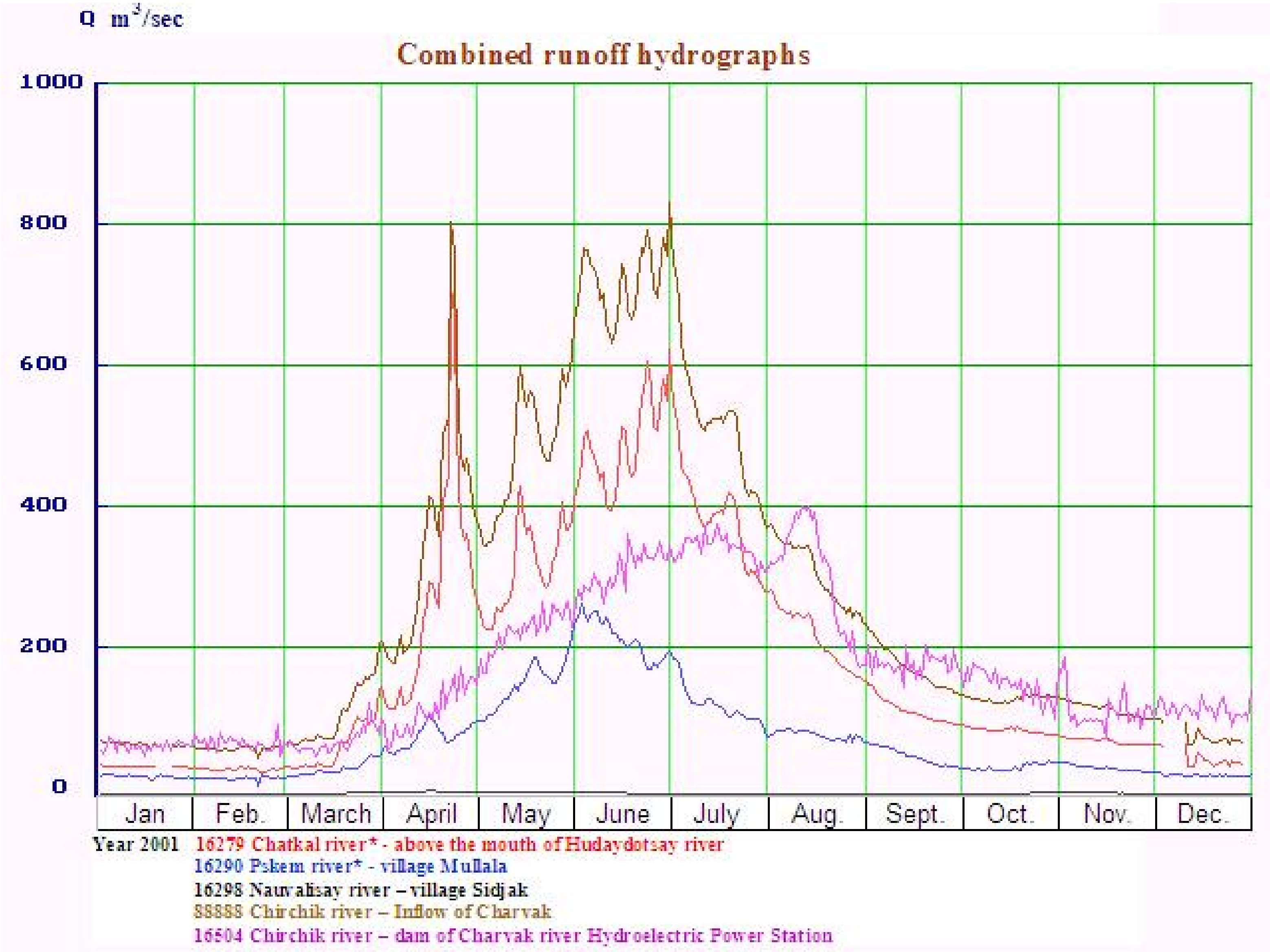



**Figure S 2.1.12 (3) Water Inflow Quantities for Charvak Dam**

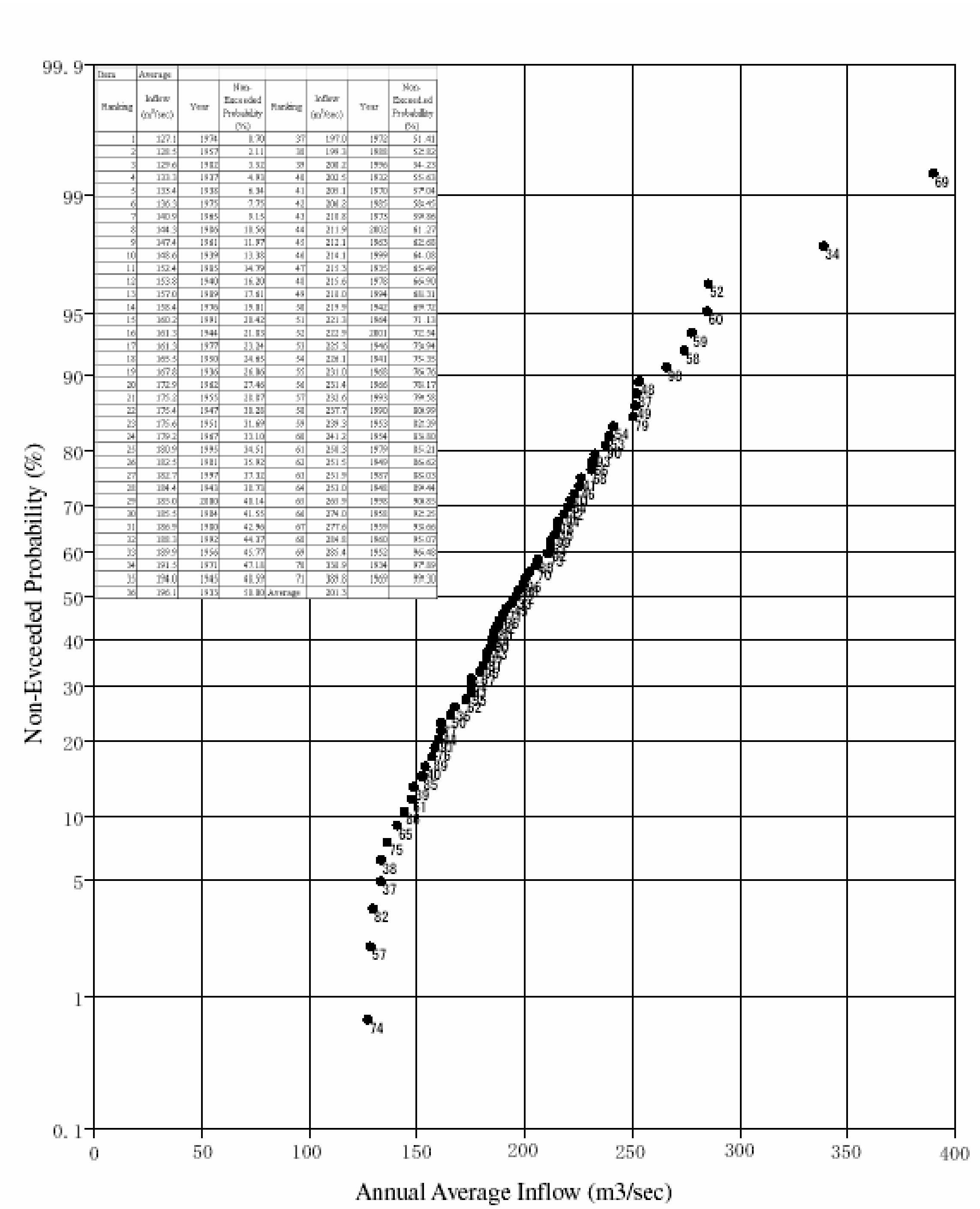
2) Probability calculations for the dam inflow

Probability inflow of the dam is very important to decide the intake capacity from the dam. Figure S 2.1.13 (1) shows the plotting of the annual average probability inflow, and Figure S 2.1.13 (2) shows the plotting of the monthly minimum probability.

Based on these calculations, the major hydrological standard years and the inflow amount to Charvak dam of each year are shown in Table S 2.1.15. The value of flow rate in the table is chosen from the real value in Table S 2.1.14 as the value for the nearest probability year. Basically the intake capacity from the dam is decided based on the inflow of 1/10 Draught Year-loss (leakage from waterway and evaporation from water surface). As shown Table S 2.1.15, the annual flow amount of average year is around 6.2 billion $m^3$ and the annual flow of 1/100 drought year is 4 billion $m^3$, its not so low. Therefore the capacity of the dam lake is around one-third to the annual average inflow amount (2 billion/6 billion).

**Table S 2.1.15 Main Standard year and Inflow Amount to Charvak Dam**

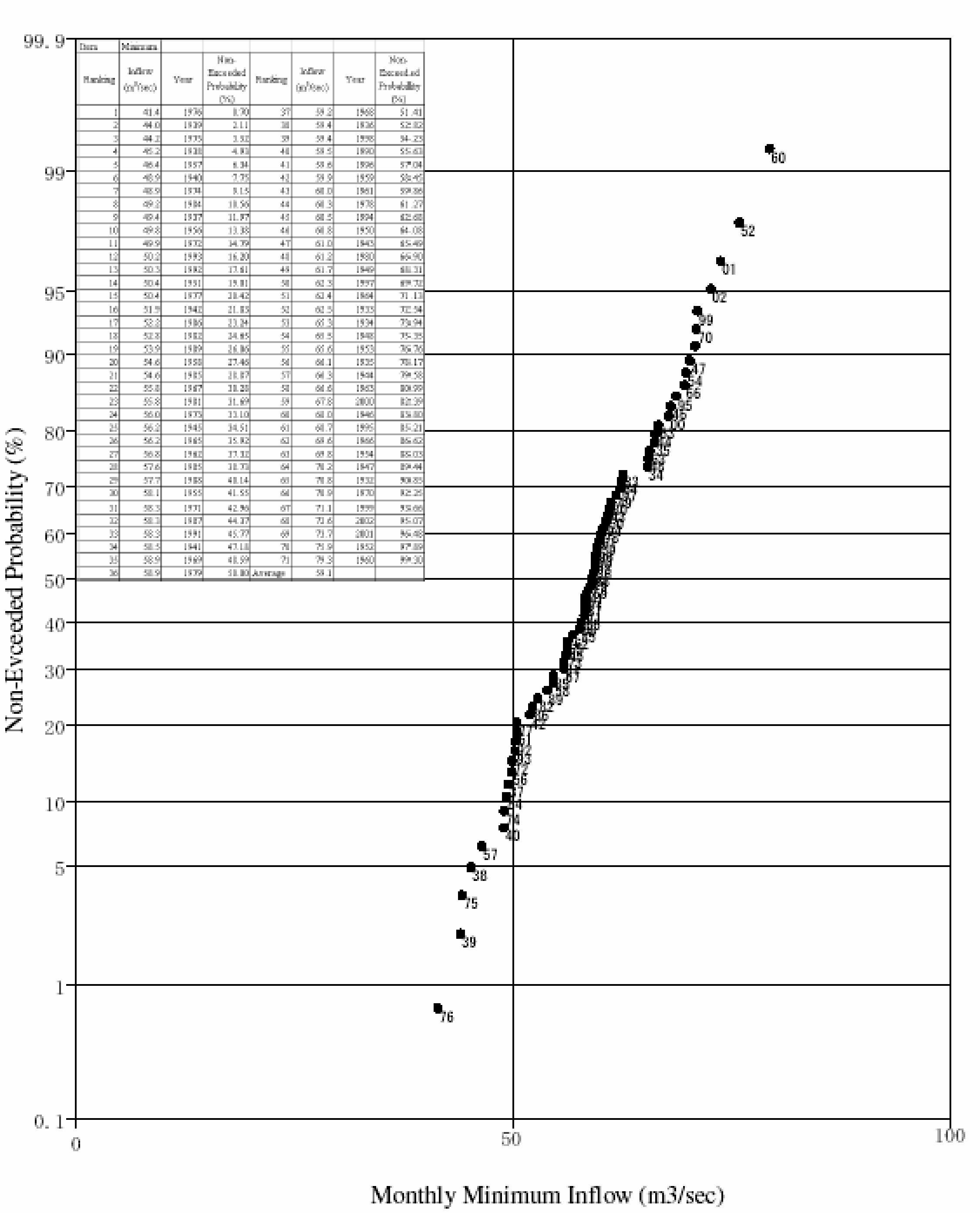
| Items | Annual Average | | | Monthly Minimum | |
|---|---|---|---|---|---|
| | Inflow ($m^3$/sec) | Annual Flow ($10^6 m^3$) | Year | Inflow ($m^3$/sec) | Year |
| Average Year | 196.1 | 6,184.2 | 1933 | 58.9 | 1979 |
| 1/5 Draught Year | 160.2 | 5,052.1 | 1991 | 50.4 | 1977 |
| 1/10 Draught Year | 144.3 | 4,550.6 | 1986 | 49.2 | 1984 |
| 1/20 Draught Year | 133.3 | 4,203.7 | 1937 | 45.2 | 1938 |
| 1/50 Draught Year | 128.5 | 4,052.4 | 1957 | 44.0 | 1939 |
| 1/100 Draught Year | 127.1 | 4,008.2 | 1974 | 41.4 | 1976 |
| Annual Average | 201.3 | 6,348.5 | | 59.1 | |



| Data Ranking | Average Inflow ($m^3$/sec) | Year | Non-Exceeded Probability (%) | Ranking | Inflow ($m^3$/sec) | Year | Non-Exceeded Probability (%) |
|---|---|---|---|---|---|---|---|
| 1 | 127.1 | 1974 | 0.70 | 37 | 197.0 | 1972 | 51.41 |
| 2 | 128.5 | 1957 | 2.11 | 38 | 199.3 | 1988 | 52.82 |
| 3 | 129.6 | 1982 | 3.52 | 39 | 200.2 | 1996 | 54.23 |
| 4 | 133.3 | 1937 | 4.93 | 40 | 202.5 | 1932 | 55.63 |
| 5 | 135.4 | 1938 | 6.34 | 41 | 205.1 | 1970 | 57.04 |
| 6 | 136.3 | 1975 | 7.75 | 42 | 206.2 | 1983 | 58.45 |
| 7 | 140.9 | 1965 | 9.15 | 43 | 210.8 | 1973 | 59.86 |
| 8 | 144.3 | 1986 | 10.56 | 44 | 211.9 | 2002 | 61.27 |
| 9 | 147.4 | 1961 | 11.97 | 45 | 212.1 | 1963 | 62.68 |
| 10 | 148.6 | 1939 | 13.38 | 46 | 214.1 | 1999 | 64.08 |
| 11 | 152.4 | 1985 | 14.79 | 47 | 215.3 | 1933 | 65.49 |
| 12 | 153.8 | 1940 | 16.20 | 48 | 215.6 | 1978 | 66.90 |
| 13 | 157.0 | 1989 | 17.61 | 49 | 218.0 | 1994 | 68.31 |
| 14 | 158.4 | 1976 | 19.01 | 50 | 219.9 | 1942 | 69.72 |
| 15 | 160.2 | 1991 | 20.42 | 51 | 221.3 | 1964 | 71.13 |
| 16 | 161.3 | 1944 | 21.83 | 52 | 222.9 | 2001 | 72.54 |
| 17 | 161.3 | 1977 | 23.24 | 53 | 225.3 | 1946 | 73.94 |
| 18 | 165.5 | 1950 | 24.65 | 54 | 228.1 | 1941 | 75.35 |
| 19 | 167.8 | 1936 | 26.06 | 55 | 231.0 | 1968 | 76.76 |
| 20 | 172.9 | 1962 | 27.46 | 56 | 231.4 | 1966 | 78.17 |
| 21 | 175.2 | 1955 | 28.87 | 57 | 232.6 | 1993 | 79.58 |
| 22 | 175.4 | 1947 | 30.28 | 58 | 237.7 | 1990 | 80.99 |
| 23 | 175.6 | 1951 | 31.69 | 59 | 239.3 | 1953 | 82.39 |
| 24 | 179.2 | 1987 | 33.10 | 60 | 241.2 | 1954 | 83.80 |
| 25 | 180.9 | 1995 | 34.51 | 61 | 250.3 | 1979 | 85.21 |
| 26 | 182.5 | 1981 | 35.92 | 62 | 251.5 | 1949 | 86.62 |
| 27 | 182.7 | 1997 | 37.32 | 63 | 251.9 | 1967 | 88.03 |
| 28 | 184.4 | 1943 | 38.73 | 64 | 253.0 | 1948 | 89.44 |
| 29 | 185.0 | 2000 | 40.14 | 65 | 266.9 | 1998 | 90.85 |
| 30 | 185.5 | 1984 | 41.55 | 66 | 274.0 | 1958 | 92.25 |
| 31 | 186.9 | 1980 | 42.96 | 67 | 277.6 | 1959 | 93.66 |
| 32 | 188.3 | 1992 | 44.37 | 68 | 284.8 | 1960 | 95.07 |
| 33 | 189.9 | 1956 | 45.77 | 69 | 285.4 | 1952 | 96.48 |
| 34 | 191.5 | 1971 | 47.18 | 70 | 338.9 | 1934 | 97.89 |
| 35 | 194.0 | 1945 | 48.59 | 71 | 389.8 | 1969 | 99.30 |
| 36 | 196.1 | 1935 | 50.00 | Average | 201.3 | | |



**Figure S 2.1.13 (1) Probability Plotting of Annual Average Inflow to Charvak Dam**



| Data | Minimum | | | | | | |
|---|---|---|---|---|---|---|---|
| Ranking | Inflow ($m^3$/sec) | Year | Non-Exceeded Probability (%) | Ranking | Inflow ($m^3$/sec) | Year | Non-Exceeded Probability (%) |
| 1 | 41.4 | 1976 | 0.70 | 37 | 59.2 | 1968 | 51.41 |
| 2 | 44.0 | 1939 | 2.11 | 38 | 59.4 | 1936 | 52.82 |
| 3 | 44.2 | 1975 | 3.52 | 39 | 59.4 | 1998 | 54.23 |
| 4 | 45.2 | 1938 | 4.93 | 40 | 59.5 | 1990 | 55.63 |
| 5 | 46.4 | 1957 | 6.34 | 41 | 59.6 | 1996 | 57.04 |
| 6 | 48.9 | 1940 | 7.75 | 42 | 59.9 | 1959 | 58.45 |
| 7 | 48.9 | 1974 | 9.15 | 43 | 60.0 | 1961 | 59.86 |
| 8 | 49.2 | 1984 | 10.56 | 44 | 60.3 | 1978 | 61.27 |
| 9 | 49.4 | 1937 | 11.97 | 45 | 60.5 | 1994 | 62.68 |
| 10 | 49.8 | 1956 | 13.38 | 46 | 60.8 | 1950 | 64.08 |
| 11 | 49.9 | 1972 | 14.79 | 47 | 61.0 | 1943 | 65.49 |
| 12 | 50.2 | 1993 | 16.20 | 48 | 61.2 | 1980 | 66.90 |
| 13 | 50.3 | 1982 | 17.61 | 49 | 61.7 | 1949 | 68.31 |
| 14 | 50.4 | 1951 | 19.01 | 50 | 62.3 | 1997 | 69.72 |
| 15 | 50.4 | 1977 | 20.42 | 51 | 62.4 | 1964 | 71.13 |
| 16 | 51.9 | 1942 | 21.83 | 52 | 62.5 | 1933 | 72.54 |
| 17 | 52.2 | 1986 | 23.24 | 53 | 63.3 | 1934 | 73.94 |
| 18 | 52.8 | 1983 | 24.65 | 54 | 63.5 | 1948 | 75.35 |
| 19 | 53.9 | 1989 | 26.06 | 55 | 63.6 | 1953 | 76.76 |
| 20 | 54.6 | 1958 | 27.46 | 56 | 64.1 | 1935 | 78.17 |
| 21 | 54.6 | 1985 | 28.87 | 57 | 64.3 | 1944 | 79.58 |
| 22 | 55.8 | 1987 | 30.28 | 58 | 64.6 | 1963 | 80.99 |
| 23 | 55.8 | 1981 | 31.69 | 59 | 67.8 | 2000 | 82.39 |
| 24 | 56.0 | 1973 | 33.10 | 60 | 68.0 | 1946 | 83.80 |
| 25 | 56.2 | 1945 | 34.51 | 61 | 68.7 | 1995 | 85.21 |
| 26 | 56.2 | 1965 | 35.92 | 62 | 69.6 | 1966 | 86.62 |
| 27 | 56.8 | 1962 | 37.32 | 63 | 69.8 | 1954 | 88.03 |
| 28 | 57.6 | 1985 | 38.73 | 64 | 70.2 | 1947 | 89.44 |
| 29 | 57.7 | 1988 | 40.14 | 65 | 70.8 | 1932 | 90.85 |
| 30 | 58.1 | 1955 | 41.55 | 66 | 70.9 | 1970 | 92.25 |
| 31 | 58.3 | 1971 | 42.96 | 67 | 71.1 | 1999 | 93.66 |
| 32 | 58.3 | 1987 | 44.37 | 68 | 71.6 | 2002 | 95.07 |
| 33 | 58.3 | 1991 | 45.77 | 69 | 71.7 | 2001 | 96.48 |
| 34 | 58.5 | 1941 | 47.18 | 70 | 71.9 | 1952 | 97.89 |
| 35 | 58.9 | 1969 | 48.59 | 71 | 79.3 | 1960 | 99.30 |
| 36 | 58.9 | 1979 | 50.00 | Average | 59.1 | | |



**Figure S 2.1.13 (2) Probability Plotting of Monthly Minimum Inflow to Charvak Dam**

**(4) Hydro-chemical Characteristics of the Dam Lake Waters**

The dam hydro-chemical condition is primarily formulated by its main inflows of the Chatkal and Pskem Rivers as well as by dynamic processes generating in dam and by morphological features of bowl's structure.

In hydro-chemical composition of flowing water to Charvak Dam, there are a lot of common features in long-term as well as in annual trend of mineral concentration, such as formation of ionic composition, foundation of bio-organic and organic substances. Average long-term concentration of mineral of the Chatkal, Pskem and Koksu Rivers are very common values, which are 186, 191 and 190 mg/L, respectively. When the annual inflow water amount varies, annual average concentration of dissolved salt fluctuates from 240 mg/L in drought years to 150 mg/L in wet years.

In annual trend of mineral concentration, its maximum values of the water in Pskem and Koksu Rivers in December are analyzed to be at 240-250mg/L, in the Chatkal River in February at 260 mg/L. Minimum value in these rivers are to be at 150-160 mg/L in June. The average long-term mineral concentration of the small rivers water is to be at 310 mg/L, and the value falls in November and the minimum value reaches at 260 mg/L in April.

The predominating ions are hydro-carbonate and calcium, and average long-term concentration of these in water of the Chatkal River are 118.9 mg/L and 32.5mg/L, respectively. These in the Pskem River are 125.8 mg/L and 32.2 mg/L, the Karasy River are 130.4 mg/L and 33.1 mg/L, and the small inflows are 225.3 mg/L (92.3%) and 47.4 mg/L.

The minimum concentration of ions is analyzed in June during flood period, and the maximum is analyzed in medium water discharge period from December to February. Fluctuation of average monthly values of major ions for dam's inflows are shown in Table S 2.1.16.

**Table S 2.1.16 Range of Average monthly Values of Main Ions of Inflow of Charvak Dam**

(mg/L)

| River | $Ca^{2+}$ | $Mg^{2+}_{-}$ | $Na^{+}$+K | $HCO^{-}_{3}$ | $SO^{2-}_{4}$ | $Cl^{-}$ |
|---|---|---|---|---|---|---|
| Chatkal | 27.9 – 48.8 | 5.4 - 9.5 | 3.8 – 7.5 | 101.4 – 149.3 | 10.3 – 33.5 | 3.8 – 12.8 |
| Pskem | 37.3 – 41.4 | 9.3 - 12.2 | 6.3 – 8.3 | 152.1 – 164.2 | 16.2 – 21.0 | 8.9 – 9.2 |
| Koksu | 28.4 – 39.6 | 5.8 – 11.6 | 3.0 – 6.0 | 109.8 – 164.8 | 78.8 – 14.2 | 2.8 – 5.9 |

All of the inflow water to the dam is alkalescent and the values of pH varies from 7.28 to 8.48.

The concentrations of dissolved oxygen are relatively high in all seasons with fluctuation from 6.20 to 12.40 mg/L, which account for 58-109% to the saturation value of the water. The degree of color of water is low and platinum-cobalt scale varies from 1.0 to 2.0$^{o}$.

An average long-term content of organic substances as the polluting substances of the inflow water is not so high. Potassium permanganate consumption is from 0.78 to 2.20 mg/L, potassium bichromate consumption is from 1.62 to 2.49 mg/L, and $BOD_5$ (biochemical oxygen demand) is from 1.41 to 2.49 mg/L. These concentrations of the main polluting substances varies as shown in Table S 2.1.17.

**Table S 2.1.17 Range of Major Natural Pollutants in Water of Charvak Dam Inflows** (mg/L)

| Components | $Fe_{total}$ | Si | $P_{total}$ | $NH_4$ | $NO_2$ | $NO_3$ |
|---|---|---|---|---|---|---|
| Range | 0.10–0.62 | 2.11-4.53 | 0.083-0.12 | 0.03-0.24 | 0.004-0.040 | 0.027-1.58 |

Hydro-chemical condition of the dam is generally determined by the chemical composition of inflow water. The concentration of major ions and minerals of the dam water is changed according to the inflow water quality.

During the period of snow-glacial flood (June-July), the concentration of major ions and minerals of water is getting lower and reach the average monthly value of 170 mg/L. As the inflow of surface water to the dam lake is decreasing and the rate of groundwater is increasing from the summer to the autumn, the total concentration of salts is gradually increasing and reaches 260-270 mg/L in January-February.

The long-term average concentration of minerals of dam water is 223mg/L, which is 15% higher than that of minerals of the inflow water. This is caused by lixiviation of salt derived from the surface soil of the dam reservoir in conditions of intensive marginal erosion because of the annual large fluctuation of the water level of the dam. The yearly average mineral concentration varies from 200mg/L in wet year to 270mg/L in dry years. Yearly fluctuations of major ions' concentration in reservoir water are shown in Table S 2.1.18.

**Table S 2.1.18 Range of yearly Concentrations of major Ions in Charvak Dam Water** (mg/L)

| Ions | $Ca^{2+}$ | $Mg^{2+}$- | $Na^{+}$+K | $HCO^{-}_3$ | $SO^{2-}_4$ | $Cl^{-}$ |
|---|---|---|---|---|---|---|
| Range | 63-67 | 24-27 | 8-13 | 75-84 | 11-15 | 6-11 |

The fluctuation extent of the mineral concentration and the composition of main ions in the water of the dam is not large and does not exceed 20% in average. In water layer at near-bottom, the salt concentration is usually 10-15% higher than that in the surface layer. The long-term average concentrations of major ions in the dam water are shown in Table S2.1.19.

**Table S 2.1.19 Average Long-term Concentration of major Ions in Charvak Dam Water**

| Ions | $Ca^{2+}$ | $Mg^{2+}$- | $Na^{+}$+K | $HCO^{-}_3$ | $SO^{2-}_4$ | $Cl^{-}$ |
|---|---|---|---|---|---|---|
| mg/L | 40.4 | 8.6 | 5.5 | 138.2 | 22.6 | 7.8 |
| Percentage | 68.5 | 24.1 | 7.4 | 76.6 | 16.0 | 7.4 |

The condition of dissolved oxygen of the dam water is determined by the general autochthonous processes, connecting to the strength of wind-induced mixture of the lake, the processes of photosynthesis in warm period of the year, interaction at the bottom of lake and decomposition of organic substances in deep water layer. During the first three years of the dam operation, dissolved oxygen concentration was 1.5-2 times reduced in deep water layer, and it was 20-30% reduced in surface layer because of the decomposition processes of the top-soil of submerged territory and the erosion of shores. Later, these processes became stable.

It is necessary to note that the oxygen condition in the dam is connected to the thermal fluctuation; fall-winter period with falling of temperature, oxygen dissolving increases from 8.45 to 13.6 mg/L in upper water layer compared with natural level from 7.80 to 11.9 mg/L. During summer period, concentration of oxygen slightly decreases in accordance with the water depth from 7.70 to 10.9 mg/L. This shows us that the process of photosynthesis in the dam lake, which generates oxygen and let to increase dissolved oxygen, weakly generates because the concentration in the summer season is less than the winter season. The concentrations of oxygen throughout of all area of the dam in the same periods do not show big differences, and the annual oxygen concentration level is relatively high. The average monthly long-term concentration of dissolved oxygen of the lake water varies from 7.08 to 9.07 mg/L (81.0% to the saturation value).

The concentration of dissolved oxygen of the tail-water (bottom water) is high (8.05-12.6mg/L) and it means that the oxygen consumption in the bottom zone of the lake is low and the oxygen is smoothly supplied to the bottom zone. The dam water is alkalescent condition (pH = 7.78 - 8.10) (Table S 2.1.20), and the pH value of the tail-water is similar value and also varies slightly (pH = 7.80 - 8.40).

Nitrogen ammonium is a final decomposed product of the protein, and a further process of the mineralization, which nitrogen ammonium is converted to nitrite or nitrate nitrogen ($NO_2^-$, $NO_3^-$ ) is undergoing in the bottom of the lake. These nitrogen compounds are used by phytoplankton for the process of photosynthesis. The annual average long-term concentration of $NH^+_4$ of the dam water varies from 0.03 to 0.24 mg/L and average concentration for total duration of analysis is 0.10mg/L. The maximum value is analyzed in the winter period (Table S 2.1.20). The average long-term concentration of $NO_3$ and $NO_2$ are 1.22 and 0.020 mg/L, respectively.

**Table S 2.1.20 Monthly Water Quality of Dam Lake**

| Component | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Ave. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $NH^{-}_{4}$. mg/L | 0.08 | 0.06 | 0.11 | 0.09 | 0.08 | 0.07 | 0.24 | 0.09 | 0.03 | 0.14 | 0.12 | - | 0.1 |
| $NO^{-}_{2}$. mg/L | 0.015 | 0.052 | 0.026 | 0.016 | 0.017 | 0.02 | 0.016 | 0.017 | 0.01 | 0.034 | 0.016 | 0.007 | 0.02 |
| $NO^{-}_{3}$. mg/L | 1.53 | 1.49 | 1.42 | 1.24 | 1.08 | 0.8 | 0.74 | 1.02 | 1.04 | 1.17 | 1.48 | 1.64 | 1.22 |
| $P_{total}$. mg/L | 0.056 | 0.005 | 0.02 | 0.04 | 0.03 | 0.13 | 0.1 | 0.065 | 0.053 | 0.04 | 0.03 | 0.045 | 0.056 |
| Si. mg/L | 4.2 | 3.6 | 5.3 | 3.4 | 5.5 | 5.4 | 9.5 | 6.4 | 5.8 | 5.5 | 6.8 | 5.7 | 5.5 |
| Fe. mg/L | 0.14 | 0.23 | 0.12 | 0.06 | 0.08 | 0.07 | 0.05 | 0.07 | 0.1 | 0.09 | 0.09 | 0.12 | 0.1 |
| PO.as O mg/L | 1.04 | 1.28 | 2.05 | 2.3 | 3.72 | 5.01 | 5.26 | 4.61 | 3.02 | 2.84 | 2.02 | 1.25 | 2.86 |
| BO.as O mg/L | 2.09 | 2.51 | 3.86 | 4.91 | 6.44 | 8.27 | 8.73 | 8.32 | 7.26 | 6.17 | 4.11 | 2.36 | 5.42 |
| $BOD_5$. mg/L | 0.72 | 0.87 | 0.81 | 3.7 | 1.04 | 3.05 | 3.2 | 3.81 | 2.93 | 1.14 | 0.88 | 2.24 | 2.11 |
| Colour | 2 | 2 | 1.5 | 1.7 | 1.7 | 2 | 1.5 | 2 | 1.5 | 1.5 | 1.2 | 2 | 1.7 |
| PH | 8.05 | 8.05 | 7.95 | 8.05 | 7.85 | 8.07 | 8.06 | 7.85 | 8 | 8.1 | 8.05 | 8.05 | 8 |
| $O_2 \ldots^{o}$ | 8.72 | 5.82 | 8.22 | 90.5 | 7.08 | 8.07 | 8.06 | 8.08 | 7.24 | 7.15 | 7.23 | 9.07 | 8.06 |
| $O_2$. mg/L | 84.1 | 88.3 | 88.6 | 88.2 | 74.2 | 81.6 | 81.4 | 81.7 | 77.5 | 71.4 | 73.7 | 81.2 | 81 |

**(5) Water Use of Basin**

The complexity of the canal network system for irrigation purpose in the Chirchik River Basin is illustrated in Figure S 2.1.14. Figure S 2.1.15 also shows the canal system as the location of hydropower stations. Shown as these figures, the canal system withdrawn from the Chirchik River is huge and useful for the irrigation, the power generation, and the water supply for cities.

The Chirchik River Basin is one of the oldest irrigation areas on the territory of Uzbekistan. The Boz-su Canal was constructed in far B.C. and was utilized for irrigation purpose.
At the present time, Charvak Dam is constructed at the rivers junction of the Chatkal, Koksu, and Pskem River as aforementioned, and it is controlled for seasonal runoff with the capacity of 380-75 $m^3$/sec for the purpose of irrigation, power generation and water distribution for the city. Khodjikent hydropower station was built with the dam for daily runoff control. At the dawn stream of the station, Gazalkent Intake Weir Station is located. The Boz-su Canal (another name is Upper Diversion) takes water from to the right bank of the station, and the Yangi Canal is taken from left one.

These Main canals are almost same length with the Chirchik River from Gazalkent Station to the mouth of the Chirchik River, which is connected with the Sirdaria River, and many smaller canals and some large ones are branched off from these. Zakh and Hanim on the right bank of the Boz-su Canal are such canals, and they diverts from the Chirchik runoff to Keles River Basin in Kazakhstan territory. The Karasu Canal transfers from the Chirchik runoff into the Ahangaran River Basin. Discharging of water from these canals into the Chirchik River or other canals is conducted through numerous manifolds. Thus majority of the water, which reaches the Chirchik River Mouth, is not natural runoff, and it is composed by the flow of manifolds, groundwater due to filtration from irrigation fields, and the excess water of canals.

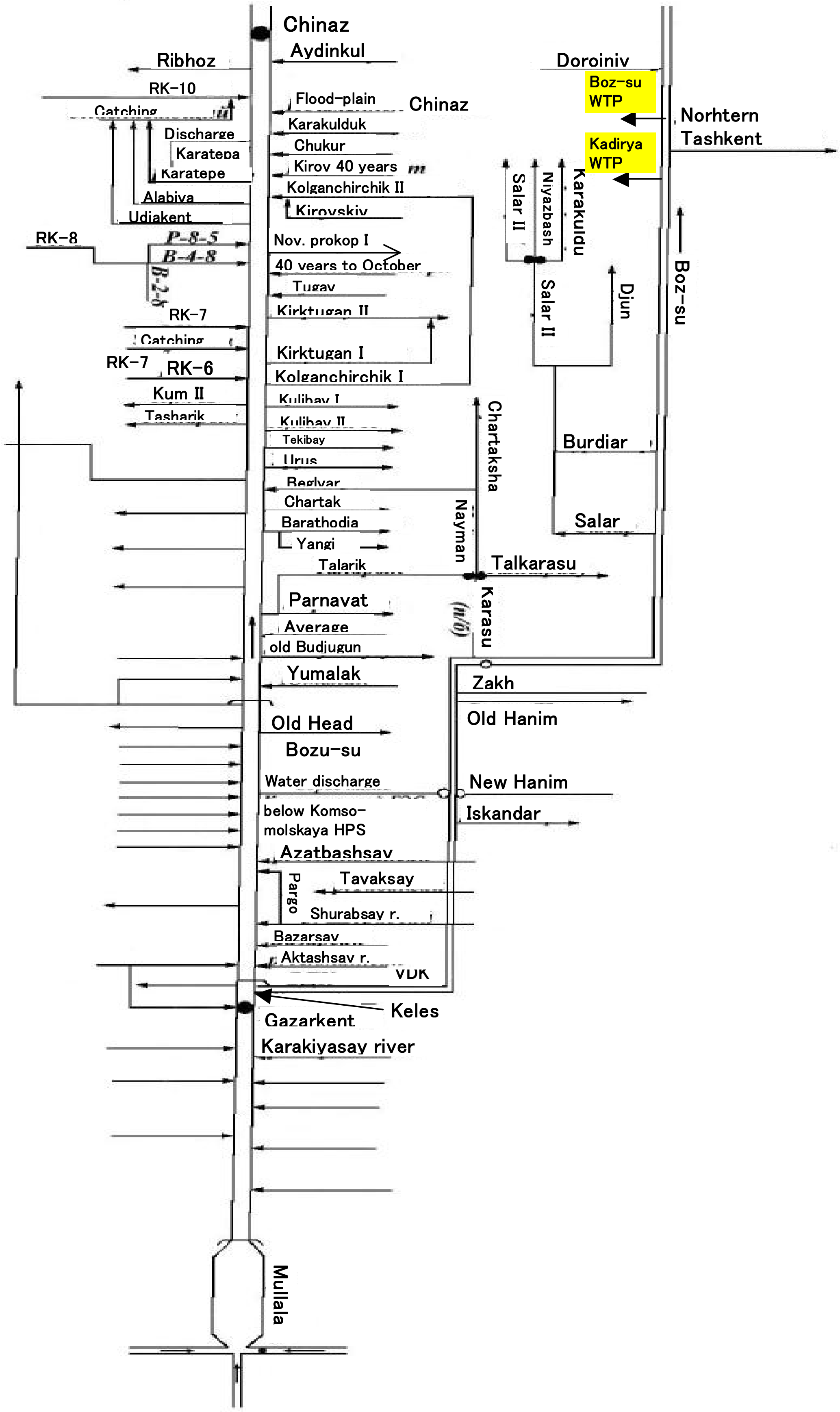



**Figure S 2.1.14 Linear Layout of Irrigation Network in Chirchik River Basin.**

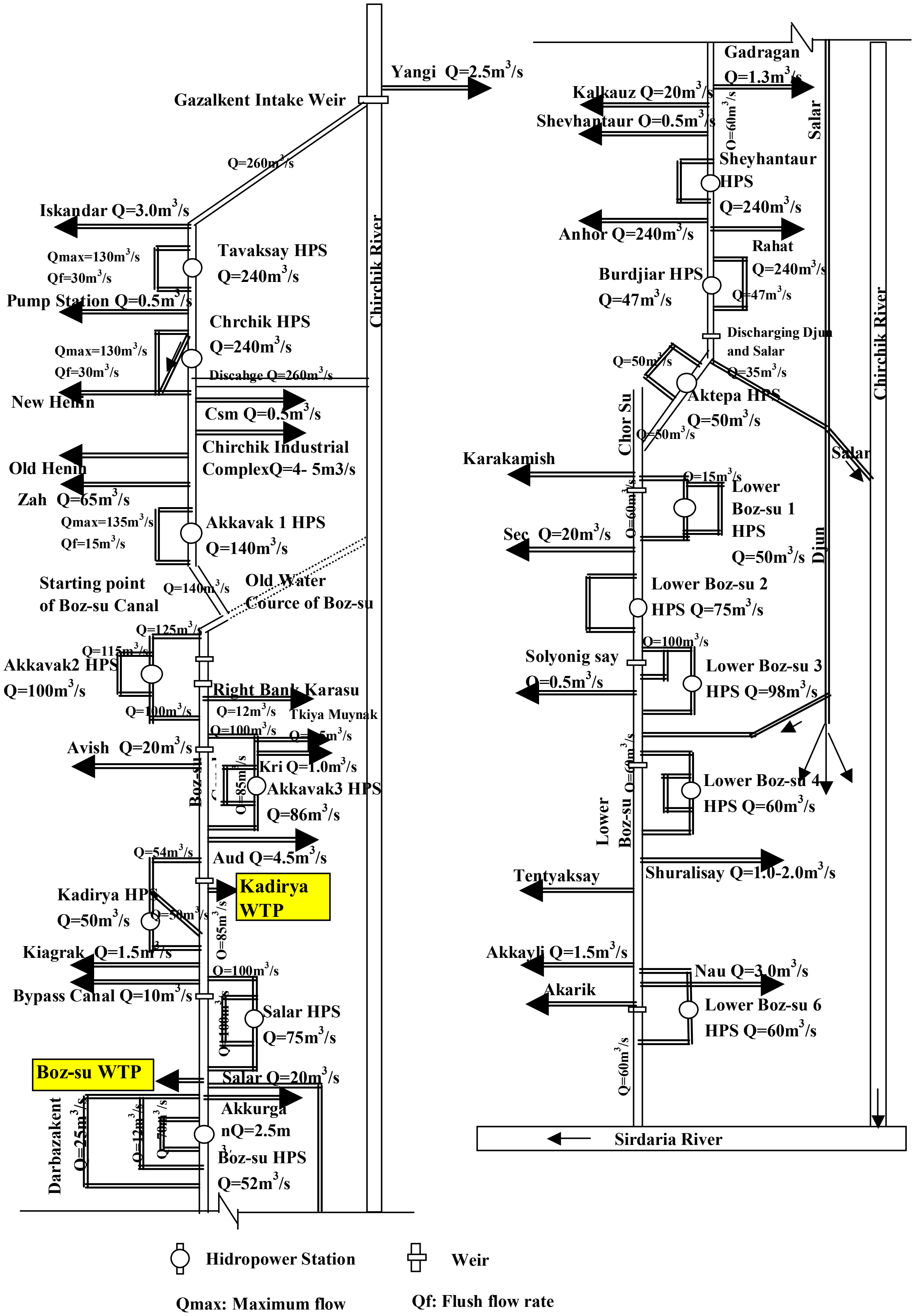



**Figure S 2.1.15 Layouts of Hydropower Stations Along Boz-su Canal**

As aforementioned, Charvak Dam is the first and primary structure in the Chrchik River Basin, which controls the runoff of the Chirchik River mainly for irrigation purposes. The monthly inflow and outflow data for average, wet and drought years is shown in Table S 2.1.21, and inflow and outflow data of Charvak Dam data is plotted in Figure S 2.1.16 (1) and (2).

Shown as the table and figures, the feature of inflow and outflow of Charvak Dam is as Follows:

- The average annual inflow and outflow amount is almost same value: around 6.3 billion $m^3$,
- The difference of inflow water amount between drought year and average year (1:0.64) is not so large,
- The monthly peak inflow appears in June and monthly inflow from May to July are large a year,
- Outflow is started to increase from April and the peak is from May to September, and
- Minimum outflow is controlled from October to March and the average flow rate in the season is controlled around $100m^3$/sec.

**Table S 2.1.21 Inflow and Outflow of Charvak Dam**

| In/Out | Item | | Unit | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Ave. | Annual Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inflow | Average | Flow | $m^3$/sec | 63 | 60 | 76 | 216 | 403 | 546 | 403 | 226 | 132 | 98 | 86 | 72 | 199 | |
| | | Amount | $10^6m^3$ | 168 | 146 | 205 | 560 | 1,079 | 1,415 | 1,079 | 605 | 342 | 261 | 223 | 193 | 533 | 6,276 |
| | Wet Year (1969) | Flow | $m^3$/sec | 69 | 63 | 154 | 386 | 852 | 1,120 | 910 | 477 | 251 | 195 | 175 | 129 | 399 | |
| | | Rate to Ave. | % | 110 | 105 | 202 | 179 | 211 | 205 | 226 | 211 | 190 | 200 | 203 | 179 | 201 | |
| | | Amount | $10^6m^3$ | 184 | 169 | 412 | 1,034 | 2,282 | 3,000 | 2,437 | 1,278 | 672 | 522 | 469 | 346 | 1,069 | 12,805 |
| | Drought Year (1974) | Flow | $m^3$/sec | 58 | 56 | 62 | 120 | 243 | 351 | 241 | 148 | 22 | 73 | 61 | 50 | 127 | |
| | | Rate to Ave. | % | 93 | 93 | 81 | 56 | 60 | 64 | 60 | 65 | 17 | 75 | 70 | 70 | 64 | |
| | | Amount | $10^6m^3$ | 156 | 151 | 166 | 321 | 651 | 940 | 645 | 396 | 59 | 196 | 162 | 134 | 330 | 4,018 |
| Out-flow | Average | Flow | $m^3$/sec | 92 | 86 | 105 | 136 | 274 | 458 | 470 | 346 | 164 | 105 | 87 | 91 | 201 | |
| | | Amount | $10^6m^3$ | 246 | 209 | 281 | 353 | 734 | 1,187 | 1,259 | 927 | 425 | 281 | 224 | 245 | 538 | 6,371 |
| | Wet Year (1994) | Flow | $m^3$/sec | 149 | 199 | 239 | 315 | 520 | 596 | 596 | 369 | 187 | 134 | 128 | 169 | 300 | |
| | | Rate to Ave. | % | 162 | 230 | 228 | 232 | 190 | 130 | 127 | 107 | 114 | 128 | 148 | 185 | 149 | |
| | | Amount | $10^6m^3$ | 399 | 533 | 640 | 844 | 1,393 | 1,596 | 1,596 | 988 | 501 | 359 | 343 | 453 | 804 | 9,645 |
| | Drought Year (1983) | Flow | $m^3$/sec | 57 | 54 | 49 | 92 | 95 | 259 | 381 | 299 | 134 | 90 | 72 | 51 | 136 | |
| | | Rate to Ave. | % | 35 | 23 | 22 | 40 | 50 | 199 | 300 | 280 | 118 | 71 | 48 | 28 | 91 | |
| | | Amount | $10^6m^3$ | 151 | 145 | 131 | 245 | 253 | 694 | 1,020 | 801 | 359 | 242 | 192 | 137 | 364 | 4,371 |

The dam inflow data is evaluated based on the data of six posts as aforementioned.

The runoff from the reservoir is discharged through the turbines of the hydroelectric power station and the flood-control outlet, where the both waterways water through and flows into the Chirchik River. In the hottest months (May-August) of the year, when water consumption for irrigation and distribution for cities is increased, the dam runoff exceeds its inflow, although in these months the inflow into the dam is the largest due to melting of glaciers, or mountainous snow and snow fields.

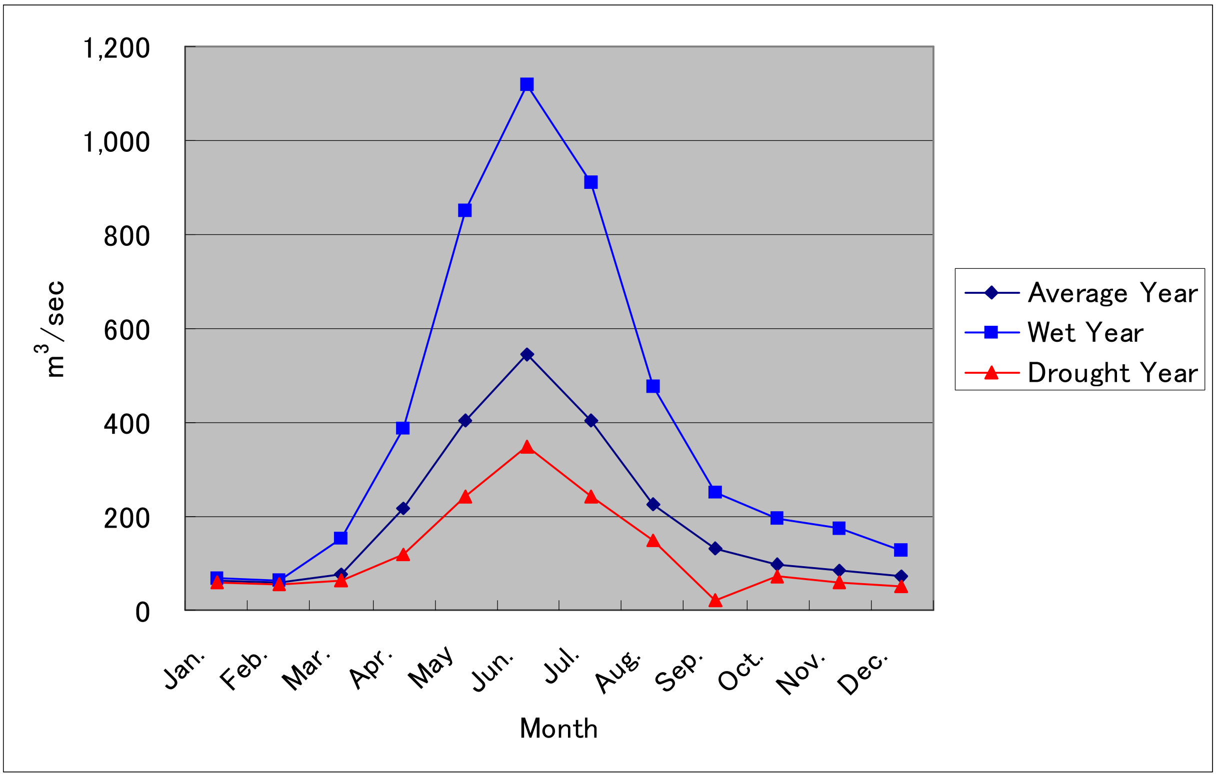



**Figure S 2.1.16 (1) Inflow into Charvak Dam**

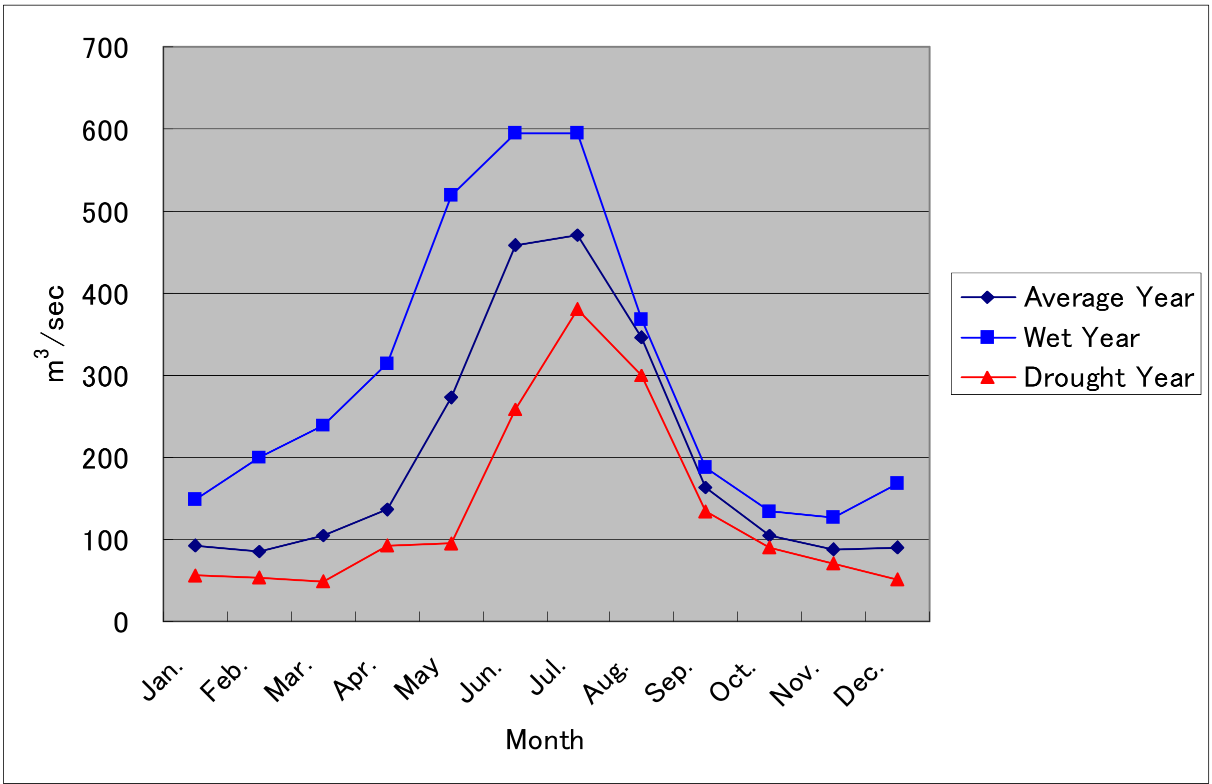



**Figure S 2.1.16 (2) Outflow From Charvak Dam**

The area from the Gazalkent Intake Weir Station to the river mouth was chosen to characterize the water balance of the Chirchik River basin discharged from Charvak Dam.

For calculation, the data from 1980 to 1998 years period is used. The reason why the period was chosen, if more prolonged period in this case was used, the difference in hydro-economic activity on this river section will have an effect. Calculation results are shown in Table S 2.1.22. Figure S 2.1.17 shows the balance between inflow and outflow to the section point.

**Table S 2.1.22 Monthly Average Water Balance of Chirchik River section from "Gazalkent" to "Chinaz" posts for the period of 1980 -1998 ($m^3/s$)**

| Item | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water flow on Gazalkent | 104.0 | 101.0 | 133.0 | 201.0 | 361.0 | 542.0 | 506.0 | 369.0 | 184.0 | 123.0 | 102.0 | 109.0 | 238.0 |
| Accounted inflow water through Canals | 39.7 | 43.7 | 57.6 | 105.0 | 205.0 | 314.0 | 262.0 | 170.0 | 60.0 | 37.0 | 36.1 | 37.8 | 109.0 |
| Total accounted inflow | 143.7 | 144.7 | 190.6 | 306.0 | 566.0 | 856.0 | 768.0 | 539.0 | 244.0 | 160.0 | 138.1 | 146.8 | 347.0 |
| Accounted offtake on the section (Chinaz post) | 108.0 | 104.0 | 122.0 | 238.0 | 400.0 | 569.0 | 605.0 | 505.0 | 228.0 | 146.0 | 116.0 | 114.0 | 271.0 |
| Water Flow on the Section | 59.7 | 61.8 | 78.8 | 81.2 | 136.0 | 153.0 | 96.0 | 36.8 | 32.8 | 38.8 | 48.2 | 63.9 | 74.0 |
| Total accounted outflow | 167.7 | 165.8 | 200.8 | 319.2 | 536.0 | 722.0 | 701.0 | 541.8 | 260.8 | 184.8 | 164.2 | 177.9 | 345.0 |
| Imbalance | 24.0 | 21.1 | 10.2 | 13.2 | -30.0 | -134.0 | -67.0 | 2.8 | 16.8 | 24.8 | 26.1 | 31.1 | -2.0 |

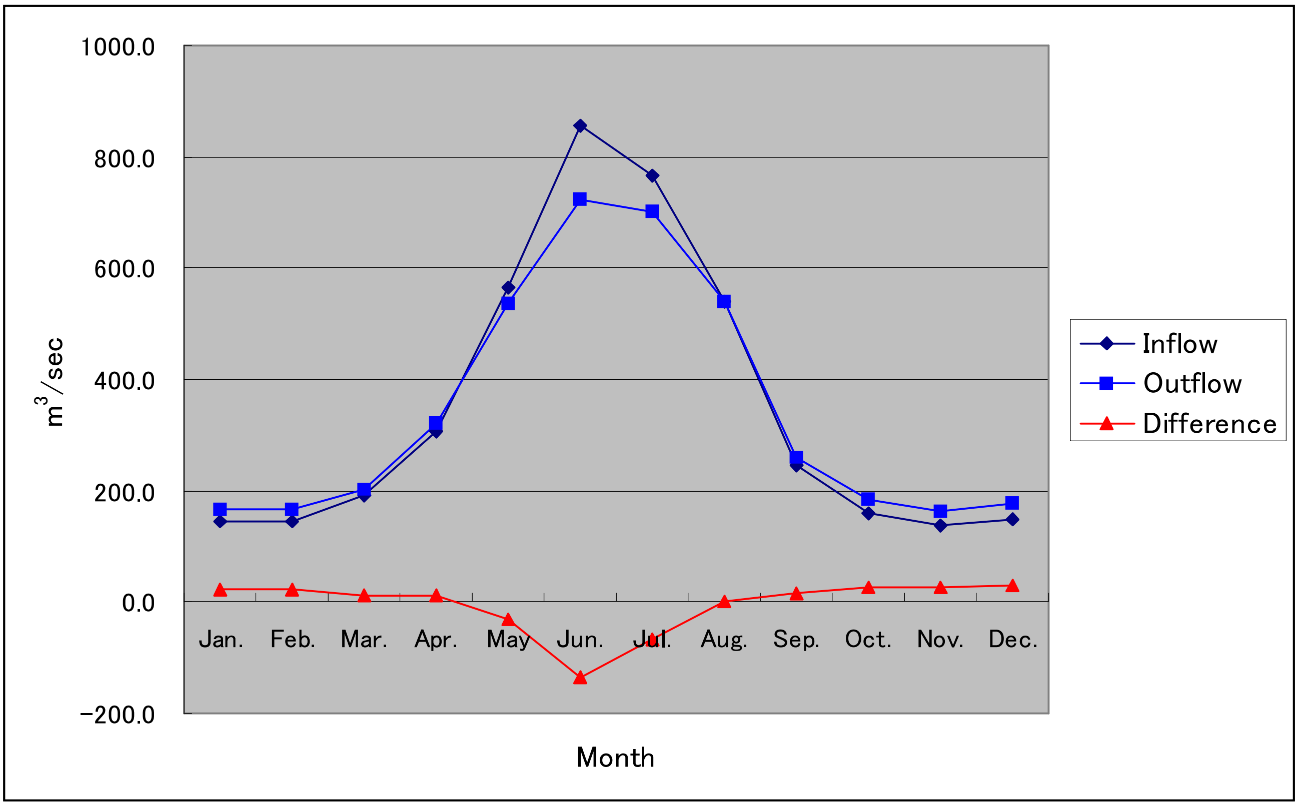



**Figure S 2.1.17 The Balance between Inflow and Outflow in the Chinaz Post**

From the table and figure, the total discharge amount of the river from August to April exceeds the inflow of the Chinaz Post, the outflow is below the inflow from May to July on the contrary. This means that river waters are reused from August to April, and there may be much uncounted for water consumption of the purpose for agricultural, industrial and supply of the cities from May to July.

Quality of intake account and discharge water through manifolds is also important for consumers. Except for return waters through manifolds, since their considerable part of water flows into the river through subsurface ways, the way serves as a good drain line along whole Chirchik River length. In this case, imbalance should be positive in whole year. Then underground inflow to the river could be estimated in irrigation area, which takes place on this territory because of the runoff from irrigations fields through subsurface ways. This runoff is important in vegetation period as well. This has been observed repeatedly while expeditionary works on the irrigation territory of the Chirchik Basin.

Reference Data

1. Shultz V.L. Central Asia rivers - L.: Gidrometeoizdat. 1965. - 692 p.
2. Hydrologic characteristic of upper part of Amudarya basin / Shultz V.L.. Shalatova L.I. Lukina N.K. Vidineeva E. M.-Tashkent: FAN. 1975. - 124 p.
3. USSR glaciers catalogue. V. 14. 1st edition. part 1. Pskem river basin. L.: Gidrometeoizdat. 1968. 48 p.
4. USSR glaciers catalogue. V. 14. 1st edition. part 21. Chatkal river basin. L.: Gidrometeoizdat. 1970. 42 p.
5. Schetinnikov A.S. Glaciers of Pskem river basin. L.: Gidrometeoizdat. 1978. 120 p.

## S2.3.2 Relevant Laws and Regulations

The Charter of Vodokanal and extractions of some of the relevant laws mentioned in chapter 2.3.2 are presented below.

**CHARTER**

**of Tashkent Water Supply and Sewerage Enterprise Vodokanal**

*(extractions)*

(…)

3. Objects and purposes of activity

3.1. The objects and purposes of the enterprise are:

- Providing population, offices, organizations and enterprises with drinking water and service of sewerage system situated in area of Tashkent city and vicinity area.
- Development of the city water supply and sewerage systems, provision with technical exploitation of water intake and treatment facilities, water supply and sewerage systems.
- To provide implementation of achievements of technical progress, automation and mechanization of industrial processes directed to improvement of utilization of real capacity, raise the culture of business, study and make suggestions on perspective development of water supply and sewerage systems.
- To provide desired water quality and accounting of distributed water in city, conducting and rectification foul water through sewerage system of collectors and constructions.
- Timely elaboration on the base of acting data requests for logistical support and for correct utilization of given logistical resources and funds.
- To provide high techno-economical indications in operation of facilities, in city water supply and sewerage systems.
- Elaboration capital construction plans for water supply and sewerage systems, to issue assignments for designing, consideration and approval of design documents and timely transfer of it in established order to contract enterprises for constructing and design, provision objects for building materials, equipments, preparation routes and areas for construction water supply and sewerage objects.
- Delivery engineering specifications for construction water supply and sewerage in area of Tashkent city and vicinity areas, identification of business participation industry enterprises, constructing and other organizations in development of city water supply and sewerage, drawing minutes of agreement on transferring the funds of business participation, checking the duties of different types of ownerships on technical conditions of the enterprise "Vodokanal" in constructing city objects of water supply and sewerage, agreement of documents for special water consumption by enterprises, city and Tashkent agglomeration in the competence of the enterprise.

3.2. The Enterprise to achieve the aims in its competence has rights:

- In established order to formulate perspective plans for industrial and economic activity of the enterprise, allot quotas among divisions of the enterprise, define for them annual, quarter and monthly assignments, control their execution.

- to fully control of financial activities of structural departments of the enterprise, allocate and allot current assets;
- to conclude agreements for delivery drinking water and service on sewerage;
- to take all stipulated measures for development labor management;
- to manage productive and social activity of structural divisions of the enterprise, control execution of production plan and output programme;
- to select and arrange top executives, take measures to raising the level of enterprise workers skills in structural departments;
- to control an adherence to the current legislation, including requirements of safety measures and industry sanitation in structural departments;
- to provide fully logistics for enterprise as well as in centralized way or by buying inventory holdings at market price in cash or barter;
- to have a foreign-economic activity in order to satisfy the needs of enterprise in accordance with its aims and purposes.

3.3 To achieve established aims and tasks the enterprise in its activity has a right to deal with any kinds of economical activity not prohibited by current legislation and answering the purpose as defined in current Charter.

## 5. Management

5.1 Management of Enterprise is realized in accordance with Charter on the base of combination of principles of self-administration of labor collectives and owner's right to use its property on economical utilization.

5.2 Enterprise independently defines the structure of management and establishes staff in conformation with higher organization.

5.3 Appointment of the manager of Enterprise is enrolled by Decree of Tashkent city Khokimiyat and respective warrant of TKEO.

5.4. Divisions of management with participation of labor collective and competent authorities frame and take a decision on social-economical issues concerning activity of the Enterprise, defining the form of ownership.

5.5 Labor collective of enterprise consists of all the people taking part with their actions in its activity on the base of labor contract or other forms, regulating labor relations of employee with Enterprise.

5.6. The main form of exercise of powers of labor collective of the Enterprise is conference, which is authorized to consider all the issues of the Enterprise activity relating to its competence by legislation of the Republic of Uzbekistan.

6. Finance and credit

6.1 The profit, depreciation, joint activity revenue, and other incomes not prohibited by the current legislation are the sources to form financial resources of the enterprise.

6.2 Enterprise has a right to loan from bank and other creditors on the contract base.

6.3 The Enterprise has a right to open current and other accounts including foreign accounts, as well as do all kinds of bank operations through them.

6.4 All payments of the Enterprise, including payments to budget and wage payment will be done in established order.

6.5 The Enterprise is liable to follow all credit contracts and payments in the amount provided by current legislation.

(…)

8. Planning, economic relations and materials & equipment procurement

8.1 Enterprise independently plans its activity and determines outlook of development, based on demand for final production, work, services, in necessity with production provision and social development of Enterprise, and increasing income of its workers.

Basis of planning consists of real demand of the city in drinking water and sewerage services.

8.2 Relations of Enterprise with juridical and physical persons in all spheres of economic activity will be on basis of agreement

8.3 Enterprise provides its material & technical needs buying resources in the market of goods and services.

8.4 Enterprise has a right to buy resources directly from manufacturers, wholesale traders, on fairs, in organizations of material & technical provision, as well as from intermediate organizations.

8.5 Enterprise has a right to buy resources by contract and commercial prices.

9. Price formation

9.1 Enterprise sells its production, work and services at free tariffs according to the current legislation, except tariffs for population (…)

9.2 Basis for determination of price is established calculation.

(…)

12. Accounting & Reporting

12.1 In result of its activity Enterprise makes operational and business accounting, makes statistical reports.

12.2 Enterprise presents forms of state statistical reports, set by governmental organizations of statistics.

12.3 Enterprise has no right to present statistical reports with infringement of the set discipline.

12.4 Officials of enterprise are liable in accordance with the legislation for distortion of statutory report.

(…)

14. Enterprise activity control

14.1 Owner of property has a right to make a complex of financial and economical audit of enterprise activity by its own initiative, not less than once a year.

14.2 State tax organizations, which are in charge to inspect certain sides of enterprise activity by legislation, can execute these actions in case of necessity, strongly within the range of their competence.

14.3 Enterprise has a right no to fulfill request of the above mentioned organizations, in questions not related to object of control.

(…)

16. General manager of the Enterprise

16.1 The head of enterprise, namely its General Manager, is designated and dismissed from his position by the owner of property in determined order.

16.2 General Manager of the enterprise has following rights:

- To act in the name of enterprise without a warrant with state governmental organizations, including court and economical court.
- To participate on behalf of the enterprise in all establishments, organizations, and enterprises with any kind of ownership;
- To dispose property of enterprise
- To conclude commercial and labour contracts;
- To designate and dismiss staff of enterprise;
- To delegate authority;
- To open accounts, foreign and other accounts in banks;
- To appoint enterprise staff;
- To establish internal statutory acts (regulations, instructions);
- To issue orders and give instructions obligatory for all employees of enterprise;
- To solve other questions within his competence and not within the competence of the employees conference.

16.3 Chief Engineer of Enterprise and deputies of General Manager act in the name of enterprise within their competence, presenting it in other institutions and organizations, make commercial operations, which do not entail juridical acts and consequences.

16.4 Competence of Chief Engineer and General Manager deputies is determined by General Manager himself in frame of defined legislation.

(…)

**RELEVANT LAW**

*(extractions)*

## Civil Code of the Republic of Uzbekistan

*Law of the Republic of Uzbekistan, approved by Decision of Olij Majlis No. 257-I of 29.08.1996 (with subsequent amendments).*

<u>Article 70. Unitary enterprise.</u>

A unitary enterprise is a commercial organization, which does not have the ownership right on the assets which it has in possession. <…>

A unitary enterprise is not liable for obligations of the owner of its assets. <…>

The owner of the assets of a unitary enterprise is not liable for obligations of this unitary enterprise. <…>

<u>Article 71. Unitary enterprise based on self-sufficiency.</u>

A unitary enterprise based on self-sufficiency is established by a decision of the owner or by a body authorized by the owner.

A unitary enterprise based on self-sufficiency is established by approving its charter in accordance with the adopted procedures.

A unitary enterprise based on self-sufficiency can establish separate legal entities – unitary enterprises (subsidiaries) by transferring to them some of the possessed assets in accordance with the adopted procedures.

<…>

<u>Article 177. Rights of the owner in respect of the assets possessed by a unitary enterprise based on the self-sufficiency.</u>

The owner of the assets decides in accordance with the law to establish an enterprise for possession of its assets possession, determines the subject and objectives of its activity, its re-organizations and liquidation, appoint the director (general manager) of the enterprise, carries out control over the purposes of use and integrity of the assets possessed by the enterprise.

The owner is entitled for a share of profits derived from the assets possessed by the enterprise.

The unitary enterprise can not sell the immovable assets possessed, rent them out, to pawn, to contribute to the charter capital of other legal entities and to dispose by other means without getting an approval of the owner.

Other assets possessed by the enterprise can be disposed on the enterprise’s discretion.

<…>

**Law on Natural Monopolies**

*Law of the Republic of Uzbekistan No. 398-I of 24.04.1997 (with subsequent amendments).*

Article 4. State regulation of activities of natural monopolies.

State regulation of activities of natural monopolies is set in the following areas:

<…> water supply and sewerage services, <…> .

The state authorities for regulation of natural monopolies are: the Cabinet of Ministers of the Republic of Uzbekistan, the authorized body assigned by the Cabinet of Ministers.

Article 5. Methods of regulation of activities of natural monopolies.

Regulation of activities of natural monopolies is carried out by the following methods:

price regulation through determining (setting) of prices (tariffs) and their limits, determination of the customers which must be served and/or setting the minimal levels of service in the cases when full provision of the service of the natural monopoly is not possible.

For regulation of natural monopolies, other methods can be used, in accordance with the legislation.

Article 6. Basics for adoption of the methods of regulation by the body authorized for control of natural monopolies.

The authorized body for control of natural monopolies decides about adoption of the methods of regulation, in respect of a specific natural monopoly based on analysis of its activity, which are stipulated in this and other laws <…> . Under this analysis, justification of costs is assessed, taking into account:

operational costs, including wages, costs of raw materials, overheads, taxes and other obligatory payments; cost of fixed assets, investment requirements for their rehabilitation, depreciation <…> .

Article 7. Price regulation.

Price regulation of activities of natural monopolies is carried out by the authorized body.

For setting prices (tariffs), natural monopolies submit to the authorized body proposed prices (tariffs) with supporting calculations in accordance with the procedures as determined by the Cabinet of Ministers of the Republic of Uzbekistan .<…>

Article 16. Limitation of activity of natural monopolies.

Natural monopolies are prohibited <…> to charge the fees in excess of the limit set by the authorized body. <…>

# S 2.3.4 Survey for Water Consumption of Domestic Customers in the City

## (1) JICA Study in 1999

1) Apartment

The results of the water consumption survey for apartment conducted on the JICA Study in 1999 are shown in Table S 2.3.4.1.

Water bulk meters, which were installed on the supply pipes for apartment buildings and used for the water consumption survey, were newly installed by the JICA Team.

As shown in the table, the average consumption is over 500L/capita/day (lpcd) and the difference of per capita consumption between summer and autumn is not so large.

The Team also measured and recorded the supply flow rates for three apartment buildings by ultra-sonic flow meters. The measured flow rates were almost flat for all day long, which indicated a huge water leakage from apartment flats.

**Table S 2.3.4.1 Results of Water Consumption Survey in 1999**

| Apart No. | Address | Stories | Occupied Units | Occupants No. | Average | | | Water consumption | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Unit area $m^2$ | No. of Occupant | Area/ person | Sep.8 to Sep.12 | | Nov.24 to Nov.30 | |
| | | | | | | | | Total $m^3$/day | L/cap/d | Total $m^3$/day | L/cap/d |
| 4 | Sergeli -2 | 5 | 40 | 188 | 100 | 4.7 | 21.3 | 140.5 | 747 | 136.17 | 724 |
| 5 | | 4 | 56 | 179 | 73 | 3.2 | 22.9 | 101.7 | 568 | 99.83 | 558 |
| 6 | | 5 | 70 | 223 | 72 | 3.2 | 22.7 | 108.3 | 486 | 139.67 | 626 |
| 14 | | 5 | 70 | 197 | 72 | 2.8 | 25.7 | | | 103.33 | 525 |
| 21 | | 5 | 70 | 193 | 75 | 2.8 | 27.1 | 156.8 | 813 | | |
| 23 | | 5 | 40 | 184 | 100 | 4.6 | 21.7 | 98.0 | 533 | | |
| 25 | | 5 | 30 | 159 | 100 | 4.0 | 25.0 | | | | |
| 26 | | 5 | 30 | 94 | 63 | 3.1 | 20.3 | | | 66.17 | 704 |
| 66 | | 5 | 89 | 242 | 60 | 2.7 | 21.9 | 168.3 | 696 | 144.29 | 596 |
| 67 | | 5 | 80 | 241 | 66 | 3.0 | 21.9 | 128.5 | 533 | 38.00 | 158 |
| 2 | Dustlik -2 | 9 | 71 | 296 | 95 | 4.2 | 22.8 | 149.7 | 506 | 67.67 | 229 |
| 13 | | 9 | 72 | 302 | 88 | 4.2 | 21.0 | 148.3 | 491 | | |
| 24 | | 9 | 71 | 296 | 95 | 4.2 | 22.8 | 161.7 | 546 | 127.57 | 431 |
| 26 | | 9 | 71 | 270 | 92 | 3.8 | 24.2 | 243.3 | 901 | 171.33 | 635 |
| 30 | | 9 | 36 | 150 | 90 | 4.2 | 21.6 | 99.5 | 663 | 95.83 | 639 |
| Total | | | 896 | 3214 | | | | 1704.7 | 617 | 1189.86 | 501 |
| Aver-age | | | 59.7 | 214.3 | 82.7 | 3.6 | 22.9 | 142.1 | 617 | 108.2 | 501 |

2) Detached house

The results of the survey for detached houses conducted on the Study are shown in Table S 2.3.4.2. The water meters for these houses were also installed by JICA team, and the metered tariff system was not introduced. Therefore the survey results can be taken for the consumption data of detached houses where water meters were not installed. Sewer lines were not served in this area.

As shown in the table, the customers divided into two categories: one is the large consumers of which the average consumption in summer season exceeded 2,000 lpcd, others are the average cusumers of which the average consumption was less than 300 lpcd even in summer season.

**Table 2.3.4.2 Survey Results for Consumers of Detached Houses**

| Division | Item | Total Area(x100sq.m) | | | No of Taps | Occupant Number | Consumption | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total | House | Garden | | | Aug.7 to Aug.14 | | Sep.21 to Sep.28 | | Nov.22 to Nov.30 | |
| | | | | | | | $m^3/d$ | L/cap/d | $m^3/d$ | L/cap/d | $m^3/d$ | L/cap/d |
| Large Consumer | House number: 6 | | | | | | | | | | | |
| | Total | --- | --- | --- | --- | 31 | 62.88 | --- | 85.83 | --- | 10.75 | --- |
| | Average | 6.0 | 2.2 | 2.6 | 2.7 | 5.2 | 10.48 | 2,028 | 14.31 | 2,769 | 1.79 | 538 |
| Average Consumer | House number: 42 | | | | | | | | | | | |
| | Total | --- | --- | --- | --- | 212 | 49.95 | --- | 61.79 | --- | 22.25 | --- |
| | Average | 6.0 | 1.9 | 2.2 | 2.7 | 5.0 | 1.19 | 236 | 1.47 | 291 | 0.53 | 136 |
| All Average | | 6.0 | 1.9 | 2.3 | 2.7 | 5.1 | 2.35 | 460 | 3.08 | 601 | 0.92 | 180 |

The number of large consumers was only 13% of total number of customers, however they were consuming around half out of total water consumption in the survey area.

The customer in the area consumed double in the summer season compared to other seasons and they reduced their consumption in autumn. Total average consumption in summer season in the area is around 500 lpcd in summer, 200 lpcd in autumn, and there were a big difference between summer (irrigation season) and autumn (non-irrigation season) for customers of detached houses.

The results for detached houses connecting sewer lines are shown in Table S 2.3.4.3. Since the metered tariff system had already introduced to these houses, the consumption was smaller than the results of aforementioned survey although these houses were connected by sewer line.

**Table S 2.3.4.3 Survey Results for consumers of Detached House with Sewer**

| Item | Total Area (x100sq.m) | | | No of taps | Number of Occupants | Consumption | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | House | Garden | | | Aug31 to Sep.6 | | Sep.23 to Sep.29 | |
| | | | | | | $m^3$/d | L/cap./d | $m^3$/d | L/cap./d |
| House number: 15 | | | | | | | | | |
| Total | --- | --- | --- | --- | 109 | 25.43 | --- | 32.83 | --- |
| Average | 5.8 | 2.1 | 0.7 | 3.2 | 7.3 | 1.70 | 233 | 2.19 | 301 |

### (2) Survey by Vodokanal in 2001

Vodokanal carried out consumption survey for apartments and detached houses from January to March in 2001. As shown in Table S 2.3.4.4, there is a big difference of consumption between apartment residents with and without water meters. This survey result is considered to be reliable because the sample number of consumers was big.

**Table S 2.3.4.4 Consumption Survey Results by Vodokanal**

| Division | Meter Installation | Average L/cap./d | Quota L/cap./d | Sample Population |
|---|---|---|---|---|
| Apartment | With | 161 | 330 | 62,162 |
| | Without | 583 | 330 | 21,056 |
| Detached House | With | 203 | 190 | 63,937 |

### (3) Water Consumption Survey for Apartment Residents in this JICA Study

This survey was carried out for two apartment buildings from August 28th to September 3rd in Sergeli District. In same time, a consumption survey for detached houses was conducted. However the results of this survey was not reliable, since consumption was too little because many houses were using their own wells.

Figure S 2.3.4.1 shows the daily fluctuation of per capita consumption. The data is shown in Table 2.3.4.5 (1) and Table 2.3.4.5 (2). As shown in the figures, the daily consumption in weekend was decreased, however September 1st was a special day as " Independent Day of Uzbekistan". The consumption of House No.1 in Sergeli 7 is smaller than that of another apparently.

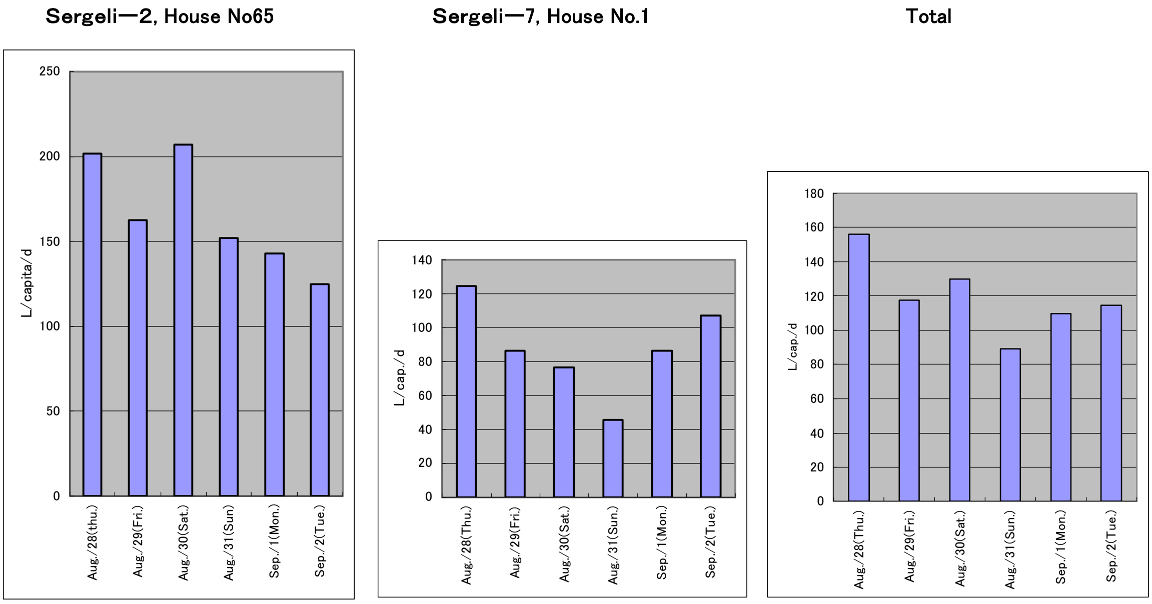



**Figure S 2.3.4.1 Daily fluctuation of Apartment Building**

The difference between consumption of these two apartments was large. This may arise from difference whether hot water meters are installed. Thus residents in the apartment No.1 in Sergeli 7 where hot water meters were not installed might have consumed hot water mainly.

**Table S.2.3.4.5 (1) Consumption Survey Results for Apartment (1)**

| Address | No. | Feature of Flat | | | | | Measured Results | |
|---|---|---|---|---|---|---|---|---|
| | | Flat No. | Number of Rooms | Total Area ($m^2$) | Number of residents | Area/ per-son ($m^2$) | Daily usage ($m^3$) | Consumption (L/capita/d) |
| Apartment Noo.65 Sergeli—2 | 1 | 3 | 2 | 29.35 | 3 | 9.8 | 0.167 | 56 |
| | 2 | 4 | 1 | 16.63 | 1 | 16.6 | 0.417 | 417 |
| | 3 | 6 | 2 | 29.35 | 5 | 5.9 | 0.167 | 33 |
| | 4 | 11 | 1 | 16.63 | 1 | 16.6 | 0.167 | 167 |
| | 5 | 15 | 2 | 29.35 | 3 | 9.8 | 0.750 | 250 |
| | 6 | 17 | 3 | 43.27 | 4 | 10.8 | 1.917 | 479 |
| | 7 | 18 | 2 | 29.35 | 2 | 14.7 | 0.083 | 42 |
| | 8 | 22 | 2 | 29.35 | 3 | 9.8 | 0.583 | 194 |
| | 9 | 26 | 3 | 43.27 | 4 | 10.8 | 0.167 | 42 |
| | 10 | 30 | 3 | 43.27 | 4 | 10.8 | 0.167 | 42 |
| | 11 | 31 | 2 | 29.35 | 4 | 7.3 | 0.500 | 125 |
| | 12 | 34 | 3 | 43.27 | 4 | 10.8 | 0.500 | 125 |
| | 13 | 37 | 3 | 43.27 | 4 | 10.8 | 0.333 | 83 |
| | 14 | 40 | 2 | 29.35 | 3 | 9.8 | 0.333 | 111 |
| | 15 | 42 | 2 | 29.35 | 2 | 14.7 | 0.333 | 167 |
| | 16 | 45 | 3 | 43.27 | 5 | 8.7 | 1.500 | 300 |
| | 17 | 48 | 3 | 43.27 | 4 | 10.8 | 0.333 | 83 |
| | 18 | 53 | 2 | 29.37 | 2 | 14.7 | 0.417 | 208 |
| | 19 | 56 | 2 | 29.37 | 2 | 14.7 | 0.083 | 42 |
| | 20 | 57 | 3 | 43.27 | 3 | 14.4 | 0.500 | 167 |
| | 21 | 59 | 3 | 43.27 | 4 | 10.8 | 0.333 | 83 |
| | 22 | 62 | 2 | 29.35 | 3 | 9.8 | 0.167 | 56 |
| | 23 | 63 | 3 | 43.27 | 3 | 14.4 | 0.167 | 56 |
| | 24 | 65 | 3 | 43.27 | 4 | 10.8 | 0.333 | 83 |
| | 25 | 69 | 2 | 29.25 | 1 | 29.3 | 0.167 | 167 |
| | 26 | 70 | 3 | 43.27 | 5 | 8.7 | 0.333 | 67 |
| | 27 | 71 | 2 | 29.35 | 3 | 9.8 | 0.250 | 83 |
| | 28 | 72 | 3 | 43.27 | 4 | 10.8 | 0.333 | 83 |
| | 29 | 73 | 2 | 29.35 | 1 | 29.4 | 0.333 | 333 |
| | 30 | 74 | 3 | 43.27 | 2 | 21.6 | 0.833 | 417 |
| | 31 | 5 | 1 | 16.63 | 3 | 5.5 | 0.333 | 111 |
| | 32 | 12 | 2 | 29.35 | 2 | 14.7 | 0.167 | 83 |
| | 33 | 14 | 1 | 16.63 | 2 | 8.3 | 0.167 | 83 |
| | 34 | 23 | 3 | 43.27 | 5 | 8.7 | 0.500 | 100 |
| | 35 | 25 | 3 | 43.27 | 2 | 21.6 | 0.167 | 83 |
| Total | | | | | 107 | | 14.000 | 131 |

Note: Each flat was installed hot water meters

**Table S.2.3.4.5 (2) Consumption Survey Results for Apartment (2)**

| Address | No. | Feature of Flat | | | | | Measured Results | |
|---|---|---|---|---|---|---|---|---|
| | | Flat No. | Number of Rooms | Total Area ($m^2$) | Number of residents | Area/ per-son ($m^2$) | Daily usage ($m^3$) | Consumption (L/capita/d) |
| Apartment No.1 Sergeli—7 | 1 | 2 | 2 | 28.5 | 3 | 9.50 | 0.250 | 83 |
| | 2 | 3 | 4 | 54.27 | 4 | 13.57 | 0.200 | 50 |
| | 3 | 4 | 2 | 28.5 | 1 | 28.50 | 0.100 | 100 |
| | 4 | 5 | 4 | 54.27 | 5 | 10.85 | 0.400 | 80 |
| | 5 | 6 | 2 | 28.5 | 4 | 7.13 | 0.567 | 142 |
| | 6 | 7 | 4 | 54.27 | 4 | 13.57 | 0.400 | 100 |
| | 7 | 8 | 2 | 28.5 | 1 | 28.50 | 0.333 | 333 |
| | 8 | 9 | 4 | 54.27 | 1 | 54.27 | 0.217 | 217 |
| | 9 | 10 | 2 | 28.5 | 5 | 5.70 | 0.233 | 47 |
| | 10 | 12 | 2 | 28.5 | 2 | 14.25 | 0.260 | 130 |
| | 11 | 13 | 4 | 54.27 | 1 | 54.27 | 0.283 | 283 |
| | 12 | 14 | 2 | 28.5 | 2 | 14.25 | 0.167 | 83 |
| | 13 | 15 | 4 | 54.27 | 3 | 18.09 | 0.200 | 67 |
| | 14 | 16 | 2 | 28.5 | 4 | 7.13 | 0.183 | 46 |
| | 15 | 17 | 4 | 54.27 | 4 | 13.57 | 0.367 | 92 |
| | 16 | 18 | 2 | 28.5 | 2 | 14.25 | 0.300 | 150 |
| | 17 | 20 | 2 | 28.5 | 1 | 28.50 | 0.667 | 667 |
| | 18 | 22 | 2 | 28.5 | 6 | 4.75 | 0.317 | 53 |
| | 19 | 24 | 2 | 28.5 | 5 | 5.70 | 0.333 | 67 |
| | 20 | 25 | 4 | 54.27 | 2 | 27.14 | 0.333 | 167 |
| | 21 | 27 | 4 | 54.27 | 3 | 18.09 | 0.283 | 94 |
| | 22 | 28 | 4 | 28.5 | 4 | 7.13 | 0.333 | 83 |
| | 23 | 29 | 2 | 54.27 | 1 | 54.27 | 0.217 | 217 |
| | 24 | 30 | 4 | 28.5 | 1 | 28.50 | 0.283 | 283 |
| | 25 | 31 | 4 | 54.27 | 1 | 54.27 | 0.217 | 217 |
| | 26 | 32 | 2 | 28.5 | 6 | 4.75 | 0.250 | 42 |
| | 27 | 34 | 2 | 28.5 | 5 | 5.70 | 0.233 | 47 |
| | 28 | 36 | 2 | 28.5 | 6 | 4.75 | 0.217 | 36 |
| | 29 | 1 | 2 | 54.05 | 4 | 13.51 | 0.250 | 63 |
| | 30 | 2 | 2 | 28.66 | 4 | 7.17 | 0.233 | 58 |
| | 31 | 3 | 4 | 54.05 | 1 | 54.05 | 0.200 | 200 |
| | 32 | 5 | 2 | 54.05 | 3 | 18.02 | 0.250 | 83 |
| Sub-Total | | | | | 99 | | 9.077 | 92 |

Note: Flats was installed no hot water meter.

Table S 2.3.4.6 shows calculation results of water consumption based on meter reading records for apartment No.65 in Sergeli 2. As shown in the table, the results are not so different with measured result as shown in Table S 2.3.4 5, and water consumption was reduced after the first meter reading.

**Table S 2.3.4.6 Water consumption analysis based on Meter Reading Records**

| No. | Flat No. | Starting Date | | Checked Date | | 1st | | | 15/09/03 | 2nd | | | Residents | Cons./capita | | Mesured |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Date | Value $m^3$ | Date | Value $m^3$ | Days | value $m^3$ | Cons. $m^3/d$ | Value $m^3$ | Days | value $m^3$ | Cons. $m^3/d$ | Number | 1st L/cap/d | 2nd L/cap/d | Data L/cap/d |
| 1 | 3 | 30/12/02 | 35 | 15/04/03 | 55 | 106 | 20 | 0.189 | 80.5 | 141 | 25.5 | 0.181 | 3 | 63 | 60 | 56 |
| 2 | 4 | 9/04/03 | 38 | 1/07/03 | 177 | 84 | 139 | 1.655 | 193 | 64 | 16 | 0.250 | 2 | 827 | 125 | 417 |
| 3 | 5 | 30/12/02 | 15 | 1/07/03 | 51 | 183 | 36 | 0.197 | 66 | 64 | 15 | 0.234 | 3 | 66 | 78 | 111 |
| 4 | 6 | 25/12/02 | 18 | 28/04/03 | 54 | 124 | 36 | 0.290 | 83 | 128 | 29 | 0.227 | 5 | 58 | 45 | 33 |
| 5 | 11 | 30/12/02 | 10 | 19/03/03 | 22 | 79 | 12 | 0.152 | 29 | 168 | 7 | 0.042 | 1 | 152 | 42 | 167 |
| 6 | 12 | 30/12/02 | 27 | 28/04/03 | 66 | 119 | 39 | 0.328 | 90 | 128 | 24 | 0.188 | 2 | 164 | 94 | 83 |
| 7 | 14 | 30/12/02 | 15 | 28/04/03 | 30 | 119 | 15 | 0.126 | 54 | 128 | 24 | 0.188 | 2 | 63 | 94 | 83 |
| 8 | 15 | 30/12/02 | 37 | 12/05/03 | 102 | 133 | 65 | 0.489 | 144.5 | 114 | 42.5 | 0.373 | 3 | 163 | 124 | 250 |
| 9 | 17 | 30/12/02 | 28 | 7/07/03 | 108 | 189 | 80 | 0.423 | 180.5 | 58 | 72.5 | 1.250 | 4 | 106 | 313 | 479 |
| 10 | 18 | 25/12/02 | 2 | 12/05/03 | 14 | 138 | 12 | 0.087 | 24.5 | 114 | 10.5 | 0.092 | 2 | 43 | 46 | 42 |
| 11 | 22 | 30/12/02 | 33 | 15/03/03 | 39 | 75 | 6 | 0.080 | 144.5 | 172 | 105.5 | 0.613 | 3 | 27 | 204 | 194 |
| 12 | 23 | 30/12/02 | 43 | 4/04/03 | 102 | 95 | 59 | 0.621 | 150 | 153 | 48 | 0.314 | 5 | 124 | 63 | 100 |
| 13 | 25 | 25/01/03 | 25 | 28/04/03 | 30 | 93 | 5 | 0.054 | 41 | 130 | 11 | 0.085 | 2 | 27 | 42 | 83 |
| 14 | 26 | 30/12/02 | 60 | 7/07/03 | 108 | 189 | 48 | 0.254 | 128 | 58 | 20 | 0.345 | 4 | 63 | 86 | 42 |
| 15 | 30 | 27/02/03 | 20 | 28/04/03 | 28 | 60 | 8 | 0.133 | 52 | 128 | 24 | 0.188 | 4 | 33 | 47 | 42 |
| 16 | 31 | 25/01/03 | 52 | 12/05/03 | 106.5 | 107 | 54.5 | 0.509 | 167 | 114 | 60.5 | 0.531 | 4 | 127 | 133 | 125 |
| 17 | 34 | 25/01/03 | 116 | 28/04/03 | 140 | 93 | 24 | 0.258 | 265 | 128 | 125 | 0.977 | 4 | 65 | 244 | 125 |
| 18 | 37 | 25/01/03 | 33 | 28/04/03 | 65 | 93 | 32 | 0.344 | 116 | 128 | 51 | 0.398 | 4 | 86 | 100 | 83 |
| 19 | 40 | 25/01/03 | 44 | 28/04/03 | 89 | 93 | 45 | 0.484 | 175 | 128 | 86 | 0.672 | 3 | 161 | 224 | 111 |
| 20 | 42 | 25/01/03 | 3 | 16/06/03 | 34 | 142 | 31 | 0.218 | 68 | 79 | 34 | 0.430 | 2 | 109 | 215 | 167 |
| 21 | 45 | 18/01/03 | 100 | 31/07/03 | 433 | 194 | 333 | 1.716 | 490 | 34 | 57 | 1.676 | 5 | 343 | 335 | 300 |
| 22 | 48 | 18/01/03 | 36 | 14/06/03 | 96 | 147 | 60 | 0.408 | 148 | 81 | 52 | 0.642 | 4 | 102 | 160 | 83 |
| 23 | 53 | 19/01/03 | 36 | 28/04/03 | 111 | 99 | 75 | 0.758 | 135 | 128 | 24 | 0.188 | 2 | 379 | 94 | 208 |
| 24 | 56 | 19/01/03 | 38 | 12/05/03 | 47 | 113 | 9 | 0.080 | 59.5 | 114 | 12.5 | 0.110 | 2 | 40 | 55 | 42 |
| 25 | 57 | 19/01/03 | 100 | 31/07/03 | 287 | 193 | 187 | 0.969 | 305 | 34 | 18 | 0.529 | 3 | 323 | 176 | 167 |
| 26 | 59 | 19/01/03 | 35 | 29/04/03 | 55 | 100 | 20 | 0.200 | 90 | 127 | 35 | 0.276 | 4 | 50 | 69 | 83 |
| 27 | 62 | 31/01/03 | 4 | 15/05/03 | 15 | 104 | 11 | 0.106 | 33 | 111 | 18 | 0.162 | 3 | 35 | 54 | 56 |
| 28 | 63 | 19/01/03 | 32 | 29/04/03 | 58 | 100 | 26 | 0.260 | 83 | 127 | 25 | 0.197 | 3 | 87 | 66 | 56 |
| 29 | 65 | 19/01/03 | 55 | 29/04/03 | 105 | 100 | 50 | 0.500 | 170 | 127 | 65 | 0.512 | 4 | 125 | 128 | 83 |
| 30 | 70 | 19/01/03 | 100 | 12/05/03 | 187 | 113 | 87 | 0.770 | 272 | 114 | 85 | 0.746 | 5 | 154 | 149 | 67 |
| 31 | 71 | 19/01/03 | 15 | 31/07/03 | 55 | 224 | 40 | 0.179 | 64.5 | 34 | 9.5 | 0.279 | 3 | 60 | 93 | 83 |
| 32 | 72 | 25/01/03 | 11 | 12/05/03 | 44 | 107 | 33 | 0.308 | 78 | 114 | 34 | 0.298 | 4 | 77 | 75 | 83 |
| 33 | 73 | 25/01/03 | 7 | 12/05/03 | 15.5 | 107 | 8.5 | 0.079 | 24 | 114 | 8.5 | 0.075 | 1 | 79 | 75 | 333 |
| 34 | 74 | 19/01/03 | 220 | 29/04/03 | 643 | 100 | 423 | 4.230 | 790 | 127 | 147 | 1.157 | 4 | 1,058 | 289 | 417 |
| Total | | | | | | | | 17.454 | | | | 14.422 | 109 | 160 | 132 | 127 |

### (4) Water Consumption Survey Based on Meter Reading Records

As shown in Section (3), water consumption survey in Sergeli District was carried out. However the targets of survey area, the number of residents and duration are so limited in this case that the water consumption survey based on analyzing meter reading record was conducted in the Study.

The results of the survey are summarized in Table S 2.3.4.7.

**Table S 2.3.4.7 Summarized Consumption Date collected from 5 districts**

| Division | District | Items | Winter | Spring/ Autumn | Summer | Annual Average |
|---|---|---|---|---|---|---|
| Apartment | Sergeli | Data number | 48 | 49 | 49 | |
| | | Residents | 131 | 136 | 136 | 135 |
| | | Consumption (L/cap./d) | 135 | 149 | 193 | 157 |
| | Akmal Ikramov | Data number | 50 | 48 | 45 | |
| | | Residents | 114 | 115 | 109 | 113 |
| | | Consumption(L/cap./d) | 111 | 101 | 83 | 99 |
| | Mirabad | Data number | 18 | 18 | 17 | |
| | | Residents | 74 | 74 | 68 | 73 |
| | | Consumption(L/cap./d) | 109 | 97 | 118 | 105 |
| | Mirzo-Ulugbek | Data number | 20 | 23 | 7 | |
| | | Residents | 104 | 126 | 41 | 99 |
| | | Consumption (L/cap./d) | 102 | 135 | 101 | 123 |
| | Sum Average | | 116 | 124 | 134 | 124 |
| Detached house with sewer | Sergeli | Data number | 24 | 30 | 33 | |
| | | Residents | 75 | 104 | 135 | 105 |
| | | Consumption (L/cap./d) | 401 | 403 | 312 | 373 |
| | Mirabad | Data number | 5 | 5 | 5 | |
| | | Residents | 31 | 31 | 31 | 31 |
| | | Consumption (L/cap./d) | 155 | 282 | 344 | 266 |
| | Akmal Ikram | Data number | 50 | 50 | 50 | |
| | | Residents | 368 | 368 | 368 | 368 |
| | | Consumption (L/cap./d) | 104 | 153 | 192 | 151 |
| | Sobir Rahimov | Data number | 50 | 50 | 50 | |
| | | Residents | 312 | 312 | 312 | 312 |
| | | Consumption (L/cap./d) | 135 | 243 | 284 | 226 |
| | Sum Average | | 147 | 224 | 251 | 212 |
| Detached house without sewer | Sergeli | Data number | 23 | 31 | 37 | |
| | | Residents | 81 | 117 | 141 | 114 |
| | | Consumption (L/cap./d) | 224 | 210 | 244 | 223 |
| | Mirabad | Data number | 30 | 36 | 23 | |
| | | Residents | 171 | 192 | 133 | 172 |
| | | Consumption (L/cap./d) | 279 | 271 | 451 | 308 |
| | Sobir Rahimov | Data number | 50 | 50 | 50 | |
| | | Residents | 318 | 318 | 318 | 318 |
| | | Consumption (L/cap./d) | 57 | 85 | 124 | 88 |
| | Sum Average | | 147 | 182 | 234 | 176 |

These meter reading records were collected from Sergeli, Akmal Ikramov, Mirabad, Sobir Rahimov and Mirzo-Ulugbek District. These records were classified into apartment, detached house with sewer connection and detached house without sewer connection. Additionally, the data was divided into three seasons: winter, spring/autumn and summer. However the data of some categories by district could not be collected because the consumers of concerned categories were too few in the specific district.

Figure S 2.3.4.2 (1) shows the annual consumption tendency for apartments in each district, and Figure S 2.3.4.2 (2) shows that of detached houses. Figure S 2.3.4.3 shows average consumption of apartment and detached house.

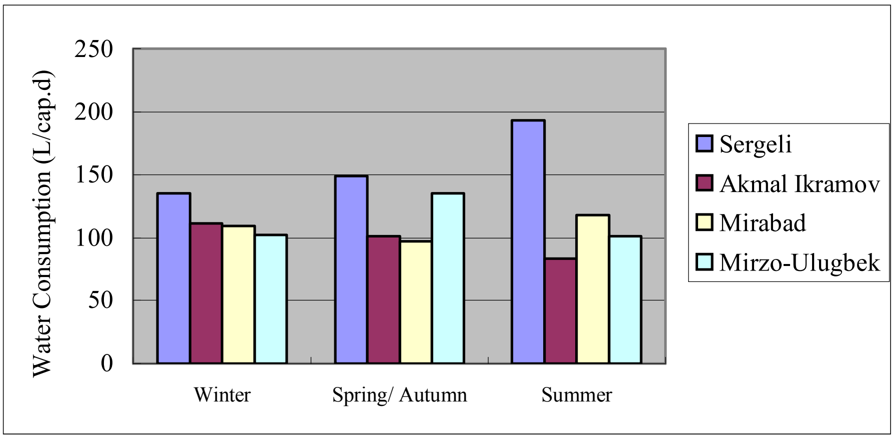



**Figure S 2.3.4.2 (1) Water Consumption Tendency of each district for Apartment**

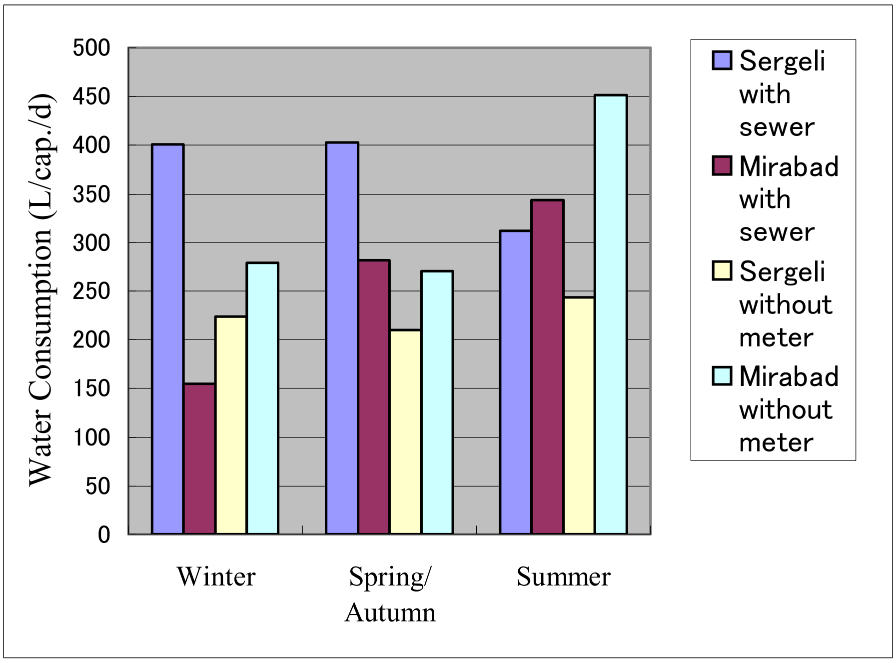



**Figure S 2.3.4.2 (2) Water Consumption Tendency of each district for Detached House**

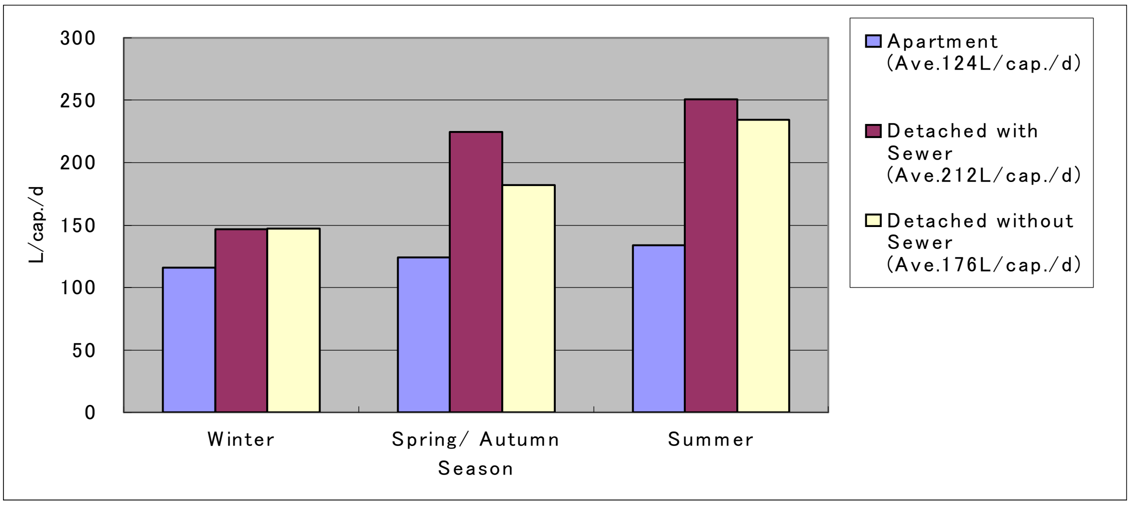



**Figure S 2.3.4.3 Average Consumption for Apartment and Detached House**

As shown in these Figures, the following features can be described:

- Water consumption is largely different between districts,
- Water consumption for detached houses is lager than that of apartments,
- Detached houses with sewer connection is the largest in three categories, which are apartment, detached house with sewer connection and detached house without sewer connection,
- Water consumption in summer season is the largest in these categories,
- That in winter season is the smallest,

Water consumption per capita for apartment flats and detached house with small number residents is larger than that with larger number residents. Figure S 2.3.4.4 (1) and (2) clearly shows the fact that the difference by resident number of detached house is larger than that of apartment. As shown in the figures, the water charge of per capita quota should be changed based on resident number of target flats or houses.

The analyzed consumption data for apartments, which is basic data in previous analysis, is shown in Table S.2.3.4.8 (1), (2), (3) and (4). That for detached houses with sewer connection is shown in Table S 2.3.4.9 (1), (2), (3) and (4), and that for detached houses without sewer connection is also shown in Table S 2.3.10 (1), (2) and (3).

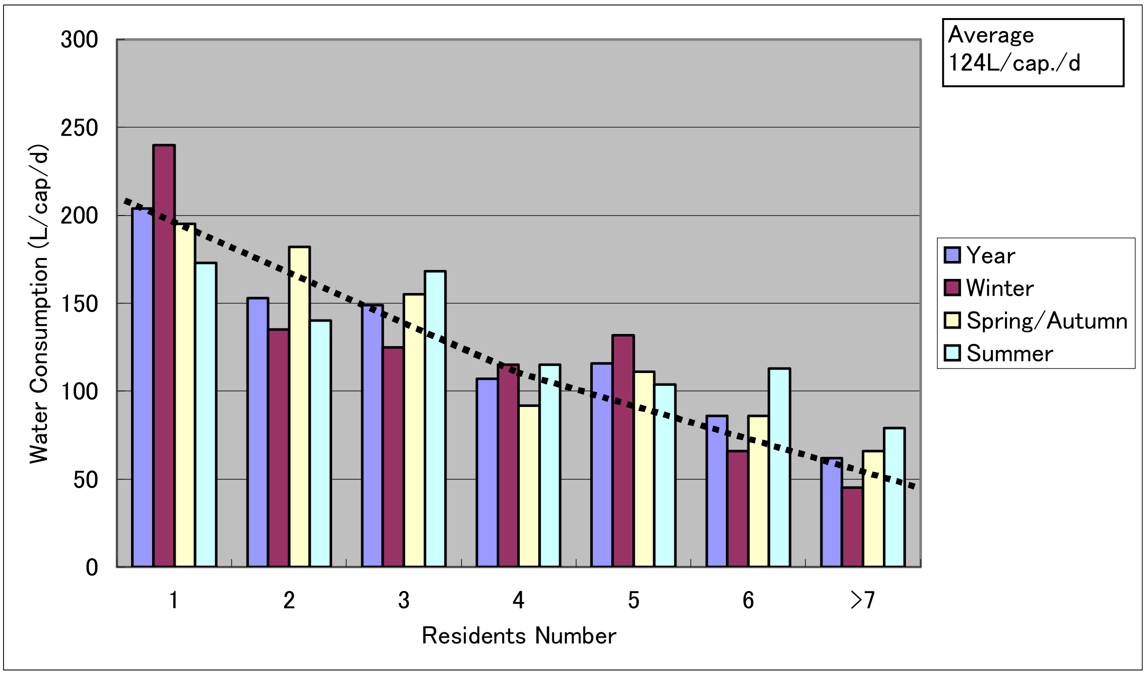



**Figure S 2.3.4.4 (1) Water Consumption Tendency by Resident Number for Apartment**

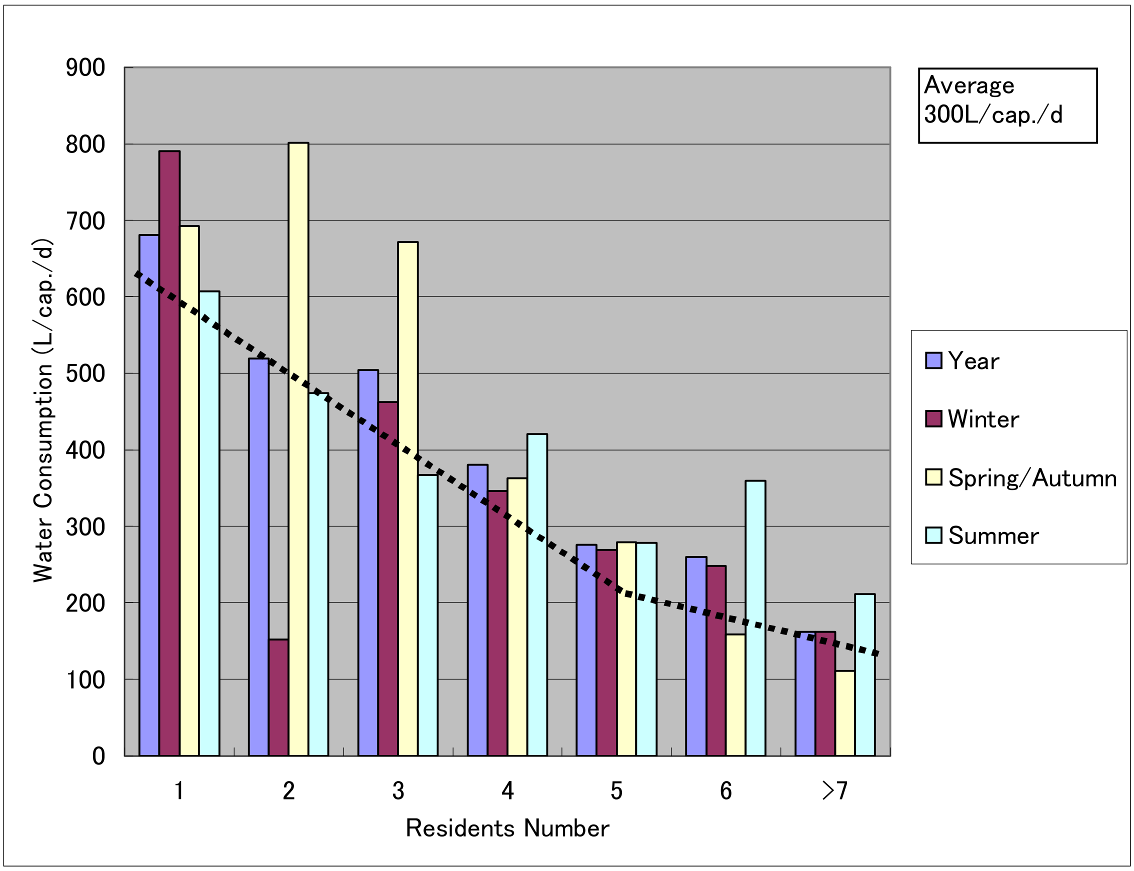



**Figure S 2.3.4.4 (2) Water Consumption Tendency by Resident Number for Detached House**

# Table S.2.3.4.8(1) Water Consumption Date for Apartments(1)

**Sergeli District**

| No. | Address | Apart No. | Flat No. | Number of residents | Winter Season | | | | | | | | Spring/Autumn season | | | | | | | | Summer season | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | |
| | | | | | Date | Value(m3 | Date | Value(m3 | $m^3$ | Day | $m^3/d$ | L/cap./d | Date | Value(m3 | Date | Value(m3 | $m^3$ | Day | $m^3/d$ | L/cap./d | Date | Value(m3 | Date | Value(m3 | $m^3$ | Day | $m^3/d$ | L/cap./d |
| 1 | Sergeli-2 | 38 | 2 | 3 | 28.01.03 | 39 | 01.03.03 | 77 | 38 | 32 | 1.188 | 396 | 02.05.03 | 191 | 03.06.03 | 243 | 52 | 32 | 1.625 | 542 | 04.07.03 | 296 | 04.11.03 | 547 | 251 | 123 | 2.041 | 680 |
| 2 | | 38 | 3 | 4 | 17.03.03 | 39 | 18.04.03 | 56 | 17 | 32 | 0.531 | 133 | 02.05.03 | 64 | 03.06.03 | 81 | 17 | 32 | 0.531 | 133 | 04.07.03 | 99 | 03.11.03 | 173 | 74 | 122 | 0.607 | 152 |
| 3 | | 38 | 4 | 1 | 28.01.03 | 2 | 01.03.03 | 5 | 3 | 32 | 0.094 | 94 | 02.05.03 | 11 | 03.06.03 | 14 | 3 | 32 | 0.094 | 94 | 30.06.03 | 17 | 03.11.03 | 20.5 | 3.5 | 126 | 0.028 | 28 |
| 4 | | 38 | 5 | 1 | 28.01.03 | 8 | 01.03.03 | 19 | 11 | 32 | 0.344 | 344 | 02.05.03 | 52 | 03.06.03 | 56 | 4 | 32 | 0.125 | 125 | 04.07.03 | 62 | 03.11.03 | 77 | 15 | 122 | 0.123 | 123 |
| 5 | | 38 | 6 | 4 | 28.01.03 | 4 | 01.03.03 | 7 | 3 | 32 | 0.094 | 23 | 02.05.03 | 18 | 03.06.03 | 23 | 5 | 32 | 0.156 | 39 | 04.07.03 | 35 | 29.08.03 | 55 | 20 | 56 | 0.357 | 89 |
| 6 | | 38 | 7 | 1 | 28.01.03 | 1 | 01.03.03 | 2 | 1 | 32 | 0.031 | 31 | 02.05.03 | 3 | 03.06.03 | 10 | 7 | 32 | 0.219 | 219 | 01.07.03 | 19 | 03.11.03 | 32 | 13 | 125 | 0.104 | 104 |
| 7 | | 38 | 8 | 2 | 28.01.03 | 13 | 01.03.03 | 19 | 6 | 32 | 0.188 | 94 | 02.05.03 | 38 | 03.06.03 | 59 | 21 | 32 | 0.656 | 328 | 04.07.03 | 88 | 03.11.03 | 90 | 2 | 122 | 0.016 | 8 |
| 8 | | 38 | 9 | 4 | 28.01.03 | 1 | 01.03.03 | 5 | 4 | 32 | 0.125 | 31 | 30.04.03 | 17 | 03.06.03 | 22 | 5 | 32 | 0.156 | 39 | 04.07.03 | 30 | 03.11.03 | 61 | 31 | 122 | 0.254 | 64 |
| 9 | | 38 | 11 | 3 | 19.03.03 | 26 | 20.04.03 | 32 | 6 | 32 | 0.188 | 63 | 02.05.03 | 35 | 03.06.03 | 41 | 6 | 32 | 0.188 | 63 | 04.07.03 | 47 | 03.11.03 | 75 | 28 | 122 | 0.230 | 77 |
| 10 | | 38 | 12 | 4 | 28.01.03 | 2 | 01.03.03 | 8 | 6 | 32 | 0.188 | 47 | 02.05.03 | 26 | 03.06.03 | 34 | 8 | 32 | 0.250 | 63 | 04.07.03 | 52 | 03.11.03 | 93 | 41 | 122 | 0.336 | 84 |
| 11 | | 38 | 13 | 1 | 06.04.03 | 5 | 18.04.03 | 7 | 2 | 12 | 0.167 | 167 | 30.05.03 | 18 | 01.07.03 | 22 | 4 | 32 | 0.125 | 125 | 13.07.03 | 28 | 30.09.03 | 47 | 19 | 79 | 0.241 | 241 |
| 12 | | 38 | 14 | 2 | 17.03.03 | 16 | 18.04.03 | 19 | 3 | 32 | 0.094 | 47 | 02.05.03 | 21 | 03.06.03 | 28 | 7 | 32 | 0.219 | 109 | 17.08.03 | 37 | 03.11.03 | 49 | 12 | 78 | 0.154 | 77 |
| 13 | | 38 | 15 | 4 | 28.01.03 | 3 | 01.03.03 | 41 | 38 | 32 | 1.188 | 297 | 02.05.03 | 73 | 03.06.03 | 92 | 19 | 32 | 0.594 | 148 | 04.07.03 | 104 | 03.11.03 | 202 | 98 | 122 | 0.803 | 201 |
| 14 | | 38 | 16 | 6 | 19.03.03 | 18 | 18.04.03 | 51 | 33 | 30 | 1.100 | 183 | 02.05.03 | 68 | 03.06.03 | 104 | 36 | 32 | 1.125 | 188 | 04.07.03 | 155 | 03.11.03 | 360 | 205 | 122 | 1.680 | 280 |
| 15 | | 38 | 17 | 10 | 28.01.03 | 17 | 01.03.03 | 26 | 9 | 32 | 0.281 | 28 | 02.05.03 | 45 | 03.06.03 | 54 | 9 | 32 | 0.281 | 28 | 04.07.03 | 78 | 03.11.03 | 135 | 57 | 122 | 0.467 | 47 |
| 16 | | 38 | 18 | 3 | 28.01.03 | 3 | 01.03.03 | 11 | 8 | 32 | 0.250 | 83 | 02.05.03 | 27 | 03.06.03 | 35 | 8 | 32 | 0.250 | 83 | 04.07.03 | 43 | 08.09.03 | 63 | 20 | 66 | 0.303 | 101 |
| 17 | | 38 | 19 | 2 | 28.01.03 | 2 | 01.03.03 | 19 | 17 | 32 | 0.531 | 266 | 02.05.03 | 40 | 03.06.03 | 57 | 17 | 32 | 0.531 | 266 | 04.07.03 | 74 | 03.11.03 | 144 | 70 | 122 | 0.574 | 287 |
| 18 | | 38 | 20 | 5 | 17.03.03 | 5 | 18.04.03 | 46 | 41 | 32 | 1.281 | 256 | 02.05.03 | 69 | 03.06.03 | 110 | 41 | 32 | 1.281 | 256 | 04.07.03 | 175 | 03.11.03 | 349 | 174 | 122 | 1.426 | 285 |
| 19 | | 38 | 22 | 3 | 28.01.03 | 13 | 01.03.03 | 39 | 26 | 32 | 0.813 | 271 | 12.04.03 | 78 | 13.07.03 | 150 | 72 | 92 | 0.783 | 261 | 03.08.03 | 228 | 03.11.03 | 409 | 181 | 92 | 1.967 | 656 |
| 20 | | 38 | 23 | 6 | 28.01.03 | 6 | 01.03.03 | 15 | 9 | 32 | 0.281 | 47 | 02.05.03 | 32 | 03.06.03 | 45 | 13 | 32 | 0.406 | 68 | 04.07.03 | 56 | 03.11.03 | 91 | 35 | 122 | 0.287 | 48 |
| 21 | | 38 | 24 | 5 | 28.01.03 | 16 | 01.03.03 | 30 | 14 | 32 | 0.438 | 88 | 11.04.03 | 68 | 10.05.03 | 82 | 14 | 29 | 0.483 | 97 | 17.08.03 | 71 | 03.11.03 | 89 | 18 | 78 | 0.231 | 46 |
| 22 | | 38 | 26 | 4 | 28.01.03 | 6 | 01.03.03 | 10 | 4 | 32 | 0.125 | 31 | 09.04.03 | 17 | 03.06.03 | 29 | 12 | 55 | 0.218 | 55 | 04.07.03 | 54 | 03.11.03 | 85 | 31 | 122 | 0.254 | 64 |
| 23 | | 38 | 28 | 3 | 28.01.03 | 8 | 01.03.03 | 14 | 6 | 32 | 0.188 | 63 | 07.03.03 | 17 | 17.05.03 | 43 | 26 | 71 | 0.366 | 122 | 09.06.03 | 55 | 03.11.03 | 135 | 80 | 147 | 0.544 | 181 |
| 24 | | 38 | 30 | 1 | 28.01.03 | 9 | 01.03.03 | 22 | 13 | 32 | 0.406 | 406 | 02.05.03 | 51 | 03.06.03 | 66 | 15 | 32 | 0.469 | 469 | 05.07.03 | 73 | 03.11.03 | 104 | 31 | 121 | 0.256 | 256 |
| 25 | | 38 | 31 | 4 | 28.01.03 | 8 | 01.03.03 | 19 | 11 | 32 | 0.344 | 86 | 02.05.03 | 54 | 03.06.03 | 65 | 11 | 32 | 0.344 | 86 | 05.07.03 | 78 | 03.11.03 | 129 | 51 | 121 | 0.421 | 105 |
| 26 | | 38 | 33 | 3 | | | | | | | | | | | | | | | | | 05.07.03 | 73 | 03.11.03 | 104 | 31 | 121 | 0.256 | 85 |
| 27 | | 38 | 34 | 2 | 28.01.03 | 4 | 01.03.03 | 6 | 2 | 32 | 0.063 | 31 | 02.05.03 | 8 | 03.06.03 | 14 | 6 | 32 | 0.188 | 94 | 17.08.03 | 31 | 03.11.03 | 42 | 11 | 92 | 0.120 | 60 |
| 28 | | 38 | 35 | 3 | 28.01.03 | 2 | 01.03.03 | 3 | 1 | 32 | 0.031 | 10 | 18.04.03 | 46 | 03.06.03 | 62 | 16 | 46 | 0.348 | 116 | 05.07.03 | 90 | 03.11.03 | 153 | 63 | 121 | 0.521 | 174 |
| 29 | | 38 | 36 | 1 | 06.04.03 | 47 | 18.04.03 | 53 | 6 | 12 | 0.500 | 500 | 02.05.03 | 60 | 03.06.03 | 73 | 13 | 32 | 0.406 | 406 | 05.07.03 | 7 | 03.11.03 | 109 | 102 | 121 | 0.843 | 843 |
| 30 | | 38 | 37 | 6 | 28.01.03 | 34 | 01.03.03 | 60 | 26 | 32 | 0.813 | 135 | 02.05.03 | 97 | 03.06.03 | 128 | 31 | 32 | 0.969 | 161 | 05.07.03 | 141 | 03.11.03 | 291 | 150 | 121 | 1.240 | 207 |
| 31 | | 38 | 38 | 2 | 28.01.03 | 10 | 01.03.03 | 30 | 20 | 32 | 0.625 | 313 | 02.05.03 | 50 | 03.06.03 | 56 | 6 | 32 | 0.188 | 94 | 07.07.03 | 63 | 16.11.03 | 73 | 10 | 138 | 0.072 | 36 |
| 32 | | 38 | 39 | 5 | | | | | | | | | 02.05.03 | 72 | 09.06.03 | 104 | 32 | 32 | 1.000 | 200 | 05.07.03 | 113 | 07.11.03 | 205 | 92 | 125 | 0.736 | 147 |
| 33 | | 38 | 40 | 6 | 28.01.03 | 1 | 01.03.03 | 5 | 4 | 32 | 0.125 | 21 | 02.05.03 | 11 | 03.06.03 | 16 | 5 | 32 | 0.156 | 26 | 06.07.03 | 22 | 03.11.03 | 47 | 25 | 120 | 0.208 | 35 |
| 34 | | 38 | 41 | 1 | 28.01.03 | 6 | 01.03.03 | 14 | 8 | 32 | 0.250 | 250 | 02.05.03 | 23 | 03.06.03 | 40 | 17 | 32 | 0.531 | 531 | 05.07.03 | 48 | 08.09.03 | 82 | 34 | 65 | 0.523 | 523 |
| 35 | | 38 | 42 | 3 | 17.03.03 | 3 | 18.04.03 | 11 | 8 | 32 | 0.250 | 83 | 02.05.03 | 16 | 03.06.03 | 24 | 8 | 32 | 0.250 | 83 | | | | | | | | |
| 36 | | 38 | 43 | 3 | 28.01.03 | 9 | 01.03.03 | 20 | 11 | 32 | 0.344 | 115 | 02.05.03 | 44 | 03.06.03 | 55 | 11 | 32 | 0.344 | 115 | 05.07.03 | 69 | 03.11.03 | 105 | 36 | 121 | 0.298 | 99 |
| 37 | | 38 | 45 | 4 | 19.03.03 | 50 | 18.04.03 | 63 | 13 | 30 | 0.433 | 108 | 02.05.03 | 78 | 03.06.03 | 86 | 8 | 32 | 0.250 | 63 | 25.06.03 | 50 | 03.11.03 | 207 | 157 | 131 | 1.198 | 300 |
| 38 | | 38 | 48 | 1 | 28.01.03 | 24 | 01.03.03 | 41 | 17 | 32 | 0.531 | 531 | 02.05.03 | 58 | 03.06.03 | 69 | 11 | 32 | 0.344 | 344 | 17.08.03 | 78 | 03.11.03 | 103 | 25 | 78 | 0.321 | 321 |
| 39 | | 38 | 50 | 3 | 15.03.03 | 11 | 18.04.03 | 14 | 3 | 34 | 0.088 | 29 | 02.05.03 | 17 | 03.06.03 | 21 | 4 | 32 | 0.125 | 42 | 03.07.03 | 25 | 03.11.03 | 42 | 17 | 123 | 0.138 | 46 |
| 40 | | 38 | 51 | 2 | 15.03.03 | 32 | 18.04.03 | 56 | 24 | 34 | 0.706 | 353 | 02.05.03 | 61 | 03.06.03 | 86 | 25 | 32 | 0.781 | 391 | 05.07.03 | 103 | 04.11.03 | 155 | 52 | 122 | 0.426 | 213 |
| 41 | | 38 | 52 | 3 | 28.01.03 | 10 | 01.03.03 | 12 | 2 | 32 | 0.063 | 21 | 27.05.03 | 19 | 03.06.03 | 22 | 3 | 32 | 0.094 | 31 | 05.07.03 | 50 | 04.11.03 | 139 | 89 | 122 | 0.730 | 243 |
| 42 | | 38 | 54 | 2 | 28.01.03 | 35 | 01.03.03 | 46 | 11 | 32 | 0.344 | 172 | 02.05.03 | 68 | 03.06.03 | 99 | 31 | 32 | 0.969 | 484 | 05.07.03 | 137 | 20.08.03 | 150 | 13 | 46 | 0.283 | 141 |
| 43 | | 38 | 55 | 2 | 28.01.03 | 201 | 01.03.03 | 203 | 2 | 32 | 0.063 | 31 | 02.05.03 | 205 | 03.06.03 | 206 | 1 | 32 | 0.031 | 16 | 05.07.03 | 208 | 04.11.03 | 219 | 11 | 122 | 0.090 | 45 |
| 44 | | 38 | 59 | 3 | 28.01.03 | 46 | 01.03.03 | 68 | 22 | 32 | 0.688 | 229 | 02.05.03 | 110 | 03.06.03 | 131 | 21 | 32 | 0.656 | 219 | 05.07.03 | 145 | 03.11.03 | 354 | 209 | 121 | 1.727 | 576 |
| 45 | | 38 | 61 | 1 | 28.01.03 | 5 | 01.03.03 | 8 | 3 | 32 | 0.094 | 94 | 02.05.03 | 15 | 03.06.03 | 18 | 3 | 32 | 0.094 | 94 | 05.07.03 | 23 | 03.11.03 | 30 | 7 | 121 | 0.058 | 58 |
| 46 | | 38 | 64 | 2 | 28.01.03 | 8 | 01.03.03 | 12 | 4 | 32 | 0.125 | 63 | 16.04.03 | 22 | 03.06.03 | 26 | 4 | 32 | 0.125 | 63 | 05.08.03 | 47 | 03.11.03 | 73 | 26 | 90 | 0.289 | 144 |
| 47 | | 38 | 65 | 3 | 28.01.03 | 11 | 01.03.03 | 19 | 8 | 32 | 0.250 | 83 | 02.05.03 | 28 | 03.06.03 | 37 | 9 | 32 | 0.281 | 94 | 14.07.03 | 62 | 03.11.03 | 103 | 41 | 109 | 0.376 | 125 |
| 48 | | 38 | 66 | 2 | 28.01.03 | 4 | 01.03.03 | 8 | 4 | 32 | 0.125 | 63 | 02.05.03 | 14 | 03.06.03 | 19 | 5 | 32 | 0.156 | 78 | 14.07.03 | 23 | 24.10.03 | 38 | 15 | 102 | 0.147 | 74 |
| 49 | | 38 | 67 | 2 | 04.02.03 | 6 | 01.03.03 | 11 | 5 | 32 | 0.156 | 78 | 02.05.03 | 21 | 03.06.03 | 26 | 5 | 32 | 0.156 | 78 | 31.07.03 | 37 | 17.09.03 | 45 | 8 | 48 | 0.167 | 83 |
| 50 | | 38 | 68 | 4 | 28.01.03 | 45 | 01.03.03 | 65 | 20 | 32 | 0.625 | 156 | 23.03.03 | 87 | 03.06.03 | 108 | 21 | 72 | 0.292 | 73 | 05.07.03 | 130 | 03.11.03 | 344 | 214 | 121 | 1.769 | 442 |
| Total/Average | | | | 139 | | Residents | 131 | | 553 | | 17.744 | 135 | | Residents | 136 | | 728 | | 20.208 | 149 | | Residents | 136 | | 2998.5 | | 26.239 | 193 |

## Table S.2.3.4.8(2) Water Consumption Date for Apartments(2)

### Akmal Ikramov District

| No. | Address | Apart No. | Flat No. | Number of residents | Winter Season | | | | | | | | Spring/Autumn season | | | | | | | | Summer season | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | |
| | | | | | Date | Value(m³) | Date | Value(m³) | m³ | Day | m³/d | L/cap./d | Date | Value(m³) | Date | Value(m³) | m³ | Day | m³/d | L/cap./d | Date | Value(m³) | Date | Value(m³) | m³ | Day | m³/d | L/cap./d |
| 1 | 12th blocks of buildings | 1 | 4 | 3 | 02.12.02 | 10 | 26.02.03 | 27 | 17 | 86 | 0.198 | 66 | 26.02.03 | 27 | 05.05.03 | 52 | 25 | 68 | 0.368 | 123 | 05.05.03 | 52 | 31.08.03 | 102 | 50 | 118 | 0.424 | 141 |
| 2 | | 1 | 6 | 2 | 02.12.02 | 5 | 26.02.03 | 17 | 12 | 86 | 0.140 | 70 | 26.02.03 | 17 | 05.05.03 | 33 | 16 | 68 | 0.235 | 118 | 05.05.03 | 33 | 31.08.03 | 60 | 27 | 118 | 0.229 | 114 |
| 3 | | 1 | 9 | 4 | 02.12.02 | 4 | 26.02.03 | 46 | 42 | 86 | 0.488 | 122 | 26.02.03 | 46 | 05.05.03 | 69 | 23 | 68 | 0.338 | 85 | 05.05.03 | 69 | 31.08.03 | 100 | 31 | 118 | 0.263 | 66 |
| 4 | | 1 | 10 | 3 | 02.12.02 | 4 | 26.02.03 | 19 | 15 | 86 | 0.174 | 58 | 26.02.03 | 19 | 05.05.03 | 34 | 15 | 68 | 0.221 | 74 | 05.05.03 | 34 | 31.08.03 | 52 | 18 | 118 | 0.153 | 51 |
| 5 | | 1 | 13 | 2 | 02.12.02 | 7 | 26.02.03 | 17 | 10 | 86 | 0.116 | 58 | 26.02.03 | 17 | 05.05.03 | 29 | 12 | 68 | 0.176 | 88 | 05.05.03 | 29 | 31.08.03 | 45 | 16 | 118 | 0.136 | 68 |
| 6 | | 1 | 14 | 1 | 02.12.02 | 21 | 26.02.03 | 29 | 8 | 86 | 0.093 | 93 | 26.02.03 | 29 | 05.05.03 | 41 | 12 | 68 | 0.176 | 176 | 05.05.03 | 41 | 31.08.03 | 77 | 36 | 118 | 0.305 | 305 |
| 7 | | 1 | 19 | 1 | 02.12.02 | 1 | 26.02.03 | 4 | 3 | 86 | 0.035 | 35 | 26.02.03 | 6 | 05.05.03 | | | | | | 05.05.03 | 6 | 31.08.03 | 11 | 5 | 118 | 0.042 | 42 |
| 8 | | 1 | 21 | 2 | 02.12.02 | 1 | 26.02.03 | 9 | 8 | 86 | 0.093 | 47 | 26.02.03 | 21 | 05.05.03 | 48 | 27 | 68 | 0.397 | 199 | 05.05.03 | 48 | 31.08.03 | 71 | 23 | 118 | 0.195 | 97 |
| 9 | | 1 | 26 | 1 | 02.12.02 | 2 | 26.02.03 | 7 | 5 | 86 | 0.058 | 58 | 26.02.03 | 7 | 05.05.03 | 11 | 4 | 68 | 0.059 | 59 | 05.05.03 | 11 | 31.08.03 | 17 | 6 | 118 | 0.051 | 51 |
| 10 | | 1 | 27 | 1 | 02.12.02 | 2 | 26.02.03 | 7 | 5 | 86 | 0.058 | 58 | 26.02.03 | 7 | 05.05.03 | 12 | 5 | 68 | 0.074 | 74 | 05.05.03 | 12 | 31.08.03 | 24 | 12 | 118 | 0.102 | 102 |
| 11 | | 1 | 28 | 3 | 02.12.02 | 4 | 26.02.03 | 21 | 17 | 86 | 0.198 | 66 | 26.02.03 | 21 | 05.05.03 | 35 | 14 | 68 | 0.206 | 69 | 05.05.03 | 35 | 31.08.03 | 70 | 35 | 118 | 0.297 | 99 |
| 12 | | 1 | 32 | 1 | 02.12.02 | 2 | 26.02.03 | 4 | 2 | 86 | 0.023 | 23 | 26.02.03 | 4 | 05.05.03 | 6 | 2 | 68 | 0.029 | 29 | 05.05.03 | 6 | 31.08.03 | 9 | 3 | 118 | 0.025 | 25 |
| 13 | | 1 | 36 | 2 | 02.12.02 | 6 | 26.02.03 | 11 | 5 | 86 | 0.058 | 29 | 26.02.03 | 11 | 05.05.03 | 18 | 7 | 68 | 0.103 | 51 | 05.05.03 | 18 | 31.08.03 | 28 | 10 | 118 | 0.085 | 42 |
| 14 | | 1 | 43 | 5 | 02.12.02 | 12 | 26.02.03 | 35 | 23 | 86 | 0.267 | 53 | 26.02.03 | 35 | 05.05.03 | 68 | 33 | 68 | 0.485 | 97 | 05.05.03 | 68 | 31.08.03 | 119 | 51 | 118 | 0.432 | 86 |
| 15 | | 1 | 46 | 2 | 02.12.02 | 9 | 26.02.03 | 13 | 4 | 86 | 0.047 | 23 | 26.02.03 | 13 | 05.05.03 | 22 | 9 | 68 | 0.132 | 66 | 05.05.03 | 22 | 31.08.03 | 31 | 9 | 118 | 0.076 | 38 |
| 16 | | 1 | 49 | 4 | 02.12.02 | 4 | 26.02.03 | 18 | 14 | 86 | 0.163 | 41 | 26.02.03 | 31 | 05.05.03 | 47 | 16 | 68 | 0.235 | 59 | 05.05.03 | 47 | 31.08.03 | 65 | 18 | 118 | 0.153 | 38 |
| 17 | | 1 | 55 | 2 | 02.12.02 | 20 | 26.02.03 | 38 | 18 | 86 | 0.209 | 105 | 26.02.03 | 38 | 05.05.03 | 57 | 19 | 68 | 0.279 | 140 | 05.05.03 | 57 | 31.08.03 | 76 | 19 | 118 | 0.161 | 81 |
| 18 | | 1 | 56 | 2 | 02.12.02 | 20 | 26.02.03 | 31 | 11 | 86 | 0.128 | 64 | 26.02.03 | 31 | 05.05.03 | 52 | 21 | 68 | 0.309 | 154 | 05.05.03 | 52 | 31.08.03 | 71 | 19 | 118 | 0.161 | 81 |
| 19 | | 1 | 67 | 3 | 02.12.02 | 2 | 26.02.03 | 4 | 2 | 86 | 0.023 | 8 | 26.02.03 | 4 | 05.05.03 | 6 | 2 | 68 | 0.029 | 10 | 05.05.03 | 6 | 31.08.03 | 12 | 6 | 118 | 0.051 | 17 |
| 20 | | 1 | 72 | 1 | 02.12.02 | 2 | 26.02.03 | 14 | 12 | 86 | 0.140 | 140 | 26.02.03 | 14 | 05.05.03 | 27 | 13 | 68 | 0.191 | 191 | 05.05.03 | 27 | 31.08.03 | 40 | 13 | 118 | 0.110 | 110 |
| 21 | | 3 | 4 | 2 | 17.11.02 | 1 | 21.02.03 | 13 | 12 | 96 | 0.125 | 63 | 21.02.03 | 13 | 31.05.03 | 23 | 10 | 99 | 0.101 | 51 | 31.05.03 | 23 | 04.09.03 | 38 | 15 | 96 | 0.156 | 78 |
| 22 | | 3 | 6 | 3 | 17.11.02 | 6 | 21.02.03 | 44 | 38 | 96 | 0.396 | 132 | 21.02.03 | 44 | 31.05.03 | 99 | 55 | 99 | 0.556 | 185 | 31.05.03 | 99 | 04.09.03 | 134 | 35 | 96 | 0.365 | 122 |
| 23 | | 3 | 7 | 1 | 17.11.02 | 2 | 21.02.03 | 22 | 20 | 96 | 0.208 | 208 | 21.02.03 | 22 | 31.05.03 | 39 | 17 | 99 | 0.172 | 172 | 31.05.03 | 39 | 04.09.03 | 56 | 17 | 96 | 0.177 | 177 |
| 24 | | 3 | 9 | 3 | 17.11.02 | 2 | 21.02.03 | 13 | 11 | 96 | 0.115 | 38 | 21.02.03 | 13 | 31.05.03 | 24 | 11 | 99 | 0.111 | 37 | 31.05.03 | 24 | 04.09.03 | 37 | 13 | 96 | 0.135 | 45 |
| 25 | | 3 | 10 | 4 | 17.11.02 | 10 | 21.02.03 | 38 | 28 | 96 | 0.292 | 73 | 21.02.03 | 38 | 31.05.03 | 71 | 33 | 99 | 0.333 | 83 | 31.05.03 | 71 | 04.09.03 | 94 | 23 | 96 | 0.240 | 60 |
| 26 | | 3 | 13 | 5 | 17.11.02 | 9 | 21.02.03 | 60 | 51 | 96 | 0.531 | 106 | 21.02.03 | 60 | 31.05.03 | 111 | 51 | 99 | 0.515 | 103 | 31.05.03 | 111 | 04.09.03 | 164 | 53 | 96 | 0.552 | 110 |
| 27 | | 3 | 14 | 1 | 17.11.02 | 4 | 21.02.03 | 9 | 5 | 96 | 0.052 | 52 | 21.02.03 | 9 | 31.05.03 | 16 | 7 | 99 | 0.071 | 71 | 31.05.03 | 16 | 04.09.03 | 25 | 9 | 96 | 0.094 | 94 |
| 28 | | 3 | 18 | 3 | 17.11.02 | 7 | 21.02.03 | 38 | 31 | 96 | 0.323 | 108 | 21.02.03 | 38 | 31.05.03 | 71 | 33 | 99 | 0.333 | 111 | 31.05.03 | 71 | 04.09.03 | 93 | 22 | 96 | 0.229 | 76 |
| 29 | | 3 | 20 | 3 | 17.11.02 | 3 | 21.02.03 | 31 | 28 | 96 | 0.292 | 97 | 21.02.03 | 31 | 31.05.03 | 58 | 27 | 99 | 0.273 | 91 | 31.05.03 | 58 | 04.09.03 | 85 | 27 | 96 | 0.281 | 94 |
| 30 | | 3 | 24 | 4 | 17.11.02 | 4 | 21.02.03 | 29 | 25 | 96 | 0.260 | 65 | 21.02.03 | 29 | 31.05.03 | 43 | 14 | 99 | 0.141 | 35 | 31.05.03 | 43 | 04.09.03 | 63 | 20 | 96 | 0.208 | 52 |
| 31 | | 3 | 31 | 3 | 17.11.02 | 2 | 21.02.03 | 30 | 28 | 96 | 0.292 | 97 | 21.02.03 | 30 | 31.05.03 | 45 | 15 | 99 | 0.152 | 51 | 31.05.03 | 45 | 04.09.03 | 65 | 20 | 96 | 0.208 | 69 |
| 32 | | 3 | 38 | 1 | 17.11.02 | 1 | 21.02.03 | 9 | 8 | 96 | 0.083 | 83 | 21.02.03 | 9 | 31.05.03 | 16 | 7 | 99 | 0.071 | 71 | 31.05.03 | 16 | 04.09.03 | 20 | 4 | 96 | 0.042 | 42 |
| 33 | | 3 | 39 | 5 | 17.11.02 | 2 | 21.02.03 | 27 | 25 | 96 | 0.260 | 52 | 21.02.03 | 27 | 31.05.03 | 51 | 24 | 99 | 0.242 | 48 | 31.05.03 | 51 | 04.09.03 | 74 | 23 | 96 | 0.240 | 48 |
| 34 | | 3 | 43 | 1 | 17.11.02 | 5 | 21.02.03 | 7 | 2 | 96 | 0.021 | 21 | 21.02.03 | 7 | 31.05.03 | 9 | 2 | 99 | 0.020 | 20 | 31.05.03 | 9 | 04.09.03 | 11 | 2 | 96 | 0.021 | 21 |
| 35 | | 3 | 51 | 3 | 17.11.02 | 3 | 21.02.03 | 22 | 19 | 96 | 0.198 | 66 | 21.02.03 | 22 | 31.05.03 | 42 | 20 | 99 | 0.202 | 67 | 31.05.03 | 42 | 04.09.03 | 61 | 19 | 96 | 0.198 | 66 |
| 36 | | 3 | 53 | 2 | 17.11.02 | 2 | 21.02.03 | 19 | 17 | 96 | 0.177 | 89 | 21.02.03 | 19 | 31.05.03 | 32 | 13 | 99 | 0.131 | 66 | 31.05.03 | 32 | 04.09.03 | 58 | 26 | 96 | 0.271 | 135 |
| 37 | 13th blocks of buildings | 2 | 4 | 1 | 20.02.03 | 27 | 28.02.03 | 31 | 4 | 8 | 0.500 | 500 | 01.04.03 | 35 | 23.04.03 | 39 | 4 | 22 | 0.182 | 182 | | | | | | | | |
| 38 | | 2 | 5 | 1 | 20.02.03 | 15 | 28.02.03 | 26 | 11 | 8 | 1.375 | 1375 | 01.04.03 | 37 | 23.04.03 | 50 | 13 | 22 | 0.591 | 591 | | | | | | | | |
| 39 | | 2 | 9 | 2 | --- | --- | --- | --- | --- | --- | | | 15.10.03 | 6 | 31.10.03 | 8 | 2 | 16 | 0.125 | 63 | 02.08.03 | 2 | 31.08.03 | 4 | 2 | 29 | 0.069 | 34 |
| 40 | | 2 | 10 | 3 | 20.02.03 | 6 | 28.02.03 | 11 | 5 | 8 | 0.625 | 208 | 23.04.03 | 16 | 30.05.03 | 26 | 10 | 37 | 0.270 | 90 | | | | | | | | |
| 41 | | 2 | 11 | 1 | 20.02.03 | 23 | 28.02.03 | 26 | 3 | 8 | 0.375 | 375 | 23.04.03 | 35 | 20.05.03 | 38 | 3 | 37 | 0.081 | 81 | 15.07.03 | 45 | 15.08.03 | 48 | 3 | 31 | 0.097 | 97 |
| 42 | | 2 | 12 | 5 | 20.02.03 | 23 | 28.02.03 | 28 | 5 | 8 | 0.625 | 125 | 23.04.03 | 39 | 08.05.03 | 43 | 4 | 15 | 0.267 | 53 | | | | | | | | |
| 43 | | 2 | 15 | 2 | 20.02.03 | 40 | 28.02.03 | 46 | 6 | 8 | 0.750 | 375 | 23.04.03 | 63 | 30.04.03 | 69 | 6 | 7 | 0.857 | 429 | 01.08.03 | 74 | 15.08.03 | 80 | 6 | 14 | 0.429 | 214 |
| 44 | | 2 | 16 | 2 | 20.02.03 | 97 | 28.02.03 | 101 | 4 | 8 | 0.500 | 250 | 23.04.03 | 105 | 30.04.03 | 109 | 4 | 7 | 0.571 | 286 | 02.06.03 | 113 | 11.06.03 | 117 | 4 | 9 | 0.444 | 222 |
| 45 | | 2 | 19 | 1 | --- | --- | --- | --- | --- | --- | | | 23.04.03 | 329 | 30.04.03 | 331 | 2 | 7 | 0.286 | 286 | 02.08.03 | 321 | 29.08.03 | 323 | 2 | 27 | 0.074 | 74 |
| 46 | | 2 | 22 | 3 | 20.02.03 | 23 | 28.02.03 | 26 | 3 | 8 | 0.375 | 125 | 23.04.03 | 31 | 30.04.03 | 34 | 3 | 7 | 0.429 | 143 | 01.08.03 | 45 | 15.08.03 | 48 | 3 | 14 | 0.214 | 71 |
| 47 | | 2 | 24 | 3 | 20.02.03 | 206 | 28.02.03 | 211 | 5 | 8 | 0.625 | 208 | 23.04.03 | | | | 0 | | | | 01.08.03 | 253 | 15.08.03 | 258 | 5 | 14 | 0.357 | 119 |
| 48 | | 2 | 31 | 2 | 20.02.03 | 9 | 28.02.03 | 12 | 3 | 8 | 0.375 | 188 | 23.04.03 | | | | 0 | | | | 01.08.03 | 27 | 11.08.03 | 30 | 3 | 10 | 0.300 | 150 |
| 49 | | 2 | 34 | 4 | --- | --- | --- | --- | --- | --- | | | 01.09.03 | 15 | 25.09.03 | 17 | 2 | 24 | 0.083 | 21 | 12.08.03 | 12 | 31.08.03 | 15 | 3 | 19 | 0.158 | 39 |
| 50 | | 2 | 35 | 2 | 20.02.03 | 33 | 28.02.03 | 35 | 2 | 8 | 0.250 | 125 | 01.04.03 | 39 | 23.04.03 | 47 | 8 | 22 | 0.364 | 182 | | | | | | | | |
| Total/Average | | | | 121 | | Residents | 114 | | 632 | 3344 | 12.709 | 111 | | Residents | 115 | | 675 | | 11.574 | 101 | | Residents | 109 | | 766 | | 9.008 | 83 |

## Table S.2.3.4.8(3) Water Consumption Date for Apartments(3)

**Mirabad District**

| No. | Address | Apart No. | Flat No. | Number of residents | Winter Season | | | | | | | | Spring/Autumn season | | | | | | | | Summer season | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | |
| | | | | | Date | Value(m$^3$ | Date | Value(m$^3$ | m$^3$ | Day | m$^3$/d | L/cap./d | Date | Value(m$^3$ | Date | Value(m$^3$ | m$^3$ | Day | m$^3$/d | L/cap./d | Date | Value(m$^3$ | Date | Value(m$^3$ | m$^3$ | Day | m$^3$/d | L/cap./d |
| 1 | Gospitalnaya | 10 | 8 | 5 | 14.12.0 | 1478.9 | 08.03.0 | 1654.4 | 175.5 | 84 | 2.089 | 418 | 02.09.0 | 1703.4 | 06.11.0 | 1747.6 | 44.2 | 65 | 0.680 | 136 | 08.03.0 | 1654.4 | 02.09.0 | 1703.4 | 49 | 178 | 0.275 | 55 |
| 2 | | 10 | 17 | 5 | 11.12.0 | 00625 | 27.02.0 | 00681 | 56 | 78 | 0.718 | 144 | 01.03.0 | 00681 | 22.05.0 | 00697 | 16 | 82 | 0.195 | 39 | 22.05.0 | 00697 | 20.10.0 | 00773 | 76 | 151 | 0.503 | 101 |
| 3 | | 10 | 18 | 2 | 18.12.0 | 00447 | 03.03.0 | 00480 | 33 | 75 | 0.440 | 220 | 03.03.0 | 00480 | 28.05.0 | 00520 | 40 | 86 | 0.465 | 233 | 28.05.0 | 00520 | 20.09.0 | 00601 | 81 | 115 | 0.704 | 352 |
| 4 | | 10 | 23 | 3 | 13.11.0 | 05001 | 10.03.0 | 05047 | 46 | 117 | 0.393 | 131 | 10.03.0 | 05047 | 02.06.0 | 05057 | 10 | 84 | 0.119 | 40 | 02.06.0 | 05057 | 15.09.0 | 05103 | 46 | 105 | 0.438 | 146 |
| 5 | | 10 | 24 | 5 | 22.11.0 | 01280 | 21.02.0 | 01288 | 8 | 91 | 0.088 | 18 | 21.02.0 | 01288 | 25.05.0 | 01320 | 32 | 103 | 0.311 | 62 | 25.05.0 | 01320 | 02.08.0 | 01350 | 30 | 69 | 0.435 | 87 |
| 6 | | 10 | 25 | 6 | 12.12.0 | 01298 | 04.03.0 | 01309 | 11 | 81 | 0.136 | 23 | 04.03.0 | 01309 | 14.07.0 | 01323 | 14 | 132 | 0.106 | 18 | 14.07.0 | 01323 | 25.09.0 | 01373 | 50 | 73 | 0.685 | 114 |
| 7 | | 10 | 26 | 3 | 03.12.0 | 02925 | 10.03.0 | 03010 | 85 | 97 | 0.876 | 292 | 10.03.0 | 03010 | 02.05.0 | 03154 | 144 | 53 | 2.717 | 906 | 02.05.0 | 03154 | 22.10.0 | 03314 | 160 | 173 | 0.925 | 308 |
| 8 | | 10 | 27 | 4 | 22.11.0 | 00755 | 12.02.0 | 00785 | 30 | 82 | 0.366 | 91 | 12.02.0 | 00785 | 23.06.0 | 0825 | 40 | 131 | 0.305 | 76 | 23.06.0 | 0825 | 22.10.0 | 00910 | 85 | 121 | 0.702 | 176 |
| 9 | | 10 | 29 | 5 | 16.12.0 | 00808 | 28.02.0 | 00838 | 30 | 74 | 0.405 | 81 | 28.02.0 | 00838 | 09.06.0 | 00888 | 50 | 101 | 0.495 | 99 | 09.06.0 | 00888 | 12.08.0 | 00928 | 40 | 64 | 0.625 | 125 |
| 10 | | 10 | 33 | 5 | 25.12.0 | 01274 | 21.02.0 | 01289 | 15 | 58 | 0.259 | 52 | 21.02.0 | 01289 | 09.06.0 | 01318 | 29 | 108 | 0.269 | 54 | 09.06.0 | 01318 | 04.08.0 | 01337 | 19 | 56 | 0.339 | 68 |
| 11 | | 10 | 35 | 2 | 30.12.0 | 00472 | 10.03.0 | 00479 | 7 | 70 | 0.100 | 50 | 10.03.0 | 00479 | 09.06.0 | 00489 | 10 | 91 | 0.110 | 55 | 09.06.0 | 00489 | 12.08.0 | 00532 | 43 | 64 | 0.672 | 336 |
| 12 | | 10 | 36 | 5 | 09.12.0 | 00250 | 10.04.0 | 00316 | 66 | 122 | 0.541 | 108 | 10.04.0 | 00316 | 27.05.0 | 00338 | 22 | 46 | 0.478 | 96 | 27.05.0 | 00338 | 27.08.0 | 00381 | 43 | 92 | 0.467 | 93 |
| 13 | | 10 | 37 | 6 | 28.11.0 | 00639 | 14.02.0 | 00669 | 30 | 78 | 0.385 | 64 | 14.02.0 | 00669 | 14.05.0 | 00675 | 6 | 89 | 0.067 | 11 | | | | | | | | |
| 14 | | 10 | 38 | 4 | 10.12.0 | 00639 | 27.02.0 | 00668 | 29 | 79 | 0.367 | 92 | 27.02.0 | 00668 | 22.05.0 | 00684 | 16 | 84 | 0.190 | 48 | 22.05.0 | 00684 | 10.10.0 | 00710 | 26 | 171 | 0.152 | 38 |
| 15 | | 10 | 40 | 2 | 30.11.0 | 00609 | 15.02.0 | 00619 | 10 | 77 | 0.130 | 65 | 15.02.0 | 00619 | 17.05.0 | 00639 | 20 | 91 | 0.220 | 110 | 17.05.0 | 00639 | 28.08.0 | 00659 | 20 | 103 | 0.194 | 97 |
| 16 | | 10 | 41 | 2 | 30.11.0 | 00565 | 20.02.0 | 00572 | 7 | 82 | 0.085 | 43 | 20.02.0 | 00572 | 14.05.0 | 00600 | 28 | 83 | 0.337 | 169 | 14.05.0 | 00600 | 06.09.0 | 00635 | 35 | 115 | 0.304 | 152 |
| 17 | | 10 | 44 | 6 | 25.12.0 | 00913 | 02.03.0 | 00934 | 21 | 67 | 0.313 | 52 | 02.03.0 | 00934 | 25.05.0 | 00940 | 6 | 84 | 0.071 | 12 | 25.05.0 | 00940 | 06.09.0 | 00980 | 40 | 104 | 0.385 | 64 |
| 18 | | 10 | 47 | 4 | 22.11.0 | 00523 | 13.03.0 | 00565 | 42 | 111 | 0.378 | 95 | 13.03.0 | 00565 | 22.05.0 | 00570 | 5 | 70 | 0.071 | 18 | 22.05.0 | 00570 | 06.09.0 | 00591 | 21 | 104 | 0.202 | 50 |
| Total/Average | | | | 74 | | | 74 | | | | 8.070 | 109 | | | 74 | | | | 7.208 | 97 | | | 68 | | | | 8.009 | 118 |

## Table S 2.3.4.8 (4) Meter Reading Results at Apartment (4)

**Mirzo Ulugbek District**

| No. | Adress | Apart No. | Flat No. | Number of residents | Winter season | | | | | | | | Spring/Autumn season | | | | | | | | Summer season | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | |
| | | | | | Date | Value(m$^3$ | Date | Value(m$^3$ | m$^3$ | Day | m$^3$/d | L/cap./d | Date | Value(m$^3$ | Date | Value(m$^3$ | m$^3$ | Day | m$^3$/d | L/cap./d | Date | Value(m$^3$ | Date | Value(m$^3$ | m$^3$ | Day | m$^3$/d | L/cap./d |
| 1 | TTZ-4 | 42 | 3 | 6 | 27.12.0 | 95 | 28.02.0 | 109 | 14 | 63 | 0.222 | 37 | 01.03.0 | 109 | 30.05.0 | 191 | 82 | 90 | 0.911 | 152 | | | | | | | | |
| 2 | | 42 | 6 | 6 | | | | | | | | | 01.03.0 | 200 | 31.05.0 | 229 | 29 | 91 | 0.319 | 53 | 01.06.0 | 224 | 31.08.0 | 248 | 24 | 91 | 0.264 | 44 |
| 3 | | 42 | 7 | 4 | 27.12.0 | 27 | 28.02.0 | 38 | 11 | 63 | 0.175 | 44 | 01.03.0 | 38 | 31.05.0 | 55 | 17 | 91 | 0.187 | 47 | 01.06.0 | 55 | 01.08.0 | 66 | 11 | 61 | 0.180 | 45 |
| 4 | | 42 | 11 | 3 | 27.12.0 | 82 | 28.02.0 | 98 | 16 | 63 | 0.254 | 85 | 01.03.0 | 98 | 31.05.0 | 122 | 24 | 91 | 0.264 | 88 | 01.06.0 | 122 | 01.08.0 | 135 | 13 | 61 | 0.213 | 71 |
| 5 | | 42 | 12 | 3 | 28.12.0 | 181 | 28.02.0 | 251 | 70 | 62 | 1.129 | 376 | 01.03.0 | 251 | 31.05.0 | 320 | 69 | 91 | 0.758 | 253 | | | | | | | | |
| 6 | | 42 | 13 | 10 | 23.12.0 | 394 | 28.02.0 | 424 | 30 | 67 | 0.448 | 45 | 01.03.0 | 424 | 31.05.0 | 469 | 45 | 91 | 0.495 | 49 | 01.06.0 | 469 | 02.07.0 | 487 | 18 | 31 | 0.581 | 58 |
| 7 | | 42 | 14 | 2 | 27.12.0 | 35 | 28.02.0 | 105 | 70 | 63 | 1.111 | 556 | 01.03.0 | 105 | 31.05.0 | 210 | 105 | 91 | 1.154 | 577 | 01.06.0 | 210 | 27.09.0 | 353 | 143 | 118 | 1.212 | 606 |
| 8 | | 42 | 15 | 8 | 27.12.0 | 486 | 28.02.0 | 496 | 10 | 63 | 0.159 | 20 | 01.03.0 | 496 | 31.05.0 | 511 | 15 | 91 | 0.165 | 21 | 01.06.0 | 511 | 30.08.0 | 526 | 15 | 90 | 0.167 | 21 |
| 9 | | 42 | 16 | 5 | 27.12.0 | 43 | 28.02.0 | 109 | 66 | 63 | 1.048 | 210 | 01.03.0 | 109 | 31.05.0 | 209 | 100 | 91 | 1.099 | 220 | | | | | | | | |
| 10 | | 42 | 17 | 14 | | | | | | | | | 27.12.0 | 244 | 30.05.0 | 501 | 257 | 154 | 1.669 | 119 | | | | | | | | |
| 11 | | 42 | 18 | 11 | 27.12.0 | 253 | 28.02.0 | 255 | 2 | 63 | 0.032 | 3 | 01.03.0 | 255 | 30.05.0 | 263 | 8 | 90 | 0.089 | 8 | | | | | | | | |
| 12 | | 42 | 19 | 11 | 27.12.0 | 133 | 28.02.0 | 179 | 46 | 63 | 0.730 | 66 | 01.03.0 | 179 | 30.05.0 | 311 | 132 | 90 | 1.467 | 133 | | | | | | | | |
| 13 | | 42 | 20 | 3 | 27.12.0 | 171 | 28.02.0 | 200 | 29 | 63 | 0.460 | 153 | 01.03.0 | 200 | 30.08.0 | 285 | 85 | 90 | 0.944 | 315 | | | | | | | | |
| 14 | | 42 | 22 | 2 | 27.12.0 | 110 | 28.02.0 | 114 | 4 | 63 | 0.063 | 32 | 01.03.0 | 114 | 30.05.0 | 125 | 11 | 90 | 0.122 | 61 | | | | | | | | |
| 15 | | 42 | 24 | 6 | 27.12.0 | 95 | 28.02.0 | 107 | 12 | 63 | 0.190 | 32 | 01.03.0 | 107 | 30.05.0 | 201 | 94 | 90 | 1.044 | 174 | | | | | | | | |
| 16 | | 42 | 25 | 2 | 27.12.0 | 68 | 28.02.0 | 73 | 5 | 63 | 0.079 | 40 | 01.03.0 | 73 | 30.05.0 | 145 | 72 | 90 | 0.800 | 400 | | | | | | | | |
| 17 | | 42 | 26 | 4 | 27.12.0 | 130 | 28.02.0 | 193 | 63 | 63 | 1.000 | 250 | 01.03.0 | 193 | 31.08.0 | 384 | 191 | 183 | 1.044 | 261 | | | | | | | | |
| 18 | | 42 | 27 | 2 | 27.12.0 | 0 | 28.02.0 | 40 | 40 | 63 | 0.635 | 317 | 01.03.0 | 40 | 31.08.0 | 161 | 121 | 183 | 0.661 | 331 | | | | | | | | |
| 19 | | 42 | 28 | 8 | | | | | | | | | 27.12.0 | 217 | 31.08.0 | 465 | 248 | 247 | 1.004 | 126 | | | | | | | | |
| 20 | | 42 | 29 | 1 | 28.12.0 | 98 | 28.02.0 | 103 | 5 | 62 | 0.081 | 81 | 01.03.0 | 103 | 30.05.0 | 110 | 7 | 90 | 0.078 | 78 | | | | | | | | |
| 21 | | 42 | 30 | 4 | 26.12.0 | 197 | 28.02.0 | 298 | 101 | 64 | 1.578 | 395 | 01.03.0 | 298 | 30.08.0 | 601 | 303 | 182 | 1.665 | 416 | | | | | | | | |
| 22 | | 42 | 31 | 3 | 27.12.0 | 200 | 28.02.0 | 222 | 22 | 63 | 0.349 | 116 | 01.03.0 | 222 | 01.06.0 | 289 | 67 | 92 | 0.728 | 243 | | | | | | | | |
| 23 | | 42 | 32 | 8 | 27.12.0 | 30 | 28.02.0 | 85 | 55 | 63 | 0.873 | 109 | 01.03.0 | 85 | 31.05.0 | 114 | 29 | 91 | 0.319 | 40 | 01.06.0 | 114 | 30.08.0 | 250 | 136 | 90 | 1.511 | 189 |
| Total/Average | | | | 126 | | | 104 | | | | 10.617 | 102 | | | 126 | | | | 16.985 | 135 | | | 41 | | | | 4.127 | 101 |

# Table S 2.3.4.9 (1) Meter Reading Results at Detached House with Sewer Connection(1)

**Sergeli District**

| No. | Address | House No. | Water-ing area(m2 | Number of residents | Winter season | | | | | | | | Spring/Autumn season | | | | | | | | Summer season | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | |
| | | | | | Date | 3) | Date | 3) | m3 | Day | m3/d | d | Date | 3) | Date | 3) | m3 | Day | m3/d | d | Date | 3) | Date | 3) | m3 | Day | m3/d | d |
| 1 | Nozaniy, | 11 | 60 | 4 | | | | | | | | | | | | | | | | | 23.05.02 | 302 | 13.10.03 | 640 | 338 | 143 | 2.364 | 591 |
| 2 | 5th | 9 | 100 | 1 | | | | | | | | | 23.05.03 | 490 | 21.06.03 | 501 | 11 | 29 | 0.379 | 379 | 23.05.03 | 490 | 11.10.03 | 518 | 28 | 141 | 0.199 | 199 |
| 3 | passage | 5 | 150 | 5 | | | | | | | | | | | | | | | | | 23.05.03 | 41 | 31.07.03 | 70 | 29 | 69 | 0.420 | 84 |
| 4 | | 1 | 100 | 5 | | | | | | | | | | | | | | | | | 15.05.03 | 1130 | 29.09.03 | 1200 | 70 | 137 | 0.511 | 102 |
| 5 | Nozaniy | 4 | 100 | 5 | 17.11.02 | 500 | 17.12.02 | 511 | 11 | 30 | 0.367 | 73 | 29.09.03 | 684 | 05.11.03 | 718 | 34 | 37 | 0.919 | 184 | 30.05.03 | 584 | 31.08.03 | 675 | 91 | 93 | 0.978 | 196 |
| 6 | | 5 | 100 | 4 | | | | | | | | | | | | | | | | | 26.04.03 | 270 | 25.09.03 | 350 | 80 | 152 | 0.526 | 132 |
| 7 | | 12 | 100 | 4 | | | | | | | | | 25.04.03 | 2674 | 15.07.03 | 2810 | 236 | 82 | 2.878 | 720 | 15.07.03 | 2810 | 12.11.03 | 2910 | 100 | 120 | 0.833 | 208 |
| 8 | | 17 | 100 | 3 | 17.11.02 | 884 | 25.02.03 | 900 | 16 | 100 | 0.160 | 53 | 28.03.03 | 909 | 25.10.03 | 1145 | 236 | 211 | 1.118 | 373 | 25.05.03 | 959 | 30.08.03 | 1095 | 136 | 97 | 1.402 | 467 |
| 9 | | 19 | 100 | 5 | | | | | | | | | | | | | | | | | 25.04.03 | 2431 | 26.10.03 | 2566 | 135 | 183 | 0.738 | 148 |
| 10 | | 25 | 100 | 4 | | | | | | | | | 25.05.03 | 211 | 30.08.03 | 268 | 57 | 97 | 0.588 | 147 | 18.07.03 | 250 | 26.10.03 | 350 | 100 | 100 | 1.000 | 250 |
| 11 | | 28 | 100 | 5 | 28.12.02 | 3336 | 28.01.03 | 3345 | 9 | 31 | 0.290 | 58 | | | | | | | | | 23.05.03 | 3436 | 29.09.03 | 3513 | 77 | 129 | 0.597 | 119 |
| 12 | | 40 | 100 | 6 | | | | | | | | | 20.06.03 | 682 | 13.11.03 | 768 | 86 | 146 | 0.589 | 98 | 20.06.03 | 682 | 31.07.03 | 708 | 26 | 41 | 0.634 | 106 |
| 13 | | 40 | 100 | 6 | | | | | | | | | 17.05.03 | 568 | 25.10.03 | 629 | 61 | 161 | 0.379 | 63 | 17.05.03 | 568 | 28.08.03 | 615 | 47 | 103 | 0.456 | 76 |
| 14 | | 24 | 100 | 7 | | | | | | | | | 28.04.04 | 1365 | 28.09.03 | 1465 | 100 | 153 | 0.654 | 93 | 20.06.03 | 1415 | 28.08.03 | 1465 | 50 | 69 | 0.725 | 104 |
| 15 | 2th | 6 | 100 | 5 | 25.11.02 | 1352 | 12.02.03 | 1384 | 32 | 79 | 0.405 | 81 | 21.07.03 | 1600 | 01.12.03 | 1800 | 200 | 133 | 1.504 | 301 | | | | | 0 | | | 8416 |
| 16 | Adolat, 1st | 16 | 50 | 4 | | | | | | | | | 23.07.03 | 2000 | 12.11.03 | 2300 | 300 | 112 | 2.679 | 670 | | | | | 0 | | | |
| 17 | dead end | 12 | 100 | 3 | | | | | | | | | 05.04.03 | 949 | 23.07.03 | 1092 | 184 | 109 | 1.688 | 563 | 23.07.03 | 1092 | 07.10.03 | 1133 | 41 | 76 | 0.539 | 180 |
| 18 | | 11 | 50 | 2 | 15.12.03 | 632 | 13.02.03 | 656 | 24 | 60 | 0.400 | 200 | 05.04.03 | 739 | 23.07.03 | 803 | 92 | 109 | 0.844 | 422 | 23.07.03 | 803 | 07.10.03 | 831 | 28 | 76 | 0.368 | 184 |
| 19 | | 8 | 100 | 6 | | | | | | | | | 05.04.03 | 919 | 03.07.03 | 1091 | 172 | 89 | 1.933 | 322 | 03.07.03 | 1091 | 29.11.03 | 1123 | 32 | 149 | 0.215 | 36 |
| 20 | | 2 | 100 | 3 | 23.12.02 | 794 | 08.02.03 | 814 | 20 | 47 | 0.426 | 142 | | | | | | | | | 20.06.03 | 862 | 29.11.03 | 975 | 113 | 162 | 0.698 | 233 |
| 21 | | 2 | 100 | 2 | | | | | | | | | 05.04.03 | 3018 | 25.09.03 | 3480 | 462 | 173 | 2.671 | 1335 | | | | | | | | |
| 22 | | 19 | 100 | 2 | | | | | | | | | 09.06.03 | 1046 | 12.11.03 | 1815 | 769 | 156 | 4.929 | 2465 | 09.06.03 | 1046 | 12.11.03 | 1815 | 769 | 156 | 4.929 | 2465 |
| 23 | | 3 | 50 | 2 | 30.10.02 | 1265 | 25.01.03 | 1430 | 165 | 87 | 1.897 | 948 | 14.04.03 | 1630 | 09.10.03 | 1810 | 180 | 178 | 1.011 | 506 | | | | | 0 | | | |
| 24 | | 8 | 100 | 5 | | | | | | | | | | | | | | | | | 18.05.03 | 1930 | 19.09.03 | 2083 | 153 | 124 | 1.234 | 247 |
| 25 | Adolat | 9 | 100 | 1 | 28.01.03 | 1139 | 28.02.03 | 1161 | 22 | 31 | 0.710 | 710 | | | | | | | | | 30.06.03 | 1286 | 30.07.03 | 1323 | 37 | 30 | 1.233 | 1233 |
| 26 | Sputnik 12 | 9 | | 3 | | | | | | | | | 01.12.02 | 1056 | 30.10.03 | 1490 | 434 | 333 | 1.303 | 434 | | | | | 0 | | | |
| 27 | | 10 | | 6 | | | | | | | | | | | | | | | | | 14.07.03 | 1001 | 30.10.03 | 1400 | 399 | 108 | 3.694 | 616 |
| 28 | | 11 | | 3 | | | | | | | | | 11.12.02 | 1118 | 30.10.03 | 1253 | 135 | 323 | 0.418 | 139 | | | | | 0 | | | |
| 29 | | 12 | | 4 | | | | | | | | | | | | | | | | | 16.07.03 | 950 | 06.11.03 | 983 | 33 | 113 | 0.292 | 73 |
| 30 | | 16 | | 2 | | | | | | | | | 16.07.03 | 92 | 06.11.03 | 162 | 70 | 113 | 0.619 | 310 | 16.07.03 | 92 | 25.08.03 | 117 | 25 | 40 | 0.625 | 313 |
| | | 17 | | 5 | | | | | | | | | 10.12.02 | 407 | 30.10.03 | 578 | 171 | 324 | 0.528 | 106 | | | | | 0 | | | |
| 32 | | 23 | | 1 | | | | | | | | | | | | | | | | | 06.07.03 | 200 | 30.10.03 | 245 | 45 | 116 | 0.388 | 388 |
| 33 | | 24 | | 10 | | | | | | | | | | | | | | | | | 21.06.03 | 250 | 10.07.03 | 310 | 60 | 19 | 3.158 | 316 |
| 34 | | 25 | | 5 | 18.01.03 | 203 | 1.03.03 | 261 | 58 | 42 | 1.381 | 276 | 1.03.03 | 261 | 31.10.03 | 500 | 239 | 244 | 0.980 | 196 | | | | | 0 | | | |
| 35 | | 26 | | 3 | 1.01.03 | 381 | 28.02.03 | 440 | 59 | 58 | 1.017 | 339 | | | | | | | | | 6.06.03 | 550 | 30.10.03 | 708 | 158 | 146 | 1.082 | 361 |
| 36 | | 28 | | 3 | 1.01.03 | 565 | 1.03.03 | 640 | 75 | 59 | 1.271 | 424 | | | | | | | | | 6.06.03 | 740 | 30.10.03 | 900 | 160 | 146 | 1.096 | 365 |
| 37 | | 29 | | 4 | 12.01.03 | 200 | 8.03.03 | 285 | 85 | 55 | 1.545 | 386 | 8.03.03 | 285 | 9.06.03 | 400 | 115 | 93 | 1.237 | 309 | | | | | | | | |
| 38 | | 30 | | 3 | 29.01.03 | 823 | 27.03.03 | 898 | 75 | 57 | 1.316 | 439 | 27.03.03 | 898 | 10.10.03 | 1380 | 482 | 197 | 2.447 | 816 | | | | | | | | |
| 39 | | 31 | | 3 | 16.02.03 | 827 | 16.03.03 | 927 | 100 | 28 | 3.571 | 1190 | 16.04.03 | 1027 | 16.11.03 | 1727 | 700 | 184 | 3.804 | 1268 | | | | | | | | |
| 40 | | 32 | | 3 | 2.01.03 | 1247 | 23.03.03 | 1280 | 33 | 80 | 0.413 | 138 | 23.03.03 | 1280 | 19.05.03 | 1330 | 50 | 57 | 0.877 | 292 | | | | | | | | |
| 41 | | 34 | | 1 | 8.01.03 | 243 | 1.03.03 | 290 | 47 | 52 | 0.904 | 904 | 17.05.03 | 400 | 28.11.03 | 500 | 100 | 195 | 0.513 | 513 | | | | | | | | |
| 42 | | 35 | | 1 | 19.01.03 | 700 | 1.03.03 | 800 | 100 | 41 | 2.439 | 2439 | 22.04.03 | 827 | 30.10..03 | 1000 | 173 | 191 | 0.906 | 906 | | | | | | | | |
| 43 | | 36 | | 6 | 7.01.03 | 302 | 23.02.03 | 400 | 98 | 47 | 2.085 | 348 | | | | | | | | | 25.06.03 | 550 | 17.08.03 | 720 | 170 | 53 | 3.208 | 535 |
| 44 | | 37 | | 1 | 12.01.03 | 900 | 12.02.03 | 910 | 10 | 31 | 0.323 | 323 | | | | | | | | | | | | | 0 | | | |
| 45 | | 39 | | 4 | 1.01.03 | 1000 | 28.02.03 | 1100 | 100 | 58 | 1.724 | 431 | | | | | | | | | 06.07.03 | 1600 | 30.10.03 | 2000 | 400 | 116 | 3.448 | 862 |
| 46 | | 40 | | 2 | 17.01.03 | 782 | 26.02.03 | 800 | 18 | 40 | 0.450 | 225 | 19.03.03 | 850 | 6.06.03 | 912 | 62 | 79 | 0.785 | 392 | | | | | 0 | | | |
| 47 | | 45 | | 2 | 9.01.03 | 40 | 28.02.03 | 65 | 25 | 50 | 0.500 | 250 | | | | | | | | | 06.07.03 | 130 | 30.10.03 | 230 | 100 | 116 | 0.862 | 431 |
| 48 | | 48 | | 5 | 14.01.03 | 455 | 12.03.03 | 621 | 166 | 57 | 2.912 | 582 | 12.03.03 | 621 | 4.08.03 | 771 | 150 | 145 | 1.034 | 207 | 4.07.03 | 733 | 04.08.03 | 771 | 38 | 31 | 1.226 | 245 |
| 49 | | 49 | | 3 | 16.02.03 | 510 | 16.03.03 | 610 | 100 | 28 | 3.571 | 1190 | 16.04.03 | 710 | 16.08.03 | 920 | 210 | 122 | 1.721 | 574 | 16.08.03 | 920 | 30.10.03 | 1100 | 180 | 75 | 2.400 | 800 |
| Ave. | | | | 182 | | | 75 | | | | 30.08 | 401 | | | 104 | | | 4575 | 41.93 | 403 | | | 135 | | | | 42.08 | 312 |

## Table S 2.3.4.9 (2) Meter Reading Results at Detached House with Sewer Connection (2)

**Akmal Ikran District**

| No. | Adress | House No. | Watering area(m2 | Number of residents | Winter season | | | | | | | | Spring/Autumn season | | | | | | | | Summer season | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | |
| | | | | | Date | ³) | Date | ³) | m³ | Day | m³/d | d | Date | ³) | Date | ³) | m³ | Day | m³/d | d | Date | ³) | Date | ³) | m³ | Day | m³/d | d |
| 1 | Shodlik | 2 | | 10 | 2003/1/15 | 385 | 2003/5/4 | 481 | 96.00 | 109.00 | 0.88 | 88.07 | 2003/9/1 | 582 | 2003/11/27 | 641 | 59.00 | 87.00 | 0.68 | 67.82 | 2003/5/4 | 481 | 2003/9/1 | 582 | 101.00 | 120.00 | 0.84 | 84.17 |
| 2 | Shodlik | 4 | | 10 | 2002/11/11 | 820 | 2003/4/26 | 929 | 109.00 | 166.00 | 0.66 | 65.66 | 2003/8/12 | 1022 | 2003/11/27 | 1101 | 79.00 | 107.00 | 0.74 | 73.83 | 2003/4/26 | 922 | 2003/8/12 | 1022 | 100.00 | 108.00 | 0.93 | 92.59 |
| 3 | Shodlik | 27 | | 9 | 2002/1/27 | 261 | 2003/4/26 | 390 | 129.00 | 454.00 | 0.28 | 31.57 | 2003/8/12 | 491 | 2003/11/27 | 534 | 43.00 | 107.00 | 0.40 | 44.65 | 2003/4/26 | 390 | 2003/8/12 | 491 | 101.00 | 108.00 | 0.94 | 103.91 |
| 4 | Shodlik | 21 | | 12 | 2003/1/4 | 696 | 2003/4/26 | 801 | 105.00 | 112.00 | 0.94 | 78.13 | 2003/8/12 | 1024 | 2003/11/27 | 1114 | 90.00 | 107.00 | 0.84 | 70.09 | 2003/4/26 | 801 | 2003/8/12 | 1024 | 223.00 | 108.00 | 2.06 | 172.07 |
| 5 | Shodlik | 9 | | 6 | 2002/11/10 | 154 | 2003/4/26 | 254 | 100.00 | 167.00 | 0.60 | 99.80 | 2003/8/12 | 365 | 2003/11/27 | 424 | 59.00 | 107.00 | 0.55 | 91.90 | 2003/4/26 | 254 | 2003/8/12 | 365 | 111.00 | 108.00 | 1.03 | 171.30 |
| 6 | .P. Hakim | 3 | | 7 | 2002/1/27 | 0046 | 2003/5/1 | 00146 | 100.00 | 459.00 | 0.22 | 31.12 | 2003/7/15 | 00256 | 2003/11/29 | 00316 | 60.00 | 137.00 | 0.44 | 62.57 | 2003/5/1 | 146 | 2003/7/15 | 256 | 110.00 | 75.00 | 1.47 | 209.52 |
| 7 | .P. Hakim | 7 | | 4 | 2002/1/27 | 136 | 2003/5/1 | 236 | 100.00 | 459.00 | 0.22 | 54.47 | 2003/7/15 | 00586 | 2003/12/2 | 00691 | 105.00 | 140.00 | 0.75 | 187.50 | 2003/5/1 | 236 | 2003/7/15 | 586 | 350.00 | 75.00 | 4.67 | 1166.67 |
| 8 | .P. Hakim | 9 | | 10 | 2002/1/26 | 00323 | 2003/5/1 | 00623 | 300.00 | 460.00 | 0.65 | 65.22 | 2003/7/15 | 00926 | 2003/12/2 | 001001 | 75.00 | 140.00 | 0.54 | 53.57 | 2003/5/1 | 623 | 2003/7/15 | 926 | 303.00 | 75.00 | 4.04 | 404.00 |
| 9 | .P. Hakim | 19 | | 5 | 2002/11/2 | 00100 | 2003/4/26 | 00247 | 147.00 | 175.00 | 0.84 | 168.00 | 2003/7/15 | 00553 | 2003/11/2 | 00801 | 248.00 | 110.00 | 2.25 | 450.91 | 2003/4/26 | 00247 | 2003/7/15 | 00553 | 306.00 | 80.00 | 3.83 | 765.00 |
| 10 | .P. Hakim | 21 | | 5 | 2002/11/2 | 00060 | 2003/4/26 | 00160 | 100.00 | 175.00 | 0.57 | 114.29 | 2003/7/15 | 00320 | 2003/11/2 | 00501 | 181.00 | 110.00 | 1.65 | 329.09 | 2003/4/26 | 00160 | 2003/7/15 | 00320 | 160.00 | 80.00 | 2.00 | 400.00 |
| 11 | .P. Hakim | 29 | | 12 | 2002/11/2 | 000120 | 2003/4/26 | 00241 | 121.00 | 175.00 | 0.69 | 57.62 | 2003/7/15 | 00364 | 2003/11/2 | 00460 | 96.00 | 110.00 | 0.87 | 72.73 | 2003/4/26 | 00241 | 2003/7/15 | 00364 | 123.00 | 80.00 | 1.54 | 128.13 |
| 12 | .P. Hakim | 21 | | 6 | 2002/12/14 | 00044 | 2003/4/26 | 00144 | 100.00 | 133.00 | 0.75 | 125.31 | 2003/7/11 | 00255 | 2003/11/2 | 00341 | 86.00 | 114.00 | 0.75 | 125.73 | 2003/4/26 | 00144 | 2003/7/11 | 00255 | 111.00 | 76.00 | 1.46 | 243.42 |
| 13 | .P. Hakim | 14 | | 6 | 2003/1/2 | 001074 | 2003/4/12 | 01294 | 220.00 | 100.00 | 2.20 | 366.67 | 2003/4/12 | 01294 | 2003/11/2 | 01384 | 90.00 | 204.00 | 0.44 | 73.53 | 2003/4/12 | 001294 | 2003/9/11 | 1350 | 56.00 | 152.00 | 0.37 | 61.40 |
| 14 | .P. Hakim | 12 | | 2 | 2002/12/14 | 000254 | 2003/4/26 | 00464 | 210.00 | 133.00 | 1.58 | 789.47 | 2003/9/11 | 00681 | 2003/11/2 | 00790 | 109.00 | 52.00 | 2.10 | 1048.08 | 2003/4/26 | 464 | 2003/9/11 | 681 | 217.00 | 138.00 | 1.57 | 786.23 |
| 15 | .P. Hakim | 6 | | 6 | 2003/1/4 | 00900 | 2003/4/26 | 001134 | 234.00 | 112.00 | 2.09 | 348.21 | 2003/9/11 | 1441 | 2003/11/2 | 1601 | 160.00 | 52.00 | 3.08 | 512.82 | 2003/4/26 | 1134 | 2003/9/11 | 1441 | 307.00 | 138.00 | 2.22 | 370.77 |
| 16 | .P. Hakim | 2 | | 14 | 2003/1/4 | 00526 | 2003/4/26 | 00736 | 210.00 | 112.00 | 1.88 | 133.93 | 2003/9/11 | 00986 | 2003/11/29 | 001256 | 270.00 | 79.00 | 3.42 | 244.12 | 2003/4/26 | 00736 | 2003/9/4 | 00986 | 250.00 | 131.00 | 1.91 | 136.31 |
| 17 | O.Zoidov | 17 | | 6 | 2002/10/8 | 00023 | 2003/4/24 | 169 | 146.00 | 198.00 | 0.74 | 122.90 | 2003/9/4 | 271 | 2003/12/3 | 351 | 80.00 | 90.00 | 0.89 | 148.15 | 2003/4/24 | 169 | 2003/9/4 | 271 | 102.00 | 133.00 | 0.77 | 127.82 |
| 18 | O.Zoidov | 19 | | 8 | 2002/9/1 | 361.5 | 2003/4/24 | 385 | 23.50 | 235.00 | 0.10 | 12.50 | 2003/9/4 | 385 | 2003/12/3 | 553 | 168.00 | 90.00 | 1.87 | 233.33 | 2003/4/24 | 553 | 2003/9/4 | 801 | 248.00 | 133.00 | 1.86 | 233.08 |
| 19 | O.Zoidov | 9 | | 6 | 2002/10/8 | 169 | 2003/4/24 | 279 | 110.00 | 198.00 | 0.56 | 92.59 | 2003/9/4 | 581 | 2003/12/3 | 655 | 74.00 | 90.00 | 0.82 | 137.04 | 2003/4/24 | 279 | 2003/9/4 | 581 | 302.00 | 133.00 | 2.27 | 378.45 |
| 20 | O.Zoidov | 7 | | 7 | 2002/11/28 | 00370 | 2003/4/26 | 00570 | 200.00 | 149.00 | 1.34 | 191.75 | 2003/9/4 | 00786 | 2003/12/3 | 00976 | 190.00 | 90.00 | 2.11 | 301.59 | 2003/4/26 | 00570 | 2003/9/4 | 786 | 216.00 | 131.00 | 1.65 | 235.55 |
| 21 | O.Zoidov | 5 | | 7 | 2003/1/25 | 673 | 2003/4/26 | 773 | 100.00 | 91.00 | 1.10 | 156.99 | 2003/9/4 | 983 | 2003/12/3 | 1074 | 91.00 | 90.00 | 1.01 | 144.44 | 2003/4/26 | 773 | 2003/9/4 | 983 | 210.00 | 131.00 | 1.60 | 229.01 |
| 22 | O.Zoidov | 30 | | 5 | 2003/1/2 | 00286 | 2003/5/11 | 00486 | 200.00 | 129.00 | 1.55 | 310.08 | 2003/9/4 | 00786 | 2003/12/3 | 00855 | 69.00 | 90.00 | 0.77 | 153.33 | 2003/5/11 | 00486 | 2003/9/4 | 00786 | 300.00 | 116.00 | 2.59 | 517.24 |
| 23 | N.Saidov | 6 | | 7 | 2003/1/2 | 00186 | 2003/5/11 | 00386 | 200.00 | 129.00 | 1.55 | 221.48 | 2003/9/4 | 00386 | 2003/12/3 | 00787 | 401.00 | 90.00 | 4.46 | 636.51 | 2003/5/11 | 00787 | 2003/9/4 | 00981 | 194.00 | 116.00 | 1.67 | 238.92 |
| 24 | ıpik N.Sai | 2 | | 6 | 2003/1/2 | 00016 | 2003/5/4 | 00166 | 150.00 | 122.00 | 1.23 | 204.92 | 2003/9/4 | 288 | 2003/12/3 | 341 | 53.00 | 90.00 | 0.59 | 98.15 | 2003/5/4 | 00166 | 2003/9/4 | 00288 | 122.00 | 123.00 | 0.99 | 165.31 |
| 25 | proezd Do | 15 | | 21 | 2003/1/2 | 114 | 2003/2/2 | 144 | 30.00 | 31.00 | 0.97 | 46.08 | 2003/3/2 | 144 | 2003/5/5 | 184 | 40.00 | 64.00 | 0.63 | 29.76 | 2003/5/5 | 184 | 2003/8/10 | 434 | 250.00 | 97.00 | 2.58 | 122.73 |
| 26 | 3 pr.Dadil | 17 | | 5 | 2002/12/18 | 98 | 2003/3/2 | 143 | 45.00 | 74.00 | 0.61 | 121.62 | 2003/3/2 | 143 | 2003/5/5 | 199 | 56.00 | 64.00 | 0.88 | 175.00 | 2003/3/2 | 143 | 2003/5/5 | 199 | 56.00 | 64.00 | 0.88 | 175.00 |
| 27 | 3 pr.Dadil | 19 | | 5 | 2002/12/19 | 79 | 2003/3/2 | 124 | 45.00 | 73.00 | 0.62 | 123.29 | 2003/3/2 | 124 | 2003/5/5 | 188 | 64.00 | 64.00 | 1.00 | 200.00 | 2003/3/2 | 124 | 2003/5/5 | 188 | 64.00 | 64.00 | 1.00 | 200.00 |
| 28 | 3 pr.Dadil | 21 | | 9 | 2002/12/20 | 124 | 2003/3/2 | 164 | 40.00 | 72.00 | 0.56 | 61.73 | 2003/3/2 | 164 | 2003/5/5 | 224 | 60.00 | 64.00 | 0.94 | 104.17 | 2003/3/2 | 164 | 2003/5/5 | 224 | 60.00 | 64.00 | 0.94 | 104.17 |
| 29 | 1pr. Dadil | 19 | | 10 | 2002/12/21 | 214 | 2003/3/2 | 252 | 38.00 | 71.00 | 0.54 | 53.52 | 2003/3/2 | 252 | 2003/5/5 | 332 | 80.00 | 64.00 | 1.25 | 125.00 | 2003/3/2 | 252 | 2003/5/5 | 332 | 80.00 | 64.00 | 1.25 | 125.00 |
| 30 | 1pr. Dadil | 17 | | 16 | 2002/12/22 | 201 | 2003/3/2 | 232 | 31.00 | 70.00 | 0.44 | 27.68 | 2003/3/2 | 232 | 2003/5/5 | 304 | 72.00 | 64.00 | 1.13 | 70.31 | 2003/3/2 | 232 | 2003/5/5 | 304 | 72.00 | 64.00 | 1.13 | 70.31 |
| 31 | 1pr. Dadil | 15 | | 8 | 2002/12/23 | 198 | 2003/3/2 | 229 | 31.00 | 69.00 | 0.45 | 56.16 | 2003/3/2 | 229 | 2003/5/5 | 289 | 60.00 | 64.00 | 0.94 | 117.19 | 2003/3/2 | 229 | 2003/5/5 | 289 | 60.00 | 64.00 | 0.94 | 117.19 |
| 32 | 1pr. Dadil | 13 | | 7 | 2002/12/24 | 101 | 2003/3/2 | 126 | 25.00 | 68.00 | 0.37 | 52.52 | 2003/3/2 | 126 | 2003/5/5 | 191 | 65.00 | 64.00 | 1.02 | 145.09 | 2003/3/2 | 126 | 2003/5/5 | 191 | 65.00 | 64.00 | 1.02 | 145.09 |
| 33 | 1pr. Dadil | 9 | | 12 | 2002/12/25 | 112 | 2003/3/2 | 153 | 41.00 | 67.00 | 0.61 | 51.00 | 2003/3/2 | 153 | 2003/5/5 | 219 | 66.00 | 64.00 | 1.03 | 85.94 | 2003/3/2 | 153 | 2003/5/5 | 219 | 66.00 | 64.00 | 1.03 | 85.94 |
| 34 | 1pr. Dadil | 7 | | 6 | 2002/12/26 | 103 | 2003/3/2 | 133 | 30.00 | 66.00 | 0.45 | 75.76 | 2003/3/2 | 133 | 2003/5/5 | 205 | 72.00 | 64.00 | 1.13 | 187.50 | 2003/3/2 | 133 | 2003/5/5 | 205 | 72.00 | 64.00 | 1.13 | 187.50 |
| 35 | 1pr. Dadil | 5 | | 8 | 2002/12/27 | 129 | 2003/3/2 | 141 | 12.00 | 65.00 | 0.18 | 23.08 | 2003/3/2 | 141 | 2003/5/5 | 219 | 78.00 | 64.00 | 1.22 | 152.34 | 2003/3/2 | 141 | 2003/5/5 | 219 | 78.00 | 64.00 | 1.22 | 152.34 |
| 36 | 1pr. Dadil | 30 | | 6 | 2002/12/28 | 112 | 2003/3/2 | 134 | 22.00 | 64.00 | 0.34 | 57.29 | 2003/3/2 | 134 | 2003/5/5 | 204 | 70.00 | 64.00 | 1.09 | 182.29 | 2003/3/2 | 134 | 2003/5/5 | 204 | 70.00 | 64.00 | 1.09 | 182.29 |
| 37 | 1pr. Dadil | 3 | | 6 | 2002/12/29 | 104 | 2003/3/2 | 138 | 34.00 | 63.00 | 0.54 | 89.95 | 2003/3/2 | 138 | 2003/5/5 | 212 | 74.00 | 64.00 | 1.16 | 192.71 | 2003/3/2 | 138 | 2003/5/5 | 212 | 74.00 | 64.00 | 1.16 | 192.71 |
| 38 | 1pr. Dadil | 8 | | 4 | 2002/12/30 | 99 | 2003/3/2 | 124 | 25.00 | 62.00 | 0.40 | 100.81 | 2003/3/2 | 124 | 2003/5/5 | 187 | 63.00 | 64.00 | 0.98 | 246.09 | 2003/3/2 | 124 | 2003/5/5 | 187 | 63.00 | 64.00 | 0.98 | 246.09 |
| 39 | 1pr. Dadil | 10 | | 5 | 2002/12/31 | 102 | 2003/3/2 | 131 | 29.00 | 61.00 | 0.48 | 95.08 | 2003/3/2 | 131 | 2003/5/5 | 193 | 62.00 | 64.00 | 0.97 | 193.75 | 2003/3/2 | 131 | 2003/5/5 | 193 | 62.00 | 64.00 | 0.97 | 193.75 |
| 40 | 1pr. Dadil | 14 | | 7 | 2003/1/1 | 124 | 2003/3/2 | 151 | 27.00 | 60.00 | 0.45 | 64.29 | 2003/3/2 | 151 | 2003/5/5 | 209 | 58.00 | 64.00 | 0.91 | 129.46 | 2003/3/2 | 151 | 2003/5/5 | 209 | 58.00 | 64.00 | 0.91 | 129.46 |
| 41 | 1pr. Dadil | 16 | | 5 | 2003/1/2 | 131 | 2003/3/2 | 169 | 38.00 | 59.00 | 0.64 | 128.81 | 2003/3/2 | 169 | 2003/5/5 | 242 | 73.00 | 64.00 | 1.14 | 228.13 | 2003/3/2 | 169 | 2003/5/5 | 242 | 73.00 | 64.00 | 1.14 | 228.13 |
| 42 | 1pr. Dadil | 4a | | 2 | 2003/1/3 | 102 | 2003/3/2 | 138 | 36.00 | 58.00 | 0.62 | 310.34 | 2003/3/2 | 138 | 2003/5/5 | 138 | 0.00 | 64.00 | 0.00 | 0.00 | 2003/3/2 | 138 | 2003/5/5 | 138 | 0.00 | 64.00 | 0.00 | 0.00 |
| 43 | 3pr. Dadil | 8 | | 3 | 2003/1/4 | 100 | 2003/3/2 | 131 | 31.00 | 57.00 | 0.54 | 181.29 | 2003/3/2 | 131 | 2003/5/5 | 155 | 24.00 | 64.00 | 0.38 | 125.00 | 2003/3/2 | 131 | 2003/5/5 | 155 | 24.00 | 64.00 | 0.38 | 125.00 |
| 44 | 3pr. Dadil | 12a | | 8 | 2003/1/5 | 124 | 2003/3/2 | 149 | 25.00 | 56.00 | 0.45 | 55.80 | 2003/3/2 | 149 | 2003/5/5 | 199 | 50.00 | 64.00 | 0.78 | 97.66 | 2003/3/2 | 149 | 2003/5/5 | 199 | 50.00 | 64.00 | 0.78 | 97.66 |
| 45 | 3pr. Dadil | 10 | | 5 | 2003/1/6 | 98 | 2003/3/2 | 129 | 31.00 | 55.00 | 0.56 | 112.73 | 2003/3/2 | 129 | 2003/5/5 | 167 | 38.00 | 64.00 | 0.59 | 118.75 | 2003/3/2 | 129 | 2003/5/5 | 167 | 38.00 | 64.00 | 0.59 | 118.75 |
| 46 | 3pr. Dadil | 12 | | 12 | 2003/1/7 | 168 | 2003/3/2 | 213 | 45.00 | 54.00 | 0.83 | 69.44 | 2003/3/2 | 213 | 2003/5/5 | 304 | 91.00 | 64.00 | 1.42 | 118.49 | 2003/3/2 | 213 | 2003/5/5 | 304 | 91.00 | 64.00 | 1.42 | 118.49 |
| 47 | 3pr. Dadil | 14 | | 11 | 2003/1/8 | 191 | 2003/3/2 | 244 | 53.00 | 53.00 | 1.00 | 90.91 | 2003/3/2 | 244 | 2003/5/5 | 314 | 70.00 | 64.00 | 1.09 | 99.43 | 2003/3/2 | 244 | 2003/5/5 | 314 | 70.00 | 64.00 | 1.09 | 99.43 |
| 48 | 3pr. Dadil | 16 | | 6 | 2003/1/9 | 104 | 2003/3/2 | 145 | 41.00 | 52.00 | 0.79 | 131.41 | 2003/3/2 | 145 | 2003/5/5 | 207 | 62.00 | 64.00 | 0.97 | 161.46 | 2003/3/2 | 145 | 2003/5/5 | 207 | 62.00 | 64.00 | 0.97 | 161.46 |
| 49 | 3pr. Dadil | 18 | | 4 | 2003/1/10 | 121 | 2003/3/2 | 169 | 48.00 | 51.00 | 0.94 | 235.29 | 2003/3/2 | 169 | 2003/5/5 | 221 | 52.00 | 64.00 | 0.81 | 203.13 | 2003/3/2 | 169 | 2003/5/5 | 221 | 52.00 | 64.00 | 0.81 | 203.13 |
| 50 | 3pr. Dadil | 26 | | 1 | 2002/12/18 | 10 | 2003/3/2 | 68 | 58.00 | 74.00 | 0.78 | 783.78 | 2003/3/2 | 68 | 2003/5/5 | 121 | 53.00 | 64.00 | 0.83 | 828.13 | 2003/3/2 | 68 | 2003/5/5 | 121 | 53.00 | 64.00 | 0.83 | 828.13 |
| | | | | 368 | | | | | | | 38.38 | 104 | | | | | | | 56.27 | 153 | | | | | | | 70.49 | 192 |

# Table S 2.3.4.9 (3)  Meter Reading Results at Detached House with Sewer Connection (3)

**Sobir Rahim District**

| No. | Adress | House No. | Watering area(m2 | Number of residents | Winter season | | | | | | | | Spring/Autumn season | | | | | | | | Summer season | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | |
| | | | | | Date | 3) | Date | 3) | m3 | Day | m3/d | d | Date | 3) | Date | 3) | m3 | Day | m3/d | d | Date | 3) | Date | 3) | m3 | Day | m3/d | d |
| 1 | Dababoeva | 32 | 25 | 6 | 01.12.2002 | 335 | 28.02.2003 | 450 | 115.00 | 91.00 | 1.26 | 210.62 | 01.03.2003 | 450 | 30.5.2003 | 585 | 135.00 | 91.00 | 1.48 | 247.25 | 01.06.2003 | 585 | 31.08.2003 | 800 | 215.00 | 89 | 2.42 | 402.62 |
| 2 | upik Dabab | 3 | 50 | 6 | 01.12.2002 | 598 | 28.02.2003 | 758 | 160.00 | 91.00 | 1.76 | 293.04 | 01.03.2003 | 758 | 30.5.2003 | 805 | 47.00 | 91.00 | 0.52 | 86.08 | 01.06.2003 | 805 | 31.08.2003 | 909 | 104.00 | 89 | 1.17 | 194.76 |
| 3 | ect Tursunl | 6 | 50 | 6 | 01.12.2002 | 680 | 28.02.2003 | 750 | 70.00 | 91.00 | 0.77 | 128.21 | 01.03.2003 | 750 | 30.5.2003 | 851 | 101.00 | 91.00 | 1.11 | 184.98 | 01.06.2003 | 851 | 31.08.2003 | 1085 | 234.00 | 89 | 2.63 | 438.20 |
| 4 | ect Tursunl | 14 | 50 | 7 | 01.12.2002 | 1089 | 28.02.2003 | 1400 | 311.00 | 91.00 | 3.42 | 488.23 | 01.03.2003 | 1400 | 30.5.2003 | 1490 | 90.00 | 91.00 | 0.99 | 141.29 | 01.06.2003 | 1490 | 31.08.2003 | 1771 | 281.00 | 89 | 3.16 | 451.04 |
| 5 | ect Tursunl | 16 | 25 | 13 | 01.12.2002 | 758 | 28.02.2003 | 801 | 43.00 | 91.00 | 0.47 | 36.35 | 01.03.2003 | 801 | 30.5.2003 | 989 | 188.00 | 91.00 | 2.07 | 158.92 | 01.06.2003 | 989 | 31.08.2003 | 1130 | 141.00 | 89 | 1.58 | 121.87 |
| 6 | ect Tursunl | 22 | 50 | 2 | 01.12.2002 | 541 | 28.02.2003 | 661 | 120.00 | 91.00 | 1.32 | 659.34 | 01.03.2003 | 661 | 30.5.2003 | 795 | 134.00 | 91.00 | 1.47 | 736.26 | 01.06.2003 | 795 | 31.08.2003 | 1041 | 246.00 | 89 | 2.76 | 1382.02 |
| 7 | ect Tursunl | 36 | 50 | 2 | 01.12.2002 | 362 | 28.02.2003 | 468 | 106.00 | 91.00 | 1.16 | 582.42 | 01.03.2003 | 468 | 30.5.2003 | 512 | 44.00 | 91.00 | 0.48 | 241.76 | 01.06.2003 | 512 | 31.08.2003 | 662 | 150.00 | 89 | 1.69 | 842.70 |
| 8 | ect Tursunl | 44 | 50 | 3 | 01.12.2002 | 284 | 28.02.2003 | 400 | 116.00 | 91.00 | 1.27 | 424.91 | 01.03.2003 | 400 | 30.5.2003 | 490 | 90.00 | 91.00 | 0.99 | 329.67 | 01.06.2003 | 490 | 31.08.2003 | 600 | 110.00 | 89 | 1.24 | 411.99 |
| 9 | ect Tursunl | 65 | 50 | 6 | 01.12.2002 | 1091 | 28.02.2003 | 1200 | 109.00 | 91.00 | 1.20 | 199.63 | 01.03.2003 | 1200 | 30.5.2003 | 1312 | 112.00 | 91.00 | 1.23 | 205.13 | 01.06.2003 | 1312 | 31.08.2003 | 1511 | 199.00 | 89 | 2.24 | 372.66 |
| 10 | ect Tursunl | 61 | 50 | 2 | 01.12.2002 | 400 | 28.02.2003 | 500 | 100.00 | 91.00 | 1.10 | 549.45 | 01.03.2003 | 500 | 30.5.2003 | 550 | 50.00 | 91.00 | 0.55 | 274.73 | 01.06.2003 | 550 | 31.08.2003 | 628 | 78.00 | 89 | 0.88 | 438.20 |
| 11 | ect Tursunl | 105 | 50 | 6 | 01.12.2002 | 744 | 28.02.2003 | 850 | 106.00 | 91.00 | 1.16 | 194.14 | 01.03.2003 | 850 | 30.5.2003 | 995 | 145.00 | 91.00 | 1.59 | 265.57 | 01.06.2003 | 995 | 31.08.2003 | 1212 | 217.00 | 89 | 2.44 | 406.37 |
| 12 | ect Tursunl | 99 | 50 | 5 | 01.12.2002 | 643 | 28.02.2003 | 785 | 142.00 | 91.00 | 1.56 | 312.09 | 01.03.2003 | 785 | 30.5.2003 | 900 | 115.00 | 91.00 | 1.26 | 252.75 | 01.06.2003 | 990 | 31.08.2003 | 1100 | 110.00 | 89 | 1.24 | 247.19 |
| 13 | ect Tursunl | 97 | 25 | 6 | 01.12.2002 | 730 | 28.02.2003 | 850 | 120.00 | 91.00 | 1.32 | 219.78 | 01.03.2003 | 850 | 30.5.2003 | 975 | 125.00 | 91.00 | 1.37 | 228.94 | 01.06.2003 | 975 | 31.08.2003 | 1030 | 55.00 | 89 | 0.62 | 103.00 |
| 14 | t pr V.Juma | 47 | − | 4 | 01.12.2002 | 300 | 28.02.2003 | 330 | 30.00 | 91.00 | 0.33 | 82.42 | 01.03.2003 | 330 | 30.5.2003 | 400 | 70.00 | 91.00 | 0.77 | 192.31 | 01.06.2003 | 400 | 31.08.2003 | 500 | 100.00 | 89 | 1.12 | 280.90 |
| 15 | t pr V.Juma | 31 | 25 | 5 | 01.12.2002 | 650 | 28.02.2003 | 700 | 50.00 | 91.00 | 0.55 | 109.89 | 01.03.2003 | 700 | 30.5.2003 | 800 | 100.00 | 91.00 | 1.10 | 219.78 | 01.06.2003 | 800 | 31.08.2003 | 870 | 70.00 | 89 | 0.79 | 157.30 |
| 16 | t pr V.Juma | 14 | 50 | 4 | 01.12.2002 | 1330 | 28.02.2003 | 1381 | 51.00 | 91.00 | 0.56 | 140.11 | 01.03.2003 | 1381 | 30.5.2003 | 1481 | 100.00 | 91.00 | 1.10 | 274.73 | 01.06.2003 | 1481 | 31.08.2003 | 1681 | 200.00 | 89 | 2.25 | 561.80 |
| 17 | t pr V.Juma | 43a | − | 5 | 01.12.2002 | 700 | 28.02.2003 | 750 | 50.00 | 91.00 | 0.55 | 109.89 | 01.03.2003 | 750 | 30.5.2003 | 820 | 70.00 | 91.00 | 0.77 | 153.85 | 01.06.2003 | 820 | 31.08.2003 | 969 | 149.00 | 89 | 1.67 | 334.83 |
| 18 | t pr V.Juma | 44 | − | 10 | 01.12.2002 | 1960 | 28.02.2003 | 2110 | 150.00 | 91.00 | 1.65 | 164.84 | 01.03.2003 | 2010 | 30.5.2003 | 2110 | 100.00 | 91.00 | 1.10 | 109.89 | 01.06.2003 | 2110 | 31.08.2003 | 2300 | 190.00 | 89 | 2.13 | 213.48 |
| 19 | t pr V.Juma | 20 | 50 | 4 | 01.12.2002 | 330 | 28.02.2003 | 380 | 50.00 | 91.00 | 0.55 | 137.36 | 01.03.2003 | 380 | 30.5.2003 | 480 | 100.00 | 91.00 | 1.10 | 274.73 | 01.06.2003 | 480 | 31.08.2003 | 647 | 167.00 | 89 | 1.88 | 469.10 |
| 20 | d pr. Tash- | 14 | 50 | 4 | 01.12.2002 | 450 | 28.02.2003 | 492 | 42.00 | 91.00 | 0.46 | 115.38 | 01.03.2003 | 492 | 30.5.2003 | 600 | 108.00 | 91.00 | 1.19 | 296.70 | 01.06.2003 | 600 | 31.08.2003 | 950 | 350.00 | 89 | 3.93 | 983.15 |
| 21 | t pr V.Juma | 34 | − | 4 | 01.12.2002 | 300 | 28.02.2003 | 350 | 50.00 | 91.00 | 0.55 | 137.36 | 01.03.2003 | 350 | 30.5.2003 | 400 | 50.00 | 91.00 | 0.55 | 137.36 | 01.06.2003 | 400 | 31.08.2003 | 450 | 50.00 | 89 | 0.56 | 140.45 |
| 22 | d pr. Tash- | 30a | 50 | 7 | 01.12.2002 | 100 | 28.02.2003 | 150 | 50.00 | 91.00 | 0.55 | 78.49 | 01.03.2003 | 150 | 30.5.2003 | 220 | 70.00 | 91.00 | 0.77 | 109.89 | 01.06.2003 | 220 | 31.08.2003 | 330 | 110.00 | 89 | 1.24 | 176.57 |
| 23 | t pr V.Juma | 29 | 50 | 9 | 01.12.2002 | 700 | 28.02.2003 | 750 | 50.00 | 91.00 | 0.55 | 61.05 | 01.03.2003 | 750 | 30.5.2003 | 850 | 100.00 | 91.00 | 1.10 | 122.10 | 01.06.2003 | 850 | 31.08.2003 | 1000 | 150.00 | 89 | 1.69 | 187.27 |
| 24 | t pr V.Juma | 12 | 50 | 3 | 01.12.2002 | 700 | 28.02.2003 | 750 | 50.00 | 91.00 | 0.55 | 183.15 | 01.03.2003 | 750 | 30.5.2003 | 900 | 150.00 | 91.00 | 1.65 | 549.45 | 01.06.2003 | 900 | 31.08.2003 | 1100 | 200.00 | 89 | 2.25 | 749.06 |
| 25 | t pr V.Juma | 41 | 50 | 9 | 01.12.2002 | 900 | 28.02.2003 | 950 | 50.00 | 91.00 | 0.55 | 61.05 | 01.03.2003 | 950 | 30.5.2003 | 1859 | 909.00 | 91.00 | 9.99 | 1109.89 | 01.06.2003 | 1059 | 31.08.2003 | 1309 | 250.00 | 89 | 2.81 | 312.11 |
| 26 | pr. M.Goli | 6 | 25 | 4 | 11.12.2002 | 1075 | 28.02.2003 | 1125 | 50.00 | 79 | 0.63 | 158.23 | 28.02.2003 | 1125 | 01.06.2003 | 1300 | 175.00 | 91.00 | 1.92 | 480.77 | 01.06.2003 | 1300 | 10.09.2003 | 1600 | 300.00 | 101 | 2.97 | 742.57 |
| 27 | pr. M.Goli | 23 | - | 8 | 11.12.2002 | 705 | 28.02.2003 | 755 | 50.00 | 79 | 0.63 | 79.11 | 28.02.2003 | 755 | 01.06.2003 | 795 | 40.00 | 91.00 | 0.44 | 54.95 | 01.06.2003 | 795 | 10.09.2003 | 835 | 40.00 | 101 | 0.40 | 49.50 |
| 28 | pr. M.Goli | 21 | - | 22 | 11.12.2002 | 2800 | 28.02.2003 | 2843 | 43.00 | 79 | 0.54 | 24.74 | 28.02.2003 | 2843 | 01.06.2003 | 3287 | 444.00 | 91.00 | 4.88 | 221.78 | 01.06.2003 | 3287 | 10.09.2003 | 3600 | 313.00 | 101 | 3.10 | 140.86 |
| 29 | pr. M.Goli | 19 | - | 10 | 11.12.2002 | 450 | 28.02.2003 | 487 | 37.00 | 79 | 0.47 | 46.84 | 28.02.2003 | 487 | 01.06.2003 | 530 | 43.00 | 91.00 | 0.47 | 47.25 | 01.06.2003 | 530 | 10.09.2003 | 611 | 81.00 | 101 | 0.80 | 80.20 |
| 30 | pr. M.Goli | 17 | - | 3 | 11.12.2002 | 400 | 28.02.2003 | 450 | 50.00 | 79 | 0.63 | 210.97 | 28.02.2003 | 450 | 01.06.2003 | 500 | 50.00 | 91.00 | 0.55 | 183.15 | 01.06.2003 | 500 | 10.09.2003 | 600 | 100.00 | 101 | 0.99 | 330.03 |
| 31 | pr. M.Goli | 15 | - | 7 | 11.12.2002 | 1800 | 28.02.2003 | 1850 | 50.00 | 79 | 0.63 | 90.42 | 28.02.2003 | 1850 | 01.06.2003 | 2000 | 150.00 | 91.00 | 1.65 | 235.48 | 01.06.2003 | 2000 | 10.09.2003 | 2169 | 169.00 | 101 | 1.67 | 239.04 |
| 32 | pr. M.Goli | 11 | - | 5 | 11.12.2002 | 1304 | 28.02.2003 | 1354 | 50.00 | 79 | 0.63 | 126.58 | 28.02.2003 | 1354 | 01.06.2003 | 1504 | 150.00 | 91.00 | 1.65 | 329.67 | 01.06.2003 | 1504 | 10.09.2003 | 1904 | 400.00 | 101 | 3.96 | 792.08 |
| 33 | pr. M.Goli | 1 | - | 2 | 11.12.2002 | 550 | 28.02.2003 | 600 | 50.00 | 79 | 0.63 | 316.46 | 28.02.2003 | 600 | 01.06.2003 | 700 | 100.00 | 91.00 | 1.10 | 549.45 | 01.06.2003 | 700 | 10.09.2003 | 850 | 150.00 | 101 | 1.49 | 742.57 |
| 34 | pr. M.Goli | 8 | - | 10 | 11.12.2002 | 1550 | 28.02.2003 | 1614 | 64.00 | 79 | 0.81 | 81.01 | 28.02.2003 | 1614 | 01.06.2003 | 1814 | 200.00 | 91.00 | 2.20 | 219.78 | 01.06.2003 | 1814 | 10.09.2003 | 2014 | 200.00 | 101 | 1.98 | 198.02 |
| 35 | pr. M.Goli | 69 | 50 | 11 | 11.12.2002 | 400 | 28.02.2003 | 464 | 64.00 | 79 | 0.81 | 73.65 | 28.02.2003 | 464 | 01.06.2003 | 500 | 36.00 | 91.00 | 0.40 | 35.96 | 01.06.2003 | 500 | 10.09.2003 | 600 | 100.00 | 101 | 0.99 | 90.01 |
| 36 | pr. M.Goli | 67 | 50 | 10 | 11.12.2002 | 200 | 28.02.2003 | 265 | 65.00 | 79 | 0.82 | 82.28 | 28.02.2003 | 265 | 01.06.2003 | 385 | 120.00 | 91.00 | 1.32 | 131.87 | 01.06.2003 | 385 | 10.09.2003 | 508 | 123.00 | 101 | 1.22 | 121.78 |
| 37 | pr. M.Goli | 37 | 50 | 10 | 11.12.2002 | 700 | 28.02.2003 | 750 | 50.00 | 79 | 0.63 | 63.29 | 28.02.2003 | 750 | 01.06.2003 | 850 | 100.00 | 91.00 | 1.10 | 109.89 | 01.06.2003 | 850 | 10.09.2003 | 1050 | 200.00 | 101 | 1.98 | 198.02 |
| 38 | pr. M.Goli | 35 | 50 | 6 | 11.12.2002 | 600 | 28.02.2003 | 650 | 50.00 | 79 | 0.63 | 105.49 | 28.02.2003 | 650 | 01.06.2003 | 750 | 100.00 | 91.00 | 1.10 | 183.15 | 01.06.2003 | 750 | 10.09.2003 | 950 | 200.00 | 101 | 1.98 | 330.03 |
| 39 | pr. M.Goli | 31 | 50 | 6 | 11.12.2002 | 1200 | 28.02.2003 | 1230 | 30.00 | 79 | 0.38 | 63.29 | 28.02.2003 | 1230 | 01.06.2003 | 1800 | 570.00 | 91.00 | 6.26 | 1043.96 | 01.06.2003 | 1800 | 10.09.2003 | 1312 | -488.00 | 101 | -4.83 | -805.28 |
| 40 | l pr.Tosh-v | 24 | 50 | 8 | 11.12.2002 | 600 | 28.02.2003 | 650 | 50.00 | 79 | 0.63 | 79.11 | 28.02.2003 | 650 | 01.06.2003 | 750 | 100.00 | 91.00 | 1.10 | 137.36 | 01.06.2003 | 750 | 10.09.2003 | 1021 | 271.00 | 101 | 2.68 | 335.40 |
| 41 | l pr.Tosh-v | 17 | 50 | 6 | 11.12.2002 | 600 | 28.02.2003 | 630 | 30.00 | 79 | 0.38 | 63.29 | 28.02.2003 | 630 | 01.06.2003 | 700 | 70.00 | 91.00 | 0.77 | 128.21 | 01.06.2003 | 700 | 10.09.2003 | 806 | 106.00 | 101 | 1.05 | 174.92 |
| 42 | l pr.Tosh-v | 97 | 50 | 11 | 11.12.2002 | 600 | 28.02.2003 | 653 | 53.00 | 79 | 0.67 | 60.99 | 28.02.2003 | 653 | 01.06.2003 | 700 | 47.00 | 91.00 | 0.52 | 46.95 | 01.06.2003 | 700 | 10.09.2003 | 780 | 80.00 | 101 | 0.79 | 72.01 |
| 43 | Tosh-v | 43 | 50 | 5 | 11.12.2002 | 1850 | 28.02.2003 | 1900 | 50.00 | 79 | 0.63 | 126.58 | 28.02.2003 | 1900 | 01.06.2003 | 2013 | 113.00 | 91.00 | 1.24 | 248.35 | 01.06.2003 | 2013 | 10.09.2003 | 2213 | 200.00 | 101 | 1.98 | 396.04 |
| 44 | Tosh-v | 54a | 50 | 3 | 11.12.2002 | 800 | 28.02.2003 | 850 | 50.00 | 79 | 0.63 | 210.97 | 28.02.2003 | 850 | 01.06.2003 | 950 | 100.00 | 91.00 | 1.10 | 366.30 | 01.06.2003 | 950 | 10.09.2003 | 1200 | 250.00 | 101 | 2.48 | 825.08 |
| 45 | Tosh-v | 9a | 50 | 6 | 11.12.2002 | 500 | 28.02.2003 | 530 | 30.00 | 79 | 0.38 | 63.29 | 28.02.2003 | 530 | 01.06.2003 | 600 | 70.00 | 91.00 | 0.77 | 128.21 | 01.06.2003 | 600 | 10.09.2003 | 700 | 100.00 | 101 | 0.99 | 165.02 |
| 46 | Tosh-v | 19 | 50 | 6 | 11.12.2002 | 1116 | 28.02.2003 | 1300 | 184.00 | 79 | 2.33 | 388.19 | 28.02.2003 | 1300 | 01.06.2003 | 1700 | 400.00 | 91.00 | 4.40 | 732.60 | 01.06.2003 | 1700 | 10.09.2003 | 2400 | 700.00 | 101 | 6.93 | 1155.12 |
| 47 | 4 pr. Tosh-v | 7a | 50 | 4 | 11.12.2002 | 1000 | 28.02.2003 | 1020 | 20.00 | 79 | 0.25 | 63.29 | 28.02.2003 | 1020 | 01.06.2003 | 1070 | 50.00 | 91.00 | 0.55 | 137.36 | 01.06.2003 | 1070 | 10.09.2003 | 1270 | 200.00 | 101 | 1.98 | 495.05 |
| 48 | Tosh-v | 15 | 50 | 4 | 11.12.2002 | 800 | 28.02.2003 | 860 | 60.00 | 79 | 0.76 | 189.87 | 28.02.2003 | 860 | 01.06.2003 | 980 | 120.00 | 91.00 | 1.32 | 329.67 | 01.06.2003 | 980 | 10.09.2003 | 1060 | 80.00 | 101 | 0.79 | 198.02 |
| 49 | Tosh-v | 17 | 50 | 4 | 11.12.2002 | 1100 | 28.02.2003 | 1178 | 78.00 | 79 | 0.99 | 246.84 | 28.02.2003 | 1178 | 01.06.2003 | 1300 | 122.00 | 91.00 | 1.34 | 335.16 | 01.06.2003 | 1300 | 10.09.2003 | 1500 | 200.00 | 101 | 1.98 | 495.05 |
| 50 | Tosh-v | 13 | - | 3 | 11.12.2002 | 900 | 28.02.2003 | 924 | 24.00 | 79 | 0.30 | 101.27 | 28.02.2003 | 924 | 01.06.2003 | 1055 | 131.00 | 91.00 | 1.44 | 479.85 | 01.06.2003 | 1055 | 10.09.2003 | 1255 | 200.00 | 101 | 1.98 | 660.07 |
| | | | | 312 | | | | | | | 42.04 | 135 | | | | | | | 75.87 | 243 | | | | | | | 88.69 | 284 |

## Table S 2.3.4.10(1) Meter Reading Results at Detached House withoout Sewer Connection (1)

**Sergeli District**

| House No. | Watering area($m^2$) | Number of residents | Winter season | | | | | | | | Spring/Autumn season | | | | | | | | Summer season | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | |
| | | | Date | Value(m | Date | Value(m | $m^3$ | Day | $m^3/d$ | L/cap./d | Date | Value(m | Date | Value(m | $m^3$ | Day | $m^3/d$ | L/cap./d | Date | Value(m | Date | Value(m | $m^3$ | Day | $m^3/d$ | L/cap./d |
| 4 | 100 | 1 | | | | | | | | | 03.06.03 | 166 | 27.10.03 | 238 | 72 | 146 | 0.493 | 493 | 03.06.03 | 166 | 27.07.03 | 191 | 25 | 54 | 0.463 | 463 |
| 7 | 100 | 1 | | | | | | | | | 28.05.03 | 373 | 27.10.03 | 463 | 90 | 151 | 0.596 | 596 | | | | | | | | |
| 12 | 100 | 5 | | | | | | | | | 07.05.03 | 128 | 21.10.03 | 152 | 24 | 167 | 0.144 | 29 | | | | | | | | |
| 27 | 100 | 5 | | | | | | | | | 22.02.03 | 409 | 02.06.03 | 442 | 33 | 100 | 0.330 | 66 | | | | | | | | |
| 30 | 100 | 1 | | | | | | | | | 02.06.03 | 310 | 24.10.03 | 471 | 161 | 144 | 1.118 | 1118 | 02.06.03 | 310 | 25.07.03 | 362 | 52 | 53 | 0.981 | 981 |
| 5 | 100 | 1 | 11.11.02 | 110 | 22.02.03 | 150 | 40 | 103 | 0.388 | 388 | 22.02.03 | 150 | 21.07.03 | 210 | 60 | 90 | 0.667 | 667 | | | | | | | | |
| 28 | 100 | 4 | | | | | | | | | 21.07.03 | 236 | 23.10.03 | 263 | 27 | 94 | 0.287 | 72 | 21.07.03 | 236 | 25.07.03 | 250 | 14 | 4 | 3.500 | 875 |
| 4 | 100 | 5 | | | | | | | | | 22.02.03 | 130 | 07.07.03 | 210 | 80 | 135 | 0.593 | 119 | 07.07.03 | 210 | 12.08.03 | 227 | 17 | 36 | 0.472 | 94 |
| 7 | 100 | 6 | | | | | | | | | 09.07.03 | 219 | 24.11.03 | 419 | 200 | 138 | 1.449 | 242 | | | | | | | | |
| 8 | 100 | 5 | | | | | | | | | 22.02.03 | 194 | 02.06.03 | 244 | 50 | 69 | 0.725 | 145 | 02.06.03 | 244 | 25.07.03 | 261 | 17 | 51 | 0.333 | 67 |
| 17A | 100 | 5 | | | | | | | | | 19.05.03 | 468 | 21.10.03 | 694 | 226 | 155 | 1.458 | 292 | | | | | | | | |
| 4 | 100 | 2 | | | | | | | | | | | | | | | | | 25.05.03 | 435 | 23.07.03 | 463 | 28 | 59 | 0.475 | 237 |
| 8 | 100 | 5 | | | | | | | | | 23.07.03 | 435 | 12.11.03 | 555 | 120 | 112 | 1.071 | 214 | 23.07.03 | 435 | 28.08.03 | 471 | 36 | 36 | 1.000 | 200 |
| 22 | 100 | 5 | | | | | | | | | 29.03.03 | 2499 | 21.06.03 | 2607 | 108 | 84 | 1.286 | 257 | 21.06.03 | 2607 | 28.08.03 | 2697 | 90 | 68 | 1.324 | 265 |
| 24 | 100 | 1 | 11.11.02 | 675 | 28.02.03 | 740 | 65 | 109 | 0.596 | 596 | 05.04.03 | 877 | 23.09.03 | 1127 | 250 | 170 | 1.471 | 1471 | | | | | | | | |
| 19 | 100 | 1 | 30.11.02 | 558 | 07.02.03 | 608 | 50 | 69 | 0.725 | 725 | | | | | | | | | 09.06.03 | 708 | 18.09.03 | 758 | 50 | 101 | 0.495 | 495 |
| 42 | 150 | 5 | 28.01.03 | 601 | 28.02.03 | 618 | 17 | 31 | 0.548 | 110 | | | | | | | | | 21.07.03 | 701 | 25.10.03 | 950 | 249 | 96 | 2.594 | 519 |
| 43 | 100 | 3 | | | | | | | | | 03.07.03 | 717 | 26.10.03 | 830 | 113 | 115 | 0.983 | 328 | 3.07.03 | 717 | 21.07.03 | 741 | 24 | 18 | 1.333 | 444 |
| 16 | 100 | 4 | | | | | | | | | 20.06.03 | 245 | 26.10.03 | 379 | 134 | 128 | 1.047 | 262 | 20.06.03 | 245 | 31.07.03 | 345 | 100 | 41 | 2.439 | 610 |
| 21 | 100 | 5 | 20.01.03 | 1066 | 21.02.03 | 1078 | 12 | 32 | 0.375 | 75 | 21.02.03 | 1078 | 18.05.03 | 1266 | 188 | 86 | 2.186 | 437 | 18.05.03 | 1266 | 25.10.03 | 1429 | 163 | 160 | 1.019 | 204 |
| 5 | 100 | 1 | | | | | | | | | 31.07.03 | 1543 | 13.11.02 | 1633 | 90 | 105 | 0.857 | 857 | | | | | | | | |
| 11 | 100 | 3 | 18.01.03 | 177 | 03.04.03 | 217 | 40 | 75 | 0.533 | 178 | 03.04.03 | 217 | 26.06.03 | 397 | 180 | 84 | 2.143 | 714 | | | | | | | | |
| 4 | 50 | 4 | 18.01.03 | 132 | 04.03.03 | 148 | 16 | 45 | 0.356 | 89 | | | | | | | | | 10.06.03 | 198 | 22.09.03 | 265 | 67 | 104 | 0.644 | 161 |
| 7-2 | 50 | 2 | 18.11.02 | 118 | 25.02.03 | 124 | 6 | 99 | 0.061 | 30 | | | | | | | | | 23.06.03 | 136 | 18.10.03 | 156 | 20 | 117 | 0.171 | 85 |
| 6-3 | 50 | 2 | 09.01.03 | 877 | 04.06.03 | 900 | 23 | 146 | 0.158 | 79 | | | | | | | | | 04.06.03 | 900 | 18.09.03 | 984 | 84 | 106 | 0.792 | 396 |
| 3 | 50 | 8 | | | | | | | | | 04.03.03 | 238 | 10.06.03 | 269 | 31 | 98 | 0.316 | 40 | 10.06.03 | 269 | 30.08.03 | 319 | 50 | 81 | 0.617 | 77 |
| 5 | | 5 | | | | | | | | | 23.03.03 | 595 | 07.05.03 | 655 | 60 | 45 | 1.333 | 267 | 07.05.03 | 655 | 30.08.03 | 737 | 82 | 115 | 0.713 | 143 |
| 9 | | 5 | 26.02.03 | 921 | 04.04.03 | 976 | 55 | 37 | 1.486 | 297 | 04.04.03 | 976 | 04.10.03 | 1152 | 176 | 183 | 0.962 | 192 | | | | | | | | |
| 21 | | 1 | | | | | | | | | 01.03.03 | 35 | 01.08.03 | 63 | 28 | 153 | 0.183 | 183 | | | | | | | | |
| 23 | | 1 | 24.02.03 | 617 | 20.05.03 | 636 | 19 | 85 | 0.224 | 224 | 20.05.03 | 636 | 04.10.03 | 694 | 58 | 137 | 0.423 | 423 | 30.08.03 | 681 | 04.10.03 | 694 | 13 | 35 | 0.371 | 371 |
| 35 | | 2 | | | | | | | | | 15.09.03 | 687 | 04.10.03 | 700 | 13 | 19 | 0.684 | 342 | 06.06.03 | 632 | 15.09.03 | 687 | 55 | 101 | 0.545 | 272 |
| 37 | | 4 | | | | | | | | | 04.03.03 | 177 | 07.05.03 | 251 | 74 | 64 | 1.156 | 289 | 06.06.03 | 276 | 30.08.03 | 353 | 77 | 85 | 0.906 | 226 |
| 39 | | 6 | 24.02.03 | 297 | 04.03.03 | 328 | 31 | 8 | 3.875 | 646 | 04.03.03 | 328 | 30.08.03 | 578 | 250 | 179 | 1.397 | 233 | | | | | | | | |
| 43 | | 5 | | | | | | | | | 04.03.03 | 43 | 07.05.03 | 81 | 38 | 64 | 0.594 | 119 | 07.05.03 | 81 | 30.08.03 | 202 | 121 | 115 | 1.052 | 210 |
| 61 | | 9 | 20.01.03 | 125 | 01.03.03 | 176 | 51 | 40 | 1.275 | 142 | | | | | | | | | 06.06.03 | 301 | 24.08.03 | 450 | 149 | 79 | 1.886 | 210 |
| 82 | | 6 | | | | | | | | | 06.03.03 | 46 | 18.05.03 | 95 | 49 | 75 | 0.653 | 109 | 18.05.03 | 95 | 02.09.03 | 255 | 160 | 107 | 1.495 | 249 |
| 80 | 25 | 1 | 04.01.03 | 270 | 07.03.03 | 287 | 17 | 62 | 0.274 | 274 | | | | | | | | | 14.06.03 | 309 | 20.09.03 | 380 | 71 | 98 | 0.724 | 724 |
| 78 | | 5 | 04.01.03 | 1500 | 12.03.03 | 1550 | 50 | 67 | 0.746 | 149 | | | | | | | | | 18.06.03 | 1597 | 06.10.03 | 1698 | 101 | 110 | 0.918 | 184 |
| 76 | | 7 | 14.02.03 | 1069 | 04.03.03 | 1099 | 30 | 18 | 1.667 | 238 | | | | | | | | | 14.06.03 | 1119 | 20.09.03 | 1189 | 70 | 98 | 0.714 | 102 |
| 72 | 25 | 4 | 04.01.03 | 521 | 12.03.03 | 605 | 84 | 67 | 1.254 | 313 | | | | | | | | | 06.06.03 | 702 | 17.08.03 | 806 | 104 | 72 | 1.444 | 361 |
| 68 | | 4 | 14.02.03 | 435 | 01.04.03 | 450 | 15 | 60 | 0.250 | 63 | | | | | | | | | 01.06.03 | 476 | 20.09.03 | 538 | 62 | 111 | 0.559 | 140 |
| 40 | | 2 | | | | | | | | | | | | | | | | | 06.06.03 | 18 | 05.11.03 | 88 | 70 | 152 | 0.461 | 230 |
| 38 | 20 | 2 | | | | | | | | | 01.04.03 | 303 | 23.05.03 | 323 | 20 | 52 | 0.385 | 192 | 08.07.03 | 345 | 02.09.03 | 382 | 37 | 46 | 0.804 | 402 |
| 26 | | 6 | 08.01.03 | 279 | 12.03.03 | 369 | 90 | 53 | 1.698 | 283 | | | | | | | | | 03.06.03 | 459 | 15.08.03 | 545 | 86 | 73 | 1.178 | 196 |
| 18 | | 2 | 12.02.03 | 307 | 19.03.03 | 316 | 9 | 35 | 0.257 | 129 | | | | | | | | | 03.06.03 | 345 | 29.08.03 | 380 | 35 | 87 | 0.402 | 201 |
| 16 | | 4 | 06.01.03 | 1026 | 24.03.03 | 1060 | 34 | 77 | 0.442 | 110 | | | | | | | | | 18.06.03 | 1100 | 01.09.03 | 1200 | 100 | 75 | 1.333 | 333 |
| 12 | | 6 | | | | | | | | | 06.10.03 | 10 | 01.12.03 | 25 | 15 | 56 | 0.268 | 45 | | | | | 0 | | | |
| 8 | | 3 | 06.02.03 | 150 | 19.03.03 | 175 | 25 | 41 | 0.610 | 203 | | | | | | | | | 30.06.03 | 269 | 01.09.03 | 321 | 52 | 63 | 0.825 | 275 |
| 3 | | 3 | | | | | | | | | | | | | | | | | 26.06.03 | 0 | 01.09.03 | 35 | 35 | 67 | 0.522 | 174 |
| 4 | | 4 | 08.01.03 | 125 | 27.03.03 | 151 | 26 | 68 | 0.382 | 96 | | | | | | | | | 29.05.03 | 169 | 01.09.03 | 204 | 35 | 95 | 0.368 | 92 |
| | | 187 | | | 81 | | | | 18.180 | 224 | | | 117 | | | | 24.576 | 210 | | Residents | 141 | | | | 34.432 | 244 |

## Table S 2.3.4.10 (2) Meter Reading Results at Detached House withoout Sewer Connection (2)

**Mirabad District**

| House No. | Watering area($m^2$) | Number of residents | Winter season | | | | | | | | Spring/Autumn season | | | | | | | | Summer season | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | |
| | | | Date | Value(m | Date | Value(m | $m^3$ | Day | $m^3$/d | L/cap./d | Date | Value(m | Date | Value(m | $m^3$ | Day | $m^3$/d | L/cap./d | Date | Value(m | Date | Value(m | $m^3$ | Day | $m^3$/d | L/cap./d |
| 4 | 50 | 5 | 08.10.02 | 381 | 12.02.03 | 654 | 273 | 127 | 2.150 | 430 | 12.02.03 | 654 | 12.05.03 | 693 | 39 | 89 | 0.438 | 88 | 12.05.03 | 693 | 12.09.03 | 730 | 37 | 123 | 0.301 | 60 |
| 7 | 100 | 9 | 30.12.02 | 512 | 28.02.03 | 581 | 69 | 59 | 1.169 | 130 | | | | | 0 | | | | 13.06.03 | 590 | 30.09.03 | 611 | 21 | 109 | 0.193 | 21 |
| 9 | 100 | 6 | 24.10.02 | 160 | 10.02.03 | 226 | 66 | 109 | 0.606 | 101 | 10.02.03 | 226 | 10.07.03 | 331 | 105 | 150 | 0.700 | 117 | 10.07.03 | 331 | 18.09.03 | 340 | 9 | 70 | 0.129 | 21 |
| 11 | 100 | 7 | 13.10.02 | 268 | 15.03.03 | 480 | 212 | 153 | 1.386 | 198 | 15.03.03 | 480 | 23.07.03 | 520 | 40 | 130 | 0.308 | 44 | 23.07.03 | 520 | 18.09.03 | 560 | 40 | 57 | 0.702 | 100 |
| 13 | 100 | 10 | 13.10.02 | 294 | 23.02.03 | 494 | 200 | 133 | 1.504 | 150 | 13.08.03 | 494 | 19.11.03 | 550 | 56 | 98 | 0.571 | 57 | | | | | | | | |
| 10 | 100 | 6 | 07.10.02 | 235 | 28.02.03 | 375 | 140 | 144 | 0.972 | 162 | 28.02.03 | 375 | 13.05.03 | 391 | 16 | 74 | 0.216 | 36 | 13.05.03 | 391 | 21.08.03 | 435 | 44 | 100 | 0.440 | 73 |
| 2 | 100 | 1 | 06.10.02 | 348 | 15.04.03 | 600 | 252 | 191 | 1.319 | 1319 | 15.04.03 | 600 | 23.08.03 | 693 | 93 | 130 | 0.715 | 715 | | | | | | | | |
| 3 | 100 | 8 | 06.10.02 | 266 | 23.03.03 | 401 | 135 | 168 | 0.804 | 100 | 23.03.03 | 401 | 15.08.03 | 513 | 112 | 145 | 0.772 | 97 | | | | | | | | |
| 11 | 100 | 5 | 16.01.03 | 143 | 16.06.02 | 238 | 95 | 120 | 0.792 | 158 | 21.03.03 | 301 | 16.08.03 | 418 | 117 | 146 | 0.801 | 160 | | | | | | | | |
| 5 | 100 | 4 | 16.12.02 | 83 | 13.04.03 | 390 | 307 | 118 | 2.602 | 650 | 13.04.03 | 390 | 28.09.03 | 519 | 129 | 168 | 0.768 | 192 | | | | | | | | |
| 6 | 100 | 6 | 06.10.02 | 253 | 10.03.03 | 523 | 270 | 132 | 2.045 | 341 | 10.03.03 | 523 | 01.08.03 | 613 | 90 | 174 | 0.517 | 86 | | | | | | | | |
| 7 | 100 | 5 | 06.10.02 | 253 | 10.03.03 | 390 | 137 | 132 | 1.038 | 208 | 10.03.03 | 390 | 13.05.03 | 424 | 34 | 64 | 0.531 | 106 | | | | | | | | |
| 1 | 100 | 4 | 08.12.02 | 205 | 23.03.03 | 398 | 193 | 105 | 1.838 | 460 | 23.03.03 | 398 | 17.08.03 | 498 | 100 | 147 | 0.680 | 170 | | | | | | | | |
| 9 | 100 | 4 | 23.11.02 | 127 | 20.02.03 | 348 | 221 | 89 | 2.483 | 621 | 20.02.03 | 348 | 18.09.03 | 512 | 164 | 210 | 0.781 | 195 | | | | | | | | |
| 5 | 100 | 5 | | | | | 0 | | | | 04.02.03 | 490 | 18.09.03 | 790 | 300 | 226 | 1.327 | 265 | | | | | | | | |
| 11 | 100 | 8 | 23.11.02 | 57 | 03.03.03 | 230 | 173 | 100 | 1.730 | 216 | 03.03.03 | 230 | 16.08.03 | 401 | 171 | 166 | 1.030 | 129 | | | | | | | | |
| 13 | 100 | 5 | 24.10.02 | 84 | 12.03.03 | 201 | 117 | 139 | 0.842 | 168 | 12.03.03 | 201 | 17.07.03 | 483 | 282 | 157 | 1.796 | 359 | | | | | | | | |
| 20 | 100 | 3 | 05.12.02 | 57 | 23.04.03 | 183 | 126 | 139 | 0.906 | 302 | 23.04.03 | 183 | 24.06.03 | 308 | 125 | 62 | 2.016 | 672 | | | | | | | | |
| 8 | 100 | 10 | 23.11.02 | 340 | 25.04.03 | 681 | 341 | 153 | 2.229 | 223 | 25.04.03 | 681 | 13.07.03 | 700 | 19 | 79 | 0.241 | 24 | | | | | | | | |
| 6 | 20 | 4 | 23.11.02 | 137 | 13.04.03 | 361 | 224 | 141 | 1.589 | 397 | 13.04.03 | 361 | 21.08.03 | 513 | 152 | 130 | 1.169 | 292 | | | | | | | | |
| 2 | 50 | 7 | 07.10.02 | 107 | 19.05.03 | 358 | 251 | 224 | 1.121 | 160 | 19.05.03 | 358 | 23.06.03 | 483 | 125 | 41 | 3.049 | 436 | | | | | | | | |
| 4 | 100 | 4 | 23.11.02 | 216 | 28.02.03 | 403 | 187 | 97 | 1.928 | 482 | 28.02.03 | 403 | 24.06.03 | 509 | 106 | 116 | 0.914 | 228 | | | | | | | | |
| 19 | 100 | 4 | 04.01.03 | 60 | 19.03.03 | 209 | 149 | 74 | 2.014 | 503 | 19.03.03 | 209 | 19.07.03 | 381 | 172 | 152 | 1.132 | 283 | | | | | | | | |
| 9 | 100 | 5 | 08.02.02 | 70 | 19.03.03 | 198 | 128 | 39 | 3.282 | 656 | 19.03.03 | 198 | 19.07.03 | 300 | 102 | 152 | 0.671 | 134 | | | | | | | | |
| 28 | 100 | 5 | | | | | 0 | | | | 08.04.03 | 403 | 28.06.03 | 581 | 178 | 81 | 2.198 | 440 | | | | | | | | |
| 2 | 100 | 4 | 14.12.02 | 145 | 24.02.03 | 325 | 180 | 72 | 2.500 | 625 | 23.09.03 | 790 | 15.11.03 | 835 | 45 | 53 | 0.849 | 212 | 15.05.03 | 375 | 30.08.03 | 758 | 383 | 107 | 3.579 | 895 |
| 3 | 100 | 5 | 25.12.02 | 939 | 14.02.03 | 1000 | 61 | 51 | 1.196 | 239 | 15.09.03 | 1501 | 12.11.03 | 1645 | 144 | 58 | 2.483 | 497 | 14.05.03 | 1537 | 30.08.03 | 1633 | 96 | 108 | 0.889 | 178 |
| 15 | 50 | 13 | 14.12.02 | 4101 | 24.02.03 | 4225 | 124 | 72 | 1.722 | 132 | 10.09.03 | 5440 | 09.11.03 | 5473 | 33 | 60 | 0.550 | 42 | 28.04.03 | 4480 | 02.08.03 | 5381 | 901 | 96 | 9.385 | 722 |
| 48 | 50 | 4 | 01.12.02 | 100 | 17.02.03 | 252 | 152 | 78 | 1.949 | 487 | 11.09.03 | 457 | 02.11.03 | 502 | 45 | 52 | 0.865 | 216 | 17.05.03 | 350 | 14.08.03 | 450 | 100 | 89 | 1.124 | 281 |
| 50 | 100 | 5 | 30.11.02 | 123 | 02.02.03 | 351 | 228 | 64 | 3.563 | 713 | 06.09.03 | 503 | 17.10.03 | 602 | 99 | 41 | 2.415 | 483 | 21.05.03 | 356 | 28.08.03 | 479 | 123 | 99 | 1.242 | 248 |
| 51 | 100 | 6 | 01.12.02 | 2191 | 05.02.03 | 2207 | 16 | 66 | 0.242 | 40 | 14.09.03 | 2574 | 25.10.03 | 2633 | 59 | 41 | 1.439 | 240 | 14.06.03 | 2294 | 30.08.03 | 2541 | 247 | 77 | 3.208 | 535 |
| 279 | 100 | 4 | 02.12.02 | 54 | 12.02.03 | 68 | 14 | 72 | 0.194 | 49 | 05.09.03 | 100 | 12.11.03 | 372 | 272 | 68 | 4.000 | 1000 | 25.05.03 | 144 | 01.08.03 | 253 | 109 | 68 | 1.603 | 401 |
| 225 | 100 | 3 | | | | | | | | | 14.09.03 | 1879 | 21.10.03 | 2020 | 141 | 37 | 3.811 | 1270 | | | | | 0 | | | |
| 21 | 100 | 5 | | | | | | | | | 17.09.03 | 2104 | 14.11.03 | 2384 | 280 | 58 | 4.828 | 966 | | | | | 0 | | | |
| 78 | 50 | 6 | | | | | | | | | | | | | 0 | | | | 29.05.03 | 3576 | 05.09.03 | 4235 | 659 | 99 | 6.657 | 1109 |
| 186 | 100 | 4 | | | | | | | | | 25.08.03 | 100 | 17.11.03 | 401 | 301 | 84 | 3.583 | 896 | | | | | 0 | | | |
| 273 | 50 | 3 | | | | | | | | | 26.08.03 | 200 | 14.11.03 | 335 | 135 | 80 | 1.688 | 563 | | | | | 0 | | | |
| 45 | 100 | 5 | | | | | | | | | | | | | 0 | | | | 28.05.03 | 323 | 15.10.03 | 948 | 625 | 140 | 4.464 | 893 |
| 267 | 100 | 6 | | | | | | | | | | | | | 0 | | | | 12.06.03 | 185 | 02.09.03 | 531 | 346 | 92 | 3.761 | 627 |
| 152 | 100 | 6 | | | | | | | | | | | | | 0 | | | | 15.06.03 | 310 | 14.09.03 | 525 | 215 | 91 | 2.363 | 394 |
| 5 | 100 | 6 | | | | | | | | | | | | | 0 | | | | 05.06.03 | 264 | 05.09.03 | 526 | 262 | 92 | 2.848 | 475 |
| 16 | 100 | 7 | | | | | | | | | | | | | 0 | | | | 14.06.03 | 636 | 05.09.03 | 855 | 219 | 83 | 2.639 | 377 |
| 15 | 100 | 4 | | | | | | | | | | | | | 0 | | | | 24.06.03 | 149 | 05.09.03 | 393 | 244 | 73 | 3.342 | 836 |
| 19 | 100 | 5 | | | | | | | | | | | | | 0 | | | | 30.06.03 | 866 | 05.09.03 | 1266 | 400 | 67 | 5.970 | 1194 |
| 3 | 100 | 6 | | | | | | | | | | | | | 0 | | | | 15.05.03 | 422 | 04.09.03 | 677 | 255 | 112 | 2.277 | 379 |
| 1 | 100 | 4 | | | | | | | | | | | | | 0 | | | | 24.06.03 | 1185 | 03.09.03 | 1285 | 100 | 71 | 1.408 | 352 |
| 9 | 100 | 5 | | | | | | | | | 14.08.03 | 105 | 12.11.03 | 300 | 195 | 91 | 2.143 | 429 | | | | | 0 | | | |
| 1 | 50 | 4 | | | | | | | | | | | | | | | | | 15.06.03 | 144 | 12.10.03 | 325 | 181 | 119 | 1.521 | 380 |
| | | 260 | | | 171 | | | | 47.713 | 279 | | | 192 | | | | 51.996 | 271 | | | 133 | | | | 60.044 | 451 |

# Table S 2.3.4.10 (3) Meter Reading Results at Detached House withoout Sewer Connection (3)

**Sabir Rahimov District**

| House No. | Watering area($m^2$) | Number of residents | Winter season | | | | | | | | Spring/Autumn season | | | | | | | | Winter season | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | | Beginning | | Finish | | Difference | | Consumption | |
| | | | Date | 3) | Date | 3) | $m^3$ | Day | $m^3/d$ | L/cap./d | Date | 3) | Date | 3) | $m^3$ | Day | $m^3/d$ | L/cap./d | Date | 3) | Date | 3) | $m^3$ | Day | $m^3/d$ | L/cap./d |
| 39 | 50 | 7 | 2002/12/1 | 1118 | 2003/2/28 | 1198 | 80.00 | 89 | 0.90 | 128.41 | 2003/3/1 | 1200 | 2003/6/1 | 1425 | 225.00 | 92 | 2.45 | 349.38 | 2003/6/1 | 1425 | 2003/9/1 | 1625 | 200.00 | 92.00 | 2.17 | 310.56 |
| 29 | 50 | 9 | 2002/12/1 | 700 | 2003/2/28 | 750 | 50.00 | 89 | 0.56 | 62.42 | 2003/3/1 | 751 | 2003/6/1 | 850 | 99.00 | 92 | 1.08 | 119.57 | 2003/6/1 | 850 | 2003/9/1 | 1000 | 150.00 | 92.00 | 1.63 | 181.16 |
| 8 | 25 | 1 | 2002/12/1 | 128 | 2003/2/28 | 159 | 31.00 | 89 | 0.35 | 348.31 | 2003/3/1 | 287 | 2003/6/1 | 357 | 70.00 | 92 | 0.76 | 760.87 | 2003/6/1 | 357 | 2003/9/1 | 457 | 100.00 | 92.00 | 1.09 | 1086.96 |
| 63 | 50 | 6 | 2002/12/1 | 183 | 2003/2/28 | 220 | 37.00 | 89 | 0.42 | 69.29 | 2003/3/1 | 223 | 2003/6/1 | 328 | 105.00 | 92 | 1.14 | 190.22 | 2003/6/1 | 328 | 2003/9/1 | 478 | 150.00 | 92.00 | 1.63 | 271.74 |
| 10 | 50 | 4 | 2002/12/1 | 294 | 2003/2/28 | 344 | 50.00 | 89 | 0.56 | 140.45 | 2003/3/1 | 345 | 2003/6/1 | 445 | 100.00 | 92 | 1.09 | 271.74 | 2003/6/1 | 445 | 2003/9/1 | 545 | 100.00 | 92.00 | 1.09 | 271.74 |
| 12 | - | 7 | 2002/12/1 | 1518 | 2003/2/28 | 1548 | 30.00 | 89 | 0.34 | 48.15 | 2003/3/1 | 1549 | 2003/6/1 | 1748 | 199.00 | 92 | 2.16 | 309.01 | 2003/6/1 | 1748 | 2003/9/1 | 1958 | 210.00 | 92.00 | 2.28 | 326.09 |
| 20 | 50 | 13 | 2002/12/1 | 1210 | 2003/2/28 | 1300 | 90.00 | 89 | 1.01 | 77.79 | 2003/3/1 | 1300 | 2003/6/1 | 1400 | 100.00 | 92 | 1.09 | 83.61 | 2003/6/1 | 1400 | 2003/9/1 | 1610 | 210.00 | 92.00 | 2.28 | 175.59 |
| 44 | 30 | 10 | 2002/12/1 | 600 | 2003/2/28 | 629 | 29.00 | 89 | 0.33 | 32.58 | 2003/3/1 | 630 | 2003/6/1 | 750 | 120.00 | 92 | 1.30 | 130.43 | 2003/6/1 | 750 | 2003/9/1 | 930 | 180.00 | 92.00 | 1.96 | 195.65 |
| 54 | 50 | 4 | 2002/12/1 | 127 | 2003/2/28 | 150 | 23.00 | 89 | 0.26 | 64.61 | 2003/3/1 | 151 | 2003/6/1 | 160 | 9.00 | 92 | 0.10 | 24.46 | 2003/6/1 | 160 | 2003/9/1 | 207 | 47.00 | 92.00 | 0.51 | 127.72 |
| 56 | 50 | 9 | 2002/12/1 | 690 | 2003/2/28 | 712 | 22.00 | 89 | 0.25 | 27.47 | 2003/3/1 | 713 | 2003/6/1 | 753 | 40.00 | 92 | 0.43 | 48.31 | 2003/6/1 | 753 | 2003/9/1 | 812 | 59.00 | 92.00 | 0.64 | 71.26 |
| 16 | 50 | 10 | 2002/12/1 | 110 | 2003/2/28 | 130 | 20.00 | 89 | 0.22 | 22.47 | 2003/3/1 | 130 | 2003/6/1 | 160 | 30.00 | 92 | 0.33 | 32.61 | 2003/6/1 | 160 | 2003/9/1 | 190 | 30.00 | 92.00 | 0.33 | 32.61 |
| 16 | 50 | 5 | 2002/12/1 | 50 | 2003/2/28 | 70 | 20.00 | 89 | 0.22 | 44.94 | 2003/3/1 | 70 | 2003/6/1 | 85 | 15.00 | 92 | 0.16 | 32.61 | 2003/6/1 | 85 | 2003/9/1 | 110 | 25.00 | 92.00 | 0.27 | 54.35 |
| 24 | 25 | 9 | 2002/12/1 | 40 | 2003/2/28 | 55 | 15.00 | 89 | 0.17 | 18.73 | 2003/3/1 | 55 | 2003/6/1 | 70 | 15.00 | 92 | 0.16 | 18.12 | 2003/6/1 | 70 | 2003/9/1 | 90 | 20.00 | 92.00 | 0.22 | 24.15 |
| 12 | 25 | 6 | 2002/12/1 | 100 | 2003/2/28 | 115 | 15.00 | 89 | 0.17 | 28.09 | 2003/3/1 | 115 | 2003/6/1 | 120 | 5.00 | 92 | 0.05 | 9.06 | 2003/6/1 | 120 | 2003/9/1 | 135 | 15.00 | 92.00 | 0.16 | 27.17 |
| 18 | 50 | 7 | 2002/12/1 | 60 | 2003/2/28 | 75 | 15.00 | 89 | 0.17 | 24.08 | 2003/3/1 | 76 | 2003/6/1 | 96 | 20.00 | 92 | 0.22 | 31.06 | 2003/6/1 | 97 | 2003/9/1 | 117 | 20.00 | 92.00 | 0.22 | 31.06 |
| 12 | 50 | 6 | 2002/12/1 | 90 | 2003/2/28 | 103 | 13.00 | 89 | 0.15 | 24.34 | 2003/3/1 | 104 | 2003/6/1 | 116 | 12.00 | 92 | 0.13 | 21.74 | 2003/6/1 | 117 | 2003/9/1 | 130 | 13.00 | 92.00 | 0.14 | 23.55 |
| 10 | 50 | 3 | 2002/12/1 | 75 | 2003/2/28 | 100 | 25.00 | 89 | 0.28 | 93.63 | 2003/3/1 | 101 | 2003/6/1 | 114 | 13.00 | 92 | 0.14 | 47.10 | 2003/6/1 | 115 | 2003/9/1 | 132 | 17.00 | 92.00 | 0.18 | 61.59 |
| 12 | 50 | 10 | 2002/12/1 | 80 | 2003/2/28 | 101 | 21.00 | 89 | 0.24 | 23.60 | 2003/3/1 | 102 | 2003/6/1 | 120 | 18.00 | 92 | 0.20 | 19.57 | 2003/6/1 | 121 | 2003/9/1 | 140 | 19.00 | 92.00 | 0.21 | 20.65 |
| 10 | 50 | 3 | 2002/12/1 | 70 | 2003/2/28 | 80 | 10.00 | 89 | 0.11 | 37.45 | 2003/3/1 | 81 | 2003/6/1 | 95 | 14.00 | 92 | 0.15 | 50.72 | 2003/6/1 | 96 | 2003/9/1 | 120 | 24.00 | 92.00 | 0.26 | 86.96 |
| 7 | 50 | 12 | 2002/12/1 | 84 | 2003/2/28 | 100 | 16.00 | 89 | 0.18 | 14.98 | 2003/3/1 | 101 | 2003/6/1 | 120 | 19.00 | 92 | 0.21 | 17.21 | 2003/6/1 | 121 | 2003/9/1 | 140 | 19.00 | 92.00 | 0.21 | 17.21 |
| 28 | 50 | 6 | 2002/12/1 | 97 | 2003/2/28 | 110 | 13.00 | 89 | 0.15 | 24.34 | 2003/3/1 | 111 | 2003/6/1 | 125 | 14.00 | 92 | 0.15 | 25.36 | 2003/6/1 | 126 | 2003/9/1 | 144 | 18.00 | 92.00 | 0.20 | 32.61 |
| 42 | 50 | 5 | 2002/12/1 | 100 | 2003/2/28 | 111 | 11.00 | 89 | 0.12 | 24.72 | 2003/3/1 | 112 | 2003/6/1 | 127 | 15.00 | 92 | 0.16 | 32.61 | 2003/6/1 | 128 | 2003/9/1 | 147 | 19.00 | 92.00 | 0.21 | 41.30 |
| 13 | 50 | 6 | 2002/12/1 | 106 | 2003/2/28 | 120 | 14.00 | 89 | 0.16 | 26.22 | 2003/3/1 | 121 | 2003/6/1 | 135 | 14.00 | 92 | 0.15 | 25.36 | 2003/6/1 | 136 | 2003/9/1 | 150 | 14.00 | 92.00 | 0.15 | 25.36 |
| 2 | 50 | 6 | 2002/12/1 | 60 | 2003/2/28 | 72 | 12.00 | 89 | 0.13 | 22.47 | 2003/3/1 | 73 | 2003/6/1 | 85 | 12.00 | 92 | 0.13 | 21.74 | 2003/6/1 | 86 | 2003/9/1 | 100 | 14.00 | 92.00 | 0.15 | 25.36 |
| 5 | 50 | 7 | 2002/12/1 | 100 | 2003/2/28 | 112 | 12.00 | 89 | 0.13 | 19.26 | 2003/3/1 | 113 | 2003/6/1 | 130 | 17.00 | 92 | 0.18 | 26.40 | 2003/6/1 | 131 | 2003/9/1 | 150 | 19.00 | 92.00 | 0.21 | 29.50 |
| 37 | 50 | 5 | 2002/12/1 | 315 | 2003/2/28 | 412 | 97.00 | 89 | 1.09 | 217.98 | 2003/3/1 | 412 | 2003/5/30 | 486 | 74.00 | 90 | 0.82 | 164.44 | 2003/6/1 | 487 | 2003/8/31 | 618 | 131.00 | 91.00 | 1.44 | 287.91 |
| 1 | 50 | 7 | 2002/12/1 | 372 | 2003/2/28 | 475 | 103.00 | 89 | 1.16 | 165.33 | 2003/3/4 | 475 | 2003/5/30 | 562 | 87.00 | 87 | 1.00 | 6.05 | 2003/6/1 | 562 | 2003/8/31 | 693 | 131.00 | 91.00 | 1.44 | 238.00 |
| 17 | 50 | 6 | 2002/12/1 | 349 | 2003/2/28 | 412 | 63.00 | 89 | 0.71 | 117.98 | 2003/3/1 | 412 | 2003/5/30 | 549 | 137.00 | 90 | 1.52 | 12.90 | 2003/6/1 | 549 | 2003/8/31 | 705 | 156.00 | 91.00 | 1.71 | 132.86 |
| 33 | 50 | 7 | 2002/12/1 | 400 | 2003/2/28 | 507 | 107.00 | 89 | 1.20 | 171.75 | 2003/3/1 | 507 | 2003/5/30 | 589 | 82.00 | 90 | 0.91 | 5.30 | 2003/6/1 | 589 | 2003/8/31 | 710 | 121.00 | 91.00 | 1.33 | 250.65 |
| 35 | 50 | 5 | 2002/12/1 | 165 | 2003/2/28 | 196 | 31.00 | 89 | 0.35 | 69.66 | 2003/3/1 | 196 | 2003/5/30 | 209 | 13.00 | 90 | 0.14 | 2.07 | 2003/6/1 | 209 | 2003/8/31 | 329 | 120.00 | 91.00 | 1.32 | 635.98 |
| 39 | 50 | 6 | 2002/12/1 | 205 | 2003/2/28 | 230 | 25.00 | 89 | 0.28 | 46.82 | 2003/3/1 | 230 | 2003/5/30 | 285 | 55.00 | 90 | 0.61 | 13.05 | 2003/6/1 | 285 | 2003/8/31 | 392 | 107.00 | 91.00 | 1.18 | 90.08 |
| 47 | 50 | 11 | 2002/12/1 | 136 | 2003/2/28 | 194 | 58.00 | 89 | 0.65 | 59.24 | 2003/3/1 | 194 | 2003/5/30 | 300 | 106.00 | 90 | 1.18 | 19.88 | 2003/6/1 | 300 | 2003/8/31 | 429 | 129.00 | 91.00 | 1.42 | 71.31 |
| 41 | 50 | 7 | 2002/12/1 | 370 | 2003/2/28 | 489 | 119.00 | 89 | 1.34 | 191.01 | 2003/3/1 | 489 | 2003/5/30 | 553 | 64.00 | 90 | 0.71 | 3.72 | 2003/6/1 | 553 | 2003/8/31 | 680 | 127.00 | 91.00 | 1.40 | 374.87 |
| 43 | 50 | 6 | 2002/12/1 | 300 | 2003/2/28 | 358 | 58.00 | 89 | 0.65 | 108.61 | 2003/3/6 | 359 | 2003/5/30 | 401 | 42.00 | 85 | 0.49 | 4.55 | 2003/6/1 | 401 | 2003/8/31 | 489 | 88.00 | 91.00 | 0.97 | 212.57 |
| 42 | 50 | 3 | 2002/12/1 | 290 | 2003/2/28 | 351 | 61.00 | 89 | 0.69 | 228.46 | 2003/3/6 | 351 | 2003/5/30 | 455 | 104.00 | 85 | 1.22 | 5.36 | 2003/6/1 | 455 | 2003/8/31 | 605 | 150.00 | 91.00 | 1.65 | 307.79 |
| 198 | 25 | 7 | 2002/12/1 | 125 | 2003/2/28 | 145 | 20.00 | 89 | 0.22 | 32.10 | 2003/3/6 | 145 | 2003/5/30 | 170 | 25.00 | 85 | 0.29 | 9.16 | 2003/6/1 | 170 | 2003/8/31 | 220 | 50.00 | 91.00 | 0.55 | 59.97 |
| 222 | 25 | 9 | 2002/12/1 | 117 | 2003/2/28 | 139 | 22.00 | 89 | 0.25 | 27.47 | 2003/3/6 | 139 | 2003/5/30 | 164 | 25.00 | 85 | 0.29 | 10.71 | 2003/6/1 | 164 | 2003/8/31 | 210 | 46.00 | 91.00 | 0.51 | 47.20 |
| 224 | 25 | 6 | 2002/12/1 | 674 | 2003/2/28 | 687 | 13.00 | 89 | 0.15 | 24.34 | 2003/3/6 | 687 | 2003/5/30 | 715 | 28.00 | 85 | 0.33 | 13.53 | 2003/6/1 | 715 | 2003/8/31 | 765 | 50.00 | 91.00 | 0.55 | 40.61 |
| 19a | 25 | 6 | 2002/12/1 | 200 | 2003/2/28 | 220 | 20.00 | 89 | 0.22 | 37.45 | 2003/3/6 | 220 | 2003/5/30 | 249 | 29.00 | 85 | 0.34 | 9.11 | 2003/6/1 | 249 | 2003/8/31 | 300 | 51.00 | 91.00 | 0.56 | 61.52 |
| 258 | 50 | 3 | 2002/12/1 | 71 | 2003/2/28 | 82 | 11.00 | 89 | 0.12 | 41.20 | 2003/3/6 | 82 | 2003/5/30 | 107 | 25.00 | 85 | 0.29 | 7.14 | 2003/6/1 | 107 | 2003/8/31 | 127 | 20.00 | 91.00 | 0.22 | 30.79 |
| 260 | 25 | 4 | 2002/12/1 | 88 | 2003/2/28 | 100 | 12.00 | 89 | 0.13 | 33.71 | 2003/3/6 | 100 | 2003/5/30 | 115 | 15.00 | 85 | 0.18 | 5.24 | 2003/6/1 | 115 | 2003/8/31 | 155 | 40.00 | 91.00 | 0.44 | 83.96 |
| 266 | 25 | 8 | 2002/12/1 | 250 | 2003/2/28 | 272 | 22.00 | 89 | 0.25 | 30.90 | 2003/3/6 | 272 | 2003/5/30 | 305 | 33.00 | 85 | 0.39 | 12.56 | 2003/6/1 | 305 | 2003/8/31 | 345 | 40.00 | 91.00 | 0.44 | 34.98 |
| 260a | 25 | 5 | 2002/12/1 | 157 | 2003/2/28 | 170 | 13.00 | 89 | 0.15 | 29.21 | 2003/3/6 | 170 | 2003/5/30 | 187 | 17.00 | 85 | 0.20 | 6.85 | 2003/6/1 | 187 | 2003/8/31 | 238 | 51.00 | 91.00 | 0.56 | 81.86 |
| 262 | 25 | 2 | 2002/12/1 | 43 | 2003/2/28 | 47 | 4.00 | 89 | 0.04 | 22.47 | 2003/3/6 | 47 | 2003/5/30 | 60 | 13.00 | 85 | 0.15 | 6.81 | 2003/6/1 | 60 | 2003/8/31 | 80 | 20.00 | 91.00 | 0.22 | 32.29 |
| t5 h6a | 25 | 11 | 2002/12/1 | 140 | 2003/2/28 | 161 | 21.00 | 89 | 0.24 | 21.45 | 2003/3/6 | 161 | 2003/5/30 | 193 | 32.00 | 85 | 0.38 | 17.55 | 2003/6/1 | 193 | 2003/8/31 | 260 | 67.00 | 91.00 | 0.74 | 41.95 |
| 193 | 25 | 4 | 2002/12/1 | 350 | 2003/2/28 | 367 | 17.00 | 89 | 0.19 | 47.75 | 2003/3/6 | 367 | 2003/5/30 | 390 | 23.00 | 85 | 0.27 | 5.67 | 2003/6/1 | 390 | 2003/8/31 | 448 | 58.00 | 91.00 | 0.64 | 112.48 |
| 229 | 50 | 5 | 2002/12/1 | 80 | 2003/2/28 | 96 | 16.00 | 89 | 0.18 | 35.96 | 2003/3/6 | 96 | 2003/5/30 | 128 | 32.00 | 85 | 0.38 | 10.47 | 2003/6/1 | 128 | 2003/8/31 | 177 | 49.00 | 91.00 | 0.54 | 51.43 |
| 197 | 50 | 7 | 2002/12/1 | 116 | 2003/2/28 | 133 | 17.00 | 89 | 0.19 | 27.29 | 2003/3/6 | 133 | 2003/5/30 | 160 | 27.00 | 85 | 0.32 | 11.64 | 2003/6/1 | 160 | 2003/8/31 | 205 | 45.00 | 91.00 | 0.49 | 42.48 |
| 225 | 50 | 2 | 2002/12/1 | 75 | 2003/2/28 | 81 | 6.00 | 89 | 0.07 | 33.71 | 2003/3/6 | 81 | 2003/5/30 | 92 | 11.00 | 85 | 0.13 | 3.84 | 2003/6/1 | 92 | 2003/8/31 | 115 | 23.00 | 91.00 | 0.25 | 65.83 |
| 225a | 100 | 5 | 2002/12/1 | 100 | 2003/2/28 | 116 | 16.00 | 89 | 0.18 | 35.96 | 2003/3/6 | 116 | 2003/5/30 | 141 | 25.00 | 85 | 0.29 | 8.18 | 2003/6/1 | 141 | 2003/8/31 | 187 | 46.00 | 91.00 | 0.51 | 61.80 |
| | | 318 | | | | | | | 18.27 | 57 | | | | | | | 26.98 | 85 | | | | | | | 39.45 | 124 |

# S 2.3.5 Water Analysis for Raw Water of WTP and Distribution Water

## (1) Sampling Schedule and Points

1) Sampling number and shedule

Target water for sampling and analysis to evaluate operation of water supply system in this Study are raw water of large scale WTPs, Kadirya, Kibray, Boz-su and South, and distribution water in the City at three Districts.

The raw water for Kadirya and Boz-su WTPs is taken from the Boz-su Canal, and Kadirya WTP is located in upstream of the Canal. That for Kibray and South WTP is taken groundwater by wells.

Basically, the sampling from the Boz-su Canal was planned to be carried out in early spring season, when the surface water is muddy due to the thaw of snow. In 2004, since the Boz-su Canal had already been muddy in middle of February, the sampling day on Feb. 25$^{th}$ was decided. However unfortunately the turbidity value of the water was not so high. Other samplings for groundwater and distribution water were decided to match with the day to sample the surface water. The sampling from distribution pipes was carried out on Feb.26$^{th}$.

When the Team took the raw water samples, the analysts of Vodokanal assigned at each WTP also take same sample.

2) Sampling points

Since the sampling points from Boz-su Canal for Kadirya and Boz-su WTP had been already decided as regular points, the Team sampled from the points. At Kibray WTP, the Team took the sample water from Well No. 66 at left bank, because the Team could not take it from the transmission pipe, which transmits well's yield water from the left bank to the reservoir and the Team intended to take from, because of minus pressure of the pipe. From South WTP the team sampled from transmission pipe for well No.2 –No.6.

Sampling points from distribution pipes was decided at; Mirzo Ulugbek District as Southeast area of the City distributed from Kadirya WTP, Yunusabad District as North area of the City distributed from Boz-su WTP and Sergeli District as South area of the City distributed by Kibray WTP. The water was taken from taps in the City.

**(2) Analysis Results and Evaluation**

Analysis results for raw water are shown in Table S 2.3.5.1, and that for distribution water is shown in Table S 2.3.5.2.

1) Evaluation of analysis results conducted by the Team and Vodokanal

The team contracted out the water sampling and analysis to a public company and the analysis was actually carried out by a small official laboratory organization. Therefore it was a comparison of analysis results between a laboratory organization and each Vodokanal's laboratory of WTP.

As shown in Table S 2.3.5.1 and S 3.3.5.2, the value differences of a lot of results are from 20 to 50%, and it is difficult to determine which value is exact. Therefore, analysis accuracy need to be improved.

2) Evaluation of surface water quality

As shown in Table S.2.3.5.1, most concentrations of analysis items for Boz-su are higher than those of Kadirya WTP. The discharged sedimentation sludge and washed water of rapid filter form Kadirya WTP may affect the quality.

Some items exceed the national drinking water standard, however since these materials can be removed by the water treatment process, both of the quality has no problems as raw water of WTP.

3) Evaluation of Groundwater quality

As shown in Table S 2.3.5.2, quality of Kibray WTP is better than that of South WTP. The value of total hardness and manganese of South WTP is over the standard. However because the exceeded extent of hardness to standard is small, distribution water is lower than the standard value by mixing with other yield water. While that of manganese is large, it may be problem for consumers because of color by the manganese.

**Table S 2.3.5.1 Analysis Results of Raw Water**

| No. | Items | Units | Analysis Method | Standard Value | Kadirya WTP | | Boz-su WTP | | Kibray WTP | | South WTP | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Team | Vodo. | Team | Vodo. | Team | Vodo. | Team | Vodo. |
| | | | | | Boz-su Canal | | Boz-su Canal | | Wells at Left B | | Combined Well | |
| 1 | Temperature | C° | 3351-46 | -- | 5 | | 11 | | 7 | | 17 | |
| 2 | Odor by $20^0/60^0$ | | 3351-74 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | Taste by $20^0$ | | 3351-74 | 2 | | | | | 0 | | 0 | |
| 4 | Color | C° | 3351-74 | 20 | 5 | | 5 | | 0 | | 0 | |
| 5 | Turbidity*1 | mg/L | 3351-74 | 1.5 | --- | 24 | --- | 40 | --- | 0 | --- | 0 |
| 6 | Sediment (description) | | | | ND | | ND | | ND | | ND | |
| 7 | pH | pH | 2874-82 | 6-9 | 7.0 | 8.2 | 7.7 | 8 | 7.7 | 8 | 6.5 | 7.5 |
| 8 | Acidity | mgO$_2$/L | | | 1.68 | 0.68 | 1.76 | 0.81 | 1.2 | 0.48 | 1.52 | 1.56 |
| 9 | Ammonia | mg/L | 4192-48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | Nitrite | mg/L | 4192-48 | 3 | 0.03 | 0.01 | 0.04 | 0 | 0.01 | 0 | 0.04 | 0 |
| 11 | Nitrate | mg/L | 18826-73 | 45 | 0.9 | 2.12 | 1.0 | 2.8 | 0.9 | 3.99 | 27 | 28.7 |
| 12 | General hardness*2 | mg-eqv/L | 4151-72 | 7 | 2.50 | 2.37 | 2.55 | 2.6 | 2.90 | 3.00 | 7.5 | 8.2 |
| 13 | Total solid | mg/L | 18164-72 | 1000 | | | | 12.9 | | | | |
| 14 | Sulfate | mg/L | 4389-72 | 400 | 25 | 14.5 | 32 | 18.2 | 45 | 23.5 | 163 | 94 |
| 15 | Iron | mg/L | 4011-72 | 0.3 | ND | 0.122 | ND | 0.23 | ND | 0 | ND | 0 |
| 16 | Chloride | mg/L | 4245-72 | 250 | 4.5 | 2.73 | 5.0 | 3.5 | 8.5 | 6.5 | 20 | 26 |
| 17 | Copper | mg/L | 4389-72 | 1 | 0.07 | 0.07 | 0.07 | 0.13 | 0.03 | | 0.04 | |
| 18 | Zinc | mg/L | 18293-72 | 3 | 2.59 | 0 | 2.75 | 0 | 2.99 | | 2.28 | |
| 19 | Arsenic | mg/L | 18294-72 | 0.05 | ND | 0 | ND | 0 | ND | | ND | |
| 20 | Lead | mg/L | 18293-72 | 0.03 | 0.03 | 0.03 | 0.03 | 0 | ND | | 0.03 | |
| 21 | Fluorine | mg/L | 4386-72 | 0.7 | 0.15 | 0.71 | 0.24 | 0.25 | 0.27 | | 0.29 | |
| 22 | Cyanide | mg/L | | | ND | | ND | | ND | | | |
| 23 | Mercury | mg/L | ISO 5666/3-84 | 0.0005 | ND | | ND | | ND | | | |
| 24 | Polyphosphate | mg/L | 18309-72 | 3.5 | 0.01 | 0.01 | ND | 0 | 0.04 | | ND | |
| 25 | Chromium($Cr^{+6}$) | mg/L | ISO 9174-90 | 0.06 | ND | | ND | | ND | | 0.029 | |
| 26 | Cadmium | mg/L | ISO 5961-85 | 0.001 | ND | | ND | | ND | | ND | |
| 27 | Manganese | mg/L | 4974-72 | 0.1 | 0.01 | 0.01 | ND | 0 | 0.02 | | 0.23 | |
| 28 | Alkalinity*3 | mg-eqv/L | 23268.3-78 | | 2.30 | 1.52 | 2.10 | 2.20 | 2.30 | 2.35 | 2.90 | 3.20 |
| 29 | Calcium hardness | mg-eqv/L | | | 2.0 | | 1.50 | | 2.50 | | | |
| 30 | Magnesium hardness | mg-eqv/L | | | 0.50 | | 1.05 | | 0.40 | | | |
| 31 | Calcium | mg/L | | | 40.08 | | 30.06 | | 51.10 | | | |
| 32 | Magnesium | mg/L | | | 6.08 | | 12.77 | | 4.86 | | | |
| 33 | Total bacteria | | 18963-73 | 1000 | 600 | | 6200 | | 93 | | 4 | |
| 34 | Coliform | in 1 ml | 18963-73 | 3 | ND | | ND | | ND | | ND | |
| 35 | Pathogenic flora | | | | ND | | ND | | | | | |

*1:The laboratory analyzed for the Team cannot obtain the Standard bottles for Turbidity analysis
*2: Equivalent of $Na_2CO_3$ (atomic number=53)
*3: Equivalent of Na OH (atomic number=40)

A feature of water quality of relative high concentration of zinc, and the values are near to standard value.

4) Evaluation of distribution standard

There is no problem for distribution water as shown in Table S 2.3.5.2.

**Table S 2.3.5.1 Analysis Results of Distribution Water**

| No. | Items | Units | Method | Standad Value | Pipeline in District | | |
|---|---|---|---|---|---|---|---|
| | | | | | Mirzo Ulugbek | Yunusabad | Sergeli |
| 1 | Temperature | C° | 3351-46 | --- | 5 | 5 | 9 |
| 2 | Odor by 20⁰/60⁰ | | 3351-74 | --- | 0 | 0 | 0 |
| 3 | Flavor by 20⁰ | | 3351-74 | 2 | 0 | 0 | 0 |
| 4 | Color | C° | 3351-74 | 20 | 0 | 0 | 0 |
| 5 | Turbidity | mg/L | 3351-74 | 1.5 | --- | --- | --- |
| 6 | Sediment (description) | | | | ND | ND | ND |
| 7 | PH | pH | 2874-82 | 6-9 | 7.5 | 7.3 | 7.0 |
| 8 | Free chlorine | mg/L | 18190-72 | 0.2 | 0.4 | 0.3 | 0.2 |
| 9 | Nitrite | mg/L | 4192-48 | 3 | 0.013 | 0.003 | 0 |
| 10 | Nitrate | mg/L | 18826-73 | 45 | 1.0 | 1.0 | 1 |
| 11 | General hardness | mg-eqv/L | 4151-72 | 7 | 2.90 | 2.35 | 3.20 |
| 12 | Sulfate | mg/L | 4389-72 | 400 | 32 | 29 | 36 |
| 13 | Iron | mg/L | 4011-72 | 0.3 | ND | ND | ND |
| 14 | Chloride | mg/L | 4245-72 | 250 | 7.0 | 5.0 | 6.0 |
| 15 | Copper | mg/L | 4389-72 | 1 | 0.06 | 0.07 | 0.05 |
| 16 | Zinc | mg/L | 18293-72 | 3 | 2.55 | 1.06 | 2.72 |
| 17 | Arsenic | mg/L | 18294-72 | 0.05 | ND | ND | ND |
| 18 | Lead | mg/L | 18293-72 | 0.03 | ND | ND | ND |
| 19 | Fluorine | mg/L | 4386-72 | 0.7 | 0.16 | 0.14 | 0.05 |
| 20 | Polyphosphate | mg/L | 18309-72 | 3.5 | ND | ND | ND |
| 21 | Chromium | mg/L | ISO 9174-90 | 0.06 | ND | 0.008 | 0.002 |
| 22 | Cadmium | mg/L | ISO 5961-85 | 0.001 | ND | ND | ND |
| 23 | Manganese | mg/L | 4974-72 | 0.1 | 0.01 | ND | ND |
| 24 | Coli-index | | 18963-73 | 1000 | < 3 | < 3 | < 3 |
| 25 | Colonies number | in 1 ml | 18963-73 | 3 | ND | ND | 1 |

# S 2.3.6 Operation Status for Tashkent Water Supply System

## (1) Balance of Water Distribution and Consumption by Consumers

Monthly water distribution amounts from each WTP from year 2000 to 2002 are shown in Table S 2.3.6.1. Table S 2.3.6.2 shows charged monthly water consumption (counted-for-water) in the city. The differences between distribution and consumption quantity are shown in Table S 2.3.6.3.

**Table S 2.3.6.3 Difference of distribution and consumption**.

| Year | Water Quantity ($10^6 m^3$/year) | | | Rate (%) |
|---|---|---|---|---|
| | Distribution | Charged Consumption | Difference | |
| 2000 | 833.7 | 603.7 | 230.0 | 27.6 |
| 2001 | 807.4 | 587.6 | 219.7 | 27.2 |
| 2003 | 754.3 | 540.3 | 214.0 | 28.4 |

As shown in the table, the difference of quantity (non-revenue water) is around 28% in these three years. However the actual consumption of individual customers are more than the consumption of charged water consumption since there are large differences between Norma (330L/capita/day) and actual consumption (580L/capita/day) for the apartment residents whose population is around 65% of the city.

As the result of comparison between actual water consumption of and distribution quantity shown in Table S 2.3.6.1, the water loss rate of water supply system was 10 to 20%.

The distribution flow pattern of the city in 1999 was shown in Figure S 2.3.6.1, and it is assumed that the pattern was almost same in 2003. The figure shows that there is large loss of distribution water in the distribution network, because although actual consumption in the City should be largely fluctuated between in daytime and in nighttime, the flow pattern was almost flat.

Therefore the Team started to investigate the record of the intake pump operation and flow measurement at large scale WTPs. Result of that, the Team found the flow record of Kadirya WTP as shown in Table S 2.3.6.1 was doubtful.

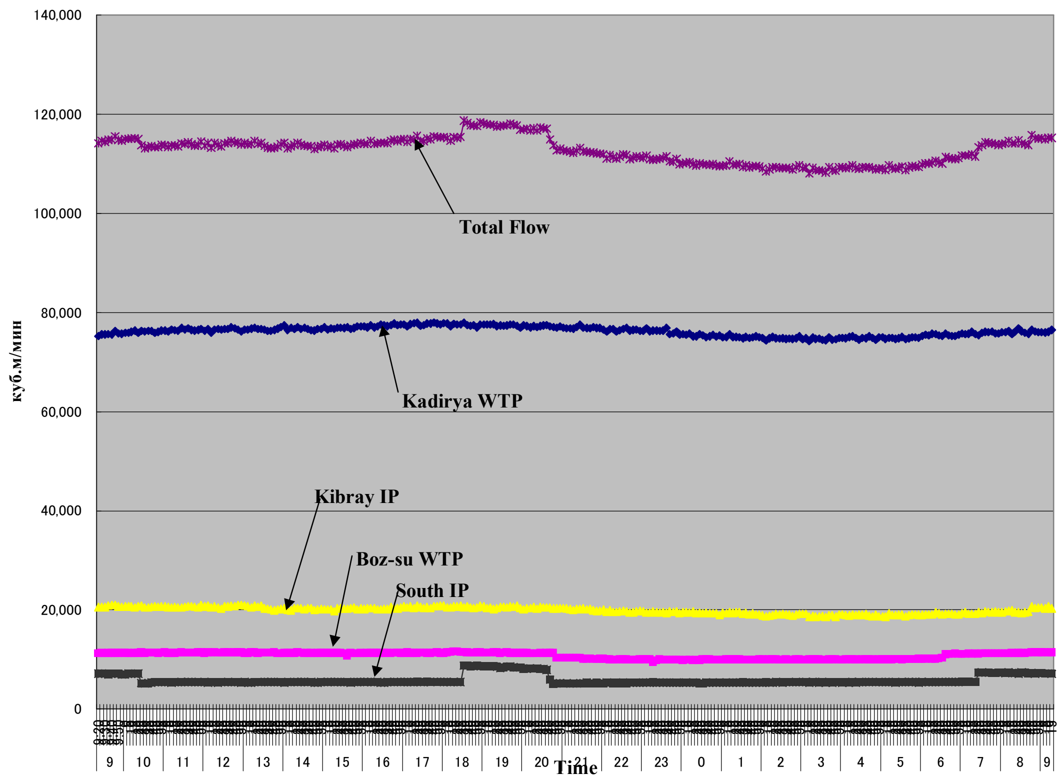
**Table S 2.3.6.1 Monthly Water Distribution Amount to the City from WTPs**

| Name | Year | Capacity $10^3m^3/d$ | Daily Quantity ($10^3m^3$) | | | | | | | | | | | | | Annual Total ($10^6m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Average | |
| Kadirya | 2000 | 1,375 | 1,412.7 | 1,419.0 | 1,207.0 | 1,245.8 | 1,308.5 | 1,437.9 | 1,585.8 | 1,573.8 | 1,356.5 | 1,241.1 | 1,216.1 | 1,318.4 | 1,360.2 | 496.5 |
| | 2001 | | 1,235.8 | 1,295.6 | 1,181.5 | 1,292.4 | 1,334.8 | 1,470.5 | 1,540.8 | 1,526.6 | 1,385.9 | 1,265.3 | 1,270.3 | 1,300.9 | 1,341.9 | 489.8 |
| | 2002 | | 1,235.2 | 1,180.9 | 1,152.1 | 1,280.0 | 1,193.1 | 1,316.8 | 1,326.0 | 1,369.0 | 1,386.5 | 1,173.1 | 1,130.6 | 1,162.4 | 1,242.2 | 453.4 |
| Boz-su | 2000 | 235.6 | 256.0 | 246.7 | 230.2 | 230.5 | 250.8 | 270.5 | 270.5 | 271.1 | 250.7 | 241.2 | 250.8 | 289.5 | 255.0 | 93.1 |
| | 2001 | | 227.4 | 225.2 | 226.9 | 238.8 | 254.7 | 275.4 | 262.8 | 252.7 | 255.8 | 245.9 | 261.2 | 270.5 | 249.9 | 91.2 |
| | 2002 | | 227.2 | 224.9 | 226.7 | 236.9 | 228.6 | 247.8 | 225.4 | 226.8 | 255.9 | 227.1 | 232.9 | 244.7 | 233.7 | 85.3 |
| Kibray | 2000 | 455.2 | 401.2 | 387.0 | 400.4 | 331.1 | 353.1 | 445.2 | 478.8 | 481.3 | 436.2 | 394.9 | 393.5 | 376.4 | 406.8 | 148.5 |
| | 2001 | | 374.6 | 372.2 | 374.2 | 310.9 | 328.7 | 416.1 | 442.4 | 430.0 | 406.6 | 369.7 | 399.1 | 348.4 | 381.1 | 139.1 |
| | 2002 | | 374.3 | 338.9 | 364.8 | 310.1 | 295.6 | 374.4 | 379.7 | 385.5 | 406.8 | 342.5 | 359.0 | 310.7 | 353.5 | 129.0 |
| South | 2000 | 143 | 198.0 | 189.8 | 163.8 | 168.2 | 174.5 | 215.2 | 155.3 | 155.6 | 155.3 | 122.9 | 140.7 | 172.5 | 167.4 | 61.1 |
| | 2001 | | 150.1 | 150.4 | 124.3 | 126.6 | 130.7 | 156.5 | 155.0 | 155.8 | 155.2 | 121.5 | 141.4 | 150.0 | 143.0 | 52.2 |
| | 2002 | | 150.0 | 150.1 | 124.3 | 125.0 | 130.0 | 155.1 | 155.1 | 155.1 | 155.1 | 120.0 | 140.0 | 150.3 | 142.4 | 52.0 |
| Sergeri | 2000 | 40 | 23.5 | 23.9 | 15.5 | 17.0 | 17.8 | 30.6 | 31.1 | 31.1 | 30.6 | 15.5 | 17.0 | 23.5 | 23.1 | 8.4 |
| | 2001 | | 23.5 | 24.8 | 15.5 | 16.5 | 17.8 | 29.6 | 30.8 | 30.9 | 30.6 | 15.3 | 16.5 | 23.0 | 22.9 | 8.4 |
| | 2002 | | 22.5 | 23.8 | 15.4 | 17.5 | 17.0 | 30.5 | 31.0 | 31.1 | 30.5 | 15.2 | 16.7 | 23.5 | 22.9 | 8.3 |
| Bektemir | 2000 | 20 | 23.5 | 22.7 | 23.5 | 23.5 | 23.5 | 23.5 | 23.5 | 23.5 | 23.5 | 23.5 | 23.4 | 23.5 | 23.4 | 8.6 |
| | 2001 | | 23.5 | 23.5 | 23.5 | 23.5 | 23.5 | 23.5 | 23.0 | 23.5 | 23.0 | 23.5 | 23.5 | 23.0 | 23.4 | 8.5 |
| | 2002 | | 23.1 | 23.2 | 23.0 | 23.1 | 23.0 | 23.4 | 23.1 | 23.5 | 23.2 | 23.1 | 23.0 | 23.5 | 23.2 | 8.5 |
| Kara-Su | 2000 | 20 | 24.6 | 23.7 | 24.6 | 25.4 | 30.4 | 34.6 | 35.3 | 35.3 | 30.2 | 25.1 | 25.1 | 25.1 | 28.3 | 10.3 |
| | 2001 | | 25.1 | 25.1 | 28.8 | 30.2 | 31.0 | 35.3 | 34.6 | 35.3 | 29.6 | 25.1 | 25.1 | 24.6 | 29.2 | 10.6 |
| | 2002 | | 24.7 | 24.8 | 24.6 | 29.7 | 30.4 | 35.3 | 34.8 | 35.3 | 29.8 | 24.7 | 24.6 | 25.1 | 28.7 | 10.5 |
| Kuiluk | 2000 | 20 | 21.9 | 20.0 | 14.8 | 15.3 | 13.5 | 25.0 | 25.0 | 25.0 | 25.5 | 15.1 | 13.6 | 22.4 | 19.8 | 7.2 |
| | 2001 | | 22.4 | 21.1 | 15.1 | 13.6 | 13.8 | 26.2 | 26.2 | 27.0 | 25.5 | 17.1 | 14.5 | 23.5 | 20.5 | 7.5 |
| | 2002 | | 22.0 | 20.5 | 15.1 | 14.5 | 13.5 | 25.6 | 25.5 | 26.3 | 25.5 | 14.9 | 13.3 | 22.4 | 19.9 | 7.3 |
| Total | 2000 | 2,309 | 2,361.4 | 2,332.8 | 2,079.8 | 2,056.8 | 2,172.1 | 2,482.5 | 2,605.3 | 2,596.7 | 2,308.5 | 2,079.3 | 2,080.2 | 2,251.3 | 2,284.1 | 833.7 |
| | 2001 | | 2,082.4 | 2,137.9 | 1,989.8 | 2,052.5 | 2,135.0 | 2,433.1 | 2,515.6 | 2,481.8 | 2,312.2 | 2,083.4 | 2,151.6 | 2,163.9 | 2,211.9 | 807.4 |
| | 2002 | | 2,079.0 | 1,987.1 | 1,946.0 | 2,036.8 | 1,931.2 | 2,208.9 | 2,200.6 | 2,252.6 | 2,313.3 | 1,940.6 | 1,940.1 | 1,962.6 | 2,066.6 | 754.3 |

**Table S 2.3.6.2 Monthly Tariff Base Water Consumption of the City**

| Year | Item | | | Quantity ($10^3m^3$) Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Annual Total ($10^6m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2000 | Individual | | monthly | 24,000 | 24,100 | 21,200 | 21,300 | 21,300 | 21,700 | 22,250 | 21,510 | 21,500 | 21,200 | 21,200 | 21,200 | 262,460 |
| | Public | | monthly | 8,525 | 8,147 | 6,366 | 6,431 | 6,497 | 7,052 | 7,696 | 8,012 | 6,794 | 6,126 | 6,101 | 6,430 | 84,177 |
| | Other Large | | monthly | 23,471 | 23,385 | 20,443 | 20,354 | 20,364 | 19,366 | 19,885 | 19,078 | 19,838 | 21,855 | 21,877 | 27,177 | 257,093 |
| | Total | | monthly | 55,995 | 55,632 | 48,009 | 48,085 | 48,162 | 48,118 | 49,831 | 48,600 | 48,132 | 49,182 | 49,178 | 54,807 | 603,730 |
| | | | daily | 1,806 | 1,987 | 1,549 | 1,603 | 1,554 | 1,604 | 1,607 | 1,568 | 1,604 | 1,587 | 1,639 | 1,768 | 1,654 |
| 2001 | Individual | | monthly | 22,000 | 22,100 | 21,200 | 20,850 | 21,400 | 21,700 | 22,100 | 21,650 | 21,600 | 21,500 | 21,500 | 21,800 | 259,400 |
| | Public | | monthly | 5,506 | 5,642 | 5,061 | 5,204 | 4,971 | 5,628 | 6,192 | 5,802 | 5,054 | 5,339 | 5,835 | 5,251 | 65,486 |
| | Other Large | | monthly | 22,910 | 22,422 | 21,790 | 22,107 | 21,944 | 21,001 | 20,122 | 20,702 | 22,079 | 22,161 | 22,066 | 23,462 | 262,764 |
| | Total | | monthly | 50,416 | 50,164 | 48,051 | 48,161 | 48,315 | 48,329 | 48,414 | 48,154 | 48,733 | 49,000 | 49,400 | 50,513 | 587,649 |
| | | | daily | 1,626 | 1,792 | 1,550 | 1,605 | 1,559 | 1,611 | 1,562 | 1,553 | 1,624 | 1,581 | 1,647 | 1,629 | 1,610 |
| 2002 | Individual | | monthly | 16,827 | 15,822 | 17,007 | 20,554 | 19,529 | 20,010 | 19,024 | 18,853 | 21,634 | 17,038 | 16,924 | 17,224 | 220,445 |
| | Large Consumer | Budgetary | monthly | 4,984 | 8,748 | 9,684 | 10,922 | 8,331 | 8,300 | 9,189 | 9,557 | 14,678 | 7,342 | 6,936 | 7,048 | 105,719 |
| | | Hot Water | monthly | 17,593 | 16,149 | 16,676 | 13,640 | 13,360 | 11,280 | 9,631 | 11,602 | 9,842 | 11,265 | 14,978 | 20,445 | 166,462 |
| | | Small commercial | monthly | 3,741 | 3,305 | 3,204 | 3,182 | 3,125 | 3,176 | 3,323 | 3,567 | 3,829 | 3,484 | 3,410 | 3,102 | 40,448 |
| | | Total | monthly | 26,318 | 28,202 | 29,564 | 27,744 | 24,816 | 22,757 | 22,143 | 24,726 | 28,348 | 22,092 | 25,324 | 30,596 | 312,629 |
| | Sum total | | monthly | 43,688 | 44,588 | 47,119 | 48,983 | 44,975 | 43,434 | 41,781 | 44,187 | 50,703 | 39,679 | 42,812 | 48,375 | 540,324 |
| | | | daily | 1,409 | 1,592 | 1,520 | 1,633 | 1,451 | 1,448 | 1,348 | 1,425 | 1,690 | 1,280 | 1,427 | 1,560 | 1,480 |

**Figure S 2.3.6.1 Flow Pattern of Distribution**




### (2) Measurement for Distribution Flow of Kadirya WTP

1) Measurement by Previous JICA Study

The distribution flow from Kadirya WTP was measured under the previous JICA Study (conducted in 1999). Seven ultra-sonic flow meters used to measure, and attached points are shown in Figure S 2.3.6.2 at Kadirya WTP. In this measurement, flow-meters, called F2, F3, F4, F5, F6, F7 and F8 were attached as shown in the figure. In this time, water flow F1 and F2 was concentrated in the pipe on which F2 was attached.

When the measurement was carried out, eight large intake pumps (the discharge capacity is around 10,000m$^3$/hr) and one small pump (the discharge capacity is around 5,000m$^3$/hr) were operating. The measurement was continued for over 24 hours, and the total daily quantity was about 2.2million m$^3$/day.

The measurement results are shown in Table S 2.3.6.4.

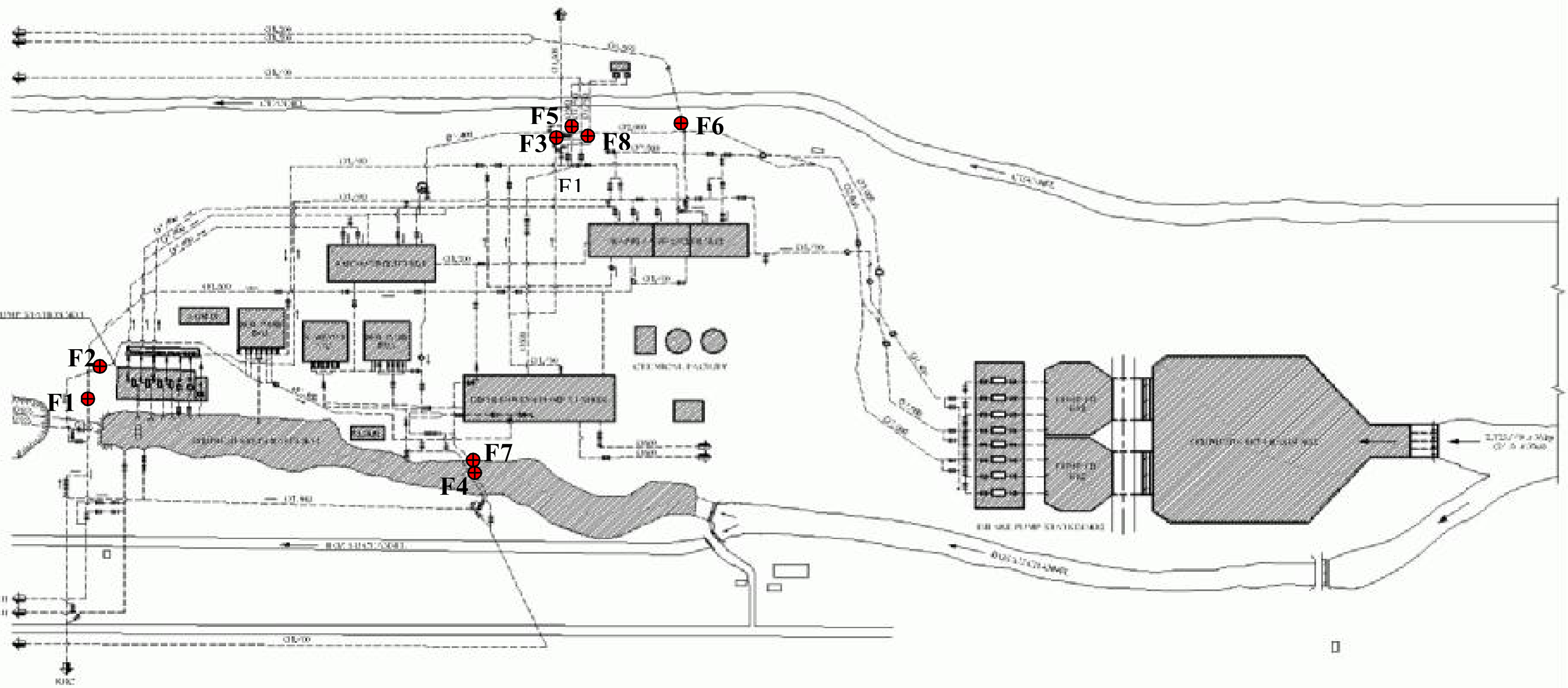



**Figure S 2.3.6.2 Location of Measurement Points in Kadirya WTP**

**Table S 2.3.6.4 Measurement Results of Distribution Flow for Kadirya WTP**

| No. | Diameter (mm) | Previous JICA Study | | Vodokanal Data | | | |
|---|---|---|---|---|---|---|---|
| | | | | High flow season | | Low flow season | |
| | | Value ($m^3$/h) | P/O | Value ($m^3$/h) | P/O | Value (m3/h) | P/O |
| F1 | 1600 | 21,000 | 8.5 | 19,200 | 9 | 18,000 | 8.5 |
| F2 | 1600 | | 8.5 | 11,400 | 9 | 10,000 | 8.5 |
| F3 | 1600 | 14,400 | 8.5 | 8,500 | 9 | 7,500 | 8.5 |
| F4 | 1200 | 7,500 | 8.5 | 6,500 | 9 | 5,600 | 8.5 |
| F5 | 1400 | 10,800 | 8.5 | 10,000 | 9 | 9,500 | 8.5 |
| F6 | 1600 | 15,600 | 8.5 | 16,000 | 9 | 16,000 | 8.5 |
| F7 | 1800 | 20,400 | 8.5 | 20,400 | 9 | 20,400 | 8.5 |
| F8 | 1000 | 1,000 | 8.5 | 1,000 | 9 | 1,000 | 8.5 |
| | Total | 90,700 | 8.5 | 93,000 | 9 | 88,000 | 8.5 |
| Daily m3/d | | 2,176,800 | | 2,232,000 | | 2,112,000 | |

(highlighted box) Estimated Value

P/O: Pump Operation Number

The Team obtained the information of pump operation and measured records of flow meters installed distribution pipes from operators at Kadirya WTP. However since the F7 flow meter was out of order and F8 was not installed, the Team put in the values measured in 1999.

Result of the investigation, the estimated distribution flow exceeded 2.2million $m^3$/day in high flow season such as summer, and in even low flow season, the flow was around 2.1 million $m^3$/day.

In high flow season, the number of operating intake pumps is 9-10, and in low flow season is 8-8.5 (8 large pumps and one small pump), not so different. The operation number of intake pumps in low flow season is same with the number operating in the previous measurement.

2) Measurement in January 2004

Based on the investigation, the Team requested to Vodokanal to measure the distribution flow of Kadirya WTP by the two ultra-sonic flow meters prepared by JICA.

The measurement was carried out by Vodokanal staff with the Team in January 2004.

Ultra-sonic flow meters were attached at the points of F1 to F8 as shown in Figure S 2.3.6.2.

The Measurements were kept one to two hours and average flow rate were adopted as the measured values. The results are shown in Table S 2.3.6.5. As shown in the table, water flow in the season of large consumption was estimated at around 2.2 million $m^3$/day and 2.0 to 2.1 million $m^3$/day in the season of lower consumption.

**Table S 2.3.6.5 Measured Results of Distribution Flow**

| No. | Diameter (mm) | Average quantity ($m^3$/hr) | Measured day | P/O | Previous JICA Study | | Vodokanal Data | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | High flow season | | Low flow season | |
| | | | | | Value ($m^3$/h) | P/O | Value ($m^3$/h) | P/O | Value ($m^3$/h) | P/O |
| F1 | 1600 | 21,000 | 23,Jan. | 9 | 21,000 | 8.5 | 19,200 | 9 | 18,000 | 8.5 |
| F2 | 1600 | 10,000 | 23,Jan. | 9 | | 8.5 | 11,400 | 9 | 10,000 | 8.5 |
| F3 | 1600 | 8,500 | 15, Jan | 9 | 14,400 | 8.5 | 8,500 | 9 | 7,500 | 8.5 |
| F4 | 1200 | 7,500 | 22,Jan. | 9 | 7,500 | 8.5 | 6,500 | 9 | 5,600 | 8.5 |
| F5 | 1400 | 10,700 | 22.Jan. | 9 | 10,800 | 8.5 | 10,000 | 9 | 9,500 | 8.5 |
| F6 | 1600 | 14,000 | 22,Jan. | 9 | 15,600 | 8.5 | 16,000 | 9 | 16,000 | 8.5 |
| F7 | 1800 | 16,800 | 20.Jan. | 8.5 | 20,400 | 8.5 | 16,800 | 9 | 16,800 | 8.5 |
| F8 | 1000 | 1,600 | 22,Jan. | 9 | 1,000 | 8.5 | 1,600 | 9 | 1,600 | 8.5 |
| | Total | 90,100 | | | 90,700 | 8.5 | 90,000 | 9 | 85,000 | 8.5 |
| Daily m3/d | | 2,162,400 | | | 2,176,800 | | 2,160,000 | | 2,040,000 | |

Estimated Value (highlighted)
P/O: Pump Operation Number

In the report, the maximum water distribution flow from Kadirya WTP is adapted at 2.2million $m^3$/day and the annual average flow is 2.1 million $m^3$/day.

2) Measurement in December 2004 by Vodokanal

The management of Vodokanal is opposed to the daily average distribution amount estimated by the Study Team, and asserts that the value is 2.5 million $m^3$/d. They showed the measured records of the distribution amount from Kadirya WTP on 20th December 2004, and that amount was 1.83 million $m^3$/d as shown in Table S 2.3.6.6. In this case, since operation number of intake pumps is 8 (large pumps:7, small pumps:2), the value was reasonable compared with previous measured results.

Vodokanal said that total distribution amount of other WTPs was around 700,000$m^3$/d. Therefore total distribution amount to the City is 2,480,000$m^3$/d (1,830,000 + 700,000= 2,530,000 $m^3$/d), and it is match with their declared value.

## Table S 2.3.6 Water Measurement Report

18-19 December, 2004

### Water Measurement REPORT

Committee composed of "Suvsoz" chief engineer Salikhov G.E., chief technologist Kamalov K. and Krijenkov V.A., with participation of Kadirya WTP manager Talipov F.A. measured drinking water distribution to city by deferent pipes of Kadirya WTPs. The measurement was conducted every 6 hours purposely to get more exact twenty-four-hour results.

During making measurements, facilities operated in the following routine: 8 pumps 48D-22 and 1 pump 32D-19 from 10 a.m. till 10 p.m., and 8 pumps 48D-22 at night time.

Following average statistical data's were received:

| | $m^3$/ h | $1000m^3$/day |
|---|---|---|
| Main pipe #1 d-1600mm | 15,800 | 379.2 |
| Main pipe #2 d-1600mm | 8,800 | 211.2 |
| Main pipe #3 d-1400mm | 8,000 | 192 |
| Main pipe #4 d-1000mm (at measuring point) | 5,400 | 129.6 |
| Main pipe #5 d-1400mm | 6,800 | 163.2 |
| Main pipe #6 d-1600mm | 13,800 | 331.2 |
| Cross pipe in KWTP d-1800mm | 14,000 | 336.0 |
| Grouped pipe d-1000mm | 2,600 | 62.4 |
| Main pipe d-600mm in Ulughbek village | 800 | 19.2 |
| Pipeline 2d-200mm in Kibray region | 128 | 3.1 |
| | | 1827.1 |

| | |
|---|---|
| **Chief engineer** | **Salikhov G.E.** |
| **Chief technologist** | **Kamilov K.** |
| **General Manager Adviser** | **Krijenkov V.A** |

### (3) Water Leakage Survey for Pipelines in Sergeli District

In the course of 1st Field Investigation Study, verification of the current water distribution volume has been an issue between Vodokanal and the Study Team. Both sides have a different opinion on water losses in the distribution pipelines, that is; Vodokanal insisted that water losses (about 37%) examined by the Study Team was overestimated. However, both sides have no concrete data to justify the amount of water losses. Therefore, the Study Team conducted a water leakage survey to verify the water losses in cooperation with Vodokanal.

1) Survey Area and Population Served

i) Survey area

As for the survey area, a part of Sergeli District was selected through discussion with Vodokanal, from the viewpoint to meet the conditions that water source/s and pipe network to supply service area are easily identified. In order to grasp the distribution flow in this specific area, a total of seven (7) measuring points were selected as shown in Figure S 2.3.6.3.

In the area, three (3) booster pump stations (Sergeli No.2, No.8 and Stoitel) and Hot Water Plant No. 8 are receiving their water sources from the distribution mains which deliver water from Kibray WTP. In addition, Sergeli 3/5 PS supplies water tapped from Sergeli and South WTPs supplies a part of water within the area.

ii) Population served

Population served in the whole Sergeli area

Total Population served in Sergeli District and vicinity town (Ata) for year 2002 released by Vodokanal is shown in Table S 2.3.6.7

**Table S 2.3.6.7 Total Population Served in Sergeli District**

| Area | Apartment | w/ meter | Detached | w/ meter | Total |
|---|---|---|---|---|---|
| Sergeli Dist. | 101,800 | 3.9% | 82,400 | 94.6% | 184,200 |
| Ata* | 13,100 | 0% | 20,600 | 42.1% | 33,700 |
| Total | 114,900 | 3.5% | 103,000 | 84.1% | 217,900 |

*(Source: Vodokanal)* * Vicinity town

Population served in the survey area

According to Sergeli office of Sales Department, Vodokanal, the population served (registered population) in the survey area by housing type was confirmed as below. About 106,000 of the total population served in this specific area correspond to almost a half of the population served in the whole Sergeli area.

- Population served of apartments: 82,342
- Population served of detached houses: 23,927
- Total: 106,269

By employing the same ratios of meter installation in Table S 2.3.6.7, the population served in the survey area may be further broken down as shown in Table S 2.6.6.8.

**Table S 2.3.6.8 Assumed Population Served in the Survey Area by Housing Type**

| Survey area | With/without meter | Pop. Served Apartment house | Pop. Served Detached house | Total |
|---|---|---|---|---|
| Sergeli (Part) | w/ meter | 2,900 | 200 | 3,100 |
| | w/o meter | 66,300 | 3,100 | 69,400 |
| Sub-total | | 69,200 | 3,300 | 72,500 |
| Ata | w/ meter | 0 | 8,700 | 8,700 |
| | w/o meter | 13,100 | 11,900 | 25,000 |
| Sub-total | | 13,100 | 20,600 | 33,700 |
| Total | w/ meter | 2,900 | 20,100 | 23,000 (22%) |
| | w/o meter | 79,400 | 3,800 | 83,200 (78%) |
| | - | 82,300 | 23,900 | 106,200 (100%) |

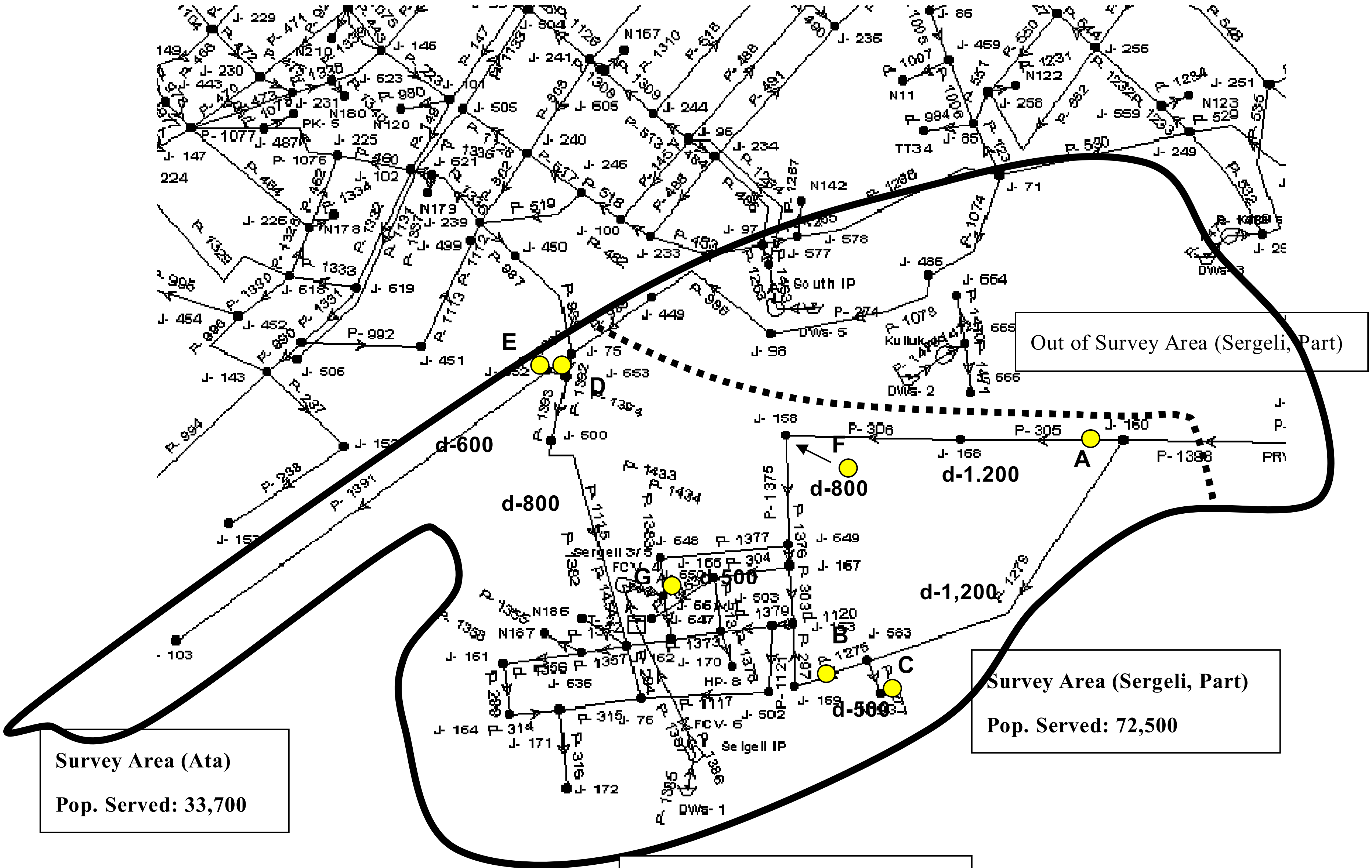



Figure S 2.3.6.3 Survey Area

2) Flow Measurement

Flow measurement was conducted to verify the differences between daytime, nighttime and peak time flow in the area from Feb. 25 to 26, 2004. Two portable ultra-sonic flow meter prepared by JICA was used in the measurement.

i) Daytime flow

At first, daytime flow was examined at all 7 points as shown in Table S 2.3.6.9. The result showed that 86 % of distribution water was supplied from Kibray WTP and the remaining 14% from Sergeli and South WTPs. Two 1,200 mm trunk mains delivered 73% of distribution water being consumed in the area.

**Table S 2.3.6.9 Daytime Flow (Feb. 25, '04)**

| Point | Time | Flow measured (m3/H) | Average (m3/H) | Note |
|---|---|---|---|---|
| A (1,200 mm) | 11:10-11:25 | 3,200-3,400 | 3,300 | |
| B (1,200 mm) | 15:40-15:50 | 1,200-1,400 | 1,300 | |
| C (500 mm, Stoitel PS)* | 16:30-16:40 | 540-620 | 600 | Constant** |
| D (800 mm) | 13:00-13:10 | 960-1,000 | 1,000 | |
| E (600 mm) | 12:40-12:50 | 180-190 | 185 | |
| F (800 mm, South WTP) | 11:50-12:00 | 250-270 | 250 | Constant** |
| G (500 mm, Sergeli 3/5 PS) | 14:40-14:50 | 750-770 | 760 | Constant** |
| Total | | | 7,400 | |

* Water source for Stoitel PS is tapped from trunk main B (1,200 mm).
** Operation status (number of pumps, flow) is almost constant through the day (according to operation staff of PS).

ii) Nighttime flow

In measuring daytime flow, it was revealed that the discharge rates of booster pump stations were almost constant throughout the day according to the operation staff of the PSs. Therefore, the nighttime flow was measured at the points except for PSs as shown Table 2.3.6.10.

Total distribution flow was reduced by 680 $m^3$/hour (or 9%) compared with daytime flow. As for respective measuring points, point E (600 mm supplying to vicinity town) showed 67% of reduction against daytime flow, which may explain why the distribution pipes were kept in fair condition since this vicinity town was newly developed.

**Table S 2.3.6.10 Nighttime Flow (Feb. 26, '04)**

| Point | Time | Flow measured ($m^3$/H) | Average (m3/H) | Note |
|---|---|---|---|---|
| A (1,200 mm) | 1:10-1:30 | 3,200-3,400 | 3,300 | |
| B (1,200 mm) | 0:30-0:50 | 900-1,000 | 950 | |
| C (500 mm, Stoitel PS)* | - | - | 600 | Assumed as constant |
| D (800 mm) | 2:30-2:40 | 800 | 800 | |
| E (600 mm) | 2:00-2:10 | 60 | 60 | |
| F (800 mm, South WTP)* | - | - | 250 | Assumed as constant |
| G (500 mm, Sergeli 3/5 PS)* | - | - | 760 | Assumed as constant |
| Total | - | - | 6,720 | |

However, the other points didn't show significant difference between daytime and night-time flow compared with the expected time variation for this scale of water supply, as discussed hereinafter. Especially, the distribution flow of 1,200 mm trunk main (Point A) indicated almost the same value with the daytime flow.

iii) Peak-time flow

Considering the above result, flow measurement for the supposed peak-time flow was carried out in two 1,200 mm trunk mains to confirm whether a significant difference was observed. For other distribution pipes, peak time flows were assumed as follows:

- Water flows at points C, F and G were assumed as constant; and
- Water flows at points D and E were assumed at 50% increased to daytime flow.

Under such conditions, the distribution flow was assumed as shown in Table 2.3.6.11.

**Table S 2.3.6.11 Supposed Peak-time Flow (Feb. 26, '04)**

| Point | Time | Flow measured ($m^3$/H) | Average (m3/H) | Note |
|---|---|---|---|---|
| A (1,200 mm) | 19:30-19:40 | 3,000-3,400 | 3,200 | |
| B (1,200 mm) | 19:00-19:15 | 800-1,000 | 900 | |
| C (500 mm, Stoitel PS)* | - | - | 600 | Assumed as constant |
| D (800 mm) | | | 1,200 | Assumed (daytime flow x 1.5) |
| E (600 mm) | | | 280 | Assumed (daytime flow x 1.5) |
| F (800 mm, South WTP)* | - | - | 250 | Assumed as constant |
| G (500 mm, Sergeli 3/5 PS)* | - | - | 760 | Assumed as constant |
| Total | - | - | 7,190 | |

Before measuring the flow of 1,200 mm trunk mains, it was expected that the distribution water for such time would show the distinct peak, however, there was no significant difference compared with daytime/nighttime flow. Even if the flows at points D and E were assumed as 50% increased to daytime flow, the total distribution volume shows no distinct peak-time flow.

Based on the above results, the time variation of distribution flow was shown in Figure S 2.3.6.4.

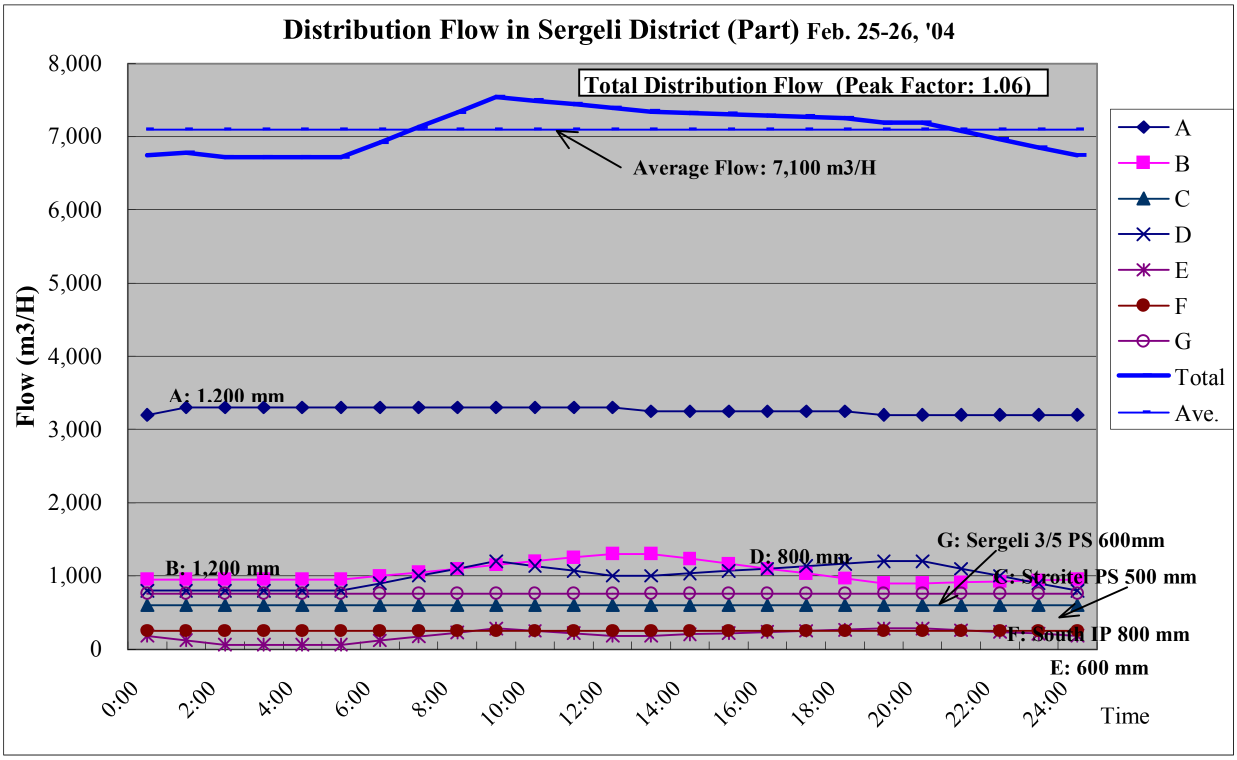



**Figure S 2.3.6.4 Distribution Flow in the Survey Area**

Although the flow measurements were not conducted continuously, 7,100 $m^3$/H of distribution flow was simply calculated in average. In addition, it is considered that no distinct peak-time flow implied there is a significant level of water losses in the survey area.

3) Estimation of Actual Water Demand

To assume water losses in the survey area, the actual water demand in the survey area was examined as below.

i) Charged water consumption

Table S 2.3.6.12 shows the charged water consumption (accounted for water) for the month of February 2004 in the survey area. The daily water consumption was calculated to be

105,170 $m^3$/d (4,400 $m^3$/H) in average, which will be employed as the billed water volume for the survey period.

**Table S 2.3.6.12 Tariff-based Water Consumption in the Survey Area in February 2004**

| Consumer type | Water consumed in February, 2004 ($m^3$) | | |
|---|---|---|---|
| | Monthly | Daily | Hourly |
| Apartments | 735,269 | 25,354 (25%) | 1,056 |
| Detached houses | 135,307 | 4,667 (4%) | 194 |
| Business enterprises | 833,967 | 28,757 (27%) | 1,198 |
| Budgetary enterprises (Hot water plant) | 1,345.399 | 46,393 (44%) | 1,933 |
| Total | 3,049,942 | 105,170 (100%) | 4,382 |

*Source: Vodokanal*

In this table, some characteristics in water usages are observed as follow:

- The ratio (44%) of water consumption of hot water plant to the total volume is larger compared with the average (31%) of the whole city; and
- Considering the current land use of the survey area, water consumption of business enterprises seems large.

ii) Estimation of actual water demand in the survey area

Aside from the charged water consumption, the following two (2) cases of water consumption were examined:

(Case-1: Actual water consumption assuming the existence of water losses in service installations)

Actual water consumption is considered to include water losses such as leakage and wasted water from service equipment within the building/house. As for water consumption of business and budgetary (incl. Hot water plant), tariff-based volume is considered as the actual consumption, since water meters are installed for almost of all users. While, for the individual/residential use, tariff-based consumption are calculated as norm for about 80% of the population. Therefore, it is considered that there is a significant difference between tariff-based and actual consumption. Employing the unit consumption assumed in this Study for the residential use, the actual water consumption including water losses in service installations is calculated to be 126,850 $m^3$/d (5,430 $m^3$/H) as shown in Table S 2.3.6.13

**Table S 2.3.6.13 Case-1: Assumed Actual Water Consumption incl. Water Losses**

| Water Use | Type | Unit Consump-tion | Population | Water Con-sumption ($m^3$/day) | Water Con-sumption ($m^3$/H) |
|---|---|---|---|---|---|
| Residential | Apartment w/ meter | 150 Lpcd | 2,900 | 435 | 20 |
| | Apartment w/o meter | 580 Lpcd | 79,400 | 46,052 | 1,920 |
| | Detached w/ meter | 200 Lpcd | 20,100 | 4,020 | 170 |
| | Detached w/o meter | 300 Lpcd | 3,800 | 1,140 | 50 |
| Large consumer | Budgetary & commercial | - | - | 28,800* | 1,200 |
| Hot water plant | Hot water supply | - | - | 46,400* | 1,930 |
| | Heating | | | | |
| Total | | - | 106,200 | 126,850 | 5,290 |

* Tariff-based water consumption

In comparison with the current distribution flow (7,100 $m^3$/H) measured in this survey, water losses in the distribution network in the survey area are assumed to be about 1,800 $m^3$/H or 25%.

(Case-2: Water demand without any water losses)

In the case above, if there are no water losses in any water use, it is considered that the actual water demand can be estimated by using the unit water consumptions for residential and large consumers (budgetary and commercial) with water meters. The water demand of Hot water plant No.8 is taken for the same as the tariff-based, because water usage at the hot water plant is out of control for Vodokanal at present.

**Table S 2.3.6.14 Case-2: Assumed Water Demand without Water Losses**

| Water Use | Type | Unit consump-tion | Population | Water Demand ($m^3$/day) | Water Demand ($m^3$/H) |
|---|---|---|---|---|---|
| Residential | Apartment | 150 Lpcd | 82,300 | 12,350 | 515 |
| | Detached | 200 Lpcd | 23,900 | 4,780 | 200 |
| Large consumer | Budgetary & commercial | 240 Lpcd* | 106,200 | 25,490 | 1,060 |
| Hot water plant | Hot water sup-ply | - | - | 46,390 | 1,930 |
| | Heating | - | - | | |
| Total | | - | 106,200 | 89,010 | 3,700 |

* Unit consumption for large consumers needs to be examined to meet the actual situation of business en-terprises in the survey area.

In this case, 240 Lpcd of unit consumption for the large consumers (Budgetary and commercial) may be overestimated compared with the current land use.

As a result, water demand of the survey area is estimated to be about 89,000 $m^3$/d (3,700 $m^3$/H).

In comparison between Case-1 and 2, water losses in service installations are assumed to be about 37,800 $m^3$/day (1,600$m^3$/H), which corresponds to about 22% of the current distribution flow (7,100 $m^3$/H).

Table S 2.3.6.15 summarizes the assumed composition of the distributed water in the survey area.

**Table S 2.3.6.15 Assumed Composition of the Distributed Water in the Survey Area**

| Composition | | Assumed by the Study Team | Vodokanal Data |
|---|---|---|---|
| Actual water demand | | 3,700 $m^3$/H (53%) | 4,400 $m^3$/H* |
| Water losses | Losses in service installations | 1,600 $m^3$/H (22%) | |
| | Losses in distribution network | 1,800 $m^3$/H (25%) | ? |
| | Sub-total | 2,400 $m^3$/H (47%) | - |
| Total | | 7,100 $m^3$/H (100%) | - |

* Tariff-based

4) Assumed time variation in water demands

Water demand in a distribution system varies hourly. Although there was no significant time variation in total distribution flow of the survey area, it is considered that actual water demand changed hourly. The table below, for example, presents the hourly factors in Oyama City of Japan, of which population served is about 140,000 with the average daily water demand of 48,000 $m^3$/H (2,000 $m^3$/H). Water losses are 4,100 $m^3$/day (8.5%) broken down into 7.6% in service installations and 0.9% in distribution pipes. Peak-time of the distributed water appears twice a day (8:00-11:00 and 19:00-21:00).

**Table 2.3.6.16 A Sample of Hourly Factors (Oyama City, Japan)**

| Time | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Factor | 0.5 | 0.34 | 0.29 | 0.28 | 0.32 | 0.62 | 1.24 | 1.62 | 1.48 | 1.3 | 1.63 | 1.05 |
| Time | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| Factor | 0.97 | 0.98 | 0.97 | 0.92 | 0.92 | 1.15 | 1.37 | 1.4 | 1.42 | 1.29 | 1.1 | 0.85 |

For the Case-2, these hourly factors were applied in assuming time variation of water demand in the area. While hourly factors for the Case-1 were modified to be intermittent values between the current distribution flow and Case-2. In both cases, water demand used for heating purpose was assumed as constant (730 $m^3$/H) through the day as described below.

(Water consumption of Hot Water Plant No.8)

Table below shows the billed water volume of Hot Water Plant No.8 in 2002. The average consumption was roughly assumed to be 1,000 $m^3$/H in summer and 1,600 $m^3$/H in winter season. Therefore, water volume of 1,000 $m^3$/H is taken for hot water supply both in summer and winter, and the difference of 600 $m^3$/H is assumed as the volume to be used for heating purpose in winter.

Based on this, the water consumption of 1,930 $m^3$/H during the survey period is broken down into 1,200 $m^3$/H for hot water supply and 730 $m^3$/H for heating purpose.

**Table S 2.3.6.17 Water Consumption at Hot Water Plant No.8 (Source: Vodokanal)**

| | Jan. | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $10^3 m^3$ | 1,300 | 1,250 | 1,100 | 1,050 | 1,100 | 950 | 650 | 600 | 700 | 900 | 1,150 | 1,400 |
| m3/day | 41,935 | 44,643 | 35,484 | 35,000 | 35,484 | 31,667 | 20,968 | 19,355 | 23,333 | 29,032 | 38,333 | 45,161 |
| m3/H | 1,747 | 1,860 | 1,478 | 1,458 | 1,478 | 1,319 | 874 | 806 | 972 | 1,210 | 1,597 | 1,882 |

Figure S 2.3.6.5 presents the comparison of the assumed time variation in Case-1, Case-2 and the current distribution flow.

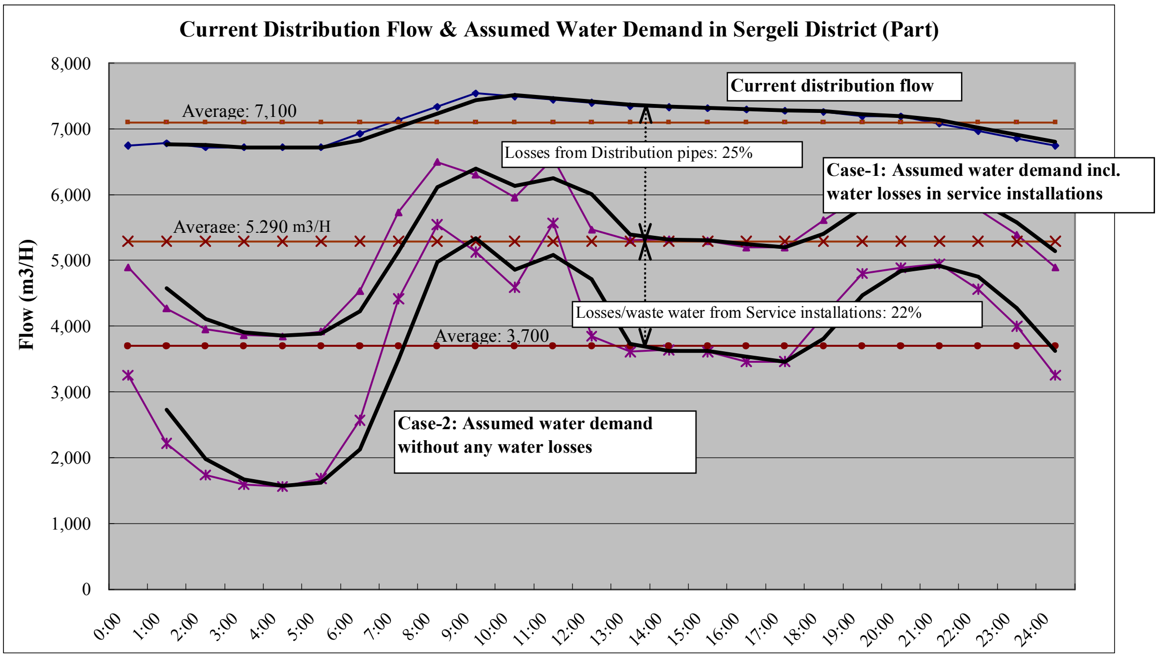



**Figure S 2.3.6.5 Comparison of Assumed Time Variation in Water Demands**

5) Conclusion

Base on the above study, the following were obtained:

- There was no significant difference in total distribution flow between daytime, night-time and peak-time flows in the survey area;
- Water losses from distribution pipes are assumed to be about 25%, however, those in the newly developed area (Ata) are considered to be small;
- Aside from water losses in distribution pipes, there is some extent of water losses including wastewater in service equipment within the building/house. The ratio is assumed to be about 20% to the total distribution flow.

Some of the existing distribution pipes in the survey area are listed in pipe replacement plan of Vodokanal, which was incorporated in the Master Plan of this JICA Study. Upon completion of the proposed pipe replacement project, improvements in minimizing water losses will be expected.

**(4) Electrical and Chemical Consumption for Tashkent Water Supply**

1) Electrical consumption and costs

Monthly electrical consumption for WTPs and Booster PSs from 2000 to 2002 is shown in Table S 2.3.6.18. As shown in the table, distribution water amount of Kadirya WTP shows two cases: one is official data and another is an assumed data (2.1 million $m^3$/d x 365 d/year) as mentioned in Section (2).

In the case (2), since the unit electricity consumptions were almost flat for three years, while the unit electricity consumptions in case (1) were decreased year by year. It means distribution quantity of case (2) is more reliable than another.

Table 2.3.6.19 shows the electricity tariff table for Vodokanal from 2000 to 2004. As shown in the Table, the tariff is rising year by year, and in December 2004, the price is around 30 soum /kWh. The raised difference in 2004 was quite large, and the operation cost of Voodkanl will be affected heavily. .

## Table S 2.3.6.18 Monthly Electrical Consumption

| Name | Year | Consumption ($10^3$kwH) | | | | | | | | | | | | | Distribution | Unit Consumption |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Total | ($10^6m^3/y$) | ($kwh/m^3$) |
| Kadirya (1) | 2000 | 6,691 | 6,323 | 6,058 | 6,388 | 6,675 | 6,984 | 7,251 | 7,430 | 7,335 | 6,242 | 6,630 | 6,220 | 80,227 | 496.5 | 0.162 |
| | 2001 | 6,403 | 6,075 | 6,409 | 6,699 | 7,202 | 7,310 | 7,802 | 7,608 | 6,998 | 6,249 | 6,231 | 6,212 | 81,198 | 489.8 | 0.166 |
| | 2002 | 6,503 | 6,145 | 6,215 | 6,560 | 7,464 | 6,941 | 7,391 | 7,222 | 6,959 | 6,313 | 6,300 | 6,281 | 80,294 | 453.4 | 0.177 |
| Kadirya (2) | 2000 | 6,691 | 6,323 | 6,058 | 6,388 | 6,675 | 6,984 | 7,251 | 7,430 | 7,335 | 6,242 | 6,630 | 6,220 | 80,227 | 766.5 | 0.105 |
| | 2001 | 6,403 | 6,075 | 6,409 | 6,699 | 7,202 | 7,310 | 7,802 | 7,608 | 6,998 | 6,249 | 6,231 | 6,212 | 81,198 | 766.5 | 0.106 |
| | 2002 | 6,503 | 6,145 | 6,215 | 6,560 | 7,464 | 6,941 | 7,391 | 7,222 | 6,959 | 6,313 | 6,300 | 6,281 | 80,294 | 766.5 | 0.105 |
| Boz-su | 2000 | 2,182 | 1,877 | 2,014 | 1,999 | 1,999 | 2,208 | 2,418 | 2,382 | 2,380 | 2,025 | 2,109 | 2,219 | 25,812 | 93.1 | 0.277 |
| | 2001 | 2,098 | 1,813 | 1,995 | 1,959 | 1,979 | 2,189 | 2,417 | 2,388 | 2,379 | 2,045 | 1,983 | 2,202 | 25,447 | 91.2 | 0.279 |
| | 2002 | 2,136 | 1,896 | 2,045 | 1,973 | 2,015 | 2,207 | 2,355 | 2,172 | 2,157 | 1,935 | 2,027 | 2,220 | 25,138 | 85.3 | 0.295 |
| Kibray | 2000 | 5,195 | 4,960 | 5,444 | 5,578 | 5,365 | 5,851 | 6,031 | 5,982 | 5,373 | 5,576 | 4,718 | 5,147 | 65,220 | 148.5 | 0.439 |
| | 2001 | 5,175 | 4,973 | 4,259 | 5,315 | 4,981 | 5,222 | 5,643 | 5,625 | 5,322 | 5,034 | 4,868 | 4,537 | 60,954 | 139.1 | 0.438 |
| | 2002 | 4,985 | 4,686 | 4,384 | 4,632 | 4,981 | 4,672 | 4,090 | 4,865 | 4,511 | 4,152 | 4,080 | 4,524 | 54,562 | 129.0 | 0.423 |
| South | 2000 | 2,002 | 1,446 | 2,031 | 1,800 | 1,850 | 1,808 | 1,995 | 1,927 | 1,950 | 2,241 | 1,680 | 2,055 | 22,785 | 61.1 | 0.373 |
| | 2001 | 2,081 | 2,006 | 2,000 | 1,900 | 1,900 | 2,227 | 2,100 | 2,278 | 2,000 | 2,000 | 1,860 | 1,860 | 24,212 | 52.2 | 0.464 |
| | 2002 | 1,776 | 1,453 | 1,550 | 1,346 | 1,369 | 1,680 | 1,616 | 2,161 | 1,571 | 1,376 | 1,614 | 1,268 | 18,780 | 52.0 | 0.361 |
| Sergeli | 2000 | 329 | 123 | 139 | 145 | 155 | 161 | 151 | 180 | 182 | 202 | 200 | 333 | 2,300 | 8.4 | 0.273 |
| | 2001 | 191 | 140 | 148 | 140 | 130 | 114 | 147 | 162 | 150 | 240 | 200 | 158 | 1,920 | 8.4 | 0.230 |
| | 2002 | 160 | 172 | 190 | 129 | 133 | 129 | 133 | 152 | 279 | 134 | 129 | 134 | 1,874 | 8.3 | 0.224 |
| Bektemir | 2000 | 97 | 85 | 94 | 100 | 96 | 88 | 104 | 114 | 98 | 108 | 94 | 108 | 1,186 | 8.6 | 0.139 |
| | 2001 | 95 | 97 | 111 | 107 | 79 | 84 | 70 | 78 | 75 | 74 | 76 | 73 | 1,019 | 8.5 | 0.119 |
| | 2002 | 68 | 62 | 65 | 72 | 63 | 86 | 79 | 79 | 66 | 72 | 78 | 208 | 998 | 8.5 | 0.118 |
| Kara-Su | 2000 | 128 | 120 | 142 | 144 | 162 | 160 | 125 | 229 | 115 | 136 | 137 | 162 | 1,760 | 10.3 | 0.170 |
| | 2001 | 157 | 138 | 143 | 33 | 29 | 165 | 143 | 116 | 116 | 270 | 190 | 145 | 1,645 | 10.6 | 0.154 |
| | 2002 | 148 | 198 | 106 | 112 | 97 | 157 | 163 | 163 | 183 | 187 | 208 | 168 | 1,890 | 10.5 | 0.181 |
| Kuiluk | 2000 | 168 | 180 | 180 | 166 | 198 | 192 | 202 | 230 | 82 | 107 | 131 | 166 | 2,002 | 7.2 | 0.278 |
| | 2001 | 189 | 210 | 183 | 157 | 153 | 126 | 217 | 261 | 216 | 185 | 150 | 170 | 2,217 | 7.5 | 0.296 |
| | 2002 | 214 | 196 | 175 | 153 | 152 | 166 | 174 | 254 | 268 | 262 | 129 | 133 | 2,276 | 7.3 | 0.313 |
| Booster PS | 2000 | 6,194 | 5,965 | 5,945 | 5,966 | 6,413 | 6,234 | 6,652 | 6,606 | 5,891 | 6,301 | 7,041 | 6,237 | 75,445 | 833.7 | 0.090 |
| | 2001 | 6,087 | 5,856 | 6,325 | 6,261 | 6,279 | 6,551 | 7,678 | 6,520 | 6,186 | 5,475 | 7,035 | 7,476 | 77,729 | 807.4 | 0.096 |
| | 2002 | 7,188 | 6,650 | 6,911 | 6,866 | 7,023 | 7,335 | 8,181 | 8,309 | 8,263 | 7,372 | 7,478 | 7,251 | 88,827 | 754.3 | 0.118 |
| Total | 2000 | 22,986 | 21,079 | 22,047 | 22,286 | 22,913 | 23,686 | 24,929 | 25,080 | 23,406 | 22,938 | 22,740 | 22,647 | 276,737 | 833.7 | 0.332 |
| | 2001 | 22,476 | 21,308 | 21,573 | 22,571 | 22,732 | 23,988 | 26,217 | 25,036 | 23,442 | 21,572 | 22,593 | 22,833 | 276,341 | 807.4 | 0.342 |
| | 2002 | 23,178 | 21,458 | 21,641 | 21,843 | 23,297 | 23,373 | 24,182 | 25,377 | 24,257 | 21,803 | 22,043 | 22,187 | 274,639 | 754.3 | 0.364 |

**Table S 2.3.6.19 Table of Electrical Tariff(**

| Month | 2000 | | | 2001 | | | 2002 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Consumption Tariff (Soum/kWh) | | Monthly tariff Soum/kW >750kW | Consumption Tariff (Soum/kWh) | | Monthly tariff Soum/kW >750kW | Consumption Tariff (Soum/kWh) | | Monthly tariff Soum/kW >750kW |
| | <750kWh | >750kWh | | <750kWh | >750kWh | | <750kWh | >750kWh | |
| Jan. | 5.50 | 2.80 | 583.33 | 7.50 | 4.40 | 816.67 | 10.00 | 5.90 | 1,066.17 |
| Feb. | 5.50 | 2.80 | 583.33 | 7.50 | 4.40 | 816.67 | 10.00 | 5.90 | 1,066.17 |
| Mar. | 5.50 | 2.80 | 583.33 | 7.50 | 4.40 | 816.67 | 10.00 | 5.90 | 1,066.17 |
| Apr. | 5.50 | 2.80 | 583.33 | 7.50 | 4.40 | 816.67 | 11.40 | 6.50 | 1,173.34 |
| May | 5.50 | 2.80 | 583.33 | 7.50 | 4.40 | 816.67 | 11.40 | 6.50 | 1,173.34 |
| Jun. | 5.50 | 2.80 | 583.33 | 7.50 | 4.40 | 816.67 | 12.30 | 7.00 | 1,250.00 |
| Jul. | 5.50 | 2.80 | 583.33 | 7.50 | 4.40 | 816.67 | 12.30 | 7.00 | 1,250.00 |
| Aug. | 7.50 | 4.40 | 816.67 | 8.75 | 5.15 | 958.33 | 13.15 | 7.60 | 1,358.33 |
| Sep. | 7.50 | 4.40 | 816.67 | 8.75 | 5.15 | 958.33 | 13.15 | 7.60 | 1,358.33 |
| Oct. | 7.50 | 4.40 | 816.67 | 10.00 | 5.90 | 1,066.17 | 14.35 | 8.35 | 1,483.33 |
| Nov. | 7.50 | 4.40 | 816.67 | 10.00 | 5.90 | 1,066.17 | 14.35 | 248.35 | 1,483.33 |
| Dec. | 7.50 | 4.40 | 816.67 | 10.00 | 5.90 | 1,066.17 | 15.55 | 9.05 | 1,608.33 |
| | | | | | **2004 December** | | **29.5** | **24** | **4,266.7** |

Note: <750kW shows the contract capacity less than 750kw
>750kW shows the contract capacity more than 750kW

2) Chemical consumption and costs

Annual consumption of comical from 2000 to 2002 is shown in Table S 2.3.6.20. Table S 2.3.6.21 shows chemical consumption for WTPs in 2002, and for Kadirya WTP, the distribution water quantity of case (2) is adapted to calculate unit consumption of chemical. The price of chemical is shown in Table S 2.3.6.22

**Table S 2.3.6.20 Annual Chemical Consumption**

| Name | Chemical | 2000 | 2001 | 2002 |
|---|---|---|---|---|
| Kadirya | Aluminum Sulfate | 545.9 | 785.9 | 1533 |
| | Liquid chlorine | 381.1 | 417.1 | 523.3 |
| Boz-su | Aluminum Sulfate | 882.1 | 789.2 | 1048.7 |
| | Liquid chlorine | 76.8 | 71.2 | 73.57 |
| Kibray | Liquid chlorine | 66.4 | 53.2 | 46.9 |
| South | Liquid chlorine | 17.8 | 18 | 15.6 |
| Sergeli | Liquid chlorine | 3.8 | 3.5 | 3.43 |
| Bektemir | Hypo-chloride | 2.4 | 2.3 | 2.5 |
| Kara-Su | Hypo-chloride | 6.2 | 6.1 | 4.06 |
| Kuiluk | Hypo-chloride | 3.3 | 3.2 | 3.16 |

**Table S 2.3.6.22 Price of Chemicals**

| Name | Price | Unit |
|---|---|---|
| Aluminum Sulfate | 110 | $/ton |
| Liquid chlorine | 160 | Soum/kg |
| Hypo-chloride: | 1000 | Soum/kg |

**Table S 2.3.6.21 Monthly Chemical Consumption**

| Name | Chemical | Quantity (ton) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Total |
| Kadirya | Distribution ($10^3m^3$/m) | 66,402 | 60,564 | 61,845 | 60,480 | 63,798 | 63,000 | 66,402 | 67,704 | 65,520 | 62,496 | 61,740 | 66,402 | 766,500 |
| | Aluminum Sulfate (t) | 82.5 | 143.6 | 281.7 | 452.1 | 292.8 | 55.1 | 93 | 0.4 | 0.4 | 0.4 | 7.8 | 123.2 | 1,533 |
| | Injection Rate (m/L) | 1.24 | 2.37 | 4.55 | 7.48 | 4.59 | 0.87 | 1.40 | 0.01 | 0.01 | 0.01 | 0.13 | 1.86 | 2.00 |
| | Liquid chlorine (t) | 52 | 45.4 | 57.2 | 40 | 44.9 | 41.8 | 45.3 | 40.9 | 38.7 | 38.6 | 35.5 | 43 | 523 |
| | Injection Rate (m/L) | 0.78 | 0.75 | 0.92 | 0.66 | 0.70 | 0.66 | 0.68 | 0.60 | 0.59 | 0.62 | 0.57 | 0.65 | 0.68 |
| Boz-su | Distribution ($10^3m^3$/m) | 7,043 | 6,297 | 7,028 | 7,107 | 7,087 | 7,434 | 6,987 | 7,031 | 7,677 | 7,040 | 6,987 | 7,586 | 85,304 |
| | Aluminum Sulfate (t) | 51.5 | 48.5 | 44.1 | 139 | 113 | 106.6 | 104.1 | 110.8 | 79.5 | 66.2 | 93.9 | 91.5 | 1,049 |
| | Injection Rate (m/L) | 7.31 | 7.70 | 6.28 | 19.56 | 15.95 | 14.34 | 14.90 | 15.76 | 10.36 | 9.40 | 13.44 | 12.06 | 12.29 |
| | Liquid chlorin e(t) | 4.8 | 4.6 | 4.37 | 7.6 | 7 | 7 | 7 | 7.5 | 7.5 | 5.8 | 5.6 | 4.8 | 74 |
| | Injection Rate (m/L) | 0.68 | 0.73 | 0.62 | 1.07 | 0.99 | 0.94 | 1.00 | 1.07 | 0.98 | 0.82 | 0.80 | 0.63 | 0.86 |
| Kibray | Distribution ($10^3m^3$/m) | 11,603 | 9,489 | 11,309 | 9,303 | 9,164 | 11,232 | 11,771 | 11,951 | 12,204 | 10,618 | 10,770 | 9,632 | 129,044 |
| | Liquid chlorine (t) | 3.8 | 3.8 | 3.8 | 3.8 | 4.275 | 4.2 | 3.8 | 3.7 | 3.2 | 3.6 | 3.6 | 5.4 | 47 |
| | Injection Rate (m/L) | 0.33 | 0.40 | 0.34 | 0.41 | 0.47 | 0.37 | 0.32 | 0.31 | 0.26 | 0.34 | 0.33 | 0.56 | 0.36 |
| South | Distribution ($10^3m^3$/m) | 4,650 | 4,203 | 3,853 | 3,750 | 4,030 | 4,653 | 4,808 | 4,808 | 4,653 | 3,720 | 4,200 | 4,659 | 51,988 |
| | Liquid chlorine (t) | 1.3 | 1.2 | 1.2 | 1 | 1.3 | 1.2 | 1.7 | 1.6 | 1.6 | 1.3 | 1.1 | 1.1 | 16 |
| | Injection Rate (m/L) | 0.28 | 0.29 | 0.31 | 0.27 | 0.32 | 0.26 | 0.35 | 0.33 | 0.34 | 0.35 | 0.26 | 0.24 | 0.30 |
| Sergeli | Distribution ($10^3m^3$/m) | 698 | 666 | 477 | 525 | 527 | 915 | 961 | 964 | 915 | 471 | 501 | 729 | 8,349 |
| | Liquid chlorine (t) | 0.18 | 0.31 | 0.35 | 0.29 | 0.31 | 0.34 | 0.15 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 3 |
| | Injection Rate (m/L) | 0.26 | 0.47 | 0.73 | 0.55 | 0.59 | 0.37 | 0.16 | 0.31 | 0.33 | 0.64 | 0.60 | 0.41 | 0.41 |
| Bektemir | Distribution ($10^3m^3$/m) | 729 | 658 | 729 | 705 | 729 | 705 | 713 | 729 | 690 | 729 | 705 | 713 | 8,532 |
| | Hypo-chloride (t) | 0.15 | 0.3 | 0.24 | 0.14 | 0.16 | 0.17 | 0.24 | 0.24 | 0.1 | 0.3 | 0.16 | 0.3 | 3 |
| | Injection Rate (m/L) | 0.21 | 0.46 | 0.33 | 0.20 | 0.22 | 0.24 | 0.34 | 0.33 | 0.14 | 0.41 | 0.23 | 0.42 | 0.29 |
| Kara-Su | Distribution ($10^3m^3$/m) | 766 | 694 | 763 | 891 | 942 | 1,059 | 1,079 | 1,094 | 894 | 766 | 738 | 778 | 10,464 |
| | Hypo chloride (t) | 0.3 | 0.27 | 0.3 | 0.35 | 0.37 | 0.42 | 0.4 | 0.4 | 0.35 | 0.3 | 0.3 | 0.3 | 4 |
| | Injection Rate (m/L) | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 | 0.40 | 0.37 | 0.37 | 0.39 | 0.39 | 0.41 | 0.39 | 0.39 |
| Kuiluk | Distribution ($10^3m^3$/m) | 682 | 574 | 468 | 435 | 419 | 768 | 791 | 815 | 765 | 462 | 399 | 694 | 7,272 |
| | Hypo-chloride (t) | 0.2 | 0.2 | 0.26 | 0.2 | 0.17 | 0.3 | 0.35 | 0.3 | 0.28 | 0.3 | 0.3 | 0.3 | 3 |
| | Injection Rate (%) | 0.29 | 0.35 | 0.56 | 0.46 | 0.41 | 0.39 | 0.44 | 0.37 | 0.37 | 0.65 | 0.75 | 0.43 | 0.43 |

### (4) Staff Assignment

Table S 2.3.6.23 shows staff assignment for facilities. The staff was divided engineer (including managing staff) and worker.

**Table S 2.3.6.23 Arrangement of Operational Staff**

| Name | Division | Staff Arrangement for O & M | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Shift Operation | Managing | Operation | Machine | Electric | Repair | Laboratory | Total |
| Kadirya | Engineer | 9 | 3 | 9 | 1 | 2 | 0 | 6 | 30 |
| | Worker | 79 | 0 | 48 | 2 | 4 | 12 | 5 | 150 |
| | Total | 88 | 3 | 57 | 3 | 6 | 12 | 11 | 180 |
| Boz-su | Engineer | 4 | 2 | 8 | 1 | 1 | 0 | 4 | 20 |
| | Worker | 47 | | 35 | 10 | 8 | 13 | 7 | 120 |
| | Total | 51 | 2 | 43 | 11 | 9 | 13 | 11 | 140 |
| Kibray | Engineer | 6 | 2 | 18 | 1 | 1 | 0 | 3 | 31 |
| | Worker | 54 | 0 | 67 | 18 | 16 | 0 | 7 | 162 |
| | Total | 60 | 2 | 85 | 19 | 17 | 0 | 10 | 193 |
| South | Engineer | 4 | 5 | 4 | 1 | 0 | 0 | 4 | 18 |
| | Worker | 44 | | 30 | 1 | 14 | 0 | 8 | 97 |
| | Total | 48 | 5 | 34 | 2 | 14 | 0 | 12 | 115 |
| Sergeli | Engineer | 9 | 3 | 8 | 0 | 0 | 0 | 3 | 23 |
| | Worker | 62 | | 22 | 0 | 12 | 5 | 4 | 105 |
| | Total | 71 | 3 | 30 | 0 | 12 | 5 | 7 | 128 |
| Kara-su | Engineer | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Worker | 42 | 0 | 0 | 0 | 0 | 2 | 5 | 49 |
| | Total | 42 | 0 | 0 | 0 | 0 | 2 | 5 | 49 |
| Bectemir | Engineer | 5 | 2 | 4 | 0 | 0 | 0 | 0 | 11 |
| | Worker | 39 | 0 | 2 | 0 | 8 | 1 | 0 | 50 |
| | Total | 44 | 2 | 6 | 0 | 8 | 1 | 0 | 61 |
| Kuiluk | Engineer | 4 | 2 | 1 | 0 | 0 | 0 | 0 | 7 |
| | Worker | 17 | 0 | 2 | 0 | 5 | 4 | 0 | 28 |
| | Total | 21 | 2 | 3 | 0 | 5 | 4 | 0 | 35 |
| PS | Engineer | 0 | 2 | 54 | 4 | 2 | 0 | 0 | 62 |
| | Worker | 585 | 0 | 117 | 0 | 0 | 30 | 0 | 732 |
| | Total | 585 | 2 | 171 | 4 | 2 | 30 | 0 | 794 |
| Sub-Total | Engineer | 41 | 21 | 106 | 8 | 6 | 0 | 20 | 202 |
| | Worker | 969 | 0 | 323 | 31 | 67 | 67 | 36 | 1493 |
| | Total | 1010 | 21 | 429 | 39 | 73 | 67 | 56 | 1695 |
| Others Including Vodokanal | Engineer | | | | | | | | 959 |
| | Worker | | | | | | | | 1757 |
| | Total | | | | | | | | 2716 |
| Total | Engineer | | | | | | | | 1161 |
| | Worker | | | | | | | | 3250 |
| | Total | | | | | | | | 4411 |

# S 2.3.7 Tariff

### (1) Types of tariff

Two types of tariff are applied by Tashkent Vodokanal: a Metered tariff and a Fixed rate tariff (called "Norm"). The Norm rate is set depending on domestic customers' lifestyle (e.g. with/without sewage, with/without hot water supply etc.) as presented in Table S2.3.7.1.

**Table S2.3.7.1 The Norm Base Consumption and Monthly Water Charges**

| | Level of provision of amenities | Water supply | | | Sewerage | | | Total payment for one person per month (sum) | Total amount for one person per month | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Consumption/person (liters/day) | Tariff /m³ (sum) | Payment for one person per month (sum) | Volume / person (liters/day) | Tariff /m³ (sum) | Payment for one person per month (sum) | | Water m³ | Sewerage m³ |
| In houses without sewerage | | | | | | | | | | |
| 1 | With intake of water from taps on the streets | 50 | 22 | 33.46 | | | | 33.46 | 1.52 | |
| 2 | With intake of water from taps in the yards | 94 | 22 | 62.90 | | | | 62.90 | 2.86 | |
| 3 | With intake of water from taps in the yard (with washing toilet in the yard) | 155 | 22 | 103.72 | | | | 103.72 | 4.71 | |
| 4 | With in-house water supply, wash-bowl, sink | 122 | 22 | 81.64 | | | | 81.64 | 3.71 | |
| 5 | With in-house water supply, wash-bowl, sink, lavatory pan | 183 | 22 | 122.46 | | | | 122.46 | 5.57 | |
| 6 | With in-house water supply, wash bowl, sink, bath or shower with local water-hitting device | 216 | 22 | 144.54 | | | | 144.54 | 6.57 | |
| 7 | With in-house water supply, wash bowl, sink, bath or shower with local water-hitting device, lavatory pan | 277 | 22 | 185.36 | | | | 185.36 | 8.43 | |
| In houses with sewerage | | | | | | | | | | |
| 8 | With in-house water supply, wash bowl | 143 | 22 | 95.69 | 143 | 10.5 | 45.67 | 141.36 | 4.35 | 4.35 |
| 9 | With in-house water supply, wash bowl, lavatory pan | 179 | 22 | 119.78 | 179 | 10.5 | 57.17 | 176.95 | 5.44 | 5.44 |
| 10 | With in-house water supply, wash bowl, bath or shower with local water-hitting device | 248 | 22 | 165.95 | 248 | 10.5 | 79.21 | 245.16 | 7.54 | 7.54 |
| 11 | With in-house water supply, wash bowl, bath (sauna) or shower with | 284 | 22 | 190.04 | 284 | 10.5 | 90.70 | 280.74 | 8.64 | 8.64 |

| | Level of provision of amenities | Water supply | | | Sewerage | | | Total payment for one person per month (sum) | Total amount for one person per month | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Consumption/person (liters/day) | Tariff /m³ (sum) | Payment for one person per month (sum) | Volume / person (liters/day) | Tariff /m³ (sum) | Payment for one person per month (sum) | | Water m³ | Sewerage m³ |
| | local water-hitting device, lavatory pan | | | | | | | | | |
| In houses with sewerage and hot water supply | | | | | | | | | | |
| 12 | With in-house water supply, wash bowl, bath, shower, lavatory pan | 330 | 22 | 220.83 | 429 | 10.5 | 137.01 | 357.84 | 10.04 | 13.05 |
| 13 | In dormitories (corridor system) with hot water supply, sewerage, wash bowl, sink, laundry | 171 | 22 | 114.43 | 222 | 10.5 | 70.09 | 185.33 | 5.20 | 6.75 |
| 14 | The same in dormitories(sectional) | 281 | 22 | 188.04 | 365 | 10.5 | 116.57 | 304.61 | 8.55 | 11.10 |

# S 2.3.8 Financial Status

Abbreviated Statutory Balance Sheets and Income statements of Vodokanal for 2003 and the third quarters of 2004 are provided below.

**Table S2.3.8.1 Income Statements of Vodokanal (unaudited)**

| | 2003 | | | | 9 months of 2004 / 9месяцев 2004г. | | | |
|---|---|---|---|---|---|---|---|---|
| | Suvsoz | Ulgurjisuvsavdo | Combined (excl. Intercompany) | % | Suvsoz | Ulgurjisuvsavdo | Combined (excl. Intercompany) | % |
| **Net sales** | **16,934** | **1,086** | **17,233** | | **11,531** | **2,043** | **12,213** | |
| Cost of sales | (13,142) | (1,036) | *(13,391)* | | (11,387) | (1,742) | *(11,767)* | |
| **Gross margin** | **3,792** | **51** | **3,842** | *22%* | **144** | **302** | **445** | *4%* |
| Sales, general & administration expenses | (1,442) | (86) | (1,528) | | (2,182) | (162) | (2,344) | |
| Other net operating income (expenses) | (1,760) | (61) | (1,820) | | 327 | (101) | 226 | |
| **Operating income** | **590** | **(96)** | **494** | *3%* | **(1,711)** | **38** | **(1,673)** | *-14%* |
| Other net financial income (expenses) | (50) | - | (50) | | (10) | 11 | 1 | |
| **Income before tax** | **540** | **(96)** | **444** | *3%* | **(1,721)** | **49** | **(1,672)** | *-14%* |
| Taxes | (334) | - | (334) | | - | (19) | (19) | |
| **Net income** | **206** | **(96)** | **110** | *1%* | **(1,721)** | **30** | **(1,691)** | *-14%* |

## Table S2.3.8.1 Balance Sheets of Vodokanal (unaudited)

| | 31.12.2003 | | | 30.09.2004 | | |
|---|---|---|---|---|---|---|
| | Suvsoz | Ulgurjisuvsavdo | Combined (excl. Intercompany) | Suvsoz | Ulgurjisuvsavdo | Combined (excl. Intercompany) |
| **Assets** | | | | | | |
| Fixed assets: | | | | | | |
| Acquisition cost | 35,953 | 1,228 | 37,182 | 36,292 | 1,630 | 37,922 |
| Less: accumulated depreciation | (16,817) | (534) | (17,351) | (18,882) | (681) | (19,563) |
| Net book value | 19,137 | 695 | 19,831 | 17,410 | 949 | 18,359 |
| Other long-term assets | 1,667 | - | 1,662 | 2,349 | - | 2,344 |
| Total fixed assets | 20,803 | 695 | 21,493 | 19,760 | 949 | 20,703 |
| Current assets: | | | | | | |
| Inventories | 853 | 34 | 886 | 1,132 | 41 | 1,172 |
| Prepaid expenses | 221 | 0 | 221 | 221 | 0 | 221 |
| Cash | 43 | 54 | 97 | 113 | 94 | 208 |
| Debtors | 11,502 | 232 | 11,659 | 13,670 | 324 | 13,845 |
| Total current assets | 12,619 | 320 | 12,864 | 15,136 | 460 | 15,446 |
| Total Assets | 33,422 | 1,015 | 34,356 | 34,895 | 1,409 | 36,150 |
| **Equity & Liabilities** | | | | | | |
| Equity: | | | | | | |
| Charter capital | 112 | 5 | 112 | 112 | 5 | 112 |
| Reserve capital | 26,052 | - | 26,052 | 26,304 | 86 | 26,390 |
| Retained earnings | 1,385 | (96) | 1,289 | (413) | (66) | (478) |
| Total equity | 27,549 | (91) | 27,453 | 26,004 | 25 | 26,024 |
| Liabilities: | | | | | | |
| Loans | 847 | 726 | 1,573 | 602 | 951 | 1,553 |
| Suppliers and contractors | 2,125 | 154 | 2,204 | 6,018 | 186 | 6,055 |
| Settlements with budget | 830 | 22 | 852 | 237 | 46 | 283 |
| Wages & salaries | 314 | 36 | 350 | 346 | 83 | 429 |
| Social insurance payments | 814 | 19 | 833 | 365 | - | 365 |
| Other creditors | 943 | 149 | 1,092 | 1,322 | 118 | 1,441 |
| Total liabilities | 5,873 | 1,106 | 6,903 | 8,891 | 1,384 | 10,126 |
| Total Equity & Liabilities | 33,422 | 1,015 | 34,356 | 34,895 | 1,409 | 36,150 |

# S 2.3.9 Recent Changes in Institutions & Organization, Management and Financial Status Not Reflected in the Master Plan

This supporting memo is an update of the most significant changes in institutions & organization, as well as changes in the management and financial status of Vodokanal since the end of the fieldwork on formulating of the M/P and thus it covers only the period from March 2004 to January 2005. Please refer to respective chapters of the M/P for further details.

## (1) Institutions & Organization Changes

Two new subsidiaries were established by Vodokanal in July 2004: Suvolchagichxizmati and Suvsozplast. Suvolchagichxizmati was established in the result of a spin-off of then existed Water Meters Division of Vodokanal and it has taken over all Vodokanal's functions relating to water meters, such as their installation, repair, concluding agreements with customers, collection of installation fees, sealing of meters, etc. The business of Suvsozplast, the second newly established small subsidiary of Vodokanal, is installation of plastic pipers without excavation, primarily for Vodokanal. It should be noted also that Vodokanal is in the process of establishment of a separate group within its Sales Department, which would be in charge of receiving (by phone) and control of all information about accidents.

## (2) Progress towards the Metered Tariff System

Individual water meters are already installed for 31% of domestic customers (172,818 meters in total) as of December 1, 2004, including 30.4% - in apartments and 40% - in detached houses. According to Vodokanal and TKEO officials, the program for installation of water meters remains unchanged, as well as its financing problems. On the other hand, the practice of charging customers for water meters in installments during the period of 2 to 4 years (or even 8 years in certain cases) has been introduced. Also, Vodokanal has started installation of bulk meters, in addition to installation of individual meters, in order to cope with leakages and illegal connections in the basins of the apartment buildings. The difference between the bulk meter readings and the sum of individual meters readings is planned to be charged to respective TSZhs in the future. However, there have been no changes in the tariff revision methods, nor in the standard consumption volumes (Norms).

### (3) Increase of Tariffs

Vodokanal raised its water tariffs to 25 soums/$m^3$ (earlier – 22 soums/$m^3$) for all domestic customers and communal services on June 1, 2004. Vodokanal's water tariff for Ulgurjisuvsavdo, Vodokanal's wholesale subsidiary for the industrial customers, have been raised gradually and reached the same level of 25 soums/$m^3$ from October 1, 2004. The current (January 2005) water tariff of Ulgurjisuvsavdo to industry is 47.8 soums/$m^3$ (earlier – 39.66 soums/$m^3$), excluding VAT. The increase of water tariffs was in line with the official inflation rates in Uzbekistan and was justified primarily by a sharp growth of electricity costs. Further adjustment of tariffs, which is planned from February 1, 2005, is as follows: 30 soums/$m^3$ - for domestic customers and communal services and 55.8 soums/$m^3$ - for industry (tariff of Ulgurjisuvsavdo).

### (4) Recent Financial Situation

Since the annual financial statements of Vodokanal for 2004 are expected to be issued only in February 2005, brief review of the recent financial situation is based on the accounting data for 2003 and the 9 months of 2004. (Details of the financial statements are provided in the Supporting Report.) Net sales of Vodokanal were decreasing, whereas the production costs were increasing, mostly due to the significant growth of electricity prices. As the result, the gross margin has sharply deteriorated and Vodokanal showed net losses for the 9 months of 2004. At the same time, the debtors' and creditors' balances had a growth tendency during the reviewed period; however, a subsequent set-off of debtors against creditors in the amount of 4 billion soums, which was carried out in November 2004, resulted in the respective decrease of the both balances. On the other hand, collection of water charges in cash has slightly improved, resulting in improvement of the situation with the cash flows.

### (5) EBRD Project Loan

A loan agreement between EBRD and Tashkent City Hokimiyat in connection with the Tashkent Water Supply Improvement Project was signed in April 2004. The proceeds of the EBRD loan are on-lent to Vodokanal. The repayment period for the loan is 15 years, including 3 years as a grace period, and the interest rate is LIBOR + 1%. Repayment of the loan will be made twice a year starting from 2007. The Project is planned to be completed by 2007 and the total Project costs are estimated at 14.67 million USD, of which up to 10.0 million USD will be financed by the loan and the remainder of the investment costs - by Vodokanal. The Project Implementation Unit has been established under the Department of Investments of Tashkent City Hokimiyat.

### (6) EBRD Financial & Operational Performance Improvement Program

In the context of the EBRD loan, a granted Financial and Operational Performance Improvement Program will be implemented for the period of a year starting in the end of January 2005. The Program will comprise: (1) Operations improvement; (2) Institutional development and support to attract private sector participation; (3) Accounting policies and budget management; (4) Capital investment planning; and (5) Development and implementation of IT strategy for Vodokanal. The consultants for implementation of this EU funded Program, are supposed to focus on the short-term financial, accounting and operational issues, as well as on achievement of the private sector participation in the operations of Vodokanal.

### (7) Other Management Issues

The following management issues are also worth mentioning:

- Vodokanal is launching its own website in January 2005, where the customers can get all necessary information about Vodokanal's activity;
- Installation of PCs in rayon vodokanals has progressed during the reviewed period; and

- Vodokanal has developed training programs for its employees and is equipping the training room.

### (8) Achievement Status for the Management Action Plan

For the F/S Project could achieve its objectives, implementation of the technical components should be accompanied by practical steps taken in accordance with the proposed Management Action Plan, which was described in details in the M/P (see Table 5.13.2). The main ideas of this Management Action Plan are understood and shared by the management of Vodokanal. Table S 2.3.9.1, which is provided below, describes the current (January 2005) realization status of the proposed measures, the obstacles which have occurred on the way to their practical implementation, as well as the required countermeasures and changes to the proposed schedule.

The management of Vodokanal will be assisted through a EU-funded program in preparation and implementation of Vodokanal's short-term Financial and Operational Performance Improvement Program, which will focus on solving immediate financial, accounting and operational issues as well as the achievement of private sector participation into the operations of Vodokanal. Since the EU-funded assistance will likely address the vast majority of the issues raised in the Management Action Plan, in order to avoid duplication of ODA work between two donors, further elaboration on the short- and medium-term action plans for the management of Vodokanal is left for the EU consultants. Those measures of the Management Action Plan, which will happen not to be covered by the short-term Financial and Operational Performance Improvement Program developed with the EU assistance, the management of Vodokanal should revisit upon fulfillment of the short-term Program and pursue on its own.

**Table S 2.3.9.1 Achievement Status to the Proposed Management Action Plan**

| Program | Proposed Action | Achievement Status (January 2005) |
|---|---|---|
| UFW Reduction Measures | (1) Promotion of meters installation | Individual water meters have already been installed for approx. one third of domestic customers. According to Vodokanal and TKEO officials, the earlier approved governmental schedule for installation of water meters still remains valid, with the major obstacle for its practical implementation being the lack of funds. Establishment of a new subsidiary Suvolchagichxizmati, which deals with meters' installation, their repair, agreements with customers, collection of the meters' costs, etc., is supposed to speed up the meters installation. The practice of charging |

| | | |
|---|---|---|
| | | customers for water meters in installments has also been introduced. Finally, Vodokanal has started installation of bulk meters, in addition to installation of individual meters, in order to cope with the problem of leakages and illegal connections in the basins of apartment buildings. |
| | (2) Pipe replacement | The deteriorated distribution network in the City remains one of the most urgent problems for Vodokanal; however, the progress of its rehabilitation is limited due to financial constraints. Replacement of pipes is one of the components of the proposed scope of the F/S Project. Also, establishment of the subsidiary for installation of plastic pipes Suvsozplast is supposed to contribute to solving the problem. |
| | (3) Strengthening management | Vodokanal has already started installation of flow meters at WTPs in order to monitor the actual amount of the water amount distributed to the City. Internal control over the meter reading procedures is being strengthened. |
| Financial Status Improvement Program | (1) Formulation of a proper funding plan | The funding plan for the M/P will be formulated once the M/P itself is adopted. Also, new steps to speed up the reforms in the sector are expected to be undertaken soon by the Government. |
| | (2) Implementation of a proper funding plan | Attraction of a loan from the EBRD and practical implementation of the EBRD project is the first step. Conduction of the present F/S is the next practical step. |
| Planning and Implementa-tion Program for Technical LTDP Management | (1) Establishment of the PMU | The PIU for implementation of the EBRD project has already been established under Hokimiyat. A similar executing agency should be established for the F/S implementation if the Project starts. Finally, improvement of the capital investment planning in Vodokanal in general will be one of the tasks for the EU-granted Program. |
| | (2) Actions needed to progress with the restructuring of WTPs and PSs | Not due yet (planned from 2007 to 2010). |
| Improvement Program for the Tariff System | (1) Reforms indepen-dent from the Metered Tariff System<br>1) Reforms in the methods for tariff revision | Revision of the tariffs of Vodokanal is carried out in accordance with the valid legislation of Uzbekistan. Therefore, any changes in the tariff revision methods will be possible when the related legislation is amended countrywide. |
| | 2) IT utilization for billing & collection systems | Vodokanal has completed installation of PCs in all *rayon vodokanals*. Also, development and implementation of the IT strategy of Vodokanal will be one of the tasks for the EU-granted Program. |
| | (2) Reforms for the metered tariff system<br>1) New tariff system | Transition to the metered tariff system is carried out keeping pace with installation of individual water meters. Use of the progressive two-tier tariff table will become possible in the future only when the meters are installed for the vast majority of the customers. Apart from the required legal changes, the major obstacle for the future two-tier tariff will be the fact that that the basic charge might be misunderstood by customers as a return to the Norm system, therefore special PR activities will be required in this respect. As for the use of the progressive scale, its practical application will need to be implemented very carefully, especially for large families, in order to avoid social problems. |
| | 2) Indoor repair | Indoor repair is the responsibility of the respective households and TSZhs, not that of Vodokanal. Installation of individual water meters will push indoor repairs by the owners. |

| | | |
|---|---|---|
| | 3) Integrating of billing & collection with other public services | Creating of special centers in the City, which would be in charge for collection of the fees of public utilities, is currently under consideration of Tashkent City TKEO. |
| | 4) Improvement of meters installation method | Possibilities for installation of water meters outdoors and other improvements in their installation methods are being investigated by Vodokanal. |
| Strengthening Program for Management and Organization | (1) Strengthening of management<br>1) Strengthening management for LTDP | The management of Vodokanal has taken proactive position in formulation of the M/P, which is being developed. |
| | 2) Management based on PDCA Cycle | Even though the management of Vodokanal intuitively tries to follow in practice this theory, the formal PDCA Cycle approach will need to be taken into account when developing the new internal procedures. |
| | 3) Org. atmosphere reform | Even though the change of the organizational atmosphere in Vodokanal (employee awareness, attitude towards solving problems, etc.) cannot go ahead of the overall movement towards the market economy, it has been accelerated since the coming of the new management team of the company. |
| | (2) Reform of person. management<br>1) Improving personnel evaluation | The system of the personnel evaluation is progressing in line with the movement of Vodokanal towards the market economy. For instance, with separation of certain sections from Vodokanal, they employ more performance-based salary systems. However, this process will be boosted only by the privatization of Vodokanal. |
| | 2) Employees' training | Vodokanal has recently developed training programs and scheduled for employees of all major professions. Currently, a new training center is being equipped by PCs, training materials, etc. in Vodokanal's main building. |
| | (3) Org. reform<br>1) Introducing private sector | Preparation of a plan for introduction of the private sector participation will be one of the tasks for the EU-granted Program. Meanwhile, Vodokanal has continued its preparation for introducing the private sector (privatization) by further spinning off in 2004 certain functions (water meters section). |
| | 2) Org. reform | Organizational structure of Vodokanal has been further streamlined. Thus, a spin off of the water meters section has taken place recently. |
| Development Program for Management Information | (1) Strengthening man. information reliability and information sharing | The management of Vodokanal is working on this issue, with certain progress being achieved in introduction of IT in districts, strengthening of the internal controls, improvement of the document flow and data verification. |
| | (2) Strengthening the reliability of financial information | Application of the International Accounting Standards by Vodokanal is addressed in the agreements related to the EBRD loan. |
| PR Program | | Launching of the company's web site in January 2005 is one of the most noticeable achievements. Another achievement is the lottery among "good customers" at the end of 2004, which has boosted the collection rate. One more example of the on-going improvements in customers' relations area – the planned installation of a dedicated multi-channel telephone line and establishment of a group in charge for receiving and following up information on accidents. |