1.2. Status of Water and Energy Complex of the Kazakhstan Part of the Syrdarya Basin, V. Borisovsky

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1. Water Management

Kazakhstan has several water facilities on the Syr Darya River. The biggest is the Shardara Hydropower Plant with a reservoir and hydraulic structures. The Shardara Reservoir capacity, if the storage has normal maximum operating level, is 5.2 million m^3 and 700 million m^3, in case of dead storage. Hence, the reservoir operating capacity is 4.5 million m^3. The reservoir is intended for agricultural water users to supply them with secured water during the growing season. The reservoir head (i.e. the place where the river falls in the reservoir) is situated just on the state boundary between Kazakhstan and Uzbekistan, and the latter is the country from which the Syr Darya flows to Kazakhstan. Numerous small hydraulic facilities intended only for irrigation water withdrawals from the river are situated downstream, below Shardara Reservoir. The biggest among them is the hydraulic complex in the Kyzyl Orda area.

In two past decades after some measures were implemented to regulate the Syr Darya flow (long-period and average long-period storage reservoirs were built at Toktogul, Kairakkum and Shardara HPP) water flow regime was essentially modified versus natural flow (Table 1). In the recent years, the Shardara peak inflow occurred during winter months – December-Februaries. In the preceding time, the main portion of the flow was maintained in summer and in amount much exceeding the one formed recently. That was the result of a smaller flow diversion from the upper river, and no seasonal flow reallocation condition. This caused the riverbed silting, and the discharge capacity significantly decreased. To avert non-plan flooding, when instream discharges were high, long-distance dikes were constructed at sites according to "primitive" projects. Natural decrease of instream flow discharge and absolutely insufficient carrying capacity to the lower reach of the improperly built Kyzyl Orda hydraulic facilities caused problems: Kysyl Orda is under inundation risk in case more than 400 m^3/s of water flows in the Shardara lower reach and water is not diverted. With this condition taken into consideration, after the irrigation releases are over Kazakhstani water management bodies set water releases from Shardara Reservoir as much as 400 m^3/s (Table 1, Fig. 1). As in October-December the Shardara inflow (500-1200 m^3/s) is essentially bigger than the releases the reservoir storage level gradually grows and by early January it reaches the marginal value (Table 1, Fig. 3).

Consequently, each January-March 2.5-3.0 km^3 of water is discharged from Shardara Reservoir into the Arnasai depression on the Uzbek territory (Table 1, Fig. 2). If this useless water reached the Aral Sea the problem of the Sea would not be so acute, as of late the Syr Darya actual flow to the Aral Sea has been 5-6 km^3. Table 1 and Fig. 1 present the Shardara inflow schedule.

The Shardara winter inflow (800-1200 m^3/s) analysis shows that out of total Toktogul winter extreme releases amount to 850-880 m^3/s (Table 2), and this constitutes about 75% of Shardara inflow. The remained inflow makes up an additional Kairakkum release, exceeding 250 m^3/s in 2000. In 1997, the excess release from Kairakkum Reservoir was above 300 m^3/s. A big excess Kairakkum release is the result of

Andijan Reservoir water evacuation from the Uzbek territory. In January 2000 some daily Andijan releases reached 500 m^3/s, and this essentially affected Kairakkum releases. Figures 4, 5 show that 1998-2000 non-vegetation water releases from Toktogul Reservoir extensively exceeded vegetation water releases. The same is true of the releases from Kairakkum Reservoir.

To increase the Syr Darya instream discharge capacity Kazakhstan undertakes certain measures. For example, in 1999, the consortium of design institutes developed a project relating to reconstruction of hydro facilities and construction/reconstruction of the operating check dams. The Project designated the work priorities. The Project was developed due to international grants, but the investment source for its implementation has not been found. The reconstruction works and construction of new check facilities require of the order of $150 million.

Interstate agreements identify summer releases. The agreements fix amount of water released from each reservoir (the defining value is water release from Toktogul Reservoir), water amount intended for use by each basin country, they set water amounts diverted into main irrigation canals. The agreements also establish a mutual settlement procedure for irrigation water and generated electric power.

1998 and 1999 were relatively wet, thus the inflow to Shardara Reservoir was provided by lateral inflow from Chirchik, Bozsu, and Keles. Less intensive releases from Toktogul Reservoir versus stipulated in the international agreements were required those years to form irrigation flows for Kazakhstani agricultural water users.

Table 1. Chardara Reservoir Operation in 1998-2000

Months	Inflow, m^3/s			Discharge, m^3/s			Level, m			Storage, billion m^3			Discharge to Arnasai		
	1998	1999	2000	1998	1999	2000	1998	1999	2000	1998	1999	2000	1998	1999	2000
January	932	1185	1185	365	945	780	247.09	250.25	249.8	2.14	3.90	3.60	0	548	716
February	929	1029	1097	413	841	1042	249.84	251.09	251.3	3.66	4.54	4.69	39	369	647
March	1392	959		1286	927		251.73	251.72	251.51	5.00	4.99	4.83	759	239	
April	700	775		639	652		252.17	251.84		5.28	5.08		42	0	
May	948	423		954	682		251.31	252.28		5.44	5.40		0	0	
June	1560	300		1669	757		252.32	251.32		5.43	4.71		324	0	
July	516	306		1120	719		251.93	249.61		5.15	3.52		0	0	
August	216	165		652	655		249.62	247.66		3.53	2.42		0	0	
Sept.	215	186		525	313		247.55	244.46		2.36	1.10		0	0	
October	497	342		515	342		245.73	243.25		1.56	0.77		0	0	
Nov.	855	936		577	499		245.62	243.26		1.51	0.77		0	0	
Dec.	1021	1007		400	374		244.9	246.57		2.23	1.91		0	0	
As of 31 Dec.							250.25	249.8		3.90	3.60				
Average annual, m^3/s	738.9	633.8		683.2	643.0		3.16	-0.45		1.76	-0.29		33.1	121.4	171.3
Billion m^3	25.58	19.85		23.98	20.20										

Note: Reservoir storage at normal maximum operating level: 5.2 million m^3
Dead storage: 700 million m^3
Operating storage 4.5 million m^3

Table 2. Water Balance Dynamics at Toktogul Site

	1997				1998				1999				2000			
	Inflow	**Dis.**	**Level**	**Storage**	**Inflow**	**Dis.**	**Level**	**Storage**	**Inflow**	**Dis.**	**Level**	**Storage**	**Inflow**	**Dis.**	**Level**	**Storage**
	m^3/s		**m**	**bil/m^3**	**m^3/s**		**m**	**bil/m^3**	**m^3/s**		**m**	**bil/m^3**	**m^3/s**		**m**	**bil/m^3**
January	156	645	875.3	13.07	138	591	862.43	10.22	157	634	877.31	13.54	181	673	881.42	14.53
February	149	617	869.56	11.76	139	540	856.55	9.00	167	574	871.60	12.22	178.9	675.6	875.91	13.22
March	186	503	864.3	10.63	154	447	851.63	8.03	221	552	867.31	11.27			870.48	11.97
April	375	286	860.36	9.78	393	218	847.51	7.25	229	428	863.00	10.34				
May	521	273	861.46	10.01	557	168	848.6	7.45	754	222	866.83	9.88				
June	750	464	864.58	10.67	1216	147	854.15	8.52	905	246	867.63	11.34				
July	645	633	867.99	11.42	1152	286	867.42	11.29	1154	422	875.18	13.05				
August	486	480	868.14	11.45	732	331	877.57	13.61	724	408	882.63	14.83				
Sept.	287	164	868.21	11.46	423	244	881.71	14.61	429	197	885.96	15.67				
Oct.	184	161	869.68	11.79	267	324	883.58	15.07	320	298	888.30	16.27				
Nov.	189	451	869.96	11.85	228	412	882.97	14.92	263	540	888.50	16.32				
Dec.	178	534	866.89	11.17	237	551	881.03	14.44	210	611	885.71	15.61				
Of 31 Dec.			862.43	10.22			877.31	13.54			881.42	14.53				
Year + –			-12.87	-2.86			14.88	3.33			4.11	0.99				
Year annual, m^3/s	343.1	433.8			460.0	354.5			458.7	427.3						
Year bil/m^3	10.8	13.7			14.9	11.2			14.6	13.5						

Power Generation, total (MkWh)								**3868**				**5121**				_____
4697								1290				1708				_____
Including:	Quarter 1							412				817				_____
1625		Quarter 2						860				1073				_____
878								1306				1523				
	Quarter 3															
1116																
	Quarter 4															
1078																

Table 3. Kairakkum Water Balance by Years

	1997				1998				1999				2000			
	Inflow	**Dis.**	**Level**	**Storage**	**Inflow**	**Dis.**	**Level**	**Storage**	**Inflow**	**Dis.**	**Level**	**Storage**	**Inflow**	**Dis.**	**Level**	**Storage**
	m^3/s		**m**	**bil/m^3**	**m^3/s**		**m**	**bil/m^3**	**m^3/s**		**m**	**bil/m^3**	**m^3/s**		**m**	**bil/m^3**
January	874	1047	347.67	3.50	827	844	346.10	2.73	899	896	345.47	2.47	998.3	1253.5	347.54	3.43
February	792	1002	347.62	3.47	859	887	346.81	3.08	831	920	346.70	3.02	932.4	1186.1	347.40	3.36
March	639	930	347.47	3.40	725	972	347.36	3.35	770	899	347.10	3.22			347.39	3.36
April	503	406	346.57	2.96	464	448	347.08	3.21	664	744	346.87	3.11				
May	311	397	347.40	3.36	611	705	347.51	3.42	460	552	347.66	3.49				
June	406	451	346.98	3.16	925	1032	347.62	3.47	376	504	347.45	3.39				
July	406	548	346.19	2.77	475	706	347.57	3.45	428	619	346.63	2.99				
August	339	442	344.68	2.15	341	607	346.46	2.90	385	575	345.39	2.43				
Sept.	197	183	343.39	1.68	298	274	344.52	2.09	313	235	343.95	1.86				
Oct.	253	256	343.46	1.70	470	577	344.63	2.13	479	502	344.34	2.01				
Nov.	619	489	343.42	1.69	618	846	344.26	1.98	920	743	344.40	2.04				
Dec.	823	636	344.36	2.02	982	767	342.70	1.46	1042	851	345.44	2.45				
As of 01.01.00			346.10	2.73			345.47	2.47			347.54	3.43				
Year + –			-1.57	-0.77			-0.63	-0.26			2.07	0.97			-347.54	-3.43
Year annual, m^3/s	539.6	564.0			713.2	721.5			699.9	669.2			88.6	197.5		
Year bil/m^3																
Power Generation, total (MkWh)								**673.7**				**544.8**				**0.0**
632.2								183.2				256.2				—
Including: Quarter 1								182.0				183.6				—
242.3 Quarter 2								115.0				105.1				—
138.0								193.6								
Quarter 3																
117.1																
Quarter 4																
134.8																

Energy Complex

The previous section indicates that the Kazakhstan energy complex on the Syr Darya contains the Shardara hydropower plant (SHPP) of 100 MW installed capacity. The operating mode fully depends upon the release schedule that is established by water management bodies. The SHPP is a state stock company, and the Kazakh Ministry of Energy, Industry, and Trade is a 100% shareholder. The SHPP itself has restricted right to reallocate a daily water discharge schedule established by water management bodies. Hence, the Shardara energy schedule is subordinate and does not have independent value.

Implementation of annual interstate agreements causes many problems relating to Kyrgyz electric power transferred to Kazakhstan in summer and energy supplier (Karaganda energy coal) compensation. Structural rearrangements caused difficulties and from year it is increasingly strenuous to meet the agreement requirements. In 1999, following the decisions of the Kazakh Government particular economic entities received electric power, and namely they delivered to Kyrgyzstan energy coal on completely "non-transparent" terms. For 2000 such economic entities as for 20 March have not been identified yet.

In winter 1999-2000 Kyrgyzstan on its own initiative avoiding any agreements sold electric power to Kazakhstan water users on preferential terms. For this Kyrgyzstan increased Naryn-Syr Darya water releases intensifying the Shardara overfilling and water discharges into the Arnasai depression.

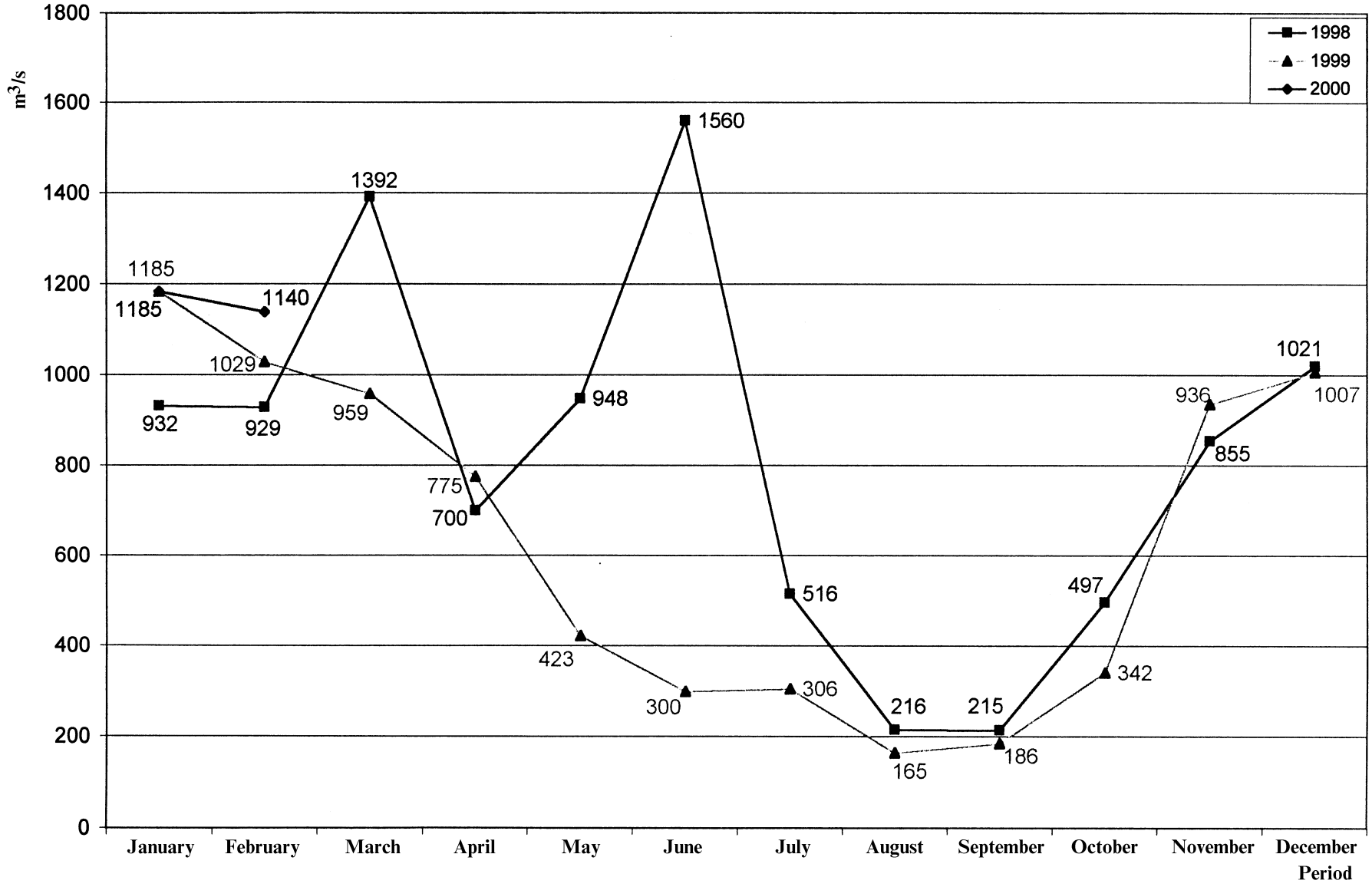

Figure 1. Chardara Inflow Diagram, 1998-1999

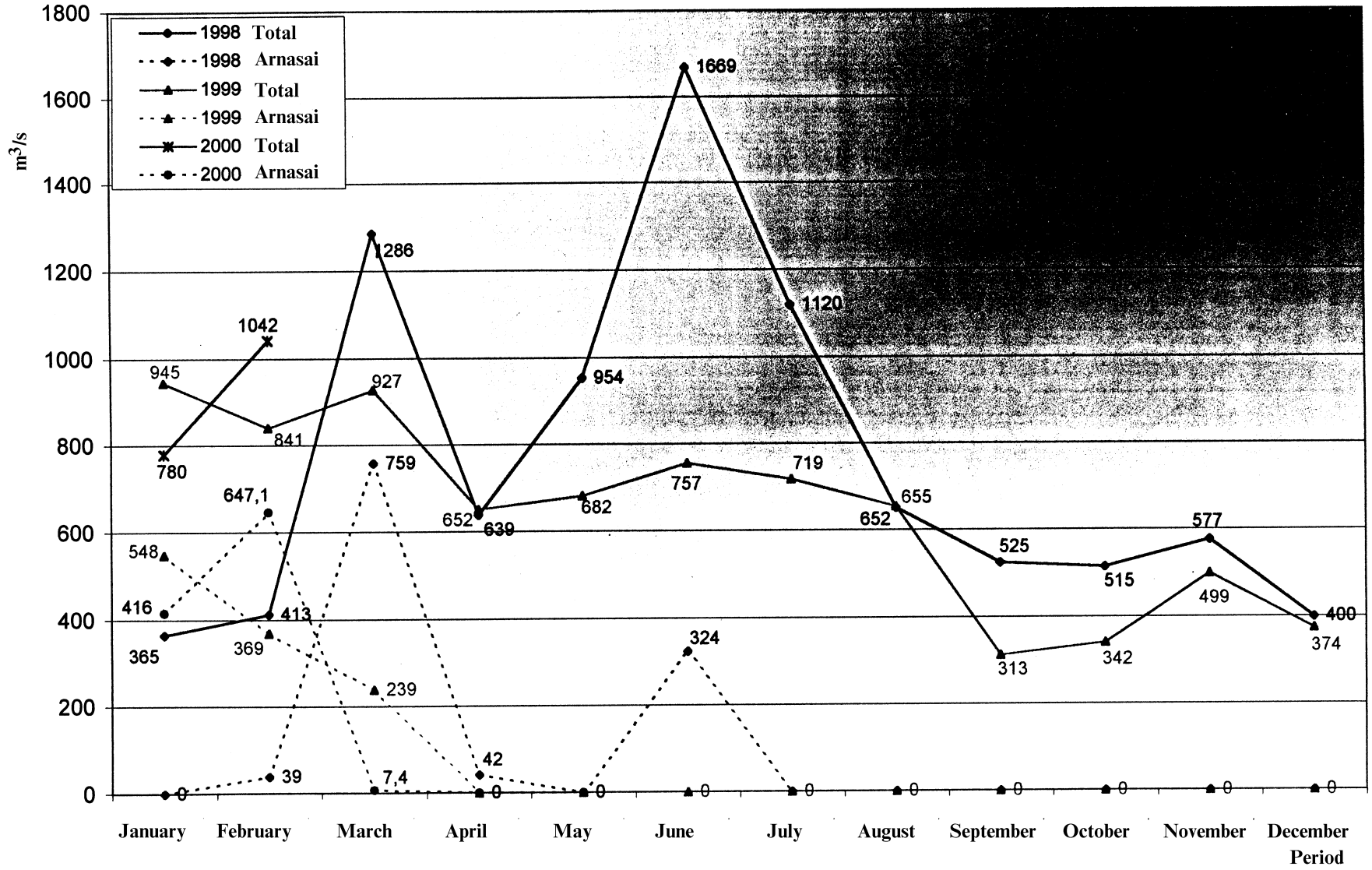

Figure 2. Water Releases from Chardara Reservoir, Including Releases in the Arnasai Depression 1998-2000

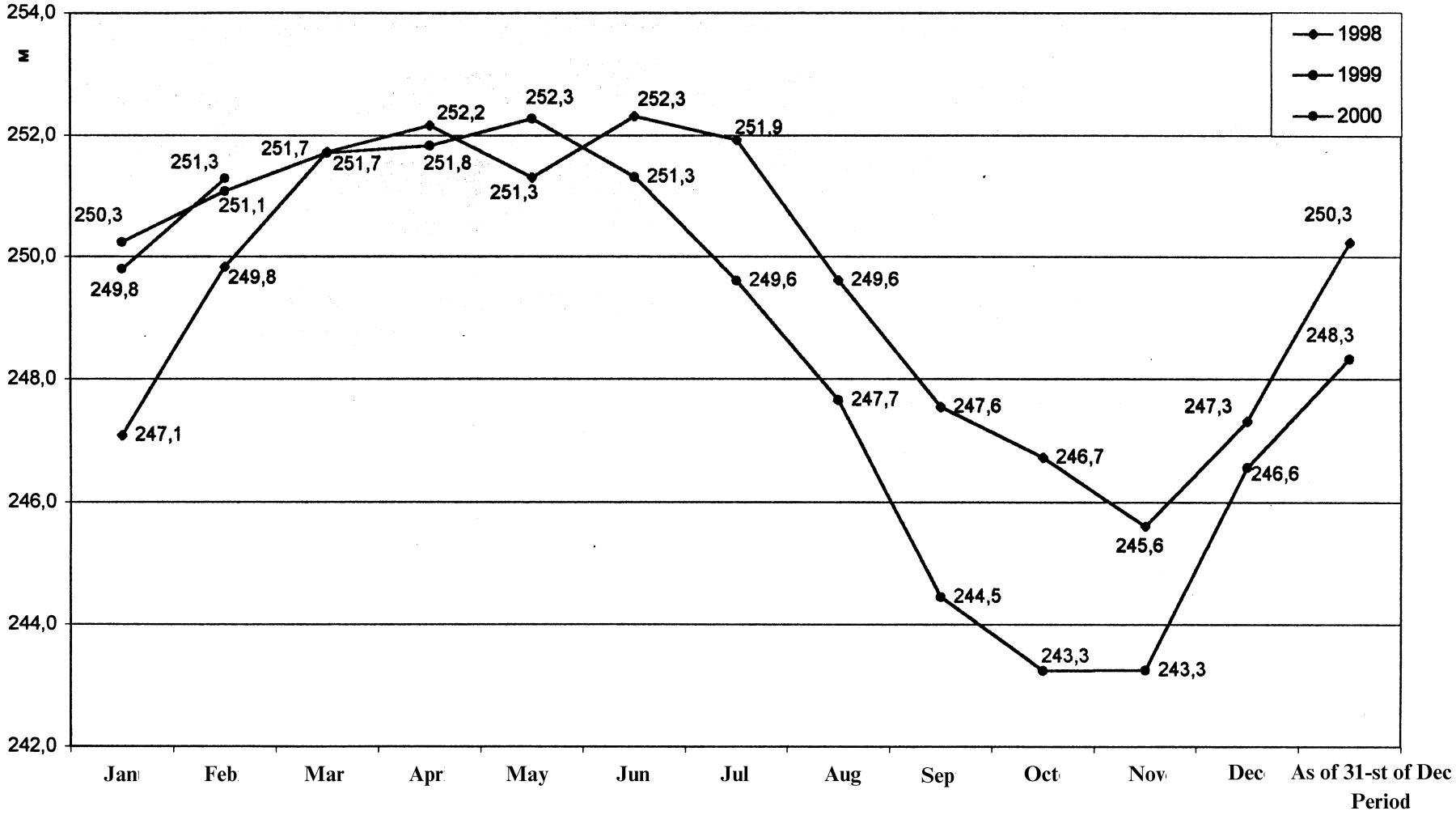

Figure 3. Chardara Storage Levels, 1998-2000

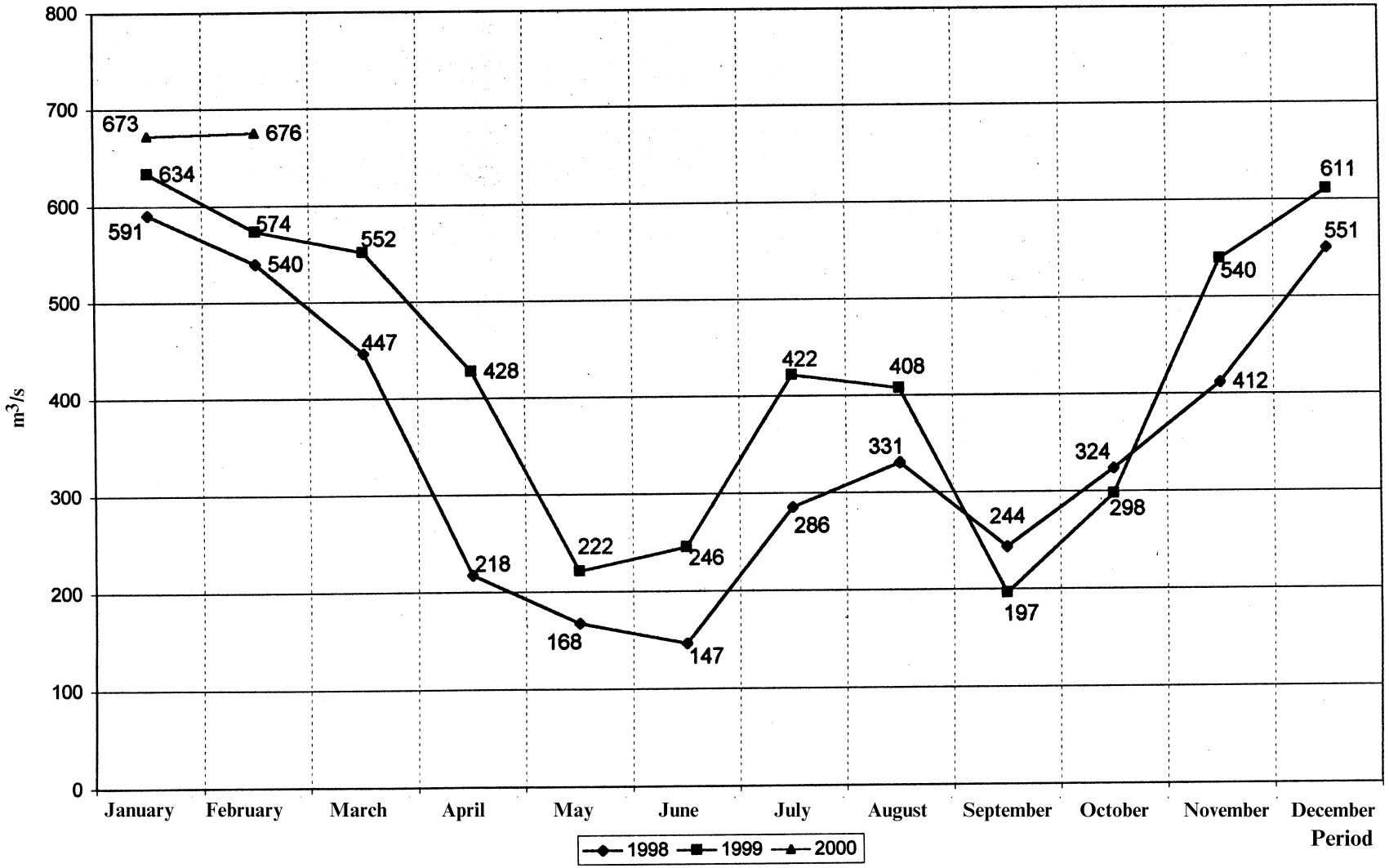

Figure 4. Water Releases from Toktogul Reservoir

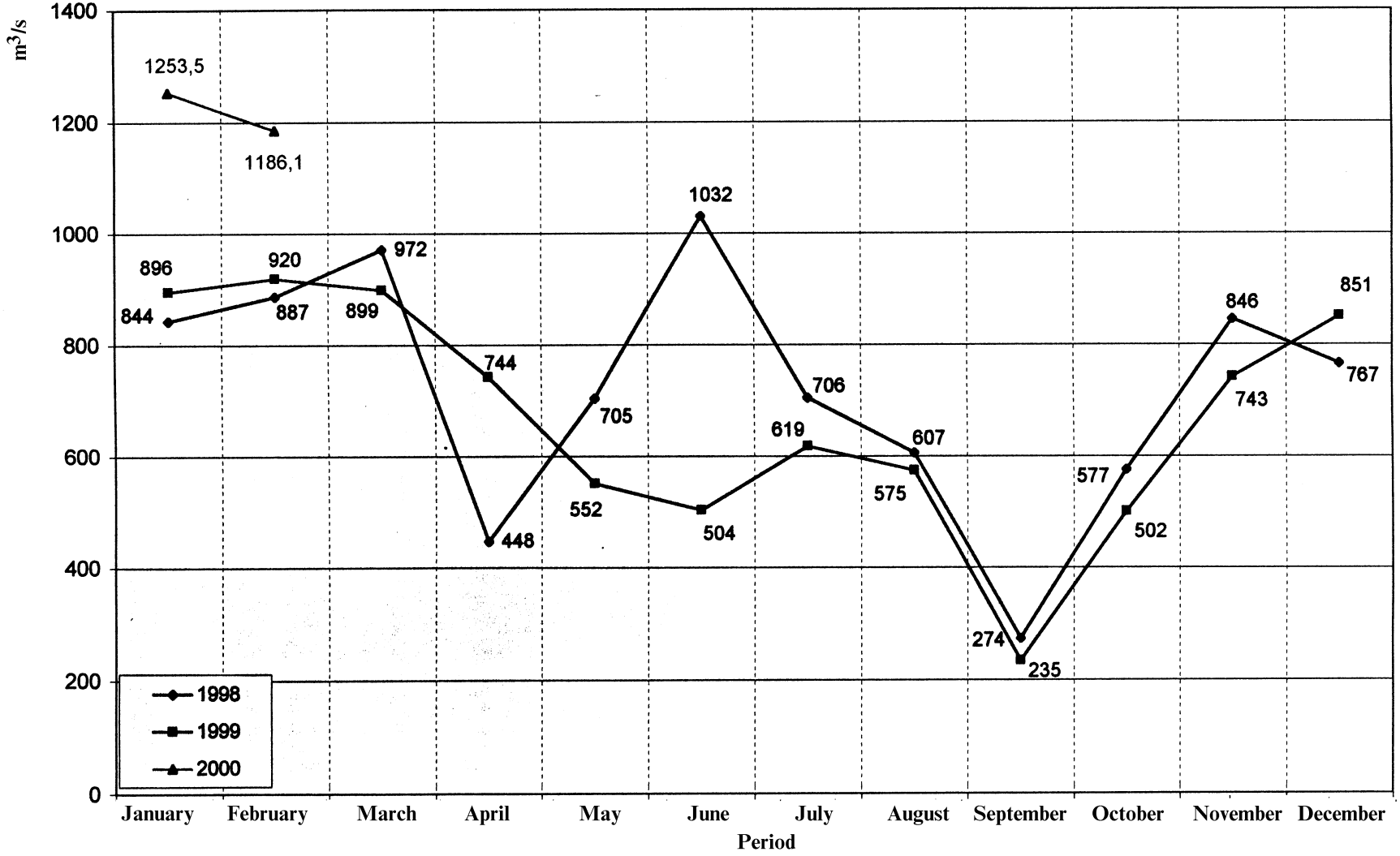

Figure 5. Water Releases from Kairakkum Reservoir, 1998-2000