

H. ADDITIONAL REPORT FOR THE EMERGENCY
PROJECT



JAPAN INTERNATIONAL COOPERATION AGENCY

MINISTRY OF PUBLIC UTILITIES

STATE COMMITTEE OF UZBEKISTAN FOR NATURE PROTECTION

REPUBLIC OF UZBEKISTAN

**THE STUDY
ON
WATER SUPPLY SYSTEM IN SIX CITIES
OF
THE ARAL SEA REGION IN UZBEKISTAN**

EMERGENCY PROJECT

DECEMBER 1996

**TOKYO ENGINEERING CONSULTANTS CO., LTD
IN ASSOCIATION WITH
KYOWA ENGINEERING CONSULTANTS CO., LTD**

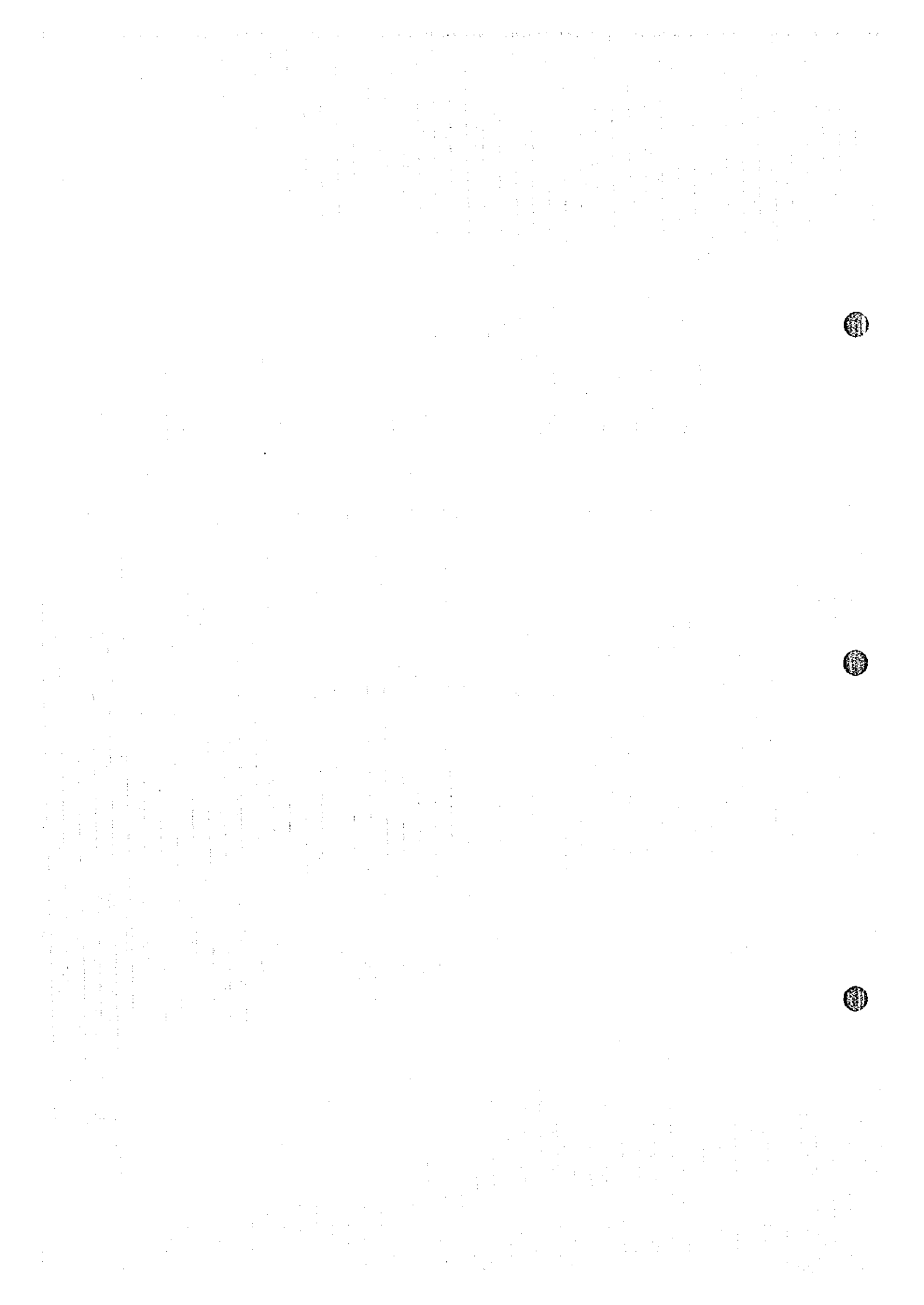
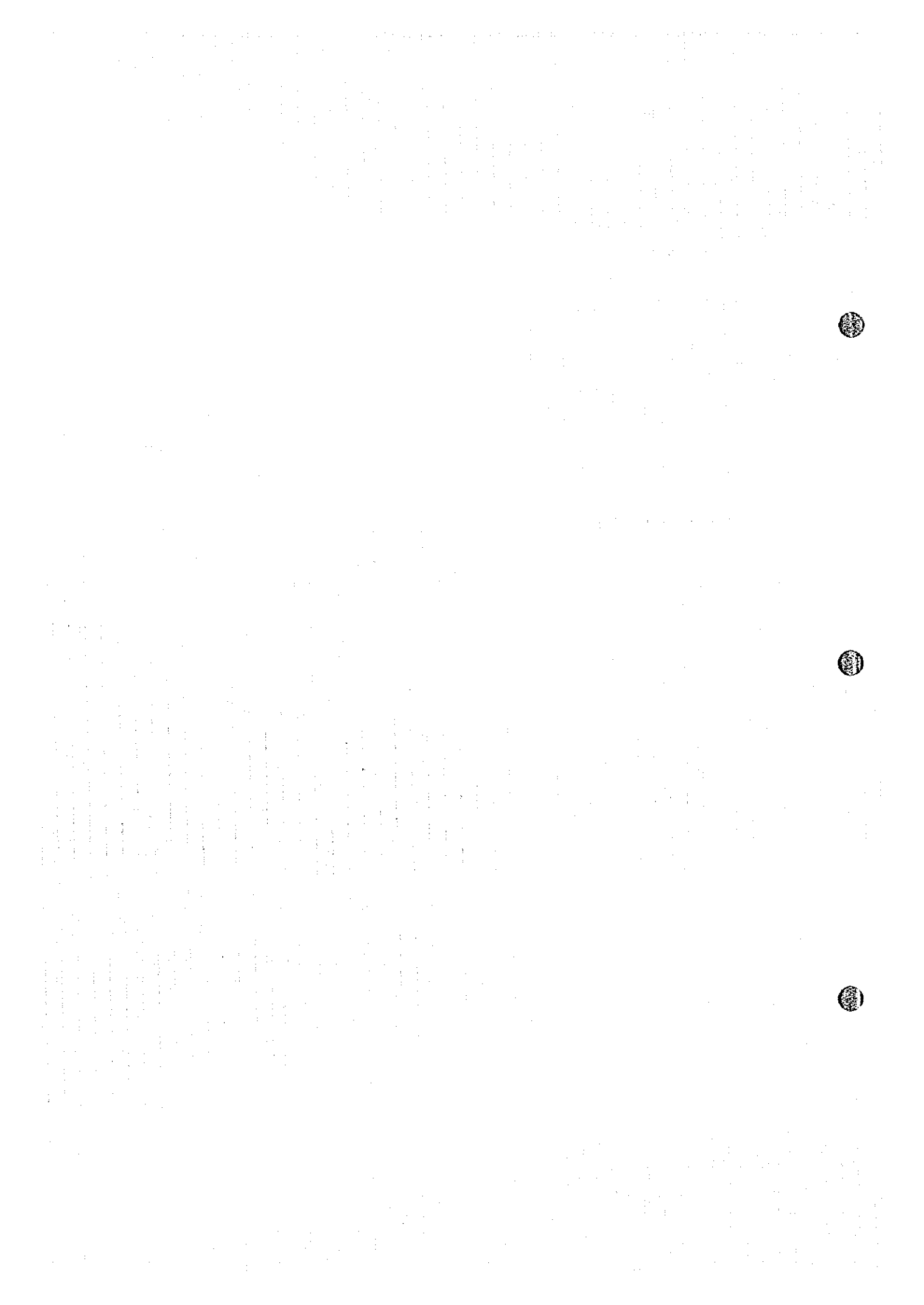


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1. Introduction

JICA carried out the Study on the water supply systems in the Six Cities (Fig. 1.1) of the autonomous Republic of Uzbekistan (Nukus, Chimbay, Kungrad, Muynak) and Khorezm Province (Urgench and Khiva), including the two inter-regional water supply systems - Tuyamuyun-Nukus (T-N) and Tuyamuyun-Urgench (T-U) from August 1994. After JICA commenced its Study, the World Bank (WB) started its own study on drinking water supply with the main focus on the rural areas of the same regions mentioned above. The result was that there was a duplication of the studies carried out by the two parties, with the plans also resembling each other's plan. JICA then decided to coordinate between the both projects and to investigate optimum means to avoid duplication in the studies and to implement the project in cooperation with the World Bank. The following projects of the two parties are investigated here.

- (1) JICA project: First priority (Feasibility Study)
- (2) World Bank project: First Stage (Feasibility Study)

2. Outline of the JICA Project

As a result of the JICA Study, water supply plan for the both regions was formulated to improvement of the urban water supply systems and the T-N and T-U inter-regional water supply systems with the main aim of improving the drinking water quality.

2.1 Outline of water supply improvement plan

In the water supply plan, a facilities plan was formulated as shown in the following tables and figures. Facilities will be constructed on priority and the plan implemented in two stages.

Fig. 2.1: Proposed water supply facilities by JICA (First Priority Project)

Fig. 2.2: Proposed Kaparas raw water facilities by JICA (First Priority Project)

Table 2.1: Proposed water supply facilities and construction cost

Table 2.2: Development of distribution network and water meter installation plan

Fig. 2.3: Location map of Regions

First Priority Project (FPP)

- (1) Improvement in quality of drinking water
- (2) Improvement in the tight water supply and demand situation in Khorezm
- (3) Increase in the served population and reduce of water leakage in the urban areas

- (4) Improvement in water conservation and collection of correct water tariff in the urban areas through installation of water meter

Second Priority Project (SPP)

- (1) Improvement in the tight water supply and demand situation in Karakalpakstan
- (2) Rehabilitation of Tuyamuyun water treatment plants
- (3) Same as (3) and (4) of FPP

2.2 Project cost

The construction cost for each priority project is given below. Details are given in Table 2.2.

FPP:	277.8 million US dollars (46%)
SPP:	324.8 million US dollars (54%)
Total:	602.6 million US dollars (100%)

2.3 Implementation schedule

The implementation period for each priority project has been set as given below. Fig. 2.4 shows the implementation schedule of the construction for various facilities.

FPP:	Five years from 1998 to 2002
SPP:	Eight years from 2003 to 2010

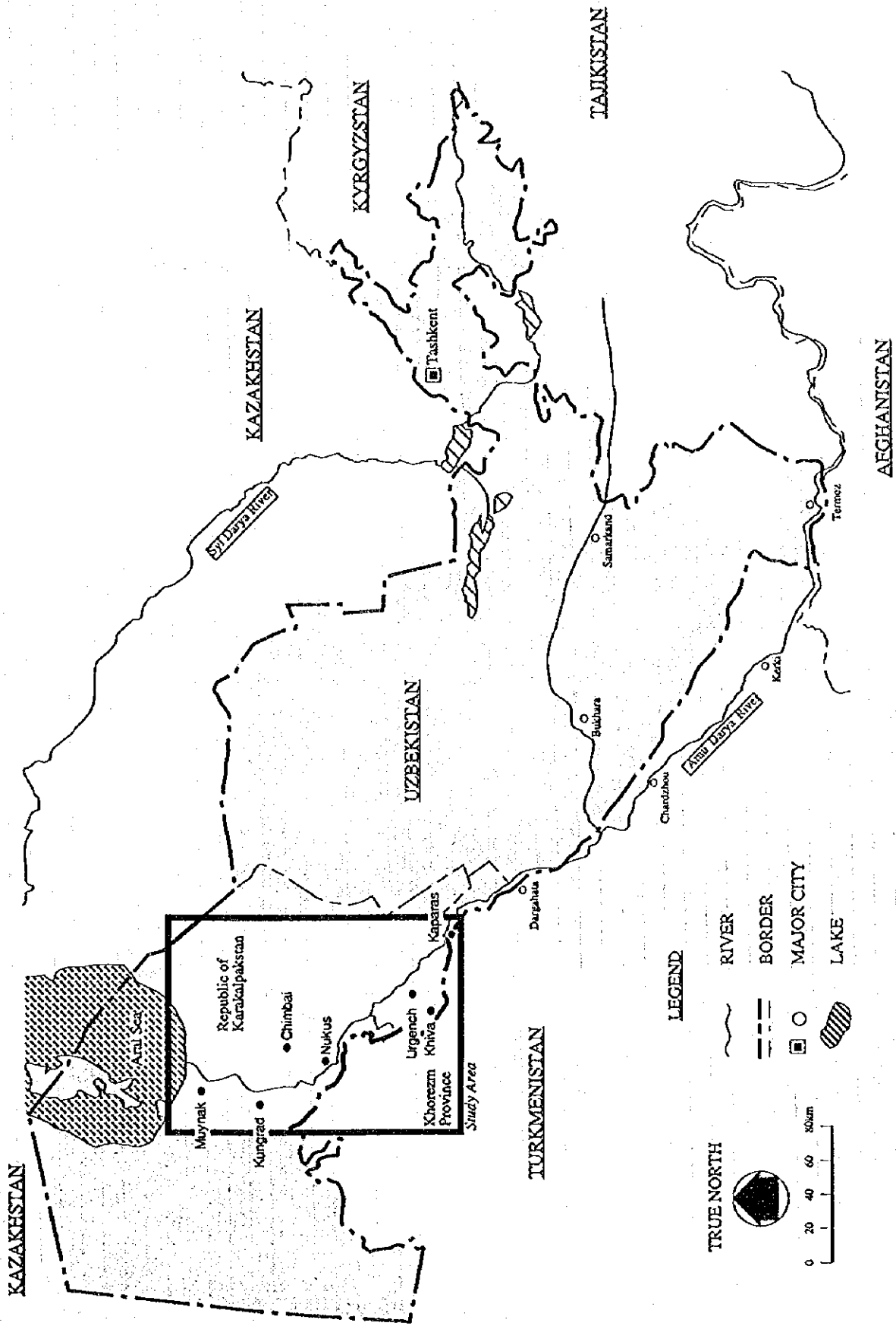
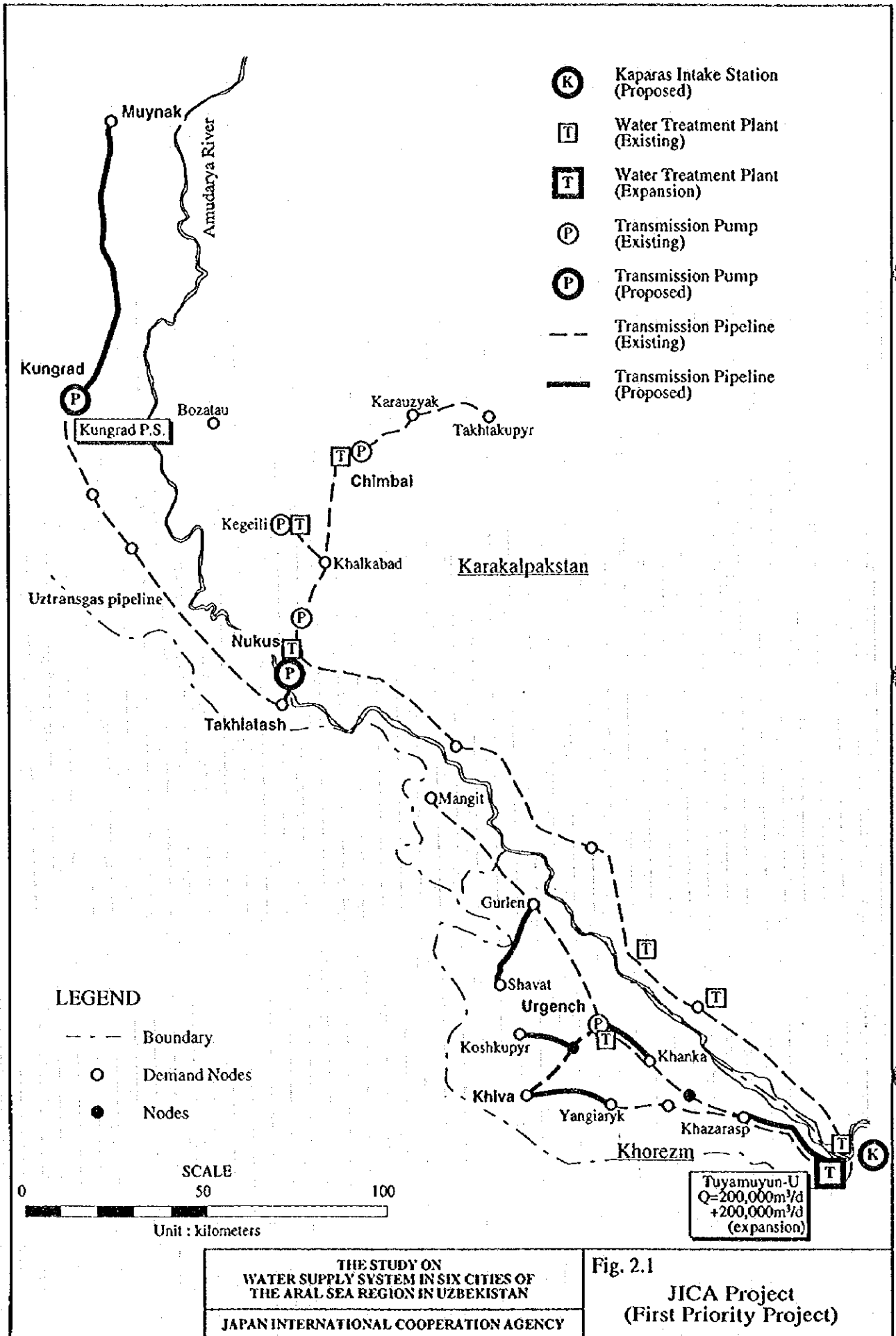


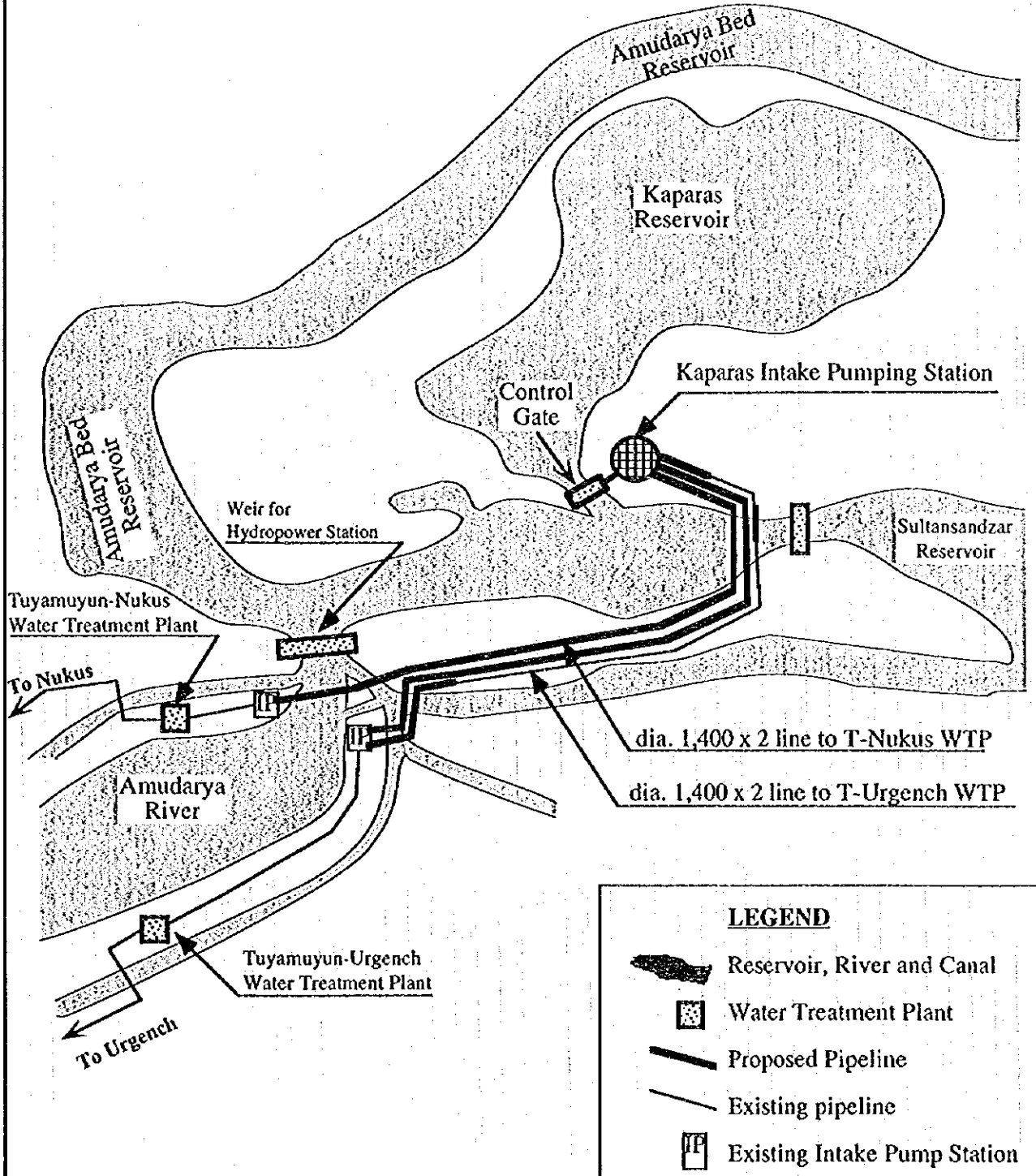
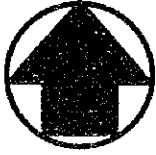
Fig.1.1 Location Map of Study Area



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Fig. 2.1
JICA Project
(First Priority Project)

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Fig. 2.2

Proposed Kaparas Intake
Facilities (First Priority)

Table 2.1 Proposed Water Supply Facilities and Construction Cost
(JICA Project) (unit: million US \$)

Work Item	Specification	Project Cost		
		Total	First Priority	Second Priority
1. Kaparas Raw Water Intake System				
1.1 Kaparas Intake Station	Q=750,000 m3/d	12.9	12.9	
1.2 Raw Water Mains Pipeline				
1.2.1 Kaparas I.S. to T-N Existing Intake Station	D=1,400 L=10.7 km	18.7	18.7	
1.2.2 Kaparas I.S. to T-U Existing Intake Station	D=1,400 L= 1.0 km	1.6	1.6	
1.2.3 Kaparas I.S. to T-U Existing Intake Station	D=1,400 L= 9.0 km	12.7	12.7	
Sub-total		45.9	45.9	
2. Tuyamuyun-Nukus Water Supply System				
2.1 Water Treatment Plant				
2.1.1 Rehabilitation	Q=200,000 m3/d	15.5		15.5
2.1.2 Expansion	Q=150,000 m3/d	44.6		44.6
2.2 Transmission and Distribution Pumping Station				
2.2.1 No. 2 Booster Pumping Station	Q=234,410 m3/d	9.5		9.5
2.2.2 Nukus North Distribution Station	Q=122,950 m3/d	10.8	10.8	
2.2.3 Kungrad Transmission and Distribution Station	Q= 42,130 m3/d	10.5	10.5	
2.3 Transmission Pipeline				
2.3.1 WTP. - No. 1 Pumping Station	D=1,400 L= 63.0 km	82.7		82.7
2.3.2 Nukus - Takhiatash L=21 km	D=1,200 L= 11.0 km	14.7	14.7	
2.3.3 Kungrad - Muynak (Q=8,870 m3/d)	D=500 L= 96.5 km	28.5	28.5	
2.3.4 Kegeili - Bozatau	D=400 L= 50.0 km	15.0		15.0
Sub-total		231.8	64.5	167.3
3. Tuyamuyun-Urgench Water Supply System				
3.1 Water Treatment Plant				
3.1.1 Rehabilitation	Q=200,000 m3/d	15.5		15.5
3.1.2 Expansion	Q=200,000 m3/d	56.8	56.8	
3.2 Transmission Pipeline				
3.2.1 WTP. - Khazarasp Pumping Station	D=1,200 L=27.0 km	27.6	27.6	
3.2.2 Khanki - Urgench	D=1,200 L=13.2 km	8.1	8.1	
3.2.3 Yanglaryk - Khiva	D=600 L=20.0 km	7.3	7.3	
3.2.4 S.P.1 - Koshkupyrt	D=600 L=14.0 km	5.2	5.2	
3.2.5 Gurlen - Shavat	D=600 L=19.5 km	3.3	3.3	
Sub-total		123.8	108.3	15.5
4. Vodokanal Karakalpakstan				
4.1 Water Treatment Plant				
4.1.1 Nukus WTP (Rehabilitation)	Q= 65,000 m3/d	17.7		17.7
4.1.2 Chimbai WTP (Rehabilitation)	Q= 2,200 m3/d	1.6		1.6
4.1.3 Water Treatment Plant (Rehabilitation) , 3Cities	Q= 14,000 m3/d	6.6		6.6
4.2 Distribution Network				
4.2.1 Replacement D=100~D=400	L=228.8 km	53.2	20.5	32.7
4.2.2 Expansion D=100~D=400	L=119.6 km	28.0	10.8	17.2
4.3 Metering System				
4.3.1 Meter Installation D=20	N=115,960 Pieces	10.3	3.9	6.4
Sub-total		117.4	35.2	82.2
5. Vodokanal Khorezm				
5.1 Water Treatment Plant				
5.1.1 Urgench WTP (Rehabilitation)	Q= 50,000 m3/d	19.7		19.7
5.1.2 Chalish (Rehabilitation)	Q= 11,000 m3/d	1.9		1.9
5.2 Distribution Network				
5.2.1 Replacement D=100~D=400	L=170.3 km	39.9	15.3	24.6
5.2.2 Expansion D=100~D=400	L= 71.5 km	16.8	6.5	10.3
5.3 Metering System				
5.3.1 Meter Installation D=20	N=60,970 Pieces	5.4	2.1	3.3
Sub-total		83.7	23.9	59.8
Total		602.6	277.8	324.8

Table 2.2 Plan for Development of Distribution Network and Installation of Water Meter (JICA Project)

Development of Distribution Network (Urban)					Water Meter (Urban)		
No.	Region for network development	Diameter (mm)	Rehabilitation (km)	Expansion (km)	No.	Region for installation	Dia. 20 mm (pieces)
Karakalpakstan							
1	Kungrad	100	68.6	36.0	1	Kungrad	115,960
2	Muynak				2	Muynak	
3	Bozatau				3	Bozatau	
4	Chimbai				4	Chimbai	
5	Karauzyak				5	Karauzyak	
6	Takhtakupyr				6	Takhtakupyr	
7	Kegeili				7	Kegeili	
8	Shumanai				8	Shumanai	
9	Leninabad				9	Leninabad	
10	Nukus				10	Nukus	
11	Khodjeili				11	Khodjeili	
12	Amudarya	12	Amudarya				
13	Beruni	13	Beruni				
14	Ellikkala	14	Ellikkala				
15	Turtkul	15	Turtkul				
	Total		228.8	119.6			
Khorezm							
1	Gurlen	100	51.2	21.6	1	Gurlen	60,970
2	Yangibazar				2	Yangibazar	
3	Shavat				3	Shavat	
4	Urgench				4	Urgench	
5	Koshkupyr				5	Koshkupyr	
6	Khiva				6	Khiva	
7	Yangiaryk				7	Yangiaryk	
8	Khanka				8	Khanka	
9	Bagat				9	Bagat	
10	Khazarasp				10	Khazarasp	
	Total		170.3	71.5			
	Total		399.1	191.1			176,930

Fig. 2.3 Location Map of Regions



Fig. 2.4 Implementation Schedule (JICA Project)

Description \ Year	First Priority Project					Second Priority Project								Remarks
	0 1997	1 1998	2 1999	3 2000	4 2001	5 2002	6 2003	7 2004	8 2005	9 2006	10 2007	11 2008	12 2009	
Loan Arrangement	///					///								
Preparation of Tender (Bids, Evaluations)	///					///								
1. Kaparas Raw Water Intake System														
1.1 Kaparas Intake Station Q=750,000 m ³ /d		■	■	■										
1.2 Raw Water Mains Pipeline														
1.2.1 Kaparas I.S. to T-N Existing Intake Station D=1,400 L=10.7 km		■	■	■										
1.2.2 Kaparas I.S. to T-U Existing Intake Station D=1,400 L= 1.0 km		■												
1.2.3 Kaparas I.S. to T-U Existing Intake Station D=1,400 L= 9.0 km			■	■										
2. Tuyamuyun-Nukus Water Supply System														
2.1 Water Treatment Plant Q=350,000 m ³ /d														
2.1.1 Rehabilitation Q=200,000 m ³ /d														
2.1.2 Expansion Q=150,000 m ³ /d														
2.2 Transmission and Distribution Pumping Station														
2.2.1 No. 2 Booster Pumping Station Q=234,410 m ³ /d														
2.2.2 Nukus North Distribution Station Q=122,950 m ³ /d														
2.2.3 Kungrad Transmission and Distribution Station Q= 42,130 m ³ /d														
2.3 Transmission Pipeline														
2.3.1 W.T.P. - No. 1 Pumping Station D=1,400 L= 63.0 km														
2.3.2 Nukus - Takhtatash L=21 km D=1,200 L= 11.0 km														
2.3.3 Kungrad - Muynak (Q=8,870 m ³ /d) D=500 L= 96.5 km														
2.3.4 Kegelli - Bozatau D=400 L= 50.0 km														
3. Tuyamuyun-Urgench Water Supply System														
3.1 Water Treatment Plant Q=400,000 m ³ /d														
3.1.1 Rehabilitation Q=200,000 m ³ /d														
3.1.2 Expansion Q=200,000 m ³ /d														
3.2 Transmission Pipeline														
3.2.1 W.T.P. - Khazarasp Pumping Station D=1,200 L=27.0 km														
3.2.2 Khanki - Urgench D=1,200 L=13.2 km														
3.2.3 Yangiaryk - Khiva D=600 L=20.0 km														
3.2.4 S.P.1 - Koshkuyr D=600 L=14.0 km														
3.2.5 Gurien - Shavat D=600 L=19.5 km														
4. YodoKanal Karakalpakstan														
4.1 Water Treatment Plant														
4.1.1 Nukus W.T.P (Rehabilitation) Q= 65,000 m ³ /d														
4.1.2 Chimbai W.T.P (Rehabilitation) Q= 2,200 m ³ /d														
4.1.3 Water Treatment Plant (Rehabilitation) , 3Cliter Q= 14,000 m ³ /d														
4.2 Distribution Network														
4.2.1 Replacement D=100~D=400 L=228.8 km														
4.2.2 Expansion D=100~D=400 L=119.6 km														
4.3 Metering System														
4.3.1 Meter Installation D=20 N=115,960 Pieces														
5. YodoKanal Khorezm														
5.1 Water Treatment Plant														
5.1.1 Urgench W.T.P (Rehabilitation) Q= 50,000 m ³ /d														
5.1.2 Chalish (Rehabilitation) Q= 11,000 m ³ /d														
5.2 Distribution Network														
5.2.1 Replacement D=100~D=400 L=170.3 km														
5.2.2 Expansion D=100~D=400 L= 71.5 km														
5.3 Metering System														
5.3.1 Meter Installation D=20 N=60,970 Pieces														

3. Outline of World Bank Project

The World Bank Project envisages a improvement plan of the water supply system for the whole area of the both regions, including the T-N and T-U water supply systems with the aim of supplying drinking water mainly to the rural areas

3.1 Outline of water supply improvement plan

In the water supply improvement plan, facilities mainly for increase in the water supply coverage rate (population served), reduction in leakage, and improvement in the quality of drinking water, are planned. Details of the facilities are shown in Table 3.1 and Table 3.2.

3.2 Project cost

The construction cost for each phase is as given below. Details are given in Table 3.1. This cost does not include physical and price contingencies (15%). Facilities will be constructed in two phases as below.

Phase 1	84.12 million US dollars (57%)
Phase 2	63.55 million US dollars (43%)
Total:	147.67 million US dollars (100%)

3.3 Implementation schedule

The implementation period of Phase 1 of the project is 6 years, from 1997 to 2002. The implementation schedule of facilities is shown in Fig. 3.1.

Table 3.1 Water Supply Component (WB Project)

(unit: million US dollar)

Description	Total	Phase 1	Phase 2
Subcomponent (a) - Main pipeline supply system			
(i) Rehabilitation of distribution systems in RC's in Karakalpakstan	13.38	13.38	-
(ii) Rehabilitation of distribution systems in RC's in Khorezm	11.89	11.89	-
(iii) Expansion of distribution system in RC's Karakalpakstan	29.9	10.60	19.3
(iv) Expansion of distribution system in RC's Khorezm	12.17	4.00	8.17
(v) Rehabilitation of Nukus WTP	1.5	1.50	-
(vi) Rehabilitation of Urgench WTP	1.8	1.80	-
(vii) Additional trunk mains in Karakalpakstan	15.48	8.29	7.19
(viii) Additional trunk mains in Khorezm	13.69	-	13.69
(ix) Rehabilitation of rural distribution centers in Karakalpakstan	3.04	1.68	1.36
(x) Rehabilitation of rural distribution centers in Khorezm	1.2	1.20	-
Sub-total	104.05	54.34	49.71
Subcomponent (b) Development of local systems			
(i) Muynak Water Supply	7.94	7.94	-
(ii) Installation of handpumps in Karakalpakstan and Khorezm	3.68	1.84	1.84
(iii) Rehabilitation of existing desalination units	1.00	1.00	-
(iv) Rehabilitation and development of groundwater sources in Karakalpakstan	2.7	2.7	-
(v) Rehabilitation and expansion of Chalish wellfield	3.3	3.3	-
(vi) Demand based expansion of rural distribution systems in Karakalpakstan	12.00	6.00	6.00
(vii) Demand based expansion of rural distribution systems in Khorezm	6.00	3.00	3.00
Sub - total	36.62	25.78	10.84
Subcomponent (c) Demand Management and Loss Reduction			
	7.00	4.00	3.00
Total	147.67	84.12	63.55

Note :

Not Including physical contingencies (10%)

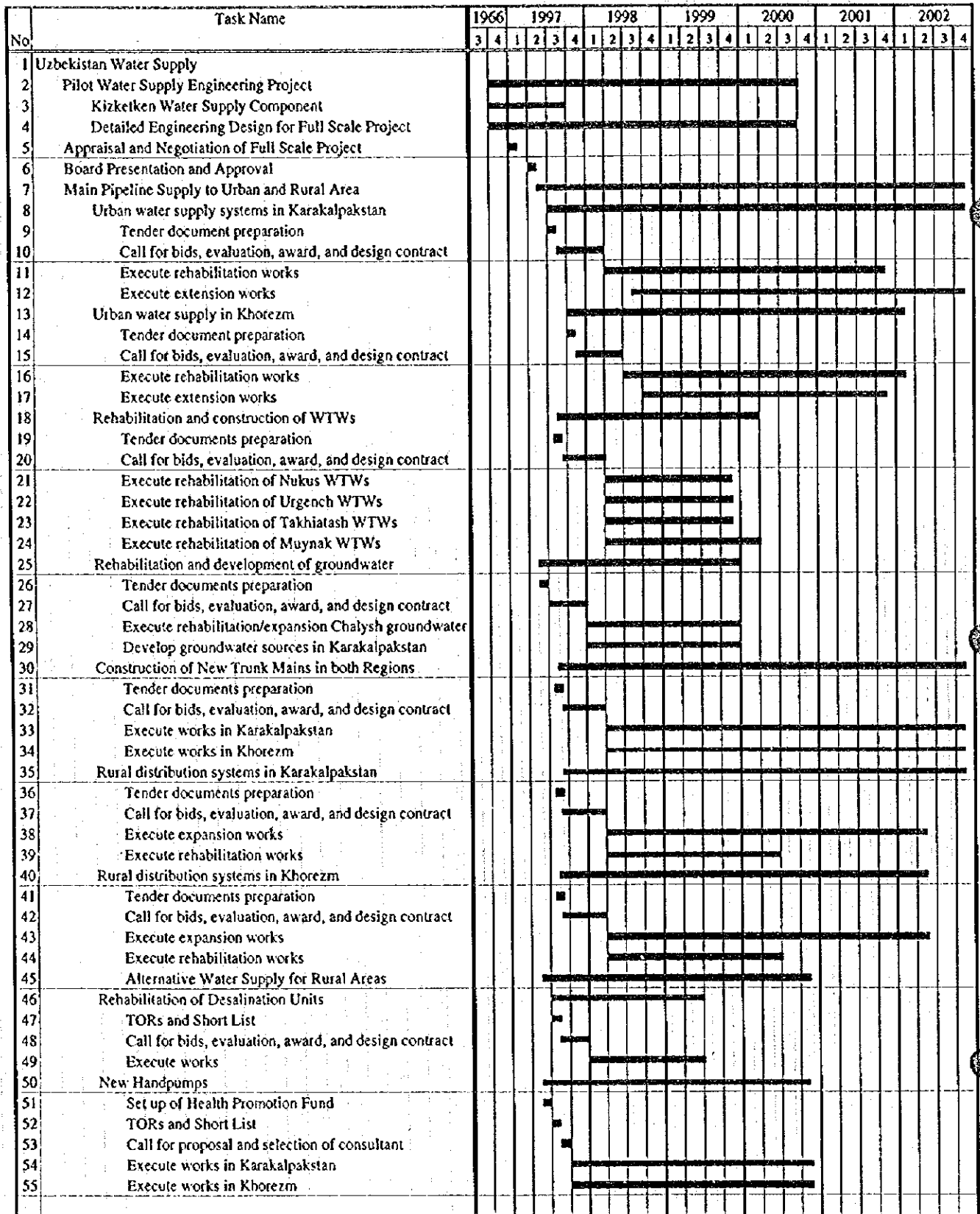
Not Including price Contingencies (5%)

Table 3.2 Development Plan for Distribution Network (WB Project)

Network development for urban area					Exclude				
No.	Region	Diameter mm	Rehabilitation km	Expansion km	No.	Region			
Karakalpakstan									
1	Kungrad	150 - 400	119	188					
2	Muynak								
								3	Bozatau
4	Chinbai								
5	Karauzyak								
6	Takhtakupyr								
7	Kegeili								
8	Shumanal								
								9	Leninabad
10	Nukus								
11	Khodjeili								
								12	Amudarya
13	Beruni								
								14	Ellikkala
15	Turtkul								
Khorezm									
1	Gurlen	150 - 400	113	113					
								2	Yangibazar
3	Shavat								
4	Urgench								
5	Koshkupyr								
6	Khiva								
7	Yangiaryk								
8	Khanka								
9	Bagat								
10	Khazarasp								
	Total		232	301					

For the region name, see Fig. 2.3.

Fig. 3.1 Project Implementation Schedule (WB Project)



4. Duplication in the JICA and World Bank projects

The JICA and World Bank projects are compared as shown in Table 4.1. Item 4.3 and 4.4 in the table show the duplicated parts in the JICA and World Bank projects. The contents of these parts include laying of new pipelines for increasing in population served for the urban areas and replacement of aged pipelines for reducing the leakage for the urban areas.

Table 4.1 Comparison of JICA and World Bank Project

Work Item	JICA Project Cost for First Priority Project	World Bank Project		Item No. in WB report
		Cost for First Phase Project including contingencies		
1. Kaparas Raw Water Intake System				
1.1 Kaparas Intake Station	12.9			
1.2 Raw Water Mains Pipeline				
1.2.1 Kaparas I.S. to T-N Existing Intake Station	18.7			
1.2.2 Kaparas I.S. to T-U Existing Intake Station	1.6			
1.2.3 Kaparas I.S. to T-U Existing Intake Station	12.7			
Sub-total	45.9			
2. Tuyamuyun-Nukus Water Supply System				
2.1 Water Treatment Plant				
2.1.1 Rehabilitation				
2.1.2 Expansion				
2.2 Transmission and Distribution Pumping Station				
2.2.1 No. 2 Booster Pumping Station				
2.2.2 Nukus North Distribution Station	10.8			
2.2.3 Kungrad Transmission and Distribution Station	10.5			
2.3 Transmission Pipeline				
2.3.1 WTP. - No. 1 Pumping Station				
2.3.2 Nukus - Takhiatash L=21 km	14.7			
2.3.3 Kungrad - Muynak (Q=8,870 m ³ /d)	28.5			
2.3.4 Kegelli - Bozatau				
Sub-total	64.5			
3. Tuyamuyun-Urgench Water Supply System				
3.1 Water Treatment Plant				
3.1.1 Rehabilitation				
3.1.2 Expansion	56.8			
3.2 Transmission Pipeline				
3.2.1 WTP. - Khazarasp Pumping Station	27.6			
3.2.2 Khanki - Urgench	8.1			
3.2.3 Yangiaryk - Khiva	7.3			
3.2.4 S.P.1 - Koshkopyr	5.2			
3.2.5 Gurten - Shavat	3.3			
Sub-total	108.3			
4. Vodokanal Karakalpakstan				
4.1 Water Treatment Plant				
4.1.1 Nukus WTP (Rehabilitation)		1.50	1.725	(a)-(v)
4.1.2 Chimbai WTP (Rehabilitation)				
4.1.3 Water Treatment Plant (Rehabilitation) , 3Cities				
4.2 Distribution Network				
4.2.1 Replacement D=100~D=400	20.5	13.38	15.387	(a)-(i)
4.2.2 Expansion D=100~D=400	10.8	10.60	12.190	(a)-(iii)

4.3 Metering System				
4.3.1 Meter Installation D=20	3.9			
Sub-total	35.2	25.48	29.302	
5. Vodokanal Khorezm				
5.1 Water Treatment Plant				
5.1.1 Urgench WIP (Rehabilitation)		1.80	2.07	(a)-(vi)
5.1.2 Chalish (Rehabilitation)				
5.2 Distribution Network				
5.2.1 Replacement D=100~D=400	15.3	11.89	13.674	(a)-(ii)
5.2.2 Expansion D=100~D=400	6.5	4.00	4.600	(a)-(iv)
5.3 Metering System				
5.3.1 Meter Installation D=20	2.1			
Sub-total	23.9	17.69	20.344	
6. Other World Bank Projects				
6.1 Additional trunk mains in Karakalpakstan		8.29	9.534	(a)-(vii)
6.2 Rehabilitation of rural distribution centers in Karakalpak		1.68	1.932	(a)-(ix)
6.3 Rehabilitation of rural distribution centers in Khorezm		1.20	1.380	(a)-(x)
6.4 Muynak Water Supply		7.94	9.131	(b)-(i)
6.5 Installation of handpumps in Karakalpakstan and Khorezm		1.84	2.116	(b)-(ii)
6.6 Rehabilitation of existing desalination units		1.00	1.150	(b)-(iii)
6.7 Rehabilitation and development of groundwater sources in Karakalpakstan		2.70	3.105	(b)-(iv)
6.8 Rehabilitation and expansion of Chalysk wellfield		3.30	3.830	(b)-(v)
6.9 Demand based expansion of rural distribution systems in Karakalpakstan		6.00	6.900	(b)-(vi)
6.10 Demand based expansion of rural distribution systems in Khorezm		3.00	3.450	(b)-(vii)
6.11 Demand Management and Loss Reduction		4.00	4.600	(c)
Sub-total		40.95	47.128	
Total	277.8	84.12	97.596	

Shaded parts indicate overlap projects of JICA with WB.

5. Joint implementation project by both parties

The JICA Study Team selects the following four projects from the JICA Projects as projects to be implemented with the cooperation of both parties, taking into consideration project cost and benefits, present progress of construction and difficulty in implementing the project.

- (1) Development of distribution pipelines in urban areas of both regions
- (2) Completion of Kaparas Intake Station and raw water mains to T-U WTP
- (3) Construction of raw water mains to T-N WTP
- (4) Installation of water meters

First priority is given to parts duplicated in both JICA and World Bank projects, development of distribution pipelines in urban areas of both regions. This project aims to increase the population served and effective volume of water. In these regions, health of the inhabitants who are not supplied water by piped water supply system is most affected by the deteriorated quality of drinking water. This project will benefit them.

The second priority is to improve the quality of drinking water, especially total hardness and mineralization. Completion of the Kaparas intake pumping station and the raw water mains to each Tuyamuyun water treatment plant (WTP) will contribute to improvement in the quality of drinking water. The pumping equipment and machinery for the Kaparas intake pumping station have already been procured and early completion of the station is possible. Also, early completion of T-U WTP is anticipated because only about 1 km of the raw water main is incomplete. Therefore, the completion of the Kaparas intake pumping station and raw water mains to T-U WTP is selected as the joint implementation project. Upon completion, good quality water of the Kaparas reservoir can be led to the T-U water treatment plant, and good quality drinking water can be supplied to Khorezm.

Although raw water mains to T-N WTP need to be constructed, its completion cannot be expected earlier and moreover, is costly. Consequently, its priority is lower.

By installing water meters, which is also a high priority, sound management of water works can be achieved, water consumption can be reduced, bill collection can be improved and appropriate water tariff can be imposed on the inhabitants. The JICA Study estimated that installation of water meters will reduce water consumption by 15 %. This saved water volume can be utilized by the new population to be served

The construction cost of the projects that have been selected as projects joint implementation by the JICA and the World Bank are given in Table 5.1 with priority settings. Table 5.2 shows costs by priority project.

Table 5.1 Construction Cost of Joint Implementation Projects

(unit : million US \$)

Work Item No.	Contents of Project	Construct. Cost	Source of Cost	Priority
4.2	Development of distribution pipelines for urban areas of Karakalpakstan	27.6	WB	1
5.2	Development of distribution pipelines for urban areas in Khorezm	18.3	WB	1
1.1	Completion of Kaparas intake pumping station	12.9	JICA	2
1.2.2	Completion of raw water mains to T-U WTP	1.6	JICA	2
1.2.1	Construction of raw water mains to T-N WTP	18.7	JICA	3
4.3.1	Water meter installation in urban areas of Karakalpakstan	3.9	JICA	4
5.3.1	Water meter installation in urban areas of Khorezm	2.1	JICA	4

Table 5.2 Construction Cost by Priority Project

(unit: million US\$)

Priority Project No.	Construction Cost
1	45.9
1,2	60.4
1,2,3	79.1
1,2,3,4	85.1

6. Benefits of the project

The population that will derive benefits if this project is implemented is as shown in the table below, which indicates large beneficial effects.

Table 6.2 Project Benefits

(unit: thousand persons)

Priority	Contents of Project	Effect	Beneficial population
1	Development of distribution pipelines for urban areas in Karakalpakstan (KKP) and Khorezm	Increase in population served and effective volume of water	124.4 (KKP) *1 51.0 (Khorezm) *1
2	Completion of Kaparas intake pumping station and raw water mains to T-U WTP	Improvement in drinking water quality in Khorezm	641 *2
3	Construction of raw water mains to T-N WTP	Improvement in drinking water quality in Karakalpakstan	580 *2
4	Water meter installation in urban areas of Karakalpakstan and Khorezm	sound management of water works and water saving	-

*1 based on the World Bank report "Water Supply, Sanitation and Health Project"

*2 based on per capita consumption in 2002 of the report "the Study on Water Supply System in Six Cities of the Aral Sea Region in Uzbekistan, Main report, Part II, page 1-18, by JICA".

The preliminary estimation on the quality of drinking water source shows that the following improvements in total hardness and mineralization concentrations can be anticipated.

Table 6.3 Water Quality Improvement by Completion of Kaparas Intake Facilities

Indicator	before completion (water quality of local sources)	after completion (water quality of Kaparas reservoir)	Standards of Uzbekistan
Total Hardness (meq/l)	10.8	6.1	7.0
Mineralization (mg/l)	1,156	675	1,000

source: JICA Main Report

