10. PROJECT EVALUATION OF THE MATER PLAN

10.1 ECONOMIC ANALYSIS

10.1.1 Objective and Assumptions

An economic analysis was conducted for the proposed master plan. The objective of the economic analysis is to confirm the economic viability of the master plan from the viewpoint of national economy.

The economic analysis was conducted based on the following conditions and assumptions.

a. Economic feasibility is confirmed by a cost-benefit analysis, deriving economic internal rate of return (EIRR), benefit-cost ratio (B/C) and net present value (NPV).
b. The period of the economic analysis is determined based on an assumed life of the pipelines at 25 years.
c. Costs and benefits are estimated on the basis of the data as of November 1998. The costs and benefits are expressed in constant terms, taking no account of inflation.
d. The costs include investment cost, operation and maintenance cost and replacement cost. The estimated costs are used with no adjustment, since a standard conversion factor was derived at close to 1.0. The estimated costs are as follows.

Costs of Master Plan and Priority Project
(Unit : thousand $)

Item	Master Plan	Priority Project
Investment cost	3,031	996
O/M cost	82	56
Replacement cost	1,593	404

e. Table Ⅲ-6 shows a process of estimating economic benefit of domestic and industrial/institutional water supply. Economic benefit of water supply for domestic and industrial/institutional use is estimated based on the concept of willingness-to-pay of water users, expressed by the water charge actually paid and additional payment consumers are willing to pay for receiving better water supply service. The idea is that the values that residents and organizations are actually

paying or they express to pay reflect the satisfaction they receive by getting water in monetary term.

Considering the nature of water, water for domestic use can be divided into the minimum requirement portion and the commercial commodity portion. The minimum requirement portion is the amount of water needed for people to maintain minimum level of life. The commercial commodity portion corresponds to the amount of water beyond the minimum requirement. The water use in this category can be adjusted depending on price, income and other factors in the same way as ordinary commercial goods. The following are the estimated economic benefit and the valves used for the estimation.

Economic Benefit by Domestic Water Supply in 2015

Item	Unit	Minimum requirement	Commercial good
1. Value of water	Tg/m³	1,875	67
	$/m³	2.11	0.08
2. Net water use			
Apartment	l/c/d	20.0	130.0
Ger	l/c/d	20.0	1.2
3. Population			
Apartment	No.	3,830	
Ger	No.	17,131	
4. Economic benefit		166	337
Apartment	10³ $/year	59	14
Ger	10³ $/year	263	1

* Discrepancies with the values in Table III-6 are due to rounding.

The average value of water for the minimum requirement portion at Tg 1,875 per m^3 is estimated based on the price of water sold to ger residents at Tg 1.25 per liter or Tg1,250 per m^3 and an addition of 50% of Tg1,250 per m^3 as the average willingness-to-pay beyond the water charge. The minimum requirement portion applies both to ger and apartment residents. Table III-7 shows the result of the Social Survey conducted in June 1997, focusing on the willingness-to-pay of the ger and apartment residents. The average willingness-to-pay beyond the existing water charge were 189% for the ger residents wishing to be connected to piped water service and 131% for the ger residents wishing to continue receiving wagon water supply. These views are expressed on the basis of water use at 5.2 l/c/d. Since the amount of water for minimum requirement is set at 20 l/c/d, the corresponding additional willingness-to-pay is set lower at 50% instead of the

surveyed values at 189% or 131%. The assumed amount of minimum requirement at 20 l/c/d as of year 2015 is determined taking into account the fact that the target for village water supply of the Japanese grant aid programs is within a range of 15 l/c/d to 40 l/c/d.

The value of water for the commercial commodity portion is set at Tg 67 per m^3, based on the existing water charge for apartment residents and an addition of 20% of it as the surveyed willingness-to-pay. Water use by apartment dwellers is considered to contain a high commercial element, therefore its water charge is regarded as representing the average value of water for the commercial commodity portion. The existing water charge for apartment residents collected on a monthly per head basis is converted to the amount basis as follows.

- Existing water charge : Tg. 250 per person per month
- Water use : 150 l/c/d
- Water charge by amount : Tg. 56 per m^3
  (Tg.250 / (150 lcd/1,000 liter/m^3 * 30 days))

Table III-8 shows the result of the Social Survey, focusing on the willingness-to-pay of apartment dwellers. The willingness-to-pay beyond the existing tariff ranges from 0% to 88% with an average of 35%. Taking rather the conservative side, 20% is employed as the additional willingness-to-pay for the commercial commodity portion.

f. Economic benefit of industrial and institutional water supply is estimated by the following formula.

Economic benefit by industrials and institutional water use = $(PR + WP) \times GR^n$
n : period in year

Where,

- PR : The present revenue by water sale at Tg63,139 thousand (1997)
- WP : The surveyed willingness-to-pay for water of the industries and institutions at 20%
- GR : The annual growth rate at 3.5% (until 2005) and at 4.5% (until 2015)

These growth rates are the averages of the economic growth rate (3.0% per year until 2005 and 4.0 % per year until 2015) and industrial sector's growth rate

(4.0% per year until 2005 and 5.0% per year until 2015). Table III-9 shows the result of the Social Survey, focusing on the willingness-to-pay of the industries and institutions. The willingness-to-pay beyond the existing water charge ranges from 0% to 44% for the organizations paying Tg 900 per m^3. Taking the mid-point of this range, 20% is employed as the average additional willingness-to-pay for industrial and institutional water use.

As a result, the following economic benefits are derived.

2005 :	$ 112 thousand per year
2015 and thereafter :	$ 174 thousand per year

10.1.2 Result

The result of the economic analysis is shown in the table below. EIRRs, B/C ratios and NPVs are estimated for the standard case and alternative cases of cost up by 10%, benefit down by 10% and these two cases combined.

Result of Economic Evaluation of Mater Plan

Case	EIRR (%)	B/C	NPV (10^3)
Standard	14.5	1.23	591
Cost 10% up	12.4	1.12	339
Benefit 10% down	12.2	1.11	280
Cost 10% up plus benefit 10% down	10.3	1.01	29

The EIRRs for the standard case are derived at 14.5%, indicating high economic return of the master plan, compared with an opportunity cost of capital or cut-off EIRR at 10%. Even in the case of cost 10% up plus benefit 10% down, the EIRRs are derived at 10.3% beyond the 10% cut-off rate. Table III-10 presents the costs and benefits of the master plan.

10.2 FINANCIAL ANALYSIS

10.2.1 Objective and Assumptions

The objectives of a financial analysis are :

- to derive appropriate water charges from the viewpoints of cost recovery and

affordability, and

- to assess financial viability of the Mater Plan by deriving a financial internal rate of return (FIRR) based on the derived water charges.

10.2.2 Water Charges

Water charges are derived in the following manner.

Cost Recovery Aspect

a. The water charges are derived in constant term, meaning taking account of no inflation. The actual charges to be derived should be adjusted along with inflation rates.
b. Water charges for cost recovery are estimated for three cases: recovery of operation and maintenance cost (O/M cost), recovery of O/M cost plus local currency portion of the investment and replacement costs and finally recovery of O/M cost plus the total investment and replacement costs including both local and foreign currency portions.
c. Water charges are derived for 2005 and 2015.
d. Water charges are derived separately for the ger area where the water is delivered by wagons and for the central area where a pipe water supply service is provided to apartment dwellers, industries and institutions. The proposed master plan aims at water supply by kiosks connected with pipes in the ger area, whereas the central area will continue receiving water through the pipes. The investment cost and replacement cost per cubic meter of water, thus, would be different in the two areas and this difference should be reflected in water charge.
e. Water charges are derived by dividing the annual cost by annual amount of water used. The investment cost and replacement cost are analyzed by applying a 25 year period and a discount rate of 3% assumed as the cost for procuring fund.
f. The proposed facilities are classified into common facilities, those exclusively for the ger area and those exclusively for the central area. The investment costs of the common facilities such as the reconstruction of the existing well, construction of a new production well, and installation of a new transmission pipeline, water level indicators, reservoir, pump station and chlorination equipment are allocated both to the ger area portion and to the central area portion in proportion to the water demand in the ger area and the central area. The following table summarizes the allocation proportions and the allocated investment cost.

Allocation Proportions and Allocated Investment Cost
in Ger and Apartment Areas

Item	Unit	2005		2015	
		Ger	Central Area	Ger	Central Area
Allocation proportions of common facilities	%	19	81	30	70
Investment cost (LC)	$ thousand	351	41	641	375
Total Investment cost	$ thousand	674	322	1,554	1,477

g. The replacement costs are usually recovered from 10 to 40 years after the installation, depending on the type of facility. To take into account the time value, the replacement costs are discounted to the year 2000 applying a discount rate at 3%. Allocation of the replacement cost for common facilities is made in proportion to the investment costs for the ger area and the central area. The following table shows the replacement cost estimated.

Total Replacement Cost Discounted to 2000

(Unit : $ 10^3)

Area	2005	2015
Local currency portion	92	229
Total cost	250	861

h. The operation and maintenance cost (O/M cost) estimated is allocated to the ger area and central area by the proportion of the investment cost. The following are the estimated O/M cost for ger and apartment area.

Operation and Maintenance Cost

(Unit : Tg thousand/year)

Area	2005	2015
Ger	38	42
Central area	19	40

i. The assumptions applied are presented in Table Ⅲ-11.

j. The water charges for cost recovery is presented in Table Ⅲ-12 and summarized in the following table.

Water Charges for Cost Recovery

Item	2005		2015	
	Ger	Central Area	Ger	Central Area
(in $/m³)				
OM cost recovery	0.64	0.07	0.32	0.13
OM cost plus investment cost (LC) Recovery	1.06	0.08	0.66	0.22
OM cost plus total investment cost recovery	1.45	0.16	1.18	0.48
(in Tg/m³)				
OM cost recovery	566	54	283	116
OM cost plus investment cost (LC) recovery	939	74	586	192
OM cost plus total investment cost recovery	1,291	145	1,053	431

* LC : local currency

Big differences are observed in the water charges between the ger area and central area. This would be the reflection of the following factors.

- Lower water consumption rate estimated for the ger area
- High proportion of sunk cost for the central area
- A large service area for the ger area leading to lower efficiency in investment

This difference will decrease after 2015 along with increased amount of water use in the ger area and additional investment to be made in the apartment area.

Affordability Aspect

k. The water charges estimated for cost recovery have been checked from the viewpoint of affordability for water consumers. Table III-13 shows an income distribution of the Altai population based on the data collected in Altai City. Table Ⅲ-14 shows the result of the affordability analysis. The proportion of expenditure on water is compared with the income of water users. It is assumed that the expenditure on water within 5% of income is the maximum affordable level for water users. The water users are distributed among various levels of income. The midpoint per capita income of the population of less than Tg 10,000 per month per person, that is Tg 5,000 or $ 5.6 per month per person, is used as the criterion. This lowest income group accounts for 80% of the ger population and 40% of the apartment population in 1998.

l. The per capita income level is assumed to grow with the economic growth and population growth at the rates set in the Socio-Economic Framework. The estimated growth rates of per capita income are 2.3 % per year until 2005 and 2.9% per year between 2005 and 2015. The mid-point per capita income is

estimated to grow as follows.

1998 : $ 5.6
2005 : $ 6.6
2015 : $ 8.8

m. Expenditure on water is estimated based on the water charges for the three cases of cost recovery and the following amounts of water use.

Average Amount of Domestic Water Use

(Unit : lcd)

Area	2005	2015
Ger	10.6	21.2
Apartment	150	150

n. The expenditures on water under the three cases of cost recovery water charges are compared with the projected income in 2005 and 2015. The following proportions are derived.

Proportions of Expenditure on Water to Income

(Unit : %)

Area	1998	2005	2015
(Case 1 : OM cost recovery)			
Ger	3.5	3.1	2.3
Apartment	5.0	4.8	6.7
(Case 2 : OM/Investment (LC) recovery)			
Ger	3.5	5.1	4.8
Apartment	5.0	5.5	11.1
(Case 3 : OM/Total investment recovery)			
Ger	3.5	7.0	8.6
Apartment	5.0	10.9	25.1

* LC : local currency

Proposed Water Charge

In the case of O/M cost recovery water charges (Case 1), all the cases except the water charge for the central area in 2015 clear the condition. The expenditure on water becomes 5.0 % of the income for the residents of the central area in 2015 if the water charge is reduced to Tg 86 per m^3.

For the Case 2, the problem in affordability emerges for all cases except ger in 2015.

In Case 3, all the cost recovery water charges are too high for all types of residents.

Considering these, the water charges for O/M cost recovery are proposed to be applied with the adjustment mentioned above and the water charge for apartment in 2005 remaining at the existing level at Tg.56 per m^3. The following are the proposed water charges based on these considerations.

Proposed Water Charges for Domestic Water

(Unit : Tg/m^3)

	Existing	2005	2015
Ger	1,250	566	283
Apartment	56	64	86
Industry/institute	900	900	900

It is proposed that the water charge for industries and institutions remain at the present level at Tg 900 per m^3 in constant term. The fact that the organizations have been paying the existing water charge without difficulty indicates that they are able to afford it.

The water charges proposed here are indicative ones. At the stage of actual adoption of the proposed water charges, the water charges to be levied should be determined in due consideration of the following factors.

a. Installation of water meters for apartment residents to realize charging by water use amount
b. Cost:
   Inflation
   indirect cost for APSD
c. Demand and income:
   - Actual water consumption rate in relation to water charge
   - Actual household income and affordability limit
d. Step-wise water tariff:
   - Consideration for the poorest segment of the population
   - Introduction of a penalizing step tariff system, by which a higher charge is levied beyond certain amount of water use
e. Review of cross-subsidy by industrial and institutional water consumers for reducing water tariff disparity between ger and apartment water users

10.2.3 Financial Internal Rate of Return

A financial internal rate of return (FIRR) of the master plan is estimated under the proposed water charges as negative. It would be necessary for the government to subsidize the investment cost and replacement cost for implementing the master plan. Table Ⅲ-15 shows a process of revenue estimate. Table Ⅲ-16 shows the costs and revenues of the master plan.

10.3 INITIAL ENVIRONMENT EXAMINATION (IEE)

10.3.1 Outline of IEE

In Mongolia IEE is defined as a General Environmental Screening Process that doesn't involve any field work survey. For this project, it was carried out on May 22, 1998 by State Senior Inspector, Policy and Coordination Department of the Ministry of Nature and the Environment.

The conclusion is that

" Based upon the General Environmental Screening Process carried out in conformity with the Mongolian Law on Environmental Impact Assessment approved by the Parliament of Mongolia, dated January 22, 1998, for the Groundwater Development of Altai City in Gobi-Altai, it is necessary to carry out a Detailed Environmental Assessment ".

Also the Scope of Actions was issued as a result of IEE. It is briefed in the next chapter. The original document of Scope of Action is attached in the Annex Ⅱ-2 of the Data Book.

10.3.2 Scope of Actions

The Scope of Actions indicates that the following items should be carried out and be concluded by a licensed Mongolian organization.

(1) The following studies and surveys to be carried out.

1) Water-related issues

- to find out the state and parameters of surface water and groundwater. This is to determine the availability of proper water resources required for industrial and household purposes
- to ensure most optimal choice of sources for water supply proceeding from the water consumption balance estimates;
- to conduct a thorough investigation in order to establish the amount and composition of household and industrial water and sewage and also to identify possible environmentally-safe ways to dispose of them;
- to establish the groundwater level fluctuations;
- to determine the water quality through analyses; and
- to study and find out possibilities to improve the quality of water and diminish its hardness.

2) Soil-related issues

- to determine the soil erosion and degradation possible to arise in the course of hydrological study; and
- to identify timings, ways and techniques for carrying out soil-related studies and analyses.

3) Flora and fauna-related issues

- to identify the habitats of rare and endangered species of flora and fauna, and also to have specialized organizations make conclusions and analyses in respect of those rare and endangered species for the purpose of coming up with measures to protect them.

4) Issues of historical and cultural monuments

- to make sure that conclusions are drawn up by specialized organizations concerning the monuments of historical and cultural significance; and

- to carry out appropriate surveys and collect information from local residents in connection with this matter. The result should be incorporated later in the

detailed assessment statement.

(2) An environmental plan of action and environmental monitoring program to be worked out.

(3) The detailed environmental impact assessment to be conducted in line with the Law on Environmental Impact Assessment. The results (the detailed environmental impact assessment statement) should be submitted to the Ministry of Nature and Environment.

11. SELECTION OF THE PRIORITY PROJECT

Considering the so far criteria mentioned such as groundwater potential, water demand, and economy, the priority project of the water supply development is targeted to improve existing water supply facilities of production wells, transmission pipes, distribution pump. It is also recommended to procure water wagons and water carts and to construct the main distribution pipe and kiosks for the ger area. These shall be examined in an implementation design in the feasibility study.

Table III-1(1) Population Projected for Altai City

Year	Population change by natural factor					Population change by social factor						Total Population (rounded)
	Population by natural change (a)	Total birth (b)	Infant mortality (c)	Total death (d)	Natural increment of population (e)	Number of labor force required to achieve economic growth (f)	Additional labor force requirement (g)	Labor force to be added by Altai population (h)	Balance in labor force (i)	Labor force out-migrating from Altai City (j)	Population out-migrating from Altai City (k)	(l)
1997	17,761	282	15	112	-	6,890	-	-	-	-	-	17,760
1998	17,916	285	15	113	155	7,097	207	426	219	110	285	17,630
1999	18,073	287	15	114	157	7,310	213	426	213	107	277	17,800
2000	18,231	290	15	115	158	7,529	219	426	207	103	269	17,960
2001	18,391	276	12	110	160	7,755	226	426	200	100	260	18,130
2002	18,545	278	13	111	154	7,987	233	426	194	97	252	18,290
2003	18,699	280	13	112	154	8,227	240	426	187	93	242	18,460
2004	18,854	283	13	113	155	8,474	247	426	179	90	233	18,620
2005	19,011	285	13	114	157	8,728	254	426	172	86	224	18,790
2006	19,169	288	12	115	158	9,077	349	585	236	118	307	18,860
2007	19,330	290	12	116	161	9,440	363	706	343	172	446	18,880
2008	19,492	292	12	117	162	9,818	378	550	172	86	224	19,270
2009	19,655	295	12	118	163	10,211	393	661	268	134	349	19,310
2010	19,820	297	12	119	165	10,619	408	379	-30	-15	-39	19,860
2011	19,986	300	11	120	166	11,044	425	256	-169	-84	-220	20,210
2012	20,155	302	11	121	169	11,486	442	387	-55	-27	-71	20,230
2013	20,325	305	11	122	170	11,945	459	253	-206	-103	-268	20,590
2014	20,497	307	11	123	172	12,423	478	267	-211	-105	-274	20,770
2015	20,670	310	11	124	173	12,920	497	270	-227	-113	-295	20,960

Table III-1(2) Assumptions for the Projection of Altai City's Population

(a) (Population by natural change)$_n$ = (Population)$_{n-1}$ + (Natural increment of population)$_n$

(b) Total birth = Population by natural change (a)/1,000 * crude birth rate

Crude birth rate (per 1,000 population) :

1995-2000 :	15.9 (average of 1996 (18.1) and 1997 (13.7))
2001-2015 :	15.0 (assumed)

(c) Infant Mortality = Number of birth * infant mortality rate

Infant mortality rates are assumed as follows.

52.73 per 1,000 live births for 1996-2000
45.00 per 1,000 live births for 2001-2005
40.00 per 1,000 live births for 2006-2010
35.00 per 1,000 live births for 2011-2015

(d) Total death = Population by natural change * crude death rate

Crude death rate (per 1,000 population) :

1995-2000 :	6.3 (average of 1996 (5.9) and 1997 (6.6))
2001-2015 :	6.0 (assumed)

(e) (Natural increment of population)$_n$ = (total birth)$_{n-1}$ - (infant mortality)$_{n-1}$ - (total death)$_{n-1}$

(f) Labor force in 1997 is estimated as follows.

Labor resource :	9,300
Unemployment :	2,410
Labor force :	6,890

Labor force requirement since 1997 is assumed to growth at the same rats as the economic growth rates as follows.

3.0% per year for 1996 - 2005 period
4.0% per year for 2005 - 2015 period

(g) (Additional labor force requirement)$_n$ = (Labor force)$_n$ - (Labor force)$_{n-1}$

(h) Data were obtained regarding the population by age strata in 1995. These data are adjusted to 1997 applying the same proportions for each age stratum. The number of population to become 16 years of age in each year are all counted as entering into the labor market. The proportion that continues on to upper level school is assumed to be cancelled out by those entering into the labor market from the upper level schools.
It is assumed that all those surviving the infant age (up to 12 months of age) reach 16 years of age.

(i) (Balance in labor force) = labor force added by Altai population(h) - labor force requirement(g)

(j) For the labor force unable to find a job in Altai City, the ratio of out-migration from Altai City and the unemployed labor force staying in Altai City are assumed as follows. Negative values indicate in-migration of labor force into Altai city.

Out-migration :	50%
Unemployment :	50%

(k) Total population to migrate out of or into Altai City is estimated by the following formula.

Migrating population = migrating labor force * dependency ratio

Dependency ratio is derived as total population divided by working labor force as follows.

Population 1997	17,761
Labor force 199	6,890
Dependency rati	2.6

(l) Total population = Population by natural change (a) - Out-migrating population (k)

Table III-2 Projected Population of Altai City by District and Dwelling Pattern

Item	Household		Population		
	Number	(%)	1997	2005	2015
District I					
Ger	680	21.6	3,709	3,924	4,377
Apartment	204	6.5	1,357	1,435	1,601
District II					
Ger	631	20.0	3,442	3,642	4,063
Apartment	0	0.0	0	0	0
District III					
Ger	809	25.7	4,413	4,669	5,208
Apartment	0	0.0	0	0	0
District IV					
Ger	541	17.2	2,951	3,122	3,483
Apartment	284	9.0	1,888	1,998	2,229
Total					
Ger	2,661	84.5	14,516	15,357	17,131
Apartment	488	15.5	3,245	3,433	3,830
Total	3,149	100.0	17,761	18,790	20,960

(1) Population in 1997 by district and dwelling pattern is estimated based on the total population in 1997 and distribution proportions of households in 1997.
(2) Population in ger area includes those living in private houses built in ger areas.
(3) It is assumed that distribution of population among districts and area remains constant in the future.
(4) Figuires may no add up to total due to rounding.

(Number of Household Members in 1997)

	Population	Household	Household member
Ger	14,516	2,661	5.5
Apartment	3,245	488	6.6
Total	17,761	3,149	5.6

Table III-3 Cost Comparison for Development Case Study

Unit: US dollar

Item	Initial Cost		Electric Power Cost (15 Years) (US$ 0.126/kwh)		Total Cost
Case 1	・Pump House (R.C. structure) Pump space area: 120m^2 ・Pump and Electric Equipment 1.3m^3/min x 35m x 18kw x 3Unit (including 1 spare) 0.9m^3/min x 55m x 18kw x 2Unit (including 1 spare)	72,860 265,240	・Daily Power Consumption (average in the year of 2010-2015) 18kw x (2unit x 8hr + 1unit x 16hr) + 18kw x 1unit x 8hr = 720 kwh ・Total consumption for 15 yeas 720kwh/d x 365d/y x 15 ys = 3,942,000	496,690	
	Sub - Total	338,100	Sub - Total	496,690	834,790
Case 2	・Pump House (R.C. structure) Pump space area: 85m^2 ・Pump and Electric Equipment 1.8m^3/min x 55m x 30kw x 3Unit (including 1 spare)	51,610 294,810	・Daily Power Consumption (average in the year of 2010-2015) 30kw x (2unit x 8hr + 1unit x 16hr) = 960 kwh ・Total consumption for 15 yeas 960kwh/d x 365d/y x 15 ys = 5,256,000	662,260	
	Sub - Total	346,420	Sub - Total	662,260	1,008,680
Case 3	・Pump House (R.C. structure) Pump space area: 70m^3 ・Reservoir (R.C. structure) 500m^3 x 2ponds ・Pump and Electric Equipment 1.5m^3/min x 65m x 30kw x 2Unit (including 1 spare)	42,500 97,680 215,370	・Daily Power Consumption (average in the year of 2010-2015) 2010: 1,320m^3/d x 30kwh/90m^3 = 440 kwh 2015: 1,500m^3/d x 30kwh/90m^3 = 500 kwh ・Total consumption for 15 yeas 0.5(440+500) kwh/d x 365d/y x 15 ys = 2,573,250	324,230	
	Sub - Total	355,550	Sub - Total	324,230	679,780

Table III-4 Detailed Direct Construction Cost

Unit : US dollar

Item	Unit	Q'ty	Specification	Unit Cost	Amount	Breakdown of Currency	
						Foreign	Local
1) Intake Facility					328,848	288,184	40,664
(1) Existing Well (reconstruction)	Nos.	4			263,078	230,547	32,531
・Well	Nos.	4	60m deep	11,755	47,020	43,988	3,032
・Pump house	Nos.	4	Block made	2,573	10,292	0	10,292
・Intake pump	Nos.	4			0		
① Submersible motor pump	Nos.	4	0.42m³/min x 60m x 7.5Kw. (Including motorcable, control cable, lift pipes, flexible joint pipe, pipes, and check valve)	18,122	72,488	72,488	0
② Control panel	Nos.	4	Stand type	12,408	49,632	49,632	0
③ Electric equipment	Set	4		6,893	27,572	27,572	0
④ Hoist, heater	Set	4		2,127	8,508	1,700	6,808
⑤ Instrumentation	Lot	4		1,260	5,040	5,040	0
⑥ Installation work	Lot	4		3,867	15,468	7,734	7,734
・Collection pipe	Nos.	4	Steel pipe Dia. 150mm x @100m	4,209	16,836	12,372	4,464
・Transportation, Insurance	Lot			-	10,222	10,021	201
(2) New production well					65,770	57,637	8,132
・Well	Nos.	1	60m deep	11,755	11,755	10,997	758
・Pump house	Nos.	1	Block made	2,573	2,573	0	2,573
・Intake pump	Nos.	1					
① Submersible motor pump	Nos.	1	0.42m³/min x 60m x 7.5Kw. (Including motorcable, control cable, lift pipes, flexible joint pipe, pipes, and check valve)	18,122	18,122	18,122	0
② Control panel	Nos.	1	Stand type	12,408	12,408	12,408	0
③ Electric equipment	Set	1		6,893	6,893	6,893	0
④ Hoist, heater	Set	1		2,127	2,127	425	1,702
⑤ Instrumentation	Lot	1		1,260	1,260	1,260	0
⑥ Installation work	Lot	1		3,867	3,867	1,934	1,933
・Collection pipe	Nos.	1	Steel pipe Dia. 150mm x @100m	4,209	4,209	3,093	1,116
・Transportation, Insurance	Lot	1		-	2,556	2,505	50
2) Transmission Facility							
・Transmission pipe-line	m	3,500	SP dia. 200mm x 2 lines (Including sluice valve, valve box)	89	311,500	245,000	66,500
3) Distribution Facility					1,276,528	741,549	534,979
・Water level indicator	Set	2		-	54,499	47,245	7,254
① Electrode	Set	2	With AC/DC exchange instrument	3,347	6,694	6,586	108
② Transmit Cable	Lot	1	3.5Km	47,805	47,805	40,659	7,146
・Water Wagon	Unit	3	Capacity : 5m³/Unit	17,600	52,800	50,400	2,400
・Water Cart	Unit	2,792	Steel made	33	92,136	0	92,136
・Water Kiosk	Unit	14	Block Structure G-1 Area : 6 Unit G-2 Area : 3 Unit G-3 Area : 5 Unit	5,106	71,484	0	71,484
・Reservoir	Unit	2	Storage cap. 500m³/Unit (R. C structure with pipe accessories)	39,070	78,140	0	78,140
・Distribution Pipe-line					631,220	400,620	230,600
① G-1 Area					192,700	128,260	64,440
Dia. 200mm	m	2,530	Steel pipe (Valve Unit, Hydrant Unit)	55	139,150	93,610	45,540
Dia. 150mm	m	1,050	ditto	51	53,550	34,650	18,900
② G-2 Area							
Dia. 150mm	m	1,350	Steel pipe (Valve Unit, Hydrant Unit)	50	67,500	40,500	27,000
③ G-3 Area							
Dia. 150mm	m	3,690	Steel pipe (Valve Unit, Hydrant Unit)	50	184,500	110,700	73,800
④ Central Area					186,520	121,160	65,360
Dia. 250mm	m	800	Steel pipe (Valve Unit, Hydrant Unit)	63	50,400	37,600	12,800
Dia. 200mm	m	600	ditto	57	34,200	22,800	11,400
Dia. 150mm	m	1,960	ditto	52	101,920	60,760	41,160
・Pump Station					206,297	157,714	48,583
① Pump house	Nos.	1		34,000	34,000	0	34,000
② Centrifugal pump	Nos.	2	1.5m3/min x 65m x 30kw (Including Power cable, control cable, flexible jointpipe, sluice valves, check valves, flange heater, and flywheel)	21,012	42,024	42,024	0
③ Pressure tank	Set	1	For water hammering prevention	21,276	21,276	21,276	0
④ Control panel	Nos.	1	Self-stand type	24,000	24,000	24,000	0
⑤ Electric equipment	Set	1		27,574	27,574	27,574	0
⑤ Hoist, Heater	Lot	1		8,510	8,510	2,553	5,957
⑦ Instrumentation	Lot	1		3,614	3,614	3,165	449
⑧ Installation work	Lot	1		38,865	38,865	31,092	7,773
⑨ Transportation, Insurance	Lot	1		-	6,434	6,030	404
・Chlorination equipment	Unit	1			53,250	53,250	0
① Chlorinator	Set	1	Liquid Chlorine gas	38,297	38,297	38,297	0
② Instrumentation	Lot	1		1,148	1,148	1,148	0
③ Installation work	Lot	1		11,833	11,833	11,833	0
④ Transportation, Insurance	Lot	1		1,972	1,972	1,972	0
・Water level indicator	Set	1			36,702	32,320	4,382
① Electrode	Set	1	With AC/DC exchange instrument	3,347	3,347	3,293	54
② Transmit cable	Lot	1	2.5Km	33,355	33,355	29,027	4,328
Ground Total					1,916,876	1,274,733	642,143

Note 1) Exchange Rate : US$ 1.00 = Yen 117.5 US$ 1.00= Tg 890

Table III-5 Investment Schedule

Unit : US Dollar

Work Item	Nos	Amount	Year (2000-2015)															
			2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
A. Direct Construction Cost		1,916,876	0	144,936	186,038	181,815	117,320	0	0	221,520	401,748	476,926	44,765	33,574	59,500	48,735	0	0
		1,274,733 642,143	0 0	50,400 94,536	162,519 23,520	114,474 67,341	55,074 62,246	0 0	0 0	180,137 41,383	310,298 91,450	286,004 190,922	29,078 15,686	21,809 11,765	35,700 23,800	29,241 19,494	0 0	0 0
(1) Intake facility																		
·Reconstruction of existing well	4 Wells	263,078			131,539	65,770				65,770								
		230,547 32,531			115,274 16,266	57,637 8,133				57,637 8,133								
·New production well	1Wells	65,770									65,770							
		57,637 8,132									57,637 8,132							
(2) Transmission facility																		
·New pipe-line (Φ200 x 2line)	3.5Km	311,500								155,750	155,750							
		245,000 66,500								122,500 33,250	122,500 33,250							
(3) Distribution facility																		
·Water level indicator																		
① Electrode	2 Sets	6,694			6,694													
		6,586 108			6,586 108													
② Transmit Cable	1 Lot	47,805			47,805													
		40,659 7,146			40,659 7,146													
·Water wagon	3 Cars	52,800		52,800														
		50,400 2,400		50,400 2,400														
·Water cart	2792 Sets	92,136		92,136														
		0 92,136		0 92,136														
·Water kiosk	14 Unit	71,484				25,530	25,530					20,424						
		0 71,484				0 25,530	0 25,530					0 20,424						
·Reservoir	2 Ponds	78,140										78,140						
		0 78,140										0 78,140						
·Pipe-line (Φ150~250)	11Km																	
① G-1 Area	(3.6Km)	192,700				38,540					77,080	77,080						
		128,260 64,440				25,652 12,888					51,304 25,776	51,304 25,776						
② G-2 Area	(1.3Km)	67,500				51,975										15,525		
		40,500 27,000				31,185 20,790										9,315 6,210		
③ G-3 Area	(3.7Km)	184,500					91,790								59,500	33,210		
		110,700 73,800					55,074 36,716								35,700 23,800	19,926 13,284		
④ Central Area	(3.4Km)	186,520										108,182	44,765	33,574				
		121,160 65,360										70,273 37,909	29,078 15,686	21,809 11,765				
·Pump Station (Including Pump)	1 St.	206,297									103,148	103,148						
		157,714 48,583									78,857 24,292	78,857 24,292						
·Chlorination equipment	Unit	53,250										53,250						
		53,250 0										53,250 0						
·Water level indicator	Set	36,702										36,702						
		32,320 4,382										32,320 4,382						
B. Land Acquisition Cost	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C. Construction Cost (A X 1.25)	-	2,396,095	0	181,170	232,547	227,268	146,650	0	0	276,900	502,185	596,158	55,956	41,967	74,375	60,919	0	0
D. Design & Supervision (C X0.1)	-	239,610	9,059	20,686	22,991	18,696	7,333	0	13,845	38,954	54,917	32,606	4,896	5,817	6,765	3,046	0	0
·Detailed Design (C x 0.05)	-	119,805	9,059	11,627	11,363	7,333	0	0	13,845	25,109	29,808	2,798	2,098	3,719	3,046	0	0	0
·Supervision (C x 0.05)	-	119,805	0	9,059	11,627	11,363	7,333	0	0	13,845	25,109	29,808	2,798	2,098	3,719	3,046	0	0
E. Physical Contingency {(C+D) X 0.15)}	-	395,356	1,359	30,278	38,331	36,895	23,097	0	2,077	47,378	83,565	94,315	9,128	7,168	12,171	9,595	0	0
Total (C+D+E)	-	3,031,061	10,418	232,134	293,869	282,859	177,080	0	15,922	363,232	640,667	723,078	69,980	54,952	93,311	73,560	0	0

Note 1) Exchange Rate : US$ 1.00 = Yen 117.5 US$ 1.00= Tg 890

2) ① ② ③ ① Total ② Foreign Portion ③ Local Portion

Table III-6 Assumptions and Results of Economic Benefit Estimate

(Domestic water)

	Unit	Minimum requiremen	Commercial element	Total	
1. Value of water					
Base	Tg/m^3	1,250	56 *		
Additional WTP	%	50%	20%		
Total WTP	Tg/m^3	1,875	67		
	Tg/$	890	890	-	(December 1998)
	$/m^3	2.11	0.08	-	

* present amount paid by apartment dwellers :
(Tg 250/person/month)/(150 lcd/(1,000l/m^3)*30days)

2. Unaccounted-for-water (UAFW)		
1997	30%	
2005	25%	
2015	20%	

3. Amount of water supplied/used (1) Amount supplied (UAFW included (2) Amount used (UAFW excluded)	Unit	Minimum requiremen	Commercial element	Total
(2005)				
Apartment	lcd	10.6	139.4	150.0
Ger	lcd	10.6	0.0	10.6
(2015)				
Apartment	lcd	20.0	130.0	150.0
Ger	lcd	20.0	1.2	21.2
4. Population				
(2005)				
Apartment	no.	-	-	3,433
Ger	no.	-	-	15,357
Total	no.	-	-	18,790
(2015)				
Apartment	no.	-	-	3,830
Ger	no.	-	-	17,131
Total	no.	-	-	20,961

5. Annual total benefit (2005)	Unit	Minimum requiremen	Commercial element	Total
Apartment	$/year	27,982	13,189	41,171
Ger	$/year	125,175	0	125,175
Total	$/year	153,157	13,189	166,346
(2015)				
Apartment	$/year	58,902	13,722	72,624
Ger	$/year	263,461	567	264,028
Total	$/year	322,364	14,288	336,652

(Industrial and institutional water)

1. Present tariff	900	Tg/m^3
2. Present revenue	63,139	thousand Tg in 1997 (indication of WTP)
	890	Tg/$
	71	thousand US$
3. Coefficient for additional WTP	20	%
4. Total WTP	85	thousand US$
5. Annual growth		
1998-2005	3.5%	per year
2005-2015	4.5%	per year
6. Annual benefit		
2005	112	thousand US$ per year
2015	174	thousand US$ per year

Table III-7 (1/4) Willingness-to-pay for Water of Selected Households in Altai City (Households with no piped water supply service)

No.	Original Serial Number	Annual income 1997 (Tg/year)	Payment for water at a time (Tg)	Perception to present water charge	Readiness to pay piped water charge	Households wishing to be linked to piped water supply			Households wishing to continue getting truck water		
						Present tariff of truck water (Tg/liter)	Willingness-to-pay for better service (Tg/liter)	% of Willingness-to-pay above present tariff (%)	Present tariff of truck water (Tg/liter)	Willingness-to-pay for better service (Tg/liter)	% of Willingness-to-pay above present tariff (%)
1	2	432,000	60	OK	yes	1.0	3.0	200			-
2	3	468,000	70	OK	yes	1.0	2.0	100			-
3	4	200,000	60	too high	yes	1.0	2.5	150			-
4	5	864,000	40	OK	yes	1.0	1.5	50			-
5	6	-100,000	100	too high	yes	1.0	1.5	50			-
6	11	360,000	60	OK	yes	1.0	2.0	100			-
7	13	720,000	100	OK	yes	1.0	3.0	200			-
8	14	20,000	60	too high	yes	1.0	2.0	100			-
9	15	168,000	60	OK	yes	1.0	5.0	400			-
10	16	336,000	90	OK	no			-	1.0	6.0	500
11	17	408,000	70	too high	yes	1.0	2.5	150			-
12	18	550,000	50	OK	yes	1.0	5.5	450			-
13	19	250,000	60	OK	yes	1.0	5.5	450			-
14	20	160,000	50	OK	no			-	1.0	1.0	0
15	21	300,000	70	too high	yes	1.0	3.0	200			-
16	22	342,100	60	OK	no			-	2.0	2.0	0
17	23	10,000	120	OK	no			-	1.0	1.0	0
18	24	639,500	60	OK	no			-	1.0	1.0	0
19	25	240,000	40	OK	yes	1.0	6.0	500			-
20	26	180,000	60	too high	yes	1.0	2.0	100			-
21	27	107,000	100	OK	yes	1.0	5.0	400			-
22	32	192,000	150	too high	yes	1.0	1.5	50			-
23	33	708,000	80	OK	yes	1.0	1.0	0			-
24	36	69,600	40	OK	no			-	1.0	1.0	0
25	38	720,000	80	OK	yes	1.0	2.0	100			-
26	39	480,000	60	OK	yes	1.0	3.0	200			-
27	40	264,000	80	OK	yes	1.0	10.0	900	1.0	10.0	900
28	41	168,000	150	OK	no			-	1.0	12.0	1100
29	42	768,000	100	too high	no			-	1.0	2.0	100
30	44		30	OK	no			-	1.0	1.0	0
31	45	20,000	30	OK	no			-	1.0	1.0	0
32	46	370,000	70	OK	yes		5.5	-			-
33	47	548,000	50	OK	yes	1.0	10.0	900	1.0	10.0	900
34	48	40,000	100	OK	no			-	1.0	1.5	50
35	49	490,000	40	OK	yes	1.0	1.5	50			-
36	50	130,800	40	OK	yes	1.0	1.0	0			-
37	51	57,000	40	OK	yes	1.0	2.0	100			-
38	52	300,000	100	OK	yes	1.0	2.0	100			-
39	53	780,000	100	too high	yes	1.0	2.0	100			-
40	54	480,000	70	too high	yes	1.0	2.5	150			-
41	55	540,000	100	OK	yes	1.0	3.0	200			-
42	56	336,000	40	too high	yes	1.0	1.0	0			-
43	57	144,000	180	too high	no			-	1.0	0.3	-75
44	58	228,000	60	OK	no			-	1.0	0.5	-50
45	59	252,000	80	too high	no			-	1.0	2.5	150
46	60	130,500	80	OK	no			-	1.0	0.5	-50

Table III-7 (2/4) Willingness-to-pay for Water of Selected Households in Altai City (Households with no piped water supply service)

No.	Original Serial Number	Annual income 1997 (Tg/year)	Payment for water at a time (Tg)	Perception to present water charge	Readiness to pay piped water charge	Households wishing to be			Households wishing to		
						Present tariff of truck water (Tg/liter)	Willingness-to-pay for better service (Tg/liter)	% of Willingness-to-pay above present tariff (%)	Present tariff of truck water (Tg/liter)	Willingness-to-pay for better service (Tg/liter)	% of Willingness-to-pay above present tariff (%)
47	61	288,000	100	OK	no			-	1.0	1.0	0
48	62	400,000	80	too high	no			-	5.0	5.0	0
49	63	456,000	60	OK	yes	1.0	10.0	900	10.0	10.0	0
50	64	-50,000	50	OK	no			-	5.0	5.0	0
51	65	500,000	50	OK	no			-	1.0	1.0	0
52	66	74,460	100	OK	no			-	1.0	1.0	0
53	67	120,000	900	too high	no			-	1.0	1.0	0
54	68	696,000	50	too high	no			-	1.0	1.0	0
55	69	576,000	100	too high	no			-	1.0	1.0	0
56	70	720,000	80	OK	no			-	1.0	0.5	-50
57	74	202,000	50	too high	yes	1.0	2.5	150			-
58	75	468,000	70	OK	yes	1.0	5.0	400			-
59	76	216,000	80	too high	yes	1.0	1.5	50			-
60	82	240,000	60	OK	no			-	1.0	4.0	300
61	83	840,000	100	OK	yes	180.0	200.0	11			-
62	84	639,600	120	OK	yes	180.0	250.0	39			-
63	85	221,000	110	OK	no			-	1.0	5.0	400
64	86	40,000	60	OK	no			-	1.0	0.3	-75
65	88	111,600	50	OK	no			-	1.0	1.0	0
66	89	407,500	100	OK	yes	1.0	5.0	400			-
67	91	250,000	30	OK	no			-	1.0	2.0	100
68	93	350,000	80	OK	yes	1.0	2.0	100			-
69	94	-	40	too high	no			-	1.0	0.3	-75
70	95	240,000	50	OK	yes	1.0	3.0	200			-
71	96	240,000	50	OK	yes	1.0	3.0	200			-
72	97	240,000	100	OK	yes	1.0	5.0	400			-
73	98	111,400	100	too high	no			-	1.0	10.0	900
74	99	225,000	60	OK	yes	1.0	4.0	300			-
75	100	426,000	90	OK	yes	1.0	5.0	400			-
76	102	276,000	100	OK	no			-		0.3	-
77	103	102,720	50	OK	no			-	1.0	0.3	-75
78	104	81,600	100	OK	no			-	1.0	1.0	0
79	105	336,000	60	OK	no			-	1.0	0.3	-75
80	110	480,000	60	OK	yes	1.0	2.0	100			-
81	111	660,000	80	OK	no			-	1.0	2.0	100
82	112	300,000	100	OK	no			-	1.0	1.0	0
83	113	144,000	70	OK	no			-	1.0	1.0	0
84	114	198,000	50	OK	yes	1.0	1.0	0			-
85	115	264,000	90	OK	yes	1.0	1.0	0			-
86	116	312,000	80	OK	yes	1.0	5.0	400			-
87	117	300,000	280	OK	yes	1.0	2.0	100			-
88	118	528,000	80	OK	yes	1.0	3.0	200			-
89	119	100,000	100	OK	no			-		2.0	-
90	120	432,000	80	OK	yes	1.0	10.0	900			-
91	121	252,000	60	OK	no			-	1.0	5.0	400
92	122	420,000	80	too high	no			-	1.0	10.0	900
93	123	480,000	150	OK	no			-	1.0	5.0	400
94	124	396,000	170	OK	no			-	1.0	2.0	100
95	125	234,000	60	OK	no			-	1.0	3.0	200
96	126	360,000	80	OK	yes	1.0	1.0	0			-
97	127	360,000	80	OK	no			-	1.0	1.0	0

Table III-7 (3/4) Willingness-to-pay for Water of Selected Households in Altai City (Households with no piped water supply service)

No.	Original Serial Number	Annual income 1997 (Tg/year)	Payment for water at a time (Tg)	Perception to present water charge	Readiness to pay piped water charge	Households wishing to be			Households wishing to		
						Present tariff of truck water (Tg/liter)	Willingness-to -pay for better service (Tg/liter)	% of Willingness-to-pay above present tariff (%)	Present tariff of truck water (Tg/liter)	Willingness-to -pay for better service (Tg/liter)	% of Willingness-to-pay above present tariff (%)
98	128	706,560	60	OK	no			-	1.0	5.0	400
99	129	361,200	80	OK	no			-	1.0	3.0	200
100	130	130,620	80	OK	no			-	1.0	0.5	-50
101	131	117,600	40	OK	no			-	1.0	3.0	200
102	132	134,400	60	OK	no			-	1.0	3.0	200
103	133	420,000	80	OK	no			-	1.0	2.0	100
104	134	240,000	60	OK	no			-	1.0	1.0	0
105	135	240,000	70	OK	no			-	1.0	3.0	200
106	136	78,216	80	OK	no			-	1.0	1.0	0
107	137	276,000	80	OK	yes	1.0	2.0	100			-
108	138	432,000	60	too high	yes	1.0	2.0	100			-
109	139	564,000	200	too high	yes	1.0	3.0	200			-
110	140	299,880	80	too high	yes	1.0	2.0	100			-
111	141	564,000	70	OK	yes	1.0	3.0	200			-
112	142	86,400	40	too high	yes	1.0	1.0	0			-
113	143	200,000	40	too high	yes	1.0	1.5	50			-
114	144	460,000	70	too high	yes	1.0	3.0	200			-
115	145	600,000	110	OK	yes	1.0	2.5	150			-
116	146	120,000	30	OK	yes	1.0	2.5	150			-
117	147	264,000	40	OK	yes	1.0	2.0	100			-
118	148	235,200	100	OK	yes	1.0	3.0	200			-
119	149	344,400	100	OK	yes	1.0	2.5	150			-
120	150	156,000	120	OK	yes	1.0	3.0	200			-
121	151	30,000	50	OK	no	1.0	1.5	50			-
122	152	120,000	240	OK	yes	1.0	2.0	100			-
123	154	192,000	60	OK	yes	1.0	3.0	200			-
124	155	420,000	100	OK	yes	1.0	2.0	100			-
125	156	80,000	300	OK	yes	1.0	2.0	100			-
126	157	480,000	90	OK	yes	1.0	3.0	200			-
127	158	360,000	100	OK	yes	1.0	3.0	200			-
128	159	612,000	100	OK	yes	1.0	2.0	100			-
129	161	1,000,000	150	OK	yes	1.0	3.0	200			-
130	162	216,000	100	OK	yes	1.0	2.0	100			-
131	163	176,400	150	OK	yes	1.0	2.0	100			-
132	164	144,000	60	OK	yes	1.0	2.0	100			-
133	165	300,000	60	OK	yes	1.0	2.0	100			-
134	166	438,000	90	OK	yes	1.0	2.5	150			-
135	167	564,000	90	OK	yes	1.0	2.0	100			-
136	168	350,000	60	too high	yes	1.0	2.0	100			-
137	169	324,000	60	too high	yes	1.0	2.0	100			-
138	170	470,600	100	OK	no			-	1.0	3.0	200
139	172	192,000	85	OK	yes	1.0	2.0	100			-
140	173	158,000	45	too high	yes	1.0	1.5	50			-
141	174	660,000	60	too high	yes	1.0	2.0	100			-
142	175	504,000	100	OK	yes	1.0	4.0	300			-
143	178	684,000	60	OK	yes	1.0	6.0	500			-
144	180	240,000	100	OK	no			-	1.0	1.0	0
145	181	120,000	30	OK	no			-	1.0	0.5	-50
146	182	120,000	60	OK	no			-	1.0	1.0	0
147	183	180,000	100	OK	no			-	1.0	1.0	0
148	184	222,000	50	OK	no			-	1.0	0.3	-75

Table III-7 (4/4) Willingness-to-pay for Water of Selected Households in Altai City (Households with no piped water supply service)

No.	Original Serial Number	Annual income 1997 (Tg/year)	Payment for water at a time (Tg)	Perception to present water charge	Readiness to pay piped water charge	Households wishing to be			Households wishing to		
						Present tariff of truck water (Tg/liter)	Willingness-to -pay for better service (Tg/liter)	% of Willingness-to-pay above present tariff (%)	Present tariff of truck water (Tg/liter)	Willingness-to -pay for better service (Tg/liter)	% of Willingness-to-pay above present tariff (%)
149	185	264,000	60	OK	no			-	1.0	1.0	0
150	186	288,000	60	OK	no			-	1.0	2.0	100
151	187	180,000	80	OK	no			-	1.0	3.0	200
152	188	144,000		too high	yes	1.0	4.0	300			-
153	189	850,000	60	OK	yes	1.0	1.5	50			-
154	190	240,000	40	OK	no			-	1.0	0.3	-75
155	191	700,000	40	OK	yes	1.0	2.0	100			-
156	192	74,400	20	too high	yes	1.0	1.5	50			-
157	193	270,000	100	OK	yes	1.0	2.0	100			-
158	195	216,000	130	OK	no			-	1.0	0.5	-50
159	196	244,000	100	OK	no			-	1.0	3.0	200
160	197	144,000	80	OK	no			-	1.0	3.0	200
Minimum		-100,000	20	-	-	1.0	1.0	0	1.0	0.3	-75
Maximum		1,000,000	900	-	-	180.0	250.0	900	10.0	12.0	1,100
Average		323,654	85	-	-	4.9	7.7	189	1.3	2.5	131

Source : Social Survey conducted by the JICA study team in June 1997

Table III-8 Willingness-to-pay for Water of Selected Households in Altai City (Households with piped water supply service)

No.	Original serial number	Income level a. Annual income 1997 (Tg/year)	Income level b. Monthly income 1997 (Tg/month)	c. Expenditure on water (Tg/month)	c. Expenditure on water (% to income)	d. Perception to water tariff	e. Confirmed tariff (Tg/person /month	f. Willing-ness to pay (Tg/person /month	g. % WTP* above confirmed tariff
1	71	569,000	47,417	320	0.7	reasonable	80	150	88
2	72	456,000	38,000	1,000	2.6	reasonable	80	110	38
3	73	600,000	50,000	320	0.6	reasonable	80	150	88
4	77	120,000	10,000	540	5.4	reasonable	180	250	39
5	78	915,600	76,300	900	1.2	reasonable	180	200	11
6	79	240,000	20,000	1,440	7.2	reasonable	180	200	11
7	80	720,000	60,000	1,080	1.8	reasonable	180	250	39
8	81	780,000	65,000	1,260	1.9	reasonable	180	250	39
9	87	450,000	37,500	560	1.5	reasonable	80	150	88
10	1	300,000	25,000	750	3.0	reasonable	180	240	33
11	8	120,000	10,000	1,200	12.0	reasonable	180	200	11
12	9	1,020,000	85,000	1,260	1.5	reasonable	180	200	11
13	10	780,000	65,000	1,250	1.9	reasonable	180	200	11
14	28	1,038,700	86,558	1,080	1.2	reasonable	180	200	11
15	29	216,000	18,000	540	3.0	reasonable	180	180	0
16	30	60,000	5,000	900	18.0	reasonable	180	180	0
17	31	456,000	38,000	360	0.9	reasonable	180	270	50
18	12	264,000	22,000	1,080	4.9	reasonable	180	190	6
19	34	780,000	65,000	750	1.2	reasonable	180	210	17
20	35	468,000	39,000	380	1.0	reasonable	180	200	11
21	37	63,600	5,300	1,260	23.8	reasonable	180	190	6
22	43	720,000	60,000	360	0.6	reasonable	180	210	17
23	92	780,000	65,000	320	0.5	reasonable	80	150	88
24	101	660,000	55,000	480	0.9	reasonable	80	150	88
25	106	244,800	20,400	810	4.0	reasonable	180	220	22
26	107	360,000	30,000	540	1.8	reasonable	180	200	11
27	108	120,000	10,000	540	5.4	reasonable	180	180	0
28	109	600,000	50,000	540	1.1	reasonable	180	220	22
29	153	280,000	23,333	900	3.9	reasonable	180	200	11
30	160	240,000	20,000	500	2.5	reasonable	180	200	11
31	171	960,000	80,000	n.a.	-	reasonable	180	250	39
32	176	720,000	60,000	320	0.5	reasonable	80	150	88
33	177	636,000	53,000	320	0.6	reasonable	80	150	88
34	179	600,000	50,000	560	1.1	reasonable	80	150	88
35	194	40,000	3,333	360	10.8	reasonable	180	250	39
Minimum		40,000.0	3,333	320	0.5	-	80	110	0
Maximum		1,038,700	86,558	1,440	23.8	-	180	270	88
verage		496,506	41,375	729	4	-	154	196	35

Source : Social Survey by the JICA Study Team conducted in June 1997
Note : * WTP=willingness-to-pay

Table III-9 Willingness-to-pay for Water of the Surveyed Factories and Institutions

Factory/institution	View on present service	Present tariff	Maximum tariff ready to pay	% above present tariff
1. Altai Hospital	not satisfied	900	1,000	11.1
2. Ilch-Altai Heating center	not satisfied	900	1,200	33.3
3. Mandal service Company	not satisfied	900	1,200	33.3
4. School No.1	satisfied	900	1,000	11.1
5. Governo's Office	not satisfied	900	900	0.0
6. Tulga-Altai Company	not satisfied	900	1,300	44.4
7. Entum Company	satisfied	900	1,100	22.2
8. Medical College	not satisfied	900	950	5.6
9. Technical Training Center	not satisfied	900	1,000	11.1
10. Altai Camel Company	satisfied	-	-	-
11. Power Station	not satisfied	900	1,300	44.4
12. Kindergarten for handicapped children	satisfied	180	190	5.6
13. Agricultural Stock Exchange	not satisfied	-	-	-
14. Mobgol Bank	satisfied	900	1,100	22.2
15. Fire Station	satisfied	-	-	-
16. Airport	satisfied	2	4	100.0
17. Social Service Center	not satisfied	2	2	0.0
18. Undram-Dyu Company	not satisfied	900	1,000	11.1
19. Goviin Urgoo Government Factory	-	-	-	-
20. Urban Service Department	not satisfied	-	-	-

Source : Social Survey conducted by JICA Study Team in June 1997

Table III-10 (1/3) Economic Evaluation of Master Plan

EIRR = 14.5%

(Unit : $)

No.	Year	Cost				Benefit			Balance
		Invest-ment	OM	Replace-ment	Total	Domestic	Industrial & instiutrional	Total	
1	2000	10,418	44,113	0	54,531	0	0	0	-54,531
2	2001	232,134	48,710	0	280,844	1,739	1,172	2,911	-277,933
3	2002	293,869	52,245	0	346,114	40,495	27,290	67,785	-278,329
4	2003	282,859	48,108	0	330,967	89,557	60,353	149,911	-181,056
5	2004	177,080	52,433	0	229,513	136,782	92,178	228,960	-553
6	2005	0	55,967	0	55,967	166,346	112,101	278,447	222,480
7	2006	15,922	56,498	0	72,420	166,346	112,586	278,932	206,512
8	2007	363,232	57,028	0	420,260	167,679	112,586	280,265	-139,995
9	2008	640,667	60,324	0	700,991	198,081	123,653	321,734	-379,257
10	2009	723,078	66,268	0	789,346	251,706	143,171	394,877	-394,469
11	2010	69,980	75,083	0	145,063	312,228	165,200	477,428	332,365
12	2011	54,952	76,724	0	131,676	318,085	167,332	485,417	353,741
13	2012	93,311	77,564	0	170,875	322,685	169,006	491,691	320,816
14	2013	73,560	79,390	0	152,950	330,495	171,849	502,344	349,394
15	2014	0	81,080	0	81,080	336,652	174,090	510,742	429,662
16	2015	0	82,161	0	82,161	336,652	174,090	510,742	428,581
17	2016	0	82,161	0	82,161	336,652	174,090	510,742	428,581
18	2017	0	82,161	0	82,161	336,652	174,090	510,742	428,581
19	2018	0	82,161	0	82,161	336,652	174,090	510,742	428,581
20	2019	0	82,161	404,081	486,242	336,652	174,090	510,742	24,500
21	2020	0	82,161	66,562	148,723	336,652	174,090	510,742	362,019
22	2021	0	82,161	0	82,161	336,652	174,090	510,742	428,581
23	2022	0	82,161	0	82,161	336,652	174,090	510,742	428,581
24	2023	0	82,161	0	82,161	336,652	174,090	510,742	428,581
25	2024	0	82,161	0	82,161	336,652	174,090	510,742	428,581
26	2025	0	82,161	408,440	490,601	336,652	174,090	510,742	20,141
27	2026	0	82,161	0	82,161	336,652	174,090	510,742	428,581
28	2027	0	82,161	0	82,161	336,652	174,090	510,742	428,581
29	2028	0	82,161	0	82,161	336,652	174,090	510,742	428,581
30	2029	0	82,161	0	82,161	336,652	174,090	510,742	428,581
31	2030	0	82,161	243,664	325,825	336,652	174,090	510,742	184,917
32	2031	0	82,161	66,562	148,723	336,652	174,090	510,742	362,019
33	2032	0	82,161	0	82,161	336,652	174,090	510,742	428,581
34	2033	0	82,161	0	82,161	336,652	174,090	510,742	428,581
35	2034	0	82,161	0	82,161	336,652	174,090	510,742	428,581
36	2035	0	82,161	404,081	486,242	336,652	174,090	510,742	24,500
37	2036	0	82,161	0	82,161	336,652	174,090	510,742	428,581
38	2037	0	82,161	0	82,161	336,652	174,090	510,742	428,581
39	2038	0	82,161	0	82,161	336,652	174,090	510,742	428,581
	Total	3,031,062	2,821,238	1,593,390	7,445,690	10,581,876	5,636,640	16,218,515	8,772,825

Sensitivity Analysis

Case	EIRR (%)	B/C	B-C ($)
Standard	14.5%	1.23	590,800
Cost 10% up	12.4%	1.12	339,377
Benefit 10% down	12.2%	1.11	280,297
Cost 10% up plus benefit 10% dow	10.3%	1.01	28,875

Table III-10 (2/3) Economic Evaluation of Master Plan (Sensitivity Analysis)

(Unit : $)

No.	Year	Cost 10% up		Balance	Benefit 10% down		Balance	Cost 10% up & Benefit 10% down		Balance
		Cost	Benefit		Cost	Benefit		Cost	Benefit	
1	2000	59,984	0	-59,984	54,531	0	-54,531	59,984	0	-59,984
2	2001	308,928	2,911	-306,017	280,844	2,620	-278,224	308,928	2,620	-306,308
3	2002	380,725	67,785	-312,941	346,114	61,006	-285,108	380,725	61,006	-319,719
4	2003	364,064	149,911	-214,153	330,967	134,920	-196,047	364,064	134,920	-229,144
5	2004	252,464	228,960	-23,505	229,513	206,064	-23,449	252,464	206,064	-46,401
6	2005	61,564	278,447	216,884	55,967	250,603	194,636	61,564	250,603	189,039
7	2006	79,662	278,932	199,270	72,420	251,039	178,619	79,662	251,039	171,377
8	2007	462,286	280,265	-182,021	420,260	252,239	-168,021	462,286	252,239	-210,047
9	2008	771,090	321,734	-449,356	700,991	289,561	-411,430	771,090	289,561	-481,530
10	2009	868,281	394,877	-473,404	789,346	355,389	-433,957	868,281	355,389	-512,892
11	2010	159,569	477,428	317,859	145,063	429,685	284,622	159,569	429,685	270,116
12	2011	144,844	485,417	340,574	131,676	436,876	305,200	144,844	436,876	292,032
13	2012	187,963	491,691	303,729	170,875	442,522	271,647	187,963	442,522	254,559
14	2013	168,245	502,344	334,099	152,950	452,110	299,160	168,245	452,110	283,865
15	2014	89,188	510,742	421,554	81,080	459,668	378,588	89,188	459,668	370,480
16	2015	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
17	2016	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
18	2017	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
19	2018	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
20	2019	534,866	510,742	-24,124	486,242	459,668	-26,574	534,866	459,668	-75,198
21	2020	163,595	510,742	347,147	148,723	459,668	310,945	163,595	459,668	296,073
22	2021	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
23	2022	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
24	2023	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
25	2024	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
26	2025	539,661	510,742	-28,919	490,601	459,668	-30,933	539,661	459,668	-79,993
27	2026	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
28	2027	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
29	2028	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
30	2029	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
31	2030	358,408	510,742	152,335	325,825	459,668	133,843	358,408	459,668	101,260
32	2031	163,595	510,742	347,147	148,723	459,668	310,945	163,595	459,668	296,073
33	2032	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
34	2033	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
35	2034	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
36	2035	534,866	510,742	-24,124	486,242	459,668	-26,574	534,866	459,668	-75,198
37	2036	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
38	2037	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
39	2038	90,377	510,742	420,365	82,161	459,668	377,507	90,377	459,668	369,291
	Total	8,190,259	16,218,515	8,028,256	7,445,690	14,596,664	7,150,974	8,190,259	14,596,664	6,406,405

Table III-10 (3/3)

Economic Evaluation of Master Plan (Net Present Value and Benefit - Cost Ratio)

(Costs and Benefits Discounted by 10% Discount Rate) (Unit : $)

No	Year	Standard case		Cost 10% up		Benefit 10% down		Cost 10% up & Benefit 10% down	
		Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit
1	2000	54,531	0	59,984	0	54,531	0	59,984	0
2	2001	255,313	2,647	280,844	2,647	255,313	2,382	280,844	2,382
3	2002	286,045	56,020	314,649	56,020	286,045	50,418	314,649	50,418
4	2003	248,660	112,630	273,526	112,630	248,660	101,367	273,526	101,367
5	2004	156,760	156,383	172,437	156,383	156,760	140,744	172,437	140,744
6	2005	34,751	172,894	38,226	172,894	34,751	155,604	38,226	155,604
7	2006	40,879	157,450	44,967	157,450	40,879	141,705	44,967	141,705
8	2007	215,660	143,820	237,226	143,820	215,660	129,438	237,226	129,438
9	2008	327,017	150,091	359,719	150,091	327,017	135,082	359,719	135,082
10	2009	334,760	167,466	368,236	167,466	334,760	150,720	368,236	150,720
11	2010	55,928	184,069	61,521	184,069	55,928	165,662	61,521	165,662
12	2011	46,152	170,136	50,767	170,136	46,152	153,122	50,767	153,122
13	2012	54,446	156,668	59,891	156,668	54,446	141,001	59,891	141,001
14	2013	44,304	145,511	48,735	145,511	44,304	130,960	48,735	130,960
15	2014	21,351	134,494	23,486	134,494	21,351	121,045	23,486	121,045
16	2015	19,669	122,268	21,636	122,268	19,669	110,041	21,636	110,041
17	2016	17,881	111,152	19,669	111,152	17,881	100,037	19,669	100,037
18	2017	16,255	101,048	17,881	101,048	16,255	90,943	17,881	90,943
19	2018	14,777	91,861	16,255	91,861	14,777	82,675	16,255	82,675
20	2019	79,504	83,510	87,455	83,510	79,504	75,159	87,455	75,159
21	2020	22,107	75,919	24,317	75,919	22,107	68,327	24,317	68,327
22	2021	11,102	69,017	12,213	69,017	11,102	62,115	12,213	62,115
23	2022	10,093	62,743	11,102	62,743	10,093	56,468	11,102	56,468
24	2023	9,176	57,039	10,093	57,039	9,176	51,335	10,093	51,335
25	2024	8,341	51,853	9,176	51,853	8,341	46,668	9,176	46,668
26	2025	45,281	47,139	49,809	47,139	45,281	42,426	49,809	42,426
27	2026	6,894	42,854	7,583	42,854	6,894	38,569	7,583	38,569
28	2027	6,267	38,958	6,894	38,958	6,267	35,062	6,894	35,062
29	2028	5,697	35,417	6,267	35,417	5,697	31,875	6,267	31,875
30	2029	5,179	32,197	5,697	32,197	5,179	28,977	5,697	28,977
31	2030	18,673	29,270	20,540	29,270	18,673	26,343	20,540	26,343
32	2031	7,748	26,609	8,523	26,609	7,748	23,948	8,523	23,948
33	2032	3,891	24,190	4,280	24,190	3,891	21,771	4,280	21,771
34	2033	3,538	21,991	3,891	21,991	3,538	19,792	3,891	19,792
35	2034	3,216	19,992	3,538	19,992	3,216	17,993	3,538	17,993
36	2035	17,302	18,174	19,033	18,174	17,302	16,357	19,033	16,357
37	2036	2,658	16,522	2,924	16,522	2,658	14,870	2,924	14,870
38	2037	2,416	15,020	2,658	15,020	2,416	13,518	2,658	13,518
39	2038	2,197	13,655	2,416	13,655	2,197	12,289	2,416	12,289
	Total	2,514,223	3,105,023	2,765,646	3,105,023	2,514,223	2,794,521	2,765,646	2,794,521

Table III-11
Assumptions to the Estimate of Water Chrarge for Cost Recovery

1. OM cost	estimated	
2. Period	25	years
3. Discount rate :	3.0%	
4. Exchange rate :	890	Tg/$ in December 1998
5. Mean water demand (m^3/day)		

	2005	2015
Apartment	515	575
Ger	163	363
Institution	167	248
Industry	12	20
Loss	283	294
Total	1,140	1,500

6.Allocation of OM cost into ger and other portions

(1) Allocation propotion by investment cost		
Ger area	68%	51%
Central area	32%	49%

(2) OM cost ($/year)	2005	2015
Total	55,967	82,161
Ger area	37,855	42,131
Central area	18,112	40,030

7. Replacement cost discounted to year 2000 ($)	2005	2015
Local currency portion	92,399	229,426
Total cost	250,348	861,274

8. Investment cost

	2005	2015
(1) Allocation propotions for common facilities by water demand		
Ger area	19%	30%
Central area	81%	70%
(2) Investment cost, local currecy ($)		
Coefficient for overhead, design/supersision and physical contingency	1.5813	1.5813
Common facilities		
Total	50,051	388,232
Ger area	9,520	116,856
Central area	40,532	271,376
Ger area	341,534	523,805
Central area	0	103,351
Total	391,585	1,015,387
Ger area	351,054	640,661
Central area	40,532	374,726
(3) Total investment cost ($)		
Common facilities		
Total	398,171	1,690,729
Ger area	75,732	508,901
Central area	322,440	1,181,828
Ger area	598,188	1,045,396
Central area	0	294,935
Total	996,360	3,031,060
Ger area	673,920	1,554,297
Central area	322,440	1,476,763

Table III-12
Water Charges for Cost Recovery by Ger and Central Area

Item	Unit	2005		2015	
		Ger	Central area	Ger	Central area
1. Costs					
OM	thousand $/year	38	18	42	40
Investment cost (LC)	thousand $	351	41	641	375
Replacement Cost (LC)	thousand $	83	10	145	85
Total investment cost	thousand $	674	322	1,554	1,477
Total replacement cost	thousand $	169	81	442	420
LC investment cost annulaized	thousand $/year	20	2	37	22
LC replacement cost annualized	thousand $/year	5	1	8	5
Total investment cost annulaized	thousand $/year	39	19	89	85
Total replacement cost annulaized	thousand $/year	10	5	25	24
2. Amount of water used					
Daily mean	m^3/day	163	694	363	843
Annual mean	m^3/year	59,495	253,310	132,495	307,695
3. Water charge (in $)					
OM cost recovery	$/$m^3$	0.64	0.07	0.32	0.13
OM and LC investment/replacement costs recovery	$/$m^3$	1.06	0.08	0.66	0.22
OM and total investment/replacement costs recovery	$/$m^3$	1.45	0.16	1.18	0.48
(in Tg)					
OM cost recovery	Tg/m^3	566	64	283	116
OM and LC investment/replacement costs recovery	Tg/m^3	939	74	586	192
OM and total investment/replacement costs recovery	Tg/m^3	1,291	145	1,053	431

Table III-13 Distribution of Monthly Household Income of Selected Households in Altai City as of June 1998

(Total Household Income)

Income strata (Tg/month)	Data from Altai City									Result of Social Survey		
	Apartment			Ger			Total					
	(Number)		(%)	(Number)		(%)	(Number)		(%)	(Number)		(%)
	Cml.	by strata		Cml.	by strata		Cml.	by strata		Cml.	by strata	
0	9	9	5.6	77	77	9.5	86	86	8.8	0	0	0.0
1-9,999	152	11	6.8	736	59	7.3	888	81	8.3	193	19	9.8
10,000 - 19,999	141	14	8.7	677	177	21.8	807	234	24.0	174	37	19.2
20,000 - 29,999	127	13	8.1	500	177	21.8	573	187	19.2	137	45	23.3
30,000 - 39,999	114	11	6.8	323	140	17.2	386	126	12.9	92	20	10.4
40,000 - 49,999	103	14	8.7	183	70	8.6	260	72	7.4	72	26	13.5
50,000 - 59,999	89	17	10.6	113	30	3.7	188	68	7.0	46	14	7.3
60,000 - 69,999	72	15	9.3	83	37	4.6	120	30	3.1	32	18	9.3
70,000 - 79,999	57	10	6.2	46	14	1.7	90	51	5.2	14	6	3.1
80,000 - 89,999	47	32	19.9	32	14	1.7	39	10	1.0	8	4	2.1
90,000 - 99,999	15	12	7.5	18	7	0.9	29	20	2.1	4	4	2.1
100,000 -	3	3	1.9	11	11	1.4	9	9	0.9	0	0	0.0
Total	161	161	100.0	813	813	100.0	974	974	100.0	193	193	100.0
Average income		50,625			27,886			31,644			34,810	
Minimum		0			0			0			963	
Maximum		110,500			120,000			120,000			99,975	

(Income per capita)

Income strata (Tg/month/person)	Data from Altai City									Result of Social Survey		
	Apartment			Ger			Total					
	(Number)		(%)	(Number)		(%)	(Number)		(%)	(Number)		(%)
	Cumulative	by strata		Cml.	by strata		Cml.	by strata		Cml.	by strata	
0	9	9	5.6	77	77	9.5	86	86	8.8	0	0	5.6
1-4,999	152	29	18.0	736	299	36.8	888	330	33.9	193	82	18.0
5,000 - 9,999	123	26	16.1	437	271	33.3	558	304	31.2	111	53	16.1
10,000 - 14,999	97	49	30.4	166	103	12.7	254	144	14.8	58	32	30.4
15,000 - 19,999	48	19	11.8	63	43	5.3	110	73	7.5	26	18	11.8
20,000 - 24,999	29	22	13.7	20	9	1.1	37	20	2.1	8	4	13.7
25,000 - 29,999	7	4	2.5	11	4	0.5	17	8	0.8	4	3	2.5
30,000 - 35,000	3	3	1.9	7	3	0.4	9	5	0.5	1	1	1.9
35,000 - 39,999	0	0	0.0	4	4	0.5	4	4	0.4	0	0	0.0
40,000 -	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Total	161	161	100.0	813	813	100.0	974	974	100.0	193	161	100.0
Average		11,452			6,859			7,619			7,841	
Minimum		0			0			0			160	
Maximum		31,667			37,500			37,500			30,776	

Source : (1) Altai City Office, data as of June 1998 (2) Social Survey conducted by the JICA Study Team in June 199 Note : Cml. : cumulative numbers

Table III-14

Proportion of Expenditure on Water to Per Capita Monthly Income by Income Strata
(Under the revised water tariff for OM cost recovery)

Income strata (Tg/month /capita)	Propor-tion (%)	Mid-point income (Tg/month/ apita in 199	Mid-point income ($/month/capita) 1998	2005	2015	Expenditure on water ($/month/capita) 1998	2005	2015	Proportion to Income (%) 1998	2005	2015
(Ger)											
0	9.5	-	-	-	-	0.19	0.20	0.20	-	-	-
1-4,999	36.8	2,500	2.8	3.3	4.4	0.19	0.20	0.20	6.9	6.2	4.6
5,000 - 9,999	33.3	7,500	8.4	9.9	13.2	0.19	0.20	0.20	2.3	2.1	1.5
1 - 9,999	*79.6*	*5,000*	*5.6*	*6.6*	*8.8*	*0.19*	*0.20*	*0.20*	*3.5*	*3.1*	*2.3*
10,000 - 14,999	12.7	12,500	14.0	16.5	21.9	0.19	0.20	0.20	1.4	1.2	0.9
15,000 - 19,999	5.3	17,500	19.7	23.1	30.7	0.19	0.20	0.20	1.0	0.9	0.7
20,000 - 24,999	1.1	22,500	25.3	29.6	39.5	0.19	0.20	0.20	0.8	0.7	0.5
25,000 - 29,999	0.5	27,500	30.9	36.2	48.2	0.19	0.20	0.20	0.6	0.6	0.4
30,000 - 35,000	0.4	32,500	36.5	42.8	57.0	0.19	0.20	0.20	0.5	0.5	0.4
35,000 - 39,999	0.5	37,500	42.1	49.4	65.8	0.19	0.20	0.20	0.5	0.4	0.3
40,000 -	0	-	-			-	-	-	-		
(Apartment)											
0	5.6	-	-	-	-	0.28	0.32	0.59	-	-	-
1-4,999	18	2,500	2.8	3.3	4.4	0.28	0.32	0.59	10.0	9.6	13.3
5,000 - 9,999	16.1	7,500	8.4	9.9	13.2	0.28	0.32	0.59	3.3	3.2	4.4
1 - 9,999	*39.7*	*5,000*	*5.6*	*6.6*	*8.8*	*0.28*	*0.32*	*0.59*	*5.0*	*4.8*	*6.7*
10,000 - 14,999	30.4	12,500	14.0	16.5	21.9	0.28	0.32	0.59	2.0	1.9	2.7
15,000 - 19,999	11.8	17,500	19.7	23.1	30.7	0.28	0.32	0.59	1.4	1.4	1.9
20,000 - 24,999	13.7	22,500	25.3	29.6	39.5	0.28	0.32	0.59	1.1	1.1	1.5
25,000 - 29,999	2.5	27,500	30.9	36.2	48.2	0.28	0.32	0.59	0.9	0.9	1.2
30,000 - 35,000	1.9	32,500	36.5	42.8	57.0	0.28	0.32	0.59	0.8	0.7	1.0
35,000 - 39,999	0	37,500	42.1	49.4	65.8	0.28	0.32	0.59	0.7	0.6	0.9
40,000 -	0	-	-	-	-	-	-	-	-	-	-

Note :

(1) Exchange rate : 890 Tg/US$ (average rate in December 1998)

(2) Growth of personal income is estimated based on the economic growth rates and population growth rates assumed in the Socio-Economic Framework.

	-2005	2005-2015
Economic growth (%/year)	3.0	4.0
Population growth (%/year)	0.7	1.1
Per capita incomegrowth (%/year)	2.3	2.9

(3) Expenditure on water		1998	2005	2015
(Ger)				
Water consumption rate	lcd	4.6	10.6	21.2
Water charge	$/m^3$	1.40	0.64	0.32
Expenditure on water	$/month/capi	0.19	0.20	0.20
(Apartment)				
Water consumpriton rate	lcd	150.0	150.0	150.0
Water charge	$/m^3$	0.06	0.07	0.13
Expenditure on water	$/month/capi	0.28	0.32	0.59

Table III-15 Assumptions and Results of Financial Revenue Estimate
(Under the revised water tariff for OM cost recovery)

(Domestic water)			
1. Price of water (OM cost recovery as the target)			
(1) Water charge in Tg			
(2005)			
Ger		566	Tg/m^3
Apartment		64	Tg/m^3
(2015)			
Ger		283	Tg/m^3
Apartment		87	Tg/m^3
(2) Exchange rate		890	Tg/$ (average in December 1998)
(3) Water charge in $			
(2005)			
Ger		0.64	$/m^3$
Apartment		0.07	$/m^3$
(2015)			
Ger		0.32	$/m^3$
Apartment		0.10	$/m^3$
3. Amount of water used			
(2005)			
Ger		10.6	lcd
Apartment		150.0	lcd
(2015)			
Ger		21.2	lcd
Apartment		150.0	lcd
4. Population			
(2005)			
Ger		15,357	
Apartment		3,433	
Total		3,433	
(2015)			
Ger		17,131	
Apartment		3,830	
Total		3,830	
5. Annual total revenue			
(2005)			
Ger	$/year	37,786	$/year
Apartment	$/year	13,516	$/year
Total	$/year	51,302	$/year
(2015)			
Ger	$/year	42,151	$/year
Apartment	$/year	20,498	$/year
Total	$/year	62,649	$/year
(Industrial and institutional water)			
1. Present tariff		900	Tg/m^3
2. Present revenue		63,139	thousand Tg in 1997
		890	Tg/$
		71	thousand US$
3. Annual growth of revenue			
1998-2005		3.5%	per year
2005-2015		4.5%	per year
4. Annual revenue			
2005		93	thousand US$ per year
2015		145	thousand US$ per year

Table III-16 Financial Internal Rate of Return of Master Plan
(Under the revised water tariff for OM cost recovery)

FIRR = -1.2% (Unit : $)

Year	Cost				Revenue			Balance
	Invest-ment	OM	Replace-ment	Total	Domestic	Industrial & instiutrional	Total	
2000	10,418	44.113	0	54,531	0	0	0	-54,531
2001	232,134	48,710	0	280,844	536	977	1,513	-279,331
2002	293,869	52,245	0	346,114	12,489	22,741	35,230	-310,884
2003	282,859	48,108	0	330,967	27,620	50,294	77,914	-253,053
2004	177,080	52,433	0	229,513	42,184	76,815	118,999	-110,514
2005	0	55,967	0	55,967	51,302	93,418	144,720	88,753
2006	15,922	56,498	0	72,420	51,302	93,418	144,720	72,300
2007	363,232	57,028	0	420,260	51,391	93,822	145,213	-275,047
2008	640,667	60,324	0	700,991	53,416	103,044	156,460	-544,531
2009	723,078	66,268	0	789,346	56,989	119,309	176,298	-613,048
2010	69,980	75,083	0	145,063	61,022	137,667	198,688	53,625
2011	54,952	76,724	0	131,676	61,412	139,443	200,855	69,179
2012	93,311	77,564	0	170,875	61,718	140,839	202,557	31,682
2013	73,560	79,390	0	152,950	62,239	143,207	205,446	52,496
2014	0	81,080	0	81,080	62,649	145,075	207,724	126,644
2015	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2016	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2017	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2018	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2019	0	82,161	404,081	486,242	62,649	145,075	207,724	-278,518
2020	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2021	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2022	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2023	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2024	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2025	0	82,161	408,440	490,601	62,649	145,075	207,724	-282,877
2026	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2027	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2028	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2029	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2030	0	82,161	243,665	325,826	62,649	145,075	207,724	-118,102
2031	0	82,161	66,562	148,723	62,649	145,075	207,724	59,001
2032	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2033	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2034	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2035	0	82,161	404,081	486,242	62,649	145,075	207,724	-278,518
2036	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2037	0	82,161	0	82,161	62,649	145,075	207,724	125,563
2038	0	82,161	0	82,161	62,649	145,075	207,724	125,563
Total	3,031,062	2,903,399	1,526,829	7,461,290	2,159,847	4,841,870	7,001,717	-459,573

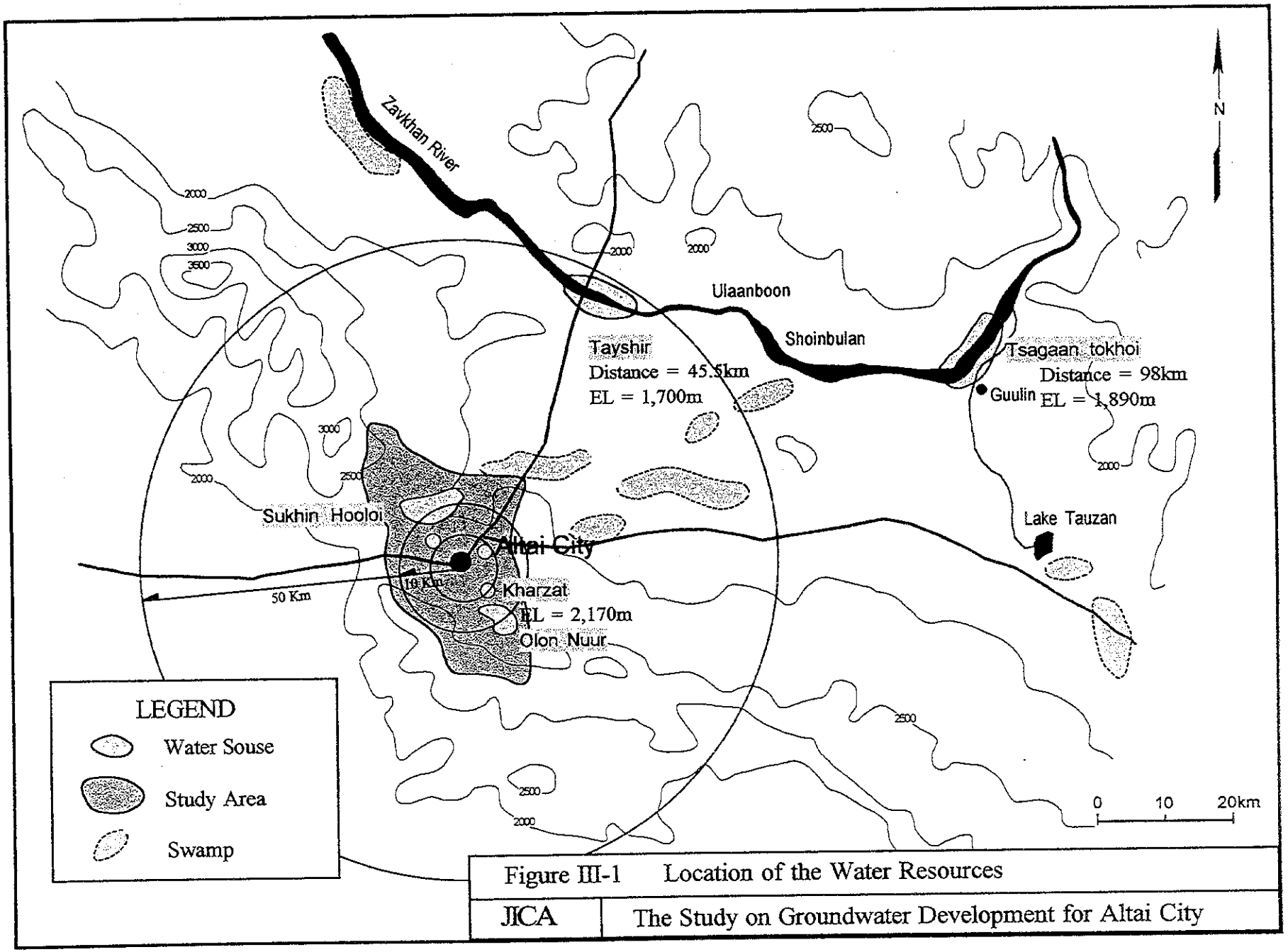


Figure III-1 Location of the Water Resources

JICA | The Study on Groundwater Development for Altai City

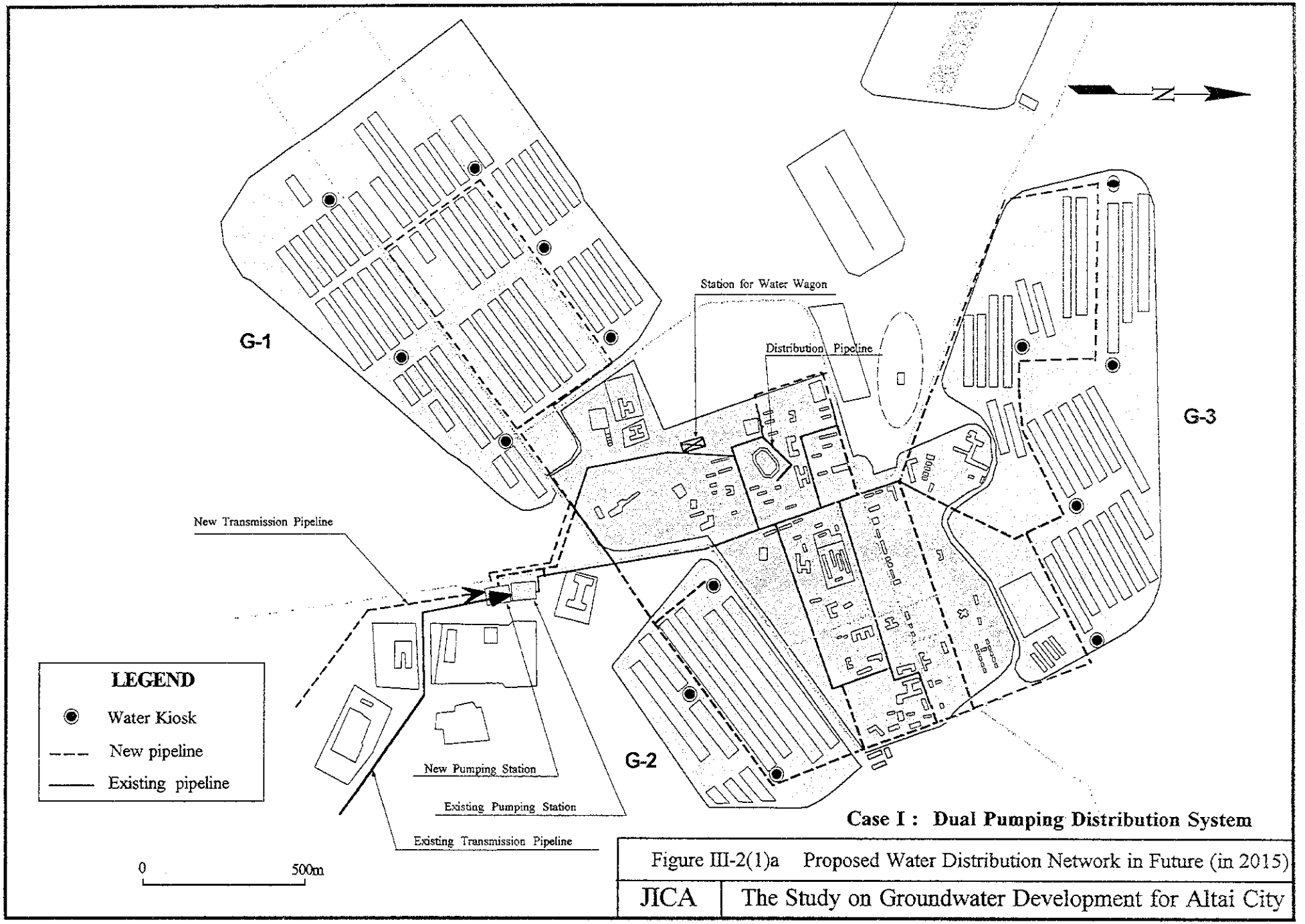


Figure III-2(1)a Proposed Water Distribution Network in Future (in 2015)

JICA | The Study on Groundwater Development for Altai City

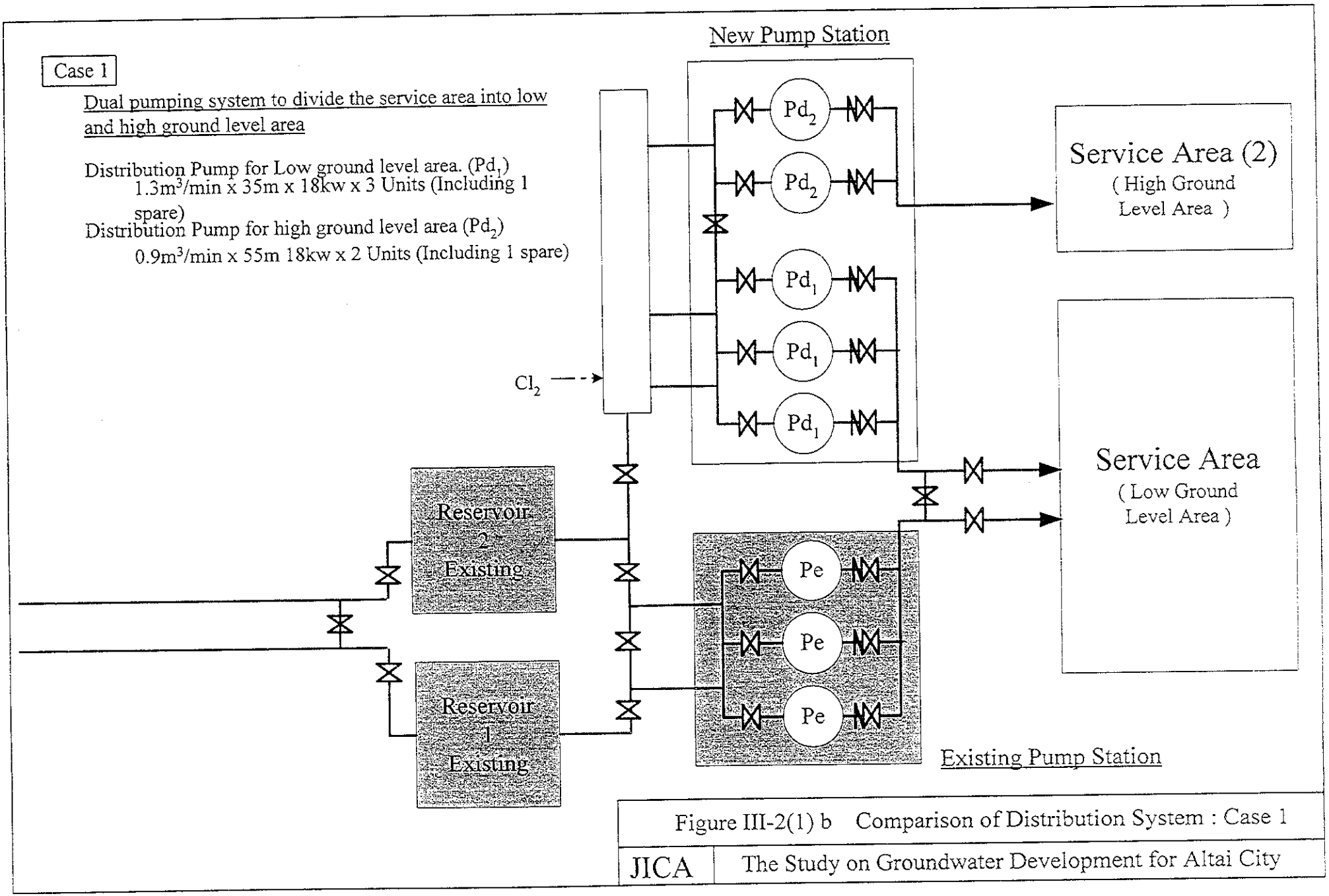


Figure III-2(1) b Comparison of Distribution System : Case 1

JICA | The Study on Groundwater Development for Altai City

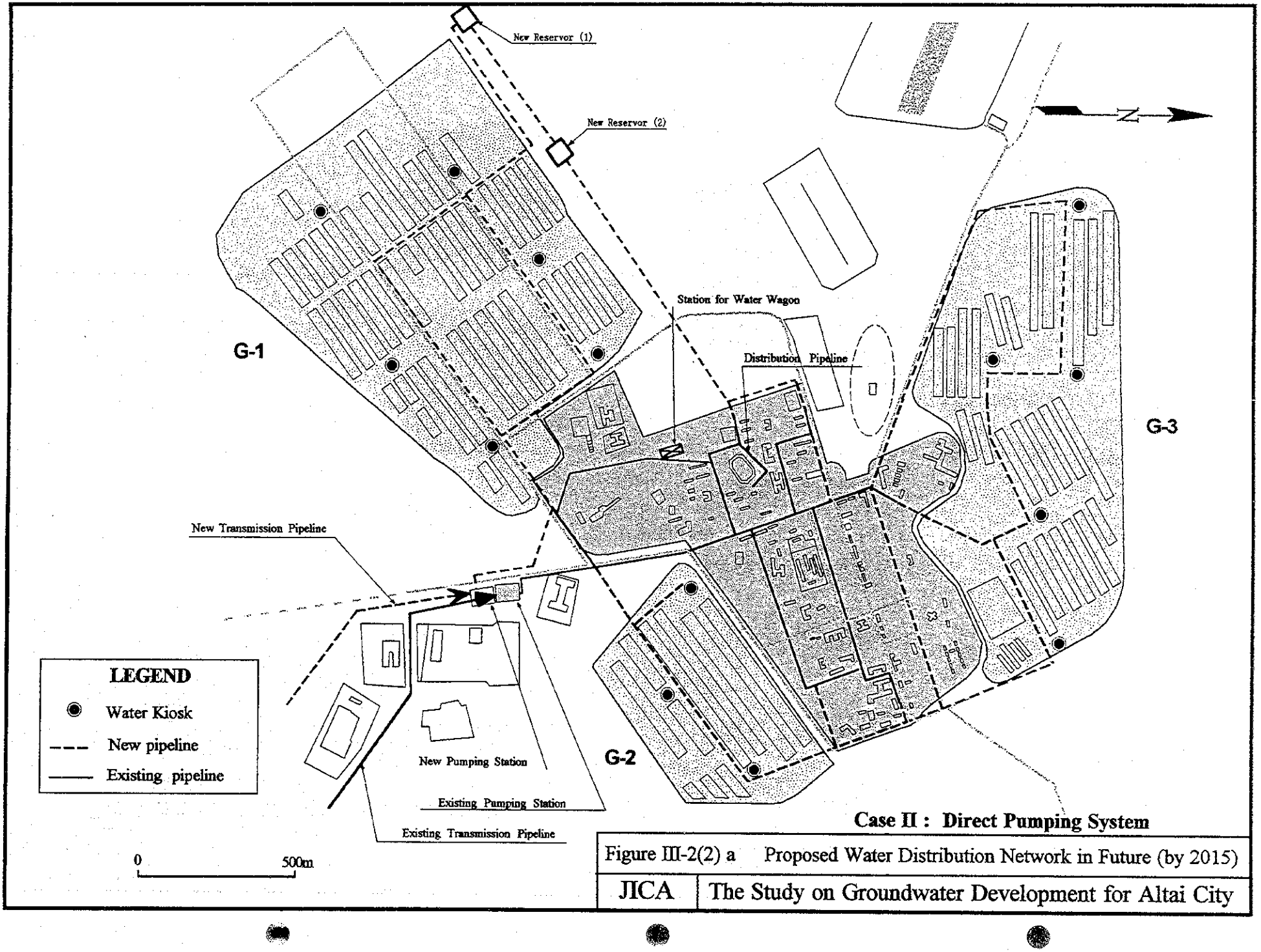


Figure III-2(2) a Proposed Water Distribution Network in Future (by 2015)

JICA | The Study on Groundwater Development for Altai City

Case 2

Direct pumping system to overall service area.

Distribution Pump (Pd):
1.8m^3/min x 55m x 30kw x 3 Units (Including 1 spare)

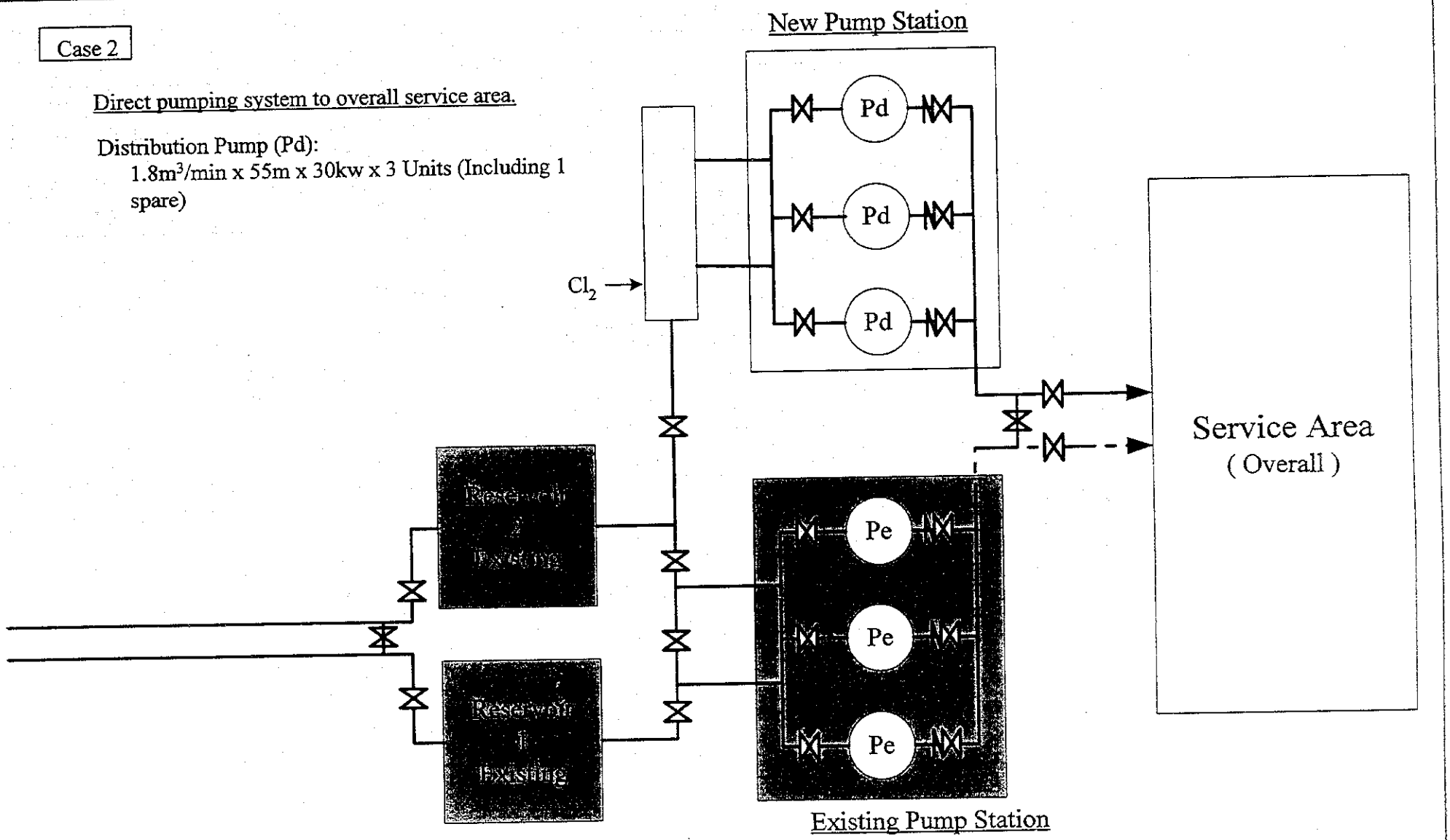


Figure III-2(2) b Comparison of Distribution System : Case 2

JICA | The Study on Groundwater Development for Altai City

Case 2

Direct pumping system to overall service area.

Distribution Pump (Pd):
1.8m³/min x 55m x 30kw x 3 Units (Including 1 spare)

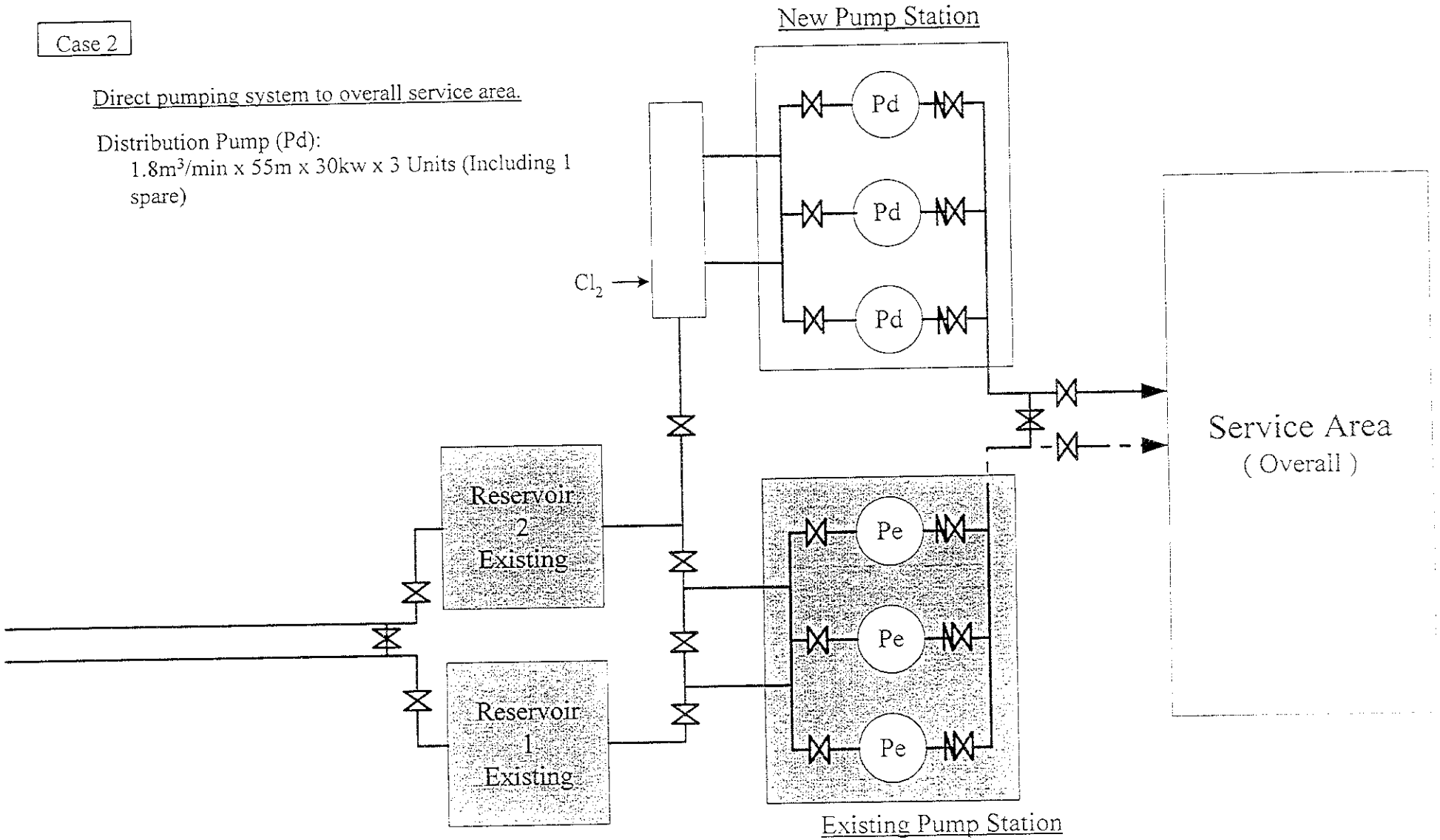
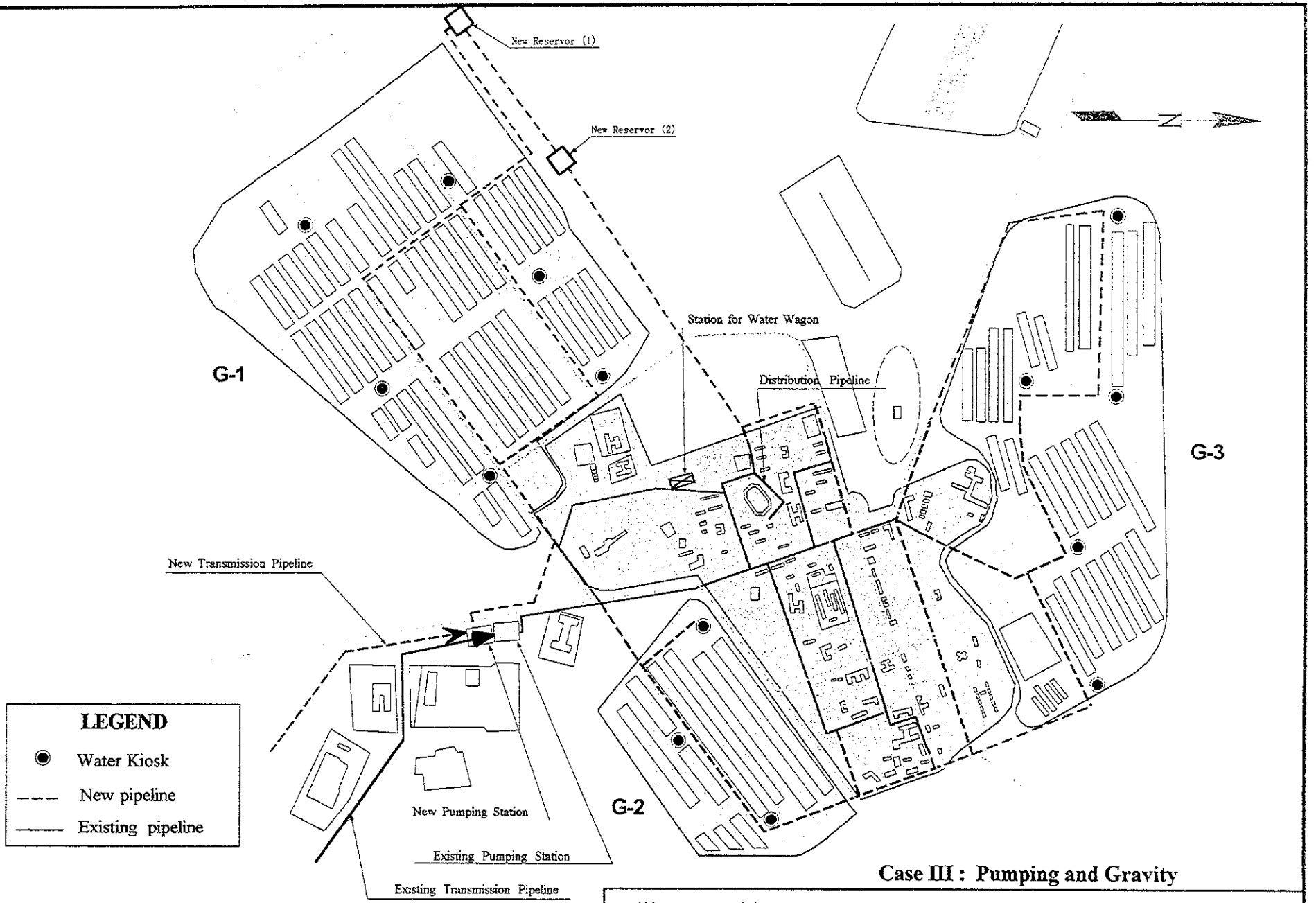


Figure III-2(2) b Comparison of Distribution System : Case 2

JICA | The Study on Groundwater Development for Altai City



Case III : Pumping and Gravity

Figure III-2(3)a Proposed Water Distribution Network in Future (in 2015)

JICA | The Study on Groundwater Development for Altai City

Case 3

Gravity distribution system to low ground level area with pumping distribution system to high ground level gel area.

Transmission & Distribution Pump(Pd):

1.5m³/min x 65m x 30kw x 2 Units (Including 1 spare)

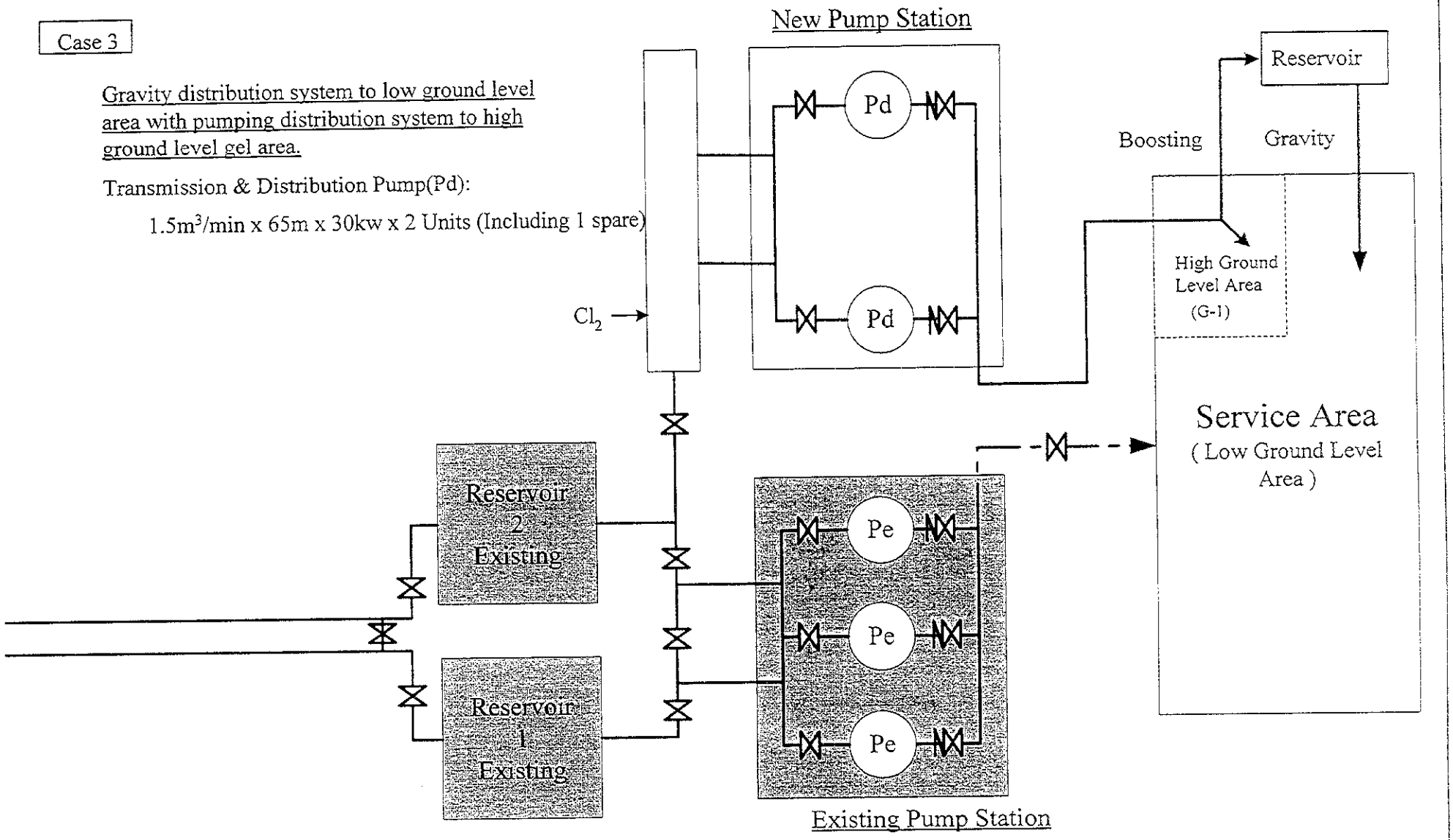


Figure III-2(3) b Comparison of Distribution System : Case 3

JICA | The Study on Groundwater Development for Altai City

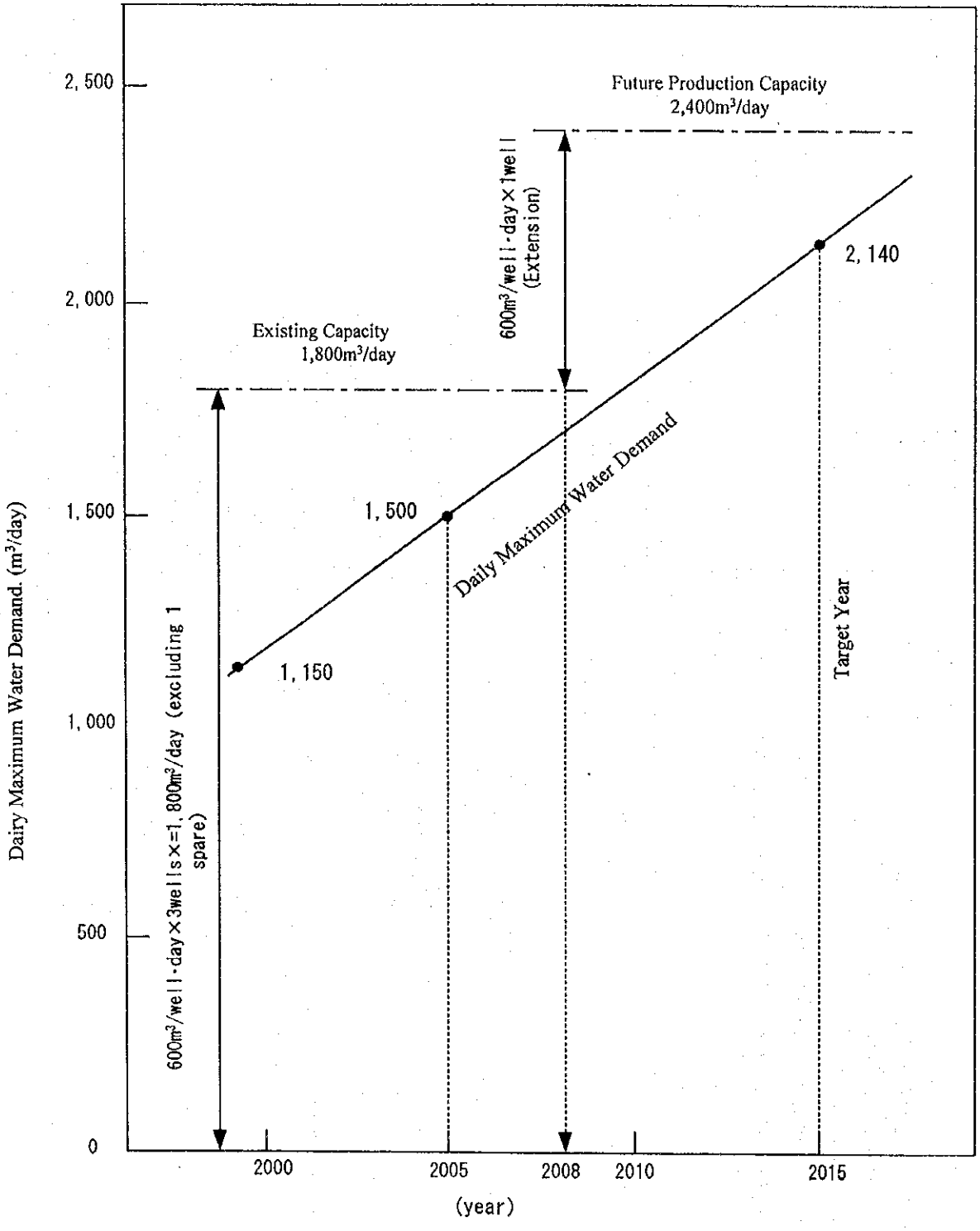


Figure III-3 Extension Plan of Intake Facilities

JICA	The Study on Groundwater Development for Altai City

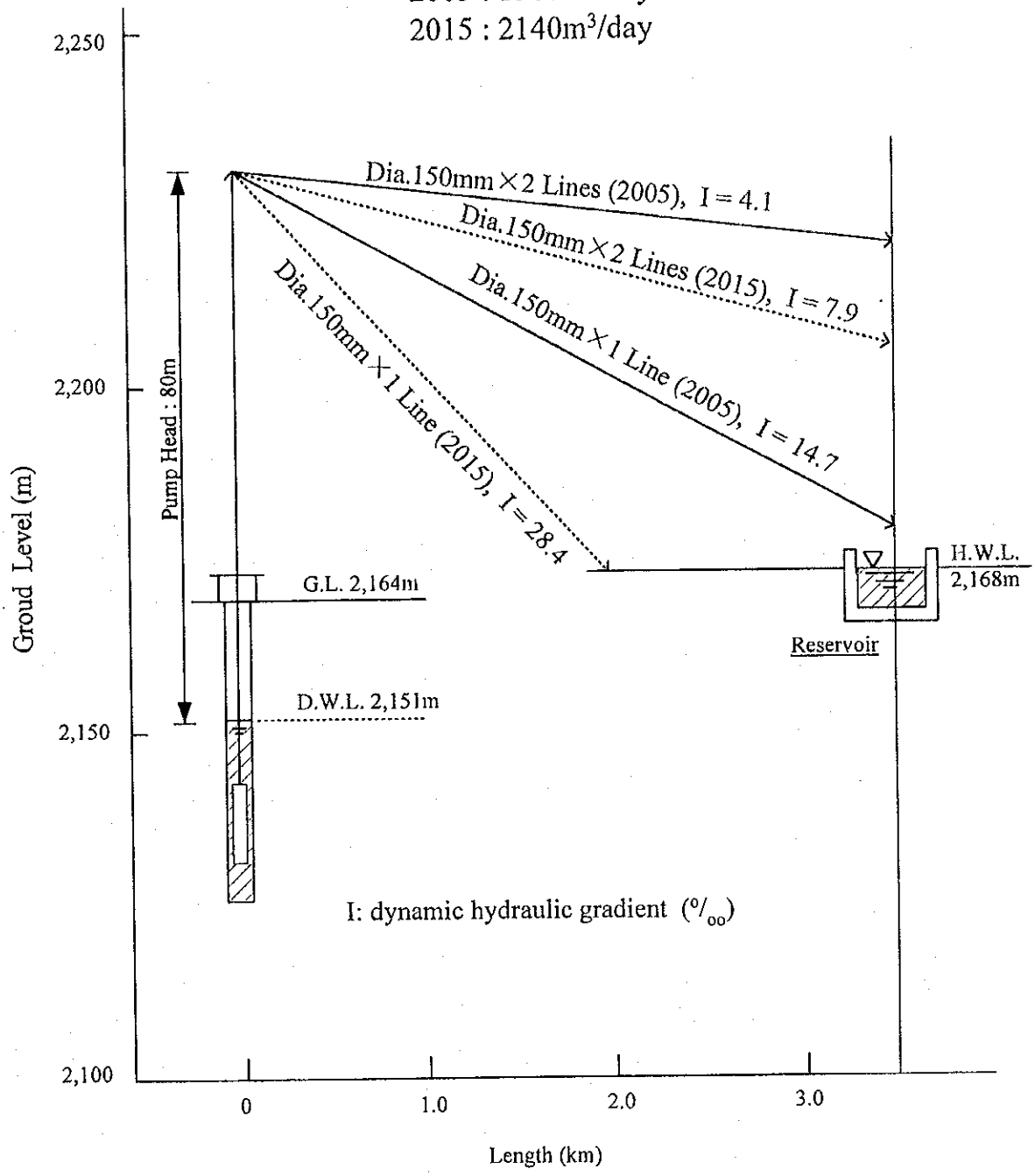


Figure III-4 Hydraulic Gradient of Existing Transmission Pipeline	
JICA	The Study on Groundwater Development for Altai City

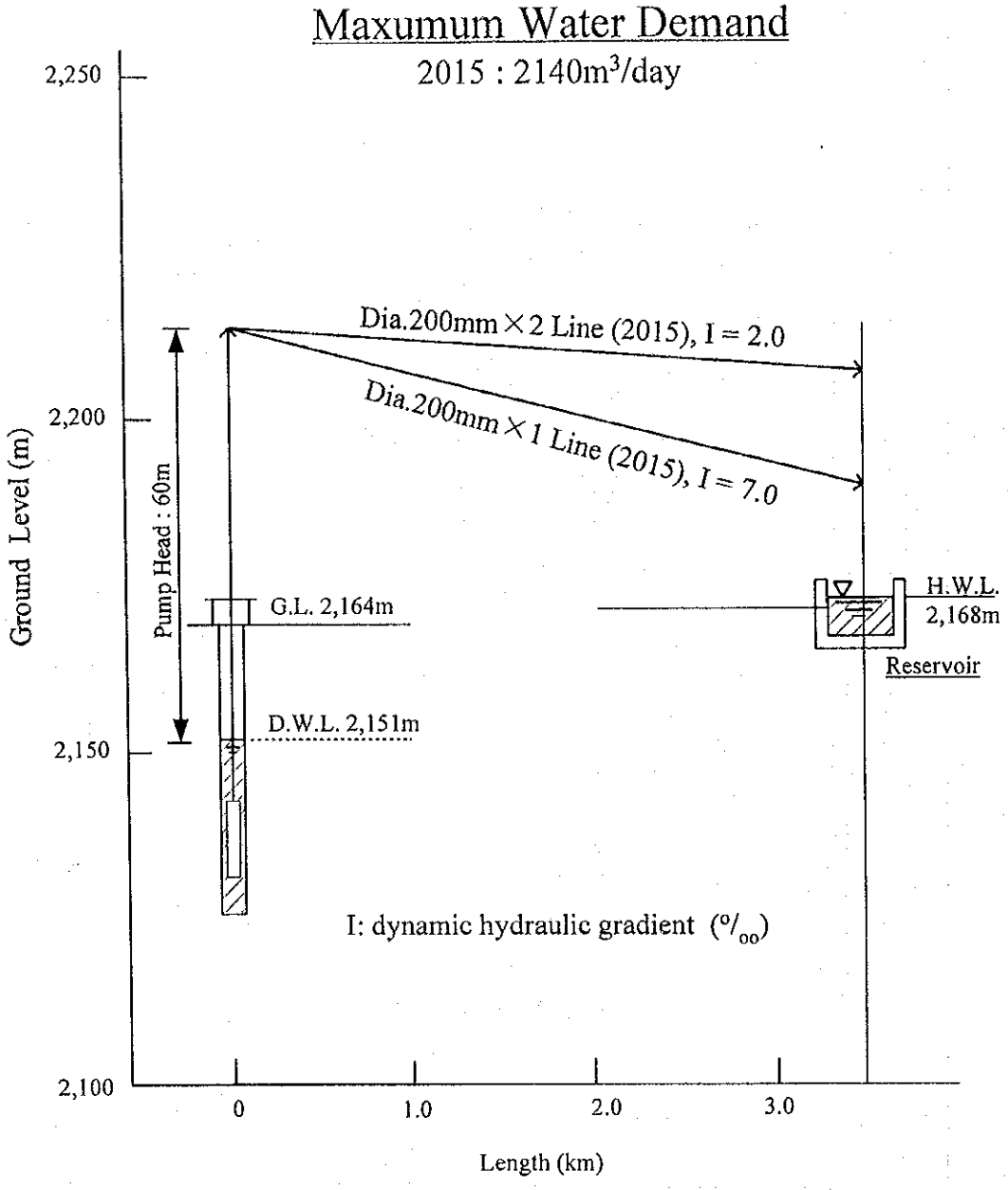


Figure III-5 Hydraulic Gradient of New Transmission Pipeline	
JICA	The Study on Groundwater Development for Altai City

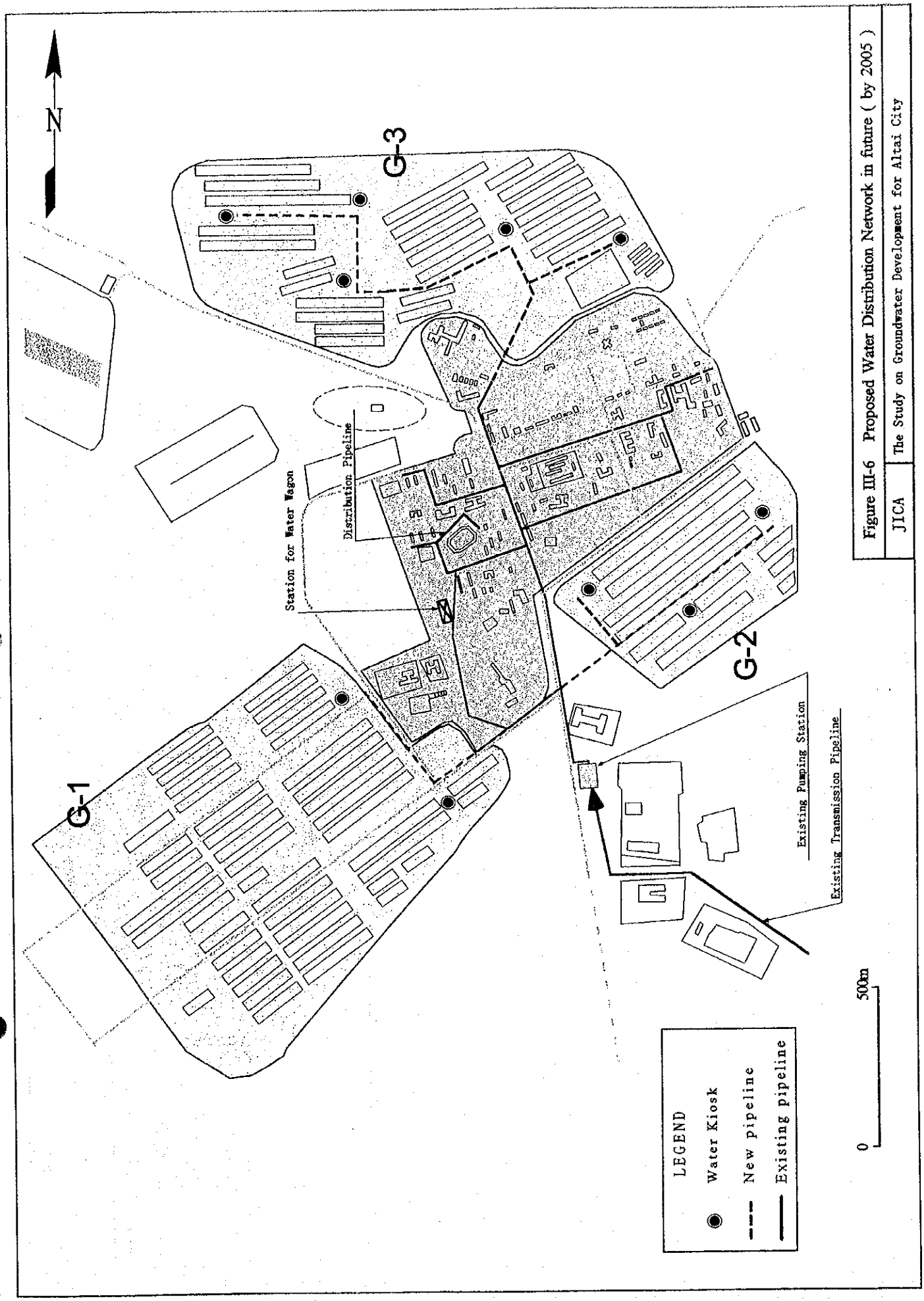


Figure III-6 Proposed Water Distribution Network in future (by 2005)

JICA | The Study on Groundwater Development for Altai City

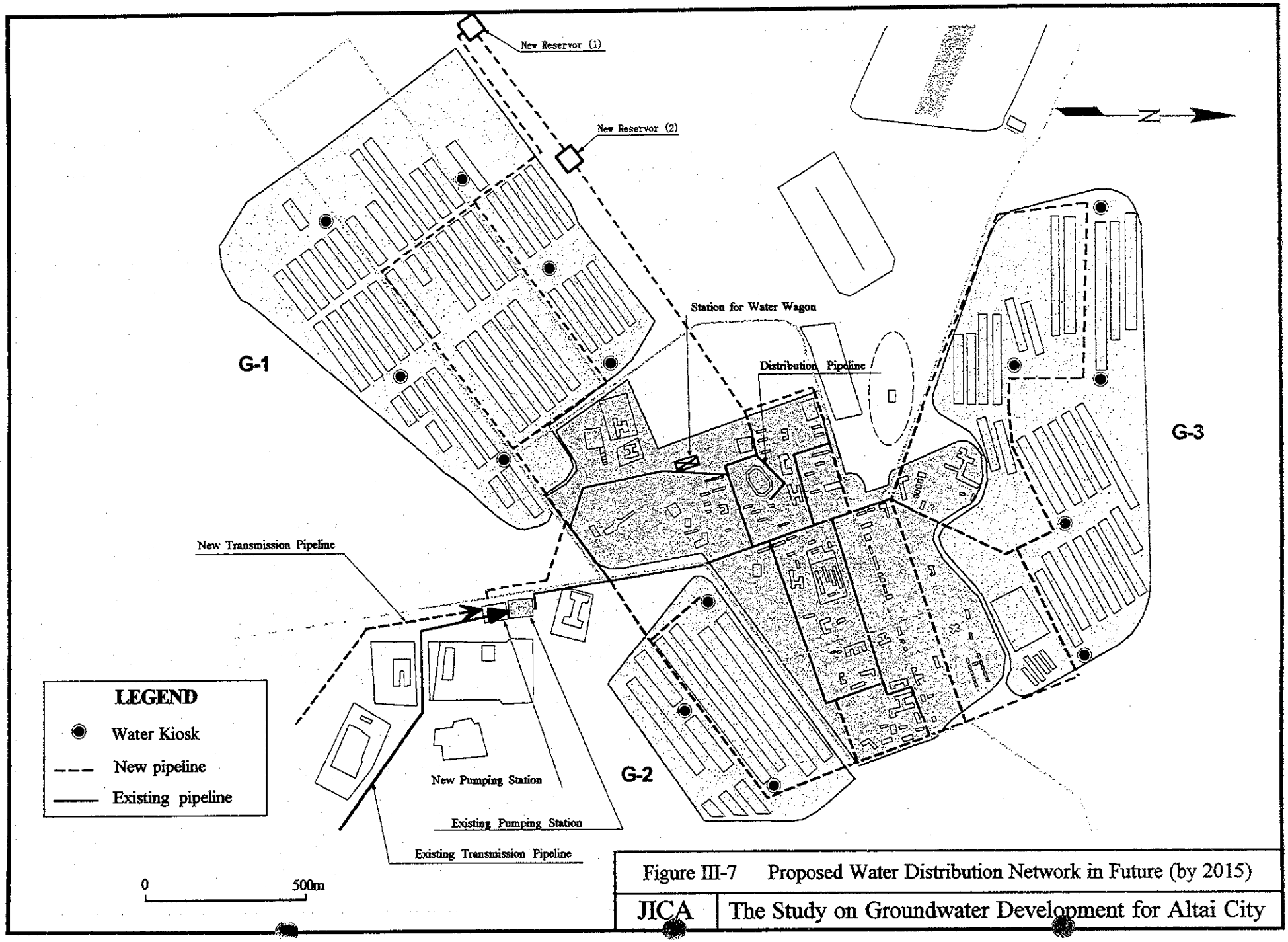


Figure III-7 Proposed Water Distribution Network in Future (by 2015)

JICA | The Study on Groundwater Development for Altai City

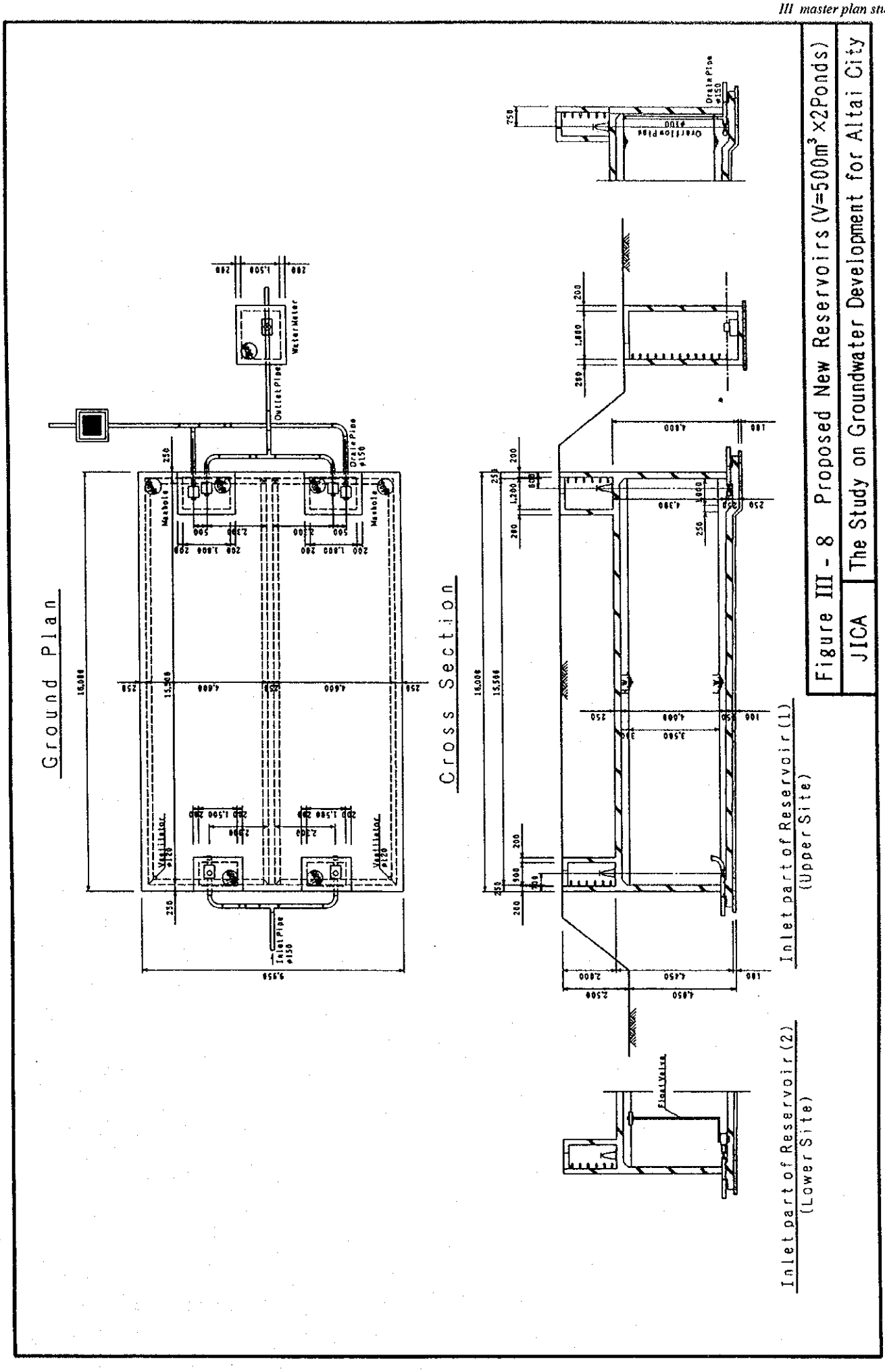


Figure III - 8 Proposed New Reservoirs (V=500m³×2Ponds)

IV FEASIBILITY STUDY

IV FEASIBILITY STUDY

1 DESIGN CONDITION

Design condition for the feasibility study on the priority project are summarized below.

(1)	Target year	:	2005
(2)	Future population in 2005	:	18,790
(3)	Population served	:	18,790 (apartment; 3,433, ger; 15,357)
(4)	Service area	:	whole apartment and ger area shown in Figure IV-1
(5)	Future water demand in 2005	:	1,500 m^3/day in maximum
(6)	Additional development capacity	:	350 m^3/day in a maximum
(7)	Water source and its potential	:	Kharzat, more than 3,000 m^3/day

2. WATER RESOURCES AND WATER SUPPLY DEVELOPMENT

2.1 GENERAL

In Kharzat water source, there are four production wells and two of them have been utilized and supplied water about 960 m^3/day in average and 1,150 m^3/day in maximum at present. This water source can be expanded to about 1,500 m^3/day in a maximum in 2005.

It was found through actual flow rate measurement that a large amount of water (34 to 38 m^3/hour) has been constantly distributed even in the night. A large portion of it is supposed to be the leakage from the pipe, water taps, and toilet instruments. It is necessary to introduce a control system to water supply facilities to decrease water supply volume by pump operation, valve operation, and other devices.

The development of water supply facilities shall proceed as follows.

① Reconstruction of three existing production wells
② Replacement of three submersible pumps
③ Installation of two sets of water level meter with indicator system at the reservoir

to control the withdrawing volume from intake wells.

④ Procurement of water wagon for supplying water to the ger area

⑤ Procurement of water cart for ger dwellers to transport water from kiosk or public tap to their home

⑥ Installation of distribution pipe for supplying water to ger area G-2, G-3, and G-1 (lower G,L part of area).

⑦ Construction of water kiosk: total 10.

Required facilities to increase the capacity of water supply

Measures	Facilities
Improvement of existing facilities	1, reconstruction of 3 wells (total 4 wells; one is spare) 2, replacement of submersible motor pump with control system : 0.42m^3/min x 60m x 3 unites (total 4 pumps; one is spare)
Additional new facilities	1, water level indicator system for reservoir : 2 sets (with installation of transmission cable: 3.5km) 2, procurement of water wagon ; 3 cars 3, procurement of water cart : 2792 (households) sets 4, distribution pipe for ger area G-1, G-2, G-3 : dia.150 ~ 200mm x 3.9km 5, Construction of water kiosk: total 10; two in G-1, three in G-2, and five in G-3.

2.2 INTAKE FACILITIES

Intake wells, submersible motor pumps, and collection pipes have the sufficient capacity for the present water demand. But, two of the four production wells which were constructed in 1979 are deteriorated and another well constructed in 1986 was damaged. They shall be reconstructed. The well constructed in 1995 is not necessary to be replaced in this stage.

Submersible motor pumps may have also deteriorated in 2005 and they shall be replaced with new pumps. A control system of pump is also necessary to manage the withdrawing volume of groundwater in the night or in the case of low consumption of water by automatically switching on and off the pumps.

2.3 DISTRIBUTION FACILITIES

Two sets of water level meter with transmission cable for a distance of about 3.5km shall be installed for the reservoir to control the withdrawing volume from intake wells. The reservoir and intake wells will be connected by the cable to communicate

information between the two sites and to realize remote control of the pumps.

There are four water wagons which transport water to ger area at present, but the number is not enough for 2005. Three more water wagons (see Figure IV-2) are necessary to procure sufficient water for ger area as soon as possible. Figure IV-3 shows transportation capacity of water wagons to be needed in each year until the year of 2015. By this year, distribution pipeline and water kiosks will be completely installed to cover overall ger areas in accordance with implementation schedule of master plan for this project.
Water cart shall be procured for ger dwellers to help carry water from the points where they can get water to their houses.

At this stage, it is necessary to extend the distribution pipeline to ger area G-1, G-2 and G-3 which can be supplied with water by existing distribution pump system according to a plan of phased implementation up to 2015, and ten water kiosks will be also installed for the above ger areas. Location of proposed extension pipeline and water kiosks for ger areas are shown in Figure IV-4.
Planned pipe size and pipeline layout in 2005 were decided based on the plan of distribution system and amount. It was confirmed to be able to supply enough water to overall water supply service area in 2015.
This planning was done by using the calculation software for pipeline network analysis. The result of pipeline network analysis is shown in AnnexIX-2 in Data Book.

2.4 LAND ACQUISITION

Land acquisition without compensation will be required for the construction of the facilities.

3. OPERATION AND MAINTENANCE PLAN

3.1 INSTITUTIONAL STRENGTHENING

Daily operation and maintenance of the water supply facilities have been conducted by APSD. The expanded and developed water supply facilities shall be also managed by strengthened organization and institution of APSD. The following items shall be included to strengthen maintenance and operation system of APSD.

- Introduction of appropriate water tariff
- Implementation of meter measuring system
- Reduction of water leakage
- Introduction of strict financial management
- Establishment of functional organization

3.2 ESTABLISHMENT OF RELATED LAW FOR THE WATER SUPPLY SERVICE

Design and operation criteria shall be established to ensure the structural and hygienic safety of the water supply facilities.
Regulations of water supply service shall be also established to provide, rational service for the consumer.

3.3 IMPROVEMENT OF DATA ARRANGEMENT

Daily or monthly operation data of water consumption, electric power consumption, chemical dosage and other necessary data shall be arranged systematically and checked well under the strengthened organization. These data are necessary to maintain water supply facilities and to make the development plan of water supply facilities.

3.4 TRAINING SYSTEM

There are 45 employees including director in APSD. They have been working for long period in the same section, and learning skills of operation and maintenance through their daily work.
It means that they do not have so much experience with skilled work in other section.
So appropriate training system is necessary to make them master the comprehensive operation and maintenance technique.

3.5 HYGIENE EDUCATION PLAN

Measure to contamination of drinking water

Other than technical improvement of water quality test, it is important to make the resident of ger area know that the responsibility of water quality lies on the residents once the water has been delivered to the ger area. It is recommended for Social

Health Center to conduct often a microbiological test on stock water in ger so that they can monitor the hygienic situation in ger area. It should be noted that the water analysis is to monitor the condition of drinking water not to measure true risk of the people. Therefore, it is encouraged to promote the understanding on the role of water analysis a swell as exchanging information between APSD and Social Health Center.

In order to increase the hygiene practice among the residents in Altai City, the following approaches are recommended.

(1) Increase of Awareness on Hygiene Practice and Water Consumption

Target group:	All the residents in Altai City
Media:	Local radio and TV
Expected outcome:	All the residents of Altai City apply the knowledge of hygienic practice to their daily life.
Implementation body:	Gobi-Altai Social Health Center / Governors' office

Media and communication are undertaken by the Governors' office. TV station with 10 staffers provides its local broadcasting service for three hours every Monday evening and radio broadcasting for 30 minutes every Monday morning. The number of TV sets and radio sets are quite large with a prevalence ratio of 1 to 25 for TV and 1 to 24 for radio respectively. Meanwhile, the Social Health Center holds education methodology specialist in its institution. If all resources above are utilized for common purpose, they will bring substantial impact. It is more preferable to conduct a series of broadcasting program on hygiene practice including sanitation and waste management.

(2) Proper Management of Stock Water and Water Consumption

Target group:	Residents in ger area
Media / Promoter:	Health Volunteer
Expected outcome:	The risk of water-borne and water-washed disease will be lowered through the proper management and use of stock water and increase of water consumption.

Recently health volunteers were appointed as promoter of community health along with the National Community Health Program. They are also expected to identify the problems to be addressed for hygiene and sanitation in their living community. With the technical support from the health promotion section of Social Health Center,

the group takes a role of health promoters in front line. In the hygiene education program within the Study, they were involved in the production process of educational material and trainer's training. The Social Health Center also experienced program implementation and was capable of handling the program.

(3) Water and Health

Target group:	School children
Media:	School class
Expected outcome:	The basic knowledge on hygiene will be put into practice in their life.

Primary and middle schools are not included for bases for health education including hygiene practice. In fact, national health education program is being prepared for schools with the joint cooperation of Ministry of Education and Ministry of Health and Social Service. However, a textbook for health education is not available yet and those textbooks / posters are usually prepared by the national health education center of Ministry of Health. The hygiene education component within the study provided the chance of developing educational materials at local setting through encouraging participation process. The process and program planning can be applied to not only future program but also other relevant programs.

4. MONITORING PLAN

Monitoring of water sources and water supply facilities shall be conducted continuously and data should be put into the database by the strengthened organization of APSD.

Recommended monitoring items for water sources are as below:

- Ground water level
- Hydrological and meteorological data
- Ground water quality
- Ground water utilization

And for water supply facilities as below:

- Water quality of raw water and distributed water.
- Residual chlorine at the water tap of the apartment dwellings at the end of

pipeline

- Distributed water pressure at pumping station
- Supplied water pressure at the end of pipelines

5. COST ESTIMATION

The total investment cost by the year of 2005 amounts to US dollars 996,359 which includes the direct construction cost, overhead cost, land acquisition cost, engineering (design & supervision) cost, and physical contingency. Its break down is shown below.

Investment Cost until the Year of 2005 (Unit : US Dollar)

Work Item	Nos	Total Cost (2000~2005)	
A. Direct Construction Cost	-	630,108	
		382,466	247,642
(1) Intake facility		197,308	
·Reconstruction of existing well	3 Wells	197,308	
		172,910	24,398
(2) Distribution facility		432,800	
·Water level indicator			
① Electrode	2 Sets	6,694	
		6,586	108
② Transmit Cable	1 Lot	47,805	
		40,659	7,146
·Water wagon	3 Cars	52,800	
		50,400	2,400
·Water cart	2792 Sets	92,136	
		0	92,136
·Water kiosk	10 Unit	51,060	
		0	51,060
·Pipe-line (Φ 150~250)	3.9 Km		
① G-1 Area	(1.0Km)	38,540	
		25,652	12,888
② G-2 Area	(1.0Km)	51,975	
		31,185	20,790
③ G-3 Area	(1.9Km)	91,790	
		55,074	36,716
B. Land Acquisition Cost	-	0	
C. Construction Cost (A X 1.25)	-	787,635	
D. Design & Supervision (C X0.1)	-	78,764	
·Detailed Design (C x 0.05)	-	39,382	
·Supervision (C x 0.05)	-	39,382	
E. Physical Contingency {(C+D) X 0.15	-	129,960	
Total (C+D+E)	-	996,359	

Note 1) Exchange Rate : US$ 1.00 = Yen 117.5 US$ 1.00 = Tg 890

2) ① ② ③ ① TOTAL ② FOREIGN PORTION ③ LOCAL PORTION

6. IMPLEMENTATION SCHEDULE

On the basis of this study, Implementation schedule for the priority project is proposed as shown below.

Implementation Schedule

Work Item	Nos	Year (2000-2005)					
		2000	2001	2002	2003	2004	2005
(1) Intake facility							
・Reconstruction of existing well (Including submersible pump)	3 Wells			■■■	■■■		
(2) Distribution facility							
・Water level indicator	2 Sets			■■■			
・Water wagon	3 Cars		■■■				
・Water cart	2,792 Sets		■■■				
・Water kiosk	10 Units				■■■	■■■	
①G-1 area	(2)				(2) ■■■		
②G-2 area	(3)				(3) ■■■		
③G-3 area	(5)					(5) ■■■	
・Pipe-line (Φ150～250)	3.9 Kms				■■■	■■■	
①G-1 area (Φ150～200)	(1.0)				(1.0) ■■■		
②G-2 area (Φ150)	(1.0)				(1.0) ■■■		
③G-3 area (Φ150)	(1.9)					(1.9) ■■■	

7 DISBURSEMENT PLAN

According to implementation schedule, the proposed disbursement of the project is shown as follows.

Disbursment Plan

(Unit : US Dollar)

Work Item	Nos	Year 2000 - 2005						Total Cost (2000~2005)
		2000	2001	2002	2003	2004	2005	
A. Direct Construction Cos	-		144,936 50,400 | 94,536	186,038 162,519 | 23,520	181,815 114,474 | 67,341	117,320 55,074 | 62,246	0 | 0	630,108 382,466 | 247,642
(1) Intake facility								197,308
·Reconstruction of existing well	3 Wells			131,339 115,274 | 16,266	65,770 57,637 | 8,133			197,308 172,910 | 24,398
(2) Distribution facility								432,800
·Water level indicator								
① Electrode	2 Sets			6,694 6,586 | 108				6,694 6,586 | 108
② Transmit Cable	1 Lot			47,805 40,659 | 7,146				47,805 40,659 | 7,146
·Water wagon	3 Cars		52,800 50,400 | 2,400					52,800 50,400 | 2,400
·Water cart	2792 Sets		92,136 0 | 92,136					92,136 0 | 92,136
·Water kiosk	10 Unit				25,530 0 | 25,530	25,530 0 | 25,530		51,060 0 | 51,060
·Reservoir	2 Ponds							0 0 | 0
·Pipe-line (Φ150~250	3.9 Km							
① G-1 Area	(1.0Km)				38,540 25,652 | 12,888			38,540 25,652 | 12,888
② G-2 Area	(1.0Km)				51,975 31,185 | 20,790			51,975 31,185 | 20,790
③ G-3 Area	(1.9Km)					91,790 55,074 | 36,716		91,790 55,074 | 36,716
B. Land Acquisition Cost	-	0	0	0	0	0	0	0
C. Construction Cost (A X 1.25)	-	0	181,170	232,547	227,268	146,650	0	787,635
D. Design & Supervision (C X0.1)	-	9,059	20,686	22,991	18,696	7,333	0	78,764
·Detailed Design (C x 0.05)	-	9,059	11,627	11,363	7,333	0	0	39,382
·Surpervision (C x 0.05)	-		9,059	11,627	11,363	7,333	0	39,382
E. Physical Contingency {(C+D) X 0.15)}	-	1,359	30,278	38,331	36,895	23,097	0	129,960
Total (C+D+E)	-	10,418	232,134	293,869	282,859	177,080	0	996,359

NOTE 1) EXCHANGE RATE : US$ 1.00 = YEN 117.5 US$ 1.00 = TG 890

2) ① TOTAL ② FOREIGN PORTION ③ LOCAL PORTION

8 OPERATION AND MAINTENACE COST

(1) General

Daily operation and maintenance has been conducted by Altai Public Service Department (APSD). APSD shall continue to carry out the maintenance of the improved facilities under a well-planned fiscal budget.

(2) Operation and Maintenance Cost

Annual Operation and Maintenance (O/M) consist of the following items:

① Electric consumption
② Chemical consumption
③ Labor cost
④ Repairing cost
⑤ Replacement cost

The annual average O/M costs after the completion of each construction works without replacement cost (as of 1998) are estimated below.

Annual Operation and Maintenance Cost

Item	Unit	Year (2000-2005)						Total
		2000	2001	2002	2003	2004	2005	
Daily Mean Demand	m3/day	1,011	1,037	1,063	1,089	1,114	1,140	
Hourly Maximum Demand	m3/h	86.4	95.6	104.9	114.1	123.3	132.5	
1. Electric Power Cost (US$0.126/KwH)	US$/Year	32,600	37,173	37,699	31,213	31,558	31,917	202,160
·Electric Consumption	KwH/Year	258,727	295,022	299,198	247,726	250,463	253,310	
①Intake Pump (Existing)	KwH/Year	162,367	166,542	170,718				
②Intake Pump (Reconst. & New)	KwH/Year				119,246	121,983	124,830	
③Distribution Pump (Existing)	KwH/Year	96,360	128,480	128,480	128,480	128,480	128,480	
④Distribution Pump (New)	KwH/Year							
2. Chemical Cost (US$0.34/Kg)	US$/Year	916	939	963	987	1,009	1,033	5,847
·Chemical (Cl_2) Consumption	Kg/Year	2,693.81	2,763.09	2,832.36	2,901.64	2,968.25	3,037.53	
3. Personnel Cost	US$/Year	10,598	10,598	11,771	11,771	13,456	15,141	73,335
4. Repair Cost (1% of Const.-Cost)	Lot	0	0	1,812	4,137	6,410	7,876	20,235
Total Annual M & O Cost	US$/Year	44,113	48,710	52,245	48,108	52,433	55,967	301,576

Note 1) Exchange Rate : US$ 1.00 = Yen 117.5 US$ 1.00 = Tg 890

The equipment shall be periodically replaced at the end of its life span. The detail replacement cost is shown in the following table.

Replacement Cost

Unit : US Dollar

No	Work Item	Unit	Life Span	Year (2000~2005)						Total
				2000	2001	2002	2003	2004	2005	
1	Intake facility (Exist. & New)					164,423	82,212			246,635
	·Well	Year	15			30,660	15,330			45,990
	·Pump house	Year	40			6,710	3,355			10,065
	·Intake pump	Year	15			116,531	58,266			174,798
	·Collection pipe	Year	25			10,522	5,261			15,783
2	Distribution facility	Year			181,170	68,124	145,056	146,650		541,000
	·Water level indicator	Year	15			68,124				68,124
	·Water wagon	Year	10		66,000					66,000
	·Water cart	Year	15		115,170					115,170
	·Water kiosk	Year	40				31,913	31,913		63,826
	·Pipe-line (Φ150~250)	Year	25				113,143	114,738		227,881
3	Total of Replacement Cost	-	-		181,170	232,547	227,268	146,650		787,635
	Every 10 Years				66,000					66,000
	Every 15 Years				115,170	215,315	73,596			404,081
	Every 25 Years					10,522	118,404	114,738		243,664
	Every 40 Years					6,710	35,268	31,913		73,890

Note 1) Exchange Rate : US$ 1.00 = Yen 117.5 US$ 1.00= Tg 890

For reference, the annual average O/M cost (without replacement cost) until the year of 2015 for the master plan is shown in Table IV-1. Replacement cost is also shown in Table IV-2 for the plan in 2015.

9 IMPROVEMENT PLAN FOR SANITATION

Improvement of the existing sewer and waste water treatment capacity are required to cope with the increase of water quantity after when water supply facilities are expanded in 2005 and 2015.

On the other hand, more waste water from ger dwellers will be discharged to the ground after the improvement of water supply system to ger area. However, there is not any facilities to collect and treat the waste water in ger area. Consequently, installation of personal or community treatment facilities is also required to prevent contamination of soil, groundwater, and other environmental factors in ger area until establishment of collection sewer system connected to central waste water treatment plant.

The following sanitary zones should be established to protect the sources of drinking water:

I - (100 m)	strictly prohibited zone.
	prohibit setting up of any sources of possible pollution in the I-zone
II - (300 m)	zone under protection.
III - (1,000 m)	monitoring zone.

Bacteriological and chemical analyses should be carried out in these zones.