Chapter 3 Current Issues of the Water Supply System

S 3.1.2 Diagnosis Study of Facilities

(1) Judgment Standard

Diagnosis ranks are stipulated as the judgment standard for civil structures and buildings as shown in Table S 3.1.2.1 (1), and mechanical and electrical facilities as shown in Table 3.1.2.1 (2).

Table S 3.1.2.1 (1) Diagnosis Rank and Evaluation for Civil Structures and Buildings

Class	Judgment
A	Good
B	No serious problem, but replacement will be necessary
C	Needed to replace within 5 years because of deterioration

Table 3.1.2.1 (2) Diagnosis Rank and Evaluation for Mechanical and Electrical Facilities

Class	Evaluation
A	Good
B	No serious problem, but replacement will be necessary in future
C1	Needed to replace because of deterioration
C2	Breakdown frequently take place, so replace needs urgently

(2) Surface WTPs

1) Kadirya WTP

i) Diagnosis for Capacity of WTP

The design capacity and the investigated actual capacity of WTP are shown in Table S 3.1.2.2.

ii) Diagnosis for Civil Structures and Buildings

Civil structures and buildings of WTP are listed in Table S 3.1.2.3 (1).

Diagnosis results of these are shown in Table S 3.1.2.3 (2) to (5).

Table S 3.1.2.2 Diagnosis for Capacity of WTP

Design Capacity				
Nominal Capacity	57,292	m^3/hr =	**1,375,000**	m^3/day
Maximum capacity by No.1 intake PS	43,800	m^3/hr =	1,051,200	m^3/d
Maximum capacity by No.2 intake PS	56,300	m^3/hr =	1,351,200	m^3/d
Total Intake capacity	100,100	m^3/hr =	**2,402,400**	m^3/d
Filtration area: No.1			2,736	m^2
Filtration area: No.2			3,984	m^2
Total Filtration area			**6,720**	m^2
Filtration Capability(7～10m/hr)	10	m/hr	240	m/d
Distribution capacity of gravity pipe			2,251,200	m^3/d
Distribution capacity of PS	6,300	m^3/hr =	151,200	m^3/d
Total Distribution Capacity			**2,402,400**	m^3/d
Washing water pump capacity	6,500	m^3/hr	156,000	m^3/d
Chlorination capacity			266	kg/hr
Coagulant injection capacity				kg/hr
Service reservoirs capacity	30,000	m^3	0.32	hr
Actual Capacity				
Maximum capacity by No.1 intake PS	55,040	m^3/hr =	1,320,960	m^3/d
Maximum capacity by No.2 intake PS	40,000	m^3/hr =	960,000	m^3/d
Total Intake capacity	95,040	m^3/hr =	**2,280,960**	m^3/d
Distribution capacity of gravity pipe			2,280,000	m^3/d
Distribution capacity of PS	5,040	m^3/hr =	120,960	m^3/d
Total Distribution Capacity			**2,280,000**	m^3/d
Washing water pump capacity	5,200	m^3/hr	124,800	m^3/d
Chlorination capacity			140	kg/hr
Coagulant injection capacity			---	kg/hr

Table S 3.1.2.3 (1) List of Civil Structures and Buildings

No.	Name	Type	Dimension	Area (m^2)	Depth (m)	Volume (m^3)	Number
1-1	No.1 Sedimentation basin	Soil bank	W50-250mxL1,500m	112,500	1.5-9	1,000,000	1
1-2	No.1 Intake Weir	Concrete	W2.5				4
1-3	No.1 Inlet screen	Steel	W2.5				6
2-1	No.2 Intake Weir	Concrete	W2.5				4
2-2	No.2 Flocculation Basin	Concrete	W26xL110m	2,860	4	11,440	1
2-3	No.2 Sedimentation basin	Soil bank	W250xL600m	120,000	1.5-6	250,000	2
2-5	No.2 Inlet chamber	Concrete	W4mx10m				2
2-6	No.2 Chlrination house	Brick		50			1
2-7	No.2 Pump pit	Concrete				10,000	2
3	No.1 Intake pump building	Concrete	W12xL60m	720			1
4	No.2 Intake pump building	Concrete	W18x90m	1,620			1
5	Administration Building	Concrete	W9xL32mx2stories	576			1
6	Filter basin(old)	Concrete	108.8m2x12+118x12	2,722			1
7	Filter basin(New)	Concrete	166m2x24	3,984			1
8	Filter building(old) with Laboratory	Concrete	W48xL164m	7,872			1
9	Filter building(New)	Concrete	W40xL148m	5,920			1
11	Chlrination Building	Brick	W12xL56mx2stories	1,344			1
12	Reservoir	Concrete	36mx56m		5	10,000	3
13	Coagulant dissolving T	Concrete	W3xL12m			120	4
14	Soluted coagulant T(circle)	Concrete	D25.2m		4	2000	2
15	Soluted coagulant T	Concrete	W25xL30m		2	1500	1
16	Coagulant feeding T	Concrete				60	4
17	Coagulation Building	Brick	W12xL28m	336			1
18	Distribution pump Building	Concrete	W18xL86	1,548			1

Table S 3.1.2.3 (2) Diagnosis Sheet of Civil Structure & Buildings for Kadirya WTP

Facility	Name	Inlet channel	Intake gate	Injection of Alum	Others	Const.year
Inlet Weir	No.1 Inlet mouth x1	A	B	C	*The most of steel-made weirs have deteriorated, but functioning well. Suspended solids cannot be removed since screen is not equipped. Also, wooden alum feeder has deteriorated almost going to collapse.	1969
	No.2 Inlet mouth x4	A	B	C	*The most of steel-made weir has corroded, but functioning well. Wooden alum feeder has deteriarated almost going to collapse.	1983

Facility	Name	Concrete					Equipment				Const.year
		Quality	Appearance	Crack	Split	Leakage	Screen	Steel cover	Gate	Inject. facilities	
Sedimentation Basin	No.1Sedimentation basin	A	A	NO	NO	NO	B	B	B	C	1969
	No.2Sedimentation basin	A	A	NO	NO	NO	B	B	B	C	1983

Facility	Name	Dike				Others
		Appearance	Erosion	Crack	Protection	
Sedimentation Basin	No.1 Sedimentation basin	A	NO	NO	NO	*Sedimentation basin using old canal has stable dike. Sediments are well dredged in 6 months every year. 3.0 m of sediments are accumulated at the deepest pont (10m) of basin.
	No.2 Sedimentation basin	A	NO	NO	NO	*All dikes are protected by concrete and well maintained. Sediments are well dredged in 6 months every year. 1.0 m of sediments are accumulated at the deepest pont (60m) of basin.

Facility	Name	Concrete					Equipment				Const.year
		Quality	Appearance	Crack	Split	Leakage	Screen	Steel cover	Gate	Inject. facilities	
Inlet Chamber	No.1	B	C	NO	NO	NO	C	C	C	C	1969
	No.2	B	C	NO	NO	NO	C	C	C	C	1969

Facility	Name	Concrete					Cover soil Appearance	Pipes	Ventilator	Others	Const.year
		Quality	Appearance	Crack	Split	Leakage					
Reservoir	No.1 Reservoir	B	B	NO	NO	NO	A	B	B	Inner condition was not examined because of filled water ,but reportedly in fair condition through hearing survey.	1969
	No.2 Reservoir	B	B	NO	NO	NO	A	B	B		1973
	No.3 Reservoir	B	B	NO	NO	NO	A	B	B		1980

Facility	Name	Concrete					Pipes	Others	Const.year
		Quality	Appearance	Crack	Split	Leakage			
Chemical Facilities	Alam mixing tank x 4	B	C	NO	NO	NO	B	Lumber being used for inner wall is seriously worm-out.	1973
	No.1 Alam storege tank	B	C	NO	NO	NO	B	Outer wall of tank is seriously deteriorated (Inner condition is relatively fair in hearing survey).	1973
	No.2 Alam storege tank	B	C	NO	NO	NO	B	Outer wall of tank is seriously deteriorated (Inner condition is relatively fair in hearing survey).	1973
	No.3 Alam storege tank	B	C	NO	NO	NO	B	Outer wall of tank is seriously deteriorated (Inner condition is relatively fair in hearing survey).	1973
	Alam injection tank	B	B	NO	NO	NO	C	Equipment of dosing point has seriously deteriorated.	1973

Table S 3.1.2.3 (3) Diagnosis Sheet of Civil Structure & Buildings for Kadirya WTP

Facility	Name	Concrete					Pipes					Const.year
		Quality	Appearance	Crack	Split	Leakage	Painting	Rust	leakage	Valve	Others	
Rapid Sand Filter No.1	Filter-1	B	B	NO	NO	NO	NO	YES	NO	C	*Concrete structures of upper and bottom part are relatively in fair condition. Most of pipes have corroded because of no coating of paint. Corrosion of lower part of pipes is so serious to cause water leak near future. As a whole, however, filters are well maintained and kept in much clean condition.	1969
	Filter-2	B	B	NO	NO	NO	NO	YES	NO	C		1969
	Filter-3	B	B	NO	NO	NO	NO	YES	NO	C		1969
	Filter-4	B	B	NO	NO	NO	NO	YES	NO	C		1972
	Filter-5	B	B	NO	NO	NO	NO	YES	NO	C		1972
	Filter-6	B	B	NO	NO	NO	NO	YES	NO	C		1972
	Filter-7	B	B	NO	NO	NO	NO	YES	NO	C		1975
	Filter-8	B	B	NO	NO	NO	NO	YES	NO	C		1975
	Filter-9	B	B	NO	NO	NO	NO	YES	NO	C		1975
	Filter-10	B	B	NO	NO	NO	NO	YES	NO	C		1975
	Filter-11	B	B	NO	NO	NO	NO	YES	NO	C		1975
	Filter-12	B	B	NO	NO	NO	NO	YES	NO	C		1975
	Filter-13	B	B	NO	NO	NO	NO	YES	NO	C		1975
	Filter-14	B	B	NO	NO	NO	NO	YES	NO	C		1975
	Filter-15	B	B	NO	NO	NO	NO	YES	NO	C		1975
	Filter-16	B	B	NO	NO	NO	NO	YES	NO	C		1975
	Filter-17	B	B	NO	NO	NO	NO	YES	NO	C		1975
	Filter-18	B	B	NO	NO	NO	NO	YES	NO	C		1975
	Filter-19	B	B	NO	NO	NO	NO	YES	NO	C		1972
	Filter-20	B	B	NO	NO	NO	NO	YES	NO	C		1972
	Filter-21	B	B	NO	NO	NO	NO	YES	NO	C		1972
	Filter-22	B	B	NO	NO	NO	NO	YES	NO	C		1969
	Filter-23	B	B	NO	NO	NO	NO	YES	NO	C		1969
	Filter-24	B	B	NO	NO	NO	NO	YES	NO	C		1969

Table S 3.1.2.3 (4) Diagnosis Sheet of Civil Structure & Buildings for Kadirya WTP

Facility	Name	Concrete					Pipes					Const.year
		Quality	Appearance	Crack	Split	Leakage	Painting	Rust	leakage	Valve	Others	
Rapid Sand Filter No.2	Filter-1	B	B	NO	NO	NO	NO	YES	YES	C	*Concrete structures of upper and bottom part are relatively fair. Most of pipes have corrorded because of no duly coating of paint. Especially, lower part of pipes are seriously affected. Valves are apt to malfunction and repaired frequently, however, water leakage occurrs due to bad quality of gasket, even after repairing. Water leakage other than this is not ovserved. As a whole, filters are well maintained and kept in much clean condition.	1978
	Filter-2	B	B	NO	NO	NO	NO	YES	YES	C		1978
	Filter-3	B	B	NO	NO	NO	NO	YES	YES	C		1978
	Filter-4	B	B	NO	NO	NO	NO	YES	YES	C		1981
	Filter-5	B	B	NO	NO	NO	NO	YES	YES	C		1981
	Filter-6	B	B	NO	NO	NO	NO	YES	YES	C		1981
	Filter-7	B	B	NO	NO	NO	NO	YES	YES	C		1981
	Filter-8	B	B	NO	NO	NO	NO	YES	YES	C		1981
	Filter-9	B	B	NO	NO	NO	NO	YES	YES	C		1981
	Filter-10	B	B	NO	NO	NO	NO	YES	YES	C		1985
	Filter-11	B	B	NO	NO	NO	NO	YES	YES	C		1985
	Filter-12	B	B	NO	NO	NO	NO	YES	YES	C		1985
	Filter-13	B	B	NO	NO	NO	NO	YES	YES	C		1985
	Filter-14	B	B	NO	NO	NO	NO	YES	YES	C		1985
	Filter-15	B	B	NO	NO	NO	NO	YES	YES	C		1985
	Filter-16	B	B	NO	NO	NO	NO	YES	YES	C		1981
	Filter-17	B	B	NO	NO	NO	NO	YES	YES	C		1981
	Filter-18	B	B	NO	NO	NO	NO	YES	YES	C		1981
	Filter-19	B	B	NO	NO	NO	NO	YES	YES	C		1981
	Filter-20	B	B	NO	NO	NO	NO	YES	YES	C		1981
	Filter-21	B	B	NO	NO	NO	NO	YES	YES	C		1981
	Filter-22	B	B	NO	NO	NO	NO	YES	YES	C		1978
	Filter-23	B	B	NO	NO	NO	NO	YES	YES	C		1978
	Filter-24	B	B	NO	NO	NO	NO	YES	YES	C		1978

Table S 3.1.2.3 (5) Diagnosis Sheet of Civil Structure & Buildings for Kadirya WTP

Facility	Name	Blick wall					Pipes	Others	Const.year
		Quality	Appearance	Crack	Split	Leakage			
Chlorination Facilities	Building	C	C	NO	NO	NO	C	*Internal and external building have deteriorated seriously. It's very dangerous that there's no space to accommodate 1-ton container. Presently, about 39 containers are placed disorderly and empty containers are left everywhere in vacant lot. *Only 9 sets of feeding equipment out of 20, are available due to majority of malfunction. *As a whole, building has deteriorated remarkably. Service pipes installed on the earth, with maximum length of 400 m to feeding point, are roughly maintained.	1969/1979

Facility	Name	Concrete floor	Concrete wall					Brick wall		Roof		
			Quality	Appearance	Crack	Split	Leakage	Appearance	Crack	Appearance	Crack	Leakage
P/S Buildings	No1 IntakeP/S	B	B	B	NO	NO	NO	-	-	C	YES	YES
	No2 IntakeP/S	B	B	B	NO	NO	NO	-	-	C	YES	YES
	Dist.P/S	B	B	B	NO	NO	NO	-	-	C	YES	YES

Facility	Name	Fitting				Equipment			Others	Const.year
		Doors	Windows	Glass	Ventilator	Step	Steel floor	Lighting		
P/S Buildings	No1 IntakeP/S	C	C	C	C	B	B	C	*Mortar and joints of external wall are removed everywhere, however, P/C concrete has not deteriorated. *Inside structure is maintained neately. Many traces of rain leaking are found, but roughly repaired.	1969
	No2 IntakeP/S	C	C	C	C	B	B	C		1983
	Dist.P/S	C	C	C	C	B	B	C		1973

10.Other Building

Facility	Name	Concrete floor	Brick wall		Concrete wall			Roof			Others	Const.year
			Appearance	Crack	Appearance	Crack	Leakage	Appearance	Crack	Leakage		
Other Buildings	Administration	B	B	NO	—	—	—	C	NO	YES	Both internal and external building have eteriorated.	1969
	Old filter	A	—	—	C	YES	YES	C	NO	YES	Especially, outer wall and ceiling have deteriorated seriously.	1969/72/75
	New filter	A	—	—	C	YES	YES	C	NO	YES	Especially, outer wall and ceiling have deteriorated seriously.	1978/81/85
	Boiler	B	B	NO	—	—	—	C	NO	YES	Both internal and external building have eteriorated.	1989
	Coagulation	B	B	NO	—	—	—	C	NO	YES	Both internal and external building have eteriorated.	1970
	Store house	B	B	NO	—	—	—	C	NO	YES	Both internal and external building have eteriorated.	1971

iii) Intake PSs

No.1 and No.2 intake pumps and related facilities are listed in Table S 3.1.2.4(1) to (4).

Diagnosis results for intake facilities are shown in Table S 3.1.2.4 (5) and (6).

Table S 3.1.2.4(1) List of Main Pump for No.1 Intake PS

No.	Name	Type	Q (m^3/hr)	Head m)	D (in, out) (mm)	Power (kW)	In Pipe (mm)	Out Valve (mm)	Inst. year
1	Main pump	48D22	12,500	24	φ 1200, φ 1000	1250	φ 1500	φ 1200	1969
2	Ditto	Ditto	12,500	24	φ 1200, φ 1000	1250	φ 1500	φ 1200	1969
3	Ditto	Ditto	12,500	24	φ 1200, φ 1000	1250	φ 1500	φ 1200	1969
4	Ditto	Ditto	12,500	24	φ 1200, φ 1000	1250	φ 1500	φ 1200	1973
5	Ditto	Ditto	12,500	24	φ 1200, φ 1000	1250	φ 1500	φ 1200	1976
6	Ditto	32D19	6,300	27	φ 900, φ 700	630	φ 1200	φ 1200	1986
7	Ditto	Ditto	6,300	27	φ 900, φ 700	580	φ 1200	φ 1000	1977

Table S 3.1.2.4(2) List of Intake Facilities for No.1 Intake PS

No.	Name	Specifications	Inst. year
1	Dredger	Micro pumping boat, Volute pump 400m^3/h 19.5m 75kW	1972
2	Intake gate	Motor gate, 2.5mx5m	1969
3	Intake screen	Bar screen, Slit width 100 mm, W2.5mxH5m	1969
4	Intake pipes	D1600x6	1969
5	Trans. Pipes	D1400mmx4	1969
6	Auto Valve	D1000-2000mm	1969
7	Manual Valve	D1000-2000mm	1969
8	Ceiling crane	W18m x 20t	1969

Table S 3.1.2.4(3) List of Main Pump for No.2 Intake PS

No.	Name	Type	Q (m^3/hr)	Head (m)	D (in, out) (mm)	Power (kW)	In Valve (mm)	Out Valve (mm)	Inst. year
1	Main pump	48D22	12,500	24	1300 ,900	1250	1600	1200	1983
2	Ditto	Ditto	12,500	24	1300 ,900	1250	1600	1200	1985
3	Ditto	Ditto	12,500	24	1300 ,900	1250	1600	1200	1983
4	Ditto	32D19	6,300	27	800 ,600	800	1600	1200	1985
5	Ditto	Ditto	6,300	27	800 ,600	800	1600	1200	1985
6	Ditto	48D22	12,500	24	1300 ,900	1250	1600	1200	1983
7	Ditto	Ditto	12,500	24	1301 ,900	1250	1600	1200	1985
8	Ditto	Ditto	12,500	24	1302 ,900	1250	1600	1200	1977

Table S 3.1.2.4(4) List of Intake Facilities for No.2 Intake PS

No.	Name	Specifications	Inst. year
1	Dredger	Micro pumping boat, Volute pump 400m^3/h 19.5m 75kW	1972
2	Intake gate	Motor gate, W2.5×H5.0m	1983
3	Intake screen	Bar screen, Slit width mm, W4mxH4m	1983
4	Intake pipes	D2,500x2	1983
5	Trans. Pipes	D2,000 mmx2+1400x2	1983
6	Auto Valve	D1,000-2,000 mm	1983
7	Manual Valve	D1,000-2,000,mm	1983
8	Ceiling crane	W18m x 20t	1983

Table S 3.1.2.4 (5) Diagnosis of No.1 Intake Facilities

Division	Name	Operation status	Condition, Appearance	Judgment
Pumps	No.1 main	A considerable water leakage is observed in bearing.	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.2 main	A considerable water leakage is observed in bearing	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.3 main	A considerable water leakage is observed in bearing	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.4 main	A considerable water leakage is observed in bearing	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.5 main	A considerable water leakage is observed in bearing	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.6 main	A considerable water leakage is observed in bearing	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.7 main	A considerable water leakage is observed in bearing	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
Pipes and other machines	Dredger	No particular problem	Functionally no problem	B
	Gate	Very few operation	Functionally no problem	B
	Screen	Paint is remarkably peeling off.	Functionally no problem	B
	Inlet Pipes	No particular problem	Remarkably deteriorated. No paint coating. Lower part has corroded thoroughly.	B
	Transmission Pipes	No particular problem	Remarkably deteriorated. No paint coating. Lower part has corroded thoroughly.	B
	Valves	A considerable water leakage	Remarkably deteriorated. Valve and case are worn down. Motors have broken down frequently.	C1
	Ceiling crane	No particular problem	Distorted wire rope	B

Table S 3.1.2.4 (6) Diagnosis of No.2 Intake Facilities

Division	Name	Operation status	Condition, Appearance	Judgment
Pumps	No.1 main	Motor has broken down. Under repair	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.2 main	Oil leak is observed in bearing. A big vibration is observed.	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.3 main	A considerable water leakage is observed in bearing	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.4 main	A considerable water leakage is observed in bearing. Motor generates a big noise.	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.5 main	Heavy cavitation occurred in impeller. Under repair, but impossible to be repaired	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.6 main	Oil leak is observed in bearing	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.7 main	Oil leak is observed in bearing	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.8 main	Oil leak is observed in bearing	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
Pipes and other machines	Dredger	No particular problem	Functionally no problem	B
	Intake gate	Very few operation	Functionally no problem	B
	Intake screen	Paint has peeled off remarkably	Functionally no problem	B
	Intake pipes	No particular problem	Remarkably deteriorated. No paint coating. Pipes have corroded thoroughly.	B
	Trans. pipes	No particular problem	Remarkably deteriorated. No paint coating. Pipes have corroded thoroughly.	B
	Auto Valve	A considerable water leakage	Remarkably deteriorated. Motors have broken down frequently.	C1
	Manual Valve	A considerable water leakage	Remarkably deteriorated. Valve and case are worn down.	C1
	Ceiling crane	No particular problem	Distorted wire rope	B

iv) Rapid Sand Filters

Rapid sand filters and related facilities are listed in Table S 3.1.2.5 (1) and (2), and the diagnosis results are shown in Table S 3.1.2.5 (3).

Table S 3.1.2.5 (1) List of Rapid Sand Filters

No.	Name	Specifications	Number	Inst. year
1-1	Filters (1)	A=108.8m2, Perforated collection pipe & double layer type, total filter layer 0.9-1.0m(quartz sand+ ceramics), Pipes and auto valve(inlet D800, outlet D800, back wash D600, drain D800)	6	1969
1-2	Pipes for filters (1)	Inlet D800, outlet D800, back wash D600, drain D800	1	1969
2-1	Filters (2)	A=118m2, Perforated collection pipe & double layer type ,total filter layer 0.9-1.0m(quartz sand+ ceramics), Pipes and auto valve(inlet D800, outlet D800, back wash D600, drain D800)	18	1972-1975
2-2	Pipes for filters (2)	inlet D800, outlet D800, back wash D600, drain D800	1	1972-1975
3-1	Filters (3)	A=166m2, Perforated collection pipe & double layer type, total filter layer 0.9-1.0m(quartz sand+ ceramics), Pipes and auto valve(inlet D800, outlet D800, back wash D800, drain D1000)	24	1978-1985
3-2	Pipes for filters (3)	Inlet D800, outlet D800, back wash D800, drain D1000)	1	1978-1985

Table S 3.1.2.5 (2) List of Facilities for Rapid Sand Filters

No.	Name	Specifications	Number	Inst. year
1	Ceiling crane (1,2)	W15 m x 20 t, moving distance150 m	2	1969
2	Ceiling crane (3)	W15 m x 20 t, moving distance150 m	2	1978
3	Washing pump (1)	32D19, 6500m3/hrx29mhx639kw, with motor valve(in1200 mm, out1000 mm)	1	1969
4	Washing pump (2)	32D19, 6500m3/hrx29mhx639kw, with motor valve(in1200 mm, out1000 mm)	1	1975
5	Washing pump (3)	32D19, 6500m3/hrx29mhx639kw, with motor valve(in1200 mm, out1000 mm)	1	1975

Table S 3.1.2.5 (3) Diagnosis Sheet for Rapid Sand Filters

Division	Name	Operation status	Condition, Appearance	Judgment
Filters	Old (1)	No particular problem in appearance	Filtration rate fluctuates due to structure of the filter. Difficult to maintain proper filtration. Lost of sand is remarkable.	C2
	Old (2)	No particular problem in appearance		C2
	New	No particular problem in appearance		C2
Pumps	No.1 Washing	No particular problem		B
	No.2 Washing	No particular problem		B
	No.3 Washing	No particular problem		B
Pipes for filters	Old (1)	No particular problem	Most of pipes have corroded due to no duly coating of pain Corrosion of lower part of pipes is so serious to cause water leak near future.	B
	Old (2)	No particular problem		B
	New	No particular problem		B
Crane	Ceiling crane (1,2)	No particular problem		B
	Ceiling crane (3)	No particular problem		B

v) Distribution PS

Distribution pumps and related facilities are listed in Table S 3.1.2.6 (1) and (2). However since most of treated water from Kadirya WTP is distributed by gravity, only one smallest pump was operating.

Table S 3.1.2.6 (1) List of Distribution Pump

No.	Name	Type	Q (m^3/hr)	Head (m)	D (in, out) (mm)	Power (kw)	In Valve (mm)	Out Valve (mm)	Inst. year
1	Main pump	VH-DS	6,300	27	800,600	630	1000	900	1971
2	Ditto	Ditto	6,300	27	800,600	630	1000	900	1973
3	Ditto	Ditto	6,300	27	800,600	630	1000	900	1969
4	Ditto	Ditto	2,700	58	600,500	780	1000	900	1973
5	Ditto	Ditto	2,700	58	500,500	500	1000	900	1973
6	Ditto	Ditto	6,500	51	800,600	1000	1000	900	1971
7	Ditto	Ditto	6,500	51	800,600	1000	1000	900	1971
8	Ditto	Ditto	6,500	51	800,600	1000	1000	900	1971

Table S 3.1.2.6 (2) List of Distribution Pump Facilities

No.	Name	Specification	Inst. year
1	Pipes	D500-1,200mm	1971
2	Auto Valve	D500-1,200mm	1971
3	Manual Valve	D500-1,200mm	1971
4	Ceiling crane	W18mx20t	1971

Table S 3.1.2.6 (3) Diagnosis Sheet for Distribution Facilities

Division	Name	Operation status	Condition, Appearance	Judgment
Pumps	No.1 main	A considerable water leakage in bearing	Remarkably deteriorated, but very few operation	C2
	No.2 main	A considerable water leakage in bearing	Remarkably deteriorated, but very few operation	C2
	No.3 main	A considerable water leakage in bearing	Remarkably deteriorated, but very few operation	C2
	No.4 main	A considerable water leakage in bearing	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.5 main	A considerable water leakage in bearing	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.6 main	A considerable water leakage in bearing	Remarkably deteriorated, but very few operation	C2
	No.7 main	A considerable water leakage in bearing	Remarkably deteriorated, but very few operation	C2
	No.8 main	A considerable water leakage in bearing	Remarkably deteriorated, but very few operation	C2
Pipes and other machines	Pipes	No particular problem	Remarkably deteriorated. No paint coating. Lower part has corroded thoroughly.	B
	Auto Valve	No particular problem	Remarkably deteriorated. No paint coating. Lower part has corroded thoroughly.	B
	Manual Valve	No particular problem	Remarkably deteriorated. No paint coating. Lower part has corroded thoroughly.	B
	Ceiling crane	No particular problem	Distorted wire rope	B

vi) Chlorinator

Chlorinators and related facilities are listed in Table S 3.1.2.7 (1), and the diagnosis results are shown in Table S 3.1.2.7 (2).

Table S 3.1.2.7 (1) List of Chlorination Facilities

Division	No.	Name	Type	Specification	Number	Inst. yera
No.1 Chlorinator	1	Cylinder scale (1)	Analog type	for 1ton Cylinder	4	1969/1979
	2	Gas filter			2	1969/1979
	3	Gas meter	Flow meter	14kg/hrxd20mm	19	1969/1979
	4	Ejector	Water ejector	D25mm	8	1969/1979
	5	Safety equipment		Sprinkler, Discharging chamber, gas mask	1	1969/1979
No.1 Chlorinator	1	Cylinder scale(1)	Analog type	for 1ton Cylinder	1	1979
	2	Gas filter			1	1979
	3	Gas meter	Flow meter	14kg/hrxd20mm	1	1979
	4	Ejector	Water ejector	D25mm from Distribution pumps	1	1979
	5	Safety equipment		Gas mask	1	1979

Table S 3.1.2.7 (2) Diagnosis Sheet of Chlorination Facilities

Division	Name	Operation Status	Condition, Appearance	Judgment
No.1 Chlorinator	Cylinder scale(1)	No problem in operation	Remarkably deteriorated, low precision	C2
	Gas filter	No problem in operation	Remarkably deteriorated	C2
	Gas meter	9sets are out of order and left	Remarkably deteriorated	C2
	Ejector	No problem in operation	Remarkably deteriorated	C2
	Safelty equipment	No problem in operation	Remarkably deteriorated	C2
No.1 Chlorinator	Cylinder scale(1)	No problem in operation	Remarkably deteriorated, low precision	C2
	Gas filter	No problem in operation	Remarkably deteriorated	C2
	Gas meter	No problem in operation	Remarkably deteriorated	C2
	Ejector	No problem in operation	Remarkably deteriorated	C2
	Safelty equipment	No problem in operation	Remarkably deteriorated	C2

i) Electrical Facilities

Table S 3.1.2.8 (1) to (5) shows the list of electrical facilities and diagnosis result of these.

Table 3.1.2.8 (1） List of Electrical Facilities and Daignosis Results

No	Facility Name	Location	Equipment Name	Specification	Inst.Year	Judgment
1	Power Receiving Facility	Substation	No.1 Transformer	Oil Immersed, Outdoor, 35/6 kV, 6300kVA	1969	B
2			No.2 Transformer	Oil Immersed, Outdoor, 35/6 kV, 6300kVA	1969	B
3			No.1 Incoming Panel (Panel No.3)	Withdrawable OCB, Outdoor	1969	B
4			No.2 Incoming Panel (Panel No.12)	Withdrawable OCB, Outdoor	1969	B
5			Feeder Panel No.1 (Panel No.1)	OCB, Outdoor (To Transformer Kiosk No.1)	1969	B
6			Feeder Panel No.2 (Panel No.2)	Withdrawable OCB, Indoor (To No.1 Intake P/S -1)	1969	B
7			Internal Use Transformer (Panel No.4)	Oil Immersed, Indoor, 6/0.1kV, 25kVA	1969	B
8			No.1 Lightning Arrester (Panel No.5)		1969	B
9			No.1 GPT (Panel No.6)	Oil Immersed, Indoor, 6/0.4kV, 25kVA	1969	B
10			Bus Sectional Panel (Panel No.7)	Withdrawable OCB, Indoor	1969	B
11			Bus Sectional Panel (Panel No.8)	DS	1969	B
12			Internal Use Transformer (Panel No.9)	Oil Immersed, Indoor, 6/0.4kV, 25kVA	1969	B
13			No.2 Lightning Arrester (Panel No.10)		1969	B
14			Internal Use Transformer (Panel No.11)	Oil Immersed, Indoor, 6/0.1kV, 25kVA	1969	B
15			Feeder Panel No.3 (Panel No.13)	Withdrawable OCB, Indoor (To No.1 Intake P/S -2)	1969	B
16			Feeder Panel No.4 (Panel No.14)	Withdrawable OCB, Indoor (To No.1 T/K -2)	1969	B
17			Incoming Panel from Outer S/S (Panel No.15)	Withdrawable OCB, Indoor	1969	B
18			Internal Use Transformer (Panel No.16)	Oil Immersed, Indoor, 6/0.1kV, 25kVA	1969	B
19			Feeder Panel No.1 (Panel No.17)	Withdrawable OCB, Indoor (To Distribution P/S)	1969	B
20			Bus Sectional Panel (Panel No.18)	Withdrawable OCB, Indoor (To Bus Bar No.1)	1969	B
21			Feeder Panel No.2 (Panel No.19)	Withdrawable OCB, Indoor	1969	B
22			Feeder Panel No.3 (Panel No.20)	Withdrawable OCB, Indoor	1969	B
23			Internal Use Transformer (Panel No.21)	Oil Immersed, Indoor, 6/0.4kV, 25kVA	1969	B
24			Bus Sectional Panel (Panel No.22)	Withdrawable OCB, Indoor (To Panel No.23)	1969	B
25			Bus Sectional Panel (Panel No.23)	DS, Indoor (To Panel No.22)	1969	B
26			Internal Use Transformer (Panel No.24)	Oil Immersed, Indoor, 6/0.4kV, 25kVA	1969	B
27			Feeder Panel (Panel No.25)	Withdrawable OCB, Indoor	1969	B
28			No.7 Pump Starter Panel (Panel No.26)	Withdrawable OCB, Indoor, 630kW	1969	B
29			Feeder Panel (Panel No.27)	Withdrawable OCB, Indoor (To Distribution P/S)	1969	B
30			Bus Sectional Panel (Panel No.28)	Withdrawable OCB, Indoor (To Panel No.13)	1969	B
31			Internal Use Transformer (Panel No.29)	Oil Immersed, Indoor, 6/0.4kV, 25kVA	1969	B
32			Incoming Panel from Outer S/S (Panel No.30)	Withdrawable OCB, Indoor	1969	B

Table 3.1.2.8 (2） List of Electrical Facilities and Daignosis Results

No	Facility Name	Location	Equipment Name	Specification	Inst.Year	Judgment
33	Intake Pump Station	No.1 Intake Pump Station	No.5 Pump Starter Panel (Panel No.1)	DS+OCB, Indoor, 1250kW	1969	C1
34			No.3 Pump Starter Panel (Panel No.2)	DS+OCB, Indoor, 1250kW	1969	C1
35			No.1 Pump Starter Panel (Panel No.3)	DS+OCB, Indoor, 1250kW	1969	C1
36			Feeder (Panel No.4)	DS+PF, Indoor (Standby)	1969	C1
37			Feeder (Panel No.5)	DS+OCB, Indoor (To Transformer Kiosk No.8)	1969	C1
38			Incoming Panel from S/S (Panel No.7,8)	DS+OCB, Indoor	1969	C1
39			Internal Use Transformer (Panel No.9)	Oil Immersed, Indoor, 6/0.4kV, 25kVA	1969	C1
40			Bus Sectional Panel (Panel No.10)	DS+OCB, Indoor (To Panel No.11)	1969	C1
41			Bus Sectional Panel (Panel No.11)	DS, Indoor (To Panel No.10)	6919	C1
42			Internal Use Transformer (Panel No.12)	Oil Immersed, Indoor, 6/0.1kV, 25kVA	1969	C1
43			Incoming Panel (Panel No.13, 14)	From S/S Panel No.13)	1969	C1
44			Internal Use Transformer (Panel No.15)	Oil Immersed, Indoor, 6/0.4kV, 25kVA	1969	C1
45			Lightning Arrester (Panel No.16)		1969	C1
46			No.2 Pump Starter Panel (Panel No.18)	DS+OCB, Indoor, 1250kW	1969	C1
47			No.4 Pump Starter Panel (Panel No.19)	DS+OCB, Indoor, 1250kW	1969	C1
48			No.6 Pump Starter Panel (Panel No.20)	DS+OCB, Indoor, 800kW	1969	C1
49			No.1 Pump Control Panel	Indoor Self-stand	1969	C1
50			No.2 Pump Control Panel	Indoor Self-stand	1969	C1
51			No.3 Pump Control Panel	Indoor Self-stand	1969	C1
52			No.4 Pump Control Panel	Indoor Self-stand	1969	C1
53			No.5 Pump Control Panel	Indoor Self-stand	1969	C1
54			No.6 Pump Control Panel	Indoor Self-stand	1969	C1
56			No.7 Pump Control Panel	Indoor Self-stand	1969	C1
57			Valve Control Panel	Indoor Self-stand		C1
58			Low Voltage Distribution Panel	Indoor Self-stand	1969	C1
59		No.2 Intake Pump Station	Feeder (Panel No.1)	DS, Indoor (Standby)	1987	C1
60			Feeder (Panel No.2)	DS+OCB, Indoor (To Transformer Kiosk No.4-1)	1987	C1
61			Lightning Arrester (Panel No.3)		1987	C1
61			No.1 Pump Starter Panel (Panel No.4)	DS+OCB, Indoor, 1250kW	1987	C1
62			No.3 Pump Starter Panel (Panel No.5)	DS+OCB, Indoor, 1250kW	1987	C1
63			No.5 Pump Starter Panel (Panel No.6)	DS+OCB, Indoor, 1250kW	1987	C1
64			No.7 Pump Starter Panel (Panel No.7)	DS+OCB, Indoor, 1250kW	1987	C1
65			Internal Use Transformer (Panel No.8)	Indoor, 25kVA	1987	C1

Table 3.1.2.8 (3) List of Electrical Facilities and Daignosis Results

No	Facility Name	Location	Equipment Name	Specification	Inst.Year	Judgment
66	Intake Pump Station	No.2 Intake Pump Station	Incoming Panel from Outer S/S (Panel No.9)	DS, Indoor	1987	C1
67			Incoming Bus Bar (Panel No.10,11)		1987	C1
68			Internal Use Transformer (Panel No.12)	Indoor	1987	C1
69			Bus Sectional Panel (Panel No.13)	DS+OCB, Indoor	1987	C1
70			Bus Sectional/Internal Use Transformer	Indoor, 25kVA	1987	C1
71			Incoming Panel from Outer S/S (Panel No.15)		1987	C1
72			Incoming Bus Bar (Panel No.16,17,18)		1987	C1
73			No.2 Pump Starter Panel (Panel No.19)	DS+OCB, Indoor, 1250kW	1987	C1
74			No.4 Pump Starter Panel (Panel No.20)	DS+OCB, Indoor, 630kW	1987	C1
75			No.6 Pump Starter Panel (Panel No.21)	DS+OCB, Indoor, 1250kW	1987	C1
76			No.8 Pump Starter Panel (Panel No.22)	DS+OCB, Indoor, 1250kW	1987	C1
77			Lightning Arrester (Panel No.23)		1989	C1
78			Feeder (Panel No.24)	DS+OCB, Indoor (To Transformer Kiosk No.4-2)	1987	C1
79			No.1 Pump Control Panel	Indoor, Self-Stand	1987	C1
80			No.1 Pump Valve Control Panel	Indoor, Self-Stand	1987	C1
81			No.2 Pump Control Panel	Indoor, Self-Stand	1987	C1
82			No.2 Pump Valve Control Panel	Indoor, Self-Stand	1987	C1
83			No.3 Pump Control Panel	Indoor, Self-Stand	1987	C1
84			No.3 Pump Valve Control Panel	Indoor, Self-Stand	1987	C1
85			No.4 Pump Control Panel	Indoor, Self-Stand	1987	C1
86			No.4 Pump Valve Control Panel	Indoor, Self-Stand	1987	C1
87			No.5 Pump Control Panel	Indoor, Self-Stand	1987	C1
88			No.5 Pump Valve Control Panel	Indoor, Self-Stand	1987	C1
89			No.6 Pump Control Panel	Indoor, Self-Stand	1987	C1
90			No.6 Pump Valve Control Panel	Indoor, Self-Stand	1987	C1
91			No.7 Pump Control Panel	Indoor, Self-Stand	1987	C1
92			No.7 Pump Valve Control Panel	Indoor, Self-Stand	1987	C1
93			No.8 Pump Control Panel	Indoor, Self-Stand	1987	C1
94			No.8 Pump Valve Control Panel	Indoor, Self-Stand	1987	C1
95			Low Voltage Distribution Panel	Indoor, Self-Stand	1987	C1
96			Valve Control Panel	Outdoor	1987	C1

Table 3.1.2.8 (4) List of Electrical Facilities and Daignosis Results

No	Facility Name	Location	Equipment Name	Specification	Inst.Year	Judgment
97	Transformer Kiosk	Each Transformer Kiosk	No.1 Transformer Kiosk	Oil Immersed, 6/0.38kV, 250kVA	1977	C1
98			No.2 Transformer Kiosk	Oil Immersed, 6/0.38kV, 160kVA	1977	C1
99			No.3 Transformer Kiosk	Oil immersed, 6/0.38kV, 250kVA	1977	C1
100			No.4 Transformer Kiosk	Oil immersed, 6/0.38kV, 400kVA	1977	C1
101	Transformer Kiosk	Each Transformer Kiosk	No.5 Transformer Kiosk	Oil immersed, 6/0.38kV, 250kVA	1977	C1
101			No.6 Transformer Kiosk	Oil immersed, 6/0.38kV, 250kVA	1989	C1
102			No.7 Transformer Kiosk	Oil immersed, 6/0.38kV, 400kVA	1989	C1
103			No.8 Transformer Kiosk	Oil immersed, 6/0.38kV, 400kVA	1989	C1
104	Filters	Filter	Centralized Monitoring and Control Panel	Self Stand	1977	C1
105			Distribution Panels for Block 1 and 2	Indoor, Self-Stand	1977	C1
106			Filter Unit Control Panels for Block 1/2	Indoor, Self-Stand	1977	C1
107			Distribution Panels for Block 3 and 4	Indoor, Self-Stand	1989	C1
108			Filter Unit Control Panels for Block 3/4	Indoor, Self-Stand	1989	C1
109	Distribution Pump Station	Distribution Pump Station	Feeder (Panel No.1)	DS+OCB, Indoor (To Transformer Kiosk No.7-1)	1972	C1
110			(Panel No.2)	DS+OCB, Indoor, 630kW	1972	C1
111			(Panel No.3)	DS+OCB, Indoor, 800kW	1972	C1
112			(Panel No.4)	DS+OCB, Indoor, 500kW	1972	C1
113			(Panel No.5)	DS+OCB, Indoor, 1000kW	1972	C1
114			Feeder (Panel No.6)	DS+OCB, Indoor (To Transformer Kiosk No.6-1)	1972	C1
115			Internal Use Transformer (Panel No.7)		1972	C1
116			Feeder (Panel No.8)	DS+OCB, Indoor (To Transformer Kiosk No.3)	1972	C1
117			Incoming Panel -1 From S/S (Panel No.9)	DS+OCB, Indoor	1972	C1
118			Internal Use Transformer (Panel No.10)		1972	C1
119			Bus Sectional Panel (Panel No.11)		1972	C1
120			Internal Use Transformer (Panel No.12)		1972	C1

Table 3.1.2.8 (5） List of Electrical Facilities and Daignosis Results

No	Facility Name	Location	Equipment Name	Specification	Inst.Year	Judgment
121	Distribution Pump Station	Distribution Pump Station	Incoming Panel -2 From S/S (Panel No.13)	DS+OCB, Indoor	1972	C1
122			Feeder (Panel No.14)	DS+OCB, Indoor (Standby)	1972	C1
123			Internal Use Transformer (Panel No.15)		1972	C1
124			Feeder (Panel No.16)	DS+OCB, Indoor (To Transformer Kiosk No.6-2)	1972	C1
125			(Panel No.17)	DS+OCB, Indoor, 583kW	1972	C1
126			(Panel No.18)	DS+OCB, Indoor, 1000kW	1972	C1
127			(Panel No.19)	DS+OCB, Indoor, 1000kW	1972	C1
128			(Panel No.20)	DS+OCB, Indoor, 630kW	1972	C1
129			Feeder (Panel No.21)	DS+OCB, Indoor (To Transformer Kiosk No.7-2)	1972	C1
130			Pump Control Panels	Indoor, Self-Stand	1972	C1
138			Valve Control Panel	Indoor, Self-Stand	1972	C1
139	Chemical and Other Facilities	Other Facilities	Distribution Panel for Chemical Facilities	Indoor, Self-Stand	1972	C1
140			No.1 Blower Control Panel	Indoor, Self-Stand	1972	C1
141	Chemical and Other Facilities	Chemical and Other Facilities	No.2 Blower Control Panel	Indoor, Self-Stand	1972	C1
142			No.3 Blower Control Panel	Indoor, Self-Stand	1972	C1
143			Distribution Panel for Chlorination Facilities	Indoor, Self-Stand	1972	B
144			Facilities	Indoor, Self-Stand	1972	C1
145			Inlet Gate Control Panel	Outdoor, Self-Stand	1972	C2

2) Boz-su WTP

i) Diagnosis for Capacity of WTP

The design capacity and the investigated actual capacity of WTP are shown in Table S 3.1.2.9.

Table S 3.1.2.9 Capacity of WTP

Design Capacity				
Nominal Capacity	9,817	m^3/hr =	**235,600**	m^3/day
Maximum capacity of intake PS	14,000	m^3/hr	**336,000**	m^3/d
Filtration area: Circle 12untis			634	m^2
Filtration area: Rectangular 6units			365	m^2
Total Filtration area			**999**	m^2
Filtration Capability(7～10m/hr)	10	m^3/hr	240	m^3/day
Filtration Capability(10～12m/hr)	12	m^3/hr	288	m^3/day
Distribution capacity of PS	13,400	m^3/hr	**321,600**	m^3/d
Washing water pump capacity	2,500	m^3/hr	60,000	m^3/d
Chlorination capacity			154	kg/hr
Coagulant injection capacity				kg/hr
Service reservoirs Capacity	29,900	m3	3.05	hr
Actual Capacity				
Maximum capacity intake PS	7,853	m^3/hr	**188,480**	m^3/d
Distribution capacity of PS	10	m^3/hr	**230**	m^3/d
Washing water pump capacity	10,720	m^3/hr	257,280	m^3/d
Chlorination capacity			60	kg/hr
Coagulant injection capacity			---	kg/hr

ii) Diagnosis for Civil Structures and Buildings

Major civil structures and buildings of WTP are listed in Table S 3.1.2.10 (1).

Diagnosis results of these are shown in Table S 3.1.2.10 (2) to (3).

Table S 3.1.2.10 (1) List of Civil Structures and Building

No.	Name	Type	Dimension	Area (m^2)	Depth (m)	Volume (m^3)	Number
1	Intake Gate structure	Concrete	W1m		1.0		2
2	Flocculation Chamber	Concrete	W 4m x L125m	500	3.0	1,500	1
3	No.1 Sedimentation basin	Soil bank	W 40m x L350m	14,000	2.6	36,400	1
4	No.2 Sedimentation basin	Soil bank	W40m x L368m	14,720	3.6	52,992	1
5	Pump intake chamber	Concrete	W2m x L50 m				1
7	Intake pump building	Concrete	W12mxL30m	360			1
8	Circular filter tanks	Concrete	D8.2m x 12units	52.8			12
9	Rectangular filter tanks	Concrete	W6m x L10m	60.8			6
10	Filter cover building	Concrete	W40m x L75m	3000			1
11	Filter pipe room	Concrete	W10m x L60m	600			1
12	Laboratory & control building	Brick	W10m x L10m x 2st.	200			2
13	Reservoir (1)	Concrete	W36m x L48m		3.8	6,600	1
14	Reservoir (2)	Concrete	W36m x L24m		3.8	3,300	1
15	Reservoir (3)	Concrete	W40m x L48m		3.8	10,000	1
16	Distribution pump building	Brick	W15m x L35m	525			1
17	Disinfection house	Brick	W12m x L20m	420			1
18	Coagulant building	Brick	W12m x L35m	420			1
19	Administration building	Brick	W12m x L30m x 2st.	720			1
20	Coagulant feeding T	Concrete				10	1

Table S 3.1.2.10 (2) Diagnosis Sheet of Civil Structure & Buildings for Boz-su WTP

Facility	Name	Intake mouth	Injection of Alum	Intake screen	Inlet gate	Others	Const.year
Intake Facilities	Intake mouth	A	C	B	B	Most of the steel-made weir has deteriorated, but roughly maintained.	1931

Facility	Name	Concrete					Equipment			
		Quality	Appearance	Crack	Split	Leakage	Screen	Steel cover	Gate	Inject.facili
Intake Facilities	Intake channel and Sedimentation basin	A	A	NO	NO	NO	B	B	B	C

Facility	Name	Dike				Others	Const.year
		Erosion	Crack	Protection	—		
Intake Facilities	Intake channel and Sedimentation basin	NO	NO	A	—	Sedimentation basin using old canal has stable dike. Sediments are well dredged in 6 months every year.	1931

Facility	Name	Concrete					Other	Const.year
		Quality	Appearance	Crack	Split	Leakage		
Intake Facilities	Intake Chaneel	B	B	NO	NO	NO	P/C concrete is in fair condition, however, most of mortar are peeled off.	1931

Facility	Name	Concrete					Pipes					Const.year
		Quality	Appearance	Crack	Split	Leakage	Painting	Rust	leakage	Valve	Others	
Rapid Sand Filter No.2	Circle filter-1	B	C	YES	NO	YES	NO	YES	YES	B	Upper and bottom part of concrete as a whole have deteriorated, and many cracks and water leaking are observed. Most of the pipes have corroded because of no coating of paint. Corrosion of lower part of pipes is so seriousl to cause water leak near future. As a whole, however, filters are well maintained and kept in much clean condition.	1961
	Circle filter-2	B	C	YES	NO	YES	NO	YES	YES	B		1961
	Circle filter-3	B	C	YES	NO	YES	NO	YES	YES	B		1961
	Circle filter-4	B	C	YES	NO	YES	NO	YES	YES	B		1961
	Circle filter-5	B	C	YES	NO	YES	NO	YES	YES	B		1961
	Circle filter-6	B	C	YES	NO	YES	NO	YES	YES	B		1961
	Circle filter-7	B	C	YES	NO	YES	NO	YES	YES	B		1961
	Circle filter-8	B	C	YES	NO	YES	NO	YES	YES	B		1961
	Circle filter-9	B	C	YES	NO	YES	NO	YES	YES	B		1961
	Circle filter-10	B	C	YES	NO	YES	NO	YES	YES	B		1961
	Circle filter-11	B	C	YES	NO	YES	NO	YES	YES	B		1961
	Circle filter-12	B	C	YES	NO	YES	NO	YES	YES	B		1961
Rapid Sand Filter No.1	Rect. Filter-1	B	C	YES	NO	YES	NO	YES	YES	B		1931
	Rect. Filter-2	B	C	YES	NO	YES	NO	YES	YES	B		1931
	Rect. Filter-3	B	C	YES	NO	YES	NO	YES	YES	B		1931
	Rect. Filter-4	B	C	YES	NO	YES	NO	YES	YES	B		1931
	Rect. Filter-5	B	C	YES	NO	YES	NO	YES	YES	B		1931
	Rect. Filter-6	B	C	YES	NO	YES	NO	YES	YES	B		1931

Table S 3.1.2.10 (3) Diagnosis Sheet of Civil Structure & Buildings for Boz-su WTP

Facility	Name	Concrete					Cover soil Appearance	Pipes	Ventilator	Const.year
		Quality	Appearance	Crack	Split	Leakage				
Reservoir	No.1reservoir	B	B	NO	NO	NO	A	B	B	1931
	No.2reservoir	B	B	NO	NO	NO	A	B	B	1931
	No.3reservoir	B	B	NO	NO	NO	A	B	B	1931
	No.4reservoir	B	B	NO	NO	NO	A	B	B	1931

Facility	Name	Concrete					Pipes	Others	Const.year
		Quality	Appearance	Crack	Split	Leakage			
Coagulation	Solution/Storage tank	C	C	NO	NO	YES	C	*Both inner and outer wall of tank as well as pipes have deteriorated remarkably.	1931

Facility	Name	Concrete floor	Brick wall					Roof				
			Quality	Appearance	Crack	Split	Leakage	Appearance	Crack	Leakage	Ventilator	—
P/S Building	IntakeP/S	B	B	C	YES	NO	YES	C	NO	YES	C	—
	Dist.P/S	B	B	C	NO	NO	NO	C	NO	YES	C	—
	Washing P/S	C	B	C	NO	NO	NO	C	NO	YES	—	—

Facility	Name	Fitting				Equipment			Others	Const.year
		Doors	Windows	Glass	Ventilator	Step	Steel ladder	Lighting		
P/S Building	IntakeP/S	C	C	C	C	B	B	C	*Both internal and external wall/slab of building have deteriorated remarkably. Especially ceiling has seriously deteriorated.	1931
	Dist.P/S	C	C	C	C	B	B	C		1961
	Washing P/S	C	C	C	C	—	—	C		1931

Facility	Name	Concrete floor	Brick wall		Roof			Others	Const.year
			Appearance	Crack	Appearance	Crack	Leakage		
Other Buildings	Administration	B	B	NO	B	NO	YES	Both internal and external building are roughly maintained, however, ceiling has deteriorated remarkably.	1936
	Chlorination	B	B	NO	C	NO	YES	Both internal and external building have deteriorated. Especially amongthem, ceiling is seriously deteriorated.	1931
	Coagulation	B	B	NO	C	NO	YES	Both internal and external building have deteriorated. Especially amongthem, ceiling is seriously deteriorated.	1931
	Filter	B	B	NO	C	NO	YES	External part of the building has deteriorated remarkably and large crack is found. Especially ceiling is seriously deteriorated.	1931/1961
	Boiler	B	B	NO	C	NO	YES	Both internal and external building have deteriorated. Especially amongthem, ceiling is seriously deteriorated.	1961
	Mashine shop	B	B	NO	B	NO	YES	Both internal and external building have deteriorated. Especially amongthem, ceiling is seriously deteriorated.	1961

iii) Intake PS

Intake pumps and related facilities are listed in Table S 3.1.2.11(1) and (2).

Diagnosis results for intake facilities are shown in Table S 3.1.2.11 (3)

Table S 3.1.2.11(1) List of Intake Pump

No.	Name	Model	Q (m^3/hr)	Head (m)	D(in,out) (mm)	Power (kW)	in Pipe (mm)	out Valve (mm)	Installation year
1	Main pump	24NDN	4700	32	800,600	500	900	600	1982
2	Ditto	32A19	6300	26	800,600	630	900	600	1982
3	Ditto	Ditto	6300	26	800,600	630	900	600	1982
4	Ditto	32D19	3000	20	800,600	320	900	600	1982

Table S 3.1.2.11 (2) List of Intake PS facilities

No.	Name	Specifications	Installation year
1	Dredger	Micro pumping boat, 400m^3/h, - m, 100kW	1987
2	Intake gate	Motor gate, W0.85m×H1.8m	1982
3	Intake screen	Bar screen, Slit width 50mm,	1982
4	Intake pipes	D900 x 4	---
5	Transmission pipe	D1,000 mm x2	---
6	Pipe /Valves	D500-1000	---
7	Ceiling crane	Electrical W 11m x 5t , manual10t	1982
8	Power receiving facilities	Receiving power 2,000KVA, Transformer, incoming panels, bus sectional panels and feeding panels	---
9	PS power panel	4 units	---
10	Control panel	4 units	---
11	Cable & others		---

iv) Rapid Sand Filters

Rapid sand filters and related facilities are listed in Table S 3.1.2.12 (1) and (2), and the diagnosis results are shown in Table S 3.1.2.12 (3).

(v) Distribution PS

Distribution pumps and related facilities are listed in Table S 3.1.2.13(1) and (2) and the diagnosis results shows in Table S 3.1.2.13 (3).

Table S 3.1.2.11 (3) Diagnosis of Intake Facilities

Division	Name	Operation status	Condition, Appearance	Judgment
Pumps	No.1 main	No particular problem	Deteriorated. Recently, break down has frequently occurred.	C2
	No.2 main	No particular problem	Deteriorated. Recently, break down has frequently occurred.	C2
	No.3 main	No particular problem	Deteriorated. Recently, break down has frequently occurred.	C2
	No.4 main	No particular problem	Deteriorated. Recently, break down has frequently occurred.	C2
Pipes and other machines	Dredger	No particular problem	No problem	B
	Gate	Very few operation	Peeling off paint is observed, but no functional problem.	B
	Screen	No particular problem	Paint has peeled off	B
	Inlet Pipes	No particular problem	Painted, but lower part has corroded.	B
	Transmission Pipes	No particular problem	Painted, but lower part has corroded.	B
	Pips/ Valves	No particular problem	Not so corroded, but deteriorated	B
	Ceiling crane	No particular problem	No problem	B
Electrical facilities	Power receiving facilities	No particular problem。	Deteriorated.	C1
	PS Power panel	No particular problem	Deteriorated and mostly out of order	C1
	Control panel	No problem	Deteriorated and all automatic circuits are out of order.	C2
	Cable and Others	No problem	Deteriorated	C1
	Power receiving facilities	No particular problem	Deteriorated	C1

Table S 3.1.2.12 (1) List of Rapid Sand Filters

No.	Name	Specifications	Number	Inst. year
1-1	Filters(1): Rectangular type	A=60.9m2, Perforated collection pipe & double layer type, total filter layer 0.9-1.0m(quartz sand+anthracite, Collecting trough W m x Lm x units, Pipes and auto valve	6	1931
1-2	Pipes for filters(1)	Inlet D800, outlet D800, back wash D600, drain D800	1	1961
2-1	Filters(2) Circle type	A=52.8m2 (D8.2m), Perforated collection pipe & double layer type, total filter layer 0.9-1.0m(quartz and + anthracite), Collecting trough W m x Lm x units, Pipes and auto valve	18	1961
2-2	Pipes for filters(2)	inlet D800, outlet D800, back wash D600, drain D800	1	1961

Table S 3.1.2.12 (2) List of Facilities for Rapid Sand Filters

No.	Name	Specifications	Number	Inst. year
1	Washing pump (1)	VH-DS, 2500m^3/hx20mx320kw, with motor valve	1	---
2	Washing pump (2)	VH-DS, 2500m^3/hx20mx320kw, with motor valve	1	---
3	Power panel	Stand	3	---
4	Filter Control panel (1)	Stand	6	---
5	Filter Control panel (2)	Stand	18	---
6	Pump Control panel	Stand	2	---
7	Cable and others		1	---

Table S 3.1.2.12 (3) Diagnosis Sheet for Rapid Sand Filters

Division	Name	Operation status	Condition, Appearance	Judgment
Filters	Circle type	Water leak due to crack. 1 filter is out of shift.	A considerable water leaking due to crack in all filters	C1
	Rectangular type	No particular problem	Deteriorated, but no problem in use	B
Pumps	No.1 Washing	Motor broke down. Under replacement work	Remarkably deteriorated. Recently, break down has frequently occurred	C2
	No.2 Washing	No problem in operation	Recently, break down has frequently occurred	C2
Pipes for filters	Circle type	No particular problem	Re-painting was not done. Further corroded.	B
	Rectangular type	No particular problem	Re-paint wan not done. Further corroded.	B
Electrical facilities	Power panel	No particular problem	Deteriorated. Instruments are left out of order.	B
	Filter control panel (1)	No particular problem	Deteriorated	C1
	Filter control panel (2)	No particular problem	Deteriorated	C1
	Pump control panel	No particular problem	Deteriorated	C1
	Cable and others	No particular problem	Deteriorated	B

Table S 3.1.2.13(1) List of Distribution Pump

No.	Name	Type	Q (m^3/hr)	Head (m)	D (in, out) (mm)	Power (kW)	In Valve (mm)	Out Valve (mm)	Inst. year
1	Main pump	22NDS	4300	52	700,500	800	800	800	---
2	Ditto	18NDS	2800	65	700,500	500	800	800	---
3	Ditto	22NDS	4300	52	700,500	800	800	800	1966
4	Ditto	Ditto	4300	52	700,500	800	800	800	1985
5	Ditto	Ditto	4300	52	700,500	800	800	800	1981
6	Ditto	32A19	6300	26	700,500	650	800	800	---

Table S 3.1.2.13 (2) List of Distribution Pump Facilities

No.	Name	Specification	Number	Inst. year
1	Pipes	D500-D1200	1	---
2	Valves	D500-D1200	1	---
3	Ceiling crane	W 11m x 5 t	1	---
4	Power panel	Stand	6	---
5	Control panel	Stand	6	---
6	Cable＆others		1	---

Table S 3.1.2.13 (3) Diagnosis Sheet for Distribution Facilities

Division	Name	Operation status	Condition, Appearance	Judgment
Pumps	No.1 main	Bearing is out of order, remarkable water leakage	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.2 main	No problem	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.3 main	No problem	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.4 main	No control panel. Bearing of this unit is used for No.1 presently.	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.5 main	No problem	Remarkably deteriorated. Recently, break down has frequently occurred	C2
	No.6 main	No problem	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
Pipes and other Machines	Pipes	No problem	Lower part has corroded thoroughly.	B
	Valves	No problem	Corroded due to no coating of paint	B
	Ceiling crane	No problem	No problem	B
Electrical Facilities	Power panel	No problem	Deteriorated. Instruments are out of order.	C1
	Control panel	No problem	Deteriorated. Automatic instruments are left out of order.	C1
	Cable＆others	No problem	Deteriorated	C1

vi) Coagulant Facilities

Coagulant facilities are listed in Table S 3.1.2.14 (1) and the diagnosis results shows in Table S 3.1.2.14 (2).

Table S 3.1.2.14 (1) List of Coagulant Facilities

No.	Name	Specifications	Number	Inst. year
1	Dissolving Tank	Steel, D2.8mxwh 1.0m=6.16m3, with mechanical mixer 1.5kw	6	---
2	Feeding Valve	Punch valve D75mm	1	---
3	Pipe & valves	D75-50mm	1	---
4	Power panel	Stand	1	---
5	Control panel	Stand	2	---
6	Cable and others		1	---

Table S 3.1.2.14 (3) Diagnosis Sheet for Coagulant Facilities

No.	Name	Operation status	Condition, Appearance	Judgment
1	Dissolving Tank	Agitator is out of order.	Deteriorated. Paint peels off. Corroded.	C1
2	Feeding Valve	No problem	Deteriorated. Especially rubber is deteriorated.	C1
3	Pipe & valves	No problem	Deteriorated	C1
4	Power panel	No problem	Deteriorated. Instruments are out of order.	C1
5	Control panel	No problem	Deteriorated. Instruments are out of order.	C1
6	Cable and others	No problem	Deteriorated. Instruments are out of order.	C1

(vii) Chlorinator

Chlorinators and related facilities are listed in Table S 3.1.2.15 (1), and the diagnosis results are shown in Table S 3.1.2.15 (2).

Table S 3.1.2.15 (1) List of Chlorination Facilities

No.	Name	Type	Specification	Number	Inst. Year
1	Cylinder scale	Analog type	for 1ton Cylinder	2	1965
2	Gas filter			2	1965
3	Gas meter	Flow meter	For sedimentation, 4kg/hrxd20mm	3	1965
			For reservoirs, 4kg/hrxd20mm	6	1965
4	Ejector	Water ejector	D25mm	4	1965
5	Safety equipment		Sprinkler, Discharging chamber, gas mask	1	1965

Table S 3.1.2.15 (2) Diagnosis Sheet of Chlorination Facilities

No.	Name	Operation Status	Condition, Appearance	Judgment
1	Cylinder scale	No operational problem	Remarkably deteriorated. Poor precision	C2
2	Gas filter	No operational problem	Remarkably deteriorated	C2
3	Gas meter	4 units are left out of order	Remarkably deteriorated	C2
4	Ejector	No operational problem	Remarkably deteriorated	C2
5	Safelty equipment	No operational problem	Remarkably deteriorated	C2

(3) Groundwater WTPs

1) Kibray WTP

i) Diagnosis for Capacity of WTP

The design capacity and the investigated actual capacity of WTP are shown in Table S 3.1.2.16.

Table S 3.1.2.16 Capacity of WTP

Design Capacity				
Nominal Capacity			**455,200**	m^3/day
Maximum intake capacity by wells	20,000	m^3/hr =	480,000	m^3/d
Maximum intake capacity from Kadirya	17,000	m^3/hr =	408,000	m^3/d
Total distribution quantity			**888,000**	m^3/d
Distribution capacity of No.1 PS	11,300	m^3/hr =	271,200	m^3/d
Distribution capacity of No.2 PS	12,900	m^3/hr =	309,600	m^3/d
Total Distribution Capacity			**580,800**	m^3/d
Chlorination capacity No.1			5	kg/hr
Chlorination capacity No.2			10	kg/hr
Service reservoirs Capacity	10,000	m3	0.53	hr
Actual Capacity				
Maximum intake capacity by wells	15,000	m^3/hr =	360,000	m^3/d
Maximum intake capacity from Kadirya	17,000	m^3/hr =	408,000	m^3/d
Total distribution quantity			**768,000**	m^3/d
Distribution capacity of No.1 PS	9,040	m^3/hr =	216,960	m^3/d
Distribution capacity of No.2 PS	10,320	m^3/hr =	247,680	m^3/d
Total Intake capacity			**464,640**	m^3/d

ii) Diagnosis for Civil Structures and Buildings

Major civil structures and buildings of WTP are listed in Table S 3.1.2.17 (1).

Diagnosis results of these are shown in Table S 3.1.2.17 (2).

Table S 3.1.2.17 (1) List of Civil Structures and Building

No.	Name	Type	Dimension	Area (m^2)	Depth (m)	Volume (m^3)	Number
1	Filter pool-1	Pond		8,000			20
2	Filter pool-2	Pond		8,000			8
3	Filter pool-3	Pond		2,800			21
4	Reservoir	Concrete	36mx32m	1,152	4.5	5000	1
5	No.1 PS house	Brick	W8mxL40m	320			1
6	No.2 PS house	Brick	W12mxL48m	576			1
7	No.1 Disinfection house	Brick	W9mxL15mx2stroies	270			1
8	No.2 Disinfection house	Brick	W9mxL15mx2stroies	270			1

iii) Wells

95 wells were constructed in Kibray WTP, and 26 wells are located in right bank of Chrchik River and the rest of 49 wells are located at left bank. The list of well structures and the results of pumping test are shown in Table S 3.1.2.18 (1) to (5) and the list of well pumps and operation condition are shown in Table S 3.1.2.19 (1) to (3). The list of maintenance status and rehabilitation method are shown in Table S 3.1.2.20 (1) to (3)

The results of diagnosis are summarized in Tables S 3.1.2.21. The capacity of Kibray WTP is decreasing year-by-year, and some drastic countermeasures should be introduced.

Table S 3.1.2.17 (2) Diagonosis Sheet for Kibray WTP

Facility	Name	Inlet channel	Wall	Bottom	Outlet channel	Function	Cost.Year
Filter pond	Pond1-3	B	B	C	B	Because of no dredging for long term, accumulated sediments have affected filter function of the pond. Therefore effect of accelerating infiltration is considered to be limited.	1977

Facility	Name	Concrete					Cover soil		Pipes	Ventilator	Others	Const.year
		Quality	Appearance	Crack	Split	Leakage	Appearance	Erosion				
Reservoir	No.1 Reservoir	A	A	NO	NO	NO	A	A	B	C	*Inner condition was not examined because of filled water ,but reportedly in fair condition through hearing	1956
	No.2 Reservoir	A	A	NO	NO	NO	A	A	B	C		1956

Facility	Name	Concrete floor	Concrete wall					Blick wall		Roof		
			Quality	Appearance	Crack	Split	Leakage	Appearance	Crack	Appearance	Crack	Leakage
P/S Building	Dist.P/S-1	C	C	C	NO	NO	NO	C	NO	C	YES	YES
	Dist.P/S-2	C	C	C	NO	NO	NO	C	NO	C	YES	YES

Facility	Name	Fitting				Equipment			Others	Const.year
		Doors	Windows	Glass	Ventilator	Step	Steel floor	Lighting		
P/S Building	Dist.P/S-1	C	C	C	C	C	C	C	Both inner and outer building as well as ceiling have deteriorated remarkably.	1956
	Dist.P/S-2	C	C	C	C	C	C	C		1955

Facility	Name	Concrete foor	Blick wall		Roof			Fitting	Equipment	Const.year
			Appearance	Crack	Appearance	Crack	Leakage			
Other Building	Administration	B	B	NO	C	NO	NO	Both internal and external building are roughly maintained.	Doors、Windows、Glass	1955
	No.1 Disinfection	C	C	NO	C	NO	YES	Both internal and external building have deteriorated.	Doors、Windows、Glass	1955
	No.2 Disinfection	C	C	NO	C	NO	YES	Both internal and external building have deteriorated.	Doors、Windows、Glass	1955
	Mashine shop	C	C	NO	C	NO	YES	Both internal and external building are roughly maintained.	Doors、Windows、Glass	1957

Table S 3.1.2.18 (1) List of Well Structure and Pumping Test Data

WPT Name	Kibray

Well No.	Construction Year	Well Structure								Pumping Test Data					Water Quality Analysis Data							
		Ground Elevation (m)	Drilled Depth (m)	Drilled Diameter (mm)	Casing		Screen			Test Yield (L/s)	Static Water Level (m)	Pumping Water Level (m)	Draw-down (m)	Specific Capacity (L/s/m)	pH	Na + K (mg/L)	Ca (mg/L)	Mg (mg/L)	Cl (mg/L)	HCO3 (mg/L)	SO4 (mg/L)	TDS (mg/L)
					Diameter (mm)	Material of Casing	Total Length (m)	Position (m)	Geology of Screen													
1	1962	503.1	60.0		600-400	steel	17.5	35.7-53.2	bl-gr-sd	69.4	6.0	7.7	1.7	40.8	7.4	6.9	97.3	21.8	6.7	298.8	88.9	460
										90.0	6.0	8.0	2.0	45.0								
2	1960	503.7	54.0		600-400	steel	19.4	30.6-50.0	bl-gr-sd	150.0	2.0	6.0	4.0	37.5	7.4	6.0	90.0	12.5	8.0	240.0	48.0	310
3	1961	503.5	45.0		600-400	steel	11.0	30.0-41.0	bl-gr	48.0	6.5	7.5	1.0	48.0	6.5	2.8	98.0	13.3		170.0	51.2	316
4	1954	503.0	56.0		600-400	steel	22.0	21.0-43.0	bl-gr-sd	66.0	4.5	12.0	7.5	8.8	6.5	2.8	78.0	13.3		170.0	51.2	316
5	1958	503.7	52.0		600-400	steel	18.0	28.0-46.0	bl-gr-sd	191.6	4.0	9.0	5.0	38.3	7.3	3.5	88.0	20.0	9.2	230.0	100.0	400
6	1958	503.8	55.0		600-400	steel	18.0	32.0-50.0	bl-gr-sd	177.0	2.0	8.0	6.0	29.5	7.3	4.0	90.0	21.0	9.4	244.0	106.0	450
7	1954	502.5	45.0		600-400	steel	15.8	24.2-40.0	gr-sd	60.5	2.0	3.0	1.0	60.5	8.3	3.5	101.0	22.0	13.0			350
8	1956	503.9	43.0		600-400	steel	17.4	20.4-37.8	gr-sd	18.0	2.6	3.0	0.4	41.9	8.3	3.3	99.9	20.4	13.0			345
9	1958	505.0	47.0		600-400	steel	16.7	25.0-41.7	bl-gr-sd	50.0	5.0	5.6	0.6	83.3	7.3	14.3	89.5	20.5	10.0	259.0	115.5	450
10	1956	504.3	45.0		600-400	steel	10.7	34.3-45.0	gr-sd	38.8	5.0	5.5	0.5	77.6	7.4	18.4	86.3	18.8	13.5	256.5	110.2	431
										55.5	5.0	5.8	0.8	69.4								
11	1958	503.8	46.0		600-400	steel	22.6	11.5-26.5 32.0-39.6	bl-gr-sd	48.0	6.5	7.5	1.0	48.0	7.4	6.0	82.3	14.4	10.3	256.2	51.0	332
12	1958	505.6	46.0		600-400	steel	27.4	4.1-21.0 33.1-43.6	bl-gr-sd	78.3	4.5	8.0	3.5	22.4	7.4	6.0	82.3	14.4	10.3	256.2	51.0	332
13	1958	506.2	45.0		600-400	steel	8.7	34.3-43.0	bl-gr	69.4	6.0	7.7	1.7	40.8	7.4	6.9	97.3	21.8	6.7	298.3	88.6	460
										90.0	6.0	8.0	2.0	45.0								
14	1960	506.8	53.0		600-400	steel	17.0	30.3-47.3	bl-gr	61.0	5.1	7.1	2.0	30.5	6.5	2.8	98.0	13.3		170.0	59.2	316
										70.0	5.1	8.1	3.0	23.3								
14a	1965	504.9	52.0		600-400	steel	16.0	30.0-46.0	bl-gr-sd	51.0	3.9	5.4	1.5	34.0	7.5	16.6	103.1	14.3	14.0	286.7	93.0	448
										71.9	3.9	6.3	2.4	30.0								
15	1963	503.1	50.0		600-400	steel	17.5	26.0-43.5	bl-gr	59.1	2.0	4.2	2.2	27.5	7.7	9.8	95.1	15.8	13.8	274.5	75.7	436
										66.6	2.0	4.8	2.8	23.8								
16	1963	503.1	50.0		600-400	steel	19.0	25.0-44.0	bl-gr	40.0	4.5	6.5	2.0	20.0	7.3	4.8	81.1	11.9	6.9	262.3	36.2	392
										42.7	4.5	7.0	2.5	17.1								
17	1964	504.4	46.0		600-400	steel	15.0	25.0-40.0	bl-gr-sd	48.0	2.6	3.1	0.5	96.0	7.4	0.3	91.3	12.4	9.7	269.3	44.7	390
										56.1	2.6	3.4	0.8	70.1								
18	1964	506.8	50.0		600-400	steel	20.0	27.0-47.0	bl-gr-sd	52.2	3.1	4.3	1.3	41.8	7.4	0.2	92.5	11.9	9.7	268.4	45.3	392
										64.1	3.1	5.0	2.0	32.9								
19	1963	507.4	51.0		600-400	steel	17.8	27.2-45.0	bl-gr	55.8	2.2	5.0	2.8	19.9	7.6	9.2	81.1	13.0	8.3	262.3	47.7	412
										60.0	2.2	5.2	3.0	20.0								
20	1964	508.9	52.0		600-400	steel	17.5	28.3-45.8	bl-gr-sd	50.0	3.3	5.2	1.9	26.3	7.4	29.4	92.5	13.0	8.3	286.7	97.1	416
										55.0	3.3	5.6	2.3	23.9								

Table S 3.1.2.18 (2) List of Well Structure and Pumping Test Data

WPT Name	Kibray

Well No.	Construction Year	Well Structure: Ground Elevation (m)	Drilled Depth (m)	Drilled Diameter (mm)	Casing: Diameter (mm)	Casing: Material of Casing	Screen: Total Length (m)	Screen: Position (m)	Screen: Geology of Screen	Pumping Test Data: Test Yield (L/s)	Static Water Level (m)	Pumping Water Level (m)	Draw-down (m)	Specific Capa-city (L/s/m)	Water Quality Analysis Data: pH	Na + K (mg/L)	Ca (mg/L)	Mg (mg/L)	Cl (mg/L)	HCO3 (mg/L)	SO4 (mg/L)	TDS (mg/L)
21	1964	510.9	50.0		600-400	steel	23.0	22.0-45.0	bl-gr-sd	56.1	2.0	3.0	1.0	56.1	7.4	0.3	90.7	12.8	9.7	268.4	45.5	390
										70.0	2.0	3.5	1.5	46.7								
22	1965	512.2	50.0		630-400	steel	17.0	25.8-43.8	bl-gr-sd	58.8	2.0	4.0	2.0	29.4	7.4	0.3	91.5	13.4	9.8	267.8	46.7	395
										70.0	2.0	5.0	3.0	23.3								
23		514.6																				
24	1964	516.4	50.0		600-400	steel	19.0	26.0-45.0	bl-gr	70.0	2.0	4.0	2.0	35.0	7.4	0.5	91.5	11.8	9.8	269.7	47.8	396
										76.9	2.0	5.5	3.5	22.0								
25	1965	516.4	50.0		630-400	steel	19.0	24.6-43.6	bl-gr-sd	58.3	2.2	4.2	2.0	29.2	7.3	0.3	90.5	11.9	10.2	267.8	46.5	396
										71.6	2.2	5.2	3.0	23.9								
26	1966	502.47	50.0		600-400	steel	20.0	24.2-44.2	bl-gr-sd	33.3	4.4	6.8	2.4	13.9	7.5	4.4	72.0	13.1	8.4	231.9	39.5	288
										50.0	4.4	8.8	4.4	11.4								
27	1966	504.16	50.0		600-400	steel	23.0	23.0-46.0	bl-gr-sd	40.0	4.5	5.6	1.1	36.4	7.2	22.8	72.0	8.8	3.3	280.6	29.2	296
										50.0	4.5	7.8	3.3	15.2								
28	1964	506.58	52.0		600-400	steel	20.4	24.2-44.6	bl-gr-sd	44.4	4.0	5.8	1.8	24.7	7.2	12.2	72.0	9.9	12.6	213.5	51.4	296
										50.0	4.0	6.0	2.0	25.0								
29	1967	508.03	50.0		600-400	steel	19.5	26.0-45.5	bl-gr-sd	55.5	1.8	4.8	3.0	18.5	7.5	5.8	67.1	9.4	7.7	213.5	31.3	248
										66.6	1.8	5.2	3.4	19.9								
30	1967	509.77	47.0		600-400	steel	19.0	24.0-43.0	bl-gr-sd	50.0	1.5	9.0	7.5	6.7	7.5	5.8	67.1	9.4	7.7	213.5	31.3	248
31	1965	510.71	50.0		600	steel	18.0	27.5-45.5	bl-gr-sd	44.4	4.0	5.8	1.8	24.7	7.3	7.1	72.0	8.8	7.0	231.8	23.6	260
										50.0	4.0	6.0	2.0	25.0								
32	1967	512.71	50.0		600	steel	20.0	26.0-46.0	bl-gr-sd	55.5	4.6	7.4	2.8	19.8	7.0	1.6	26.4	6.9	5.6	85.4	18.9	128
										61.1	4.6	7.7	3.1	19.7								
33	1966	514.58	50.0		600-400	steel	18.0	28.0-46.0	bl-gr-sd	50.0	5.1	6.7	1.6	31.3	7.4	1.6	83.1	10.3	7.7	250.1	36.2	288
										61.1	5.1	7.1	2.0	30.6								
34	1966	516.53	50.0		600-400	steel	17.0	26.0-43.0	bl-gr-sd	44.4	4.4	8.4	4.0	11.1	7.2	2.1	83.1	11.5	7.7	269.3	33.7	320
										50.0	4.4	9.0	4.6	10.9								
35	1966	518.03	50.0		600-400	steel	19.0	27.5-46.5	bl-gr-sd	50.0	4.5	8.3	3.8	13.2	7.4	2.1	19.2	13.1	7.0	256.2	34.6	272
										58.3	4.5	9.0	4.5	13.0								
36	1966	520.05	51.0		600-400	steel	21.0	24.0-45.0	bl-gr-sd	44.4	2.0	6.0	4.0	11.1	7.5	0.9	79.2	10.9	8.4	237.9	36.2	296
										50.0	2.0	6.6	4.6	10.9								
37	1966	522.03	50.0		600-400	steel	20.0	26.0-46.0	bl-gr-sd	44.4	2.2	5.1	2.9	15.3	7.5	3.7	86.4	13.1	8.4	265.4	46.1	360
										50.0	2.2	5.8	3.6	13.9								
38	1966	524.22	50.0		600-400	steel	20.0	27.0-47.0	bl-gr-sd	44.4	2.1	5.0	2.9	15.3	7.5	3.7	86.4	13.1	8.4	265.4	46.1	360
										50.0	2.1	5.7	3.6	13.9								

Table S 3.1.2.18 (3) List of Well Structure and Pumping Test Data

WPT Name	Kibray

Well No.	Construction Year	Well Structure: Ground Elevation (m)	Drilled Depth (m)	Drilled Diameter (mm)	Casing: Diameter (mm)	Casing: Material of Casing	Screen: Total Length (m)	Screen: Position (m)	Screen: Geology of Screen	Pumping Test Data: Test Yield (L/s)	Static Water Level (m)	Pumping Water Level (m)	Draw-down (m)	Specific Capa-city (L/s/m)	Water Quality Analysis Data: pH	Na + K (mg/L)	Ca (mg/L)	Mg (mg/L)	Cl (mg/L)	HCO3 (mg/L)	SO4 (mg/L)	TDS (mg/L)
39	1969	500.54	50.0		600-400	steel	35.0	8.0-23.0		58.8	3.7	5.6	1.9	30.9	7.9	0.5	78.4	20.0	7.2	207.4	96.2	284
								26.0-46.0	bl-gr-sd	69.4	3.7	6.1	2.4	28.9								
40	1967	501.95	50.0		600-400	steel	20.0	26.0-46.0	bl-gr-sd	55.5	3.0	5.0	2.0	27.8	7.1	4.8	74.5	11.7	8.4	237.0	36.2	272
										69.4	3.0	5.5	2.5	27.8								
41	1967	505.61	47.0		600-400	steel	18.1	24.0-42.1	bl-gr-sd	51.1	7.5	10.3	2.8	18.3	7.4	0.7	59.6	10.6	5.6	195.2	25.1	240
										63.8	7.5	11.0	3.5	18.2								
42	1965	506.26	50.0		600-400	steel	18.0	27.5-45.5	bl-gr-sd	44.4	4.0	5.8	1.8	24.7	7.3	7.1	72.0	8.8	7.0	231.8	23.6	260
										50.0	4.0	6.0	2.0	25.0								
43		507.07																				
44	1968	509.30	50.0		600-400	steel	18.0	26.0-44.0	bl-gr-sd	29.7	4.1	10.6	6.5	4.6	7.2	5.5	68.7	10.4	7.0	213.5	27.2	252
										38.6	4.1	12.6	8.5	4.5								
45	1968	511.26	50.0		600-400	steel	20.0	25.0-45.0	bl-gr-sd	55.0	3.5	5.3	1.8	30.6	7.4	2.1	74.4	10.4	8.5	225.7	34.6	272
										66.6	3.5	5.5	2.0	33.3								
46	1968	512.67	50.0		600-400	steel	19.5	26.0-45.5	bl-gr-sd	50.0	2.5	7.3	4.8	10.4	7.4	3.0	78.2	12.7	9.2	244.0	39.5	296
										61.1	2.5	7.5	5.0	12.2								
47	1968	514.34	50.0		600-400	steel	20.0	25.0-45.0	bl-gr-sd	51.9	2.0	6.0	4.0	13.0	7.4	7.1	72.9	13.3	5.6	256.2	32.9	280
										57.5	2.0	7.0	5.0	11.5								
48	1970	516.91	50.0		600-400	steel	20.0	27.5-47.5	bl-gr-sd													
49	1968	518.95	50.0		600-400	steel	20.0	25.0-45.0	bl-gr-sd	55.5	2.5	5.3	2.8	19.8	7.4	5.3	76.6	13.3	7.0	256.4	35.4	280
										66.6	2.5	5.5	3.0	22.2								
50	1968	520.21	50.0		600-400	steel	20.0	25.0-45.0	bl-gr-sd	77.7	2.8	3.8	1.0	77.7	7.5	6.4	82.1	12.2	7.0	271.5	34.6	304
										83.3	2.8	3.9	1.1	75.7								
51	1969	521.26	50.0		600-400	steel	7.0	36.0-43.0	bl-gr-sd													
52	1969	524.44	50.0		600-400	steel	18.9	26.5-45.4	bl-gr-sd	61.1	3.0	5.4	2.4	25.5								
										66.6	3.0	5.6	2.6	25.6								
53	1968	496.56	50.0		600-400	steel	7.0	36.0-43.0	bl-gr-sd	66.6	1.7	3.1	1.4	47.6	7.4	3.6	83.9	10.0	7.0	262.3	32.1	288
										70.0	1.7	3.2	1.5	46.7								
54	1969	498.29	50.0		600-400	steel	30.0	13.0-23.0	bl-gr-sd	66.6	2.3	4.6	2.3	29.0	7.2	1.8	84.0	4.0	8.3	225.0	37.5	220
								26.0-46.0	gr-sd	77.7	2.3	5.0	2.7	28.8								
55	1968	500.46	50.0		600-400	steel	21.0	26.0-47.0	bl-gr-sd	61.0	2.5	4.5	2.0	30.5	7.4	1.8	68.7	10.4	7.8	213.5	31.3	248
										66.6	2.5	4.6	2.1	31.7								
56	1967	501.74	50.2		600-400	steel	21.2	27.0-48.2	bl-gr-sd	55.5	4.0	5.5	1.5	37.0	7.2	5.5	67.1	9.4	7.0	219.6	27.2	280
										72.2	4.0	5.9	1.9	38.0								
57	1967	503.38	50.0		600-400	steel	20.0	26.0-46.0	bl-gr-sd	55.0	2.7	4.0	1.3	44.0	7.2	7.4	78.4	4.0	8.3	207.0	45.1	220
										76.9	2.7	4.1	1.4	57.0								

Table S 3.1.2.18 (4) List of Well Structure and Pumping Test Data

WPT Name	Kibray

Well No.	Construction Year	Well Structure: Ground Elevation (m)	Drilled Depth (m)	Drilled Diameter (mm)	Casing: Diameter (mm)	Casing: Material of Casing	Screen: Total Length (m)	Screen: Position (m)	Screen: Geology of Screen	Pumping Test Data: Test Yield (L/s)	Static Water Level (m)	Pumping Water Level (m)	Draw-down (m)	Specific Capacity (L/s/m)	Water Quality Analysis Data: pH	Na + K (mg/L)	Ca (mg/L)	Mg (mg/L)	Cl (mg/L)	HCO3 (mg/L)	SO4 (mg/L)	TDS (mg/L)
58	1965	505.40	50.0		600-400	steel	17.5	28.0-45.5	bl-gr-sd	44.4	2.2	4.1	1.9	23.4	7.5	5.8	57.6	17.5	5.4	201.3	53.5	280
										51.4	2.2	4.3	2.1	24.5								
59	1967	507.23	50.0		600-400	steel	16.2	26.5-42.7	bl-gr-sd	52.7	2.3	5.1	2.8	18.8	7.3	4.6	54.0	8.2	4.9	183.0	20.6	200
										63.8	2.3	6.1	3.8	16.8								
60	1969	509.52	50.2		600-400	steel	21.2	27.0-48.2	bl-gr-sd													
61	1969	510.67	50.0		600-400	steel	20.0	25.0-45.0	bl-gr-sd	51.9	2.2	4.0	1.8	29.7	7.9	0.1	61.1	12.0	8.6	195.0	28.0	204
										61.9	2.2	4.4	2.2	28.1								
62	1969	512.47	50.0		600-400	steel	29.1	15.0-44.1	bl-gr-sd	62.2	2.6	5.1	2.5	24.9	7.8	4.8	70.0	8.0	8.3	195.2	42.8	212
										76.9	2.6	5.6	3.0	25.6								
63	1969	514.25	50.0		600-400	steel	25.0	10.0-22.5	bl	90.0	2.8	4.3	1.5	60.0	7.6	0.1	84.0	8.0	10.4	207.4	36.2	292
								27.5-46.0	gr-sd	110.8	2.8	4.5	1.7	65.2								
64	1967	506.36	51.5		600-400	steel	25.0	23.5-48.5	bl-gr-sd	50.0	2.0	6.0	4.0	12.5	7.0	1.8	27.8	7.1	6.7	93.8	21.5	184
										61.1	2.0	6.9	4.9	12.5								
65	1965	513.60	80.0		350-200	steel	47.3	5.8-53.0	bl-gr-sd	100.0	2.63	4.30	1.67	59.9	7.3	12.0	69.0	13.0	10.0	66.0	19.0	
66	1977	507.43	35.0		600-400	steel	30.0	0.0-30.0	bl-gr-sd	85.0	1.6	3.5	1.9	44.7	7.8	16.3	60.0	7.2	9.7	170.8	58.2	236
67	1965	508.91	50.3		350-200	steel	37.2	5.3-42.5	bl-gr-sd	98.9	1.7	9.5	7.8	12.6								
68	1977	510.50	30.0		630-426	steel	26.5	3.5-30.0	bl-gr-sd	44.7	4.0	8.4	4.4	10.2	7.3		80.0	9.6	17.4	182.0	62.2	274
										50.6	4.0	8.6	4.7	10.9								
69	1977	510.78	30.0		630-426	steel	26.5	5.0-27.0	bl-gr-sd	95.0	1.4	2.6	1.2	79.2	7.9	26.9	72.0	7.2	15.9	170.8	101.0	342
										110.0	1.4	2.7	1.4	81.5								
70	1978	512.26	30.0		400	steel	24.0	2.0-26.0	bl-gr-sd	76.0	1.7	4.3	2.6	29.2	8.1	25.7	52.0	9.6	16.0	183.0	51.0	260
										93.0	1.7	4.8	3.1	30.0								
71	1978	513.24	30.0		400	steel	21.6	4.0-25.6	bl-gr-sd	67.0	1.6	3.6	2.0	33.5	7.2	13.6	72.0	7.2	16.0	195.2	53.5	260
										77.0	1.6	3.8	2.2	35.0								
72	1972	514.22	31.0		600-400	steel	24.5	4.0-21.0	bl-gr-sd	83.0	1.2	2.2	1.0	83.0	7.6	28.0	24.0	12.0	14.0	122.0	37.0	226
								22.0-29.5	bl-gr-sd													
73	1976	514.12	50.0		600-426	steel	37.8	7.0-44.8	bl-gr-sd	71.1	1.3	4.3	3.0	23.7	7.8	31.7	84.0	32.0	2.8	244.0	150.0	420
74	1976	515.14	50.0		630-426	steel	32.0	12.0-20.0	bl-gr-sd	64.7	1.0	6.0	5.0	12.9	7.5	3.7	86.4	13.1	8.4	265.0	46.8	360
								24.0-48.0	bl-gr-sd	70.8	1.0	6.8	5.8	12.2								
75	1976	516.78	50.0		630-426	steel	40.3	6.0-46.3	bl-gr-sd	77.0	1.0	3.5	2.5	30.8	7.2	14.0	56.0	4.0	13.0	134.0	46.0	246
										99.0	1.0	3.6	2.6	38.8								
76	1969	518.16	50.0		500-400	steel	27.6	15.0-42.6	bl-gr-sd	40.0	5.0	8.3	3.3	12.1	7.4	0.5	89.0	8.0	11.1	244.0	37.0	252
										55.0	5.0	9.0	4.0	13.8								
77	1976	519.18	50.0		630-426	steel	39.1	5.9-24.0	bl-gr-sd	78.0	1.5	4.4	2.9	26.9	7.2	14.0	56.0	4.0	13.0	134.0	35.0	208
								26.0-47.0	bl-gr-sd	91.0	1.5	5.0	3.5	26.0								

Table S 3.1.2.18 (5) List of Well Structure and Pumping Test Data

WPT Name	Kibray

Well No.	Construction Year	Well Structure								Pumping Test Data					Water Quality Analysis Data							
		Ground Elevation (m)	Drilled Depth (m)	Drilled Diameter (mm)	Casing		Screen			Test Yield (L/s)	Static Water Level (m)	Pumping Water Level (m)	Draw-down (m)	Specific Capa-city (L/s/m)	pH	Na + K (mg/L)	Ca (mg/L)	Mg (mg/L)	Cl (mg/L)	HCO3 (mg/L)	SO4 (mg/L)	TDS (mg/L)
					Diameter (mm)	Material of Casing	Total Length (m)	Position (m)	Geology of Screen													
78	1966	520.25	40.0		350-200	steel	28.0	5.6-33.6	bl-gr-sd	78.9	1.8	11.9	10.1	7.8	7.0	0.5	67.0	24.0	0.5	75.0	15.0	
79	1978	521.73	35.0		400	steel	23.7	6.3-30.0	bl-gr-sd	55.0	3.0	6.6	3.6	15.3	7.8	51.5	60.0	9.6	25.7	183.0	112.0	350
80	1978	522.21	31.0		400	steel	20.6	5.2-25.8	bl-gr-sd	62.5	1.7	4.0	2.3	27.2	7.8	45.7	56.0	4.8	11.1	159.0	110.0	307
										71.4	1.7	4.2	2.5	28.6								
81	1978	523.22	31.0		400	steel	21.4	4.0-25.4	bl-gr-sd	77.0	0.4	1.7	1.3	59.2	7.9	2.6	48.0	9.5	9.5	146.0	32.0	216
										100.0	0.4	2.4	2.0	50.0								
1G	1981	508.64	30.0		350	steel	19.0	5.5-24.5	bl-gr-sd	100.0	2.3	4.2	1.9	51.5								
2G	1982	507.12	30.0		350	steel	19.0	5.5-24.5	bl-gr-sd	115.0	2.3	5.7	3.4	34.0								
3G	1982	507.71	30.0		350	steel	17.3	7.0-24.3	bl-gr-sd	76.0	2.6	7.3	4.7	16.0								
4G	1981	510.65	30.0		350	steel	16.0	6.0-22.0	bl-gr-sd	75.0	1.8	8.5	6.6	11.3								
1P	U.P.	525.92																				
2P	U.P.	525.45																				
3P	U.P.	524.93																				
4P	U.P.	524.42																				
5P	U.P.	522.90																				
6P	U.P.	522.39																				
7P		519.67																				
8P	U.P.	519.26																				
9P		518.06																				
10P	U.P.	517.82																				
11P	U.P.	516.42																				
12P	U.P.	514.67																				
13P		512.72																				
14P		513.62																				
15P		510.99																				
16P		511.85																				
33P	1984	508.03	35.0		400	steel	25.0	5.0-30.0	bl-gr													
34P	1994	509.86	35.0		400	steel			bl-gr													
35P		511.17	35.0		400	steel			bl-gr													
36P	U.P.																					

Table S 3.1.2.19 (1) List of Pumps and Operation

WPT Name	Kibray																		
		Pump Facilities						Operation of Groundwater Intake											
						Pump Capacity					Pumping Test at Feb. 2003						Groundwater Level		
Well No.	Starting Year, Operated	Pump Type	Model No.	Dia-meter (mm)	Output (KW)	H (m)	Q (m3/hr)	Recom-mended Intake Rate (m3/hr)	Actual Amount of Intake (m3/hr)	Cause of Non-Operation	Test Yield (L/s)	Static GWL (m)	Pumping GWL (m)	Draw-down (m)	Specific Capacity (L/s/m)	Decline of Well Capacity(%)	Static GWL (m)	Pumping GWL (m)	Problems for Intake
1	1962	C	20A18x1	250	75	35 20	403 602	600	(300)		59.0	2.3	3.2	0.9	69.4	154.2	4.1	6.1	
2	1960	C	20A18x1	250	75	20	602	600	(300)		98.0	2.5	4.5	2.0	50.0	133.3	4.4	6.1	
3	1961	S	ETSV-12	150	45	65 30	150 270	200	(200)		48.0	6.5	14.0	7.5	6.4	13.3	3.4	4.8	
4	1958	C	20A18x1	250	75	20	602	280	(300)		50.0	2.1	4.1	2.0	25.0	284.1	4.8	7.5	
5	1958	C	20A18x1	250	75	20	602	600	(300)		177.8	3.5	10.3	6.9	26.0	67.7	4.5	7.5	
6	1958	C	20A18x1	250	75	20	602	600	(300)		166.6	4.0	12.7	8.7	19.1	64.9	5.3	7.5	
7	1955	C	20A18x1	250	75	20	602	250	470		160.0	2.0	8.0	6.0	26.7	44.1	4.3	7.2	
8	1957	C	20A18x1	250	75	20	602	600	(300)		136.0	2.6	5.3	2.7	50.0	119.4	4.6	6.4	
9	1956	C	20A18x1	250	75	20	602	200	470			6.4					6.3	9.9	
10	1959	C	20A18x1	250	75	20	602	200	370		38.9	5.0	5.5	0.5	77.7	100.1	5.4	7.3	
11	1962	S	ETSV-12	150	45	30	270	200	0	Power Source	47.2	4.0	4.7	0.7	67.4	140.5	4.5	7.1	
12	1958	C	20A18x1	250	75	20	602	320	140								6.2	8.3	
13	1958	C	20A18x1	250	75	20	602	600	0	Power Source	69.4	6.0	13.9	8.0	8.7	19.4	6.0	7.9	
14	1960	C		250				200	160		61.0	5.2	12.3	7.1	8.6	28.2	5.4	8.1	
14a	1966	S	ETSV-12	150	45	30	270	200	150		51.0	3.9	5.4	1.5	34.0	100.0	5.4	7.2	
15	1964	C	20A18x1	250	75	20	602	200	260		59.1	2.0	4.2	2.2	27.5	100.0	5.5	7.1	
16	1966	C	20A18x1	250	75	20	602	200	0	Pump	40.0	4.5	6.5	2.0	20.0	20.8	3.6	9.1	
17	1966	C	20A18x1	250	75	20	602	200	(300)		48.0	2.6	3.1	0.5	96.0	100.0	4.2	7.0	
18	1966	C	20A18x1	250	75	20	602	200	(300)		52.2	3.1	4.3	1.3	41.8	100.0	5.4	7.8	
19	1965	C	20A18x1	250	75	20	602	200	>400		55.8	2.2	5.0	2.8	19.9	100.0	4.6	6.6	
20	1965	C	20A18x1	250	75	20	602	200	(300)		50.0	3.3	5.2	1.9	26.3	100.0	3.6	9.4	
21	1966	C	20A18x1	250	75	20	602	200	>400		56.1	2.0	3.0	1.0	56.1	100.0	4.9	7.3	
22	1967	C	20A18x1	250	75	20	602	200	0	Motor	58.8	2.0	4.0	2.0	29.4	100.0	2.1		
23		C		250	75			600	0	Pump	70.0	1.0	2.8	1.8	38.9				
24	1967	C	20A18x1	250	75	20	602	600	(300)		70.0	2.0	4.0	2.0	35.0	100.0	3.0		
25	1967	C	20A18x1	250	75	20	602	200	(200)		58.3	2.2	4.2	2.0	29.2	100.0	3.3	8.3	
26	1968	C	20A18x1	250	75	20	602	200-250	0	Motor							5.9		
27	1968	C		250	75		600	250	0	Motor	40.0	4.5	5.6	1.1	36.4	100.0	4.3		
28	1969	C	20A18x1	250	75	20	602	200	0	Motor	44.4	3.0	6.0	3.0	14.8	59.2	4.0		
29	1969	C	20A18x1	250	75	20	602	200	(300)		44.4	2.2	4.1	1.9	23.4	117.5	3.9	8.6	
31	1969	C	20A18x1	250	75	20	602	200	(300)								3.3	8.1	
32	1969	S	ETSV-12	150	45	30	270	200	0	Motor	33.3	4.4	6.8	2.4	13.9	70.0	3.8	5.7	
33	1969	C	20A18x1	250	75	20	602	200	(300)		50.0	5.1	6.7	1.6	31.3	100.0	6.0	9.6	
34	1969	C	20A18x1	250	75	20	602	200	(300)		44.4	4.4	8.4	4.0	11.1	100.0	7.1	9.9	
35	1969	C	20A18x1	250	75	20	602	200	0	Motor	50.0	4.5	8.3	3.8	13.2	100.0	3.8		

Table S 3.1.2.19 (2) List of Pumps and Operation

WPT Name	Kibray																		
Well No.	Starting Year, Operated	Pump Facilities						Operation of Groundwater Intake											Problems for Intake
		Pump Type	Model No.	Dia-meter (mm)	Output (KW)	Pump Capacity		Recom-mended Intake Rate (m3/hr)	Actual Amount of Intake (m3/hr)	Cause of Non-Operation	Pumping Test at Feb. 2003						Groundwater Level		
						H (m)	Q (m3/hr)				Test Yield (L/s)	Static GWL (m)	Pumping GWL (m)	Draw-down (m)	Specific Capacity (L/s/m)	Decline of Well Capacity(%)	Static GWL (m)	Pumping GWL (m)	
30	1969	C	ATH-14	250	75	100 75 46	170 260 360	200	0	Pump									
36	1969	C	20A18x1	250	75	20	602	200	(300)		44.4	2.0	6.0	4.0	11.1	100.0	3.3	9.2	
37	1069	C	20A18x1	250	75	20	602	200	(300)		44.4	2.2	5.1	2.9	15.3	100.0	2.7		
38		C	20A18x1	250	75	20	602	200	(300)		44.4	2.1	5.0	2.9	15.3	100.0	3.9	9.6	
39		C	20A18x1	250	75	20	602	200	0	Pump	55.0	2.7	4.0	1.3	44.0	142.2	5.3	9.5	
40		C	20A18x1	250	75	20	602	200	0	Pump	51.9	2.2	4.0	1.8	28.8	103.9	2.7		
41	1969	C	20A18x1	250	75	20	602	200	0	Pump	62.2	2.6	5.1	2.5	24.9	136.3	3.6	4.6	
42	1967	C	20A18x1	250	75	20	602	200	(300)		55.5	1.8	4.8	3.0	18.5	74.0	4.3	7.3	
43		S	ETSV-12	150	45	30	270		(200)		55.5	3.0	5.0	2.0	27.8		1.9	3.7	
44	1969	C	20A18x1	250	75	20	602	200	(300)		51.1	7.5	10.3	2.8	18.3	399.4	4.5	8.3	
45	1969	C	20A18x1	250	75	20	602	200	(300)		13.0	1.0	14.0	13.0	1.0	3.0	4.4	7.1	
46	1969	C	20A18x1	250	75	20	602	200	(300)		29.7	4.1	10.6	6.5	4.6	43.9	4.2	7.5	
47	1969	C	20A18x1	250	75	20	602	200	0	Pump	55.0	3.5	5.3	1.8	30.6	235.5	4.6	8.2	
48	1969	C	20A18x1	250	75	20	602		(300)		50.0	2.5	7.3	4.8	10.4		3.9	5.9	
49	1969	C	20A18x1	250	75	20	602	200	(300)		51.9	2.0	8.0	6.0	8.7	39.0	5.9	10.0	
50	1970	C	20A18x1	250	75	20	602	200	(300)		57.7	1.4	3.0	1.6	36.1	46.4	3.3	4.8	
51	1970	C	20A18x1	250	75	20	602	200	0	Motor	55.5	2.5	5.3	2.8	19.8		4.9	8.3	
52	1969	C	20A18x1	250	75	20	602	200	(300)		77.7	2.8	3.8	1.0	77.7	303.3	4.5	7.5	
53	1972	C	20A18x1	250	75	20	602	200	0	Pump	66.6	1.7	3.1	1.4	47.6	100.0	2.4		
54	1972	C	20A18x1	250	75	20	602	200	(300)		61.1	3.0	5.4	2.4	25.5	87.9	4.5	6.2	
55	1972	C	20A18x1	250	75	20	602	200	0	Motor	61.0	2.5	4.5	2.0	30.5	96.2	4.1	6.8	
56	1969	C	20A18x1	250	75	20	602	200	0	Pump	44.4	2.2	4.1	1.9	23.4	61.5	4.4	7.1	
57	1969	C	20A18x1	250	75	20	602	200	0	Pump	44.4	4.0	5.8	1.8	24.7	43.3	4.2	6.4	
58	1967	C	20A18x1	250	75	20	602	200	0	Pipes	52.0	2.0	4.4	2.4	21.7	88.5	3.9	6.4	
59	1967	C	20A18x1	250	75	20	602	200	(300)		52.7	2.3	5.1	2.8	18.8	100.0	3.2	8.1	
60	1969	C	20A18x1	250	75	20	602	200	0	Motor	55.5	4.6	7.4	2.8	19.8		4.9	8.4	
61	1972	C	20A18x1	250	75	20	602	200	0	Motor	57.7	3.6	5.8	2.3	25.6	86.5	4.1	6.3	
62	1972	C	20A18x1	250	75	20	602	200	0	Motor	58.8	3.7	5.6	1.9	30.9	120.7	5.0	8.7	
63	1971	C	20A18x1	250	75	20	602		(300)		66.6	2.3	4.6	2.3	29.0	48.3	4.0	7.5	
64	1968	C	20A18x1	250	75	20	602	200	(300)		50.0	2.0	6.0	4.0	12.5	100.0	4.1	6.7	
65	1976	S	ETSV-12	150	45	30	270	360	(200)		57.7	1.3	2.3	1.0	57.7	96.4	3.9	5.3	
66	1980	C	20A18x1	250	75	20	602	375	630		85.0	1.6	3.5	1.9	44.7	100.0	4.0	7.5	
67	1980	S	ETSV-12	150	45	30	270	350	0	Pipes	105.6	2.2	5.3	3.1	33.7	267.6	3.2		
68	1980	S	ETSV-12	150	45	30	270	210	240		50.6	4.0	8.6	4.7	10.9	100.0	3.2	4.3	
69	1980	S	ETSV-12	150	45	30	270	210	250		110.0	1.4	2.7	1.4	81.5	100.0	3.6	4.6	

Table S 3.1.2.19 (3) List of Pumps and Operation

WPT Name	Kibray																		
Well No.	Starting Year, Operated	Pump Facilities						Operation of Groundwater Intake											
		Pump Type	Model No.	Dia-meter (mm)	Output (KW)	Pump Capacity		Recom-mended Intake Rate (m3/hr)	Actual Amount of Intake (m3/hr)	Cause of Non-Operation	Pumping Test at Feb. 2003						Groundwater Level		Problems for Intake
						H (m)	Q (m3/hr)				Test Yield (L/s)	Static GWL (m)	Pumping GWL (m)	Draw-down (m)	Specific Capacity (L/s/m)	Decline of Well Capacity(%)	Static GWL (m)	Pumping GWL (m)	
70	1980	S	ETSV-12	150	45	30	270		240		93.0	1.7	4.8	3.1	30.0	100.0	5.7	6.7	
71	1980	S	ETSV-12	150	45	30	270		240		62.2	2.6	5.1	2.5	24.9	71.1	5.1	6.5	
72	1980	C	20A18x1	250	75	20	602	200	0	Power Source	83.0	1.2	2.2	1.0	83.0	100.0	4.0		
73	1980	C	20A18x1	250	75	20	602	255	320		71.0	1.3	4.3	3.0	23.7	99.9	3.5	6.2	
74	1980	S	ETSV-12	150	45	30	270		0	Motor	70.8	1.0	6.8	5.8	12.2	100.0	3.7		
75	1980	C	20A18x1	250	75	20	602		220		99.0	1.0	3.6	2.6	38.8	282.4	4.2	7.3	
76	1980	C	20A18x1	250	75	20	602	200	280		40.0	5.0	8.3	3.3	12.1	100.0	4.4	7.4	
77	1980	C	20A18x1	250	75	20	602	255	(300)		90.0	2.8	4.3	1.5	60.0	230.8	5.3	9.7	
78	1980	S	ETSV-12	150	45	30	270	290	0	Motor	114.3	2.6	7.0	4.4	25.9	330.3	4.1	6.6	
79	1980	S	ETSV-12	150	45	30	270	290	(200)		62.0	1.6	4.6	3.0	20.7	135.3	4.1	6.5	
80	1980	S	ETSV-12	150	45	30	270	-	0	Motor	77.0	1.7	4.4	2.7	28.5	99.9	4.3	6.8	
81	1980	S	ETSV-12	150	45	30	270	250	0	Motor	100.0	1.8	3.8	2.0	50.0	100.0	4.3	5.0	
1G	1990	S	ETSV-12	150	45	30	270	350	0	Motor									
2G	1990	S	ETSV-12	150	45	30	270	350	(200)								2.8	3.7	
3G	1994	S	ETSV-12	150	45	30	270	250	0	Motor									
4G	1992	S	ETSV-12	150	45	30	270	250	0	Motor									
1P	U.P.																		
2P	U.P.																		
3P	U.P.																		
4P	U.P.																		
5P	U.P.																		
6P	U.P.																		
7P		C		150	30		210												
8P	U.P.																		
9P		C		150	30		210												
10P	U.P.																		
11P	U.P.																		
12P	U.P.																		
13P		C		150	30		210												
14P		C		150	30		210												
15P		C		150	30		210										3.5	4.3	
16P		C		150	30		210												
33P	1996	S	ETSV-12	150	45	30	270		(200)								3.8	5.1	
34P	1996	S	ETSV-12	150	45	30	270	210	(200)								3.8	4.8	
35P	1996	S	ETSV-12	150	45	30	270	210	(200)								3.9	6.3	
36P	U.P.																		

Table S.3.1.2.20 (1) List of Maitenance and Rahabilitation Status

WPT Name		Kibray							
Well No.	Starting Year, Operated	Repair and Rehabilitation							
		Equipments, often damaged	Times of Re-Instal lation of Pump	Final Installa- tion Year of Pump	Times of All Repairs	Final Repair Year of Pump	Freq. of Rehabili- tation (once in yrs)	Final Rehabili- tation Year	Contents of Rehabilitatio n
1	1962	Pump/ Motor	1	1962	28	2002	1	2003	Air Lifting
2	1960	Pump/ Motor	0	1960	25	1998	1	2003	Air Lifting
3	1961	Pump	2	1999	24	2002	1	2003	Air Lifting
4	1958	Pump/ Motor	1	1998	32	1998	1	2003	Air Lifting
5	1958	Pump/ Motor	0	1958	26	1996	1	2003	Air Lifting
6	1958	Pump/ Motor	2	1983	26	1997	1	2003	Air Lifting
7	1955	Pump	2	1973	40	2002	1	2003	Air Lifting
8	1957	Pump	0	1957	27	1999	1	2003	Air Lifting
9	1956	Pump	0	1956	23	2001	1	2003	Air Lifting
10	1959	Pump/ Motor	0	1959	27	2002	1	2003	Air Lifting
11	1962	Pump/ Motor	1	1990	39	2002	1	2003	Air Lifting
12	1958	Pump	0	1958	33	1998	1	2003	Air Lifting
13	1958	Pump	0	1958	24	1996	1	2003	Air Lifting
14	1960	Pump	2	2000	33	2003	1	2003	Air Lifting
14a	1966	Pump	2	1995	16	1996	1	2003	Air Lifting
15	1964	Pump	0	1964	24	2001	1	2003	Air Lifting
16	1966	Pump	0	1966	27	1998	1	2003	Air Lifting
17	1966	Pump/ Motor	0	1966	17	1997	1	2003	Air Lifting
18	1966	Pump	2	1980	27	2001	1	2003	Air Lifting
19	1965	Pump/ Motor	0	1965	20	1997	1	2003	Air Lifting
20	1965	Pump/ Motor	0	1965	19	2002	1	2003	Air Lifting
21	1966	Pump/ Motor	0	1966	28	2001	1	2003	Air Lifting
22	1967	Pump/ Motor/ Power Source	2	1998	27	1998	1	2003	Air Lifting
23							1	2003	Air Lifting
24	1967	Pump/ Motor	0	1967	22	1998	1	2003	Air Lifting
25	1967	Pump	3	1998	27	1998	1	2003	Air Lifting
26	1968	Pump/ Motor	6	1998	44	1998	1	2003	Air Lifting
27	1968	Pump		1998		1998	1	2003	Air Lifting
28	1969	Power Source	2	1986	22	2002	1	2003	Air Lifting
29	1969	Pump	3	1998	26	2001	1	2003	Air Lifting
30	1969	Pump	5	1997	20	1997	1	2003	Air Lifting
31	1969	Pump	9	2001	33	2001	1	2003	Air Lifting
32	1969	Pump	1	1994	21	1995	1	2003	Air Lifting
33	1969	Pump	3	1987	20	2002	1	2003	Air Lifting
34	1969	Pump	3	19999	18	2001	1	2003	Air Lifting
35	1969	Pump	1	1992	26	1998	1	2003	Air Lifting
36	1969	Pump	2	1998	32	1998	1	2003	Air Lifting
37	1969	Pump/ Motor	5	1998	28	2001	1	2003	Air Lifting
38	1969	Pump	2	1998	22	1998	1	2003	Air Lifting
39	1972	Pump/Power Source	2	1982	34	1998	1	2003	Air Lifting
40	1969	Pump	2	1998	30	2002	1	2003	Air Lifting
41	1969	Pump	0	1969	19	2001	1	2003	Air Lifting
42	1967	Pump	2	1998	15	1999	1	2003	Air Lifting
43							1	2003	Air Lifting

Table S.3.1.2.20 (2) List of Maitenance and Rahabilitation Status

WPT Name		Kibray							
Well No.	Starting Year, Operated	Repair and Rehabilitation							
		Equipments, often damaged	Times of Re-Instal lation of Pump	Final Installa-tion Year of Pump	Times of All Repairs	Final Repair Year of Pump	Freq. of Rehabili-tation (once in yrs)	Final Rehabili-tation Year	Contents of Rehabilitatio n
44	1969	Pump	2	1999	28	1999	1	2003	Air Lifting
45	1969	Pump/ Motor	3	1998	21	2002	1	2003	Air Lifting
46	1969	Pump	0	1969	28	2001	1	2003	Air Lifting
47	1969	Pump/ Motor	1	2002	24	2001	1	2003	Air Lifting
48	1969	Pump	0	1969	26	2001	1	2003	Air Lifting
49	1969	Pump/ Motor	0	1969	19	1999	1	2003	Air Lifting
50	1970	Pump/ Motor	0	1970	38	2001	1	2003	Air Lifting
51	1970	Pump/ Motor	1	1971	21	1998	1	2003	Air Lifting
52	1969	Pump/ Motor	0	1969	23	1998	1	2003	Air Lifting
53	1972	Pump/ Motor	1	1998	21	1998	1	2003	Air Lifting
54	1972	Pump/ Motor	0	1972	17	2002	1	2003	Air Lifting
55	1972	Pump	0	1972	21	1998	1	2003	Air Lifting
56	1969	Pump	0	1972	22	1998	1	2003	Air Lifting
57	1969	Pump/ Motor	0	1969	21	2001	1	2003	Air Lifting
58	1967	Pump	0	1967	25	2001	1	2003	Air Lifting
59	1967	Pump	0	1967	25	2001	1	2003	Air Lifting
60	1969	Motor\Pump	0	1969	21	2001	1	2003	Air Lifting
61	1972	Motor\Pump	0	1972	20	2002	1	2003	Air Lifting
62	1972	Pump	0	1972	21	2002	1	2003	Air Lifting
63	1971	Pump/Power Source	0	1971	18	1997	1	2003	Air Lifting
64	1968	Pump/Power Source	0	1968	18	1997	1	2003	Air Lifting
65	1976	Pump	1	1981	9	1996	1	2003	Air Lifting
66	1980	Pump	0	1980	15	1999	1	2003	Air Lifting
67	1981	Pump	1	1982	10	1995	1	2003	Air Lifting
68	1980	Pump	1	1980	10	1997	1	2003	Air Lifting
69	1980	Pump	2	2001	5	2001	1	2003	Air Lifting
70	1980	Pump	1	1989	16	2001	1	2003	Air Lifting
71	1980	Pump	1	1980	11	2001	1	2003	Air Lifting
72	1980	Pump	0	1980	12	2001	1	2003	Air Lifting
73	1980	Pump	1	1998	16	2001	1	2003	Air Lifting
74	1980	Pump	3	1999	12	2000	1	2003	Air Lifting
75	1980	Pump	2	1981	9	1996	1	2003	Air Lifting
76	1980	Pump	4	2001	14	2002	1	2003	Air Lifting
77	1980	Pump	0	1980	13	2002	1	2003	Air Lifting
78	1980	Pump	1	1983	6	1997	1	2003	Air Lifting
79	1980	Pump/Power Source	7	1999	22	2000	1	2003	Air Lifting
80	1980	Pump	0	1980	6	2001	1	2003	Air Lifting
81	1980	Pump	2	1997	15	1997	1	2003	Air Lifting
1G	1990	Pump/ Pipe	3	1995	9	1997	1	2003	Air Lifting
2G	1990	Pump	0	1990	2	1999	1	2003	Air Lifting
3G	1994	Pump	0	1994	6	1997	1	2003	Air Lifting
4G	1992	Pump	2	1996	19	1999	1	2003	Air Lifting
1P	U.P.								
2P	U.P.								

Table S.3.1.2.20 (3) List of Maitenance and Rahabilitation Status

WPT Name		Kibray							
Well No.	Starting Year, Operated	Repair and Rehabilitation							
		Equipments, often damaged	Times of Re-Instal lation of Pump	Final Installa-tion Year of Pump	Times of All Repairs	Final Repair Year of Pump	Freq. of Rehabili-tation (once in yrs)	Final Rehabili-tation Year	Contents of Rehabilitatio n
3P	U.P.								
4P	U.P.								
5P	U.P.								
6P	U.P.								
7P							1	2003	Air Lifting
8P	U.P.								
9P							1	2003	Air Lifting
10P	U.P.								
11P	U.P.								
12P	U.P.								
13P							1	2003	Air Lifting
14P							1	2003	Air Lifting
15P							1	2003	Air Lifting
16P							1	2003	Air Lifting
33P	1996	Pump	2	1997	5	1999	1	2003	Air Lifting
34P	1996	Pump	1	2002	4	1998	1	2003	Air Lifting
35P	1996	Pump	0	1996	3	2001	1	2003	Air Lifting
36P	U.P.								

Table S 3.1.2.21 Total Diagnosis of Wells

No.	Name	Well number	Well's function	Pump's function	Problem
1	Light bank wells	26	-Intake capacities are decreasing	-Relatively normal -Lack of parts for pump repair -New Pumps purchased from Russia are not reliable	- High nitrate concentration -6 wells are not operating -Well's intake capacities and pump capacities are not match
2	Left bank wells	49	-Water level is lowering -Intake capacities are decreasing rapidly	-Many pumps are out of order -Pumps are frequently breakdown -Many submerged pump cannot be repaired -Well pumps located in low elevation area cannot transmit water to reservoir -New Pumps purchased from Russia are not reliable	-20 to 30 wells are not operating -Breakdown of too many pumps

iv) Distribution PSs

No.1 (Vremennaya) distribution PS, No.2 PS and related facilities are listed in Table S 3.1.2.22 (1) to (4). Diagnosis results for intake facilities are shown in Table S 3.1.2.22 (5) and (6)

Table S 3.1.2.22 (1) List of No.1 Distribution Pump

No.	Name	Model	Q (m^3/hr)	Head (m)	D(in,out) (mm)	Power (kw)	in Valve (mm)	out Valve (mm)	Installation year
1	Main pump	HV-DS	2500	58	800, 600	500	800	600	1962
2	Ditto	Ditto	3600	52	800, 600	630	800	600	1963
3	Ditto	Ditto	3600	52	1000, 800	630	800	600	1962
4	Ditto	Ditto	5200	51	1000, 800	1000	800	600	1966
5	Ditto	Ditto	5200	51	1000, 800	1000	800	600	1966

Table S 3.1.2.22 (2) List of No.1 Distribution PS Facilities

No.	Name	Specifications	Installation year
1	Pipes	D500-1400	1962
2	Valves	D500-1400	1962
3	Ceiling crane	W11m×20t	1962
4	Power receiving facilities	Receiving 10,000KVA,Transformer, incoming panels, bus sectional panels and feeding panels	1962
5	Power panel	Stand, 5 units	1962
6	Control panel	Stand, 5 units	1962
7	Cable an others		1962

Table S 3.1.2.22(3) List of No.2 Distribution Pump

No.	Name	Model	Q (m^3/hr)	Head (m)	D(in,out) (mm)	Power (kw)	in Valve (mm)	out Valve (mm)	Installation year
1	Main pump	VH-DS	5200	51	800, 500	1000	800	1000	1969
2	Ditto	Ditto	5200	51	800, 500	1000	800	1000	1970
3	Ditto	Ditto	5200	51	800, 500	1000	800	1000	1970
4	Ditto	Ditto	5200	51	800, 500	1000	800	1000	1972
5	Ditto	Ditto	2500	58	600	630	600	600	1972

Table S 3.1.2.22 (4) List of No.2 Distribution PS Facilities

No.	Name	Specifications	Inst. year
1	Pipes	D500-1400	1970
2	Valves	D500-1400	1970
3	Ceiling crane	W7m×20t	1970
4	Power receiving facilities	Receiving 10,000KVA,Transformer, incoming panels, bus sectional panels and feeding panels	1970
5	Power panel	Stand, 5 units	1970
6	Control panel	Stand, 5 units	1970
7	Cable an others		1962

Table S 3.1.2.22 (5) Diagnosis Sheet for No.1 Distribution PS

Division	Name	Operation status	Condition, Appearance	Judgment
Pumps	No.1 main	No particular problem	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.2 main	No particular problem	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.3 main	No particular problem	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.4 main	No particular problem	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.5 main	No particular problem	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
Pipes and other Machines	Pipes	No particular problem	Corroded thoroughly due to no re-painting	C1
	Valves	No particular problem	Corroded thoroughly due to no re-painting	C1
	Ceiling crane	No particular problem	No particular problem	B

Table S 3.1.2.22 (6) Diagnosis Sheet for No.2 Distribution PS

Division	Name	Operation status	Condition, Appearance	Judgment
Pumps	No.1 main	No particular problem	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.2 main	No particular problem	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.3 main	Bearing id under re-pair.	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.4 main	No particular problem	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
	No.5 main	Motor is under repair.	Remarkably deteriorated. Recently, break down has frequently occurred.	C2
Pipes and other Machines	Pipes	No particular problem	Corroded thoroughly due to no re-painting	C1
	Valves	No particular problem	Corroded thoroughly due to no re-painting	C1
	Ceiling crane	No particular problem	No particular problem	B

v) Chlorinator

Chlorinators and related facilities are listed in Table S 3.1.2.23 (1), and the diagnosis results are shown in Table S 3.1.2.23 (2).

Table S 3.1.2.23 (1) List of Chlorination Facilities

Division	No.	Name	Type	Specification	Number	Inst. Year
No.1	1	Cylinder scale	Analog type	for 1ton Cylinder	2	1955
	2	Gas filter			2	1955
	3	Gas meter	Flow meter	2.5kg/hrxd20mm	2	1955
	4	Ejector	Water ejector	D25mm, from well pump	2	1955
	5	Safety equipment		Sprinkler, Discharging chamber, Gas mask	1	1955
No.3	1	Cylinder scale	Analog type	for 1ton Cylinder	2	1955
	2	Gas filter			2	1955
	3	Gas meter	Flow meter	2.5kg/hrxd20mm	4	1955
	4	Ejector	Water ejector	D25mm, with exclusive pump	4	1955
	5	Safety equipment		Sprinkler, Discharging chamber, Gas mask	1	1955

Table S 3.1.2.23 (2) Diagnosis Sheet of Chlorination Facilities

Division	No.	Name	Operation Status	Condition, Appearance	Judgment
No.1	1	Cylinder scale	No operational problem	Remarkably deteriorated, poor precision	C2
	2	Gas filter	No operational problem	Remarkably deteriorated	C2
	3	Gas meter	No operational problem	Remarkably deteriorated	C2
	4	Ejector	No operational problem	Remarkably deteriorated	C2
	5	Safety equipment	No operational problem	Remarkable deteriorated	C2
No.2	1	Cylinder scale	No operational problem	Remarkably deteriorated, poor precision	C2
	2	Gas filter	No operational problem	Remarkably deteriorated	C2
	3	Gas meter	No operational problem	Remarkably deteriorated	C2
	4	Ejector	No operational problem	Remarkably deteriorated	C2
	5	Safely equipment	No operational problem	Remarkably deteriorated	C2

vi) Electrical Facilities

Table S 3.1.2.24 (1) to (4) shows the list of electrical facilities and diagnosis result of these. As shown in the table, the facilities in dark cells were not working for a long time.

Table S 3.1.2.24 (1) List of Electrical Faciulities and Diagnosis Results

No	Facility Name	Location	Equipment Name	Specification	Inst Year	Judgement
1	Power Receiving Facility	S/S No.1	Power Receiving Equipment and No.1 Transformer	Oil Immersed, Outdoor, 110/35/6 kV, 10000kVA	1971	B
2			No.2 Transformer	Oil Immersed, Outdoor, 35/6 kV, 4000kVA	1971	B
3			Feeder Panel No.1 (Panel No.1)	DS+OCB, Indoor (To Transformer No.1)	1971	B
4			Lighting Transformer (Panel No.2)		1971	B
5			No.1 Incoming Panel (Panel No.3/5)	DS+OCB, Indoor	1971	B
6			No.1 Internal Use Transformer (Panel No.4)		1971	B
7			No.1 Lightning Arrester (Panel No.6)		1971	B
8			Feeder Panel No.3 (Panel No.7)	DS+OCB, Indoor (To Transformer No.6)	1971	B
9			Feeder Panel No.2 (Panel No.8)	DS+OCB, Indoor (To No.2 Intake P/S -2)	1971	B
10			Bus Sectional Panel (Panel No.9)	DS+OCB, Indoor	1971	B
11			No.2 Internal Use Transformer (Panel No.10)		1971	B
12			Feeder Panel No.7 (Panel No.12)	DS+OCB, Indoor (To Transformer No.5)	1971	B
13			Feeder Panel No.5 (Panel No.14)	DS+OCB, Indoor (To No.1 Intake P/S -2)	1971	B
14			Feeder Panel No.4 (Panel No.15)	DS+OCB, Indoor (To 6kV Transformer No.4)	1971	B
15			Feeder Panel No.6 (Panel No.16)	DS+OCB, Indoor (To No.2 Intake P/S -1)	1971	B
16			No.2 Incoming Panel (Panel No.17)	DS+OCB, Indoor	1971	B
17		S/S No.2	Power Receiving Equipment and No.1 Transformer	Oil Immersed, Outdoor, 110/35/6 kV, 10000kVA	1975	B
18			No.2 Transformer	Oil Immersed, Outdoor, 110/35/6 kV, 10000kVA	1989	B
19			Feeder Panel No.1 (Panel No.1)	DS+OCB, Indoor (To No.1 Intake P/S -1)	1975	B
20			Feeder Panel No.2 (Panel No.2)	DS+OCB, Indoor (To Transformer No.14)	1975	B
21			No.1 Incoming Panel (Panel No.3)	DS+VCB, Indoor (Frm No.1 Transformer)	1975	B
22			No.1 Internal Use Transformer (Panel No.4)	Oil Immersed, Indoor, 6/0.22 kV,	1975	B
23			Feeder Panel No.3 (Panel No.5)	DS+OCB, Indoor (To No.1 Distribution Panel)	1975	B
24			Feeder Panel No.4 (Panel No.6)	DS+OCB, Indoor (Standby)	1975	B
25			No.1 GPT (Panel No.7)	DS+PF, Indoor	1975	B
26			Feeder Panel No.5 (Panel No.16)	DS+OCB, Indoor (Standby)	1975	B
27			Feeder Panel No.6 (Panel No.8)	DS+OCB, Indoor (Sectional Panel)	1975	B
28			No.1 GPT (Panel No.9)	DS+PF, Indoor	1975	B
29			Feeder Panel No.6 (Panel No.10)	DS+OCB, Indoor (To No.1 Intake P/S -3)	1975	B
30			Feeder Panel No.7 (Panel No.11)	DS+OCB, Indoor (To No.2 Distribution Panel)	1975	B
31			No.2 Incoming Panel (Panel No.12)	DS+OCB, Indoor (From No.2 Transformer)	1975	B
32			No.2 Internal Use Transformer (Panel No.13)	Oil Immersed, Indoor, 6/0.22 kV,	1975	B
33			Feeder Panel No.8 (Panel No.14)	DS+OCB, Indoor (Standby)	1975	B
34			Feeder Panel No.9 (Panel No.15)	DS+OCB, Indoor (Standby)	1975	B
35	Pump Station	Vremenaya Pump Station	No.1 Incoming Panel (Panel No.14)	DS+OCB, Indoor (From No.2 S/S Panel No.2)	1975	B
36			No.1 Pump Starter Panel (Panel No.1)	DS+OCB, Indoor, 1000kW	1975	B
37			No.2 Pump Starter Panel (Panel No.2)	DS+OCB, Indoor, 1000kW	1975	B
38			Feeder for Transformer (Panel No.12)	DS+PF, Indoor	1975	B
39			GPT+Lightning Arrester (Panel No.11)	Indoor	1975	B
40			No.2 Incoming Panel (Panel No.10)	DS+OCB, Indoor (From No.1 S/S Panel No.14)	1975	B
41			Bus Sectional Panel (Panel No.9)	DS, Indoor (To Panel No.8)	1975	B
42			Bus Sectional Panel (Panel No.8)	DS+OCB, Indoor (To Panel No.8)	1975	B
43			No.3 Incoming Panel (Panel No.7)	DS+OCB, Indoor (From No.2 S/S Panel No.1)	1975	B
44			GPT+Lightning Arrester (Panel No.6)	Indoor	1975	B
45			Feeder for Transformer (Panel No.5)	DS+PF, Indoor	1975	B
46			No.3 Pump Starter Panel (Panel No.3)	DS+OCB, Indoor, 1000kW	1975	B
47			No.4 Pump Starter Panel (Panel No.4)	DS+OCB, Indoor, 1000kW	1975	B
48			No.5 Pump Starter Panel (Panel No.13)	DS+OCB, Indoor, 630kW	1975	B
49			Feeder Panel (Panel No.15)	DS+OCB, Indoor (Standby)	1975	B
50			No.1 Internal Use Transformer	Oil Immersed, Indoor, 6/0.4 kV, 160kVA	1975	B
51			No.2 Internal Use Transformer	Oil Immersed, Indoor, 6/0.4 kV, 160kVA	1975	B
52			No.1 Pump Control Panel	Indoor Self-stand	1975	C1
53			No.2 Pump Control Panel	Indoor Self-stand	1975	C1
54			No.3 Pump Control Panel	Indoor Self-stand	1975	C1
55			No.4 Pump Control Panel	Indoor Self-stand	1975	C1
56			No.5 Pump Control Panel	Indoor Self-stand	1975	C1
57			Valve Control Panel-1	Indoor Self-stand	1975	C1
58			Valve Control Panel-2	Indoor Self-stand	1975	C1

Table S 3.1.2.24 (2) List of Electrical Faciulities and Diagnosis Results

No	Facility Name	Location	Equipment Name	Specification	Inst Year	Judgement
59	Pump Station	No.2 Pump Station	No.1 Pump Starter Panel	DS+OCB, Indoor, 500kW	1975	C1
60			No.2 Pump Starter Panel	DS+OCB, Indoor, 800kW	1975	C1
61			No.3 Pump Starter Panel	DS+OCB, Indoor, 630kW	1975	C1
62			No.4 Pump Starter Panel	DS+OCB, Indoor, 1000kW	1975	C1
63			No.5 Pump Starter Panel	DS+OCB, Indoor, 1000kW	1975	C1
64			No.1 Pump Control Panel	Indoor Self-stand	1975	C1
65			No.2 Pump Control Panel	Indoor Self-stand	1975	C1
66			No.3 Pump Control Panel	Indoor Self-stand	1975	C1
67			No.4 Pump Control Panel	Indoor Self-stand	1975	C1
68			No.5 Pump Control Panel	Indoor Self-stand	1975	C1
69			Valve Control Panel	Indoor Self-stand	1975	C1
70			Monitoring Panel	Indoor Self-stand	1975	C1
71	Well Pump Station	Each Well Pump Station	No.1 Transformer Kiosk	Oil immersed, 6/0.38kV, 400kVA	1984	B
72			No.2 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	B
73			No.3 Transformer Kiosk	Oil immersed, 6/0.38kV, 180kVA	1964	B
74			No.4 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA x 2sets	1989	B
75			No.5 Transformer Kiosk	Oil immersed, 6/0.38kV, 180kVA	1977	B
76			No.6 Transformer Kiosk	Oil immersed, 6/0.38kV, 63kVA	1982	B
77			No.7 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	B
78			No.8 Transformer Kiosk	Oil immersed, 6/0.38kV, 160kVA	1977	B
79			No.9 Transformer Kiosk	Oil immersed, 6/0.38kV, 160kVA	1977	B
80			No.10 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1977	B
81			No.11 Transformer Kiosk	Oil immersed, 6/0.38kV, 180kVA	1964	B
82			No.12 Transformer Kiosk	Oil immersed, 6/0.38kV, 160kVA	1977	B
83			No.13 Transformer Kiosk	Oil immersed, 6/0.38kV, 180kVA	1977	B
84			No.14 Transformer Kiosk	Oil immersed, 6/0.38kV, 180kVA	1977	C1
85			No.15 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
86			No.16 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C2
87			No.17 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
88			No.18 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
89			No.19 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
90			No.20 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
91			No.21 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1984	C2
92			No.22 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C2
93			No.23 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C2
94			No.24 Transformer Kiosk	Oil immersed, 6/0.38kV, 160kVA	1977	C1
95			No.25 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
96			No.26 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1977	C2
97			No.26A Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1977	C2
98			No.27 Transformer Kiosk	Oil immersed, 6/0.38kV, 160kVA	1977	C2
99			No.28 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1977	C1
100			No.29 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1977	C2
101			No.29A Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
102			No.30 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
103			No.31 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
104			No.32 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1977	C1
105			No.33 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
106			No.34 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
107			No.35 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
108			No.36 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
109			No.37 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C2
110			No.37A Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C2
111			No.38 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C2
112			No.39 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
113			No.39A Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C2
114			No.40 Transformer Kiosk	Oil immersed, 6/0.38kV, 160kVA	1989	C1
115			No.41 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
116			No.42 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
117			No.43 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
118			No.44 Transformer Kiosk	Oil immersed, 6/0.38kV, 160kVA	1989	C1
119			No.45 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
120			No.46 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
121			No.47 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
122			No.48 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C2
123			No.49 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
124			No.50 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1977	C2

Table S 3.1.2.24 (3) List of Electrical Faciulities and Diagnosis Results

No	Facility Name	Location	Equipment Name	Specification	Inst Year	Judgement
125	Well Pump Station	Each Well Pump Station	No.51 Transformer Kiosk	Oil immersed, 6/0.38kV, 160kVA	1989	C2
126			No.52 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C2
127			No.53 Transformer Kiosk	Oil immersed, 6/0.38kV, 160kVA	1989	C1
128			No.54 Transformer Kiosk	Oil immersed, 6/0.38kV, 160kVA	1989	C2
129			No.55 Transformer Kiosk	Oil immersed, 6/0.38kV, 160kVA	1989	C1
130			No.56 Transformer Kiosk	Oil immersed, 6/0.38kV, 160kVA	1989	C1
131			No.57 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C2
132			No.58 Transformer Kiosk	Oil immersed, 6/0.38kV, 320kVA	1967	C1
133			No.58A Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1980	C1
134			No.59 Transformer Kiosk	Oil immersed, 6/0.38kV, 250kVA	1977	C1
135			No.59A Transformer Kiosk	Oil immersed, 6/0.38kV, 160kVA	1977	C1
136			No.60 Transformer Kiosk	Oil immersed, 6/0.38kV, 180kVA	1977	C2
137			No.61 Transformer Kiosk	Oil immersed, 6/0.38kV, 160kVA	1977	C1
138			No.62 Transformer Kiosk	Oil immersed, 6/0.38kV, 250kVA	1977	C1
139			No.63 Transformer Kiosk	Oil immersed, 6/0.38kV, 180kVA	1977	C2
140			No.64 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
141			No.65 Transformer Kiosk	Oil immersed, 6/0.38kV, 100kVA	1989	C1
142			No.1 Well Pump Control Panel	Self-stand, Indoor, 75kW	1962	C1
143			No.2 Well Pump Control Panel	Self-stand, Indoor, 75kW	1960	C1
144			No.3 Well Pump Control Panel	Self-stand, Indoor, 45kW	1961	C1
145			No.4 Well Pump Control Panel	Self-stand, Indoor, 75kW	1958	C1
146			No.5 Well Pump Control Panel	Self-stand, Indoor, 75kW	1958	C1
147			No.6 Well Pump Control Panel	Self-stand, Indoor, 75kW	1958	C1
148			No.7 Well Pump Control Panel	Self-stand, Indoor, 75kW	1955	C1
149			No.8 Well Pump Control Panel	Self-stand, Indoor, 75kW	1957	C1
150			No.9 Well Pump Control Panel	Self-stand, Indoor, 75kW	1956	C1
151			No.10 Well Pump Control Panel	Self-stand, Indoor, 75kW	1959	C1
152			No.11 Well Pump Control Panel	Self-stand, Indoor, 75kW	1962	C1
153			No.12 Well Pump Control Panel	Self-stand, Indoor, 75kW	1958	C1
154			No.13 Well Pump Control Panel	Self-stand, Indoor, 75kW	1958	C1
155			No.14 Well Pump Control Panel	Self-stand, Indoor,	1960	C1
156			No.14a Well Pump Control Panel	Self-stand, Indoor, 45kW	1966	C1
157			No.15 Well Pump Control Panel	Self-stand, Indoor, 75kW	1964	C1
158			No.16 Well Pump Control Panel	Self-stand, Indoor, 75kW	1966	C1
159			No.17 Well Pump Control Panel	Self-stand, Indoor, 75kW	1966	C1
160			No.18 Well Pump Control Panel	Self-stand, Indoor, 75kW	1966	C1
161			No.19 Well Pump Control Panel	Self-stand, Indoor, 75kW	1965	C1
162			No.20 Well Pump Control Panel	Self-stand, Indoor, 75kW	1965	C1
163			No.21 Well Pump Control Panel	Self-stand, Indoor, 75kW	1966	C1
164			No.22 Well Pump Control Panel	Self-stand, Indoor, 45kW	1967	C2
165			No.23 Well Pump Control Panel	Self-stand, Indoor, 75kW		C1
166			No.24 Well Pump Control Panel	Self-stand, Indoor, 75kW	1967	C1
167			No.25 Well Pump Control Panel	Self-stand, Indoor, 75kW	1967	C1
168			No.26 Well Pump Control Panel	Self-stand, Indoor, 75kW	1968	C1
169			No.27 Well Pump Control Panel	Self-stand, Indoor, 75kW	1968	C1
170			No.28 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C1
171			No.29 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C1
172			No.30 Well Pump Control Panel	Self-stand, Indoor, 100kW	1969	C2
173			No.31 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C1
174			No.32 Well Pump Control Panel	Self-stand, Indoor, 45kW	1969	C1
175			No.33 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C1
176			No.34 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C1
177			No.35 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C1
178			No.36 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C1
179			No.37 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C1
180			No.38 Well Pump Control Panel	Self-stand, Indoor, 75kW		C1
181			No.39 Well Pump Control Panel	Self-stand, Indoor, 75kW		C2
182			No.40 Well Pump Control Panel	Self-stand, Indoor, 75kW		C2
183			No.41 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C2
184			No.42 Well Pump Control Panel	Self-stand, Indoor, 75kW	1967	C1
185			No.43 Well Pump Control Panel	Self-stand, Indoor, 45kW		C2
186			No.44 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C1
187			No.45 Well Pump Control Panel	Self-stand, Indoor, 76kW		

Table S 3.1.2.24 (4) List of Electrical Faciulities and Diagnosis Results

No	Facility Name	Location	Equipment Name	Specification	Inst Year	Judgement
188	Well Pump Station	Each Well Pump Station	No.46 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C2
189			No.47 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C1
190			No.48 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C1
191			No.49 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C1
192			No.50 Well Pump Control Panel	Self-stand, Indoor, 75kW	1970	C1
193			No.51 Well Pump Control Panel	Self-stand, Indoor, 75kW	1970	C2
194			No.52 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C1
195			No.53 Well Pump Control Panel	Self-stand, Indoor, 75kW	1972	C2
196			No.54 Well Pump Control Panel	Self-stand, Indoor, 75kW	1972	C2
197			No.55 Well Pump Control Panel	Self-stand, Indoor, 45kW	1972	C2
198			No.56 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C2
199			No.57 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C2
200			No.58 Well Pump Control Panel	Self-stand, Indoor, 75kW	1967	C2
201			No.59 Well Pump Control Panel	Self-stand, Indoor, 75kW	1967	C1
202			No.60 Well Pump Control Panel	Self-stand, Indoor, 75kW	1969	C1
203			No.61 Well Pump Control Panel	Self-stand, Indoor, 75kW	1972	C2
204			No.62 Well Pump Control Panel	Self-stand, Indoor, 75kW	1972	C1
205			No.63 Well Pump Control Panel	Self-stand, Indoor, 75kW	1971	C2
206			No.64 Well Pump Control Panel	Self-stand, Indoor, 75kW	1968	C2
207			No.65 Well Pump Control Panel	Self-stand, Indoor, 45kW	1976	C2
208			No.66 Well Pump Control Panel	Self-stand, Indoor, 75kW	1980	C2
209			No.67 Well Pump Control Panel	Self-stand, Indoor, 45kW	1980	C2
210			No.68 Well Pump Control Panel	Self-stand, Indoor, 45kW	1980	C2
211			No.69 Well Pump Control Panel	Self-stand, Indoor, 45kW	1980	C1
212			No.70 Well Pump Control Panel	Self-stand, Indoor, 45kW	1980	C2
213			No.71 Well Pump Control Panel	Self-stand, Indoor, 45kW	1980	C2
214			No.72 Well Pump Control Panel	Self-stand, Indoor, 75kW	1980	C2
215			No.73 Well Pump Control Panel	Self-stand, Indoor, 75kW	1980	C2
216			No.74 Well Pump Control Panel	Self-stand, Indoor, 45kW	1980	C2
217			No.75 Well Pump Control Panel	Self-stand, Indoor, 75kW	1980	C2
218			No.76 Well Pump Control Panel	Self-stand, Indoor, 75kW	1980	C2
219			No.77 Well Pump Control Panel	Self-stand, Indoor, 75kW	1980	C1
220			No.78 Well Pump Control Panel	Self-stand, Indoor, 45kW	1980	C2
221			No.79 Well Pump Control Panel	Self-stand, Indoor, 45kW	1980	C1
222			No.80 Well Pump Control Panel	Self-stand, Indoor, 45kW	1980	C2
223			No.81 Well Pump Control Panel	Self-stand, Indoor, 45kW	1980	C2
224			No.1G Well Pump Control Panel	Self-stand, Indoor, 45kW	1990	C1
225			No.2G Well Pump Control Panel	Self-stand, Indoor, 75kW	1990	C2
226			No.3G Well Pump Control Panel	Self-stand, Indoor, 75kW	1994	C2
227			No.4G Well Pump Control Panel	Self-stand, Indoor, 75kW	1992	C2
228			No.1P Well Pump Control Panel		1980	C2
229			No.2P Well Pump Control Panel		1980	C2
230			No.3P Well Pump Control Panel	Self-stand, Indoor, 45kW	1980	C2
231			No.4P Well Pump Control Panel			C2
232			No.5P Well Pump Control Panel			C2
233			No.6P Well Pump Control Panel			C2
234			No.7P Well Pump Control Panel			C2
235			No.8P Well Pump Control Panel			C2
236			No.9P Well Pump Control Panel			C2
237			No.10P Well Pump Control Panel			C2
238			No.11P Well Pump Control Panel			C2
239			No.12P Well Pump Control Panel			C2
240			No.13P Well Pump Control Panel			C2
241			No.14P Well Pump Control Panel			C2
242			No.15P Well Pump Control Panel			C2
243			No.16P Well Pump Control Panel		1980	C2
244			No.33P Well Pump Control Panel		1996	C1
245			No.34P Well Pump Control Panel		1996	C2
246			No.35P Well Pump Control Panel		1996	C2
247			No.36P Well Pump Control Panel			C2
248	Power Distribution Facility	Cross the River	No.1 Distribution Panel	Self-stand, DS, Outdoor		C1
249			No.2 Distribution Panel	Self-stand, DS, Outdoor		C1
250			No.2 Distribution OCB Panel	Self-stand, OCB, Outdoor		C1
251			No.3 Distribution Panel	Self-stand, DS, Outdoor		C1
252			No.3 Distribution OCB Panel	Self-stand, OCB, Outdoor		C1

2) South, Sergeli, Kara-su, Kuiluk and Bectemir WTPs

i) Diagnosis for Capacity of WTPs

The design capacity and the investigated actual capacity of WTPs are shown in Table S 3.1.2.25.

Table S 3.1.2.25 Capacity of WTPs

South					
Design Capacity	Nominal Capacity	5,958	m^3/hr	143,000	m^3/day
	Maximum intake capacity	12,500	m^3/hr	300,000	m^3/day
	Well number			41	units
	Distribution capacity	4,500	m^3/hr	108,000	m^3/day
	Chlorination capacity			10	kg/day
	Service reservoir	10,000	m^3	1.68	hr
Current Function	Maximum intake capacity	8,250	m^3/hr	198,000	m^3/day
	Operating well number			27	units
	Distribution capacity	7600	m^3/hr	182,400	m^3/day
Sergeli					
Design Capacity	Nominal Capacity	1,667	m^3/hr	40,000	m^3/day
	Maximum intake capacity	1,875	m^3/hr	45,000	m^3/day
	Well number			9	units
	Distribution capacity	4,070	m^3/hr	97,680	m^3/day
	Chlorination capacity			10	kg/day
	Service reservoir	4,000	m^3	2.40	hr
Current function	Maximum intake capacity	1,292	m^3/hr	31,000	m^3/day
	Operating well number			8	units
	Distribution capacity	2,000	m^3/hr	48,000	m^3/day
Kara-su					
Design Capacity	Nominal Capacity	2,167	m^3/hr	52,000	m^3/day
	Maximum intake capacity	2,192	m^3/hr	52,600	m^3/day
	Well number			11	units
	Chlorination capacity			2	kg/day
Current function	Maximum intake capacity	1,196	m^3/hr	28,700	m^3/day
	Operating well number			6	units
Kuiluk					
Design Capacity	Nominal Capacity	833	m^3/hr	20,000	m^3/day
	Maximum intake capacity	2,000	m^3/hr	48,000	m^3/day
	Well number			9	units
	Chlorination capacity			2	kg/day
Current function	Maximum intake capacity	1,092	m^3/hr	26,200	m^3/day
	Operating well number			9	units
Bectemir					
Design Capacity	Nominal Capacity	833	m^3/hr	20,000	m^3/day
	Maximum intake capacity	1,000	m^3/hr	24,000	m^3/day
	Well number			11	units
	Distribution capacity	1,020	m^3/hr	26,200	m^3/day
	Chlorination capacity			1	kg/hr
	Service reservoir	1,000	m^3	1.20	hr
Current function	Maximum intake capacity		m^3/hr	11,000	m^3/day
	Operating well number		m^3/hr	5	units
	Distribution capacity	1,020	m^3/hr	26,200	m^3/day

ii) Diagnosis for Civil Structures and Buildings

Major civil structures and buildings of WTP are listed in Table S 3.1.2.26 (1).

Diagnosis results of these are shown in Table S 3.1.2.26 (2).

Table S 3.1.2.26 (1) List of Civil Structures and Building

WTP Name	Name	Type	Dimension	Area (m^2)	Volume (m3)	Number
South	Reservoir	Concrete	W24mxL20m		2,500	2
	Distribution PS building	Brick	W9mxL40m	360		1
	Disinfection building	Brick	W6mxL10m	60		
	Administration building	Brick	20mx40m	800		1
Sergeli	Reservoir	Concrete			2,000	2
	Distribution PS building	Brick	W12mxL24m	288		1
	Disinfection building	Brick	W6mxL12m	72		1
	Administration building	Brick	12mx24mx2stories	576		1
	Laboratory building	Brick	10mx20m	200		1
Kara-su	Administration building	Brick	12mx24mx2stories	576		
Kuiluk	Administration building	Brick	8mx30m	240		1
Bectemir	Reservoir	Concrete			1,000	1
	Distribution PS building	Brick	W5mxL12m	60		1
	Administration building	Brick	6mx12m	72		1

iii) Wells

Structures and pumping test results, pumps and operation status, and maintenance status and rehabilitation of wells at South WTP are shown in Table S3.1.2.27 (1) to (4).

These at Sergeli WTP are shown in Table S 3.1.2.28 (1) to (3). Structures and pumping test results, and pumps and operation status at Kuiluk WTP are shown in Table S 3.1.2.28 (1) and (2). The data for Kara-su and Bectemir could not be obtained.

The results of diagnosis are summarized in Tables S 3.1.2.29. Capacities of these wells at each WTP are decreasing, and majority of quantity of each well has problems as drinking water.

Table S 3.1.2.26 (2) Diagonosis Sheet for outh, Seregeli, Kara-su, Kuiluk and Bectemir WTP

Facilities	IP	Name	Concrete					Cover soil		Pipes	Ventilator	Others	Const.year
			Quality	Appearance	Crack	Split	Leakage	Appearance	Erosion				
Reservoir	South	No.1 Reservoir	B	B	NO	NO	NO	B	NO	B	C	Inner condition was not examined because of filled water ,but reportedly in fair condition through hearing survey.	1961
		No.2 Reservoir	B	B	NO	NO	NO	B	NO	B	C		1961
	Sergeli	No.1 Reservoir	B	B	NO	NO	NO	B	NO	B	C		1977
		No.2 Reservoir	B	B	NO	NO	NO	B	NO	B	C		1977

Facilities	Facility	Name	Concrete floor	Brick wall					Roof			
				Quality	Appearance	Crack	Split	Leakage	Appearance	Crack	Leakage	–
P/S Building	South	Distribution P/S	C	B	B	NO	NO	NO	C	NO	YES	–
	Sergeli	Distribution P/S	C	B	B	NO	NO	NO	C	NO	YES	–
	Bectemir	Distribution P/S	C	C	C	YES	NO	NO	C	YES	YES	

Facilities	Facility	Name	Fitting				Equipment			Others	Const.year
			Doors	Windows	Glass	Ventilator	Step	Steel floor	Lighting		
P/S Building	South	Distribution P/S	C	C	C	C	C	C	C	*Both inner and outer building as well as ceiling have deteriorated remarkably.	1962
	Sergeli	Distribution P/S	C	C	C	C	C	C	C		1977
	Bectemir	Distribution P/S	C	C	C	C	C	C	C		1973

Facilities	Facility	Name	Concrete floor	Brick wall		Roof			Fitting	Equipment	Const.year
				Appearance	Crack	Appearance	Crack	Leakage			
Other Building	South	Administration	B	C	NO	C	NO	YES	Both internal and external building have deteriorated remarkably. Especially ceiling is seriously deteriorated.	Doors、Windows、Glass	1961
		Disinfection	B	C	NO	C	NO	YES	Both internal and external building have deteriorated remarkably. Especially ceiling is seriously deteriorated.	Doors、Windows、Glass	1961
	Sergeli	Administration	B	C	NO	C	NO	YES	Both internal and external building have deteriorated remarkably. Especially ceiling is seriously deteriorated.	Doors、Windows、Glass	1977
		Disinfection	B	C	NO	C	NO	YES	Both internal and external building have deteriorated remarkably. Especially ceiling is seriously deteriorated.	Doors、Windows、Glass	1977
		Laboratory	B	C	NO	C	NO	YES	Both internal and external building have deteriorated remarkably. Especially ceiling is seriously deteriorated.	Doors、Windows、Glass	1977
	Bectemir	Administration	B	C	NO	C	NO	YES	Both internal and external building have deteriorated remarkably. Especially ceiling is seriously deteriorated.	Doors、Windows、Glass	1973
	Kuiluk	Administration	B	C	NO	C	NO	YES	Both internal and external building have deteriorated remarkably. Especially ceiling is seriously deteriorated.	Doors、Windows、Glass	1964
	Kara-su	Administration	B	C	NO	C	NO	YES	Both internal and external building have deteriorated remarkably. Especially ceiling is seriously deteriorated.	Doors、Windows、Glass	1946

Table S 3.1.2.27(1) List of Structure and Pumping Test Data of Wells at South WTP

WPT Name	South

Well No.	Construction Year	Well Structure								Pumping Test Data					Water Quality Analysis Data							
		Ground Elevation (m)	Drilled Depth (m)	Drilled Diameter (mm)	Casing		Screen			Test Yield (L/s)	Static Water Level (m)	Pumping Water Level (m)	Drawdown (m)	Specific Capacity (L/s/m)	pH	Na + K (mg/L)	Ca (mg/L)	Mg (mg/L)	Cl (mg/L)	HCO3 (mg/L)	SO4 (mg/L)	TDS (mg/L)
					Diameter (mm)	Material of Casing	Total Length (m)	Position (m)	Geology of Screen													
1	1959		59.0		400-300	steel	24.7	29.3-54.0	bl-gr-sd	10.0	1.3	1.4	0.2	62.5	7.1	1.6	145.9	36.0	87.4	6.0	199.2	760
										20.0	1.3	1.8	0.5	37.7								
										30.0	1.3	2.4	1.1	26.8								
										40.0	1.3	3.2	1.9	20.9								
										50.0	1.3	4.2	2.9	17.2								
										60.0	1.3	5.4	4.1	14.6								
										63.9	1.3	5.9	4.7	13.7								
										70.0	1.3	6.8	5.5	12.6								
2	1961		64.0		400-300	steel	29.0	30.0-59.0	bl-gr-sd	61.1	1.9	6.4	4.5	13.6	7.4	4.1	137.5	38.4	25.5	200.8	323.3	796
3	1961		64.0		400-300	steel	29.0	30.0-59.0	bl-gr-sd	61.1	1.9	6.4	4.5	13.6	7.4	4.1	137.5	38.4	25.5	200.8	323.3	796
4	1959		57.0		400-300	steel	25.5	26.1-51.6	bl-gr-sd	10.0	1.5	2.1	0.6	17.2	7.0	0.9	109.6	21.6	68.3	5.5	68.3	434
										20.0	1.5	2.3	0.8	24.7								
										22.7	1.5	2.4	0.9	24.4								
										30.0	1.5	2.8	1.3	23.6								
										40.0	1.5	3.3	1.8	22.6								
										50.0	1.5	3.8	2.3	21.6								
										55.1	1.5	4.0	2.5	22.3								
										60.0	1.5	4.4	2.9	20.8								
5	1961		63.0		400-300	steel	26.8	27.4-54.2	bl-gr-sd	48.0	3.0	9.0	6.0	8.0	7.4	2.1	147.5	33.4	50.6	353.8	142.8	596
										56.0	3.0	9.6	6.6	8.5								
6	1959		62.0		600-400	steel	30.6	28.5-59.1	bl-gr-sd	10.0	1.4	1.9	0.5	20.0	7.4	1.2	118.6	28.7	36.8	5.3	123.5	530.0
										20.0	1.4	2.5	1.1	18.2								
										27.7	1.4	3.0	1.6	17.3								
										30.0	1.4	3.2	1.8	17.1								
										40.0	1.4	4.0	2.6	15.7								
										42.5	1.4	4.2	2.8	15.2								
										50.0	1.4	4.9	3.5	14.5								
7	1965		52.0		400-300	steel	23.8	21.5-45.3	bl-gr-sd	50.0	2.3	4.3	2.0	25.0	7.5	15.6	119.3	20.8	28.1	347.7	88.9	512
										71.0	2.3	4.8	2.5	28.4								
8	1985		60.0		400-300	steel	22.0	35.0-57.0	bl-gr-sd	30.0	2.5	14.0	11.5	2.6	7.7	97.9	132.0	14.4	33.6	329.4	278.0	720
9	1961		63.0		400-300	steel	26.8	28.3-45.8	bl-gr-sd	48.0	3.0	9.0	6.0	8.0	7.4	2.1	147.5	33.4	50.6	353.8	142.8	596
										56.0	3.0	9.6	6.6	8.5								
10	1961		64.0		400-300	steel	29.0	30.0-59.0	bl-gr-sd	61.1	1.9	6.4	4.5	13.6	7.4	4.1	137.5	38.4	25.5	323.3	200.8	796
11	1985		60.0		400-300	steel	22.0	35.0-57.0	bl-gr-sd	30.0	3.0	15.0	12.0	2.5	7.4	79.5	88.0	26.4	46.2	268.4	208.0	550
12	1963		50.0		400-300	steel	35.0	23.9-58.9	bl-gr	56.0	1.8	3.8	2.0	28.0	7.3	12.0	97.0	20.5	13.1	305.0	80.6	504
13	1963		63.0		400-300	steel	35.0	23.9-58.9	bl-gr	56.0	1.8	3.8	2.0	28.0	7.3	12.0	97.0	20.5	13.1	305.0	80.6	504

Table S 3.1.2.27(2) List of Structure and Pumping Test Data of Wells at South WTP

WPT Name: South

Well No.	Construction Year	Well Structure: Ground Elevation (m)	Drilled Depth (m)	Drilled Diameter (mm)	Casing: Diameter (mm)	Casing: Material of Casing	Screen: Total Length (m)	Screen: Position (m)	Screen: Geology of Screen	Pumping Test Data: Test Yield (L/s)	Static Water Level (m)	Pumping Water Level (m)	Draw-down (m)	Specific Capacity (L/s/m)	Water Quality Analysis Data: pH	Na + K (mg/L)	Ca (mg/L)	Mg (mg/L)	Cl (mg/L)	HCO3 (mg/L)	SO4 (mg/L)	TDS (mg/L)
14	1963		61.0		400-300	steel	33.6	22.4-56.0	bl-gr	85.0	2.8	6.0	3.2	26.6	7.4	22.3	99.7	19.4	17.2	311.1	93.8	508
										113.0	2.8	6.7	3.9	29.0								
15	1964		65.0		400-300	steel	39.0	23.0-62.0	bl-gr-sd	56.0	3.8	4.9	1.1	50.9	7.3	8.1	99.7	21.6	17.4	308.1	47.9	512
										62.0	3.8	5.0	1.2	51.7								
16	1965		60.0		400-300	steel	32.5	19.4-51.9	bl-gr-sd	65.8	4.5	7.8	3.3	19.9	7.4	8.1	99.4	17.6	9.8	305.0	70.8	480
17	1965		60.6		400-300	steel	35.2	19.3-54.5	bl-gr-sd	71.0	2.6	4.0	1.4	50.7	7.6	11.7	101.3	18.7	11.2	311.1	79.0	448
										83.0	2.6	4.1	1.5	55.3								
18	1961		65.0		400-300	steel	27.2	30.0-57.2	bl-gr-sd	27.5	2.7	14.5	11.8	2.3	7.4	2.3	96.4	32.3	5.9	219.6	182.7	624
										33.0	2.7	17.0	14.3	2.3								
19	1965		62.0		400-300	steel	34.7	21.2-55.9	bl-gr-sd	50.0	3.0	4.0	1.0	50.0	7.4	15.6	97.6	18.7	12.6	280.6	102.0	456
										66.0	3.0	4.3	1.3	50.8								
20	1965		60.5		400-300	steel	35.9	18.6-54.5	bl-gr-sd	55.0	3.8	5.5	1.7	33.3	7.4	17.7	104.9	17.6	15.5	311.1	91.3	488
										65.8	3.8	5.6	1.8	37.6								
21	1965		61.0		400-300	steel	33.8	20.6-54.4	bl-gr-sd	66.6	3.5	4.7	1.2	55.5	7.5	37.2	104.0	19.2	11.9	317.2	69.9	432
										72.2	3.5	4.8	1.3	55.5								
22	1991		50.0	426	325	steel	20.0	25.0-45.0	bl-gr-sd	12.6	3.2	4.4	1.2	10.5								
23	1991		50.0	426	325	steel	20.0	25.0-45.0	bl-gr-sd	12.6	3.2	4.4	1.2	10.5								
3P	1997		50.0		400-300																	
4P	1997		50.0		400-300																	
5P	1997		50.0		400-300																	
6P	1997		50.0		400-300																	
7P	1997		50.0		400-300																	
8P	1997		50.0		400-300																	
9P	1997		50.0		400-300																	
10P	1997		50.0		400-300																	
11P	1997		50.0		400-300																	
12P	1997		50.0		400-300																	
13P	1997		50.0		400-300																	
14P	1997		50.0		400-300																	
15P	1997		50.0		400-300																	
16P	1997		50.0		400-300																	
2A	1992		50.0		400-300																	
3A	1992		50.0		400-300																	
4A	1992		50.0		400-300																	
5A	1992		50.0		400-300																	

Table S.3.1.2.27 (3) List of Pumps and Operation of Wells at South WTP

WPT Name	South																
Well No.	Starting Year, Operated	Pump Facilities						Operation of Groundwater Intake									
		Pump Type	Model No.	Dia-meter (mm)	Output (KW)	Pump Capacity		Recom-mended Intake Rate (m3/hr)	Actual Amount of Intake (m3/hr)	Cause of Non-Operation	Pumping Test at Feb., 2003						Water Qality Analysis
						H (m)	Q (m3/hr)				Test Yield (L/s)	Static GWL (m)	Pumping GWL (m)	Draw-down (m)	Specific Capacity (L/s/m)	Decline of Well Capacity(%)	Exceeded Items of Potable Water Standard (2003)
1	1959	C	ATH-14	250	75	46	360	165	(200)		40.0	1.3	3.2	1.9	20.9	100.0	Total Hardness
2	1961	C	ATH-14	250	75	46	360	200	(200)		61.1	1.9	13.7	11.8	5.2	38.1	pH value, Total Hardness
3	1961	C	ATH-14	250	75	46	360	200	(200)		51.0	2.0	10.3	8.3	6.1	45.3	pH value, Total Hardness
4	1959	C	ATH-14	250	75	46	360	230	(200)		40.0	0.8	2.8	2.0	20.0	88.5	Total Hardness
5	1961	S	ETSV-12	150	45	30	270	200	(200)		48.0	1.0	7.0	6.0	8.0	94.3	pH value, Total Hardness
6	1959	S	ETSV-12	150	45	30	270	191	(200)		27.8	1.1	2.7	1.6	17.4	101.2	Total Hardness
7	1965	S	ETSV-12	150	45	30	270	200	(200)		50.0	2.3	4.3	2.0	25.0	88.0	pH value, Total Hardness
8	1985	S	ETSV-12	150	45	30	270	120	(200)		22.8	1.5	2.4	0.9	24.5	938.5	Total Hardness
9	1961	C	ATH-14	250	75	46	360	200	(200)		33.1	1.5	2.4	1.0	33.4	393.6	Total Hardness
10	1961	C	ATH-14	250	75	46	360	200	(200)		56.0	3.8	4.9	1.1	50.9	374.9	Total Hardness
11	1985	S	ETSV-12	150	45	30	270	120	0	Pump	45.0	1.7	7.6	5.9	7.6	305.1	
12	1963	C	ATH-14	250	75	46	360	200	(200)		85.0	2.8	6.0	3.2	26.6	94.9	Total Hardness
13	1963	S	ETSV-12	150	45	30	270	120	(200)		37.5	1.9	4.4	2.5	15.0	53.6	Total Hardness
14	1963	C	ATH-14	250	75	46	360	200	(200)		56.0	1.8	3.8	2.0	28.0	96.6	Total Hardness
15	1964	C	ATH-14	250	75	46	360	200	(200)		80.0	1.5	4.7	3.2	25.0	48.4	Total Hardness
16	1965	C	ATH-14	250	75	46	360	200	(200)		65.8	4.5	7.8	3.3	19.9	100.0	Total Hardness
17	1965	C	ATH-14	250	75	46	360	200	(200)		71.0	2.6	4.0	1.4	50.7	91.7	pH value, Total Hardness
18	1961	C	ATH-14	250	75	46	360	200	(200)		50.0	2.5	5.2	2.7	18.5	802.5	Total Hardness
19	1965	S	ETSV-12	150	45	30	270	200	(200)		50.0	3.0	4.0	1.0	50.0	98.5	Total Hardness
20	1965	S	ETSV-12	150	45	30	270	200	(200)		55.0	3.8	5.5	1.7	33.3	88.7	Total Hardness
21	1965	C	ATH-14	250	75	46	360	200	(200)		66.6	3.5	4.7	1.2	55.5	99.9	Total Hardness
22	1991	S	ETSV-12	150	45	30	270		(200)								Total Hardness
23	1991	S	ETSV-12	150	45	30	270		(200)								pH value, Total Hardness
3P	1998	S	ETSV-12	150	45	30	270		0	Pump	43.0	3.5	7.0	3.6	12.0		
4P	1998	S	ETSV-12	150	45	30	270		0	Pump	38.0	3.1	6.9	3.9	9.8		
5P	1998	S	ETSV-12	150	45	30	270		(200)								
6P	1998	S	ETSV-12	150	45	30	270		0	Pump	40.0	2.9	5.7	2.8	14.4		
7P	1998	S	ETSV-12	150	45	30	270		0	Pump	40.0	3.0	6.1	3.1	13.1		
8P	1998	S	ETSV-12	150	45	30	270		0	Pump	38.0	3.1	6.9	3.9	9.8		
9P	1998	S	ETSV-12	150	45	30	270		0	Pump	43.0	2.9	6.5	3.6	11.9		
10P	1998	S	ETSV-12	150	45	30	270		(200)								
11P	1998	S	ETSV-12	150	45	30	270		0	Pump	46.0	2.0	4.8	2.7	17.0		
12P	1998	S	ETSV-12	150	45	30	270		0	Pump							
13P	1998	S	ETSV-12	150	45	30	270		0	Pump	65.0	2.2	4.1	2.0	33.0		
14P	1998	S	ETSV-12	150	45	30	270		0	Pump							
15P	1998	S	ETSV-12	150	45	30	270		0	Pump	42.0	2.3	6.4	4.1	10.1		
16P	1998	S	ETSV-12	150	45	30	270		0	Pump	42.0	2.5	6.8	4.4	9.6		
2A	1992	S	ETSV-12	150	45	30	270		(200)								pH value, Total Hardness
3A	1992	S	ETSV-12	150	45	30	270		0	Pump							
4A	1992	S	ETSV-12	150	45	30	270		0	Pump							
5A	1992	S	ETSV-12	150	45	30	270		(200)								Total Hardness

Table S 3.1.2.27(4) List of Maintenance Status and Rehabilitation of Wells at South WTP

WPT Name	South

Well No.	Starting Year, Operated	Repair and Rehabilitation							
		Equipments, often damaged	Times of Re-Instal lation of Pump	Final Installa-tion Year of Pump	Frq. Of Repairs (times/yr)	Final Repair Year of Pump	Freq. of Rehabili-tation (once in yrs)	Final Rehabili-tation Year	Contents of Rehabilitation
1	1959	Pump			0.5	2002	2		Air Lifting
2	1961	Pump			1	2003	2		Air Lifting
3	1961	Pump			1	2003	2		Air Lifting
4	1959	Pump			0.5	2002	2		Air Lifting
5	1961	Pump			0		2		Air Lifting
6	1959	Pump			0.5	2002	2		Air Lifting
7	1965	Pump		2001	0		2		Air Lifting
8	1985	Pump			1	2003	2		Air Lifting
9	1961	Pump			1.5	2002	2		Air Lifting
10	1961	Pump			0.3	2000	2		Air Lifting
11	1985	Pump			-		2		Air Lifting
12	1963	Pump			0.6	2002	2		Air Lifting
13	1963	Pump			-		2		Air Lifting
14	1963	Pump					2		Air Lifting
15	1964	Pump			0.5	2002	2		Air Lifting
16	1965	Pump			0.5	2003	2		Air Lifting
17	1965	Pump			0.5	2002	2		Air Lifting
18	1961	Pump			1	2002	2		Air Lifting
19	1965	Pump			1	2003	2		Air Lifting
20	1965	Pump			1	2003	2		Air Lifting
21	1965	Pump			1	2003	2		Air Lifting
22	1991	Pump			1	2002	2		Air Lifting
23	1991	Pump			1	2002	2		Air Lifting
3P	1998	Pump					2		Air Lifting
4P	1998	Pump					2		Air Lifting
5P	1998	Pump					2		Air Lifting
6P	1998	Pump					2		Air Lifting
7P	1998	Pump					2		Air Lifting
8P	1998	Pump					2		Air Lifting
9P	1998	Pump					2		Air Lifting
10P	1998	Pump					2		Air Lifting
11P	1998	Pump					2		Air Lifting
12P	1998	Pump					2		Air Lifting
13P	1998	Pump					2		Air Lifting
14P	1998	Pump					2		Air Lifting
15P	1998	Pump					2		Air Lifting
16P	1998	Pump					2		Air Lifting
2A	1992	Pump					2		Air Lifting
3A	1992	Pump					2		Air Lifting
4A	1992	Pump					2		Air Lifting
5A	1992	Pump					2		Air Lifting

Table S 3.1.2.28(1) List of Structure and Pumping Test Data of Wells at Sergeli WTP

WPT Name: Sergeli

Well No.	Const-ruction Year	Well Structure: Ground Eleva-tion (m)	Drilled Depth (m)	Drilled Diameter (mm)	Casing: Diameter (mm)	Casing: Material of Casing	Screen: Total Length (m)	Screen: Position (m)	Screen: Geology of Screen	Pumping Test Data: Test Yield (L/s)	Static Water Level (m)	Pumping Water Level (m)	Draw-down (m)	Specific Capa-city (L/s/m)	Water Quality Analysis Data: pH	Na + K (mg/L)	Ca (mg/L)	Mg (mg/L)	Cl (mg/L)	HCO3 (mg/L)	SO4 (mg/L)	TDS (mg/L)
1	1966		40.0		325-168	steel	19.0	21.0-40.0	gr-sd	44.4	1.3	2.1	0.8	55.6								
2	1966		70.0		426-325	steel	35.0	30.0-65.0	gr-sd	83.3	1.4	2.4	1.0	83.3								
3	1966		70.0		426-273	steel	34.0	31.0-65.0	gr-sd	83.3	1.2	2.2	1.0	83.3								
4	1966		70.0		426-273	steel	34.0	31.0-65.0	gr-sd	83.3	1.2	2.6	1.4	59.5								
5	1970		104.0		219-152	steel	21.3	73.2-94.5	gr-sd	33.3	5.0	6.0	1.0	33.3								
6	1976		50.0		426-325	steel	19.0	29.0-48.0	gr-sd	83.3	1.1	2.9	1.8	47.6								
7	1976		50.0		426-325	steel	18.0	30.0-48.0	gr-sd	83.3	1.0	2.8	1.8	47.6								
8																						
9																						

Table S.3.1.2.28 (2) List of Pumps and Operation of Wells at Sergeli WTP

WPT Name: Sergeli

Well No.	Starting Year, Operated	Pump Facilities: Pump Type	Model No.	Dia-meter (mm)	Output (KW)	Pump Capacity: H (m)	Pump Capacity: Q (m3/hr)	Operation of Groundwater Intake: Recom-mended Intake Rate (m3/hr)	Actual Amount of Intake (m3/hr)	Cause of Non-Operation	Pumping Test at Present Time: Test Yield (L/s)	Static GWL (m)	Pumping GWL (m)	Draw-down (m)	Specific Capacity (L/s/m)	Decline of Well Capacity(%)	Water Qality Analysis: Exceeded Items of Potable Water Standard (2003)
1	1966	S	ETSV-10		32		160				19.4	1.3	2.1	0.8	24.3	43.7	Total Hardness
2	1966	C	ATH-14	250	75	46	360		0	Water Quality	19.4	1.4	2.4	1.0	19.4	23.3	
3	1966	C	ATH-14	250	75	46	360				19.4	1.2	2.2	1.0	19.4	23.3	
4	1966	C	ATH-14	250	75	46	360				19.4	1.2	2.6	1.4	13.9	23.3	Total Hardness
5	1970	S	ETSV-10		32		160				14.3	5.0	6.0	1.0	14.3	42.9	Total Hardness,Intestinal Bacillus
6	1976	C	ATH-14	250	75	46	360				33.3	1.1	2.9	1.8	19.0	40.0	Total Hardness
7	1976	C	ATH-14	250	75	46	360				33.3	1.0	2.8	1.8	19.0	40.0	
8																	
9																	

Table S 3.1.2.28 (3) List of Maintenance Status and Rehabilitation of Wells at Sergeli WTP

WPT Name	South								
		Repair and Rehabilitation							
Well No.	Starting Year, Operated	Equipments, often damaged	Times of Re-Instal lation of Pump	Final Installa-tion Year of Pump	Frq. Of Repairs (times/yr)	Final Repair Year of Pump	Freq. of Rehabili-tation (once in yrs)	Final Rehabili-tation Year	Contents of Rehabilitation
1	1969	Pump	0	1964	0.5	2000	-		
2	1969	Pump	0	1964	1	2003	-		
3	1969	Pump	0	1964	0.5	2000	-		
4	1996	Power Source/Cable	1	1997	2	2003	-		
5	1969	Motor	1	1997	0.5	2002	-		
6	1969	Pump	1	1997	0.5	2000	-		
7	1969	Pump	0	1964	0.5	2000	-		
8	1969	Pump	0	1964	1	2002	-		
9	1969	Pump	0	1964	2	2000	-		

Table S 3.1.2.29(1) List of Structure and Pumping Test Data of Wells at Kuiluk WTP

WPT Name	Kuilk																					
		Well Structure								Pumping Test Data					Water Quality Analysis Data							
					Casing		Screen															
Well No.	Const-ruction Year	Ground Eleva-tion (m)	Drilled Depth (m)	Drilled Diameter (mm)	Diameter (mm)	Material of Casing	Total Length (m)	Position (m)	Geology of Screen	Test Yield (L/s)	Static Water Level (m)	Pumping Water Level (m)	Draw-down (m)	Specific Capa-city (L/s/m)	pH	Na + K (mg/L)	Ca (mg/L)	Mg (mg/L)	Cl (mg/L)	HCO3 (mg/L)	SO4 (mg/L)	TDS (mg/L)
1	1964		55.0		400-300	steel	31.3	19.0-50.3	bl-gr	65.0	5.5	6.6	1.1	59.1	7.5	11.0	97.2	19.7	8.5	311.1	77.3	408
										70.0	5.5	7.0	1.5	46.7								
2	1964		54.0		400-300	steel	30.0	19.0-49.0	bl-gr-sd	68.0	7.5	8.5	1.0	68.0	7.5	8.1	101.4	19.4	16.7	305.0	74.1	400
										70.0	7.5	9.0	1.5	46.7								
3	1964		56.0		400-300	steel	27.9	20.5-31.0	bl-gr-sd	69.4	5.5	7.0	1.5	46.3	7.3	10.8	105.0	29.5	18.1	323.3	76.5	472
								33.0-50.4	bl-gr-sd	70.8	5.5	7.3	1.8	39.3								
4	1963		56.0		400-300	steel	31.4	16.0-28.5	bl-gr-sd	50.0	4.0	4.5	0.5	100.0	7.5	3.0	81.2	38.9	23.9	311.1	77.3	460
								31.5-50.4	bl-gr-sd	62.2	4.0	5.0	1.0	62.2								
5	1962		56.0		400-300	steel	24.0	27.6-51.6	bl-gr-sd	54.7	3.4	4.3	0.9	64.4	6.5	3.8	102.2	19.4	34.0	231.0	56.0	470
										57.0	3.4	4.5	1.1	54.3								
6	1962		55.0		400-300	steel	25.0	25.0-50.0	bl-gr	29.5	3.0	8.0	5.0	5.9	6.5	3.9	91.3	14.1	26.0	237.8	69.1	456
										43.3	3.0	11.0	8.0	5.4								
7	1962		56.0		400-300	steel	20.0	31.0-51.0	bl-gr-sd	40.8	4.0	11.0	7.0	5.8		4.3	97.8	18.5	13.0	262.3	69.8	414
										50.0	4.0	14.0	10.0	5.0								
8	1962		56.0		400-300	steel	30.0	18.0-28.0	bl-gr-sd	54.0	4.0	5.5	1.5	36.0	7.4	2.8	106.4	26.6	24.1	317.2	82.3	464
								31.0-51.0	bl-gr-sd	65.0	4.0	6.0	2.0	32.5								
9	1963		50.0		400-300	steel	23.0	19.0-29.5	bl-gr-sd	41.9	6.0	7.1	1.1	38.1	7.5	5.5	80.1	22.1	25.3	219.6	85.6	392
								32.0-44.5	bl-gr-sd	50.0	6.0	7.5	1.5	33.3								

Table S.3.1.2.29 (2) List of Pumps and Operation of Wells at KuilukWTP

WPT Name	Kuilk																		
Well No.	Starting Year, Operated	Pump Facilities						Operation of Groundwater Intake											
		Pump Type	Model No.	Dia-meter (mm)	Output (KW)	Pump Capacity		Recom-mended Intake Rate (m3/hr)	Actual Amount of Intake (m3/hr)	Cause of Non-Operation	Pumping Test at Feb., 2003						Groundwater Level		Problems for Groundwater Intake
						H (m)	Q (m3/hr)				Test Yield (L/s)	Static GWL (m)	Pumping GWL (m)	Draw-down (m)	Specific Capacity (L/s/m)	Decline of Well Capacity(%)	Static GWL (m)	Pumping GWL (m)	
1	1969	C	ATH-14	250	75	46	360	200	(200)		65.0	5.5	6.6	1.1	59.1	100.0	1.7	21.4	Clogging of Screen
2	1969	C	ATH-14	250	75	46	360	200	(200)		68.0	7.5	8.5	1.0	68.0	100.0	1.0	3.5	
3	1969	C	ATH-14	250	75	46	360	200	(200)		69.4	5.5	7.0	1.5	46.3	100.0	2.6	4.9	
4	1996	S	ETSV-12	150	45	30	270	200	(200)		50.0	4.0	5.0	1.0	50.0	50.0	2.8	3.3	
5	1969	S	ETSV-12	150	45	30	270	200	(200)		54.7	3.4	7.7	4.3	12.9	20.0	1.8	4.0	
6	1969	S	ETSV-12	150	45	30	270	200	(200)		56.0	5.5	11.2	5.7	9.8	166.5	2.1	3.9	
7	1969	C	ATH-14	250	75	46	360	200	(200)		40.8	4.0	15.0	11.0	3.7	63.6	1.8	21.1	Clogging of Screen
8	1969	C	ATH-14	250	75	46	360	200	(200)		54.0	4.0	9.5	5.5	9.8	27.3	2.7	4.0	
9	1969	C	ATH-14	250	75	46	360	200	(0)	Cable	41.9	6.0	7.2	1.2	34.9	91.7	3.0	7.1	

Table S 3.1.2.30 Summarized Diagnosis Results of Wells for Small Scale WTPs

No.	Name	Well number	Well's function	Pump's function	Problem
1	South	Total: 41 Operating: 27	-Relatively normal -Unsuitable water for distribution	- Many of South area well's pumps were breakdown -Lack of parts for pump repair -New Pumps purchased from Russia are not reliable	- High hardness exceeding standard -14 wells are not operating -Well's intake capacities and pump capacities are not match
2	Sergeli	Total: 9 Operating: 8	-Decreasing rapidly	- Lack of parts for pump repair -New Pumps purchased from Russia are not reliable	-One well is unsuitable for drinking -Frequent breakdown of pumps
3	Kara-su	Total: 11 Operating:6	-Unknown because of no data	- Lack of parts for pump repair -Many submerged pump cannot be repaired	-5 wells are not operating
4	Kuiluk	Total: 9 Operating: 9	- Unknown because of no data	- Relatively normal operation - Lack of parts for pump repair	-Relatively high hardness
5	Bectemir	Total: 11 Operating: 5	- Unknown because of no data	- Lack of parts for pump repair -Many submerged pump cannot be repaired	-6 wells are not operating -Contaminated water by surround-ing pollution

iv) Distribution PSs

South, Sergeli and Bectemir WTPs have distribution PSs. Lists of distribution pumps and related facilities are shown in Table S 3.1.2.31 (1) and (2). Diagnosis results for each WTP are shown in Table S 3.1.2.31 (3) to (5).

Table S 3.1.2.31(1) List of Distribution Pumps for South, Sergeli and Bectemir WTPs

WTP Name	No.	Name	Model	Q (m^3/hr)	Head (m)	D(in,out) (mm)	Power (kw)	in Valve (mm)	out Valve (mm)	Installation year
South	1	Main pump	VH-DS	1250	125	350,200	630	400	400	1969
	2	Ditto	Ditto	2000	100	350,200	800	400	400	1974
	3	Ditto	Ditto	1250	125	350,200	630	400	400	1996
	4	Ditto	Ditto	1250	125	350,200	630	400	400	2000
	5	Ditto	Ditto	2000	100	500,300	830	1200	400	1979
Sergeli	1	Main pump	VH-DS	1250	63	400,300	250	500	500	1978
	2	Ditto	Ditto	1250	63	400,300	250	500	500	1978
	3	Ditto	Ditto	1250	63	400,300	315	500	500	1991
	4	Ditto	Ditto	1250	63	400,300	250	500	500	1978
	5	Ditto	Ditto	1250	63	400,300	315	500	500	1993
	6	Ditto	Ditto	320	50	300,250	75	300	250	1978
Bectemir	1	Main pump	VH-SS	160	30	150,100	30	300	250	1986
	2	Ditto	Ditto	160	30	150,100	30	300	250	1986
	4	Ditto	Ditto	320	50	150,100	55	300	250	1986
	5	Ditto	Ditto	320	50	150,100	55	300	250	1986

Table S 3.1.2.31 (2) List of No.1 Distribution PS Facilities

WTP Name	No.	Name	Specifications	Inst. year
South	1	Pipes	D300-1000	1963
	2	Valves	D300-1000	1963
	3	Ceiling crane	W 8.0m x 5ton	1963
	4	Power panel	Stand, 5 units	1963
	5	Control panel	Stand, 5 units	1963
	6	Cable an others		1963
Sergeli	1	Pipes	D500-1000	1978
	2	Valves	D500-1000	1978
	3	Ceiling crane	W 11m x 3.2ton	1978
	4	Power panel	Stand, 5 units	1978
	5	Control panel	Stand, 5 units	1978
	6	Cable an others		1978
Bectemir	1	Pipes	D250-500	1986
	2	Valves	D250-500	1986
	3	Ceiling crane	W 5m x 2ton	1986
	4	Power panel	Stand, 5 units	1986
	5	Control panel	Stand, 5 units	1986
	6	Cable an others		1986

Table S 3.1.2.31 (3) Diagnosis Sheet for South Distribution PS

Division	Name	Operation status	Condition, Appearance	Judgment
Pumps	No.1 main	No particular problem	Remarkably deteriorated. A large water leakage. Break down has frequently occurred.	C2
	No.2 main	No particular problem	Remarkably deteriorated. A large water leakage. Unusual motor noise. Break down has frequently occurred.	C2
	No.3 main	Motor is worn-out. Under repair	Remarkably deteriorated. Break down has frequently occurred.	C2
	No.4 main	No particular problem	Remarkably deteriorated. Break down has frequently occurred.	C2
	No.5 main	No particular problem	Remarkably deteriorated. Break down has frequently occurred.	C2
Pipes and other Machines	Pipes	No particular problem	Corroded thoroughly due to no re-painting	C1
	Valves	No particular problem	Corroded thoroughly due to no re-painting	C1
	Ceiling crane	No particular problem	No particular problem	B
Electrical Facilities	Power panel	No particular problem	Remarkably deteriorated. Instruments are partly out of order.	C1
	Control panel	No particular problem	Remarkably deteriorated. Automatic circuits are out of order.	C1
	Cable/others	No particular problem	Remarkably deteriorated	C1

Table S 3.1.2.31 (4) Diagnosis Sheet for Sergeli Distribution PS

Division	Name	Operation status	Condition, Appearance	Judgment
Pumps	No.1 main	No problem	Remarkably deteriorated. Recently serious break down of main axis has occurred.	C1
	No.2 main	No problem	Remarkably deteriorated. Recently break down has frequently occurred.	C2
	No.3 main	Motor is worn-out. Under repair	Remarkably deteriorated. Recently break down has frequently occurred.	C2
	No.4 main	Motor was fired 4 years ago. Impossible to be repaired.	Impossible to be repaired	C2
	No.5 main	No problem	Remarkably deteriorated. Recently break down has frequently occurred.	C1
	No.5 main	Replaced. Frequently used due to break down of other units.	Remarkably deteriorated. Recently break down has frequently occurred.	C2
Pipes and other Machines	Pipes	No problem	Painted. Partly corroded, but in good appearance.	C1
	Valves	No problem	Painted. Partly corroded, but in good appearance.	C1
	Ceiling crane	No problem	No problem	B
Electrical Facilities	Power panel	No particular problem	Remarkably deteriorated. A part of instruments are out of order.	C1
	Control panel	No particular problem	Remarkably deteriorated. Automatic circuits are out of order.	C1
	Cable/others	No particular problem	Remarkably deteriorated	C1

Table S 3.1.2.31(5) Diagnosis Sheet for Bectemir Distribution PS

Division	Name	Operation status	Condition, Appearance	Judgment
Pumps	No.1 main	No problem	Remarkably deteriorated. Break down has frequently occurred.	C1
	No.2 main	No problem	Remarkably deteriorated. Break down has frequently occurred.	C2
	No.3 main	No problem	Remarkably deteriorated. Break down has frequently occurred.	C2
	No.4 main	No problem	Remarkably deteriorated. Break down has frequently occurred.	C2
Pipes and other Machines	Pipes	No problem	Painted. Very little corrosion. In good appearance.	B
	Valves	No problem	Painted. Partly corroded, but in good appearance.	B
	Ceiling crane	No problem	No problem	B
Electrical Facilities	Power panel	No particular problem	Deteriorated, but in fair condition.	B
	Control panel	No particular problem	Deteriorated, but in fair condition.	B
	Cable/others	No particular problem	Deteriorated, but in fair condition.	B

iv) Chlorinator

South and Sergeli WTP are using liquid chlorine filled up in 1ton cylinders, and that for Kara-su, Kuiluk and Bectemir WTP are using calcium hypo-chlorite. Chlorinators for South and Sergeli WTP and related facilities are listed in Table S 3.1.2.32 (1), and the diagnosis results are shown in Table S 3.1.2.32 (2).

Chlorinators for Kara-su, Kuiluk and Bactemir WTPs are listed in Table S 3.3.33(1) and the diagnosis results are shown in Table S 3.1.2.33 (2).

Table S 3.1.2.32 (1) List of Chlorination Facilities using Liquid Chlorine

Division	No.	Name	Type	Specification	Number	Inst. Year
South	1	Cylinder scale	Analog type	for 1ton Cylinder	1	1961
	2	Gas filter			1	1961
	3	Gas meter	Flow meter	2.5kg/hrxd20mm	2	1961
	4	Ejector	Water ejector	D25mm, from distribution pump	2	1961
	5	Safety equipment		Sprinkler, Discharging chamber, Gas mask	1	1961
Sergeli	1	Cylinder scale	Analog type	for 1ton Cylinder	1	1977
	2	Gas filter			1	1977
	3	Gas meter	Flow meter	2.5kg/hrxd20mm	2	1977
	4	Ejector	Water ejector	D25mm, with exclusive pump	2	1977
	5	Safety equipment		Sprinkler, Discharging chamber, Gas mask	1	1977

Table S 3.1.2.32 (2) Diagnosis Sheet of Chlorination Facilities using Liquid Chlorine

Division	No.	Name	Operation Status	Condition, Appearance	Judgment
South	1	Cylinder scale	No operational problem	Remarkable deteriorated, poor precision	C2
	2	Gas filter	No operational problem	Remarkable deteriorated	C2
	3	Gas meter	No operational problem	Remarkable deteriorated	C2
	4	Ejector	No operational problem	Remarkable deteriorated	C2
	5	Safety equipment	No operational problem	Remarkable deteriorated	C2
Sergeli	1	Cylinder scale	No operational problem	Remarkable deteriorated, poor precision	C2
	2	Gas filter	No operational problem	Remarkable deteriorated	C2
	3	Gas meter	No operational problem	Remarkable deteriorated	C2
	4	Ejector	No operational problem	Remarkable deteriorated	C2
	5	Safely equipment	No operational problem	Remarkable deteriorated	C2

Table S 3.1.2.33 (1) List of Chlorination Facilities using Calcium Hypochlorite

Division	No.	Name	Type	Specification	Number	Inst. Year
Kara-su	1	Dissolving	Tank +mixer	Dissolving 10kg /day	1	1990
	2	Control Panel		Wall attached type	1	1990
Kuiluk	1	Dissolving	Tank +mixer	Dissolving 10kg /day	2	1996
	2	Control Panel		Wall attached type	2	1996
Bektemir	1	Dissolving	Tank +mixer	Dissolving 10kg /day	1	1986
	2	Control Panel		Wall attached type	1	1986

Table S 3.1.2.33 (2) Diagnosis Sheet of Chlorination Facilities using Calcium Hypochlorite

Division	No.	Name	Operation Status	Condition, Appearance	Judgment
Kara-su	1	Dissolving	No problem for operating	Good, however no standby	B
	2	Control Panel	No problem for operating	Good	B
Kuiluk	1	Dissolving	No problem for operating	Good	B
	2	Control Panel	No problem for operating	Good	B
Bektemir	1	Dissolving	No problem for operating	Deterioration is progressing	C1
	2	Control Panel	No problem for operating	Relatively good	B

(4) Booster PSs

List of Booster PS are shown in Table S 3.1.2.34 (1) to (8).

Diagnosis sheets for Booster PS are shown in Table S 3.1.2.35 (1) to (9).

Table S 3.1.2.34 (1) List of Booster PSs

No.	No. in district	Pumping station location	Supply capacity m^3/h	Constructed year	Type of pump	Number of pump	Capacity of pump		
		(Yakkasaray)					m^3/h	m	kW
1	1	Massiv Bashlik between houses 4 & 5	1000	1987	Centrifugal	No.1	320	38	55
						No.2	320	50	55
						No.3	320	50	55
						No.4	320	38	55
						No.5	320	50	55
2	2	Bobur str. In front of Bobur park	600	1998	Centrifugal	No.1	320	50	75
						No.2	320	50	75
						No.3	320	50	55
3	3	Bobur str. Close to Tash. Heat-electric central	600	1976	Centrifugal	No.1	200	36	30
						No.2	320	50	55
						No.3	200	36	30
						No.4	200	36	30
4	4	samarkandskaya str., 14	400	1976	Centrifugal	No.1	100	65	30
						No.2	100	65	30
						No.3	100	65	30
						No.4	100	65	30
5	5	baranova str., behind "Rossia" hotel	1000	1989	Centrifugal	No.1	320	50	75
						No.2	320	50	75
						No.3	320	50	75
						No.4	320	50	75
						No.5	320	50	75
6	6	Kahhar str., in front of 16-floor stories building	50	2002	Centrifugal	No1	80	50	18
						No2	80	50	18
7	7	Anhor, near White House	1000	1998	Centrifugal	No.1	320	50	75
						No.2	320	38	55
						No.3	320	38	55
8	8	Abdullaeva str., 11	500	1984	Centrifugal	No.1	80	50	15
						No.2	45	55	17
						No.3	45	30	17
						No.4	100	80	15
9	9	U. Nosir str., near "Ocean" supermarket	200	2000	Centrifugal	No.1	100	32	30
						No.2	100	32	30
10	1	50 anniversary of RU, S. Barak str., 68	1000	1988	Centrifugal	No.1	320	50	75
						No.2	320	50	75
						No.3	320	50	75
						No.4	320	50	75
						No.5	320	38	55
11	2	Ts - 7, close to Telephone stattion (56)	600	1968	Centrifugal	No.1	320	50	75
						No.2	320	50	75
						No.3	320	50	75
						No.4	320	50	75
12	3	m. Ippondrom, in front of "Himfarm" plant	1000	1987	Centrifugal	No.1	320	50	75
						No.2	320	38	55
						No.3	320	50	55
						No.4	320	38	55
						No.5	320	50	75
13	4	Fitrat 1, Fitrat str., 4a	1000	1991	Centrifugal	No.1	320	50	75
						No.2	320	50	75
						No.3	320	38	55
						No.4	320	50	55
						No.5	320	50	45
14	5	Kafanov str., 5	150	1978	Centrifugal	No.1	90	35	15
						No.2	160	20	11
						No.3	90	35	15
						No.4	30	45	7.5
15	6	Jukovskaya str., 83a	150	1987	Centrifugal	No.1	90	35	15
				2002		No.2	90	35	15
				2002		No.3	90	35	15
						No.4	100	65	15
16	7	Alibekova str., 3a	90	2000	Centrifugal	No.1	45	40	11
						No.2	45	30	7.5

Table S 3.1.2.34 (2) List of Booster PSs

No.	No. in district	Pumping station location	Supply capacity m^3/h	Constructed year	Type of pump	Number of pump	Capacity of pump		
17	8	Fitrat 11, Fitrat 4	600	2000	Centrifugal	No.1	320	38	
						No.2	320	38	55
18	9	Staradubtseva str., behind institute of transport	45	1999	Centrifugal	No.1	45	30	11
						No.2	45	30	11
						No.3	45	30	11
19	10	massiv Kuyluk - 2	800	2000	Centrifugal	No.1	800	57	200
						No.2	800	57	200
20	11	massiv Kuyluk - 4, 49	20	2000	Submergible	No.1	-	-	16
21	12	Munis str., 9 (cellar)	20	2000	Submergible	No.1	-	-	16
22	13	Kuyluk 2 (TACIS)	60	2000	Centrifugal	No.1	170	15.2	5.5
						No.2	170	15.2	5.5
						No.3	170	15.2	5.5
		(Akmal - Ikramovskiy)							
23	1	m. Chilanzar-30, school 203	3000	2000	Centrifugal	No.1	800	50	200
				2000		No.2	800	50	200
				2000		No.3	800	50	200
				2000		No.4	800	50	200
				2000		No.5	800	50	200
				2000		No.6	800	50	200
24	2	m. Chilanzar - 25 (car park)	1000	1999	Centrifugal	No.1	320	50	75
				1995		No.2	320	50	75
				1995		No.3	320	50	75
				1999		No.4	320	50	75
				1997		No.5	320	50	75
				2001		No.6	320	50	75
25	3	Uygur str. - G. Uzakova str.	1000	1991	Centrifugal	No.1	320	50	75
						No.2	320	50	75
						No.3	320	50	75
						No.4	320	50	75
26	4	Ziyo Said str., near Post office	600	1996	Centrifugal	No.1	320	50	75
				2001		No.2	320	50	75
				1995		No.3	320	50	75
27	5	m. Hondamir, Ziyo Said str.	600	1996	Centrifugal	No.1	320	50	55
						No.2	320	50	55
						No.3	320	50	55
28	6	at the territory of Uz. State Univer. Of Lang.	160	1998	Centrifugal	No.1	160	30	30
						No.2	160	30	30
						No.3	160	30	30
29	7	Rahimbabaeva str., 2 (cellar)	90	1990	Centrifugal	No.1	320	50	30
30	8	m. Chilanzar 26, terr. Tashmoloko (Tashmilk)	1000	1995	Centrifugal	No.1	320	38	55
						No.2	320	50	75
						No.3	320	38	55
						No.4	320	38	55
31	9	B-14 block	1000	1996	Centrifugal	No.1	320	50	75
				1996		No.2	320	50	75
				1996		No.3	320	50	75
				1996		No.4	320	50	75
				2000		No.5	320	50	75
32	10	m. Chilanzar 12(cellar)	20	2002	Submergebl	No.1	-	-	16
33	11	Attoyi mahallya	40	1995	Centrifugal	No.1	45	30	11
						No.2	45	30	11
34	11	1 block, build. - 50, 51, 52a	20	2001	Submergebl	No.1	-	-	11
35	12	Avangard 7	20	2001	Submergebl	No.1	-	-	16

Table S 3.1.2.34 (3) List of Booster PSs

No.	No. in district	Pumping station location	Supply capacity m^3/h	Constructed year	Type of pump	Number of pump	Capacity of pump		
		(Chilanzarskiy)							
36	1	m. Chilanzar - "E"	1000	2000	Centrifugal	No.1	320	50	75
				2000		No.2	320	50	75
				1989		No.3	320	50	75
				1985		No.4	320	50	75
37	2	m. Chilanzar - 11, Bulvarnaya	1000	1998	Centrifugal	No.1	315	71	90
				1988		No.2	320	50	75
				1998		No.3	315	71	75
				2001		No.4	200	90	75
				1998		No.5	320	50	75
38	3	Chilanzar, 16	1000	2001	Centrifugal	No.1	320	50	75
				1997		No.2	320	50	75
				1995		No.3	320	50	75
				1995		No.4	320	50	75
39	4	m. Chilanzar, 20a	1000	1999	Centrifugal	No.1	320	50	55
				1999		No.2	320	50	55
				2000		No.3	320	50	75
				1999		No.4	320	50	55
				2000		No.5	320	50	75
40	5	m. Al - Horezmiy, 27	1000	1988	Centrifugal	No.1	320	50	75
						No.2	320	50	75
						No.3	320	50	75
						No.4	320	50	75
						No.5	320	50	75
41	6	Turab Tula str.	40	1989	Centrifugal	No.1	20	30	5.5
						No.2	20	30	5.5
42	7	Hamza metro	40	1998	Centrifugal	No.1	20	30	5.5
						No.2	20	30	5.5
43	8	Pionerskaya str.	1000	1995	Centrifugal	No.1	320	50	75
						No.2	320	50	75
						No.3	320	50	75
						No.4	320	50	75
						No.5	320	50	75
44	9	National security Service - Zavki str.	40	1996	Centrifugal	No.1	20	30	5.5
45	10	m. Chilanzar 7	20	1999	Centrifugal	No.1	20	30	5.5
46	11	Nakkoshlik str., near custom service	20	2000	Centrifugal	No.1	20	30	5.5
47	12	Yoshlik metro	7200	1997	Centrifugal	No.1	1600	90	500
						No.2	1600	90	500
						No.3	1600	90	500
						No.4	630	90	200
						No.5	630	90	200
						No.6	630	90	200
						No.7	200	90	75
						No.8	200	90	75
						No.9	200	90	75
48	13	m. Chilanzar 7-33	20	2000	Centrifugal	No.1	20	30	5.5
49	14	m. Chilanzar - 19	20	2000	Centrifugal	No.1	20	30	5.5
50	15	m. Chilanzar - 1	20	2000	Centrifugal	No.1	20	30	5.5
		(Shayhantahurskiy)							
51	1	Ibn Sino, 17	-	1999	Centrifugal	No.1	200	90	250
				1999		No.2	200	90	200
				2000		No.3	800	56	200
				1998		No.4	200	90	200
				1998		No.5	200	90	200
				1998		No.6	200	90	200

Table S 3.1.2.34 (4) List of Booster PSs

No.	No. in district	Pumping station location	Supply capacity m^3/h	Constructed year	Type of pump	Number of pump	Capacity of pump		
52	2	m. Almazar	1000	1982	Centrifugal	No.1	320	55	75
				1982		No.2	320	55	75
				2000		No.3	320	55	75
				1989		No.4	320	55	75
				1989		No.5	320	55	75
53	3	m. Ts - 13, build.26	800	1993	Centrifugal	No.1	320	50	75
						No.2	320	50	75
						No.3	320	50	75
54	4	Ts - 14, behind "Ganga"	120	2000	Centrifugal	No.1	320	38	55
						No.2	320	38	55
55	5	Ipakchi str.	200	1991	Centrifugal	No.1	320	38	55
						No.1	320	50	75
56	6	Kukcha, Uygur str.	500	1999	Centrifugal	No.1	320	38	55
						No.2	320	38	55
57	7	huvaydo str., 2a	200	1976	Centrifugal	No.1	160	30	17
						No.2	160	30	17
						No.3	90	35	17
58	8	Ts - 27, near school	500	2000	Centrifugal	No.1	320	38	55
						No.2	320	38	55
59	9	Gulhani str.	1000	1995	Centrifugal	No.1	320	38	55
				1995		No.2	320	38	55
				2000		No.3	320	38	55
60	10	chorsu, Samarkand-Darbaza str, 5	400	1999	Centrifugal	No.1	90	55	30
				2003		No.2	100	65	45
				1999		No.3	90	50	22
				1999		No.4	90	50	22
				1999		No.5	90	50	22
61	11	Gulhani str.	20	2001	Centrifugal	No.1	50	50	15
						No.2	50	50	15
62	12	chorsu, Samarkand-Darbaza str, 6	60	2002	Centrifugal	No.1	90	35	18
				1999		No.2	90	35	18
63	13	Gulhani str.	20	1979	Centrifugal	No.1	320	70	-77
		Mirzo - Ulugbekskiy							
64	1	Shastri str., m. G. Petrov	1000	1987	Centrifugal	No.1	320	50	75
						No.2	320	50	75
						No.3	320	50	75
						No.4	320	38	55
						No.5	320	38	55
65	2	m. Feruza, 3	1000	1987	Centrifugal	No.1	320	50	75
						No.2	320	38	55
						No.3	320	50	75
						No.4	320	38	55
						No.5	320	38	55
66	3	m. TTZ - 4, build.1	1000	1989	Centrifugal	No.1	320	50	75
						No.2	320	50	75
						No.3	320	50	75
						No.4	320	50	75
						No.5	320	50	75
67	4	m Cherdansev, 20	40	1993	Centrifugal	No.1	90	35	15
						No.2	90	35	15
68	5	Karasu - 6	90	1988	Centrifugal	No.1	100	80	15
69	6	Humayun str.	1000	1999	Centrifugal	No.1	320	38	55
						No.2	320	38	55
						No.3	320	38	55
						No.4	320	38	55
						No.5	320	38	55
70	7	Pushkin str., Salar - river side	1000	1987	Centrifugal	No.1	320	38	55
						No.2	320	38	55
						No.3	320	38	55
						No.4	320	38	55
						No.5	320	38	55

Table S 3.1.2.34 (5) List of Booster PSs

No.	No. in district	Pumping station location	Supply capacity m^3/h	Constructed year	Type of pump	Number of pump	Capacity of pump		
		H. Olimjon. Pushkin str (under the							
71	8	No.1 group	600	1983	Centrifugal	No.1	90	85	45
						No.2	90	85	45
						No.3	90	85	45
						No.4	100	85	55
						No.5	90	85	55
		No.2 group				No.1	320	38	55
						No.2	90	35	15
						No.3	100	65	30
						No.4	85	45	45
						No.5	90	55	30
72	9	Lafarga str. 109	800	1968	Centrifugal	No.1	200	32	30
						No.2	200	32	30
						No.3	320	50	75
						No.4	200	32	30
73	10	Karasu - 3, build.13	600	1983	Centrifugal	No.1	320	50	75
						No.2	320	50	75
						No.3	320	50	75
						No.4	320	38	75
						No.5	-	-	-
74	11	Ts-1B, Gogol str, 9	60	1976	Centrifugal	No.1	90	85	45
				19976		No.2	90	85	45
				1977		No.3	200	36	45
				1999		No.4	45	55	45
				1999		No.5	45	55	15
75	12	Cherdaesev str.	30000	1967	Centrifugal	No.1	6200	51	1000
						No.2	6200	51	1000
						No.3	6200	51	1000
						No.4	6200	51	1000
						No.5	6200	51	1000
						No.6	6200	51	1000
						No.7	6200	51	1000
						No.8	5200	51	800
76	13	m. Karasu - 6 (cellar)	90	1998	Centrifugal	No.1	320	35	22
		s. Rahimovskiy							
77	1	B - 1, m. Beruniy, Guncha	3000	1998	Centrifugal	No.1	300	40	160
				2000		No.2	800	56	200
						No.3	800	56	200
						No.4	800	56	200
						No.5	800	56	200
						No.6	800	56	200
78	2	Farobiy str., - Candidates house (students)	1000	1999	Centrifugal	No.1	320	50	75
						No.2	320	50	75
						No.3	320	50	75
						No.4	320	50	75
						No.5	320	50	75
79	3	Karasayskaya 2	1000	1997	Centrifugal	No.1	320	50	75
						No.2	320	50	75
						No.3	320	50	75
						No.4	320	50	55
						No.5	320	50	75
80	4	Taksinbaeva, 11	1000	1991	Centrifugal	No.1	320	38	55
				1999		No.2	320	50	75
				1991		No.3	320	50	75
				1999		No.4	320	50	75
				1999		No.5	320	50	75

Table S 3.1.2.34 (6) List of Booster PSs

No.	No. in district	Pumping station location	Supply capacity m^3/h	Constructed year	Type of pump	Number of pump	Capacity of pump		
81	5	Ts 17-18. m. Sebzar, 20	1000	1984	Centrifugal	No.1	320	50	55
				1999		No.2	320	50	55
				1999		No.3	320	50	55
				1984		No.4	320	50	55
				1984		No.5	320	50	55
82	6	Vuzgorodok	1000	1982	Centrifugal	No.1	500	50	75
				1982		No.2	500	50	75
				1982		No.3	320	50	75
				1988		No.4	320	50	75
83	7	TashMI, Medgorodok, 12	1000	1985	Centrifugal	No.1	320	38	55
				1985		No.2	320	38	55
				2000		No.3	320	50	55
				2000		No.4	320	50	55
				1985		No.5	320	38	55
84	8	m. K. Karamish 1/2 -6	1000	1986	Centrifugal	No.1	320	50	75
				1986		No.2	320	50	75
				2001		No.3	320	50	75
				1988		No.4	320	50	90
85	9	K. Kamish 2/4 -32	400	1997	Centrifugal	No.1	320	38	55
				1997		No.2	320	38	55
				1986		No.3	320	38	55
				1997		No.4	320	38	55
86	10	Niyazova str. Beruniy str.	90	1991	Centrifugal	No.1	80	50	37
						No.2	80	35	37
87	11	Beruniy str.	20	1996	Centrifugal	No.1	20	80	4
88	12	sagban str., 3,4,5	80	1997	Centrifugal	No.1	65	150	-
89	13	Ts - 22 -103 (cellar)	20	1986	Submergebl	No.1	-	-	16
90	14	shumilovo (hospital territory)	160	1997	Centrifugal	No.1	160	30	30
						No.2	160	30	30
91	15	Kalinin - Mavzukter / Promenergo	60	1970	Centrifugal	No.1	20	30	2
92	16	Sagban 1, Doka Hleb	20	1999	Centrifugal	No.1	20	30	5.5
						No.2	20	30	5.5
93	17	Sagban 2, Huriyat str.	20	1999	Centrifugal	No.1	90	35	20
		Yunus Abad							
94	1	Boundary college	90	-	Centrifugal	No.1	90	35	30
						No.2	90	35	30
						No.3	90	35	30
						No.4	90	35	30
						No.5	90	35	30
95	2	SB-4 Y. Abad - 12 circle of bus - 72	1000	1982	Centrifugal	No.1	320	50	75
						No.2	320	50	75
						No.3	320	50	75
						No.4	320	50	75
						No.5	320	50	75
96	3	SD-2, A. Danish 2 -60	1000	1982	Centrifugal	No.1	320	38	55
						No.2	320	38	55
						No.3	320	38	55
						No.4	320	38	55
97	4	SB-4б Y. Abad - 14	3000	1982	Centrifugal	No.1	800	57	200
						No.2	800	57	200
						No.3	800	57	200
						No.4	800	57	200
						No.5	800	57	200
						No.6	800	57	200
98	5	Ts - 4	300	1971	Centrifugal	No.1	290	30	40
						No.2	290	30	40
						No.3	290	30	40
99	6	Ts - 5	600	1971	Centrifugal	No.1	320	38	55
						No.2	290	30	40
						No.3	320	38	55

Table S 3.1.2.34 (7) List of Booster PSs

No.	No. in district	Pumping station location	Supply capacity m^3/h	Constructed year	Type of pump	Number of pump	Capacity of pump		
100	7	Murtazaeva str., 4	20	1994	Centrifugal	No.1	20	30	40
						No.2	20	30	40
						No.3	20	30	40
101	8	Dj. Abidov str.	100	1988	Centrifugal	No.1	100	50	30
						No.2	100	50	30
						No.3	100	50	30
102	9	Badamzar 8	90	1991	Centrifugal	No.1	90	53	15
						No.2	90	53	15
103	10	SB-5 Y. Abad 9, circle of bus	1000	1987	Centrifugal	No.1	320	38	55
						No.2	320	38	55
						No.3	320	38	55
						No.4	320	38	55
						No.5	320	38	55
104	11	Block-8	20	1999	Submergible	No.1	-	-	16
105	12	Hasanboy - Circle, near gas-filling works	1000	1999	Centrifugal	No.1	315	71	90
						No.2	315	71	90
						No.3	315	71	90
						No.4	315	71	90
						No.5	315	71	90
106	13	Yunus Abad - 4	20	1999	Centrifugal	No.1	20	30	5.5
						No.2	20	30	5.5
107	14	Amir Timur str., 1	30	2000	Centrifugal	No.1	100	32	15
						No.2	100	32	15
						No.3	90	35	15
108	15	Zakirov str. (behind mosque)	1000	1999	Centrifugal	No.1	325	71	90
						No.2	325	71	90
						No.3	325	71	90
						No.4	325	71	90
						No.5	325	71	90
109	16	Turgunboev str.	320	1999	Centrifugal	No.1	320	38	15
						No.2	320	38	15
110	17	Krasnoprenenskaya str., 37	90	2000	Centrifugal	No.1	90	35	15
						No.2	90	35	15
111	18	Sohibkor - circle // anhor river side	20	2000	Centrifugal	No.1	20	30	4
						No.2	20	30	4
112	19	Block 18	20	2001	Submergebl	No.1	-	-	16
113	20	20 - block - 5	20	2001	Centrifugal	No.1	-	-	16
114	21	21 Housing stock of "Yulduz" Factory	20	2001	Submergebl	No.1	-	-	16
115	22	Ts - 5	20	2001	Submergebl	No.1	-	-	16
		(Hamzinskiy district)							
116	1	Lisunova str., 4	90	2002	Centrifugal	No.1	100	50	30
117	2	Lisunova str.	1000	1990	Centrifugal	No.1	320	50	75
				1990		No.2	320	50	75
				2000		No.3	320	50	75
				1990		No.4	320	50	75
				1990		No.5	320	50	75
118	3	Ahangaran - 40 let	1000	1989	Centrifugal	No.1	320	38	55
				1989		No.2	320	38	55
				2000		No.3	320	38	55
				2000		No.4	320	38	55
				1989		No.5	320	38	55
119	4	Chezelnaya str., 1a	1000	1990	Centrifugal	No.1	320	50	75
				-		No.2	320	50	75
				2000		No.3	320	50	75
				-		No.4	320	50	75
				-		No.5	320	50	75
				2003		No.6-1	100	65	30
				2003		No.6-2	100	65	30

Table S 3.1.2.34 (8) List of Booster PSs

No.	No. in district	Pumping station location	Supply capacity m^3/h	Constructed year	Type of pump	Number of pump	Capacity of pump		
120	5	district of REVS	300	1958	Centrifugal	No.1	320	50	75
						No.2	320	50	75
121	6	Kuyluk 1, Fergana Yuli str.	1000	-	Centrifugal	No.1	-	-	-
				1999		No.2	320	50	75
				2000		No.3	320	50	75
				1999		No.4	320	50	75
				1999		No.5	320	50	75
				-		No.6	-	-	-
122	7	Fergana Yuli, 15	40	1990	Centrifugal	No.1	45	30	7.5
123	8	Z. Shamutdinov str.	200	2000	Centrifugal	No.1	90	35	18
						No.2	90	35	18
						No.3	90	35	18
124	9	Havastskaya str.	45	2000	Centrifugal	No.1	90	45	8
						No.2	45	30	5
125	10	Tabibiy str.	20	2000	Centrifugal	No.1	45	30	5.5
						No.2	45	30	5.5
126	11	Panelnaya str.	600	2000	Centrifugal	No.1	320	50	55
						No.2	320	50	55
127	12	Zangori	600	2000	Centrifugal	No.1	320	50	55
						No.2	320	50	55
						No.3	320	50	55
128	13	Slonima	45	2001	Centrifugal	No.1	45	30	15
						No.2	45	30	15
129	14	Karimova	20	1999	Centrifugal	No.1	45	30	10
						No.2	45	30	10
		(Sergeliyskiy)							
130	1	Sergeli 2	1000	1983	Centrifugal	No.1	320	38	55
						No.2	320	38	55
						No.3	320	38	55
						No.4	320	38	55
131	2	Sergeli 3 - 5	3000	1995	Centrifugal	No.1	320	50	75
				1995		No.2	320	50	75
				1995		No.3	320	50	75
				2000		No.4	800	56	200
				1995		No.5	1250	63	315
				1998		No.6	300	90	315
				2000		No.7	1250	63	315
				2000		No.8	1250	63	315
132	3	Kuyluk 5	1000	1989	Centrifugal	No.1	320	50	75
						No.2	320	38	55
						No.3	320	38	55
						No.4	320	50	75
						No.5	320	38	55
133	4	Sergeli 8	1000	1993	Centrifugal	No.1-1	90	30	7.5
						No.1-2	45	30	18
						No.2	90	85	55
						No.3	320	50	75
						No.4	320	50	75
						No.5	320	50	75
						No.6	320	50	75
						No.7	320	50	75
						No.1	320	35	18
134	5	Stroitel'	1000	1993	Centrifugal	No.1	320	50	55
						No.2	320	50	55
						No.3	320	50	55
						No.4	320	50	55
						No.5	320	50	55

Table S 3.1.2.35 (1) Diagnosis of Booster PSs

P/S No.	No.of Pump	Pump noise	Casing			Cealing of axis	Bearing		Motor				Judgment	Basis of Judgment	Note
			Crack	Corrosion	Pinting exfoliation	Leaking	Temperature	Oil leakage	Noise	Rust	Vibration	Temperature			
1	No.1		No.	whole	whole	Much	Normal	No	Nomal	No	Nomal	Nomal	B	Not bad condition	
	No.2		No.	whole	whole	Much	Normal	No					B	Not bad condition	
	No.3		No.	whole	whole	Much	Normal	No					B	Not bad condition	
	No.4	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.5	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
2	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
3	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deterioration	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.4	Normal	No.	whole	whole	-	-	No	-	-	-	-	C2	Deteriorated	Motor was burned
4	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
5	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	Normal	Normal	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	-	-	-	-	-	-	-	-	-	-	-	-	-	Motor was burned
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
7	No.1	-	-	-	-	-	-	-	-	-	-	-	-	-	Motor was burned
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
8	No.1	Normal	No.	No	No	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	No	No	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.3	-	No.	No	No	-	-	No	-	-	-	-	-	-	Motor was burned
	No.4	Normal	No.	No	No	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
10	No.1	-				-	-	-	-	-	-	-	-	-	Motor was burned
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
11	No.1	Normal	No.	No	No	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	No	No	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	No	No	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.4	-				-	-	-	-	-	-	-	-	-	Motor was burned

Table S 3.1.2.35 (2) Diagnosis of Booster PSs

P/S No.	No.of Pump	Pump noise	Casing			Cealing of axis	Bearing		Motor				Judgment	Basis of Judgment	Note
			Crack	Corrosion	Pinting exfoliation	Leaking	Temperature	Oil leakage	Noise	Rust	Vibration	Temperature			
12	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	-				-	-	-	-	-	-	-	-	-	Motor was burned
13	No.1	Normal	No.	partly	partly	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	partly	partly	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
14	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
15	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
16	No.1	Normal	No.	whole	whole	Little	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Little	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
17	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
19	No.1	Normal	No.	No	No	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	No	No	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
22	No.1	Normal	No.	No	No	No	Normal	No	Nomal	No	Normal	Normal	A	New	Made in Germany
	No.2	Normal	No.	No	No	No	Normal	No	Nomal	No	Normal	Normal	A	New	Made in Germany
	No.3	Normal	No.	No	No	No	Normal	No	Nomal	No	Normal	Normal	A	New	Made in Germany
23	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.6	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
24	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.6	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned

Table S 3.1.2.35 (3) Diagnosis of Booster PSs

P/S No.	No.of Pump	Pump noise	Casing			Cealing of axis	Bearing		Motor				Judgment	Basis of Judgment	Basis of Judgment
			Crack	Corrosion	Pinting exfoliation	Leaking	Temperature	Oil leakage	Noise	Rust	Vibration	Temperature			
25	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
26	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.3	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
27	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
30	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.4	-	-	-	-	-	-	-	-	-	-	-	-	-	Motor was burned
31	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.3	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
36	No.1	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C1	Deteriorated	
37	No.1	Sound of cavitaion	No.	whole	whole	Very much	Normal	No	Nomal	Partly	Normal	Normal	C1	Deteriorated	
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
38	No.1	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
39	No.1	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Large	Normal	C1	Deteriorated	
	No.3	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	

Table S 3.1.2.35 (4) Diagnosis of Booster PSs

P/S No.	No.of Pump	Pump noise	Casing			Cealing of axis	Bearing		Motor				Judgment	Basis of Judgment	Basis of Judgment
			Crack	Corrosion	Pinting exfoliation	Leaking	Temperature	Oil leakage	Noise	Rust	Vibration	Temperature			
40	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C1	Deteriorated	
	No.2	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.3	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.4	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.5	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C1	Deteriorated	
43	No.1	Normal	No.	whole	whole	Very much	Normal	No	Noisy	Whole	Normal	Normal	C1	Deteriorated	
	No.2	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.3	Normal	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.4	-	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
51	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.6	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
52	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
53	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
54	No.1	Normal	No.	No	No	Little	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	No	No	Little	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
55	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
56	No.1	Normal	No.	partly	partly	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	partly	partly	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
58	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
59	No.1	Normal	No.	partly	partly	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	partly	partly	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	partly	partly	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
60	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.4	-	No.	whole	whole	-	Normal	-	-	-	-	-	-	-	Motor was burned
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	

Table S 3.1.2.35 (5) Diagnosis of Booster PSs

P/S No.	No.of Pump	Pump noise	Casing			Cealing of axis	Bearing		Motor				Judgment	Basis of Judgment	Basis of Judgment
			Crack	Corrosion	Pinting exfoliation	Leaking	Temperature	Oil leakage	Noise	Rust	Vibration	Temperature			
62	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
63	No.1	Normal	No.	whole	whole	少ない	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
64	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	-	-	-	-	-	Motor was burned
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
65	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
66	No.1	-	-	-	-	-				-	-	-	-	-	Not Installed
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
67	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
69	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.2	-	-	-	-	-				-	-	-	-	-	Not Installed
	No.3	-	-	-	-	-				-	-	-	-	-	Not Installed
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
70	No.1	Normal	No.	partly	partly	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	partly	partly	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	partly	partly	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	partly	partly	Much	Normal	No	Nomal	Partly	Normal	Normal	-	-	Bearing is repairing
	No.5	Normal	No.	partly	partly	Much	Normal	No	Nomal	-	-	-	-	-	Motor was burned
71	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	

Table S 3.1.2.35 (6) Diagnosis of Booster PSs

P/S No.	No.of Pump	Pump noise	Casing			Cealing of axis	Bearing		Motor				Judgment	Basis of Judgment	Basis of Judgment
			Crack	Corrosion	Pinting exfoliation	Leaking	Temperatur e	Oil leakage	Noise	Rust	Vibration	Temperatur e			
72	No.1	Normal	No.	No	No	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	No	No	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	No	No	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	No	No	Much	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
73	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	-	No.	whole	whole	-	Normal	No	Nomal	-	-	-	-	-	Motor was burned
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	-	No.	-	-	-	Normal	-	Nomal	-	-	-	-	-	Not installed
74	No.1-1	-	No.	whole	whole	-	Normal	-	Nomal	-	-	-	-	Deteriorated	Motor was burned
	No.1-2	-	No.	whole	whole	-	Normal	-	Nomal	-	-	-	-	Deteriorated	Motor was burned
	No.2	Noisy	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.3	-	No.	No	No	No	Normal	No	Nomal	No	Normal	Normal	A	Not bad condition	
	No.4	-	No.	whole	whole	-	Normal	-	Nomal	Whole	-	-	C2	Deteriorated	
75	No.1	Normal	No.	No	No	Much	Normal	No	Nomal	Partly	Normal	Normal	C1	Deteriorated	
	No.2	Normal	No.	No	No	Normal	Normal	No	Nomal	Partly	Normal	Normal	C1	Deteriorated	
	No.3	Normal	No.	No	No	Much	Normal	No	Nomal	Partly	Normal	Normal	C1	Deteriorated	
	No.4	Normal	No.	No	No	Normal	Normal	No	Nomal	Partly	Normal	Normal	-	Deteriorated	Bearing is repairing
	No.5	Normal	No.	No	No	Normal	Normal	No	Nomal	-	-	-	-	Deteriorated	Motor was burned
	No.6	Normal	No.	No	No	Much	Normal	No	Nomal	Partly	Normal	Normal	C1	Deteriorated	
	No.7	Normal	No.	No	No	Normal	Normal	No	Nomal	Partly	Normal	Normal	C1	Deteriorated	
	No.8	Normal	No.	No	No	Normal	Normal	No	Nomal	Partly	Normal	Normal	C1	Deteriorated	
77	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.6	Normal	No.	whole	whole	Much	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
79	No.1	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.3	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.5	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
80	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.3	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.5	-	-	-	-	-	-	-	-	-	-	-	-	-	Motor was burned

Table S 3.1.2.35 (7) Diagnosis of Booster PSs

P/S No.	No.of Pump	Pump noise	Casing			Cealing of axis	Bearing		Motor				Judgment	Basis of Judgment	Basis of Judgment
			Crack	Corrosion	Pinting exfoliation	Leaking	Temperature	Oil leakage	Noise	Rust	Vibration	Temperature			
81	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	High	C2	Deteriorated	
	No.2	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	
	No.3	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Noisy	Whole	Normal	Normal	C2	Deteriorated	
	No.5	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
82	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.2	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	
	No.3	-		whole	whole	-	-	-	-	-	-	-	-	-	
	No.4	Normal	Yes	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
83	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.3	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.5	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
84	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C1	Deteriorated	
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C1	Deteriorated	
	No.3	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C1	Deteriorated	
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C1	Deteriorated	
85	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.2	-	-	-	-	-	-	-	-	-	-	-	-	-	Motor was burned
	No.3	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
95	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.3	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.5	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
96	No.1	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.3	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
97	No.1	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Noisy	Whole	Normal	Normal	C2	Deteriorated	
	No.3	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.5	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.6	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
98	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.2	-	-	-	-	-	-	-	-	Whole	-	-	-	-	Pump was repiaring
	No.3	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	

Table S 3.1.2.35 (8) Diagnosis of Booster PSs

P/S No.	No.of Pump	Pump noise	Casing			Cealing of axis	Bearing		Motor				Judgment	Basis of Judgment	Basis of Judgment
			Crack	Corrosion	Pinting exfoliation	Leaking	Temperature	Oil leakage	Noise	Rust	Vibration	Temperature			
99	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.2	-	-	-	-	-	-	-	-	Whole	-	-	-	-	Pump was repiaring
	No.3	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
103	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.2	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.3	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.4	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.5	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
105	No.1	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.2	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.3	-	-	-	-	-	-	-	-	-	-	-	-	-	Motor was burned
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.5	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
108	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.2	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.3	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.4	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.5	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.6	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
117	No.1	Normal	No.	No	No	Normal	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	No	No	Normal	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	No	No	Normal	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	No	No	Normal	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	No	No	Normal	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
118	No.1	Normal	No.	whole	whole	Normal	Normal	No	Nomal	Whole	Normal	Normal	C1	Deteriorated	
	No.2	Normal	No.	whole	whole	Normal	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Normal	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Normal	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Normal	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
119	No.1	Normal	No.	partly	partly	Normal	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	partly	partly	Normal	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	No	No	Normal	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	partly	partly	Normal	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	-	No.	partly	partly	-	-	-	-	-	-	-	-	-	Motor was burned
	No.6-1	Normal	No.	No	No	Normal	Normal	No	Nomal	Partly	Normal	Normal	B	Not bad condition	
	No.6-2	Normal	No.	whole	whole	Normal	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	

Table S 3.1.2.35 (9) Diagnosis of Booster PSs

P/S No.	No.of Pump	Pump noise	Casing			Cealing of axis	Bearing		Motor				Judgment	Basis of Judgment	Basis of Judgment
			Crack	Corrosion	Pinting exfoliation	Leaking	Temperature	Oil leakage	Noise	Rust	Vibration	Temperature			
121	No.1	-		-	-	-	-	-	-	-	-	-	-	-	Motor was burned
	No.2	Normal	No.	whole	whole	Normal	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	whole	whole	Normal	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.4	Normal	No.	whole	whole	Normal	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	Normal	No.	whole	whole	Normal	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
126	No.1	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
127	No.1	Normal	No.	No	No		Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	No	No	Normal	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
	No.3	Normal	No.	No	No	Normal	Normal	No	Nomal	No	Normal	Normal	B	Not bad condition	
130	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.3	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
131	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.3	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.5	-	No.	whole	whole	-	-	-	-	-	-	-	-	-	Motor was burned
	No.6	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.7	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
	No.8	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	B	Not bad condition	
132	No.1	-				-	-	-	-	-	-	-	-	-	Motor was burned
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.3	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.5	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
133	No.1-1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.1-2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.3	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.5	-				-	-	-	-	-	-	-	-	-	Motor was burned
	No.6	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.7	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
134	No.1	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.2	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.3	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.4	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	
	No.5	Normal	No.	whole	whole	Very much	Normal	No	Nomal	Whole	Normal	Normal	C2	Deteriorated	

S 3.1.3 Evaluation of Groundwater Source of Kibray WTP

(1) Current Conditions and Problems for Existing Well System

1) Yield Amount and Operation Status of Wells

The operational data of Kibray WTP such as the monthly average intake amount and operation number of wells from February 2002 to April 2003 are shown in Table S 3.1.3.1, Figure S 3.1.2.1 and Figure S 3.1.3.2.

Table S .3.1.3.1 Wells Yield Amount and Operation Number

Year		2002											
Month		1	2	3	4	5	6	7	8	9	10	11	12
Intake Amount	(m^3/day)		338,252	380,996	423,098	422,782	420,702	452,684	451,126	406,474	367,930	392,800	378,182
Numbers of Operating Wells	Right Bank		23	16	23	18	23	25	24	21	21	23	23
	Left Bank		38	32	31	32	29	28	35	33	29	35	37
	Total		61	48	54	50	52	53	59	54	50	58	60
Percentage of Operating Wells	Right Bank		88.5	61.5	88.5	69.2	88.5	96.2	92.3	80.8	80.8	88.5	88.5
	Left Bank		55.1	46.4	44.9	46.4	42.0	40.6	50.7	47.8	42.0	50.7	53.6
	Total		64.2	50.5	56.8	52.6	54.7	55.8	62.1	56.8	52.6	61.1	63.2

Year		2003				Average
Month		1	2	3	4	
Intake Amount	(m^3/day)	348,014	342,800	355,100	391,595	403,184
Numbers of Operating Wells	Right Bank	22	19	20	16	22
	Left Bank	41	40	36	38	33
	Total	63	59	56	54	54
Percentage of Operating Wells	Right Bank	84.6	73.1	76.9	61.5	83.9
	Left Bank	59.4	58.0	52.2	55.1	47.3
	Total	66.3	62.1	58.9	56.8	57.3

As shown in the table and figures, the maximum yield amount exceeded 450,000 m^3/d, the minimum yield amount was around 350,000 m^3/d, and the average of this duration was around 392,000 m^3/d. While design capacity of Kibray WTP is 455,200 m^3/d, the capacity decline was not so large based on these data.

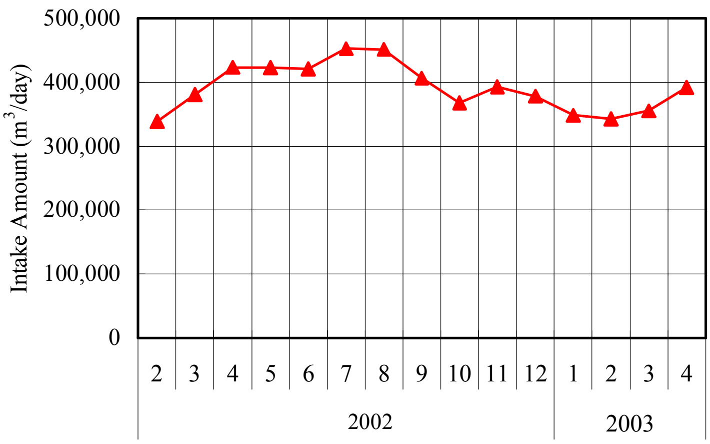


Figure S .3.1.3.1 Total Yield Amount

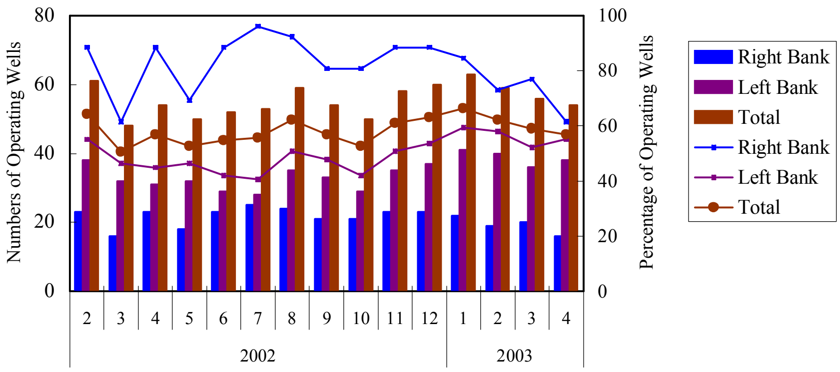


Figure S3.1.3.2 Operation Number and Ratio of Wells

Figure S 3.1.3.3 shows the water balance of Kibray WTP.

Kibray WTP receives transmission water from Kadirya WTP, and distributes mixed water with intake yield of wells to the City. Total major inlet and outlet pipes of the WTP are six (6); however, a half of flow meters of the pipes were out of order for long time.

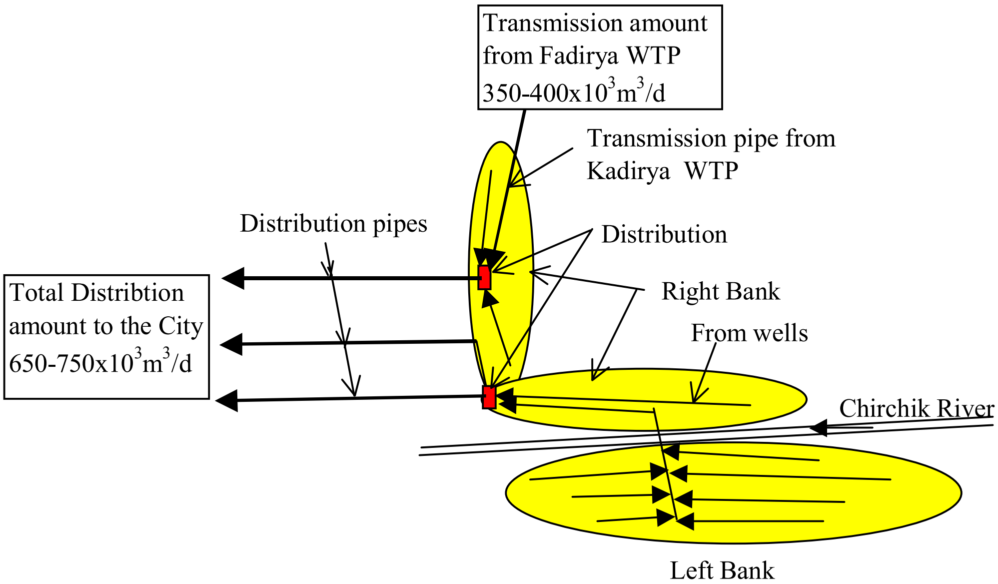


Figure S 3.1.3.3 Water Balance of Kibray WTP

Distribution amount from Kibray WTP was estimated to be 650,000-750,000 m^3/d and treated water was transmitted from Kadirya WTP. The transmission amount from Kadirya WTP had been estimated less than 300,000m^3/d until January 2004, when the transmission flow was measured by an ultra-sonic flow meter in Kadirya WTP and the measured result was around 400,000m^3/d. It means that the yield amount mentioned above may be over-estimated, because the well's yield amount was estimated to be the total distribution amount to the city minus estimated transmission amount from Kadirya WTP.

Thus if the transmission amount from Kadirya WTP was at 400,000m^3/d, yield amount of Kibray WTP was 250,000-350,000m^3/d. The maximum intake amount is presented in the summer season and the minimum is presented in winter, while the water flow of the Chirchik River is plentiful from spring to summer and that is little in the winter season. However, as shown in Table 2.1.2 (2), precipitation in summer is lowest and that in winter is relatively high. Since the water flow of the Chirchik River relies on the discharge flow from Charvak Dam, which is shown in Figure 2.1.4, the flow fluctuation mentioned above is caused.

The operation ratio of wells at the right bank is around 80% and that at the left bank is less than 50%. The reason why the ratio of the left bank was low is said that 1) the level of groundwater at the left bank easily falls and well's pumps brake down by dry operation, and 2) the liability of pumps recently installed in the wells at the left bank is low.

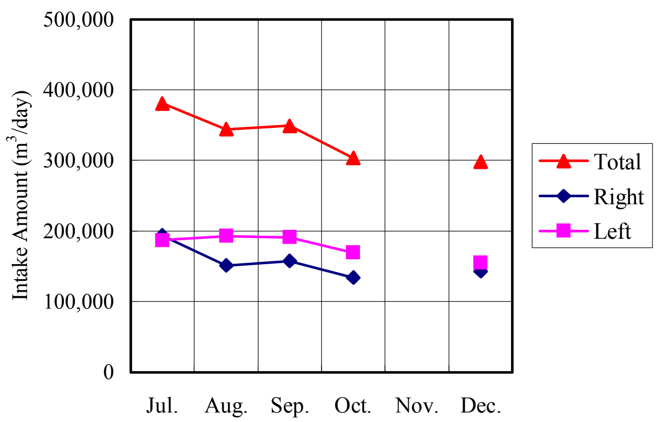


Figure S 3.1.3.4 Intake Amount in 2004

Recent data for the yield amount are shown in Figure S 3.1.3.4 based on Table S 3.1.3.2. Operation number of wells and ratio are shown in Figure S 3.1.3.5.

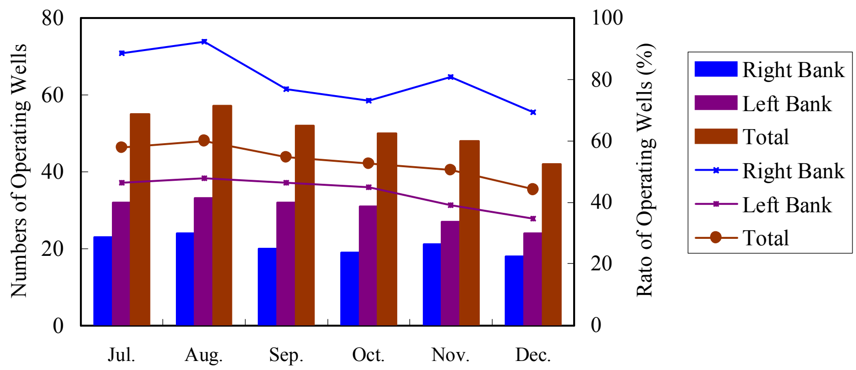


Figure S 3.1.3.5 Wells Operation Number and Ratio

The yield amount is the total of each well's yield, and the total value was checked by the flow meters of the inlet and outlet pipes of the WTP, which previously broken meters were repaired.

Table S 3.1.3.2 Monthly Intake Amount of Groundwater in 2004

Well No.	Altitude	Intake Amount (m^3/day)						
		Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
Right Bank								
1	503.9	13,008	7,200	11,040	7,200	n.m.	10,800	9,850
2	503.7	8,160	7,920	8,400	n.m.	n.m.	9,120	8,400
3	503.5	6,000	3,432	3,120	2,640	n.m.	3,600	3,758
4	503.0	10,800	7,200	11,160	10,560	n.m.	10,560	10,056
5	503.7	9,600	9,120	8,400	7,200	n.m.	9,120	8,688
6	503.8	8,880	8,160	7,920	7,680	n.m.	repair	8,160
7	503.5	8,280	7,200	9,600	8,880	n.m.	8,400	8,472
8	503.9	11,040	n.m.	n.m.	10,800	n.m.	n.m.	10,920
9	505.0	8,400	7,200	10,080	8,160	n.m.	9,600	8,688
10	504.3	11,520	8,760	14,400	10,800	n.m.	10,800	11,256
11	503.8	3,840	4,080	4,320	repair	repair	repair	4,080
12	505.6	9,600	8,160	8,400	repair	n.m.	7,920	8,520
13	506.2	8,880	8,880	8,640	6,960	n.m.	8,400	8,352
14	506.8	12,000	8,160	repair	7,680	n.m.	9,840	9,420
14a	504.9	6,120	5,280	repair	repair	repair	repair	5,700
15	503.1	12,600	7,200	11,520	8,640	n.m.	10,320	10,056
16	503.1	10,800	7,440	8,640	7,200	n.m.	7,440	8,304
17	504.4	2,640	3,120	repair	repair	repair	repair	2,880
18	506.8	3,120	2,640	3,120	2,640	n.m.	repair	2,880
19	507.4	4,920	6,480	4,560	3,960	n.m.	4,800	4,944
20	508.9	6,720	7,200	9,600	8,160	n.m.	9,600	8,256
21	510.9	7,920	5,280	8,160	7,200	n.m.	6,720	7,056
22	512.2	repair	5,520	repair	repair	n.m.	6,000	5,760
23	514.6							
24	516.4	8,880	5,520	6,720	7,680	n.m.	7,200	7,200
25	517.3	repair	repair	repair	repair	repair	repair	
Right Bank								
26	502.5							
27	504.2							
28	506.6							
29	508.0	8,640	9,600	8,880	8,640	n.m.	8,400	8,832
30	509.8							
31	510.7	repair	repair	repair	repair	repair	repair	
32	512.7	6,000	5,760	5,040	4,080	n.m.	6,120	5,400
33	514.6	repair	repair	repair	repair	repair	repair	
34	516.5	4,800	5,280	5,760	5,040	n.m.	9,120	6,000
35	518.0	repair	repair	repair	repair	repair	repair	
36	520.1	repair	repair	repair	repair	repair	repair	
37	522.0	repair	7,200	7,920	7,200	repair	repair	7,440
38	524.2	8,880	7,440	7,200	7,680	n.m.	10,080	8,256
39	500.5							
40	502.0							
41	505.6							
42	506.3	11,520	12,000	14,400	11,040	n.m.	10,800	11,952
43	507.1	2,040	2,352	2,280	2,232	n.m.	2,040	2,189
44	509.3	4,800	10,320	10,320	9,960	n.m.	9,600	9,000
45	511.3	10,080	9,840	9,600	repair	n.m.	10,320	9,960
46	512.7	9,000	8,280	7,200	7,320	repair	9,120	8,184
47	514.3	9,600	7,200	7,680	6,720	n.m.	10,320	8,304
48	516.9	7,200	7,440	7,200	7,680	n.m.	9,120	7,728
49	519.0	n.m.	n.m	n.m.	n.m.	n.m.	n.m.	n.m

Well No.	Altitude	Intake Amount (m^3/day)						
		Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
50	520.2	8,400	11,760	10,800	9,600	n.m.	10,800	10,272
51	521.3	repair	repair	repair	repair	repair	repair	
52	524.4	13,200	12,000	14,400	11,280	n.m.	10,800	12,336
53	496.6							
54	498.3							
55	500.5							
56	501.7							
57	503.4							
58	505.4	8,160	7,920	8,400	7,200	n.m.	repair	7,920
59	507.2	9,240	9,120	7,680	8,160	n.m.	8,400	8,520
60	509.5	repair	repair	repair	repair	n.m.	repair	11,040
61	510.7	9,840	7,680	n.m.	3,600	n.m.	repair	7,380
62	512.5	repair	n.m.	n.m.	n.m.	n.m.	n.m.	3,120
63	514.3	n.m.	repair	n.m.	n.m.	n.m.	n.m.	11,160
64	506.4	n.m.	n.m.	n.m.	n.m.	n.m.	n.m.	n.m
65	513.6	5,760	6,120	6,120	5,760	n.m.	5,760	5,904
66	507.4	14,400	12,000	14,400	11,280	repair	11,280	12,672
67	508.9			repair	repair	repair	repair	
68	510.5	repair	repair	repair	repair	repair	repair	
69	510.8	n.m.	n.m.	n.m.	n.m.	n.m.	n.m.	n.m
70	512.3	repair	n.m.	repair	repair	repair	repair	n.m
71	513.2	n.m.	repair	repair	repair	repair	repair	
72	514.2	repair	repair	repair	repair	repair	repair	
73	514.1	n.m.	n.m.	n.m.	n.m.	repair	repair	n.m
74	515.1	repair	repair	repair	repair	repair	repair	
75	516.8	4,080	3,600	6,720	5,280	repair	repair	4,920
76	518.2	5,040	2,640	6,000	4,800	n.m.	6,000	4,896
77	519.2	3,600	4,080	repair	4,560	n.m.	4,800	4,260
78	520.3	repair	repair	repair	repair	repair	repair	
79	521.7	repair	repair	repair	repair	repair	repair	
80	522.2	5,760	5,760	6,120	6,120	repair	repair	5,940
81	523.2	4,080	4,440	4,800	repair	n.m.	repair	4,440
1G	508.6							
2G	507.1	5,880	6,000	4,800	6,120	repair	repair	5,700
3G	507.7							
4G	510.7							
13P	512.7							
14P	513.6							
15P	511.0							
16P	511.9							
33P	508.0	2,400	2,400	2,760	3,360	n.m.	2,400	2,664
34P	509.9	5,040	4,800	4,800	4,560	n.m.	repair	4,800
35P	511.2	repair	repair	repair	repair	repair	repair	
Intake Amount	Right	193,728	151,152	157,800	134,040		143,040	181,656
	Left	187,440	193,032	191,280	169,272		155,280	221,189
	Total	381,168	344,184	349,080	303,312		298,320	402,845
Operation Number	Right	23	24	20	19	21	18	24
	Left	32	33	32	31	27	24	35
	Total	55	57	52	50	48	42	59
% of Operation wells	Right	88.5	92.3	76.9	73.1	80.8	69.2	92.3
	Left	46.4	47.8	46.4	44.9	39.1	34.8	50.7
	Total	57.9	60.0	54.7	52.6	50.5	44.2	62.1

Thus, the intake amount of this duration was reliable. The yield amount was obviously down and the operation ratio was also fallen compared to the data as shown in Table S 3.1.3 1. Each yield capacity of well based on the data from July to December in 2004 was presented in Table S 3.1.3.2. At the right bank, the average yield amount of wells exceeded 7,400m^3/d and the figure shows that the yield amount of each well at inland is larger than that of along the Chirchik River.

The wells, which have never operated, were just two at right bank.

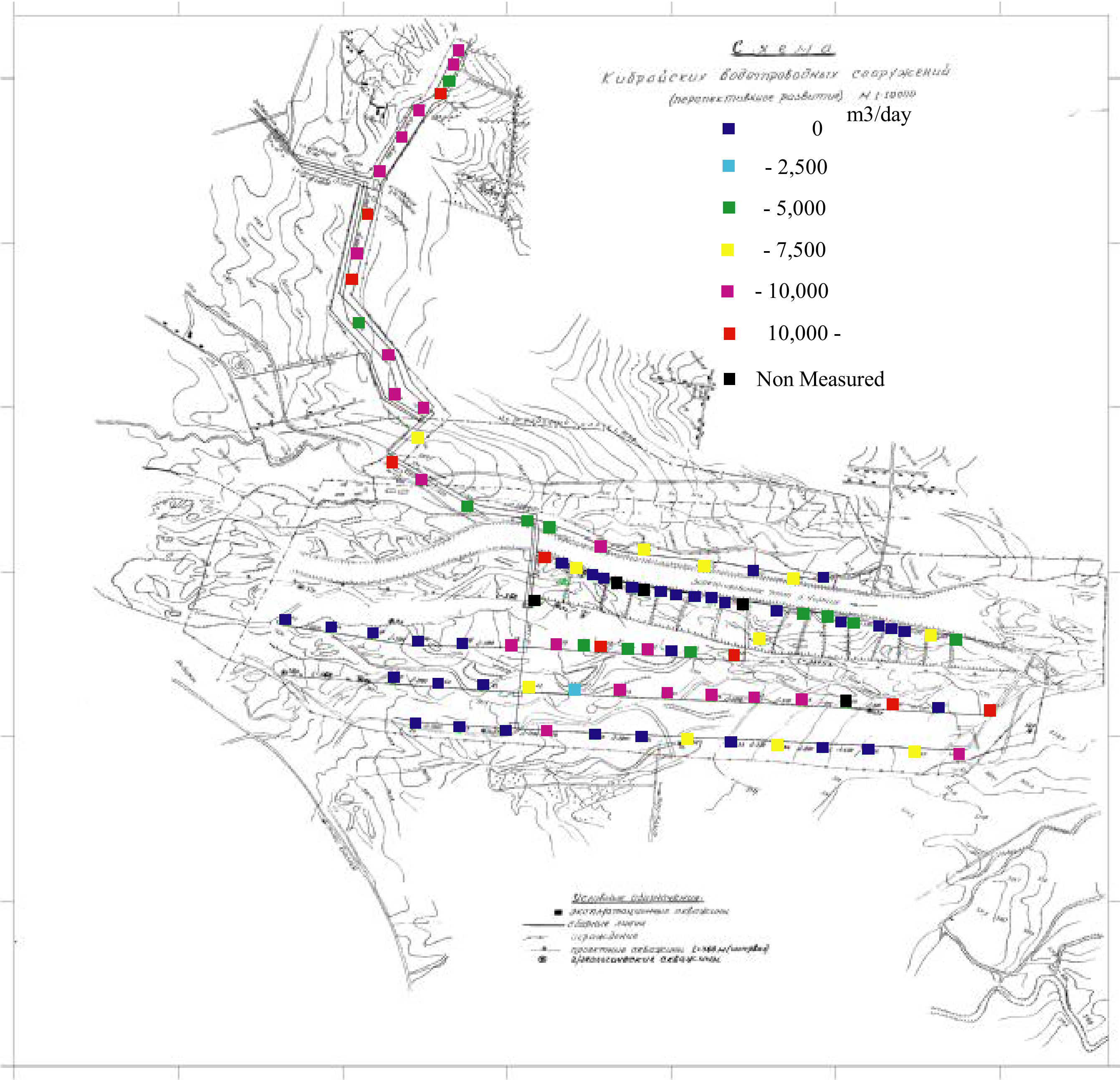


Figure S .3.1.3.6 Average Yield Capacity of Wells in 2004

At the left bank, the average yield amount of wells is similar to that at the right bank, and it is a feature that yields of the wells along the river and yields of the wells' row, which is the farthest away from the river, were little.

Around a half of the wells at the left bank have never been operated, and especially, most of wells at down stream areas and along the river were not operated. The reason why wells at down stream areas were not operated is assumed that the gradient of intake pipes of the wells is large and the transmission pipe from upstream and down stream is connected directly as shown in Figure S 3.1.3 7. Therefore, the well pumps at down stream site may be broken by water pressure.

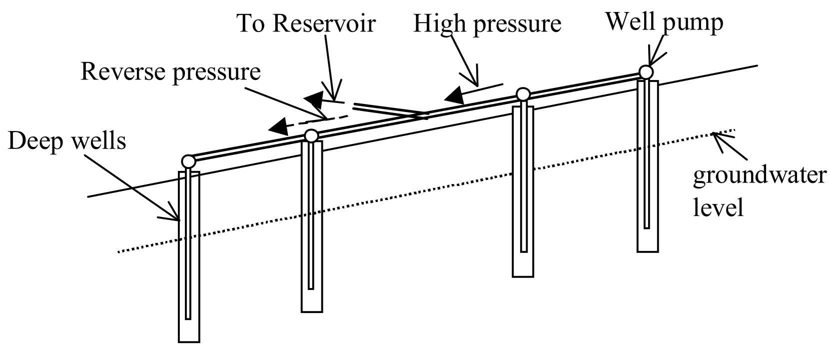


Figure S 3.1.3.7 Inclination of Ground and a Problem of Transmission

Distance of each well, minimum less than 100m, along the river is so small that the mutual interference of wells takes place. It causes a lowering of underwater level in the wells and breakdowns of well pumps by dry operation.

2) Deterioration of Wells

Installation of wells in Kibray WTP was started in 1950th and it was almost completed in 1970th. Therefore, over 40 years have passed after installation of old ones and those have become deteriorated. In addition, since the pumps with largely excessive capacity are used for wells, breakdowns of pumps have frequently taken place because of a dry operation by a drop of water level or a vibration of pump caused by excessive closing of discharge valves.

The Specific Capacity by the pump test just after construction of wells varies 4.5 -96.0 m^3/sec/m and the average value is at 30m^3/sec/m, relatively large. The values have been decreasing. The recommended yield capacities of wells based on the pump tests varied from 600 to 200 m^3/hr, while the actual yield amount of many wells exceeded the recommended yield capacity.

The Specific Capacity is defined as an intake amount, which can be withdrawn from groundwater layer by dropping 1 m of water level. When the wells' deterioration progresses, that will become smaller. Table S 3.1.3.3 (1) to (3) shows comparison of well capacity between just after construction and in 2004. Based on the table, Figure S 3.1.3.8 shows decline ratio of Specific Capacities between the value just after construction and the current actual value.

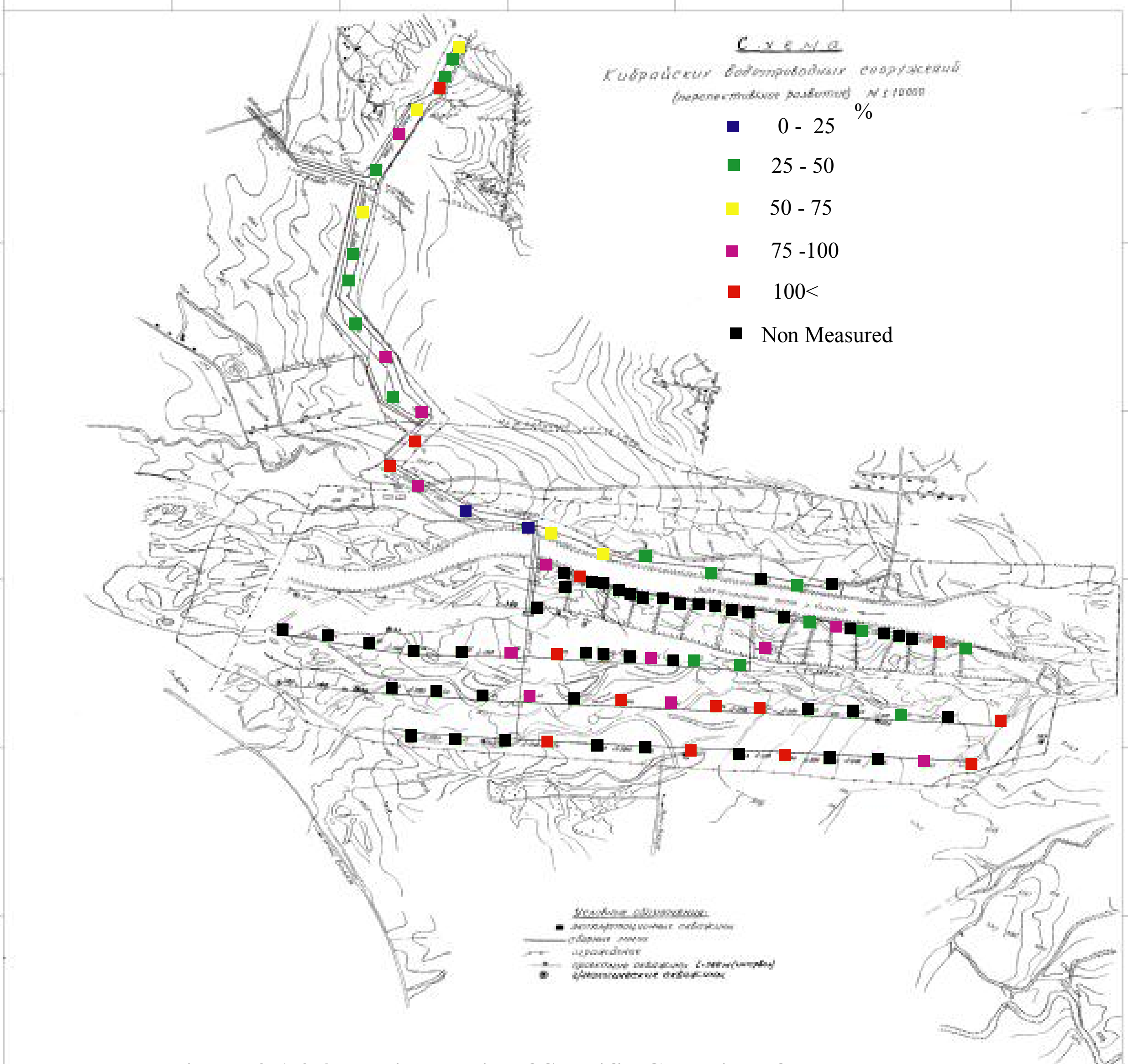


Figure 3.1.3.8 Decline Ratio of Specific Capacity of Wells

Table 3.1.3.3 (1) Comparison of Yield Capacity between just after Construction and in 2004 (1)

Well No.	Construction Year	Pumping Test Data at Construction Time							At Present (2004)					Decreasing Ratio of Well Capacity (%)	Ratio of Over Pumping (%)
		Test Yield (L/s)	Test Yield (m^3/hr)	Static Water Level (GL-m)	Pumping Water Level (GL-m)	Draw-down (m)	Specific Capacity (m^3/hr/m)	Recommended Intake Rate (m^3/hr)	Actual Intake Rate (m^3/hr)	Static Water Level (GL-m)	Pumping Water Level (GL-m)	Draw-down (m)	Specific Capacity (m^3/hr/m)		
1	1962	69.4	249.8	5.95	7.65	1.70	147.0	600	410.4	5.70	10.36	4.66	88.1	59.9	68.4
2	1960	150.0	540.0	2.00	6.00	4.00	135.0	600	350.0	4.87	10.60	5.73	61.1	45.3	58.3
3	1961	48.0	172.8	6.50	7.50	1.00	172.8	200	156.6	4.25	6.20	1.95	80.5	46.6	78.3
4	1954	66.0	237.6	4.50	12.00	7.50	31.7	280	419.0	6.43	10.95	4.52	92.6	292.4	149.6
5	1958	191.6	689.8	4.00	9.00	5.00	138.0	600	362.0	5.54	10.10	4.56	79.4	57.5	60.3
6	1958	177.0	637.2	2.00	8.00	6.00	106.2	600	370.0	5.20	9.35	4.15	89.2	84.0	61.7
7	1954	60.5	217.8	2.00	3.00	1.00	217.8	250	353.0	5.62	10.25	4.63	76.2	35.0	141.2
8	1956	18.0	64.8	2.57	3.00	0.43	150.7	600	455.0	5.95	11.25	5.30	85.8	57.0	75.8
9	1958	50.0	180.0	5.00	5.60	0.60	300.0	200	362.0	5.71	10.21	4.50	80.5	26.8	181.0
10	1956	38.8	139.7	5.00	5.50	0.50	279.4	200	469.0	5.86	9.83	3.97	118.1	42.3	234.5
11	1958	48.0	172.8	6.50	7.50	1.00	172.8	200	170.0	4.50	7.40	2.90	58.6	33.9	85.0
12	1958	78.3	281.9	4.50	8.00	3.50	80.5	320	355.0	5.91	11.18	5.26	67.5	83.8	110.9
13	1958	69.4	249.8	5.95	7.65	1.70	147.0	600	348.0	5.85	12.18	6.33	55.0	37.4	58.0
14	1960	61.0	219.6	5.10	7.10	2.00	109.8	200	416.7	5.15	10.23	5.08	82.0	74.7	208.3
14a	1965	51.0	183.6	3.90	5.40	1.50	122.4	200	237.5	4.50	5.98	1.48	161.0	131.5	118.8
15	1963	59.1	212.8	2.00	4.15	2.15	99.0	200	419.0	5.56	9.56	4.00	104.8	105.9	209.5
16	1963	40.0	144.0	4.50	6.50	2.00	72.0	200	346.0	5.66	11.54	5.88	58.8	81.7	173.0
17	1964	48.0	172.8	2.60	3.10	0.50	345.6	200	120.0	4.50	7.60	3.10	38.7	11.2	60.0
18	1964	52.2	187.9	3.05	4.30	1.25	150.3	200	120.0	4.48	8.15	3.68	32.7	21.7	60.0
19	1963	55.8	200.9	2.20	5.00	2.80	71.7	200	206.0	5.71	9.83	4.12	50.0	69.7	103.0
20	1964	50.0	180.0	3.30	5.20	1.90	94.7	200	344.0	5.44	10.46	5.02	68.5	72.3	172.0
21	1964	56.1	202.0	2.00	3.00	1.00	202.0	200	294.0	6.20	11.16	4.96	59.3	29.3	147.0
22	1965	58.8	211.7	2.00	4.00	2.00	105.8	200	240.0	5.70	11.50	5.80	41.4	39.1	120.0
23								600							
24	1964	70.0	252.0	2.00	4.00	2.00	126.0	600	282.5	5.85	10.46	4.61	61.2	48.6	47.1
25	1965	58.3	209.9	2.20	4.20	2.00	104.9	200							
26	1966	33.3	119.9	4.40	6.80	2.40	50.0	200-250							
27	1966	40.0	144.0	4.50	5.60	1.10	130.9	250							
28	1964	44.4	159.8	4.00	5.80	1.80	88.8	200							
29	1967	55.5	199.8	1.80	4.80	3.00	66.6	200	370.0	5.11	10.50	5.39	68.7	103.1	185.0
30	1967	50.0	180.0	1.50	9.00	7.50	24.0	200							
31	1965	44.4	159.8	4.00	5.80	1.80	88.8	200							

Table 3.1.3.3 (2) Comparison of Yield Capacity between just after Construction and in 2004 (2)

Well No.	Construction Year	Pumping Test Data at Construction Time							At Present (2004)					Decreasing Ratio of Well Capacity (%)	Ratio of Over Pumping (%)
		Test Yield (L/s)	Test Yield (m3/hr)	Static Water Level (GL-m)	Pumping Water Level (GL-m)	Draw-down (m)	Specific Capacity (m3/hr/m)	Recommended Intake Rate (m^3/hr)	Actual Intake Rate (m^3/hr)	Static Water Level (GL-m)	Pumping Water Level (GL-m)	Draw-down (m)	Specific Capacity (m^3/hr/m)		
32	1967	55.5	199.8	4.60	7.40	2.80	71.4	200	238.8	4.69	7.96	3.28	72.8	102.1	119.4
33	1966	50.0	180.0	5.10	6.70	1.60	112.5	200							
34	1966	44.4	159.8	4.40	8.40	4.00	40.0	200	260.0	6.13	11.85	5.73	45.4	113.7	130.0
35	1966	50.0	180.0	4.50	8.30	3.80	47.4	200							
36	1966	44.4	159.8	2.00	6.00	4.00	40.0	200							
37	1966	44.4	159.8	2.20	5.10	2.90	55.1	200	300.0	4.00	10.70	6.70	44.8	81.2	150.0
38	1966	44.4	159.8	2.10	5.00	2.90	55.1	200	344.0	4.78	9.75	4.98	69.1	125.5	172.0
39	1969	58.8	211.7	3.70	5.60	1.90	111.4	200							
40	1967	55.5	199.8	3.00	5.00	2.00	99.9	200							
41	1967	51.1	184.0	7.50	10.30	2.80	65.7	200							
42	1965	44.4	159.8	4.00	5.80	1.80	88.8	200	498.0	5.01	11.23	6.22	80.0	90.1	249.0
43									91.2	3.89	5.05	1.16	78.6		
44	1968	29.7	106.9	4.10	10.60	6.50	16.4	200	375.0	6.00	11.00	5.00	74.9	455.6	187.5
45	1968	55.0	198.0	3.50	5.30	1.80	110.0	200	415.0	5.69	10.33	4.63	89.6	81.4	207.5
46	1968	50.0	180.0	2.50	7.30	4.80	37.5	200	341.0	5.79	10.36	4.57	74.6	198.8	170.5
47	1968	51.9	186.8	2.00	6.00	4.00	46.7	200	346.0	5.69	9.69	4.01	86.4	184.9	173.0
48	1970								322.0	5.74	10.52	4.78	67.4		
49	1968	55.5	199.8	2.50	5.30	2.80	71.4	200				0.00			
50	1968	77.7	279.7	2.80	3.80	1.00	279.7	200	428.0	5.41	9.63	4.21	101.6	36.3	214.0
51	1969							200							
52	1969	61.1	220.0	3.00	5.40	2.40	91.7	200	540.0	6.30	10.10	3.80	142.1	155.1	270.0
53	1968	66.6	239.8	1.70	3.10	1.40	171.3	200							
54	1969	66.6	239.8	2.30	4.60	2.30	104.2	200							
55	1968	61.0	219.6	2.50	4.50	2.00	109.8	200							
56	1967	55.5	199.8	4.00	5.50	1.50	133.2	200							
57	1967	55.0	198.0	2.70	3.95	1.25	158.4	200							
58	1965	44.4	159.8	2.20	4.10	1.90	84.1	200	330.0	5.75	10.10	4.35	75.9	90.2	165.0
59	1967	52.7	189.7	2.30	5.10	2.80	67.8	200	355.0	5.50	10.17	4.67	76.0	112.2	177.5
60	1969							200	460.0	7.00	11.00	4.00	115.0		230.0
61	1969	51.9	186.8	2.20	3.95	1.75	106.8	200	307.5	5.31	9.21	3.90	78.8	73.8	153.8
62	1969	62.2	223.9	2.60	5.10	2.50	89.6	200	130.0	5.95	9.05	3.10	41.9	46.8	65.0
63	1969	90.0	324.0	2.80	4.30	1.50	216.0		465.0	5.92	10.90	4.98	93.3	43.2	

Table 3.1.3.3 (3) Comparison of Yield Capacity between just after Construction and in 2004 (3)

Well No.	Const-ruction Year	Pumping Test Data at Construction Time							At Present (2004)					Decreasing Ratio of Well Ca-pacity (%)	Ratio of Over Pump-ing (%)
		Test Yield (L/s)	Test Yield (m3/hr)	Static Water Level (GL-m)	Pumping Water Level (GL-m)	Draw-down (m)	Specific Capacity (m3/hr/m)	Recom-mended Intake Rate (m3/hr)	Actual Intake Rate (m3/hr)	Static Water Level (GL-m)	Pumping Water Level (GL-m)	Draw-down (m)	Specific Capacity (m3/hr/m)		
64	1967	50.0	180.0	2.00	6.00	4.00	45.0	200							
65	1965	100.0	360.0	2.63	4.30	1.67	215.6	360	246.0	4.48	5.99	1.51	163.2	75.7	68.3
66	1977	85.0	306.0	1.60	3.50	1.90	161.1	375	528.0	6.00	10.31	4.32	122.3	76.0	140.8
67	1965	98.9	355.9	1.70	9.54	7.84	45.4	350							
68	1977	44.7	160.9	3.95	8.35	4.40	36.6	210							
69	1977	95.0	342.0	1.35	2.55	1.20	285.0	210							
70	1978	76.0	273.6	1.70	4.30	2.60	105.2								
71	1978	67.0	241.2	1.60	3.60	2.00	120.6								
72	1972	83.0	298.8	1.20	2.20	1.00	298.8	200							
73	1976	71.1	256.0	1.30	4.30	3.00	85.3	255							
74	1976	64.7	232.9	1.00	6.00	5.00	46.6								
75	1976	77.0	277.2	1.00	3.50	2.50	110.9		205.0	7.10	11.57	4.47	45.9	41.4	
76	1969	40.0	144.0	5.00	8.30	3.30	43.6	200	204.0	5.96	11.14	5.18	39.4	90.3	102.0
77	1976	78.0	280.8	1.50	4.40	2.90	96.8	255	177.5	6.09	10.48	4.39	40.5	41.8	69.6
78	1966	78.9	284.0	1.82	11.90	10.08	28.2	290							
79	1978	55.0	198.0	3.00	6.60	3.60	55.0	290							
80	1978	62.5	225.0	1.70	4.00	2.30	97.8	-	247.5	6.37	8.14	1.77	139.8	142.9	
81	1978	77.0	277.2	0.40	1.70	1.30	213.2	250	185.0	5.03	8.00	2.97	62.4	29.2	74.0
1G	1981	100.0	360.0	2.30	4.24	1.94	185.6	350							
2G	1982	115.0	414.0	2.30	5.68	3.38	122.5	350	237.5	2.29	3.53	1.24	191.9	156.7	67.9
3G	1982	76.0	273.6	2.58	7.32	4.74	57.7	250							
4G	1981	75.0	270.0	1.84	8.46	6.62	40.8	250							
7P															
9P															
13P															
14P															
15P															
16P															
33P	1984								111.0	4.12	5.61	1.49	74.5		
34P	1994							210	200.0	3.63	4.95	1.33	150.9		95.2
35P								210							

The capacity decline of wells at the right bank is progressing compared to those at the left bank because the wells at the right bank are older than at the left bank.

The Specific Capacity of many wells at the left bank has not decreased. Figure S 3.1.3.9 shows the excessive yield ratio between the current recommended yield capacity and the actual yield amount. As shown the figure, the majority of wells at the right bank were withdrawing proper yield quantity, while many of the wells at the left bank were withdrawing a largely excessive yield quantity.

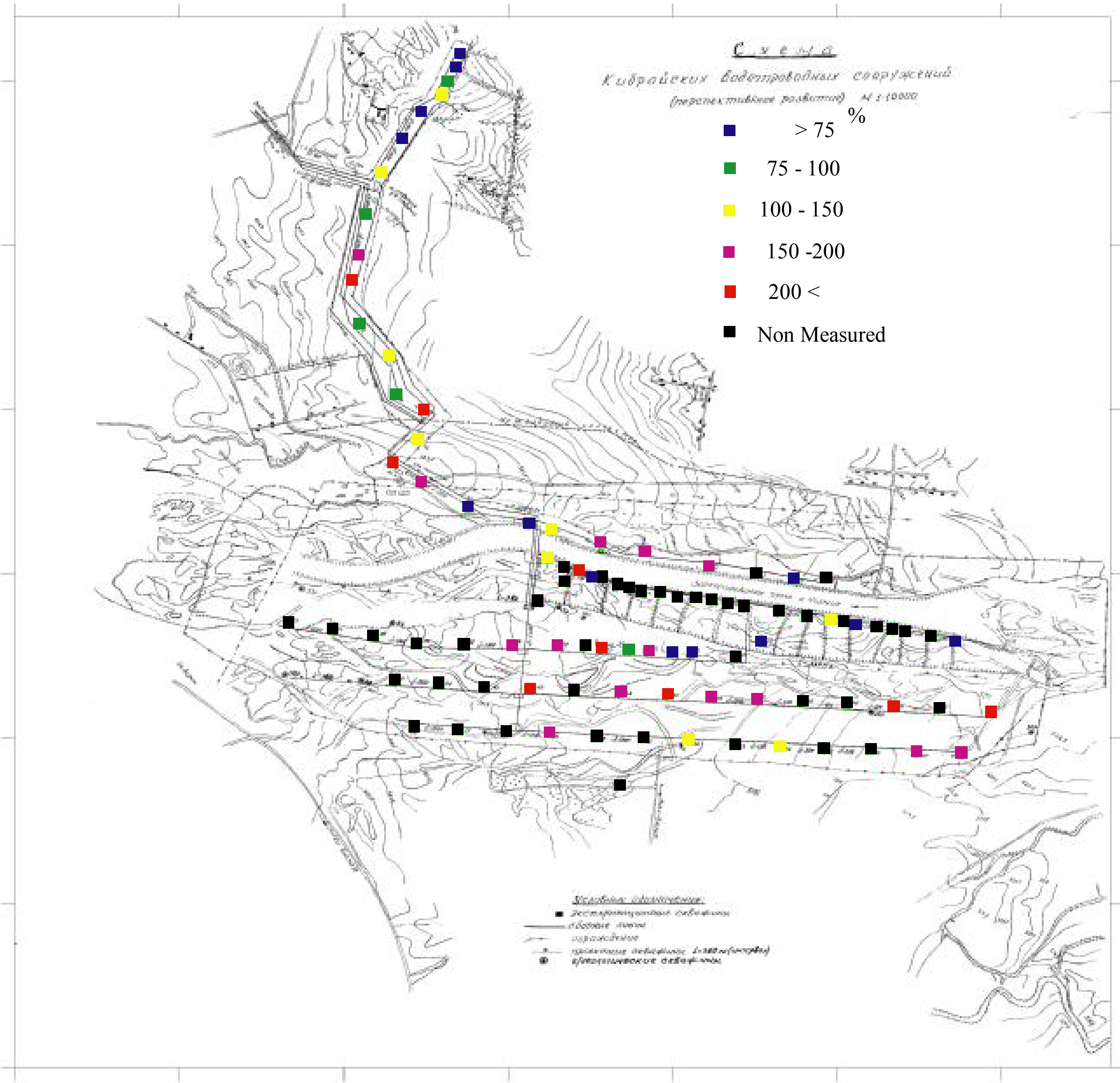


Figure S 3.1.3.9 Excessive Yield Ratio between the Value after construction and current actual Value

3) Ground water level

The average groundwater levels presented by contour at condition of statistic and well pump operating are shown in Figure S 3.1.3.10 and S 3.1.3.11 derived from the data from July to December in 2004. Figure S 3.1.3.12 shows the drawdown map for ground water based on the above two maps.

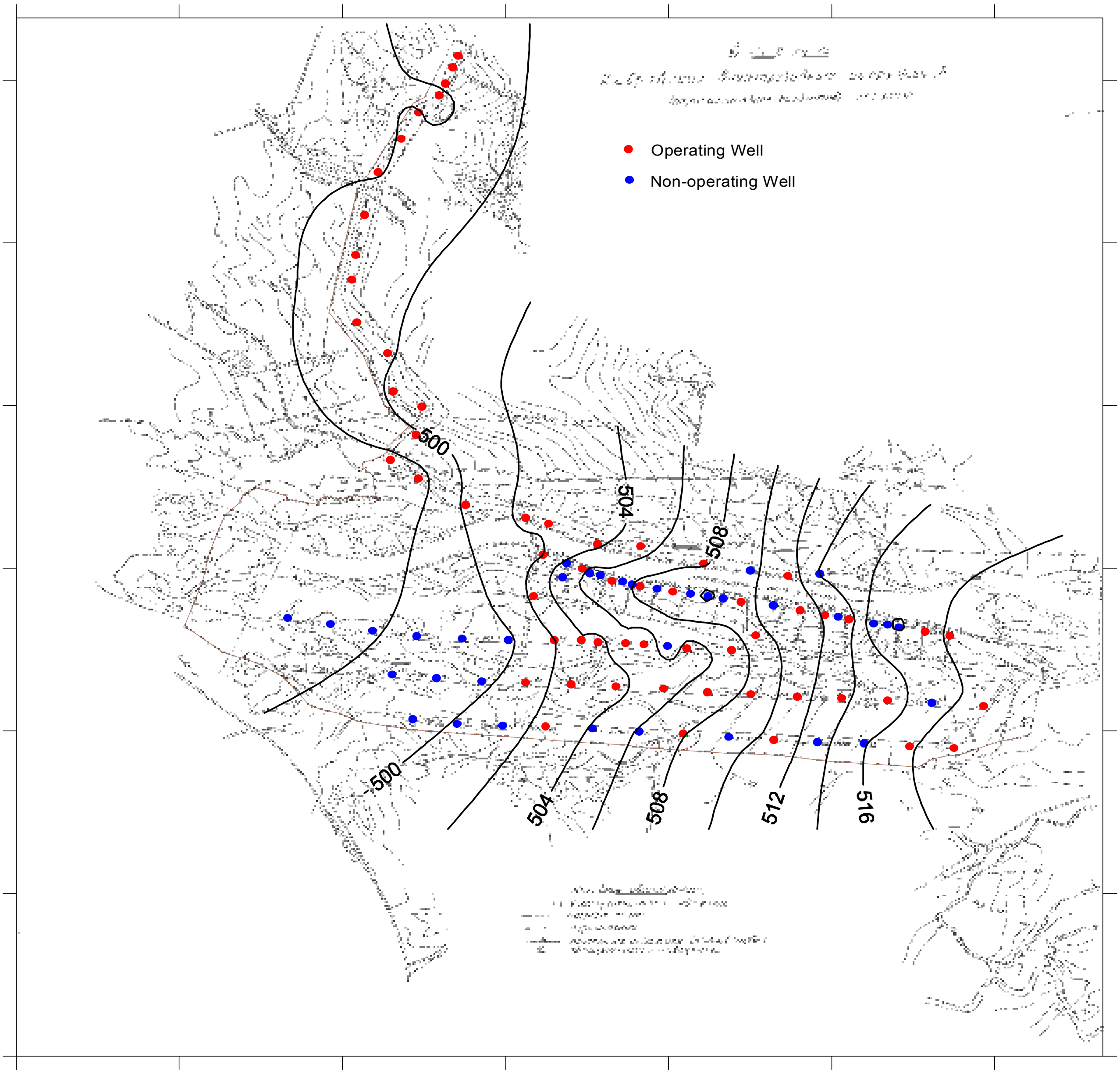


Figure S 3.1.3.10 Contour Map of Average Groundwater Level with Statistic Condition

A valley of groundwater is formed at 800m far from the Chirchik River along the River as shown in Figure S 3.1.3.10. Since the valley may have been the flow channel of the river, an active penetration flow of groundwater can be expected in this area. The groundwater level at the left bank is slightly higher than that at the right bank. Groundwater levels with the condition of well pumps operating vary based on the difference of yield amount and yield capacity of each well as shown in Figure S 3.1.3.11. As shown in Figure S 3.1.3.12, closed curved lines stood out and the fall of groundwater level is large in the area far form the river. It means that groundwater supply is not enough to recover the level compared with groundwater intake by the wells located at nearby area of the river.

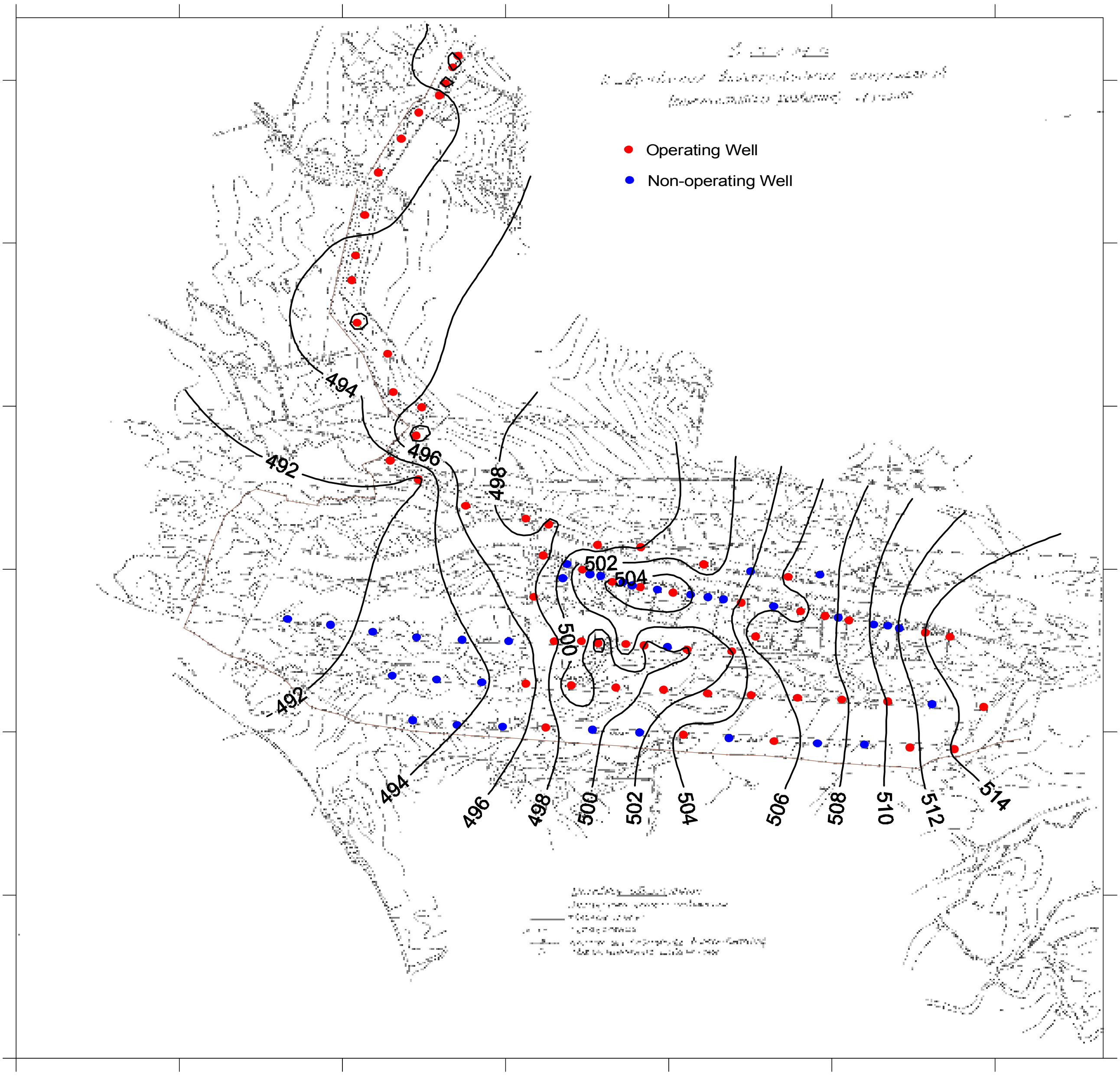


Figure S.1.3.11 Contour Map of Average Groundwater Level with Condition of Well Pump Operating

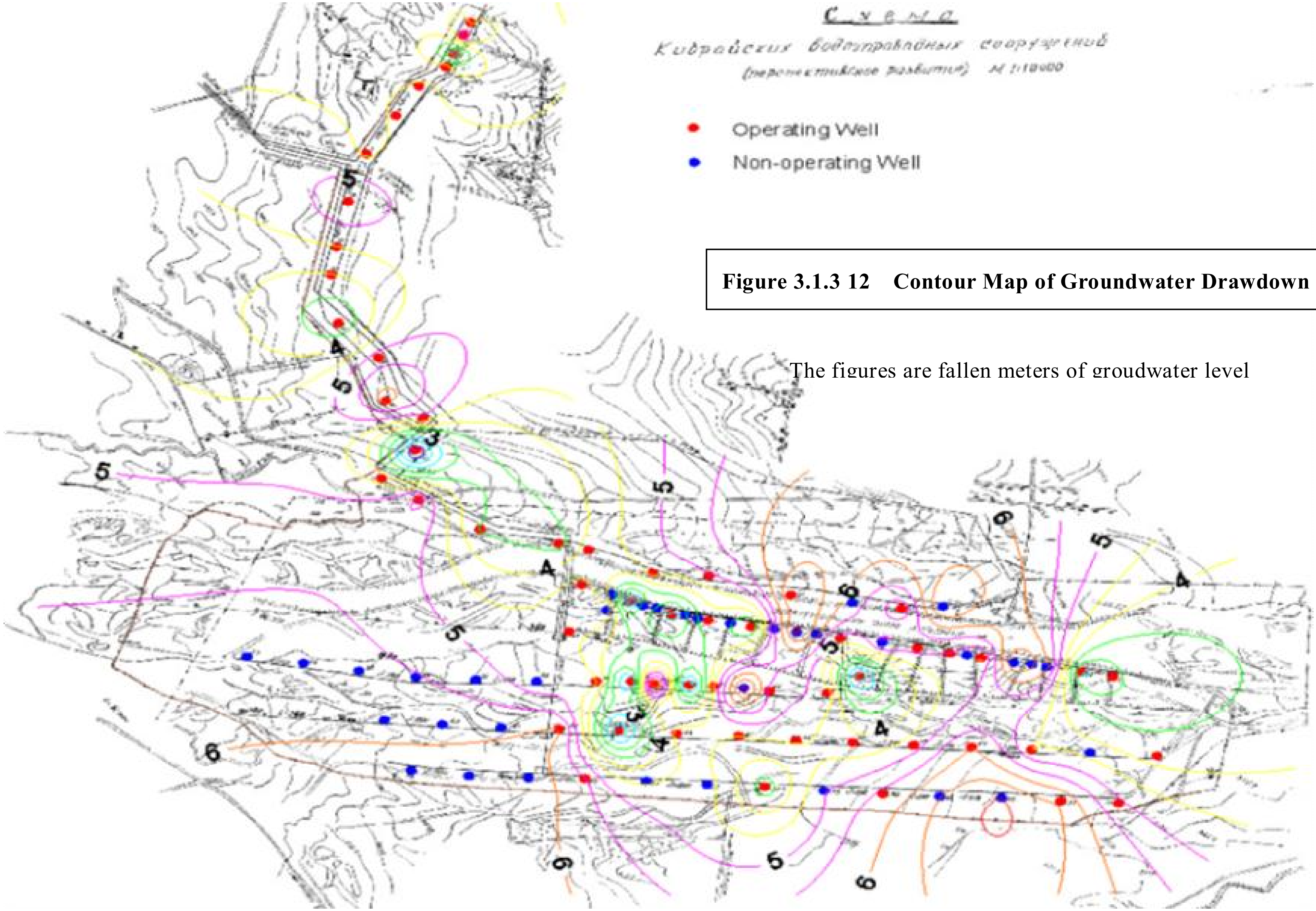


Figure 3.1.3 12 Contour Map of Groundwater Drawdown

The figures are fallen meters of groudwater level

4) High concentration of nitrate

The nitrate concentration of some wells as shown in Figure S 3.1.3.13 at the right bank has exceeded the standard value of the Drinking Water Standard in 2003. In the figure, the nitrate concentration of each well shown with red or blue figures, and red figures exceed the standard value of 45 mg/l, which is equivalent to Japanese Standard of 10mg/l as nitrogen in nitrate. The analysis data for the wells at the right bank of nitrate concentration from 1994 to 2003 is shown in Figure S 3.1.3.14 (1) to (4) based on Table S 3.1.3.4(1) to (4).

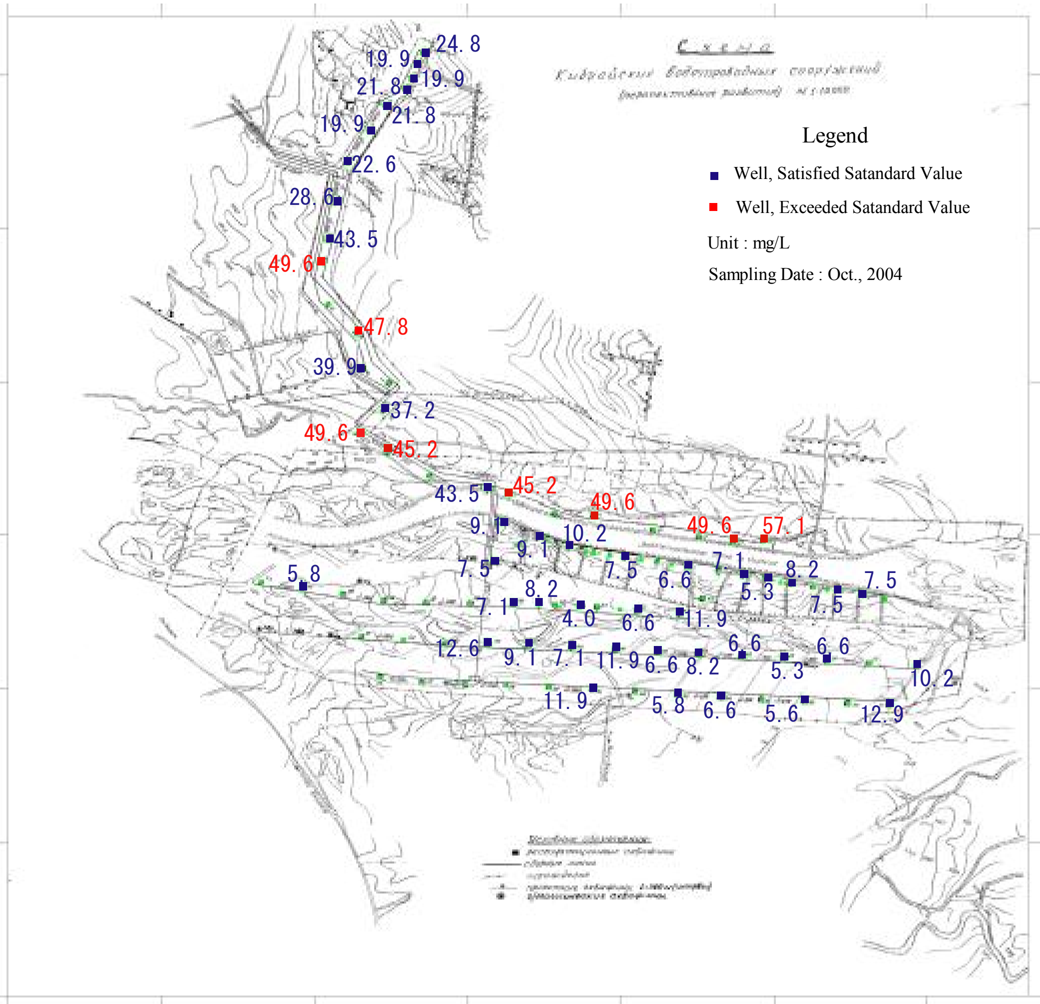
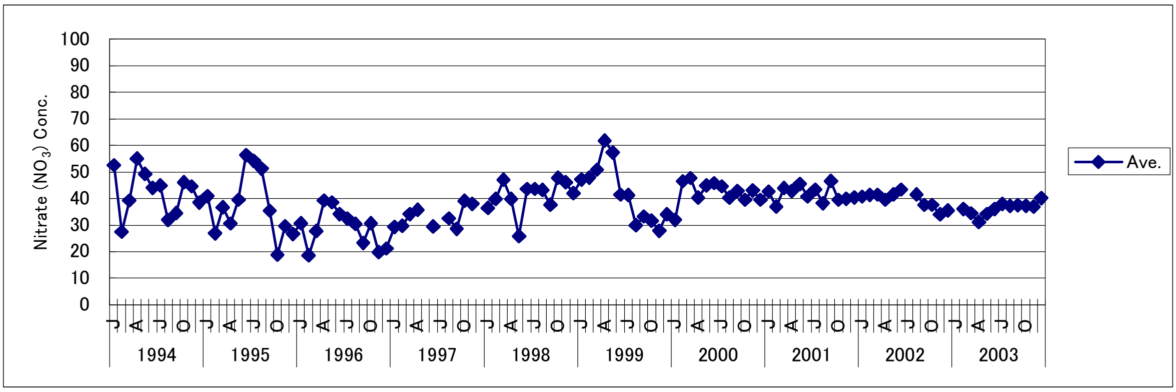
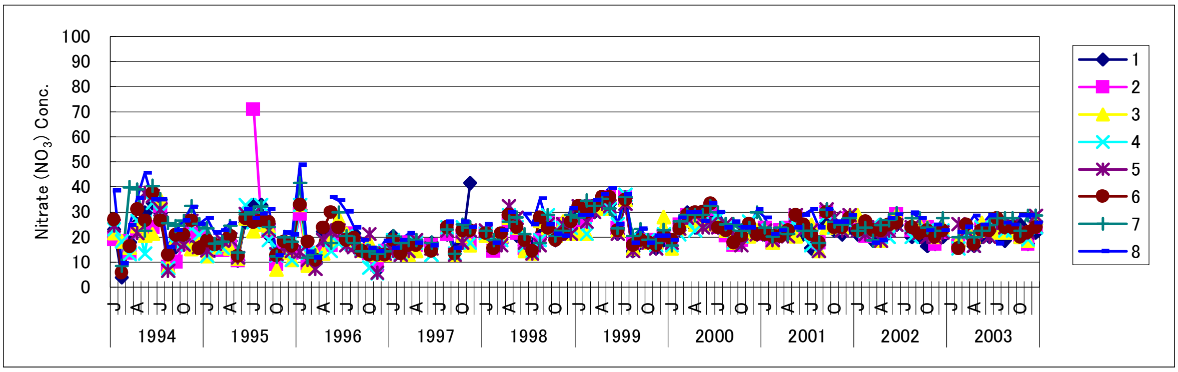


Figure S.3.1.3.13 Map of Nitrate Concentration

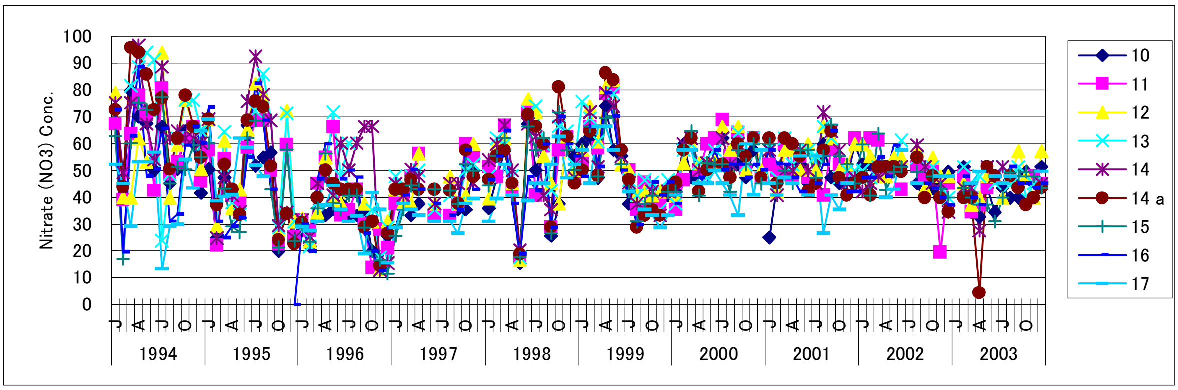
It is said that discharge water from a chemical plant, which was located in Chrchik City upstream of Kibray WTP and produced chemical fertilizer, causes the high concentration. However although the plant had already been closed in 1997, the concentration has not decreased as shown in Figure S 3.1.3.14 (1) to (4), while much nitrate fertilizer has been utilizing at the farm lands in the wide region at the right bank side of the Chirchik River.



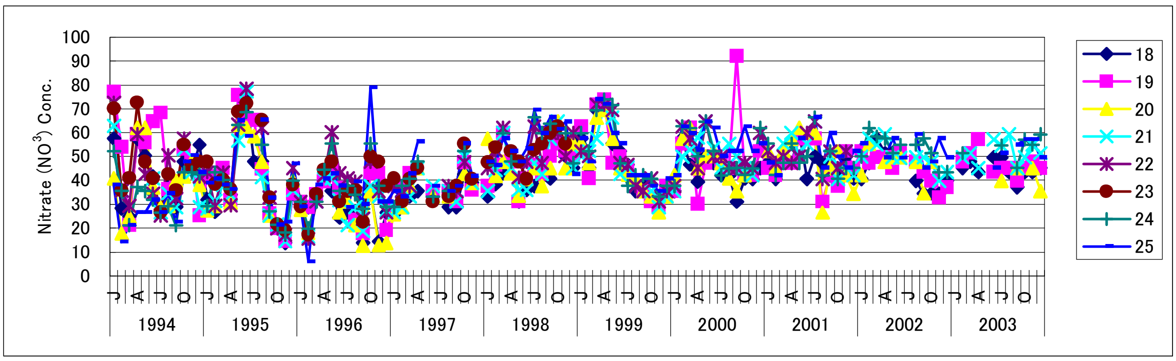
Monthly Average



Well No. 1-8



Well No. 10-17



Well No. 18-25

Figure S.3.1.3.14 Nitrate Concentration of Wells at Right Bank from 1994 to 2003

Table S 3.1.3.4 (1) Nitrate Concentration of Wells at Right Bank from 1994 to 1996

Time		Well No.																										Average
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	14 a	15	16	17	18	19	20	21	22	23	24	25	
1994	January	23.0	19.1	21.7	23.0	24.5	27.0		38.5	60.3	72.7	67.3	78.9		75.3	72.7	62.9	72.7	52.3	57.6	77.1	40.8	62.9	72.7	70.0	52.3	38.1	52.6
	February	3.9	18.2	18.2	18.2		5.7	8.5	9.5	25.4	41.0	39.1	40.1		49.3	43.9	17.1	19.6	45.1	28.4	54.0	17.9	35.7	35.7	35.7	35.7	14.2	27.5
	March	17.9	13.7	15.6	13.0		16.3	39.9	24.7	32.3	79.7	63.8	39.9	81.5	75.3	95.7	60.3	62.9	29.2	24.8	21.3	24.8		29.2	41.0	21.3	21.3	39.4
	April	25.3	23.0	24.4	26.6	21.7	31.0	39.0	35.4	70.0	70.0	78.0	62.0	88.6	96.6	93.9	75.3	88.6	53.2	57.6	59.4	62.0		59.4	72.7	37.2	26.6	55.1
	May	29.7	23.9	20.4	13.3	37.7	26.6	22.6	45.6	78.0	67.5	70.9	53.2	93.9	67.3	85.9	72.7	47.8	53.2	50.5	55.8	62.0		42.5	47.8	35.6	26.6	49.2
	June	33.7	23.9	21.3	33.7	36.3	37.7	40.3	35.0	54.1	50.1	42.5		91.3	54.1	72.7		50.5	56.7	41.6	64.7	37.2	40.8	34.6	40.8	31.9	31.9	44.0
	July	29.7	32.3	35.0	29.7	31.0	26.6	35.0	35.0	70.9	66.5	80.7	93.9	23.9	88.6	77.1	77.5	65.6	13.3	26.6	68.3	28.7	26.6	25.3	26.6	26.6	26.6	44.9
	August	9.3	8.0	8.0	7.5	6.6	12.9	25.7	16.0	43.4	45.2	48.7	39.9	48.7	62.0	50.4	45.2	31.0	29.2	37.2	36.3	29.2	34.6	50.5	42.5	29.2	34.5	32.0
	September	16.0	10.2	19.5	16.8	18.2	20.8	24.4	22.6	39.0	50.5	53.2	59.6	62.0	64.7	62.0	51.4	33.7	29.9	28.8	36.8	39.9	28.8	32.3	35.9	21.3	22.6	34.6
	October	16.8	16.8	18.2	17.3	16.8	20.8	26.6	26.6	57.6	64.7	62.0	76.2	76.2	62.0	78.1	50.5	59.4	54.1	47.8	53.2	41.6	53.2	57.6	54.9	43.4	47.8	46.2
	November	16.0	21.3	15.1	23.6	26.6	26.6	32.3	31.9	29.2	60.3	66.5	66.5	76.2	62.0	66.5	59.4	66.5	43.4	44.3	47.8	47.8	43.4	46.1	46.1	43.4	50.5	44.6
	December	18.6	20.8	18.6	20.8	16.0	15.5	25.3	25.3	18.6	41.6	46.1	50.5	64.7	60.3	54.9	54.9	60.3	64.7	54.9	25.3	38.1	28.8	41.6	47.8	42.5	43.4	38.5
	Average	20.0	19.3	19.7	20.3	23.5	22.3	29.0	28.8	48.2	59.1	59.9	60.0	70.7	68.1	71.1	57.0	54.9	43.7	41.7	50.0	39.2	39.4	44.0	46.8	35.0	32.0	**42.4**
1995	January	16.0	16.0	12.4	12.4	14.6	18.6	23.6	27.5	47.8	50.5	57.6	69.1	69.1	69.1	69.1	60.3	73.5	69.1	31.9	41.6	27.4	28.4	43.4	47.8	29.2	39.0	41.0
	February	14.6	15.5	16.0	16.0	17.3	16.8	17.3	21.7	24.8	24.8	22.2	29.2	24.8	24.8	37.2		31.0	38.5	26.9	40.8	29.2	31.5	29.2	38.5	43.4	40.8	26.9
	March	15.6	14.6	16.8	15.8	18.4		18.2	22.6	38.5	47.4	54.5	61.1	64.4	47.4	52.3	43.4	24.8	40.3	40.3	45.2		38.1	43.4	40.3	40.3	38.1	36.7
	April	18.4	16.2	15.5	19.0	19.0	20.4	24.4	25.5	31.0	40.8	40.8	35.9	38.1	40.8	43.0	29.2	29.2	41.0	33.9	31.7	30.6	33.9	29.5	36.3	36.3	36.3	30.6
	May	10.6	10.6	11.3	11.8	11.7	12.4	13.7		29.2	40.8	38.1	43.0	33.7	34.6	33.7	27.0	32.3	62.0	75.8	75.8	63.4	56.7	63.4	68.7	63.4	65.1	39.5
	June	25.9		27.5	32.7	29.2	27.5	29.2	31.0	62.0	66.9	58.5	65.3	75.8	75.8	68.7	62.0	54.9	58.5	75.8	65.3	62.0	77.2	78.4	72.2	68.7	58.5	56.4
	July	32.7	70.9	22.4	25.9	29.2	25.9	29.9	27.5	54.9	51.8	68.7	82.4	72.2	92.6	75.8	68.7	82.4	51.8	47.8	65.3	58.5						54.2
	August	32.7	25.9	24.9	32.7	27.5	26.6	32.1	29.2	47.8	54.9	68.7	78.4	85.9	78.4	73.8	68.7	68.7	47.8	47.8	44.7	47.8	41.2	62.0	65.3	54.9	65.3	51.3
	September	20.6	22.4	23.9	18.8	22.8	25.9	23.9	31.0	50.0	56.7	50.0		68.7	68.7	51.6	43.0	43.0		27.0	26.1	25.3	25.3	32.8	32.8	27.0	32.8	35.4
	October	10.9	9.1	7.0	12.6	13.1	12.6	12.2	12.6	24.1	19.9	22.6	27.9	28.8	29.5	24.1	21.5			19.9	19.9		21.5	19.9	21.5	21.5	21.5	18.9
	November	17.2	16.8	13.7		15.6	18.2	19.9	21.7	50.5		59.6	72.2	71.3	34.3	33.9	57.8			13.7	14.5		14.5	17.2	19.1	18.2	22.6	29.6
	December	13.7	13.7	10.9	10.9	14.5	16.4	18.2	20.8	21.7		25.3	31.0	31.0	24.8	22.6	23.7			34.3	34.3	39.9	35.9	45.2	38.1	39.9	47.0	26.7
	Average	19.1	21.1	16.9	19.0	19.4	20.1	21.9	24.6	40.2	45.5	47.2	54.1	55.3	51.7	48.8	45.9	48.9	51.1	39.6	42.1	42.7	36.7	42.2	43.7	40.3	42.4	**37.3**
1996	January	31.0	29.0	32.8	32.8	14.1	32.8	41.6	48.7	27.5	27.5	31.5	32.3	27.5	31.5	30.6	29.9	29.9	29.0	29.0	31.0	27.5		31.0	29.1	31.0	29.0	30.7
	February	10.0	9.2	8.4	13.7	10.9	18.2	11.7	14.1	27.5	21.7	27.5	23.5	21.7	25.3		23.5	19.9	27.5	28.8	28.8	18.2	16.4	15.5	17.2	19.9	6.0	18.6
	March	10.0	13.7	13.7	11.7	7.2	10.9	12.6	11.7	31.0		45.2	34.3	38.1	45.2	39.9	35.9	47.0	31.0		34.3		31.0	31.0	34.3	31.0	38.1	27.8
	April	22.2		13.3	18.8	18.8	23.7			35.4	33.2	54.9	54.9	47.8	47.8	50.1	56.3	59.9	37.1		39.4		40.5	42.1	44.4	44.4	40.6	39.3
	May		16.6	18.8	14.4	22.6	29.8	17.7	35.9	23.5	35.4	66.2	39.0	71.8	40.7	45.2	37.8		44.3	35.4	44.3		40.9	60.3	47.8	55.4	43.0	38.6
	June		20.8	27.5	17.5	22.6	23.7	29.9	34.6	33.2	37.8	33.2	37.8	47.8	60.3	43.0	35.4	47.0	35.4	24.4	36.8	26.6	31.7	43.0	31.0	35.4	37.8	34.2
	July	21.5	21.5	21.5	20.4	16.6	18.8	20.4	30.1	33.2	33.2	35.4	42.9	60.3	50.1	42.9	40.7	50.1	31.0	26.6		31.0	21.3	40.7	35.4	37.6	28.8	32.5
	August	21.5	17.7	18.8	16.6	15.9	19.5	17.7	23.7	34.1	33.2	42.9			60.3	42.9	40.7	47.4	33.1	23.4	23.5	21.3	28.8	39.4	35.9	34.1	39.4	30.5
	September	14.6	14.6	14.6	15.1	14.4	14.4	14.4	18.8	21.3	35.4	30.1	37.6		66.4	28.8	28.8	26.6	18.8	13.7	17.7	12.6	18.8	23.9	22.6	28.1	29.9	23.3
	October	13.3	13.3	17.7	7.8	21.3	12.9	14.4	15.5	19.0	19.9	13.7	31.0	35.4	66.4	30.9	19.9	19.9	41.6	35.4	43.0	35.4	37.6	47.9	50.1	55.4	78.9	30.7
	November	6.9	8.9	12.9	5.5	5.8	12.9	13.3	14.4	14.4	13.7	28.1	13.3	17.7	12.9	14.4	16.6	12.6	35.4	14.4	43.0	12.9	33.2	35.4	47.9	37.6	31.0	19.8
	December	14.4	14.4	12.9	14.4	13.3	12.9	14.4	18.4	20.4	25.7	21.3	31.0	28.8	15.5	26.6	11.5	28.8	15.5	26.6	19.0	13.7	27.5	26.6	37.6	28.8	31.0	21.2
	Average	16.5	16.3	17.7	15.7	15.3	19.2	18.9	24.2	26.7	28.8	35.8	34.3	39.7	43.5	35.9	31.4	35.4	31.7	25.8	32.8	22.1	29.8	36.4	36.1	36.6	36.1	**28.9**

Table S 3.1.3.4 (2) Nitrate Concentration of Wells at Right Bank from 1997 to 1999

Time		Well No.																										Average
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	14 a	15	16	17	18	19	20	21	22	23	24	25	
	January	20.4	15.5	17.7	18.8	14.4	18.8	20.4	15.5	31.0	40.7	37.6	43.0	47.9	45.2	43.0	25.7	28.8	28.8	25.7	28.8	25.7	26.6	37.6	40.7	28.8	35.4	29.3
	February	13.3	14.4	14.4	13.3	12.9	13.3	17.7	18.8	31.0	40.7	40.7	37.6	43.0	40.7	43.0	35.4	40.7	37.6	33.2	37.6	28.8	28.8	35.4	31.0	37.6	33.2	29.8
	March		17.7	12.9	14.4	14.4	16.6	18.8	21.5	35.9	33.2	47.8	37.6	47.8	50.3	46.5	44.3	50.3	35.4	33.2	42.9	37.6	33.2	37.6	40.7	40.7	42.9	34.2
	April	16.6	16.6	14.4	17.7	18.8	16.6	18.8	17.7	35.4	37.6	56.2	56.2	50.1	47.9	43.0	43.0	43.0	33.2	35.4		45.2	45.2		45.2	47.9	56.2	35.8
	May																											
	June	17.7	16.6	15.5	12.9	15.5	14.4	17.7	16.6	35.4	35.4	33.2	37.6	35.4	37.6	43.0	43.0	37.6	31.0	33.2	35.4	33.2	37.6		31.0	33.2	37.6	29.5
1997	July																											
	August	21.0	21.0	23.8	23.8	22.6	23.8	23.0	26.1	28.8	42.5	33.2	47.6	40.8	45.2	42.5	42.5	33.2	31.0	28.8	35.4	33.2	35.4	37.7	33.2	35.4	35.4	32.6
	September	14.4		12.9	13.3	12.9	13.3	13.3	15.5	31.0	35.4	37.7	37.7	37.7	45.2	37.7	37.7	35.4	26.6	28.8	31.0		31.0	35.4	37.7		37.7	28.7
	October	17.7	20.4	20.4	23.8	17.7	22.6	25.0	26.1	20.4	35.4	59.8	40.8	50.0		57.6	52.3	57.6	37.7	42.5	47.6	42.5	50.0	47.6	55.4	52.3	55.4	39.1
	November	41.5	17.7	16.6	17.7	22.6	22.6	23.8	23.8	47.6	50.0	55.4	59.8	52.3	45.2	47.6	50.0	43.0	39.4	39.0	35.9	39.0	39.0		40.5		41.9	38.0
	December																											
	Average	20.3	17.5	16.5	17.3	16.9	18.0	19.8	20.2	33.0	39.0	44.6	44.2	45.0	44.7	44.9	41.5	41.1	33.4	33.3	36.8	35.7	36.3	38.6	39.5	39.4	41.8	**33.0**
	January	21.5	21.5	20.4	21.5	22.6	21.5	22.6	25.0	35.9	35.9	51.4	39.4	47.8	53.8	46.6	44.3	46.6	31.0	33.2	37.7	57.6	35.4	45.2	47.6		47.8	36.6
	February	15.6	14.4	18.8	17.7	16.6	15.5	18.8	17.7	47.6	47.6	47.6	59.8	62.0	59.8	55.4	55.4	55.4	39.4	38.3	46.5	42.0	44.3	52.6	53.8	46.4	46.4	39.8
	March	17.7	18.8	20.4	18.8	16.6	21.5		22.6	55.4	57.4	66.9	62.0	59.8	66.9	57.6	62.0	64.7	52.3	43.0	59.8	47.8	59.8	62.0		59.8	57.6	47.1
	April	26.1	26.1	27.7	28.8	32.3	28.8	26.1	29.9	40.8	43.0	43.0	45.2	47.8	50.0	45.2	40.8	37.7	40.8	47.8	47.8	43.0	45.2		52.3	47.8	52.3	39.8
	May	20.4	21.5	23.9	23.9	27.7	23.9	27.7		13.3	15.5	17.7	16.6	17.7	20.4	18.8	17.7	18.8		31.0	31.0	33.4	35.9	41.3	47.8		47.8	25.8
	June	16.6	15.5	14.4	16.6	17.7	18.8	21.3	29.2	66.5	67.3	71.8	76.6	71.8	67.3	70.9	66.5	47.6	38.8	35.9	40.5	40.5	35.9	47.8	40.5		53.4	43.6
1998	July	16.6	13.3	13.3	14.4	13.3	14.4		25.0	40.8	50.1	40.8	71.8	74.0	62.6	66.5	57.6	42.5	45.2	37.7	46.5	45.2	47.2	62.6	52.7	66.5	69.5	43.6
	August	20.4	18.8	26.4	18.8	16.6	27.7	17.7	35.4	52.7	59.8	59.2	55.4	59.8	40.8	59.8	62.0	59.8	45.2	42.5	42.5	37.7	42.5	47.2	55.4	59.8	59.8	43.2
	September	23.6	26.1	23.6	28.8	25.0	23.6	28.8	25.0	17.7	25.7	28.8	45.2	42.5	35.4	28.8	26.6	28.8	52.3	40.8	50.1	45.2	57.6	59.8	59.8	63.6	66.5	37.7
	October	18.8	21.3	20.4	22.6	21.1	18.8	20.4	21.3	59.8	37.7	57.6	37.7	66.5	70.0	81.1	71.8	70.0	62.6		55.4	64.7	64.7	59.8	62.6		61.5	47.8
	November	21.3	25.0	26.1	23.6	25.0	21.3	22.6	20.4	64.7	62.6	62.6	62.6	64.7		62.6	57.6	59.8	47.3	50.1	52.3	45.2		50.1	55.4	59.8	64.7	46.1
	December	23.6	25.0	21.3	23.6	21.3	26.1	28.8	31.3	50.1	55.4	47.3	50.1	52.3	47.3	45.2	50.1	55.4	52.3	45.2	50.1	55.4	45.2	59.8		47.3	42.5	42.1
	Average	20.2	20.6	21.4	21.6	21.3	21.8	23.5	25.7	45.4	46.5	49.5	51.9	55.6	52.2	53.2	51.0	48.9	46.1	40.5	46.7	46.5	46.7	53.5	52.8	56.4	55.8	**41.1**
	January	28.8	26.1	21.3	29.9	32.3	32.3	27.7	28.8	42.5	59.8	52.7	57.6	75.7	55.4	50.1	57.6	47.6	57.6	57.6	62.6	55.4	50.1	52.3		59.8	57.6	47.2
	February	29.9	28.8	21.3	21.3	26.1	29.9	34.6	28.8	55.4	62.6	66.5	73.9	69.5	71.8	64.7	66.5	66.5	45.2	45.2	40.8	47.3	52.3	50.1		52.3	47.8	47.9
	March	29.9	32.3	32.3	29.9	29.9	32.3	32.3	34.6	45.4	47.3	58.5	60.9	60.9	51.4	47.8	47.8	51.4	66.5	69.5	71.8	66.5	57.6	71.8		69.5	74.0	50.9
	April	33.2	33.2	31.3		33.2	35.9	35.2	37.0	66.5	74.0	78.6	81.1		78.9	86.4	69.5	78.9	66.4	71.8	73.9	69.5	71.8	71.8		73.9	72.0	61.9
	May	33.2	35.9	37.0	31.3	32.3	35.9	31.3	39.4	71.8	57.6	81.1	83.7	78.8	74.0	83.7	70.3	70.3	57.6	55.4	47.3	57.6	66.4	69.5		71.8	59.8	57.3
	June	21.3	23.6	22.6	25.0	21.3	22.6	23.6	25.0	50.1	55.4		52.3	55.4	55.4	57.6	52.3	50.1		52.3	50.1	45.2	42.5	47.3		47.3	55.4	41.4
1999	July	33.2	35.9	34.8	37.0	33.2	34.8	35.9	37.0		37.7	50.1	50.1	46.5	45.4	46.5	42.1	42.1	42.1	46.5	45.4	42.4	45.4	46.5		37.7	42.1	41.3
	August	14.4	17.7	15.5		14.4	16.6	20.4	17.7	26.6	35.4	35.4	40.8	40.8	37.7	28.8	31.0	29.8		35.4		40.8	37.7	37.7		42.1	42.1	29.9
	September	17.7		18.8	18.8		18.8	23.3	23.3	37.6	33.2	45.6	42.1	46.5	35.4	33.2	37.6	35.4	35.4	37.6	35.4	35.4	35.4	35.4		42.1	42.1	33.3
	October	17.7	18.8	17.7	18.8	17.7	17.7	18.8	17.7	37.6	35.4	37.6	40.8	45.6	42.1	35.4	40.8	45.6	33.2	33.2	31.0	33.2	35.4	40.8		40.8	37.6	31.7
	November	15.5	17.7	17.7	16.6	15.5	16.6	17.7	20.4	33.2	33.2	37.6	42.1	35.4	33.2	33.2		40.8	28.8	31.0	28.8	26.6	28.8	31.0		33.2	35.4	27.9
	December	18.8	20.4	28.0	21.0		20.4	22.8	20.4	35.4	40.8	42.1	42.1	46.5	42.1	42.1	42.1	45.6	33.2	35.4	37.6	33.2	33.2	35.4		37.6	40.8	34.0
	Average	24.5	26.4	24.9	25.0	25.6	26.2	27.0	27.5	45.6	47.7	53.3	55.6	54.7	51.9	50.8	50.7	50.3	46.6	47.6	47.7	46.1	46.4	49.1		50.7	50.6	**42.1**

Table S 3.1.3.4 (3) Nitrate Concentration of Wells at Right Bank from 2000 to 2002

Time		Well No.																										Average
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	14 a	15	16	17	18	19	20	21	22	23	24	25	
2000	January	16.6	16.6	15.5	16.6	17.7	18.8	16.6	18.8	33.2	42.1	35.4	40.8	37.6	42.1	45.6	42.1	37.6	40.8	35.4	35.4	42.1	35.4	37.6		37.6	42.1	32.0
	February	22.8	25.0	23.3	21.0	23.3	23.3	26.4	27.7	55.4	59.8	46.5	52.7	57.6	59.8	57.6	57.6	57.6	57.6	57.6	55.4	57.6	50.0	62.6		62.6	62.6	46.5
	March	29.9	28.8	26.4	26.4	27.7	28.8	28.8	29.9	45.2	47.4		59.8	59.8	62.0	62.0	64.7	57.6	57.6	46.6	62.0	62.0	52.7	57.6		62.0	59.8	47.7
	April	23.7	26.4	25.0	22.6	28.8	29.9	28.8	29.9	42.1	50.0	50.0	52.7	52.7	50.0	42.1	40.8	47.3	45.2	39.4	30.0	45.2	57.9	45.2		50.0	52.7	40.3
	May	26.3	27.7	25.1	23.7	23.7	30.0	28.8	26.4	47.3	52.7	59.8	52.7	47.3	52.7	50.2	52.7	45.2	45.2	50.2	47.3	50.2	64.7	64.7		64.7	64.7	45.0
	June	26.4	31.0	25.1	26.4	25.1	33.5	32.3	33.5	52.3	62.0	62.0	53.3	57.6	52.3		52.3	57.6	50.0	47.3	50.0	52.3	53.4	50.0		52.3	62.0	45.8
	July	23.7	23.7	25.1	27.7	23.7	23.7	29.9	29.9	62.0	62.0	69.0	66.4	62.0	62.0	52.3	52.3	50.2	45.2	42.1	47.3	47.3	45.2	50.2		42.1	50.2	44.6
	August	23.7	20.4	22.6	23.7	25.1	22.6	25.1	23.7	42.1	52.3	55.4	57.6	52.3	52.3	47.3	42.1	52.3	40.8	42.1	45.2	40.8	55.4	45.2		45.1	52.3	40.3
	September	17.7	16.6	17.7	17.7	20.4	17.7	25.1	26.1	52.3	52.3	64.2	66.4	64.1	59.8	59.8	57.6	52.3	33.2	31.0	92.1	35.4	50.2	45.2		45.2	52.3	42.9
	October	17.7	18.8	20.4	20.4	16.6	20.4	22.6	23.7	52.3	47.3	50.2	50.2	52.3		55.4	52.3	47.3	59.8	40.8	42.1	42.1	45.2	47.3		42.3	62.6	39.6
	November	21.0	22.6	20.4	26.1		25.1	23.7	23.7	59.8	57.6	62.0	62.0	62.0		62.0	59.8	52.3	40.8	40.7	42.1		42.1	45.1		45.1	52.3	43.1
	December	21.0	21.0	22.6	22.6	21.0	21.0	29.9	31.0	21.0		47.3	50.2	47.3		47.3	45.1	50.2	57.6	45.1	52.3			59.8		62.0	55.4	39.6
	Average	22.5	23.2	22.4	22.9	23.0	24.6	26.5	27.0	47.1	53.2	54.7	55.4	54.4	54.8	52.9	51.6	50.6	47.8	43.2	50.1	47.5	50.2	50.9		50.9	55.7	**42.3**
2001	January	21.0	23.7	22.6		22.6	21.0	23.7	27.7	57.6	25.0	52.3		59.8	57.6	62.0	59.8	57.6	45.2	47.3	45.2	52.3		52.3		55.4	47.3	42.7
	February	17.7	17.7	17.7		18.8	20.4	20.4	21.0	47.3	45.2	50.0	42.1	47.3	40.7	45.2	45.2	52.6	40.7	40.7	42.1	45.2		47.3		42.2	42.1	36.9
	March	21.0	22.6	22.6		21.0	20.4	23.7	22.6	55.4	57.6	59.8	57.6	62.0	50.0	62.0	50.0	52.3	47.3	50.0	47.3	52.3	55.4	50.0		47.3		43.9
	April	21.0	23.7	22.6	23.7	20.4	22.6	21.0		52.3	59.8	47.3	57.6	52.3	50.0	59.8	45.2	47.3	45.2	47.3	47.3	57.6	59.8	47.3		55.4		42.9
	May	25.0	27.7	20.4	25.0	28.8	28.8		23.7	45.2	52.3	55.4	50.3	57.6	57.6	55.4	57.6	42.1	55.4	59.8	57.6	62.0	50.0	50.0		47.3	57.6	45.5
	June	21.0	23.7		22.6	22.6	25.0	22.6	28.8	42.1	45.2	47.3	59.8	57.6	50.0	42.1	57.6	40.7	40.7	40.7			55.4	59.8		50.0		40.7
	July	15.5	22.5	25.0	16.6	22.6	21.0	22.6	31.0	42.1	45.2	47.3	50.0	55.4	45.2	45.2	47.3	45.2	55.4	50.0	57.6	59.8	64.7	64.7		66.4	66.4	43.4
	August	17.7	17.7	14.4	14.4	14.4	17.7	17.7	23.7	47.3	59.8	40.7	66.4	66.4	71.8	57.6	55.4	52.3	26.5	47.3	31.0	26.5	40.7	40.7		42.1	45.2	38.2
	September	26.0	29.9	23.7	28.8	31.0	29.9	31.0	31.0	59.8	47.3	57.6	62.0	62.0	64.7	64.7	67.0	64.7	40.7	42.1	42.1	45.2	50.0	52.3		52.3	59.8	46.6
	October	22.5	23.7	25.0	23.7	27.7	23.7	26.1	26.1	45.2	45.2	52.3	50.0	47.3	57.6	47.3	55.4	45.2	35.4	42.1	37.7	52.3	40.7	45.2		40.7	50.0	39.5
	November	21.0	23.7	23.7	22.6	22.6	23.7	25.0	26.1	47.3	47.3	50.0	52.3	50.0	45.2	40.7	52.3	42.1	45.2	50.0	52.3	42.1	52.3	52.3		45.2	45.2	40.0
	December	23.7	27.6	28.8	25.0	28.8	27.6	27.6	28.8		59.8	62.0	59.8	50.0	47.3	45.2	45.2	42.1		40.8	45.2	34.4	42.1			45.2	52.3	40.4
	Average	21.1	23.7	22.4	22.5	23.4	23.5	23.8	26.4	49.2	49.1	51.8	55.3	55.7	53.1	52.3	53.2	48.7	43.4	46.5	45.9	48.1	51.1	51.1		49.1	51.8	**41.7**
2002	January	21.0	25.0	28.8	22.6	22.6	22.6	22.6		22.6	52.3	59.8	59.8	50.0	42.1	47.3	59.8	47.3		40.7	52.3	42.1	50.0			50.0	55.4	40.8
	February	21.0	20.4	26.1	22.6	21.0	26.1	23.7		47.3	52.3	62.0	55.4	47.3	45.2	40.7	40.7	47.3		47.3	47.3	55.4	57.6			62.0		41.4
	March	18.6	22.6	23.9	24.8	23.9	22.6	18.6	17.7	47.8	51.4	61.2	47.8	51.4	47.8	51.2	63.8	54.9		57.6	49.6		55.0			58.4		41.5
	April	18.6	23.7	18.6	19.9	18.6	22.6	24.8	18.6	42.9	49.6	47.8	47.8	49.6	49.6	51.4	42.8	47.8	39.9	51.4	49.6	47.8	59.4			57.6	49.6	39.6
	May	21.5	22.6	24.8	19.9	22.6	24.8	26.6	27.5	47.8	51.4		54.9	51.4	51.4	51.4	49.6	59.4	42.9	51.6	45.2	49.8	49.8			51.4	57.6	41.6
	June	24.7	29.0	29.0	24.7	24.7	25.7	29.5	29.0	49.4	51.4	42.9	54.9	61.2	51.4	49.4	51.4	57.6	57.6		51.4	49.6	49.4			54.9	49.4	43.4
	July																											
	August	19.9	22.6	24.8	19.9	23.9	23.9	27.5	29.7	43.4	45.2	51.4	57.6	54.9	59.4	54.9	49.6	45.2	45.2	39.9	47.8	47.8	49.6			54.9	59.4	41.6
	September	19.9		24.8	21.5	21.5	21.5	27.5	27.5	39.9	42.9	47.8	43.4	51.4	51.4	39.9		45.2		34.6	43.4	34.6	49.6			57.6	45.2	37.7
	October	16.4	23.9	23.9	22.6	19.9	22.6	23.7	22.6	37.2	43.4	49.6	54.9	51.4	45.2	47.8	47.8	43.4		34.6	39.9	47.8	47.8			51.4	47.8	37.6
	November	17.3	17.3	19.9	22.6	19.9	19.9	22.6	24.8	37.2	45.2	19.6	47.8	45.2	45.2	39.9	43.4	39.9	47.8	34.6	32.8		39.9			43.4	57.6	34.1
	December	19.9	21.8	23.9	22.6	21.8	22.6	27.5	22.6	45.2	49.6	45.2	47.8	39.9	34.6	34.6	39.9	37.2	47.8	39.9	37.2		43.5			43.5	49.6	35.6
	Average	19.9	22.9	24.4	22.2	21.9	23.2	24.9	24.4	41.9	48.6	48.7	52.0	50.3	47.6	46.2	48.9	47.8	46.9	43.2	45.1	46.9	50.1			53.2	52.4	**39.5**

Table S 3.1.3.4(4) Nitrate Concentration of Well at Right Bank in 2003

Time		Well No.																										Average
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	14 a	15	16	17	18	19	20	21	22	23	24	25	
2003	January																											
	February	16.4	16.4	18.6	15.5	25.2	15.5	19.9	21.8	45.2	51.4	47.8	45.2	51.4	43.5	39.9	43.5	47.8		45.2	47.8		49.6			51.4		36.1
	March	22.6	22.6	23.9	21.8	22.6	24.8	21.8	23.9	34.6	34.6	34.6	37.2	39.9	43.5	39.9	39.9	39.9	45.2	47.8	51.4		51.4					34.5
	April	16.4	19.9	19.9	16.4	16.4	17.3	19.9	28.5	39.9	32.8	37.2	39.9	47.8	27.5	4.4	37.2	37.2	49.6	43.5	57.1		45.2					31.1
	May	19.9	23.7	25.7	23.9	21.8	22.6	22.6	24.8	37.2	43.5	43.5	47.8	51.4	51.4	51.4	37.2											34.3
	June	19.9	23.9	22.6	19.9	19.9	22.6	24.8	28.6	31.0	34.6		47.8	45.2	47.8	47.8	31.0	47.8	47.8	49.6	43.5		57.1				45.2	36.1
	July	24.8	22.6	21.8	23.9	25.7	27.5	27.5	17.3	34.6	43.5		39.9	51.4	51.4		39.9	45.2	45.2	49.6	45.2	39.9	54.5			54.5	51.4	38.0
	August	18.6	22.6	21.8	22.6	23.9	23.9	27.5	25.7	43.5	39.9		47.8	44.6		47.8	49.1	51.4	47.8	43.5	45.2		59.4					37.2
	September	21.8	21.8	21.8	22.6	24.8	23.9	27.5	24.8	45.2	39.9		57.1	51.4		43.5	47.8	45.2		37.2	39.9	45.2	45.2			45.2	54.9	37.5
	October	24.8	19.9	19.9	21.8	21.8	19.9	22.6	28.6	43.5	49.6		47.8	39.9		37.2	49.6	45.2		43.5	45.2		49.6			57.1	57.1	37.2
	November	17.3	17.3	18.6	19.0	21.8	21.8	28.6	28.6	35.4		47.8	39.9	45.2		39.9	47.8	43.5		43.5	47.8	45.2	54.9			54.9	57.1	36.9
	December	21.8	23.9	27.5	23.9	28.5	23.9	28.6	25.7	47.8	51.4	45.2	57.1	45.2	45.2	43.5	43.5	45.2	49.6	45.2	45.2	35.4	51.4			59.4	49.6	40.2
	Average	20.4	21.3	22.0	21.0	22.9	22.2	24.6	25.3	39.8	42.1	42.7	46.1	46.7	44.3	39.5	42.4	44.8	47.5	44.9	46.8	41.4	51.8			53.8	52.6	**36.3**

In addition, the groundwater layer at the right bank is stable because the plentiful penetrated water from these areas supplies the layer. It is not sure now that high concentration of nitrate is derived from fertilizer for the farmland, because the duration since the close of the chemical has not been so long. However if the reason of the high concentration is thought to be the fertilizer for farmlands, reduction of the nitrate concentration cannot be expected. The concentration of nitrate from left bank wells must be observed carefully in the future.

(2) Evaluation of Groundwater Source

1) Surveyed results of intake potential for groundwater

Tashkent Hydro-Geological Survey Institute conducted a hydro-geological survey for the groundwater sources in surrounding area of Tashkent City. The results of survey were summarized as Table S.3.1.3.5, and this is almost the same figure with Table 2.1.5, which is a list of ground water intake rights for Tashkent Vodokanal.

Table 3.1.3.5 Estimated Groundwater Yield Potential ($10^3m^3/d$)

WTP	Area	Category				Total
		A	B	C1	C2	
Kibray	Right Bank	157.7	35.2	41.5		234.4
	Left Bank	354.6	193.0	153.6	56.2	757.4
	Sub Total	512.3	228.2	195.1	56.2	991.8
South	I	39.9				39.9
	II	99.8	20.7			120.5
Sergeli		39.0				39.0
Kuiluk		21.4				21.4
Total		712.4	248.9	195.1	56.2	1212.6

Note: A: This quantity can be always withdrawn, B: This can be temporarily withdrawn, C1: Potential of easy intake, C2: Potential of relatively difficult intake

As shown in the table, the potential of groundwater intake was judged at 991,800m^3/d. However, the current minimum intake amount is around 300,000m^3/d in Kibray WTP in 2004. The reasons of capacity decline are assumed as follows:

- A mutual interference of wells caused falls of groundwater level because of too small distances between wells;
- Excessive capacity of pumps is installed for wells compared to the actual yield capacity of wells, and it causes a fall of groundwater level and a harmful vibration of pumps due to ex-

cessive closing of discharge valves;

- Because well pumps are operated manually, when water level in the wells is dropped by excessive yield, the pumps break down seriously by the dry operation;
- Yield capacity becomes lower because it must be strained to avoid the dry operation; and
- Improper connection of transmission pipes as aforementioned.

Many of the wells at the left bank were broke down, and their operation ratio is less than 50% due to the above reasons.

2) Evaluation of Yield Capacity

Since the falls of groundwater level stand out currently, all existing wells cannot be operated continuously. Thus proper wells need to be selected to ensure stable intake.

According to the previous discussion, the conditions of proper wells should be defined as follows:

- Stable operation in the past;
- Large yield capacity;
- Capacity decline ratio is small; and
- In the zone of lowering groundwater level, some wells shall be abolished to expand the distance of each well.

Based in above conditions, wells to be operated in the future are selected as shown in Figure S.3.1.3.15. The number of selected wells at the right bank is 19, and that at the left bank is 37 as shown in the figure.

In this case, the average yield capacity of wells at the right bank is 330m^3/hr (7.900m^3/d) and that at the left bank is 225m^3/hr (5,400m^3/d).

Total capacity = 7,900m^3/d x 19 + 5,400m^3/d x 37=150,000m^3/d (right bank)+200,000m^3/d (left bank) = 350,000m^3/d

Current actual minimum yield amount from April to December is around 300,000m^3/d. It may be reduced in mid-winter. However, when all necessary pumps as shown in the figure are replaced by new pumps with proper capacity and automatic operation according to the water level, the yield amount of 350,000m^3/d is assumed to be ensured as discussed above.

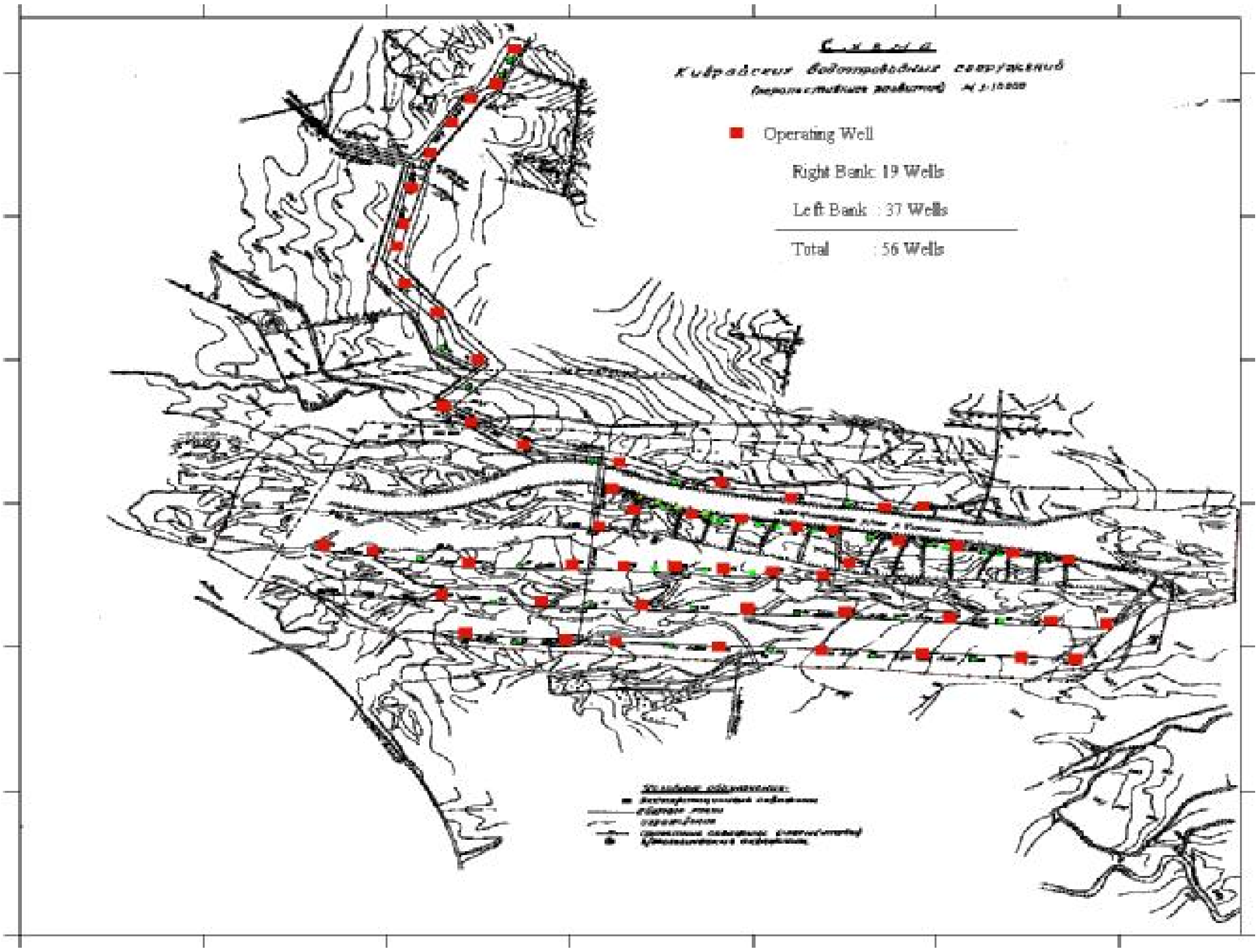


Figure S 3.1.3.15 Location of Selected Wells

S 3.1.4 Examination of Current Distribution Network

This Study examines the flow condition of existing distribution network through various hydraulic analyses/simulations, which are as shown below. Future network to be recommended is described in S 5.4.4.

(1) Availability of the Existing Data

Detailed drawings/data of existing distribution network including pipeline route, diameter, length, material, elevation of each junction and other related information are fundamentals for the Study. Although the Study Team frequently requested the concerned agencies for provision of the said data since the beginning stage of the Study, these data have not yet been released at this moment due to national security reason. Some data for the pipeline network is got by hearing with Vodokanal engineers. Under such a situation, the Study Team referred to the reports of previous JICA Study (2000) and limited data/information provided by Vodokanal in the examination of distribution network during the course of the first field investigation. Therefore, it is noted that the update of the model and/or pipeline/nodal data will be primarily required when the detailed drawings/data that are currently being collected, are available.

(2) Software Used in the Hydraulic Analysis

In the examination of distribution network, Water CAD, a water distribution model software developed by Haestad Methods, Inc., was fully used. Following are the objectives of using Water CAD and features of the software.

1) Objectives of using Water CAD in the Study

- ✓ To study/analyze water flow and pressure in existing distribution network of Tashkent City;
- ✓ To develop/recommend appropriate distribution network as well as system operation of Tashkent water supply though various analyses/simulations; and
- ✓ To enhance technical capability of Vodokanal through the above activities together with technical workshop.

2) Feature of Water CAD

Water CAD has many powerful and versatile project tools to analyze/simulate distribution pipe network as follows:

i) Laying out the Network

Using Pipe layout toolbar helps in the easy laying out of the water distribution network. Reservoir/s, tank/s, pump/s, junctions, pipes and valves are placed into the drawing pane. Pipelines are automatically placed according to placing Junction. As an alternative, drawings of network in a .DXF format (.DWG format in the AutoCAD version) can be used as a background drawing in laying out a scaled network.

ii) Easy Data Entry (add/delete/edit)

Four (4) ways to enter and modify element data are provided in Water CAD. Among them, using Dialog Box and Flex Table will be much easier to handle the model as a stand alone-basis. Aside from these, Database Connections can create connections to import and export model data using common database and spreadsheet. Alternative Editors will be used for creating alternatives from base alternatives.

iii) Performing Various Analyses/Simulations

Various analyses can be performed using Water CAD as follows:

- Steady State Analysis: Generally, water distribution for Average Daily Demand/Maximum Daily Demand will be analyzed.
- Extended Period Simulation (EPS): EPS can be conducted for any specified duration. Tank levels fluctuation, pump operation, valves open/close, and demands change throughout the day can be simulated. Variation in demand over time can be modeled using demand patterns. Demand patterns are multipliers that vary with time. Demand patterns at each node can combine different patterns of water use (residential, commercial, fire flow, etc.).
- Water Quality Analysis: Computing Water Age (Travel time from source/reservoir), Analyzing Constituent Concentrations (Chlorine residuals in the system over time) and Performing a Trace Analysis (Percentage of water from a specific source node)
- Cost Estimating: Cost Manager in Water CAD is a tool for tracking the costs associated with a water distribution construction project.

<u>Powerful Reporting Tools</u>

Many reporting tools can be used for various purposes as follows:

- Reports by Element (Detailed Report): Every element can generate a report in the same general format, which includes the name of the calculated scenario and series of tables describing the element's properties and result in detail. Graphs on the concerned items are effectively employed.
- Tabular Reports (Flex Tables): Tabular Reports are an extremely powerful tool in Water CAD. These reports are not only good presentation tools, but also very helpful in data entry and analysis. When data must be entered for a large number of elements, clicking each element and entering the data are tedious and time consuming. However, using Flex tables can make the job easier, since entering/editing the data is done on same tables. Using tabular report, elements can be changed using the global edit tool, or filtered to display only the desired elements. Values that are entered into the table will be automatically updated in the model. The tables can also be customized to contain only the desired data. Columns can be added or removed, or duplicates of the same column with different units can be displayed. The tables can be printed or copied into a spreadsheet program such as EXCEL.
- Plan View (Full View/Current View): Full View will create a plan of the entire system regardless of what the screen shows, while Current View will create a plan of exactly what is displayed in the window at that moment. These views can be printed or copied to the clipboard, and can be exported to AutoCAD or other compatible software with a.DXF file.
- Contouring: Contouring enables to generate contours for reporting attributes such as elevation, pressure and hydraulic grade. Contour interval as well as color code by index values or ranges of values can be specified.
- Element Annotation: Element annotation enables to label network attributes in the plan view and control which values are displayed, how they are labeled and how units are expressed.
- Color Coding: Color Coding enables to review results in the plan view by color-coding the elements based on attributes or range of values.
- Versatile Scenario Management: Scenario Management tools enable to create a

New Alternative, edit and create scenarios, calculate and compare scenarios. Traditionally, there have only been two possible ways of analyzing the effects of change on a software mode, such as change the model, recalculate, and review the results. Although either of these methods may be adequate for a relatively small system, the data duplication, editing, and re-editing becomes very time-consuming and error-prone as the size of the system and the number of possible conditions increase. Additionally, comparing conditions requires manual data manipulation, because all output must be stored in physically separate data files.

- Working with Data from External Sources: Water CAD supports several methods of exchanging data with external applications, preventing duplication effort and allowing saving time by reusing data already present in other locations. For instance, exchanging data with databases or GIS system, or converting CAD line work to pipe network. One or more database connections can be set up to bring in information stored in many standard database and spreadsheet formats. Drawings of network in a .DXF format (.DWG format in the AutoCAD version) can be used as a background drawing in laying out a scaled network. Importing data available from other distribution model software are Previous Water CAD/Cybernet Versions, EPANET Files and KYPIPE Data.

(3) Examination of Current Flow Condition

1) Outline of the Existing Distribution Network

As shown in Figure S 3.1.4.1, the existing distribution network in Tashekent has several features in its configuration and operation.

Distribution trunk lines with a diameter of 1,200 - 1,400 mm starting from two (2) key water sources of Kadirya and Kibray WTPs surround the City to form outer ring mains. In addition, a 1,800 mm distribution pipe is utilized for transmitting a part of Kadirya water to Kibray WTP. Other trunk lines with a diameter of 1,000 - 1,600 mm are placed through the City to finally connect the said outer ring mains and interconnect each other. As for water flow in the distribution network, water from Kibray WTP is supplied for eastern to southern part of the City of which supply zone is considered to be approximately quarter (1/4) to one-third (1/3) of total service area. Water from Kadirya WTP covers majority of the City, namely from northern east, central to southern west part of Tashkent City. It is considered that water flows directing from northern east to southern west or east to west according to elevation profile of the City. Aside from these, a specific area of central part of the City and Chilanzar District are supplied from Boz-su and South WTPs, respectively, however, distribution pipes interconnect pipe network from Kadirya WTP. Likewise, remaining areas in southern part of the City are supplied by small small WTPs such as Sergeli, Kara-su, Kuiluk and Bectemir. The concerned distribution pipes, except for Kuiluk area, also interconnect distribution network of major supply zone.

Considering elevation differences between key facilities (Kadirya and Kibray) and major supply zones, it is easily anticipated that high water pressure occur in the distribution network of lower area of the City. Because of this, Vodokanal has carried out reducing water pressure by regulating the concerned valves throughout the City. As a result, unreasonable reduction of water pressure further required provision of more than 100 booster pump stations in the distribution network. As shown in Table D 3.1.4 in Data Report, inlet and outlet water pressure of these PSs is recorded as mostly 0.2-2.8 kg/cm^2 and 3-6 kg/cm^2, respectively.

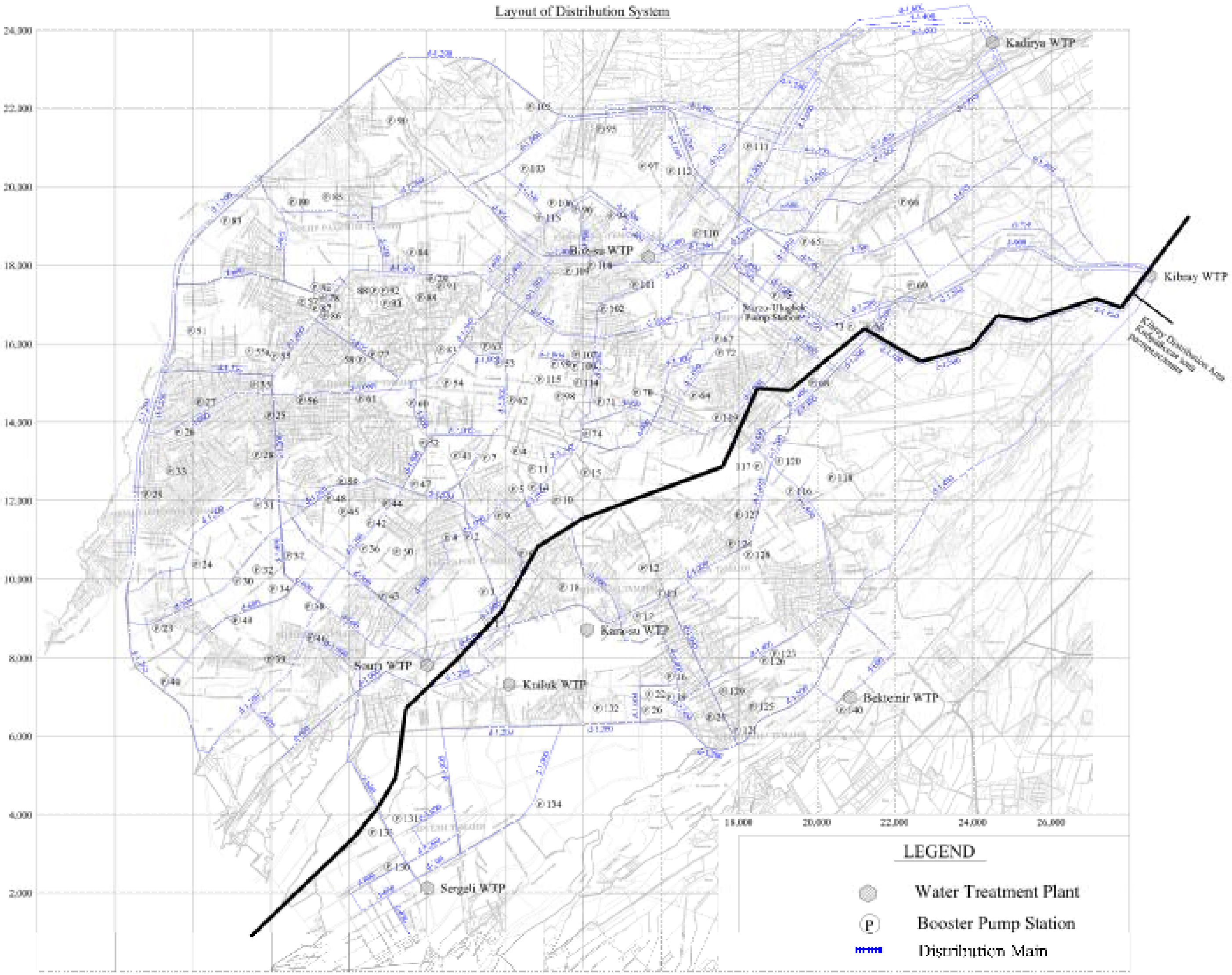


Figure S 3.1.4.1 Existing Distribution Primary Mains

In addition, respective supply zones are not completely isolated. More than 1,500 of valves are being utilized for flow control in the City and water flowing in the congested distribution network finally form flow balance. Since appropriate flow measurement is not practiced, it is difficult to exactly identify the boundaries of supply zones from different water sources. It is considered that improper or unnecessary valve regulating, especially in the distribution mains with large diameter, may have caused unreasonable water supply due to ineffective use of pipe capacity and/or unnecessary provision of booster pumps.

The extreme case is found in Chilanzar District where the farthest from Kadirya WTP and water flow seems to finally balance in the District, however, because of insufficient water pressure, the area is supplied by South WTP of which pumping head arrives at more than 100 m. Under such a condition, another boosting system of Chilanzar PS delivers water to Chilanzar from opposite side of South WTP with approximate 90 m of pumping head.

Taking account of configuration of the network system and topographic condition of the City, the distribution network of Tashekent City is considered to be relatively fair. However, its operation/flow control in specific areas is unreasonable and closely relates wastes of electric energy.

2) Hydraulic Analysis on Current Flow Condition

i) Layout of the model

Figure S 3.1.4.2 presents schematic diagram of the existing distribution network. Placed in the model are:

- Distribution pipes with a diameter of lager than 300 mm
- Surface water sources of Kadirya and Boz-su WTPs, and groundwater sources of Kibray, South, Sergeli, Kara-su, Bectemir and Kuiluk WTPs
- Major pumping stations of Mirzo-Ulugbek, Chilanzar and Sergeli 3/5
- Other booster pumping stations placed as off-take points
- Eleven (11) hot water plants consuming a large water volume

Finally, total number of pipeline and junctions placed in the model arrived at 970 and 630, respectively, which corresponds to the maximum number (1,000) of pipelines to be accommodated in Water CAD.

ii) Water demand

Total distribution volume and water consumption by water use were examined in the Study. Current water distribution volume by district was assumed as shown in Table S 3.1.4.1, based on the billed water volume provided by the Sales Department of Vodokanal.

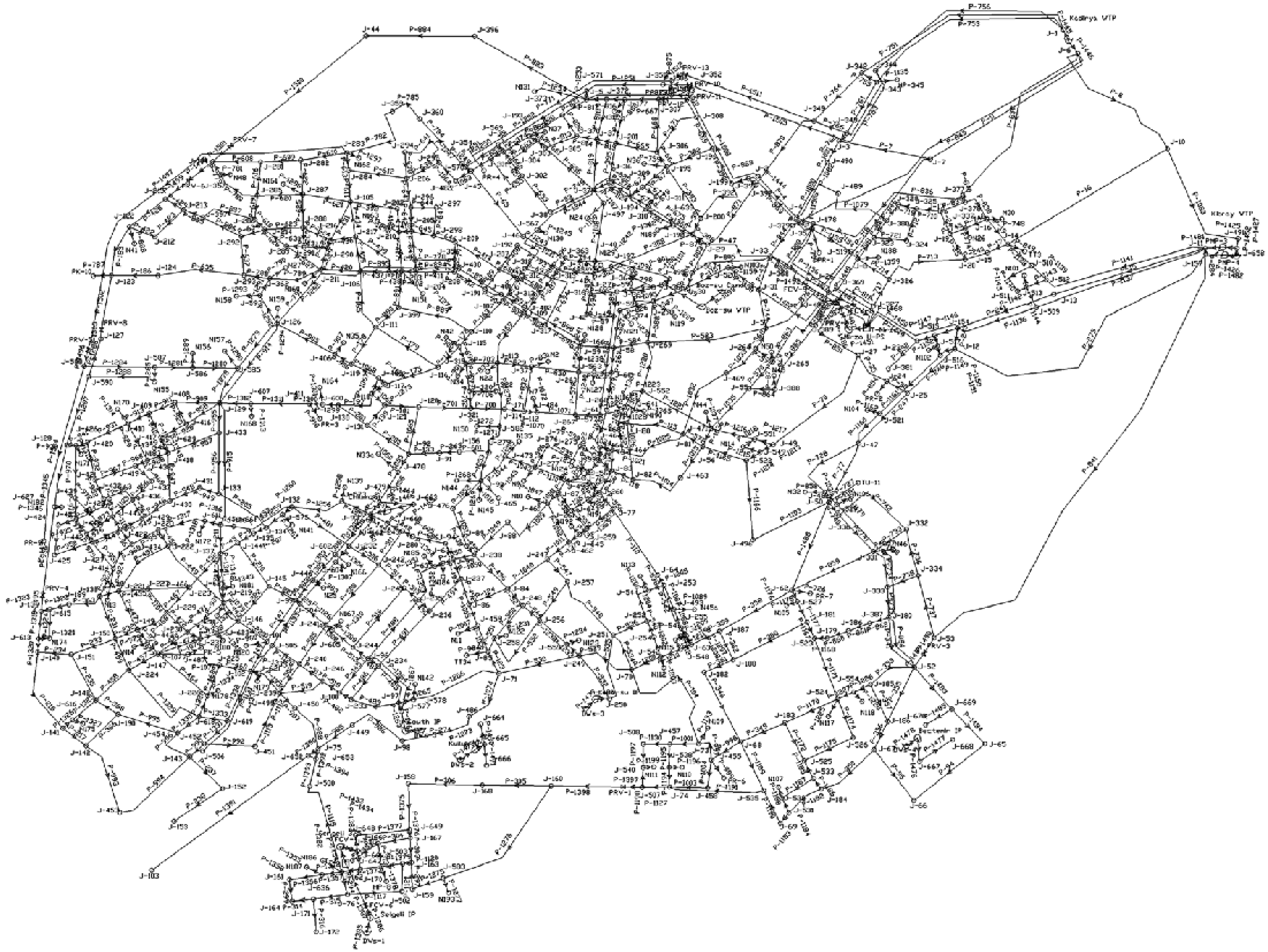


Figure S 3.1.4.2 Schematic Diagram of the Existing Distribution Network

Table S 3.1.4.1 Assumed Water Distribution Volume by District (Year 2002)

(Unit: m^3/day)

District	Consumption excl. Hot Water Plant	Consumption for Hot Water Plant	Total Consumption	Leakage	Total Distribution Volume
(Tashkent City)					
A. Ikramov	101,766	31,098	132,864	90,853	223,717
Bektemir	19,356	-	19,356	15,397	34,752
Mirabad	115,844	19,271	135,115	98,285	233,400
M. Ulgbek	172,589	66,279	238,868	158,393	397,261
S. Rahimov	131,652	39,316	170,968	117,243	288,211
Sergeli	69,877	113,423	183,300	91,702	275,002
Khamza	134,645	31,291	165,937	117,069	283,005
Chilanzar	104,304	60,423	164,727	102,210	266,937
Shayhantahur	129,782	38,510	168,291	115,499	283,790
Yunusabad	144,150	95,389	239,538	145,040	384,579
Yakkasaray	75,814	0	75,814	60,307	136,121
Sub-total	1,199,778	495,000	1,694,778	1,111,998	2,806,776
(Vicinity area)					
Kibray	29,287	-	29,287	23,297	52,584
Ata	17,666	-	17,666	14,052	31,718
Other vicinity towns	4,969	-	4,969	3,953	8,923
Sub-total	51,922	-	51,922	41,302	93,224
Total	1,251,700	495,000	1,746,700	1,153,300	2,900,000

iii) Assumed conditions for analysis

<u>Coefficient of roughness</u>

In the pipe net calculation model, the head loss due to friction in the pipeline is calculated using the following William-Hazen formula:

$$H_L = 10.667 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85} \times L$$

Where, H_L: Head loss due to friction in distribution pipe
C: Coefficient of roughness
D: Internal diameter of distribution pipe (m)
Q: Flow (m^3/sec)
L: Length of pipeline (m)

With regard to coefficient of roughness, generally a value of 90 may be used, considering the majority of the aged pipes as shown in Table S 3.1.4.2. However, as shown in Photo S 3.1.4.1, it is considered that inner surface of the aged pipes in the City are not so seriously damaged compared with the outer surface condition as shown in Photo S 3.1.4.2.

Table S 3.1.4.2 List of Existing Pipes

Diameter (mm)	Length (Km)			Length by Age																				
				<5 years			5-10 yrs			10-20 yrs			20-30 yrs			30-40 yrs			40-50 yrs			>50 yrs		
	Steel	Cast Iron	Total	Steel	Cast Iron	Total	Steel	Cast Iron	Total	Steel	Cast Iron	Total	Steel	Cast Iron	Total	Steel	Cast Iron	Total	Steel	Cast Iron	Total	Steel	Cast Iron	Total
19	2.7		2.7			0.0			0.0			0.0	2.4		2.4	0.3		0.3			0.0			0.0
25	10.7		10.7			0.0			0.0	0.6		0.6	7.9		7.9	1.9		1.9	0.3		0.3			0.0
32	24.8		24.8			0.0	0.4		0.4	5.1		5.1	6.9		6.9	7.9		7.9	4.3		4.3	0.2		0.2
38	47.7		47.7	0.1		0.1	0.6		0.6	0.3		0.3	8.5		8.5	7.1		7.1	18.9		18.9	12.2		12.2
50	254.1	84.0	338.1	7.1		7.1	1.1		1.1	21.9	6.5	28.4	93.9	8.9	102.8	74.2	66.6	140.8	43.1		43.1	12.8	2.0	14.8
63	17.8		17.8			0.0			0.0	0.4		0.4	2.6		2.6	5.5		5.5	5.6		5.6	3.7		3.7
75	103.0	11.5	114.5	18.1	0.1	18.2	5.1	0.7	5.8	7.8		7.8	29.7	2.3	32.0	33.7	4.8	38.5	5.9	0.7	6.6	2.7	2.9	5.6
100	402.2	209.4	611.6	60.5	4.0	64.5	24.3	15.7	40.0	52.8	13.1	65.9	131.4	84.4	215.8	109.5	60.9	170.4	7.9	13.7	21.6	15.8	17.6	3.1.4
125	17.9	10.3	28.2	2.1		2.1	1.1		1.1	1.2		1.2	5.9	3.9	9.8	4.4	3.0	7.4	2.9	1.0	3.9	0.3	2.4	2.7
150	244.0	273.1	517.1	43.8	3.0	46.8	52.1	16.4	68.5	31.2	47.6	78.8	27.0	103.3	130.3	81.4	64.7	146.1	6.4	20.4	26.8	2.1	17.7	19.8
200	218.5	170.3	388.8	18.4	4.0	22.4	42.6	0.8	43.4	68.8	22.4	91.2	38.3	67.5	105.8	38.1	43.7	81.8	6.4	18.5	24.9	5.9	13.4	19.3
250	44.6	41.2	85.8			0.0	1.4		1.4	21.9	2.4	24.3	5.2	6.3	11.5	13.4	4.8	18.2	0.6	5.8	6.4	2.1	21.9	24.0
275	4.8		4.8	2.1		2.1	1.5		1.5	1.0		1.0			0.0	0.2		0.2			0.0			0.0
300	266.0	247.6	513.6	9.9	3.5	13.4	15.6	8.7	24.3	128.2	60.4	188.6	64.3	72.7	137.0	36.7	70.2	106.9	4.5	19.2	23.7	6.8	12.9	19.7
325	107.9	0.3	108.2	26.5		26.5	26.8		26.8	36.0	0.3	36.3	12.7		12.7	5.9		5.9			0.0			0.0
350	4.5	2.0	6.5	0.1		0.1			0.0	2.3		2.3		1.3	1.3	0.6	0.7	1.3			0.0	1.5		1.5
400	101.8	32.7	134.5	6.9	0.1	7.0	19.2	0.5	19.7	30.1	3.5	33.6	23.0	14.0	37.0	22.3	8.1	30.4	0.3	0.3	0.6		6.2	6.2
500	46.8	17.2	64.0	8.4		8.4	10.6		10.6	19.9		19.9	5.0	5.7	10.7	2.6	9.6	12.2	0.3	1.9	2.2			0.0
600	104.2	74.8	179.0	2.8		2.8	15.4	1.2	16.6	31.9	0.8	32.7	36.0	25.9	61.9	16.0	25.9	41.9	2.1	14.1	16.2		6.9	6.9
700	30.7		30.7	7.1		7.1			0.0	2.9		2.9	14.2		14.2	6.5		6.5			0.0			0.0
800	37.0	4.0	41.0	12.1		12.1	6.5		6.5	12.5		12.5	5.8	3.3	9.1		0.7	0.7	0.1		0.1			0.0
900	2.5	17.6	20.1			0.0			0.0	0.3		0.3	2.2	9.0	11.2		2.5	2.5		6.1	6.1			0.0
1,000	94.0		94.0	8.2		8.2	8.9		8.9	20.2		20.2	39.0		39.0	17.7		17.7			0.0			0.0
1,200	161.0	0.7	161.7	4.1		4.1	29.2		29.2	20.0	0.7	20.7	89.4		89.4	18.3		18.3			0.0			0.0
1,400	90.2		90.2	5.9		5.9	3.2		3.2	25.8		25.8	54.6		54.6	0.7		0.7			0.0			0.0
1,600	11.6		11.6			0.0			0.0			0.0	11.6		11.6			0.0			0.0			0.0
1,800	3.9		3.9			0.0			0.0	1.7		1.7	2.2		2.2			0.0			0.0			0.0
Total	2,454.9	1,196.7	3,651.6	244.2	14.7	258.9	265.6	44.0	309.6	544.8	157.7	702.5	719.7	408.5	1,128.2	504.9	366.2	871.1	109.6	101.7	211.3	66.1	103.9	170.0

Photo S 3.1.4.1 Inner Surface of Removed Pipe

Photo S 3.1.4.2 Outer Surface of Removed Pipe

Although the rust on the inner surface is observed, swelling of the rust has not occurred. This means that water supplied to the City is not corrosive and inner surface of pipes is maintained relatively in fair condition. Actually, there is no water quality problem such as red water in the distribution pipe. Therefore, a value of 100 was determined as an acceptable level for distribution pipe network analysis in this Study.

Water demand to be allotted for respective nodes/off-take points

In the hydraulic analysis, water demand at peak flow was employed to respective nodes/off-take points as shown in Table S 3.1.4.3. Water losses were equally allotted to them except for hot water plants.

Table S 3.1.4.3 Water Demand Allotted to Nodes by District

District	Water Demand for Respective Nodes/Off-take Points		Water Demand for Hot Water Plant	
	Number	Water Demand/Node (m^3/h)	Number	Water Demand (m^3/h)
(Tashkent City)				
A. Ikramov	68	130	1	1,427
Bektemir	6	266		
Mirabad	48	205	1	884
M. Ulugbek	80	190	2	3,041
S. Rahimov	64	178	1	1,804
Sergeli	43	172	2	5,204
Khamza	44	262	1	1,436
Chilanzar	64	155	1	2,772
Shayhantahur	40	281	1	1,767
Yunusabad	107	124	1	4,376
Yakkasaray	37	169		
(Vicinity area)				
Kibray	4	603		
Ata	3	485		
Other vicinity towns	17	24		
Total	625	2,658,000 (m^3/d)	11	545,000 (m^3/d)

Flow/pressure control applied for specific pipelines

In the initial calculation for the existing network, any pressure control was not applied in the model, with the result that water pressure of 26 m (2.6 kg/cm^2) or larger prevailed in the most of supply zones as shown in Figure S 3.1.4.3. This result did not represent the actual inlet/outlet water pressure of booster pump station in the City. Therefore, evaluation criteria of the simulations were assumed to meet actual water pressure of booster pump stations. Because of this, during a conduct of try and error calculation, some of the pipes were closed and pressure-reducing valves were inserted in the specific pipelines in order to realize the current condition as much as possible.