(2) Status of Water Quality in Zai Treatment Plant

For the expansion of treatment plants, the current and future status of quality of water in the Zai treatment plant are investigated together with treatment methods using dosing devices.

The monthly average values of main properties of raw and treated water in the Zai treatment plant for the months from January 1994 to May 1996 are given in the table below.

Table 13 Average Properties of Water in the Zai Treatment Plant

Water properties	Raw water	Treated water
Alkalinity (mg/l)	199 - 264	157 - 216
pH value	8.06 - 8.50	7.75 - 8.10
Hardness (mg/l)	256 - 312	246 - 314
Electric conductivity (us/cm)	589 - 944	591 - 956
Total dissolved solid(mg/l)	377 - 673	378 - 612
Turbidity (NTU)	6 - 27	0.00 - 0.09
Total suspended solid (mg/l)	554 - 981	484 - 631
Total trihalomethane T-THMs (mg/l)	-	0.033 - 0.088
Fecal coliform(MPN/100ml)	142 - 2960	0.0

(* According to individual values from January 1995 to May 1996)

From the table above, the main water properties are as follows:

* The concentration of soluble inorganic salts of calcium and magnesium is high, therefore the alkalinity, pH value, hardness, electric conductivity, and TDS are all at a high level. However, all the treated water properties satisfy the water quality standards for drinking water in Jordan and are within the permissible limits.
* The variation in turbidity of raw water is large, and rather high values are attained, but the turbidity of treated water is stable and at a low level.
* The level of THM is quite high. The properties of tap water have not been measured but if the retention time is prolonged, there is a high possibility that the standards (tentative) for tap water of 0.1 mg/l will be exceeded.
* The level of fecal coliform in raw water is quite high, but almost negligible in treated water. Disinfection is adequate.
* For detecting heavy metals, tests were carried out from January 1996 to detect the presence of zinc, chrome, cadmium, cobalt and copper, but the levels of all these elements were quite low and did not pose any problem. However, compared to the maximum value of cadmium of 0.0005 mg/l according to the water quality standards, the detection limit is about 0.02 mg/l, therefore, a modification of the analytical method is recommended.

(3) Quality of Raw Water in the Future

a) Types of water sources

Raw water in the Zai system comes from three different water sources. These are surface waters from the Yarmouk river, the Tiberias lake and ground water from the Mukheiba well. According to the results of water quality investigations carried out from October 27 to December 6, 1995 and April 4 to June 26, 1996, the properties of the three types of water sources were as given below.

* Yarmouk river

The turbidity of this water source was the highest among the three types, and the variation in turbidity was also large. The level of turbidity during the investigation period was comparatively low, but it was high during rains. The alkalinity was comparatively high, but pH value, electric conductivity and TDS were at a rather low level.

* Tiberias lake

Electrical conductivity and TDS increase because of the evaporation of stored water, and are at a high level compared to other water sources. The pH value is also high but this is attributed to the photosynthetic action of seaweed. On the other hand, the turbidity is low because of the settling action. There is a high probability that planktons may breed in seaweed in the stored water.

* Mukheiba well

The alkalinity is high, but the pH value, conductivity and TDS are low in the Mukheiba well water. Turbidity is also low, and overall the quality of water is good.

b) Quality of raw water in future

The quality of raw water in the Zai system basically varies according to the proportion of water of the three water sources mentioned above. Considering turbidity investigated in the studies mentioned above, the turbidity at North Shona upstream of the intake point has a correlation with the turbidity of water at Adasiya in the Yarmouk river ($r = 0.6817$). By mixing the Mukheiba well water having low turbidity with the Tiberias lake water, the turbidity at North Shona upstream of the intake point becomes approximately 60% of the turbidity of water in the Yarmouk river. However, this turbidity is influenced considerably by the inflow water from the side wadis when rain falls.

Other properties are also influenced by the water from the Tiberias lake and the Mukheiba well. The pH value, electric conductivity, and TDS are higher and alkalinity is lower for the water at North Shona compared to the water in the Yarmouk river.

Even if the proportions of water and the turbidity of the three water sources vary considerably, a large variation in the water properties requiring a drastic change in the dosage, is not expected to occur. However, TOC and COD data for organic substances is very meager, and analysis is very difficult more so because the sampling points are not consistent, therefore the main sources of THM precursor substances are not known. However, if activated carbon is used as a measure against THM, dosing devices that inject a larger percentage of chemicals than now should be used. The judgment on the need for such equipment and expansion is entrusted to the Jordanian authorities, and is not considered in this Project. (Refer to Reference 6.)

(4) Current Status of Dosing Devices

Dosing devices installed currently in the Zai treatment plant are as given in the table below.

Table 14 Existing Dosing Devices

	Average dosage (mg/l)	Maximum dosage (mg/l)
Pre-chlorination	3	6
Intermediate chlorination	1	3
Post chlorination	0.5	1
Aluminum sulfate	10	40
Caustic soda (25% solution)	5	10
Activated carbon (powder)	2	10
Potassium permanganate	2	5
Polymer (cation)	1	2
Polymer (anion)	0.02	0.04

The monthly average dosage during January 1994 to May 1996 is given in the table below.

Table 15 Average Dosage of Chemicals

Dosing device	Average dosage (mg/l)
Post chlorination	2.27 - 4.00
Aluminum sulfate	16.24 - 22.71
Activated carbon (powder)	0.60 - 2.97
Potassium permanganate	0.77 - 3.05
Polymer (cation)	0.15 - 1.99

* Pre-chlorination and post chlorination are not being used as measures against THM.
* Caustic soda is not used because the pH value and alkalinity levels of raw water are high.
* Organic polymer (anion) is not used because it is not required for coagulation.
* Softening agents are not used because the TDS and total hardness of treated water are considerably less than the maximum values of 1500 mg/l and 500 mg/l respectively, required

by the water quality standards.

* Activated carbon is being used to eliminate foul odors.
* Potassium permanganate is used because it oxidizes organic substances and reduces the precursors of THM. The dosage is set so that a faint red color remains during jar test.
* The dosages of aluminum sulfate and organic polymer (cation) are set by the jar test carried out three times a day.
* In addition to the chemicals mentioned above, copper sulfate is also used for eliminating seaweed.

(5) Dosage of Chemicals in Future

a) Caustic soda and organic polymer (anion)

Considering the raw water quality and the high coagulation effect currently, these chemicals are not likely to become necessary in the future. Consequently, it is not necessary to install dosing devices for these chemicals.

b) Softening agent

If the target values of TDS and total hardness are to be less than the maximum values according to water quality standards in the future, it is not necessary to install dosing devices.

c) Aluminum sulfate and organic polymer (cation)

Turbidity is being kept at an adequately low level by water treatment currently. The dosages of aluminum sulfate and polymer cation was 17.10 to 27.20 mg/l and 0.35 to 1.07 mg/l respectively on days when the raw water turbidity indicated the maximum or minimum value. Almost no correlation of these chemicals was observed with raw water turbidity. Consequently, it is not necessary to change the dosage of aluminum sulfate and polymer (cation) appreciably in the future.

d) Chlorination

Since the THM in treated water may reach a considerably high level, chlorination, especially post chlorination should be carried out. However, as a measure against sudden deterioration in raw water quality, it is preferable to install pre-chlorination dosing devices. With the existing equipment, pre-chlorination is possible, and is not included in this Project.

Presently, disinfection against fecal coliform, which are indicators of disease-causing germs, is adequate. However, according to test results until 1995, some counts of heterotrophic bacteria/ml have been detected in the treated water, therefore reducing the existing chlorination dosage against THM is not recommended.

e) Potassium permanganate

Potassium permanganate oxidizes organic substances. It is likely that this chemical is dosed with the purpose of reducing the amount of THM generated, but since tests on items that become indices of organic substances are not being carried out, the effects of reduced THM cannot be quantitatively studied.

The dosage is set so that a slight red color remains during the jar test. If the dosage is increased above this level, the permanganate ions are likely to break through during treatment, therefore the dosage should not be increased above the current level.

f) Activated carbon (powder)

Activated carbon is currently introduced for eliminating foul odors, and the average maximum monthly dosage is less than 3 mg/l, therefore, it does not have an appreciable effect on reducing THM. If activated carbon (powder) is to be used for reducing THM, it is necessary to install equipment that doses a larger amount of carbon, as mentioned previously. However, the existing dosage is maintained in this Project . (Refer to Reference 6.)

(6) Treatment Method

If the treated quantity of water is to be increased by modifying the existing facilities, extensive modifications over a long period are necessary, and the stoppage time of existing facilities become prolonged. It is impractical to stop the existing water treatment plant for modifications because nearly half the demand of Amman city is being satisfied by the treatment plant. Therefore, conventional facilities should be expanded, additional facilities similar to existing facilities installed by the concept described below.

1) Design concept

a) The existing water treatment method (coagulation, settlement, rapid filtration) gives satisfactory results, and satisfactory results are anticipated for water quality in future. Moreover, the staff have become proficient in the operating the existing treatment plants, therefore, the water treatment method during the expansion stage should be the same as the existing method.

b) Changes to the dosing devices below, should be carried out as mentioned previously.

* Anion-based polymer dosing device, caustic soda dosing device and water softening equipment are not being used, and are not likely to be used in the future. They should be discarded.
* Six types of chemicals - for intermediate chlorination (dosage 3 mg/l, same units hereafter),

for post-chlorination, aluminum sulfate (40), activated carbon powder (10), potassium permanganate (5) cation-based polymer (2) are being used and need to be used in the future. The additional dosing devices for the six types of chemicals should be installed in the spaces of equipment that have been discarded, as mentioned above.

* Activated carbon dosing devices installed for eliminating foul odors are considered to be effective when used for reducing THM (trihalomethane), but are not considered for this Project. (Refer to Reference 6.)

c) Raw water regulating basins, filter basins, wash water drainage basins, clean water reservoirs and clean water tanks have adequate capacity for the Project, hence no expansion is necessary.

d) Design standards of the existing facilities should be used for all expansion facilities, buildings, machinery and equipment (mixing basins, flocculation basin, settling basin, rapid filter basin, sludge drying bed for sludge, generator building, chemicals storage building, water lift pumps, etc.) and same facilities should be added. However, the capacity of wash water and drain water return pump should be at least 10.4 m^3/min., more than two times the capacity of the existing pump (7.2 m^3/min.) and two of these pumps should be installed.

2) Facilities to be expanded

Based on the result of the investigations above, the facilities to be expanded in the Project are shown in Table 16.

Table 16 Water treatment facilities to be expanded

Facility	Description
Dosing devices	Cation-based polymer dosing pump, chlorinator and dosing devices, pumps for dosing aluminum sulfate
Coagulation/settlement equipment	Mixing basin - 1, flocculation basin - 2, settling basins 2, rapid mixers - 2, flocculators - 19, sludge extractors - 2
Rapid filtration equipment	Filter basin - 6, Filter effluent weir - 1, Wash water pump - 2, Drain recovery pump - 2
Sludge drying bed	Existing drying floor removed and 2 floors relocated
Connection pipes and drain pipes in pumping station	Additional connection pipes between raw water reservoir to rapid mixing basin and between filter basin and clean water reservoir, additional drain pipes for sludge and wash water from settling basin and filter basin
Generators and generator building	Diesel generator (250 kVA) as minimum standby power source for emergency and additional generator building
Chemicals store building	Relocation of existing chemicals store building for constructing settling basin and installation of new expansion facilities
Electrical, monitoring and control panel equipment	New electrical equipment for receiving and distributing power, and new operation control equipment for dosing devices and water treatment equipment

(7) Facilities Plan

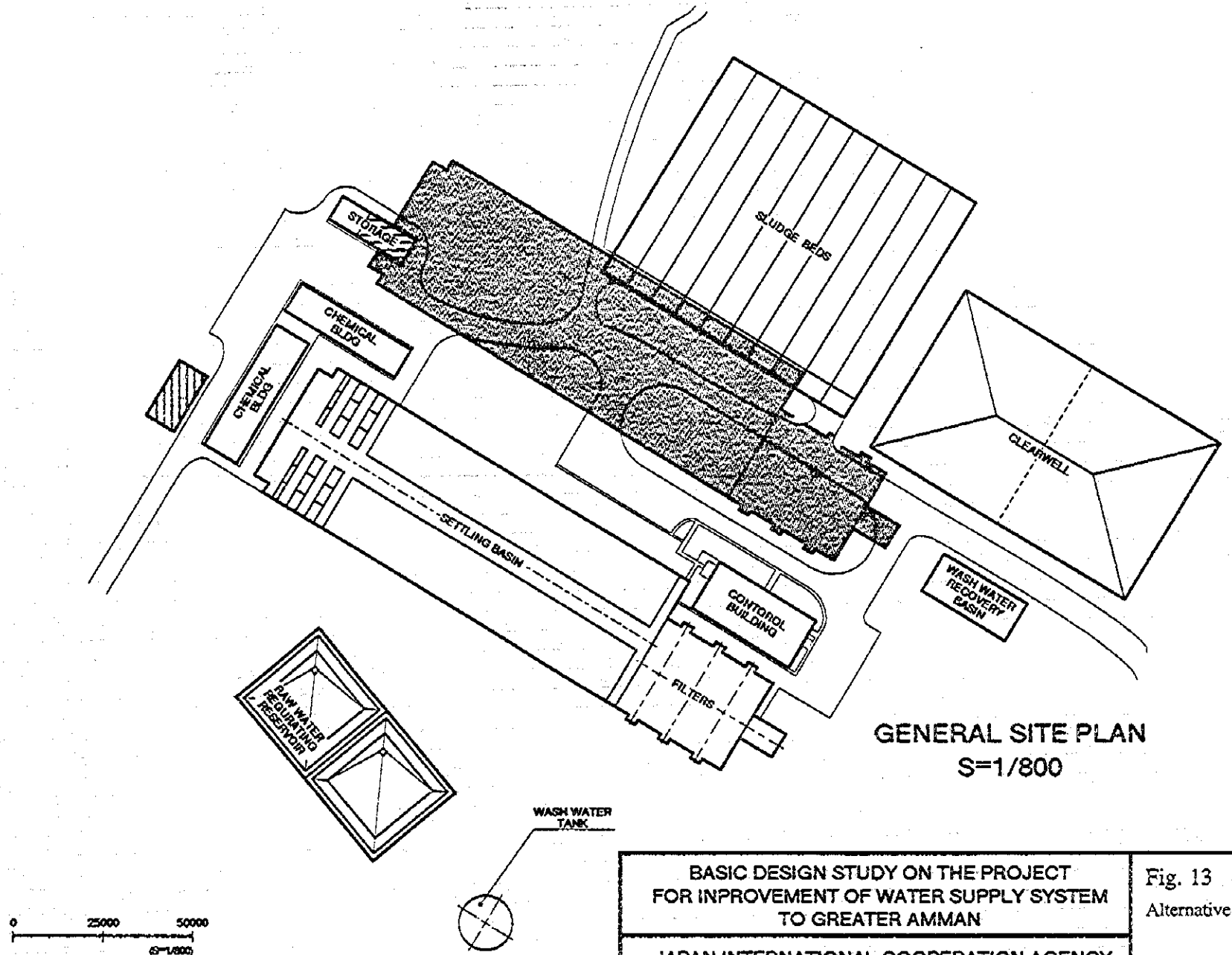
1) Layout plan

After studying the layout of expansion facilities given in Table 17 to further accommodate facilities in the empty spaces of existing treatment plants using the treatment methods described above, Alternative 1 was selected because of the reasons below.

* The management staff of the treatment plant are proficient in the operations of the plant.
* Removal/modification of the dosing building is not necessary.
* Adequate space for road for inspection and maintenance even after expansion is available.
* Construction cost of expansion facilities is economical.

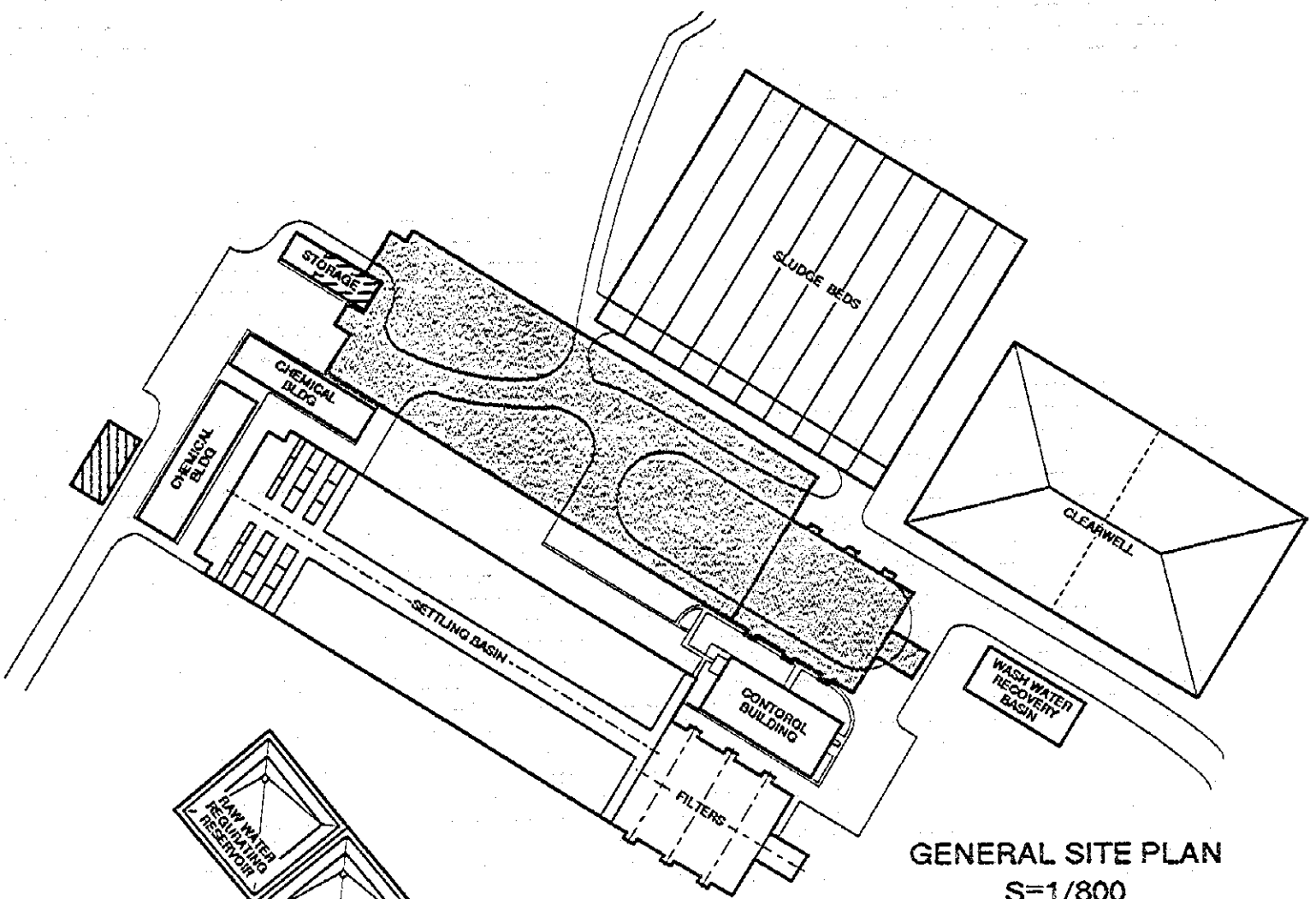
Table 17 Comparison Table of Arrangement Plans for Treatment Facilities

Item	Alternative 1	Alternative 2	Alternative 3
Conditions of arrangement plan	1) Same facilities as existing settling basin and filter basin 2) Tear down the chemicals store building	1) Same as left 2) Locate the expansion facilities adjacent to the existing facilities	1) Decrease the volume of settling basin by using inclined plates
Operations and maintenance	1) Same as existing facilities, maintenance is simpler	1) Same as left	1) Operating method of settling basin is complex compared to existing settling basin
Structures to be relocated	1) Relocation of control cables to sludge drying floor / filter basin, wash water drainage basin 2) Remove part of sludge drying floor and install two new basins in its place	1) Same as left 2) Relocation of electric room, generator room, workshop in the dosing building	1) Same as left
Stoppage period due to work	1) For a short period	1) Long period stoppage of water treatment plant necessary for moving electric panels in the dosing building	1) For a short period
Maintenance and inspection road	1) Adequate space for road for maintenance and inspection available 2) Clean water reservoir covers need to be reinforced for modifying road for maintenance and inspection by the side of the clean water reservoir	1) Difficult to construct a motorable road between main building and filter basin 2) Maintenance of settling basins is not possible because space for large vehicles to pass between basins is not available	1) Almost no space for a road between the main building and the filter basin building
Construction cost	Small	Large	Large
Maintenance cost	Small	Small	Large
Selected	O		



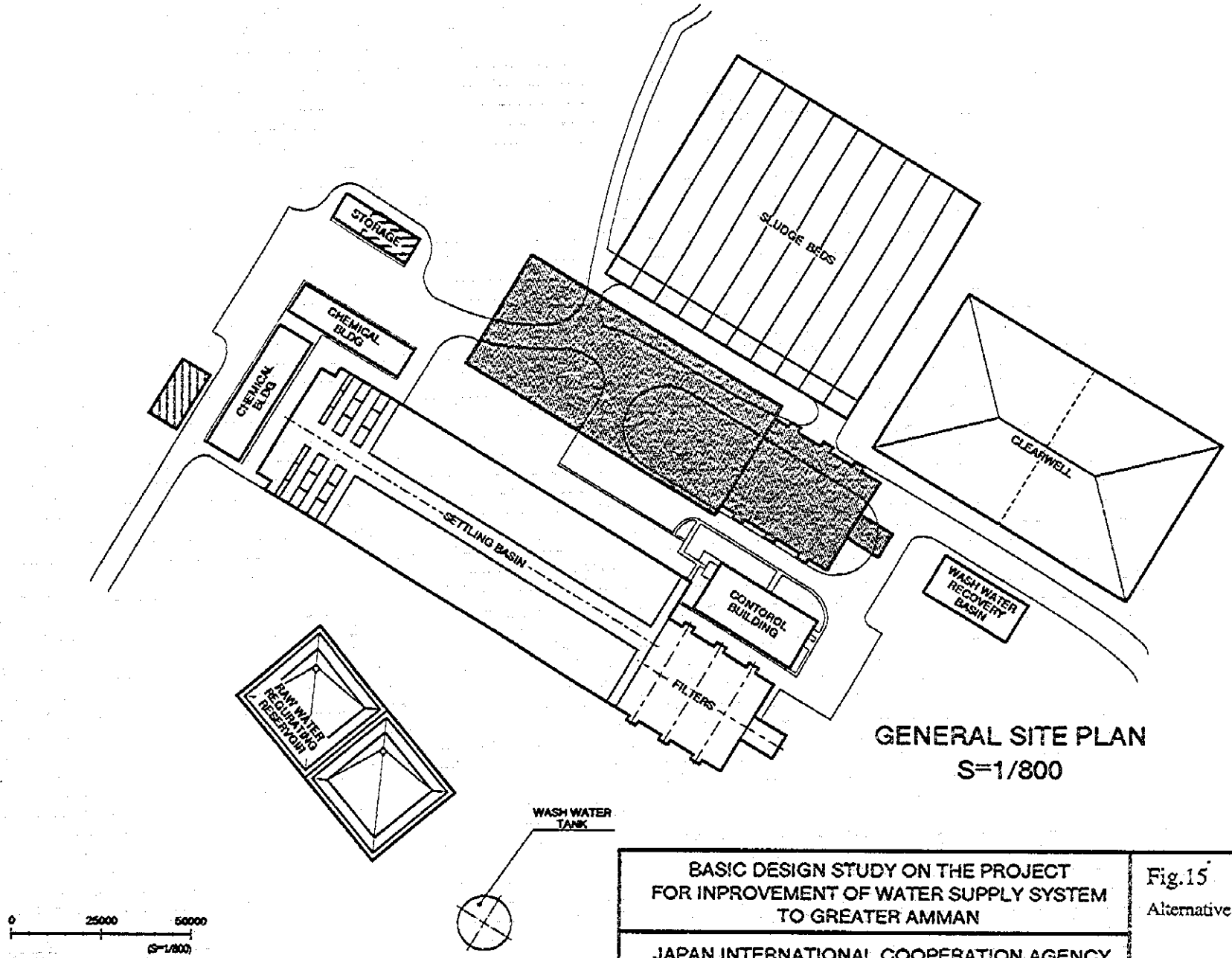
GENERAL SITE PLAN
S=1/800

BASIC DESIGN STUDY ON THE PROJECT FOR INPROVEMENT OF WATER SUPPLY SYSTEM TO GREATER AMMAN	Fig. 13 Alternative 1
JAPAN INTERNATIONAL COOPERATION AGENCY	



GENERAL SITE PLAN
S=1/800

BASIC DESIGN STUDY ON THE PROJECT FOR INPROVEMENT OF WATER SUPPLY SYSTEM TO GREATER AMMAN	Fig. 14 Alternative 2
JAPAN INTERNATIONAL COOPERATION AGENCY	



GENERAL SITE PLAN
S=1/800

BASIC DESIGN STUDY ON THE PROJECT FOR INPROVEMENT OF WATER SUPPLY SYSTEM TO GREATER AMMAN	Fig.15 Alternative 3
JAPAN INTERNATIONAL COOPERATION AGENCY	

2) Facilities plan

Following the existing water treatment method, water treatment facilities are expanded on a similar scale. All structures are arranged to present a good balance, and roads of adequate width provided for easy access to repairs and also for easy access to large vehicles for transporting materials for maintenance. Mixing basins, flocculation basins, settling basins and rapid filter basins of the same type and size are arranged.

Table 18 shows the number, size and scale of basins, structures and common facilities to be expanded.

Table 18 Expansion of Water Treatment Facilities

Structure		Existing facility	Expanded facility
Raw water regulating basin	No. of basin	2	Not expanded. Existing one used
	Size	32 m x 32 m x 5 m	-
	Volume	10,240 m^3	-
	Retention time	2 hours	1 hour
Mixing basin	No. of basin	1	Same as left
	Size	17.7 m x 2.5 m x 1.8 m	Same as left
	Volume	80 m^3	Same as left
	Retention time	1 minute	Same as left
Flocculation basin	No. of basin	2 basins x 3 sections (per basin)	Same as left
	Size	5.8 m x 18.0 m x 4.5 m	Same as left
	Volume	1,410 m^3	Same as left
	Retention time	33 分	Same as left
	Average flow rate	53 cm/min.	Same as left
Settling basin	No. of basin	2	Same as left
	Size	95 m x 18 m x 4.5 m	Same as left
	Surface load ratio	1.5 m/hour	Same as left
	Average flow rate	53 cm/min.	Same as left
Filter basin	No. of basin	6 (dual filter)	Same as left
	Size	9.6 m x 4.6 m x 2 filter media	Same as left
	Filtration area	88.32 m^3	Same as left
	Anthracite	600 mm	Same as left
	Sand	300 mm	Same as left
	Gravel	300 mm	Same as left
	Collection equipment	Nozzle-type, 868 m3/min.	Same as left
	Filtering speed	232 m/day	Same as left
Filter effluent weir	No.	1	Same as left
	Size	5.2 m x 7.5 m x 3.9 m	Same as left
	Volume	152 m^3	Same as left
	Retention time	1.83 min.	Same as left

Filter wash water basin	No.	1	Not expanded, Existing one used
	Size	26 m x 12 m x 3.95 ~5.3 m	--
	Volume	1,440 m^3	--
	Quantity from 1 filter	894 m^3	--
	Wash water return time	120 min.	60 min.
Wash water tank	No.	1	Not expanded Existing one used
	Size	16 m x 7 m	--
	Effective volume	1,410 m^3	--
	Wash water pumping	43 min. (spare pump is also	44 min.
Clean water basin	No.	2	Not expanded Existing one used
	Size	50 m x 40 m x 5 m	
	Volume	20,000 m^3	
	Retention time	3.9 hours	1.9 hours
Sludge drying bed	No.	10	Two beds relocated
	Volume	605 m2 x 10 m= 6,050 m3	605 m2 x 2 = 1,310m2
Generator, electric equipment and store house	No.	1	1
	Size	35.7 x 9.6 m	32 m x 8 m
	Area	343 m2	256 m2 RC
Chlorination, chemical store building	No.	1	1
	Size	39.6 x 9.6	25m x 8 m = 200m2
	Area	380 m2	184 m2 Store
			64 m2 Chlorination

3) Structure plan

The existing walls of the settling basin has a retaining-wall structure and the batholith has a very weak structure (bedrock of the saddle between mountains has been excavated to a depth of about 10 m, grouted with cement and the structure placed thereon). Results of soil surveys showed that the supporting bedrock for the settling basin to be expanded, is 6.5 m above the ground surface at the upstream end of the settling basin, and 7m at the downstream end. The batholith of the settling basin is 5.3 m from the ground surface, and does not reach the bedrock. Consequently, the batholith foundation is to be stabilized by broken stones and by using rigid frame construction for the settling basin in order to prevent chafing and unequal settlement of the bedrock.

The treatment plant (and the pumping station) is located in the Jordanian fault zone, therefore the seismic forces need to be considered. The settling basin and the filter basin are underground structures, therefore the effect of the seismic forces is small, but buildings are above-ground structures and the effect of the seismic forces is large. The existing buildings of the pumping station and the treatment plant comply with the Uniform Building Code, Zone 4, seismic coefficient 0.4, therefore the columns and beams are massive structures. Accordingly, for the design, the standard design level seismic coefficient is taken as 0.2, based on Japanese Road and Bridge Construction Standards, and the conditions of the foundation, and other important

correction coefficients are considered separately for seismic design.

(8) Machinery and Equipment Plan

Water treatment machinery and equipment for this Project can be broadly divided into dosing devices, water treatment equipment and electric/monitoring and control equipment. The description of machinery and equipment for the expansion is given below.

1) Dosing devices

Since there are chemicals not currently used and dosing points have been changed, plans for equipment and pipelines for this Project are based on the conditions below, after considering automatic dosing methods proportional to the flow rate.

a) Aluminum sulfate

Introduced in the mixing basin. Two dosing devices are used presently; two new dosing devices and two new pumps are to be installed.

b) Cation-based polymer

Pipelines are to be installed so that the polymer can be introduced as a coagulant aid in the settling basin effluent weir also before dosing aluminum sulfate, for micro-flocculation of fine particles. Only two new pumps are to be installed for dosing the settling basin effluent weir.

c) Chlorination

Intermediate chlorination (settling basin effluent weir), post chlorination (filter basin discharge pipe) and supplementary chlorination (clean water basin discharge pipe) are to be carried out but not pre-chlorination. Three chlorinators are used presently; these should be used for intermediate chlorination and post chlorination/ supplementary chlorination for one system. New facilities will include two dosing devices and vaporizers. Dosing for intermediate chlorination and post chlorination will be carried out.

Based on the plan above, the equipment to be newly installed are listed in Table 19.

Table 19 Dosing Equipment Provision Plan

Dosing equipment	Existing Equipment	Expanded Equipment
Potassium permanganate for raw water regulation basin	Hopper, feeder, dosing pump 1 each	-
Activated carbon for raw water regulation basin, prior to mixing basin, settled water	Hopper, feeder, dosing pump 1 each	-
Aluminum sulfate for mixing basin	Hopper, feeder, dosing pump 2 each	Same as left
Polymer coagulant (cation) prior to mixing basin	Solution tank 1, Storage tank 1 Dosing pump 2	Dosing pump 2
Polymer coagulant (Anion) for settled water	Solution tank 1, Storage tank 1 Dosing pump 2	Used for cation
Caustic soda	Softener, Dosing pump 2 Nos. each Storage tank 1 No.	No use
Chlorination	Chlorinator (37.5kg/h), 3 Nos. Vaporizer, 2 Nos.	Chlorinator (40kg/h), 2 Nos.

2) Water treatment machinery and equipment

New machinery and equipment (rapid mixer, flocculator and settling basin sludge extractor) to be installed in the mixing basin, the flocculating basin, settling basin and rapid filter basin will be of the same grade as the existing machinery and equipment.

The existing flocculator is a vertical-axis type but generally, the mixing effect is not always satisfactory compared to the horizontal-axis type flocculator. However, the settling effects are currently satisfactory, and considering the convenience of the operators and maintenance staff, vertical-axis type flocculators, same as the existing ones should be used.

Existing sludge extractors are pump suction type extractors. Since the turbidity of raw water is low, the amount of aluminum sulfate used is about half the independent dosage of aluminum sulfate by dosing polymer coagulant. Consequently, the sludge generated is reduced, and a pump suction type sludge extractor can be used. This situation is not expected to change in the future, therefore the same type of sludge extractor should be used in the future.

The dual-layer filtering method using anthracite and sand can filter water at high speed, developed in the USA. In most cases, the filtering speed is 15 m per hour (single layer filtering method using sand gives about 5 to 6.25 m/hour in Japan). For the same continuous filtration time, the particle diameter in the filter layer should be increased and the filter layer should have a larger thickness in order to maintain the high filtering speed. The table below shows the comparison of the US facility and the Zai water treatment plant.

Table 20 Comparison of Filtering Materials

Item		US example	Zai treatment plant
Anthracite		1.1 - 1.2mm	0.99m
		760mm	600mm
Sand layer	Particle diameter	0.6mm	0.55mm
	Layer thickness	300mm	300mm
Filtering speed		15m/hour	9.83m/hour

The capacities of the wash water pump and wash water drain recovery pump are determined based on the operating conditions of the filter basin.

Table 21 shows the machinery and equipment to be newly installed according to the plan described above.

Table 21 Water Treatment Machinery and Equipment Plan

Equipment	Specifications of equipment	Quantity
Rapid mixer	No.1 : Vertical paddle type, made of stainless steel	1
	No.2 : Vertical paddle type, made of stainless steel	1
Flocculator	No.1 : Vertical vortex type, made of stainless steel	6
	No.2 : Vertical vortex type, made of stainless steel	6
	No.3 : Vertical vortex type, made of stainless steel	6
Sludge extractor	Type : Portable sludge pump, max. speed: 3 m/min., minimum speed: 0.3 m/min. Sludge pump 340 l/min. x 5 m Cable winding method: Drum type	2
Filter basin wash water pump	Type: Vertical type pump, diameter 300 mm x pumping capacity 8.4 m^3/min. x head 20 m	2
Filter basin wash water drain recovery pump	Type: Vertical type pump, diameter 300 mm x pumping capacity 10.5 m^3/min. x head 22 m	2
Sampling pump	At 4 locations - raw water, filtered water (collector), post chlorination and treated water Pump type: Centrifugal, diameter 25 mm x capacity 80 l/min. x head 15 m	4

3) Electric/ monitoring and control equipment

Existing water treatment facilities have been constructed with US aid, and the entire water treatment plant is built according to the US style, adopting the central monitoring and remote operation system. The intake/conveyance pumping stations are remotely operated/ controlled from the treatment plant while monitoring the water level in the raw water regulating reservoir. Changes in dosage in the treatment plant, changeover of pump operations in the plant, and operation of sludge extractors are also controlled from the control panel of the central control

room. The washing of the filtering basin is incorporated in the wash process sequence and is carried out automatically every 12 hours.

These equipment are sophisticated, but considering the balance of existing facilities and technical level of the staff, maintenance of the equipment can be carried out by the staff, therefore, equipment with the same concepts should be used for the expansion portion.

Plans for electric power receiving and distribution equipment for operating the dosing devices, treatment equipment, pumps and filter basin power valves, operation monitoring and control panel equipment for various pumping stations and treatment plants, and diesel generators used as standby power sources for operation monitoring and control equipment and filter basin operation panels are based on the conditions given below.

Power is currently being received at two locations - dosage and coagulation/ sedimentation basin equipment system and filter basin equipment /maintenance building system, and each system supplies power after reducing the voltage to various other machinery and equipment. For the expansion facilities, the dosage and coagulation/ sedimentation basin equipment system and filter basin equipment /maintenance building system should be integrated to a single system for receiving power.

The control and telemetry equipment for pumps installed in the Zai system should be renewed because the automatic control functions of pumps need to be changed. The operators have become proficient in operating the monitoring and control system of the water treatment plant using the currently installed graphic panels therefore, the existing system should be incorporated in the expansion facilities. However, the function of generating automatic operation reports (daily reports) should be incorporated and existing equipment used during the expansion stage.

As minimum safeguards against power failure, a diesel generator (capacity 250 kVA, together with fuel tank and hoist crane as accessories) should be newly installed. The generator loads are rapid mixers, flocculators, filter basin valves, dosing devices (aluminum sulfate, polymer, chlorination), measuring equipment and emergency power supply.

Based on the plan above, the equipment to be newly installed are given in Table 22.

Table 22 Electric / Monitoring and Control Equipment Provision Plans

1. Special High Power Receiving Equipment

Equipment	Specifications	Quantity
Disconnecting switch	Outdoor type, manually operated, 36 kV, 400 A	1 set
Power fuses	36 kV, 400A	1 set
Lightning arrestor	Outdoor type	1 set
Transformer	Oil immersed, outdoor type, 500 kVA, 3-phase, 33 kV/ 380-220 V	1
L.T. main panel	Metal-enclosed, self-standing outdoor type	1
Wire, cables		1 set

2. Emergency Generator Equipment

Equipment	Specifications	Quantity
Diesel engine-driven generator	Air cooled, 250 kVA, 380-220 V, 50 Hz	1
Automatic starter panel	Metal-enclosed self-standing outdoor type	1
Fuel tank	Underground type, 2000 liters	1
Small fuel tank	Outdoor type, 195 liters	1
Fuel oil pipes		1 set
Wires, cables		1 set

3. L.T. Power Equipment (For System 1)

Equipment	Specifications	Quantity
Power panel	Metal-enclosed, self-standing outdoor type	1 set
Control center	〃	1 set
Distribution panel	〃	1 set
Auxiliary relay panel	〃	1 set
Site operation panel (for pumps)	Metal enclosed, stand-type	1 set
Wires, cables		1 set

4. L.T. Power Equipment (For System 2)

Equipment	Specifications	Quantity
Power panel	Metal-enclosed, self-standing outdoor type	1 set
Control center	〃	1 set
Distribution panel	〃	1 set
Auxiliary relay panel	〃	1 set
Site operation panel (for pumps)	Metal enclosed, stand-type	1 set
Wires, cables		1 set

5. L.T. Power Equipment (Others)

Equipment	Specifications	Quantity
Filter basin operation panel	Metal enclosed, indoor, desk type	1
Filter basin site operation panel	Metal enclosed, outdoor, self-standing type	1 set
Dosing device site operation panel	Metal-enclosed, stand-type	1 set
Flow regulating valve site operation panel	〃	1 set
Uninterrupted power equipment	Metal-enclosed, self-standing, outdoor type	1
Wires, cables		1 set

6. Control Equipment

Equipment	Specifications	Quantity
Central monitoring and control panel	metal-enclosed self-standing type with graphic panel	1 set
Instrumentation	detector, signal transmitter, indicator, regulator, integrator, and warning devices for expanded treatment plant	1 set
Wires, cables		1 set

7. Illumination Equipment

Equipment	Specifications	Quantity
Distribution panel	Metal enclosed, indoor, hanging type	1
Lighting devices	Fluorescent lamps	1 set
Lighting devices	Mercury lamps, outdoor ball-shaped	1 set
Wires, cables		1 set

8. Electric Corrosion-Preventing Equipment

Equipment	Specifications	Quantity
Rectifier panel	Metal-enclosed, outdoor, self-standing type	1
Anodes		1 set
Wires, cables		1 set

9. Control And Telemetry Equipment For Pumping Station (Zal Control Room) Equipment

Equipment	Specifications	Quantity
Graphic control panel	Metal-enclosed, indoor, self-standing type	1 set
Control and telemetry equipment (with automatic control functions)	〃	1 set
Signal I/O panel	〃	1
Data logger	Preparation of daily reports, desk-type (with functions for water treatment plant)	1 set
Modified existing VHF telephone		1 set
Wires, cables		1 set

(9) Building Plan

Building facilities include those already mentioned in the facilities plan of (7), and include generator/ electric/ store buildings in the water treatment plant, chlorination room and chemicals store building. From these, the store building is to be relocated to the store building that has been torn down, and other buildings are to be newly constructed as expanded facilities. The grade of buildings to be relocated or newly built should be the same as the grade of existing buildings.

	Function	Dimensions (m)	Area (m2)	Basis for size and area
Generator/ electric / store building		32 x 8	256	
Generator room	Room for additional generator	7 x 8	56	Equipment size, maintenance and inspection space (same area as existing generator room)
Electric room	Room for additional electric equipment	10 x 8	80	Equipment size, maintenance and inspection space
Store building	Relocation of existing store	15 x 8	120	Same as the existing one
Chlorination room / chemicals store building		25 x 8	200	
Chlorination room	For additional chlorination equipment	10 x 8	80	Equipment size, maintenance and inspection space (same area as existing room)
Chemicals store building	For additional chemicals store	15 x 8	120	Same area as existing facility

2) Cross section area plan

Since no functional problems have been found in the cross section dimensions in the existing electric/ chemicals building, the cross section dimensions should be the same as the existing dimensions (height 3.5 m, 4.6 m).

3) Structural plan

Design loads should be estimated based on self weight, loading weight, and wind loads according to the Japanese Construction Standards. Earthquakes are likely to occur in Jordan. Existing structures are based on the seismic coefficient (0.4) of the USA, however this figure is too high. For the buildings under study, the coefficient should be based on the building standards of Japan. The foundation should be a reverse-T independent mat foundation, and the foundation, columns, walls, slabs should be made of reinforced concrete.

4) Equipment plan

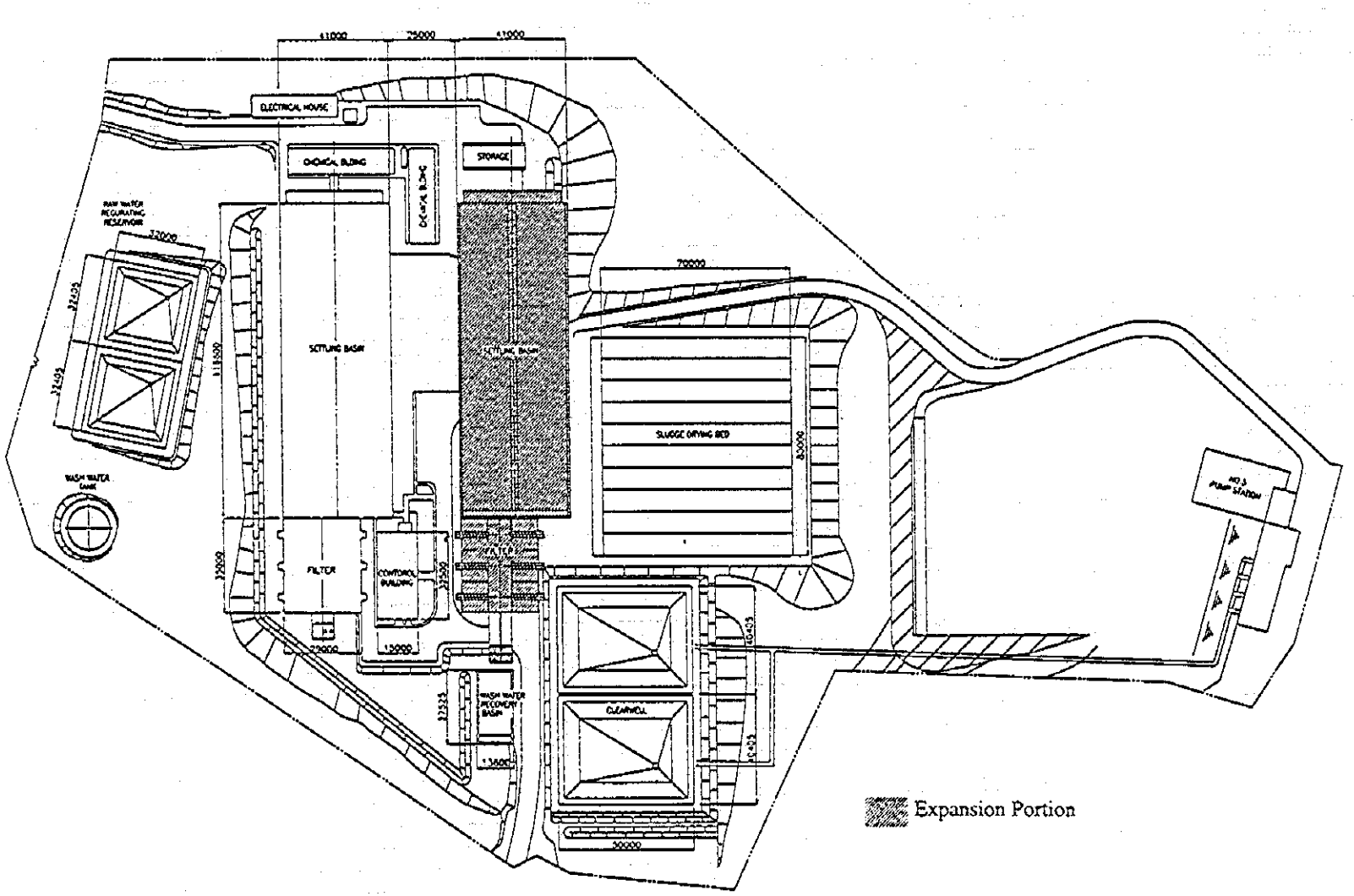
General illumination equipment, water supply equipment, and drying equipment should suit the shape and functions of each room.

5) Building material plan

Member	Finishing plan	Reasons for selection
Roof	Waterproof asphalt	Commonly used at the site
Inside and outside walls	Emulsion paint finish	Same as existing buildings
Floor	Concrete with trowel finish	Generally used in chemicals store, storehouse, electric room
Fittings	Aluminum sash windows, steel doors	Same as existing buildings

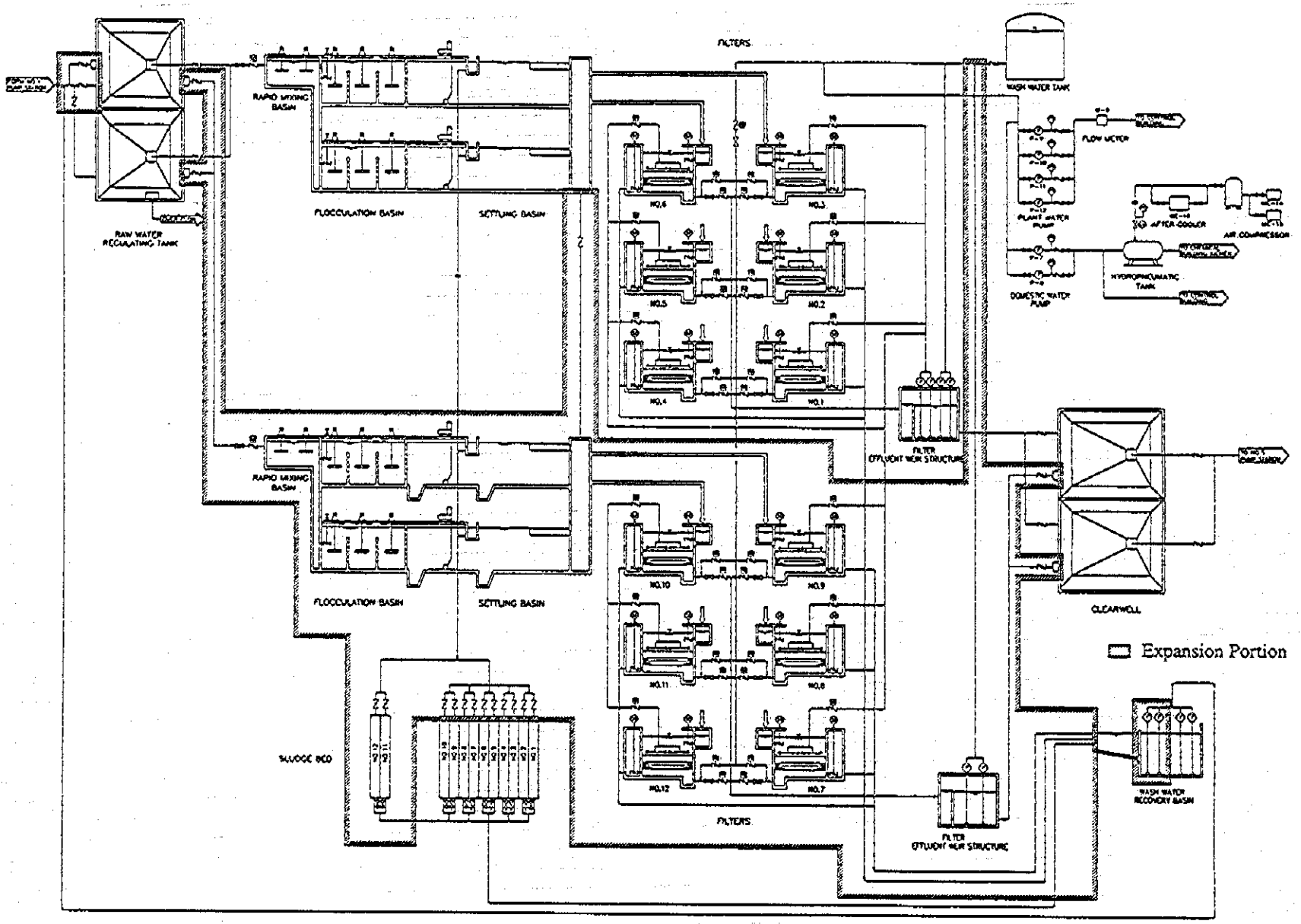
(10) Basic Drawings

Fig. 16 Treatment plant floor plan
Fig. 17 Treatment plant equipment systems diagram (Treatment facilities)
Fig. 18 Treatment plan equipment systems diagram (Dosing devices)
Fig. 19 Treatment plant equipment systems diagram (Chlorination equipment)
Fig. 20 Treatment plant dosing building
Fig. 21 Treatment plant single line wiring diagram
Fig. 22 Treatment plant central control room panel arrangement
Fig. 23 Conveyance/ delivery system control and monitoring equipment



GENERAL SITE PLAN

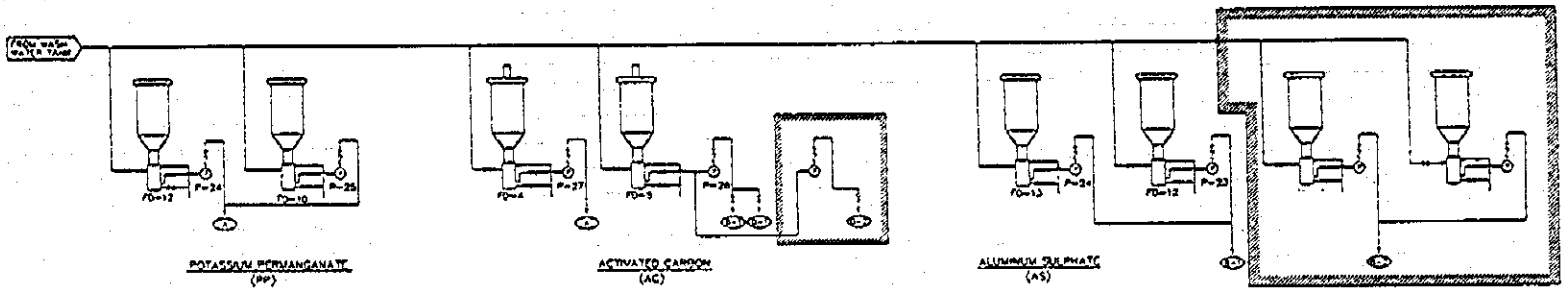
BASIC DESIGN STUDY ON THE PROJECT FOR INPROVEMENT OF WATER SUPPLY SYSTEM TO GREATER AMMAN	Fig. 16 Treatment plant floor plan
JAPAN INTERNATIONAL COOPERATION AGENCY	

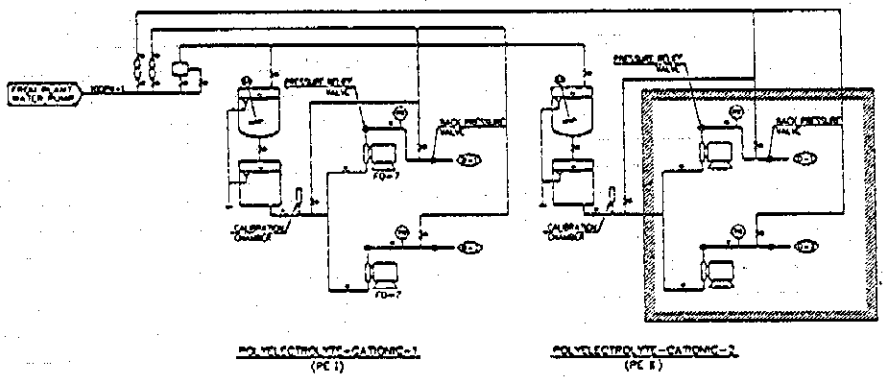


BASIC DESIGN STUDY ON THE PROJECT
FOR INPROVEMENT OF WATER SUPPLY SYSTEM
TO GREATER AMMAN

JAPAN INTERNATIONAL COOPERATION AGENCY

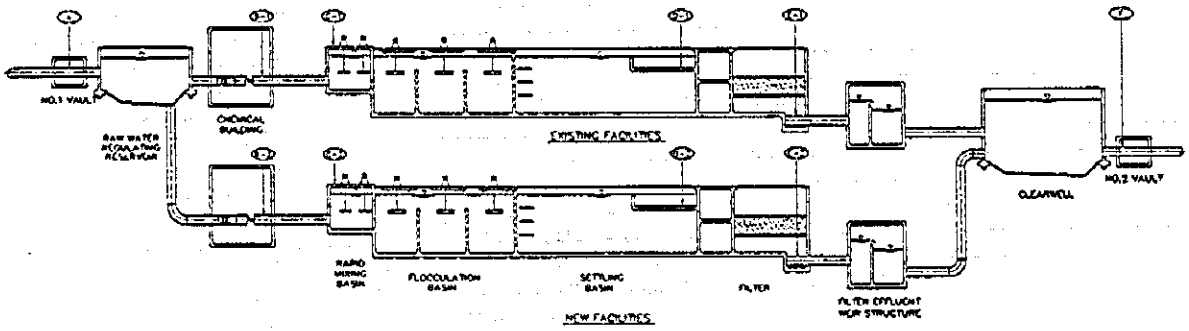
Fig. 17
Treatment plant equipment systems diagram
(Treatment facilities)





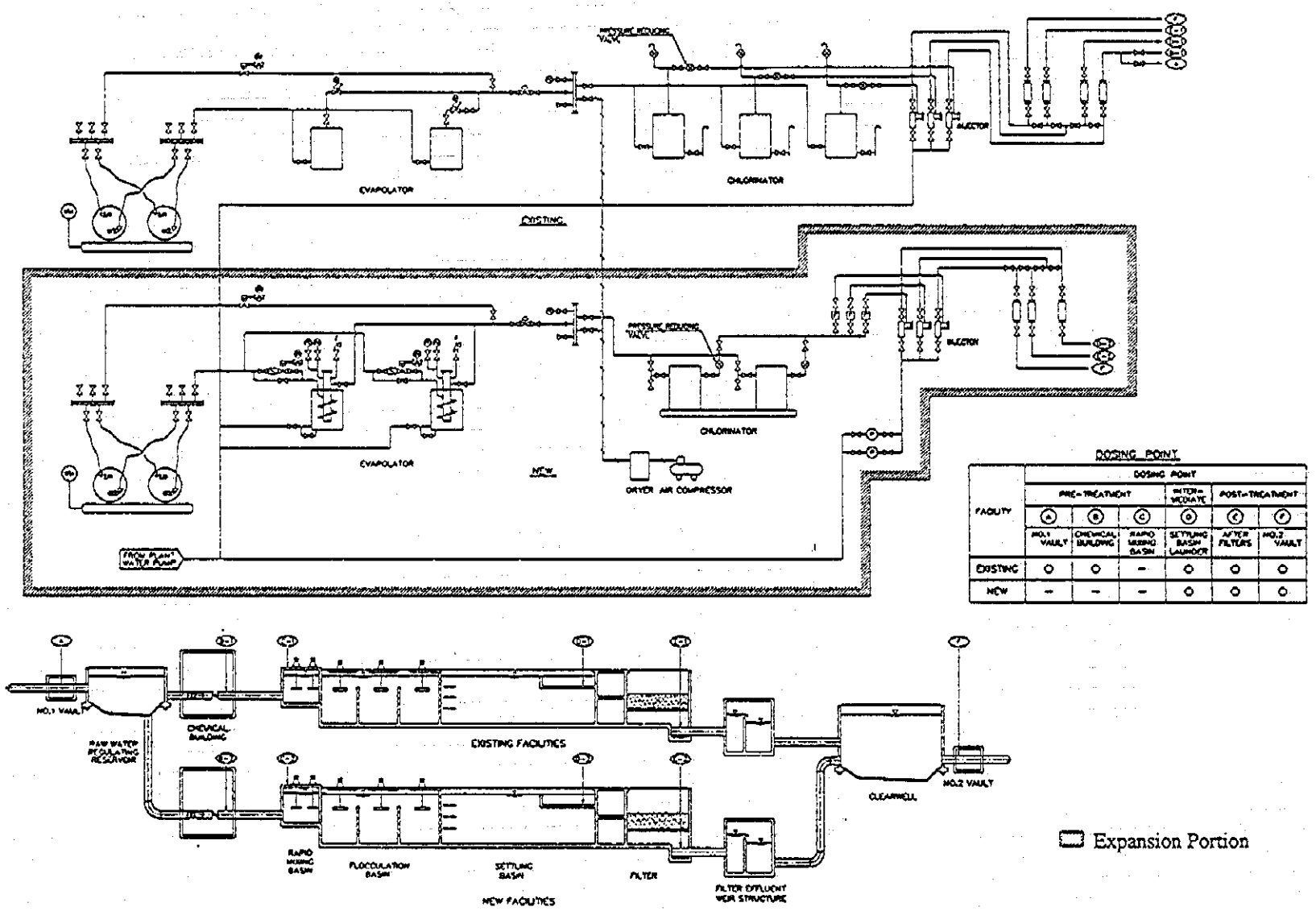
DOSING POINT

CHEMICAL	DOSING POINT					
	PRE-TREATMENT			INTER-MEDIATE	POST-TREATMENT	
	ⓐ	ⓑ	ⓒ	ⓓ	ⓔ	ⓕ
	NO.1 VAULT	CHEMICAL BUILDING	RAPID MIXING BASIN	SETTLING BASIN LAUNDER	AFTER FILTERS	NO.2 VAULT
PP	○	–	–	–	–	–
AC	–	–	–	○	–	–
AS	–	–	○	–	–	–
PE-1	–	○	–	–	–	–
PE-2	–	–	–	○	–	–



Expansion Portion

BASIC DESIGN STUDY ON THE PROJECT FOR INPROVEMENT OF WATER SUPPLY SYSTEM TO GREATER AMMAN	Fig. 18 Treatment plan equipment systems diagram (Dosing devices)
JAPAN INTERNATIONAL COOPERATION AGENCY	



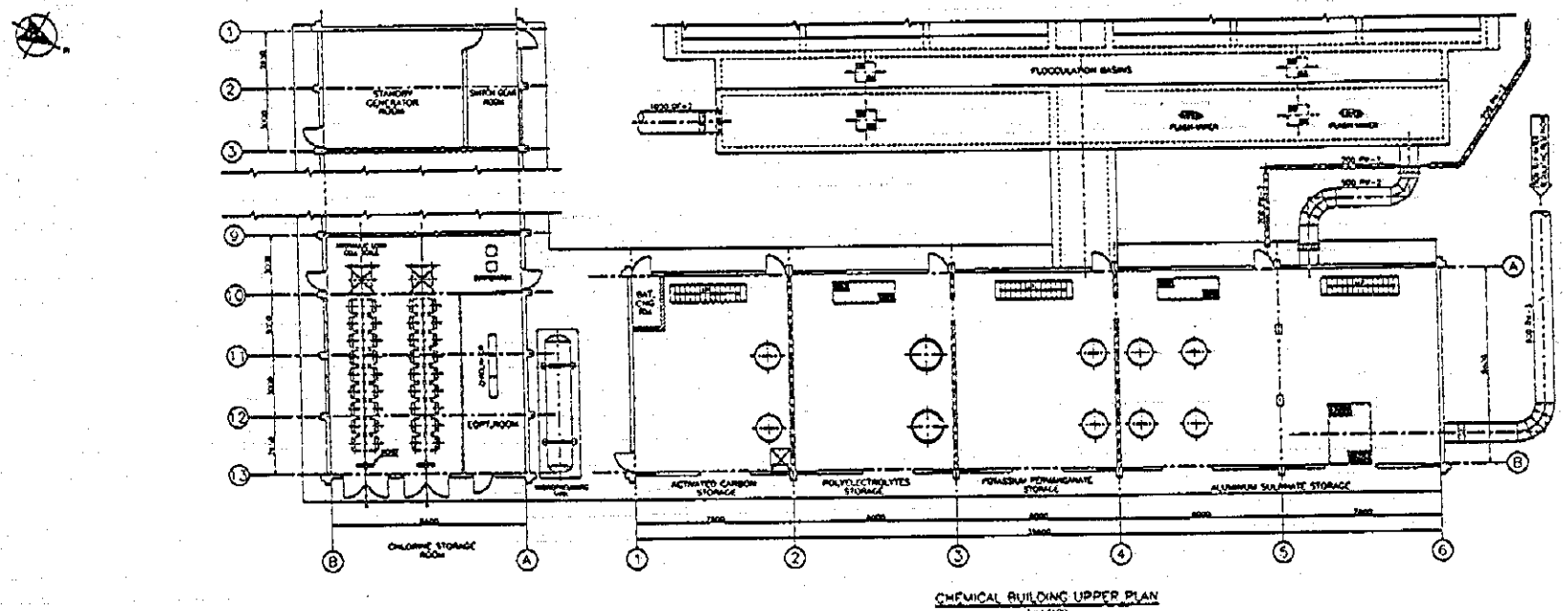
DOSING POINT

FACILITY	DOSING POINT					
	PRE-TREATMENT			INTER-MEDIATE	POST-TREATMENT	
	①	②	③	④	⑤	⑥
	NO.1 VAULT	CHEMICAL BUILDING	RAPID MIXING BASIN	SETTLING BASIN LAUNDER	AFTER FILTERS	NO.2 VAULT
EXISTING	○	○	–	○	○	○
NEW	–	–	–	○	○	○

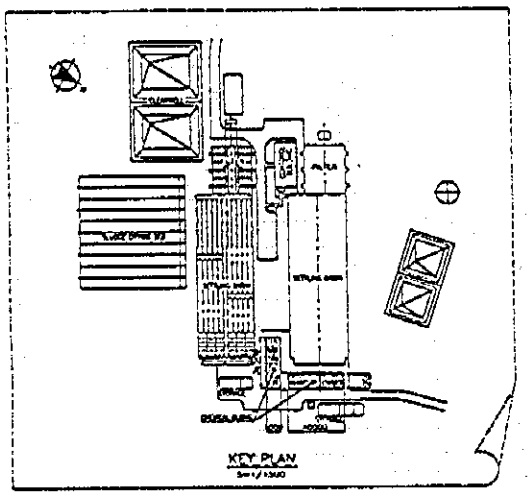
BASIC DESIGN STUDY ON THE PROJECT
FOR INPROVEMENT OF WATER SUPPLY SYSTEM
TO GREATER AMMAN

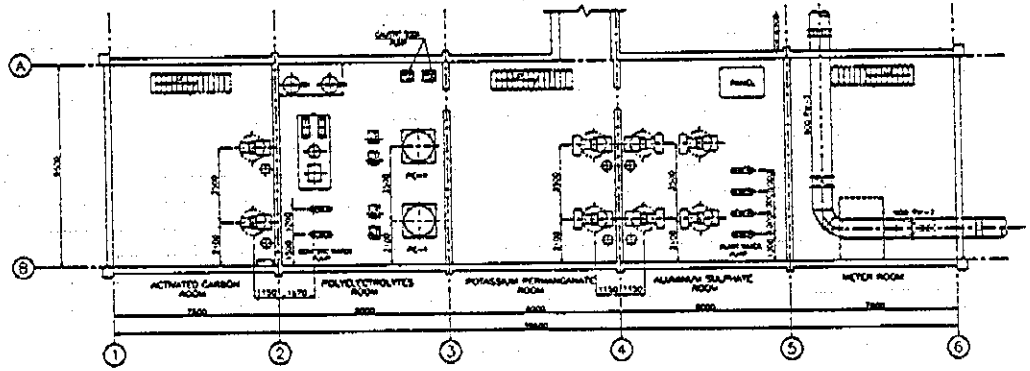
JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 19
Treatment plant equipment systems diagram
(Chlorination equipment)



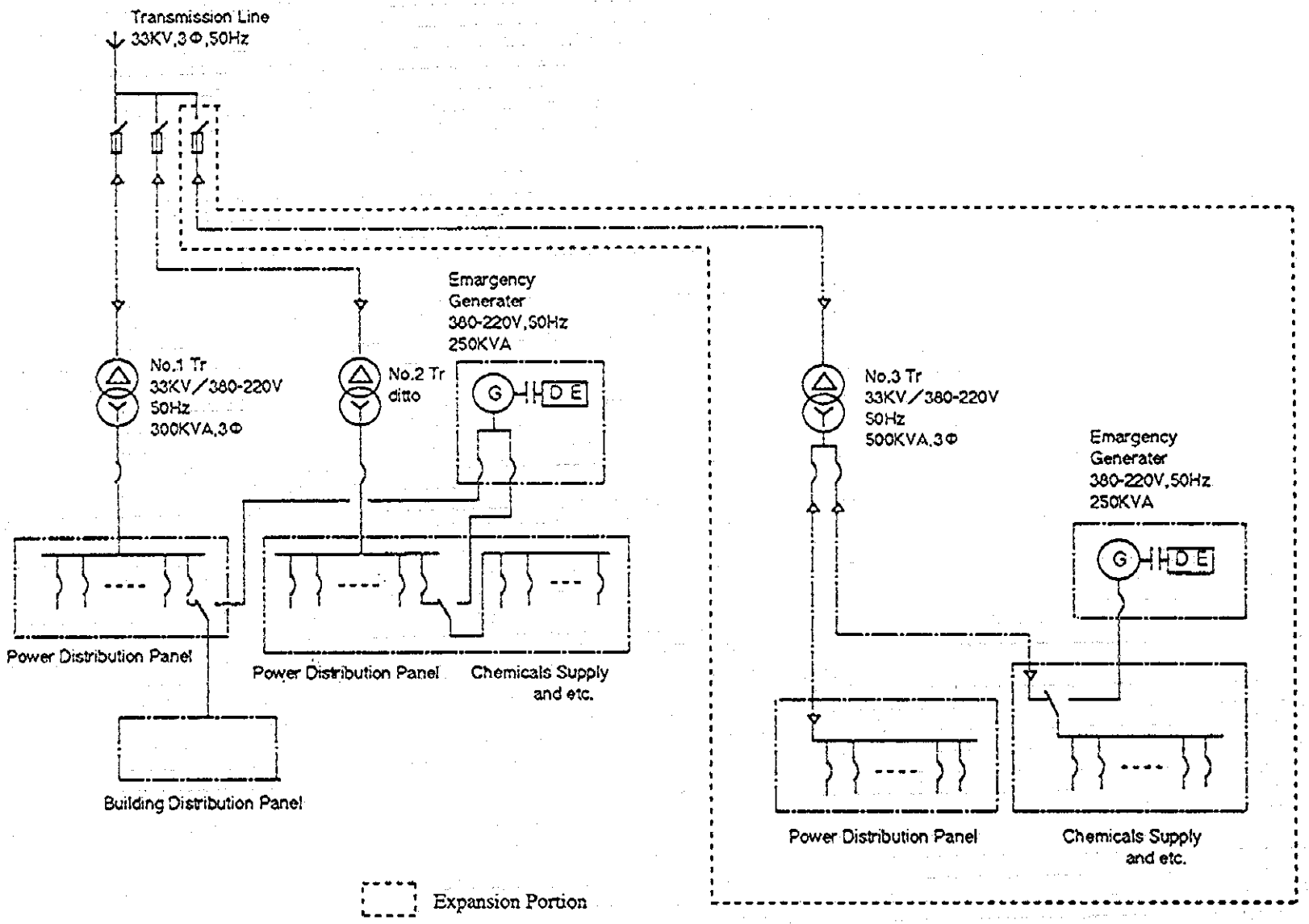
CHEMICAL BUILDING UPPER PLAN





CHEMICAL BUILDING LOWER PLAN

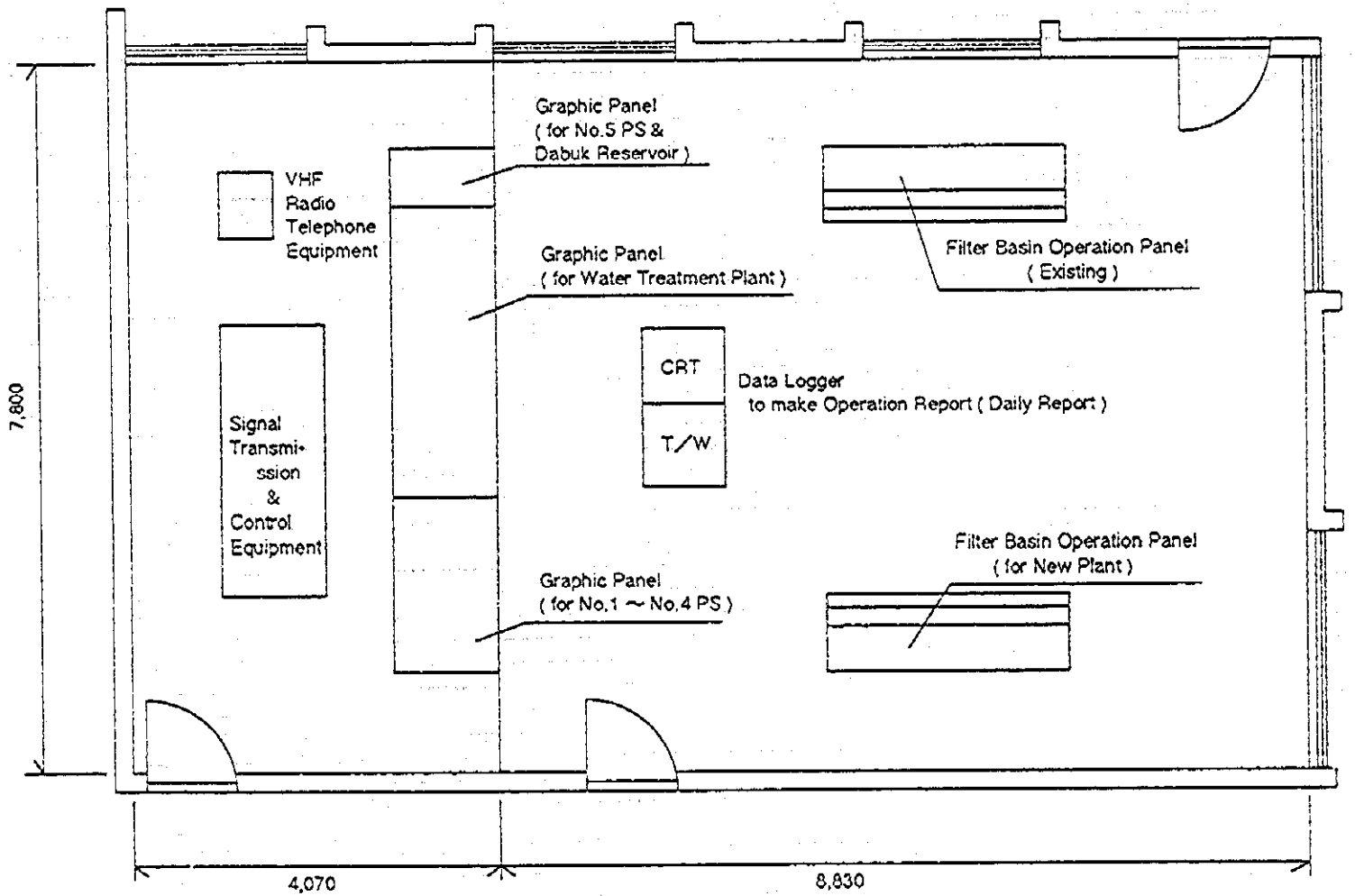
BASIC DESIGN STUDY ON THE PROJECT FOR INPROVEMENT OF WATER SUPPLY SYSTEM TO GREATER AMMAN	Fig. 20 Treatment plant dosing building
JAPAN INTERNATIONAL COOPERATION AGENCY	



BASIC DESIGN STUDY ON THE PROJECT
FOR INPROVEMENT OF WATER SUPPLY SYSTEM
TO GREATER AMMAN

JAPAN INTERNATIONAL COOPERATION AGENCY

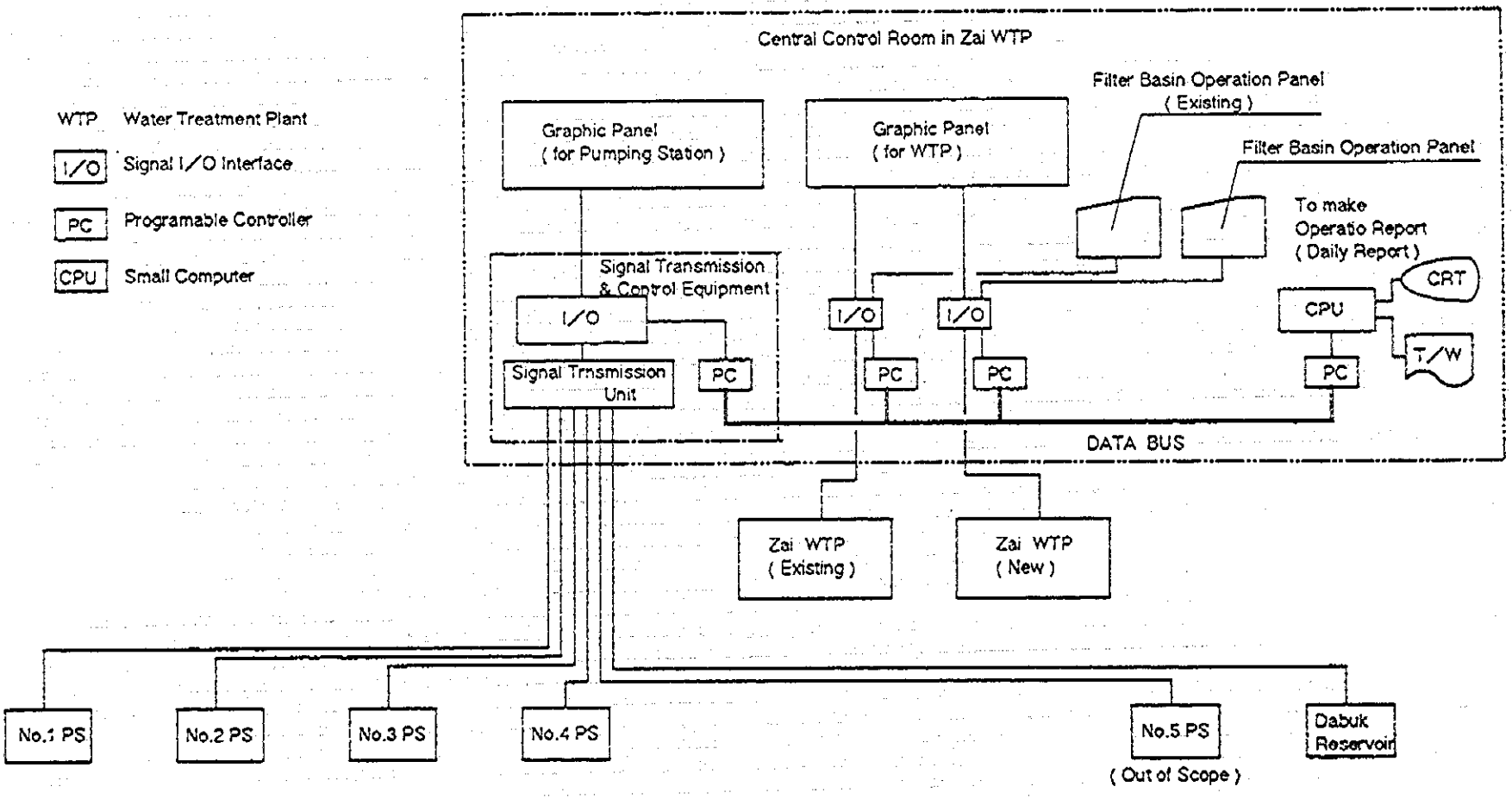
Fig. 21
Treatment plant single line wiring diagram



BASIC DESIGN STUDY ON THE PROJECT
FOR INPROVEMENT OF WATER SUPPLY SYSTEM
TO GREATER AMMAN

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 22
Treatment plant central control room panel arrangement



BASIC DESIGN STUDY ON THE PROJECT FOR INPROVEMENT OF WATER SUPPLY SYSTEM TO GREATER AMMAN

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 23
Conveyance/ delivery system control and monitoring equipment

Chapter 3
Implementation Plan

Chapter 3 Implementation Plan (Rehabilitation Portion)

3.1 Implementation Plan

3.1.1 Implementation Concept

For improving an inadequate capacity of the existing pumps, the basic design of the Project thoroughly considers the natural conditions, social conditions, construction status, current status of fund procurement and current status of maintenance and control. The main points in the design for the rehabilitation of pumping stations are summarized below.

(1) Policies with respect to social condition

Night work will not be conducted taking into account of the public order generally. When night work cannot be avoided, the procedures will be planned carefully.

(2) Policies with respect to construction procedure

Japanese engineers will be deployed on this Project which consists of removing existing pumps (one at each pumping station, PS.1 - PS.4), foundation works for new pumps and new transformers, installation of new pumps and transformers, and related electrical works. Also, local construction companies have experiences with general construction works, therefore, it is possible for them to work as sub-contractors.

(3) Effective utilization of local resources

Effective utilization of local resources lowers the project expenses to a minimum and also satisfies the economic results anticipated by the aid donor countries. Almost all resources for the construction are available in Jordan.

(4) Utilization of local construction machines

Construction machines are available, similar to (3) above. The main construction machines such as crane, drag shovels, etc. are available locally and can be used.

(5) Policies with respect to construction period

The main work in this Project is a replacement of the pumps (one pump at each pumping station; PS.1 - PS.4). From the nature of the work, splitting the construction period has no meaning. Therefore, two parties of personnel are formulated for the work to complete the work by March 1998, starting in April 1997.

(6) Total discharging amount of water from pumping stations during the works

During the pump replacement works, the existing three pumps at each pumping station shall be fully operated to ensure the 75 % of total discharging amount to Zai Water Treatment Plant.

3.1.2 Implementation Condition

(1) The terrain around the sites is steep and narrow. Therefore, transportation and handling large size of equipment shall be planned well before starting works.

(2) It is reported that the soil around the site is acid. Sulfate resisting cement is recommended for underground structure.

(3) Each pumping station site is limited in space and stand at hilly space. The access road for installing high voltage transformers shall be constructed at pumping station No.2 & 3.

(4) In summer season, air temperature reaches around 40 centigrade around the sites. The concrete placement and growing methods shall be considered carefully.

(5) Construction machines for the project are available in Jordan.

3.1.3 Scope of Works

The scope of works implemented by the Japanese and Jordanian sides is as follows,

(1) Japanese Side

1) Removal of existing pumps (One at each pumping station, four pumps in total)
2) Foundation works for pumps and high voltage transformers
3) Procurement and Installation of four pumps and high voltage transformers
4) Related electrical cabling and piping works
5) Reform of existing electrical room at each pumping station
6) Construction of access road in the sites for transporting high voltage transformer
7) Procurement of two pumps for stand-by

(2) Jordanian Side

Expansion of 33KV Transmission System to pump stations (Refer to item 4, page 12, Minutes of Discussion), JD 1.3 million

Electric power to Zai system (Intake pump station, No.1 ~ 4 pump station, Zai water treatment plant, and No.5 pump station) is supplied by 33KV transmission line (2 lines of Line A and Line B) by National Electricity Power Company (NEPCO).

Electric power demand after the Rehabilitation and the Expansion are estimated as following table.

Item	Line A	Line B	Note
Supply to	Intake PS No.1 PS, No.2 PS	No.3 PS, No.4 PS Zai treatment plant No.5 PS	After the expansion, Deir Alla intake PS will be closed.
Existing (For reference)	11MVA	15	Actual power after the 38 MCM/year
Rehabilitation	16	21	Estimated power after the 45 MCM/year
Expansion (For reference)	27	43	Estimated power on 90 MCM/year

3.1.4 Consultant Supervision

A construction and supervision plan is formulated to ensure that the rehabilitation work of the pumping stations is carried out satisfactorily under the Japanese grant aid scheme.

Work shall be supervised and monitored all the time. If the basic design conditions and the local conditions do not match, the resident supervisor shall make design changes according to the specifications and within the scope of the contract, after receiving the approval from WAJ. Quality control related to the rehabilitation work is important aspect, therefore, total trial running test shall be carried out based on the work contract. For land acquisition for temporary area and period work shall be reported to WAJ beforehand.

After the exchange of Notes (E/N) between the two governments, the Hashemite kingdom of Jordan shall conclude works contract with consultant. The contents of the work include detail design and work supervision.

(1) Detail Design

Detail design mainly involves the preparation of documents necessary for the works tender based on the basic design, that is, overall design, after carrying out detailed site studies. Sufficient time and stationing of personnel on site are considered to be necessary for carrying out on-site studies. Subsequently, the main work of the consultant in Japan includes preparation of tender documents, assistance for examining tender qualifications, presence during a tender opening, assessing tender bids, assistance in negotiating work contracts, and assistance related to work contracts.

(2) Work Supervision

Work supervision can be broadly divided into two tasks explained below.

(a) Supervisory duties

These include discussions with related personnel before start of work, confirmation of design drawings, inspection of equipment and materials before shipping, supervision of work on site,

attendance during installation of equipment, preparation of work reports during the work stages, issue of work completion certificates and payment certificates, and carrying out final inspection.

(b) Duties at the completion of work

These include issue of certificates at the completion of work, complying with formalities for handing over at the completion of work, preparation and final work report, and following procedures for completing the work.

3.1.5 Procurement Plan

The important materials and equipment that need to be procured are listed below.

(1) Materials

(a) Procured in Jordan

Aggregate, cement, reinforcing bars, plywood for formwork, steel pipe, sand, etc.

(b) Procured from Japan or Europe

Pumps, motor, transformer, specific cable, panel, high voltage transformer, etc.

(2) Construction Machines

General construction machines can be leased in Jordan, therefore, these machines shall be procured locally (Most of machines are available in Jordan).

The procurement categories for main materials to be used for the Project are given below.

Material	Procured in Jordan	Procured from Japan	Procured from Europe	Remarks
Sand / Gravel	○			These items are circulated continuously in Jordan and can be procured easily.
Cement	○			
Reinforcing bar	○			
Wood	○			
Plywood for formwork	○			
Asphalt	○			
Ordinary steel pipe	○			
General electric good	○			
Pump		○	(○)	The materials mentioned in the left column are not manufactured in Jordan, therefore, they shall be procured from Japan or Europe.
Electric motor		(○)	○	
High Voltage Transformer		(○)	○	
Control Panel		○		

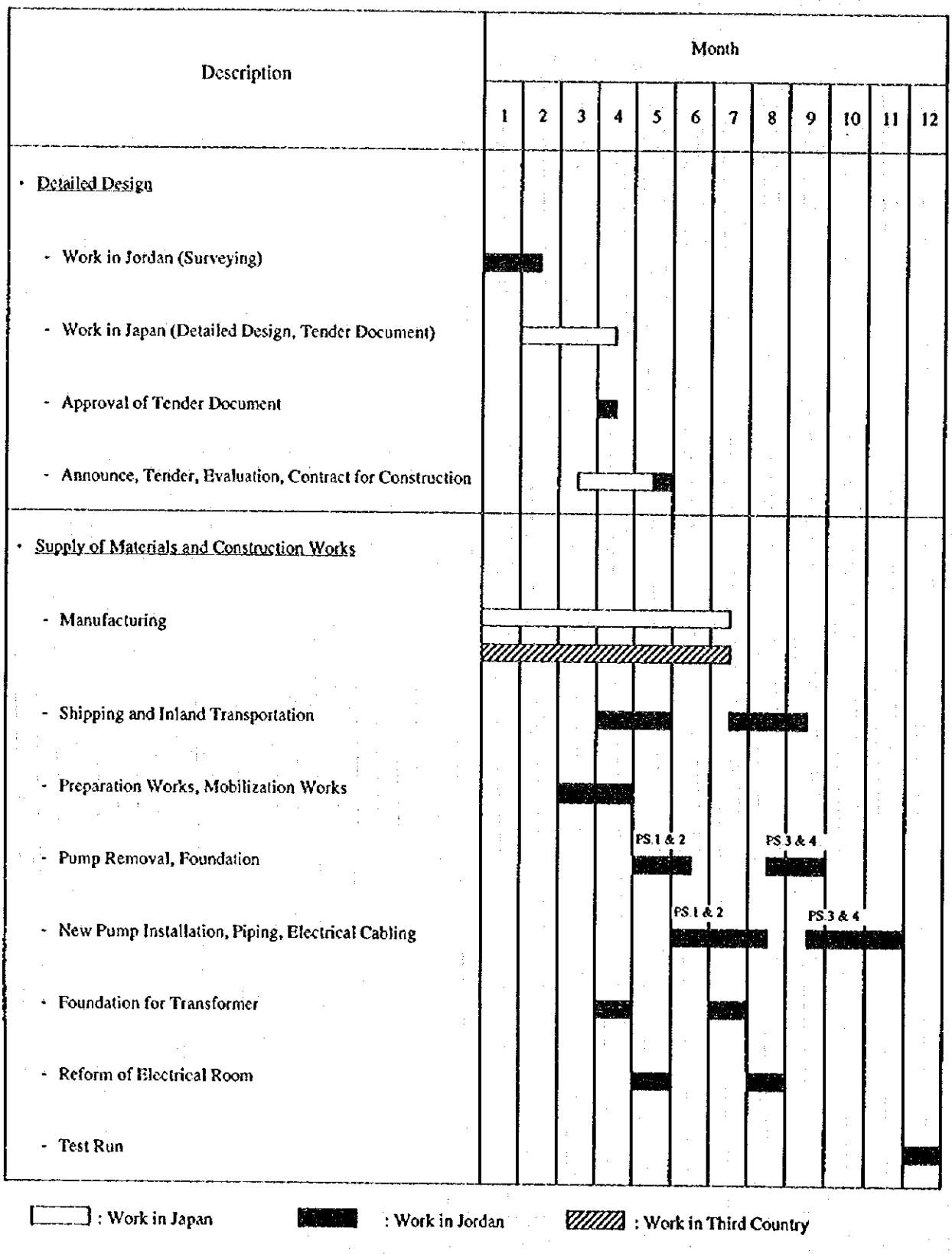
(3) Import route for equipment

The plan for the import route of equipment from Japan or Europe is inland transportation from Aqaba port in south Jordan to the site.

3.1.6 Implementation Schedule

After the Exchange of Notes are concluded between the governments of Hashemite Kingdom of Jordan and Japan based on the recommendations of Basic Design Study Report, the detailed design will start followed by the construction. Each schedule is shown in Table 23.

Table IMPLEMENTATION SCHEDULE (Rehabilitation)



3.1.7 Obligation of Recipient Country

The Government of Jordan will take the necessary measures that have been clarified in the minutes of the meetings and are shown below on condition that the Grant Aid assistance by the Government of Japan is extended to the Project

1. To secure the sites for the Project.
2. To clear, level and reclaim the sites prior to commencement of the construction.
3. To undertake incidental outdoor works such as gardening, fencing, gates and exterior lighting in and around the sites.
4. To construct the access road to the sites prior to commencement of the construction
5. To provide facilities for distribution of electricity, water supply, telephone, drainage, sewage and other incidental facilities to the Project sites.
    1) Electricity distributing line to the sites.
    2) City water distribution main to the sites.
    3) Drainage city main to the sites.
    4) Telephone trunk line and the main distribution panel of building.
    5) General furniture such as carpets, curtains, tables, chairs and others.
6. To bear commissions to the Japanese foreign exchange bank for the banking services based upon Banking Arrangement.
7. To exempt taxes and to take necessary measures for customs clearance of the materials and equipment brought for the project at the port of disembarkation.
8. To accord Japanese Nationals whose services may be required in connection with the supply of products and the services under the verified contract such facilities as may be necessary for their entry into Jordan and stay therein for the performance of their work.
9. To maintain and use properly and effectively the facilities constructed and equipment purchased under the Grant.
10. To bear all the expenses other than those to be borne by the Grant, necessary for construction of the facilities or well as for the transportation and the installation of the equipment.
11. To construct electricity distributing line to the four pumping stations by the time when the replaced pumps conduct test-runs in the "rehabilitation phase".

3.2 Operation and Maintenance Costs

Operation and maintenance costs will be increased by 15% to 7.5 million JD/year because supply amount is estimated from the current 39 MCM/year to 45 MCM/year.

Chapter 3 Implementation Plan (Expansion Portion)

3.1 Implementation Plan

3.1.1 Implementation Concept

(1) Tendering package

A water treatment facility is set up by installing civil structures, buildings, pipelines (pipelines in plant and in filtering basins) dosing devices, water treatment equipment, electrical equipment, instrumentation, and control equipment, and integrating all these equipment to form a single system. Consequently, it is preferable to examine the qualifications of various tenderers, call for tenders in one package, and unify the contract. Particularly, when work is supervised by a small number of persons, the inconveniences in preparation of documents for piecework payments and payment acknowledgment formalities, working drawings for joints in pipelines and wiring in civil and construction work, are mitigated; the responsibility of each subcontractor becomes the responsibility of the main sub-contractor, and the lines of responsibility become clearly defined.

The expansion work of the pumping station mainly consists of renewal of equipment and machinery. The work content differs from the procurement of equipment for facilities in a treatment plant, and the construction site is also remote, therefore contract for work in the pumping station should be separate from the contract of work in the treatment plant. During the construction of existing facilities also, contracts for treatment plant, pumping station and conveyance pipelines were separate.

(2) Considerations

Long period stoppage of treatment plant or pumping station is not allowed. Accordingly, construction methods that incur the minimum time for stoppages when fitting pipelines to existing structures or connecting distribution pipelines to existing pipelines should be adopted. This requires close contact and discussions with WAJ.

(3) Fields and methods in which sub-contractors work

Already many sub-contractors in the civil engineering, architecture, mechanical and electrical field are registered with the Ministry of Public Works for receiving contracted work from public organizations, and these contractors should be employed for the work as sub-contractors. Particularly, the work of authorization, arrangements for laborers, procurement and transport of construction materials and machinery, transport and assembly of formworks and reinforcements, placing and hardening of concrete and other works can be shared among the sub-contractors.

(4) Organizations and departments responsible during the implementation stage

Supervision of the project falls under the jurisdiction of the WAJ Planning and Design Department. Operation and maintenance fall under the purview of the WAJ Zai Water Treatment Department.

3.1.2 Implementation Condition

(1) Pump renewal sequence

After renewing three pumps at one location (for instance at the No. 1 pumping station), the renewal of three pumps at other locations (for instance No. 2 pumping station) is beneficial from the work and cost aspects. However, this method should not be adopted because water supply has to be stopped during the renewal period (more than 6 months) for all the pumps. To ensure continuous water supply during the renewal, one pump of large capacity renewed during the rehabilitation stage and 2 small pumps should continue to operate while one pump from each pumping station is simultaneously renewed (first time). With this renewal, two pumps of larger capacity will be installed in each pumping station, therefore the capacity of 45 million m^3/year will be maintained. Accordingly, during the second renewal, two pumps can be simultaneously renewed at each pumping station.

(2) Transportation of pipes, valves, equipment and machinery in areas with steep slopes

The treatment plant and pumping stations in this Project are located in the Jordan Valley, about 20 km from the Amman city boundary to the north west, with very little traffic in these parts, steep slopes, and many S-shaped curves traversing the slopes. Excavated material, pipes, valves and machinery need to be transported with adequate care and precautions.

(3) Precautions in placing concrete in dry areas

The concrete in the treatment plant should be watertight. After placing, no cracks should occur in the concrete due to drying shrinkage or changes in temperature. Consequently, control of slump during mixing of concrete is essential. Until the concrete hardens after it is placed, adequate precautions need to be taken by sprinkling water when direct rays of the sunlight fall on the concrete.

(4) Relocation of existing drain pipes and cables in the treatment plant

At the location where the settling basin and filter basin are to be constructed in the expansion stage, overflow pipes from the mixing basin, rain water drain pipes from the plant, sludge drain pipes to the sludge drying bed and cathode cables for preventing corrosion of steel pipes are buried in the ground and run parallel to the structure. These items need to be relocated before excavation for the structures to be erected.

(5) Reinforcement of 33 kV power receiving cable route

Power receiving equipment for dosing/ coagulation and sedimentation equipment are installed on the west side of the existing dosing building and diesel generator building, and H.T. cables are buried between the existing settling basin and underground settling basin. Due to access of heavy machinery during the construction work, these cables may be damaged. To prevent this damage, reinforcement of the cable route by covering the cables with steel plates is necessary.

(6) Procurement of materials, machinery and equipment for work

Dosing devices, water treatment machinery, steel pipes and vales are to be imported. Almost all other construction materials and machinery (portland cement, aggregates, reinforcing bars, formwork material, construction materials) can be procured locally, and heavy construction machinery can be leased. Since the soil in the treatment plant and pumping station is acidic, acidic cement is prescribed in the original design. For the design in this Project also, sulfide-resistant cement should be used. However, the local production quantity will not be able to satisfy the demand for this Project, therefore imports to meet the concrete placing schedule should be considered.

3.1.3 Scope of Works

(1) Works to be carried out by the Japanese side

The works to be carried out by the Japanese side are listed below.

Pumping station

* Renewal of three existing pumps and motors at four pumping stations (to large capacity pumps)
* Renewal of pipes and valves for the work above
* Renewal of monitoring and operating equipment for each pumping station
* Additional installation of one pressure surge tank in each pumping station

Water treatment plant

* New effluent pipeline from the existing raw water regulating basin
* New mixing basin
* New flocculating basin
* New settling basin
* New rapid filter basin and effluent weir
* New pipeline from effluent weir to existing clean water reservoir
* New dosing equipment
* Installation of water treatment machinery and equipment
* New connection pipelines, drain pipe lines

* New electric / store building
* Relocation and addition of generator room
* New chlorination room
* New central monitoring and control equipment
* Relocation of sludge drying bed

(2) Works to be carried out by the Jordanian side

The works to be carried out by the Jordanian side are listed below.

* Replacement of 1,200 mm pipes between No.4 pumping station and Zai treatment plant for 660 m
* Protection of eroded sections along the pipeline between No. 1 and No.2 pumping stations
* Arrangements for temporary sites outside the treatment plant premises
* Ensuring availability of power and water supply for work
* New sludge drying bed
* Renewal of existing dosing equipment

Name of equipment	Specifications	Quantity
Chlorinator	Vacuum-type, self-standing, capacity 900 kg/day	1
Vaporizer	Type: Electrothermal, capacity 3,600 kg	1
Polymer dosing device	Flowmeter: Model Rotormeter (dia. 25 mm, capacity 0.05 to 0.5 l/s)	2
	Batchmeter: Type Integrator (dia. 25 mm)	1
Potassium permanganate dosing device	Dosing ball tap	1
	Dosing pump air pressure gauge: Indicating range 0 to 100 psi (7 kgf/cm^2)	2
Activated carbon dosing device	Dosing pump air pressure gauge: Indicating range 0 to 100 psi (7 kgf/cm^2)	2

* Renewal of existing monitoring and control equipment

Equipment name	Specifications	Quantity
Water level gauge	Indication, records, warnings (raw water regulating reservoir, clean water basin)	2
	Indication, warnings (wash water drainage basin, wash water tank)	2
	Indication, regulation (filter basin)	1
Flowmeter	Indication, regulation, integration (raw water regulating reservoir, filter basin, water supply within plant)	3
	Indication, regulation (filter basin)	6
Gauge indicating degree of opening of valve	Indication (valves in raw water regulating reservoir, filter basin flow regulating valve)	7
Filter basin head loss gauge	Indication, warnings	6
Water quality gauge	Filter basin turbidity gauge (indication)	6
	Same as above (indication, records)	1
	Filter basin pH meter (indication, warnings)	1
	Wash water tank thermometer (indication)	1
	Residual chlorine gauge (indication, records)	1
Dosage meter	Indication, regulation (potassium permanganate, activated carbon)	2

3.1.4 Consultant Supervision

The supervisory system should account for the points mentioned below particularly when the detail design and work supervision are enforced under grant aid for this Project.

1) Understand the contents and transmission of basic design studies.
2) Understand the concept of grant aid cooperation.
3) Study the contents of E/N concluded between the two countries.
4) Study the basic concepts of WAJ and trends of other aid organizations.
5) Re-check the implementation conditions for work to be implemented by the Jordanian government requested during basic design.
6) Re-check the customs formalities and measures for exemption of duties on materials and equipment to be brought into the country, and hold discussions with WAJ to ensure that there is no effect on the work completion period.
7) Strive to study and understand the Islamic religion and customs. (Haj, Ramadan, etc.)

(1) Contents of consultancy services

After the E/N are exchanged between the governments of the two countries, the Jordanian government should conclude contracts with consultant. The detail design and work supervision for the Project work are as given below.

1) Detail design

The detail design is basically a detailed version of the basic design and its concepts. Tenders are to be called for in Jordan to continue field surveys for detail design. Tender work is as follows:

* Preparation of tender documents
* Assistance for examining tenderers' qualifications
* Meetings with tenderers
* Evaluation of tenders
* Assistance for negotiating works tenders
* Assistance for concluding works tenders

2) Work supervision

Work supervision may be broadly divided into the three categories below.

(i) Supervision work

* Discussions with concerned personnel before start of work
* Approval of design drawings
* Inspection of materials and equipment before they are shipped
* Management of works on site
* Witnessing the installation of machinery and equipment
* Preparation of work reports during the work period

* Issue of work completion certificates and payment certificates
* Inspection of completed work
* Inspection for locating defects

(ii) Tasks after completion of work
* Issue of work completion report
* Handing over formalities
* Preparation of general report

(iii) Operations and maintenance
Preparation of operation and maintenance manuals for pumping stations and plans for operations and maintenance
* Training to WAJ personnel (maintenance and operations department staff of pumping stations) by specialists
* Tests and trials of water treatment plant (including water quality) and training

The allocation of supervisors listed below for the detail design and work management system may be considered based on the considerations above.

Pump expansion
Detail design (total 7 persons)
General - 1 person
Civil and building design - 1 person
Mechanical equipment design - 1 person
Electrical equipment design (monitoring and operational equipment) - 1 person
Integration - 1 person
Tender documents - 1 person

Work management (total 5 persons)
General (spot) - 1 person
Normal resident supervisor - 1 person
Civil and building design - 1 person
Mechanical design (spot) - 1 person
Electrical design (spot) - 1 person

Expansion of water treatment plant
Detail design (total 14 persons)
General - 1 person
Treatment plant facilities design - 1 person

Design of civil structures (on site) - 1 person
Design of civil structures (domestic) - 1 person
Mechanical design - 1 person
Electrical design - 1 person
Building design - 1 person
Measurement, soil quality - 1 person
Pipe line design - 1 person
Specifications (civil Eng.) - 1 person
Specifications (mechanical) - 1 person
Specifications (electrical) - 1 person
Integration - 1 person
Tender documents - 1 person

Work management (total 10 persons)
General (spot) - 1 person
Treatment facilities design (spot) - 1 person
Civil structural design (spot) - 1 person
Resident supervisor (overall) - 1 person
Resident supervisor (only civil Eng. and building) - 1 person
Mechanical design (spot) - 1 person
Electrical design (spot) - 1 person
Building design (spot) - 1 person
Pipe line design - 1 person
Water quality operations management - 1 person

3.1.5 Procurement Plan

(1) General

Existing dosing equipment, water treatment machinery and equipment, steel pipes and valves conform to ANSI (American National Standards Institute), ASTM (American Society for Testing and Materials) and AWWA (American Water Works Association). These equipment are not manufactured in the country, therefore Jordan is dependent on imports of these equipment. Periodic inspections and maintenance of these equipment are performed by the Jordanian side. A major problem faced currently is the very high cost of spare parts. These parts cannot be easily procured by WAJ, which has a deficit budget. Two years worth of equipment should be purchased at a time, but the procurement sources for water treatment materials and equipment should be decided after considering the reliability, parts procurement and convenience,.

(2) Dosing equipment

Dosing equipment (aluminum sulfate, chlorination) are very important for quality control of water in the treatment plant, and the regulation of these equipment is likewise an important function. However, the consumption of parts for handling corrosive chemicals is rapid, and existing parts used for dosage have already been replaced. For this project, such parts should be procured from Japanese sources because of their high reliability and accuracy.

(3) Water treatment equipment

Rapid mixer and flocculator are rotating machines with large impeller diameters. Good precision finish and good balance of the impellers will reduce the frequency of breakdown and extend the service life of the machines. Sludge extractors have a span of 18 m, travel distance of 90 m and are large moving machines. It consists of a large number of components such as sludge pump, sludge extracting plates, sludge suction hoses, extractor plates winding device???, power cable winding device, operations control panel, rails, limits switch for control, etc. Since the components are procured separately and the extractor assembled on site, they should have good accuracy for the assembly. Consequently, Japanese products, which have good reliability, are selected.

Steel pipes and valves (including filter basin powered valves) should have the specific paint coating both on the inner and outer surfaces to suit the quality of the pipes used, moreover, the time required for the drying of paints when several coats of paint are applied must be ensured, and this high quality is required. Accordingly, Japanese products, which have good reliability, are selected.

(4) Reinforcing bars

Reinforcing bars of 10 to 25 mm diameter are manufactured as standard products in Jordan. The raw material for these bars is being imported from Brazil and other countries.

(5) Aggregate

Raw materials such as Fine aggregate, coarse aggregate, and boulders are available in the Jordan Valley.

(6) Cement

Currently, surplus cement is being produced and the country is also exporting cement. Therefore, this item can be locally procured.

With regard to other materials, efforts should be made to procure them locally, but items that are difficult to procure and which may affect the working schedule, or items expected to cause problems in quality, should be procured from Japan.

Table below shows the procurement sources of important materials and equipment.

Name of material/equipment	Jordan	Japan	Other country (Europe)	Remarks
Cement	O			Can be indigenously procured
Crushed stone for concrete	O			Same as above
Admixtures for concrete	O			Same as above
Sand and gravel	O			Same as above
Reinforcing bars (up to D25)	O			Same as above
Wood	O			Same as above
Plywood for formwork	O			Same as above
Asphalt compounds	O			Same as above
Gratings		O		Cannot be indigenously procured
Welded steel pipes for pipelines	O			Can be indigenously procured
Conveyance pumps		O	(O)	Requires good quality and steady supply
Main motors		(O)	O	Same as above
Operating panel		O		Same as above
Special cables		O		Same as above
General electrical materials	O			Same as above
Steel doors	O			Can be indigenously procured
Steel stairways	O			Same as above
ALM sashes	O			Same as above
ALM louvers	O			Same as above
Concrete blocks	O			Same as above
Scaffolding pipes	O			Same as above
Temporary steel material	O			Same as above
Temporary cover plates		O		Cannot be indigenously procured
Water stop plates		O		Cannot be indigenously procured
Welded steel material for piping	O			Can be indigenously procured
Reinforced concrete pipes	O			500 to 1000 mm can be procured
Anthracite	O			Can be indigenously procured
Sand for filter basin	O			Can be indigenously procured
Gravel for filter basin	O			Can be indigenously procured
Water treatment plant equipment		O		Requires good quality and steady supply

Regarding the transportation route, materials/equipment are to be transported from Aqaba??? port in Jordan to the interior parts of Jordan.

3.1.6 Implementation Schedule

Pumping station expansion

Pump expansion works are implemented in two stages. Each stage has the following schedule:

First Stage

Detail design - 3.5 months,

procurement and construction - 9 months

Second Stage

Detail design - 3.5 months,

procurement and construction - 12 months

The schedules are shown in Table .

Water treatment plant expansion

The implementation stages are scheduled as follows:

Detail design - 6.5 months,

construction - 33 months.

The stages are shown in Table .

Table IMPLEMENTATION SCHEDULE (Pump Expansion Stage I)

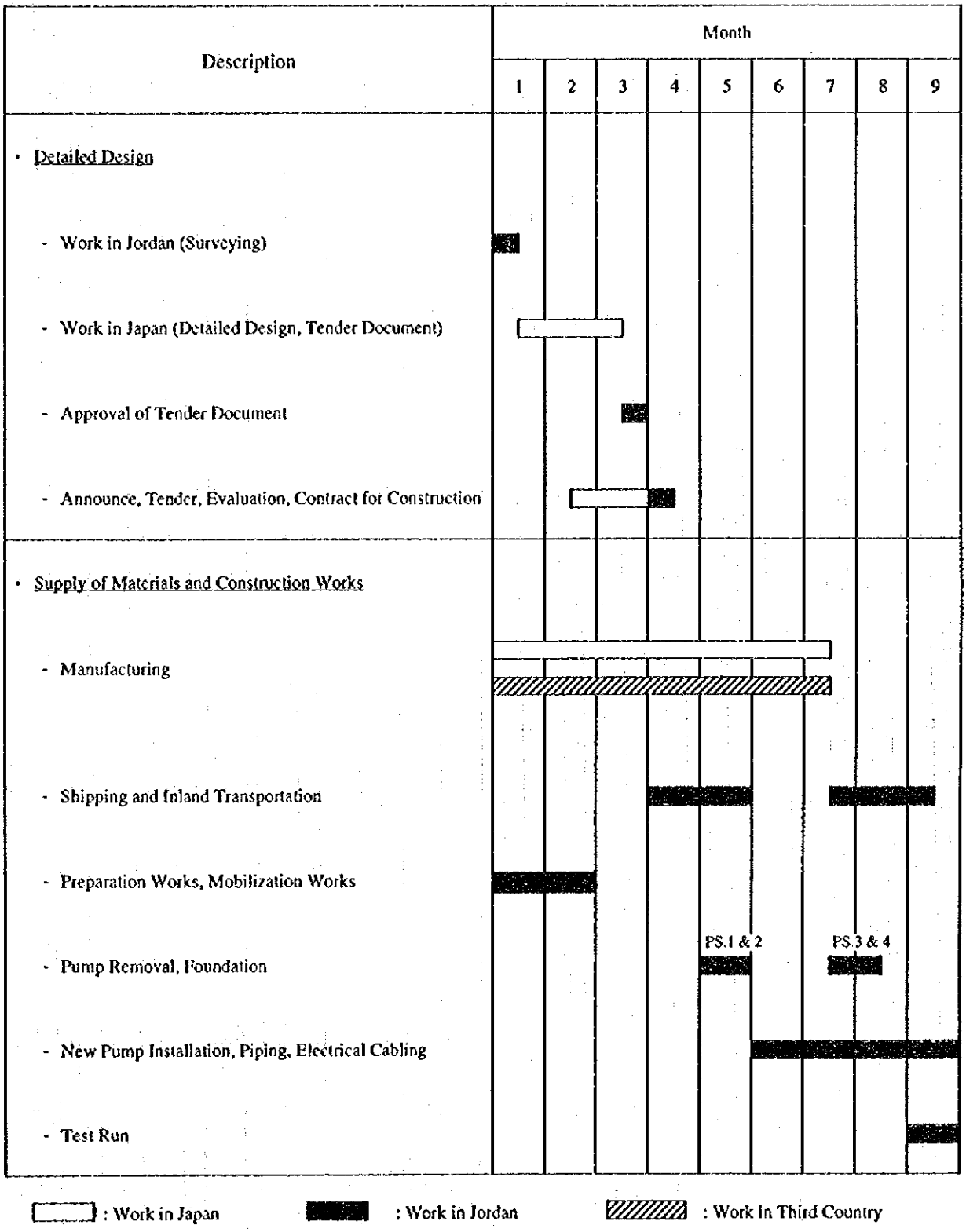


Table IMPLEMENTATION SCHEDULE (Pump Expansion Stage II)

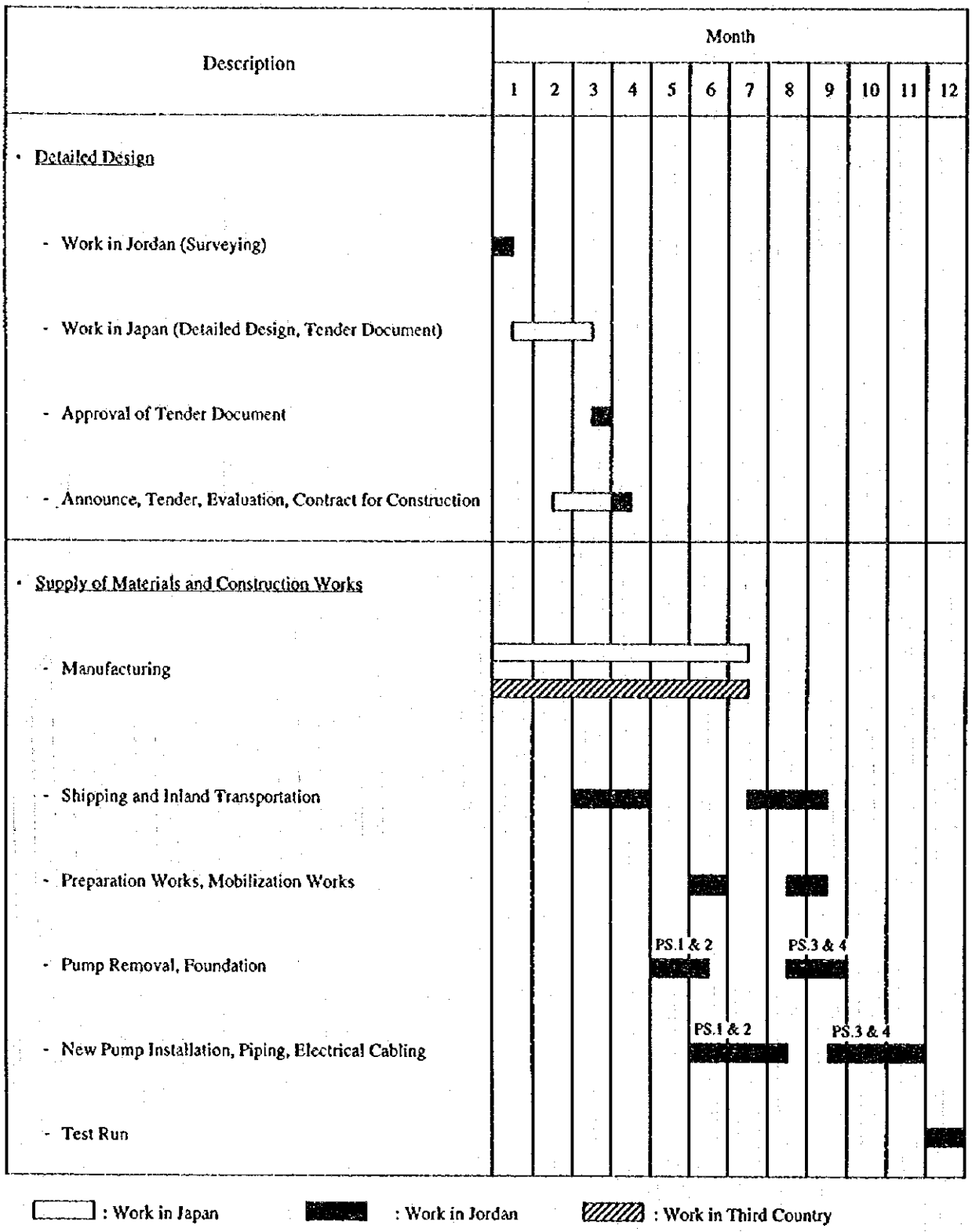
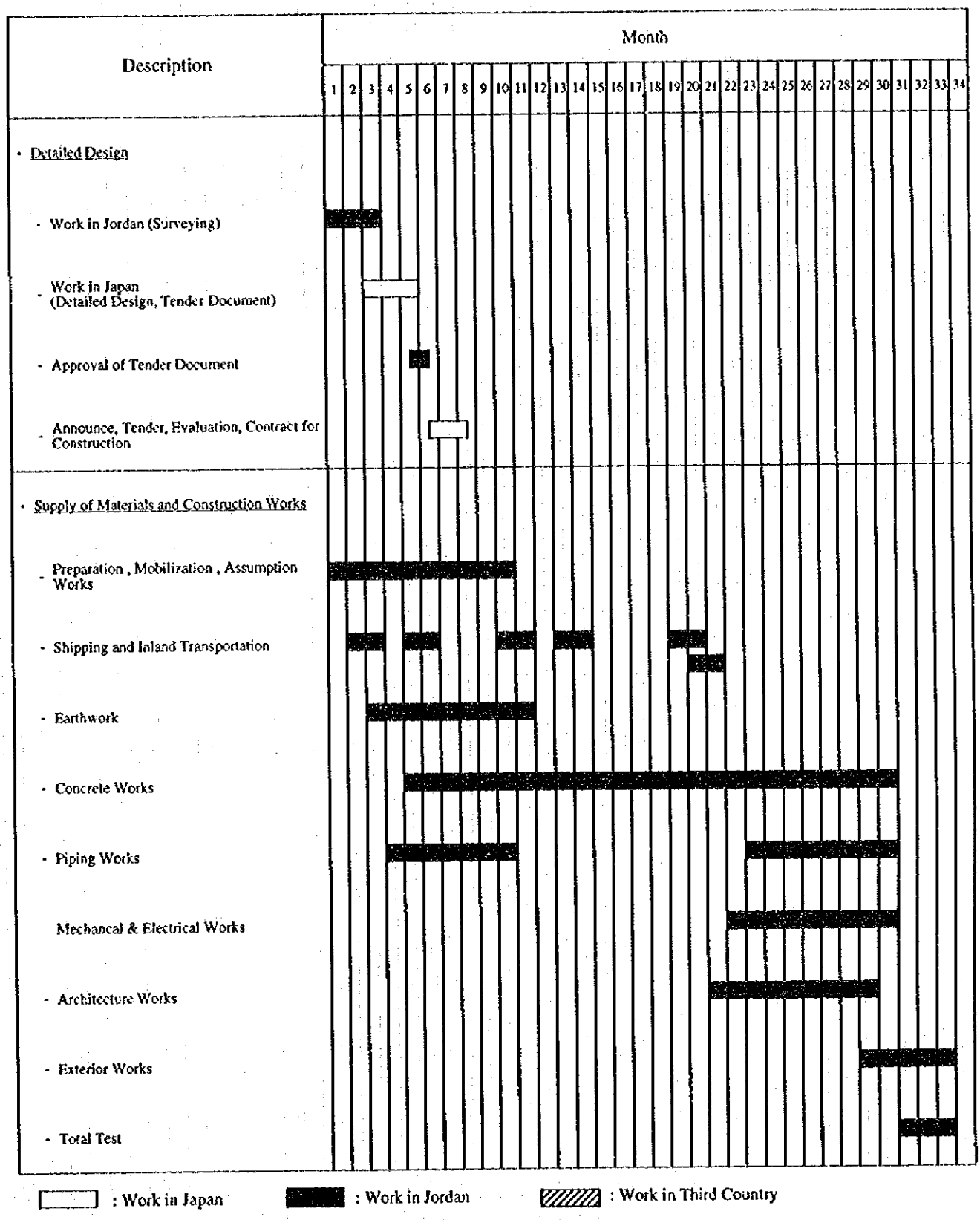


Table IMPLEMENTATION SCHEDULE (ZAI WTP Expansion)



3.1.7 Obligation of Recipient Country

The Government of Jordan will take the necessary measures that have been clarified in the minutes of the meetings and are shown below on condition that the Grant Aid assistance by the Government of Japan is extended to the Project

1. To secure the sites for the Project.
2. To clear, level and reclaim the sites prior to commencement of the construction.
3. To undertake incidental outdoor works such as gardening, fencing, gates and exterior lighting in and around the sites.
4. To construct the access road to the sites prior to commencement of the construction
5. To provide facilities for distribution of electricity, water supply, telephone, drainage, sewage and other incidental facilities to the Project sites.
   1) Electricity distributing line to the sites.
   2) City water distribution main to the sites.
   3) Drainage city main to the sites.
   4) Telephone trunk line and the main distribution panel of building.
   5) General furniture such as carpets, curtains, tables, chairs and others.
6. To bear commissions to the Japanese foreign exchange bank for the banking services based upon Banking Arrangement.
7. To exempt taxes and to take necessary measures for customs clearance of the materials and equipment brought for the project at the port of disembarkation.
8. To accord Japanese Nationals whose services may be required in connection with the supply of products and the services under the verified contract such facilities as may be necessary for their entry into Jordan and stay therein for the performance of their work.
9. To maintain and use properly and effectively the facilities constructed and equipment purchased under the Grant.
10. To bear all the expenses other than those to be borne by the Grant, necessary for construction of the facilities or well as for the transportation and the installation of the equipment.
11. To lay pipes with 1200 mm diameter for 660 m length between No.3 pumping station and No.4 pumping station (Technical information of the pipes are explained in the Draft Report) during "expansion phase".
12. To construct electricity distributing line to the four pumping stations by the time when the replaced pumps conduct test-runs in the "rehabilitation phase".
13. Surface protection on the eroded portions between No.1 and No.2 pumping stations.

3.2 Project Cost Estimation

The breakdown of expenses of Jordan required for implementing this Project through grant aid from Japan is as given below.

(1) Expenses to be borne by the Jordanian side

Item		Thousand dinars
Pump Expansion		
Laying of conveyance pipelines	660m	400
Work sites for conveyance pipelines	10,000m2, for 1 year	20
Temporary roads for conveyance pipeline work	300m	10
Protection of conveyance pipelines	200m (No.1~No.2)	50
Sub total		480
Treatment Plant Expansion		
Expenses for procuring temporary sites outside treatment plant	11,000 m2, for 3 years	55
Installation of power and water supply for work	For temporary yard / water treatment plant	10
Fencing around water treatment plant	450m	11
New sludge drying bed	80m X 80m	360
Expenses for renewing dosing equipment		125
Expenses for renewing monitoring and control equipment		230
Sub total		791
Total		1,271

(2) Estimation conditions

1) Estimation date: December 1996

2) Exchange rate: 1US$ = 109 yen
1 dinar = 154.93 yen

3) Work period: A. Period for detailed design, construction (or procurement of materials and equipment) is as shown in the work schedules.

4) Others: This Project is to be implemented under the grant aid by the Japanese government.

3.3 Operation and Maintenance Plan

(1) Operational Aspect

The Zai system is currently being managed by the Director with assistance from the Chief Engineers of Mechanical, Electrical and Water Quality Departments. The system operates full 24 hours a day with two shifts in the Operations Department, with management personnel working regular hours. The operations of each pumping station are being controlled by the remote/ automatic control system and remote monitoring / manual operation system from the Zai treatment plant.

Table Operations and Maintenance of Zai System (As Of November 1996)

Department	Daytime work (08:00 to 15:00)	Number of persons	Nighttime work (15:00 to 08:00)	Number of persons
Mechanical	Chief Engineer	2		
	Technicians	5		
	Operators	1	Operators	1
Electrical	Chief Engineer	2		
	Technicians	2		
	Operators	1	Operators	1
Water quality	Specialist	3		
	Technicians	2	Technicians	1
	Operators	2	Operators	2

In addition to the above, watchmen are assigned to each pumping station.

(2) Technical Aspect

The ability to maintain and operate the Zai system is quite high, as is evident from examples of the pumping station equipment below. Moreover, the staff have been receiving cooperation from the workshop and Central Water Quality Laboratory when necessary.

* Shafts, bearings, oil seals of pumps and motors are being replaced on site routinely.
* Repairs of small components that do not need to be machine, are being carried out on site.
* Machining of important pump components such as impeller, lining, sleeve and main shaft is being carried out in the workshop. From observations in July, 1996, the finish achieved was smooth and satisfactory.
* Devices such as pressure gauges breakdown, but temperature control and control of operating conditions are being enforced by using the five senses.
* Overhauling of pumps being done once in 2 years; overhaul of motors has been done once in the past.
* The cooling parts of bearings are being cleaned internally once in two weeks (summer).
* Pumps that have broken down are being replaced with spare ones by WAJ. After replacement, the pump operates without problems. The skill in aligning the shaft during installation is at a high level.
* Electronic circuit devices in monitoring and control equipment are also being repaired.

After completion of this Project, the supply capacity will be double, but the system is the same as before, and no increase in personnel is necessary. Therefore, the expanded facilities will be operated and maintained by existing personnel and staff.

Parts to be processed such as round bars, and consumable items can be procured in the local market. Parts such as liner rings and sleeves for pumps can also be procured in the local market.

Spare parts that need to be stored are only brushes and bearings for motors. Difficulties faced until now in replenishing parts has been, parts for the compressor, which incurred considerable time. Parts for existing equipment are being replenished periodically, and recorded in the operation ledgers. The use of spare parts required for this Project differs from the existing ones, but looking at the current system, the Jordanian side can cope with the situation adequately.

(3) Financial Aspect

It is confirmed that the WAJ's financial situations after the completion of the Project as below.

1) Water tariff revision
   * Water revenue could cover the operation and maintenance costs due to tariff increase by about 15% in 1996. However it could not cover depreciation cost and interests on loans
   * Water tariff will be revised periodically to compensate the increased expenditures.
   * Tariff structure will be improved such as progressive system and division of water usage of commerce and industry.

2) Unaccounted-for Water (UFW)
   * Unaccounted-for water ratio is still high - 54% in 1995 despite the effort of replacing galvanized steel service pipes.
   * The following schemes are under way to decrease UFW
     Inventory, monitoring, control and protection of groundwater resources
     Procurement of water meters with high accuracy
     physical rehabilitation of water network
     Rationalization of water distribution system

3) Prospect of financial situation after completion of the Project

In response to the JICA's request, WAJ submitted the financial statements up to the year 2005 for the "With" (the Project including the related projects before No. 1 pumping station and after No. 5 pumping station) case and "Without" case (See Appendix: WAJ financial statement). The statements are summarized in Table.

a) Profit Loss Statement

Profit Loss Statement

(Thousand dinar)

Year	1995		2002		2005	
	With	Without	With	Without	With	Without
Revenue						
Water sales	25,544	25,544	83,348	59,535	100,748	66,969
Wastewater	9,999	9,999	20,220	15,188	23,882	17,085
Subscription fee	3,303	3,303	4,346	4,179	4,889	4,701
Others	1,777	1,777	5,917	4,763	6,980	5,336
Total revenue	40,623	40,623	113,831	83,665	136,499	94,091
Expenses						
O & M						
Salaries & wages	16,348	16,348	23,004	23,004	26,630	26,630
Maintenance & Operation	8,467	8,467	13,283	11,914	15,376	13,792
Electricity bill	21,298	21,298	34,362	26,154	39,778	30,276
Administration & general	723	723	1,017	1,017	1,178	1,178
Sub total *1	46,836	46,836	71,666	62,089	82,962	71,876
Operational profit #	**-6,213**	**-6,213**	**42,165**	**21,576**	**53,537**	**22,215**
Depreciation(*2)	29,453	29,453	51,731	51,731	52,551	52,551
Interest on loans(*3)	16,188	16,188	35,556	38,424	18,427	29,945
Total expenses (*1+*2+ *3)	92,477	92,477	158,953	152,244	153,940	154,372
Profit	**-51,855**	**-51,855**	**-45,122**	**-68,579**	**-17,440**	**-60,281**
Foreign exchange loss	6,926	6,926	6,926	6,926	6,926	6,926
Profit for the year	-58,781	-58,781	-52,048	-75,505	-24,366	-67,206
Accumulated profit	-338,806	-338,806	-769,697	-820,221	-886,007	-1,043,861

\# Operational profit = Total revenue - sub total (*1)

* Total revenue will cover operational costs but still will not cover total expenses in both With and Without cases.
* In the Without case, financial situation will improve because total expenses will be 1.6 to 1.8 times of total revenue. However, the accumulated loss will still keep increase.
* In the With case, the accumulated loss will keep increase as is the same as the With case. However, deficit will decrease as the total expenses will be 1.1 to 1.4 times of the total revenue due to revenue increase generated by the Project.

b) Balance Sheet

Balance Sheet

(Thousand dinar)

	1995		2002		2005	
	With	Without	With	Without	With	Without
Assets						
Fixed asset	481,039	481,039	670,134	670,134	517,944	517,944
Current asset	31,627	31,627	44,582	36,139	52,069	45,639
Total asset	512,666	512,666	714,716	706,273	570,013	563,583
Capital & Liabilities Equity						
Liabilities						
Fixed liabilities						
Long term loans	252,021	252,021	481,025	523,105	307,234	458,658
Provision for contingencies	1,386	1,386	1,386	1,386	1,386	1,386
Total	253,407	253,407	482,411	524,491	308,620	460,044
Current liabilities	265,343	265,343	250,202	250,202	245,600	245,600
Total liabilities	518,750	518,750	732,613	774,693	554,220	705,644
Capital						
Capital	332,722	332,722	751,800	751,800	901,800	901,800
Accumulated deficit	-338,806	-338,806	-769,697	-820,221	886,007	-1,043,861
Net capital	-6,084	-6,084	-17,897	-68,421	15,793	-142,061
Total	512,666	512,666	714,716	706,273	570,013	563,583

* In the Without case, ratio of current liabilities to current asset will be improved to 5.4 to 6.9.
* In the With case, it will be further improved to 4.7 to 5.6. However, still financial situation will be difficult.
* The capital will keep decrease due to the increasing accumulated deficit

c) Cash Flow

Cash Flow

(Thousand dinar)

	1995		2002		2005	
	With	Without	With	Without	With	Without
Deficit for the year	-58,780	-58,780	-52,048	-75,505	-118,879	-118,879
Foreign exchange loss	6,926	6,926	6,926	6,926	6,926	6,926
Depreciation	29,453	29,453	51,731	51,731	52,551	52,551
Accounts receivable	1,642	1,642	0	0	-7,360	-7,360
Spare parts & Materials	-1,565	-1,565	-659	-659	-742	-742
Other debt balance	-766	-766	0	0	0	0
Account payable	2,462	2,462	0	0	0	0
Retention of contractors	-10	-10	0	0	0	0
Deposits	2,570	2,570	0	0	0	0
Net cash used in operating activities	-18,068	-18,068	5,950	-17,507	-67,504	-67,504
Net changes in fixed assets & project in progress	-45,017	-45,017	-33,405	-33,405	78,141	78,141
Banks payable	2,286	2,286	0		-4,602	-4,602
Long term loans	23,236	23,236	-22,544	913	-56,035	-56,035
Interest on loans	23,934	23,934	0	0	0	0
Changes in capital	18,278	18,278	50,000	50,000	50,000	50,000
Provision for contingencies	-76	-76	0	0	0	0
Net cash provided by Financing activities	63,085	63,085	27,456	50,913	-10,637	-10,637
Net change in cash & cash equivalent	-235	-235	2,234	-257	-3,588	0
Cash End of the year	563	563	9,443	1,000	7,430	1,000

d) Financial Improvement Measures

WAJ will not yield profit for both With and Without cases. But, WAJ should try to yield profit in the near future, considering that WAJ can not go bankruptcy. In addition to the tariff revisions and UFW decreasing measures for improving financial situation, the following measures are also to be considered;

* Tariff
  - Establishment of an up-to-date subscribers data base
  - Control of unregistered subscribers
  - Linkage of water subscribers data with sewer subscribers data
  - Transferring collector from one zone to other zone
* Electricity Bill
  - Optimization of pump distribution system

Chapter 4

Project Evaluation and Recommendation

Chapter 4 Project Evaluation and Recommendation

4.1 Project Effect

(1) A water supply capacity of 45 million m^3/year will be attained by rehabilitation as a part of this Project (Rehabilitation Portion), and a supply capacity of 90 million m^3/year can be assured after expansion of the Zai system. [1] (Expansion Portion) Consequently, this Project is one of the targets marked in the Economic and Social Development Plan, and is considered to coincide with the "Development of Water Resources and Energy."

(2) The quantity of water apportioned to Jordan after the Peace Treaty between Jordan and Israel is to be supplied to Amman city, so that the inhabitants of Amman can experience peace in the real sense, and is therefore a Project of significance.

(3) If the entire water quantity mentioned above is supplied to inhabitants of the Amman city area (approx. 1,500,000 persons in 1995), the habitual rationing of water in summer (2 days per week) can be eliminated, and the effect on the inhabitants will be significant.

(4) The effects will not only reach Amman, but also the citizens of the whole country. That is, the tight water supply and demand situation is faced not only by Amman but by other areas all over the country, and the measures for water sources are being adopted all over the country. If the tight water supply-demand situation in Amman is mitigated, a part of the water from sources supplying water to Amman can be diverted to other areas, mitigating the severe situation in other areas.

(5) Furthermore, the continued pumping up of excess water from wells can be decreased to some extent, and the life of wells that are likely to dry up or deteriorate, can be extended.

(6) The operations and maintenance of the existing Zai system is satisfactory. Facilities rehabilitated and expanded in this Project, will basically be the same as the existing facilities, therefore adequate maintenance and operation of the expanded facilities may be anticipated.

(7) WAJ's financial situation will be improved according to the estimated financial statements made by WAJ when the Project is implemented. Therefore, WAJ is expected to properly operate and maintain the facilities from view point of finance.

(8) Environmental effect from the Project could be overcome.

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[1] Although the capacity of the facilities is 90 million m^3/year, the actual water delivered, based on its relation with usable water quantity is approximately 87 million m^3/year.

(9) The Project could be implemented under the Japanese grant aid system.

4.2 Recommendation

As mentioned above, large beneficial effects may be anticipated by implementing this Project. At the same time, improvements to BHN of the inhabitants over a large area of the country may be anticipated, therefore, the implementation of this Project through grant aid will have profound significance. However, there are problems mentioned below, in the implementation of this Project, and if these problems are not solved, it will become difficult to implement this Project smoothly.

(1) This Project (expansion portion) can be initiated only when technical and financial arrangements are provided with other relevant projects which are 1) the intake/conveyance facilities from the Adasiya intake to the No. 1 pumping station and 2) the conveyance facilities from the No. 5 pumping station to the Dabouk reservoir in Amman city. Therefore, WAJ should accelerate the above arrangement with the relevant agencies.

(2) WAJ has understood the current bad WAJ's financial situation and the importance of improving WAJ's financial situation. Among the measures towards improvement, tariff revision will be one of the most important issues so that WAJ should implement it (see Appendix: WAJ financial statement).

(3) For attaining sound financial situation, reducing unaccounted-for-water will be other important measures. WAJ should execute and continue such measures particularly for Amman city (see Appendix: WAJ financial statement).

(4) The completion of the part of the Project assigned to Jordan is also indispensable for attaining the benefits of the Project. Particularly, improvement of electricity transmission lines, and reinforcement of conveyance pipelines are very important and should be executed according to the required schedule (see Appendix: WAJ financial statement).

The measures described below should be adopted for improving the beneficial effects of this Project.

1) Efficient use of facilities

The usable water in the winter season is 265 thousand m³/day but according to this Project, only 250 thousand m³/day can be used. On the other hand, the usable water in summer is 221 thousand m³/day, which is less than 250 thousand m³/day, the capacity of the facilities. For

WAJ to effectively use the water sources and the Zai system and ensure a water supply of 90 million m³/year, plans for using dams in the Yarmouk river should be formulated.

2) THM measures

WAJ should initiate such measures that is suggested in Appendix to mitigate THM.

Appendices

Appendix 1 Member List of Survey Team

Appendix 1 Member List of Survey Team

Inception Report Explanation Team

Haruo Iwahori	Team Leader	Development Specialist, Institute for International Cooperation, JICA
Fujiko Yoshida	Grant Aid Planner	Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs
Yoshinobu Kinjyo	Technical Councilor	Enterprise Technical Director, Okinawa Enterprise Bureau, Okinawa Prefectural Government
Kazufumi Momose	Chief Consultant/ Operation & Maintenance Planning	Tokyo Engineering Consultants
Osamu Nakagome	Water Supply Planner	Tokyo Engineering Consultants
Fujio Oyama	Civil Works Designer	Nippon Koei
Yoshinori Misawa	Mechanical Designer	Tokyo Engineering Consultants
Koichi Ota	Electrical Designer	Nippon Koei
Hisamitsu Tanaka	Pipeline Designer	Tokyo Engineering Consultants
Tokuji Okada	Cost Estimator/ Procurement Planner	Nippon Koei
Hideyo Ueno	Water Quality Expert	Tokyo Engineering Consultants
Takasi Okada	Junior Mechanical Designer	Tokyo Engineering Consultants

Draft Report Explanation Team

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Yoshinobu Kinjyo	Technical Councilor	Enterprise Technical Director, Okinawa Enterprise Bureau, Okinawa Prefectural Government
Kazufumi Momose	Chief Consultant/ Operation & Maintenance Planning	Tokyo Engineering Consultants
Yoshinori Misawa	Mechanical Designer	Tokyo Engineering Consultants
Koichi Ota	Electrical Designer	Nippon Koei
Hisamitsu Tanaka	Pipeline Designer	Tokyo Engineering Consultants

Appendix 2 Survey Schedule

Appendix 2 Survey Schedule

Inception Report Explanation Team

Date	Day	Remarks		Components
June 2	Sun	Leader & Survey Team (1 & 2)	Leave Japan	
3	Mon	ditto	Arrive Amman	
4	Tue			Courtesy call to MOP, WAJ, JICA and EOJ
5	Wed			Discussion on Inception Report with WAJ
6	Thu			ditto
7	Fri			
8	Sat	Survey Team (3)	Leave Japan	Discussion on Minutes of Discussion
9	Sun		Arrive Amman	Signing on Minutes of Discussion
10	Mon			Holiday
11	Tue			Site Survey
12	Wed			Report to JICA and EOJ
13	Thu	Leader & Survey Team (1)	Leave Amman	Site Survey
14	Fri			
15	Sat			Site Survey
16	Sun			ditto
17	Mon	Survey Team (4)	Leave Japan	ditto
18	Tue		Arrive Amman	ditto
19	Wed			ditto
20	Thu			ditto
21	Fri			
22	Sat			Site Survey
23	Sun			ditto
24	Mon			ditto
25	Tue			ditto
26	Wed			ditto
27	Thu			ditto
28	Fri			
29	Sat			Site Survey
30	Sun			ditto
July 1	Mon			ditto
2	Tue			ditto
3	Wed			ditto
4	Thu			ditto
5	Fri			
6	Sat			Site Survey
7	Sun			ditto
8	Mon			ditto
9	Tue			ditto
10	Wed			ditto
11	Thu			ditto
12	Fri			
13	Sat			Discussion with WAJ
14	Sun	Survey Team (2 to 4)	Leave Amman	Report to JICA and EOJ
15	Mon			
16	Tue		Arrive Japan	

Draft Report Explanation Team

Date	Day	Remarks		Components
Nov 26	Tue	Leave Japan		
27	Wed	Arrive at Amman		Courtesy call to MOP, WAJ, JICA and EOJ
28	Thu			Discussion on Draft Report
29	Fri			
30	Sat			Discussion on Draft Report
Dec 1	Sun			ditto
2	Mon			Discussion on Minutes of Discussion
3	Tue			ditto
4	Wed			Signing on Minutes of Discussion, Report to JICA and EOJ
5	Thu	Leave Amman		ditto
6	Fri			
7	Sat	Arrive in Japan		Discussion with WAJ

Appendix 3 List of Party Concerned in the Recipient Country

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Ministry of Planning

Director	Mr. Ohawi
Economist	Dr. Nael J.H.Alhajaj

Water Authority of Jordan (WAJ), Ministry of Water and Irrigation

Secretary General	Eng. Koussai A. Quteishat
Assistant Secretary General	Mr. Nawwaf Daoud
Director	Mr. Nazir Abu Arquob
Civil Engineer	Mr. Nabeel Zou'bi
Civil Engineer	Ms. Maysoun Zou'bi
Civil Engineer	Mr. Othman Al kurdi
Mechanical Engineer	Mr. Ihasan Sousa
Electrical Engineer	Mr. Saleh Baker
Director, Zai	Mr. Mohammad Abu Taha
Mechanical Engineer, Zai	Mr. Muntasir Zagha, Zai
Electrical Engineer, Zai	Mr. Jamal Alla'eddin, Zai
Water Quality, Zai	Mr. Riyad Abdull Ghani, Zai
Water Quality, Central Laboratory	Ms. Randa Tuffaha
Operation and Maintenance	Mr. Khaled J.Alkudah

Jordan Valley Authority (JVA) , Ministry of Water and Irrigation

Engineer	Mr. Ziahd

National Electric Power Corporation (NEPCO)

Engineer	Mr. Niazi Musa
Engineer	Mr. Walid KH Doleh