

4-4-5 Drawings of the Basic Design

The basic design is presented in the following drawings:-

<u>Name of Drawing</u>	<u>Drawing No.</u>
General layout of Simly water treatment plant	01
Flow diagram of Simly water treatment plant	02
Single-line diagram of Simly water treatment plant (1/3)	03-1
Single-line diagram of Simly water treatment plant (2/3)	03-2
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1500 Chlorination Facilities

- 1501 Construction of support for chlorine gas containers
- 1502 Replacement of chlorinator
- 1503 Replacement of pipes for water supply, solution and others
- 1504 Replacement of lifting device
- 1505 Replacement of fan
- 1506 Supply of gas mask and emergency kit
- 1507 Repair of floors in chlorine gas containers room and chlorinator room

1400 Alum Dosing Facilities

- 1401 Repair of the existing alum tank
- 1402 Replacement of alum bucket
- 1403 Replacement of mixer
- 1404 Replacement of measuring device
- 1405 Replacement of pipes for water supply, solution, overflow and drainage
- 1406 Replacement of lifting device
- 1407 Supply of pallet for alum storage

1100 Intake Facilities

- 1101 Dismantle of the existing flash mixer

1200 Flocculation and Sedimentation Basin Facilities

- 1201 Replacement of flocculator
- 1202 Replacement of drive tyres
- 1203 Replacement of scraper edge
- 1204 Replacement of sludge pump
- 1205 Replacement of weir plate

1700 Instrument Facilities

- 1701 Replacement of raw water flow meter
- 1702 Replacement of head loss meter for the filter bed
- 1703 Replacement of filtered water flow meter
- 1704 Installation of instrument panel
- 1705 Dismantle and installation of wiring
- 1706 Supply of water test kit

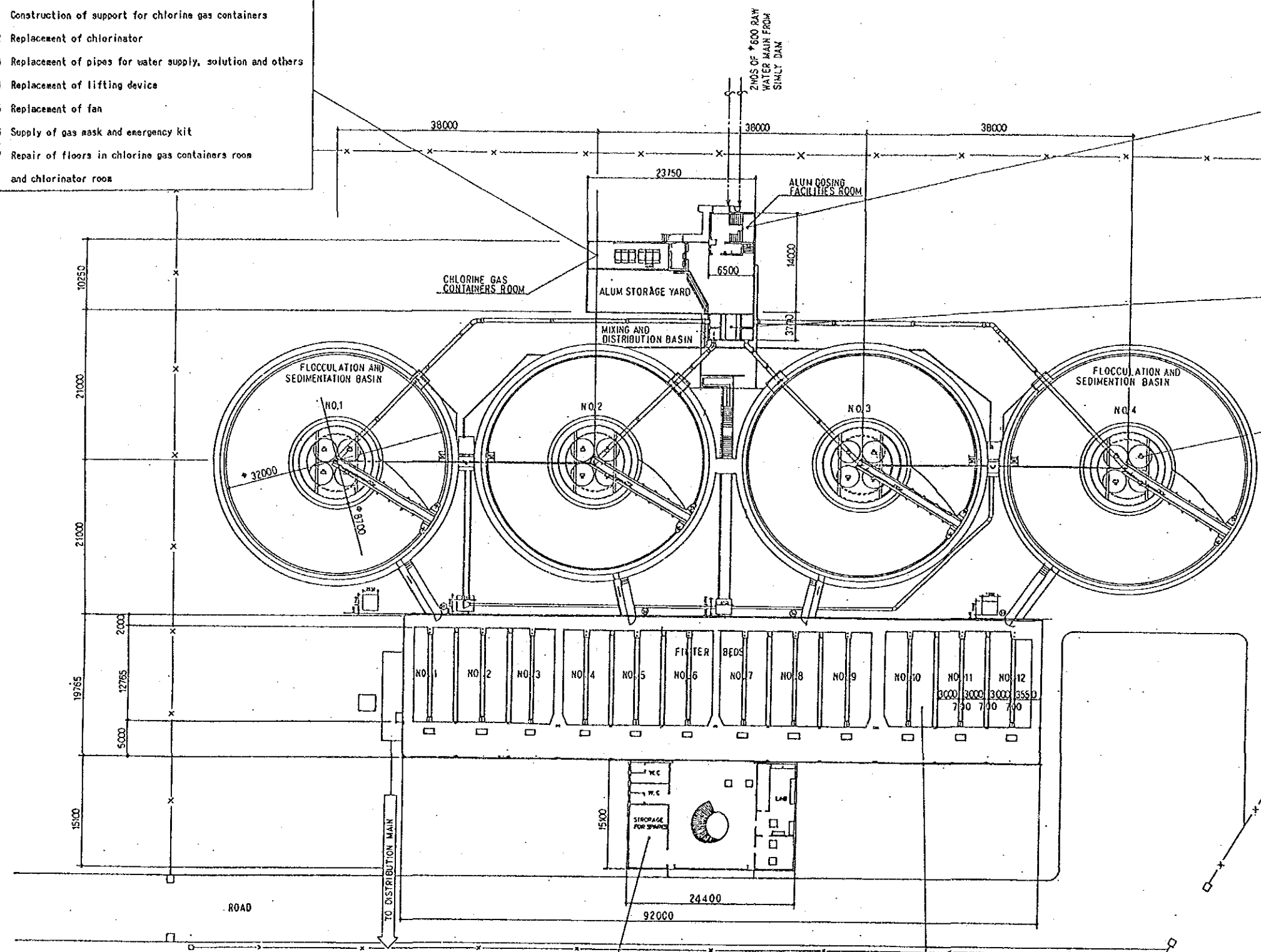
1800 Electrical Facilities

1600 Distribution Pump Facilities

- 1601 Replacement of utility water supply unit
- 1602 Replacement of floor drain pump
- 1603 Relocation of suction pipe of colony water supply pump
- 1604 Replacement of gasket/packing for the back-wash pump and pipes

1300 Filtration Facilities

- 1301 Replacement of flow control system
- 1302 Replacement of control valves
- 1303 Replenishment and washing of filter media
- 1304 Installation of compressed air unit



THE ISLAMIC REPUBLIC OF PAKISTAN
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THE PROJECT FOR REHABILITATION
OF WATER TREATMENT SYSTEM
IN ISLAMABAD

DRAWING

GENERAL LAYOUT OF

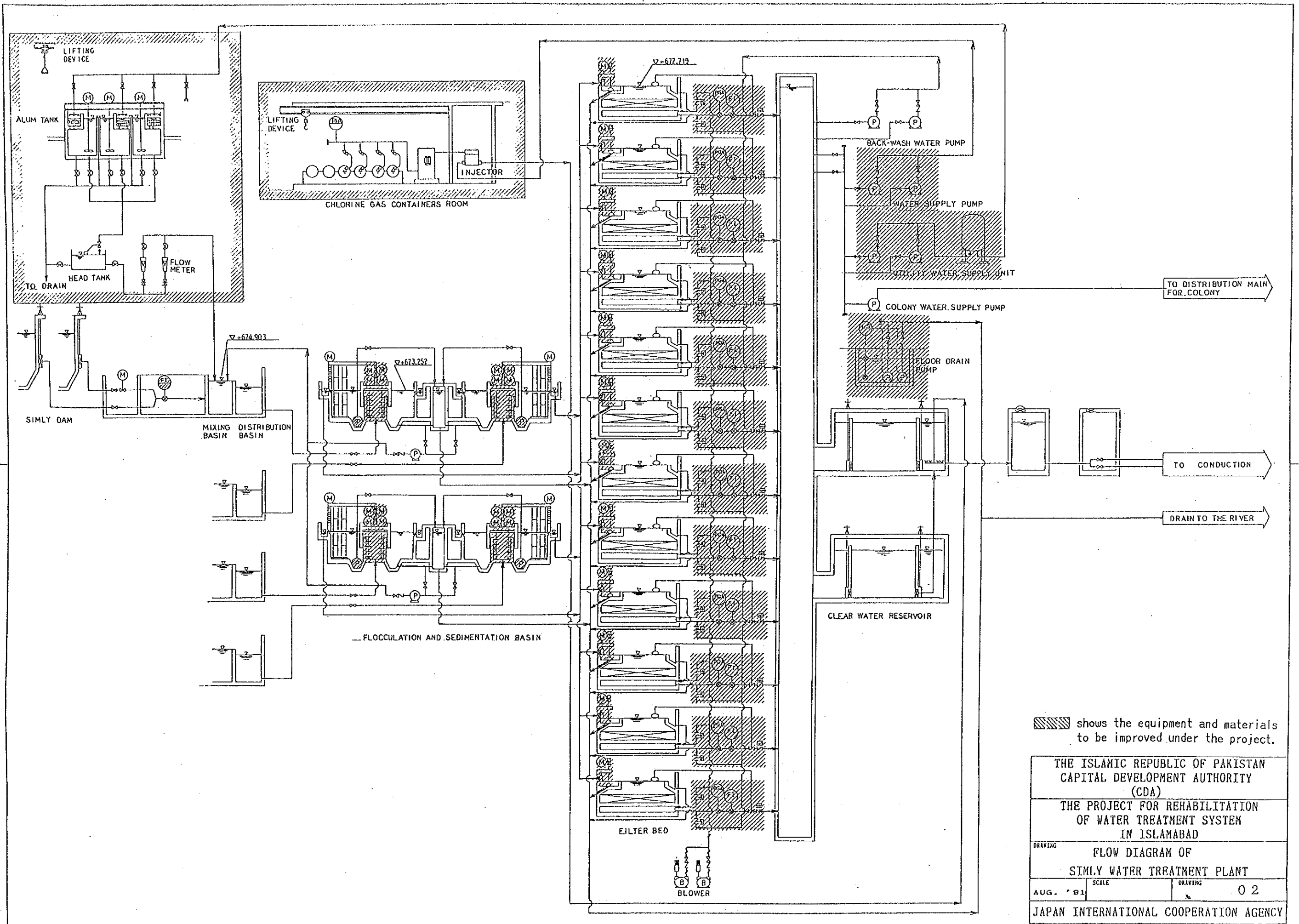
SIMLY WATER TREATMENT PLANT

AUG. '91

SCALE
1/300

DRAWING
No 01

JAPAN INTERNATIONAL COOPERATION AGENCY



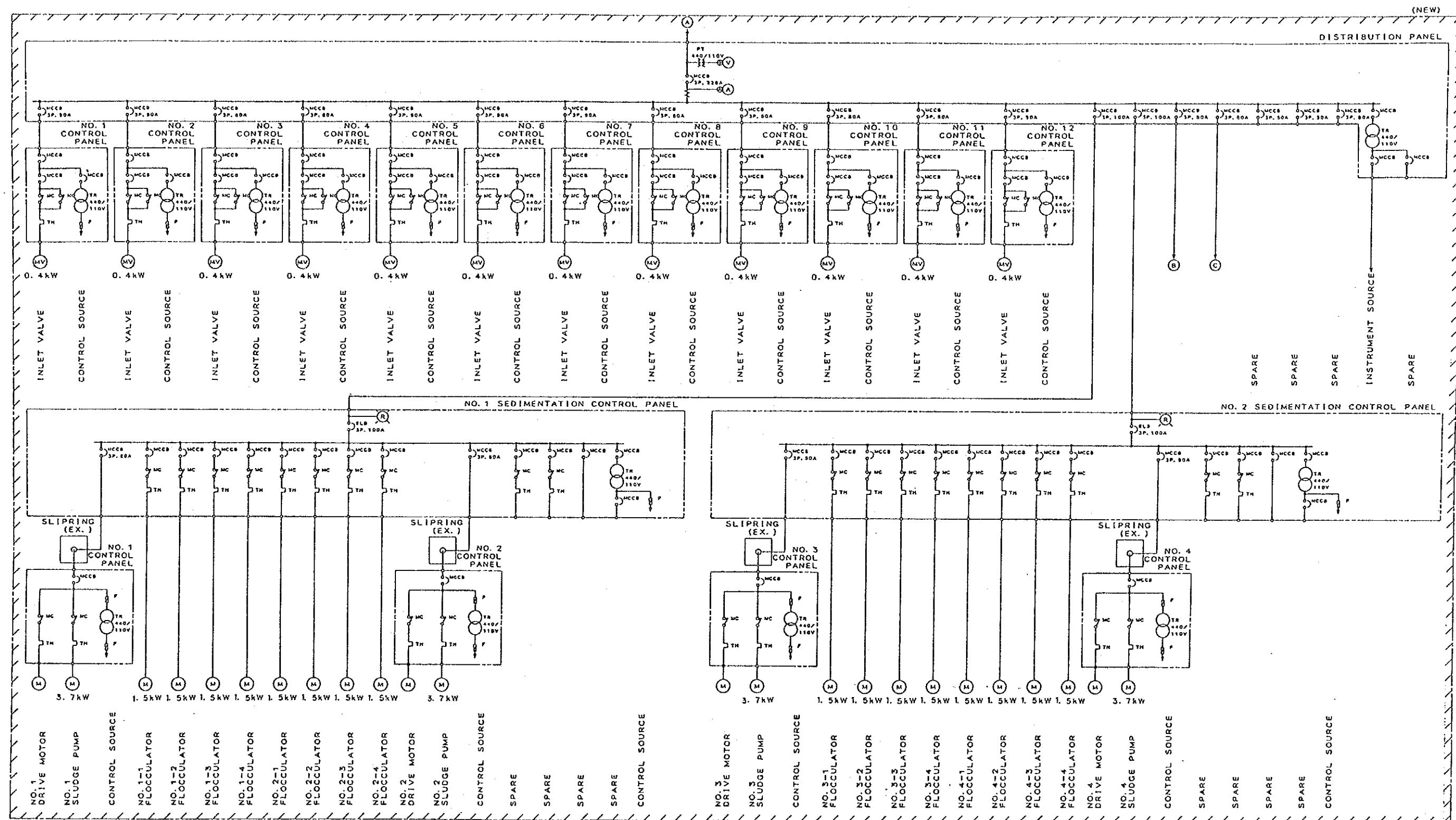
shows the equipment and materials to be improved under the project.

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THE PROJECT FOR REHABILITATION
OF WATER TREATMENT SYSTEM
IN ISLAMABAD

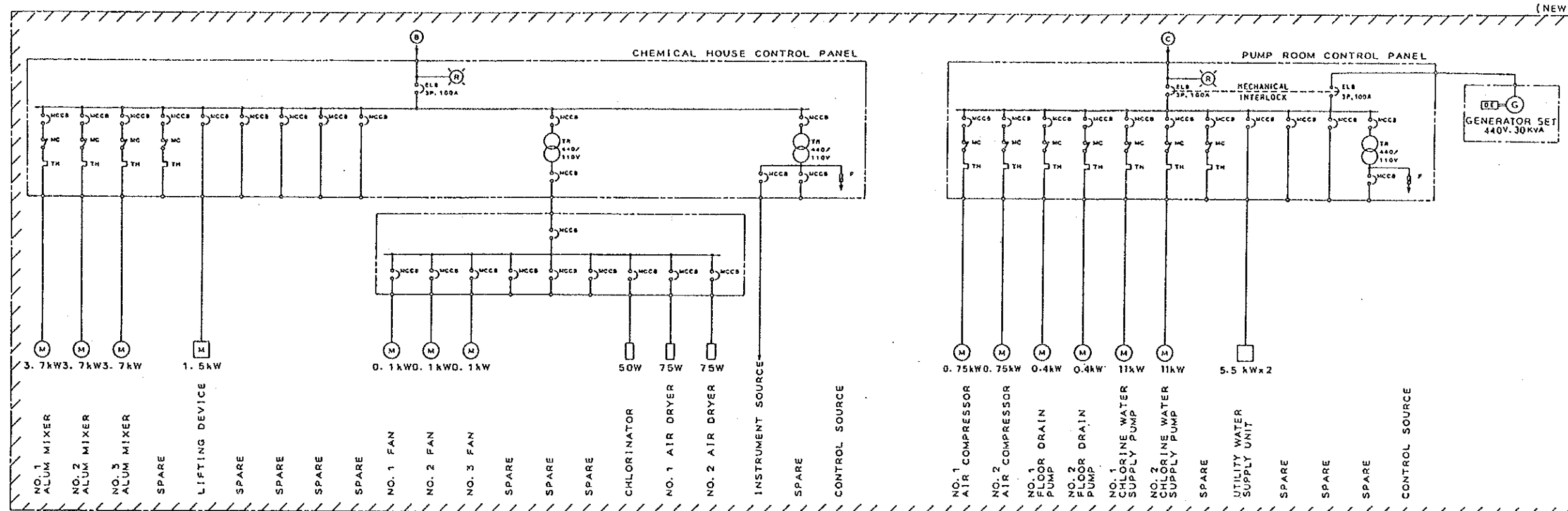
DRAWING
FLOW DIAGRAM OF
SIMLY WATER TREATMENT PLANT

AUG. '91 SCALE DRAWING 02
JAPAN INTERNATIONAL COOPERATION AGENCY



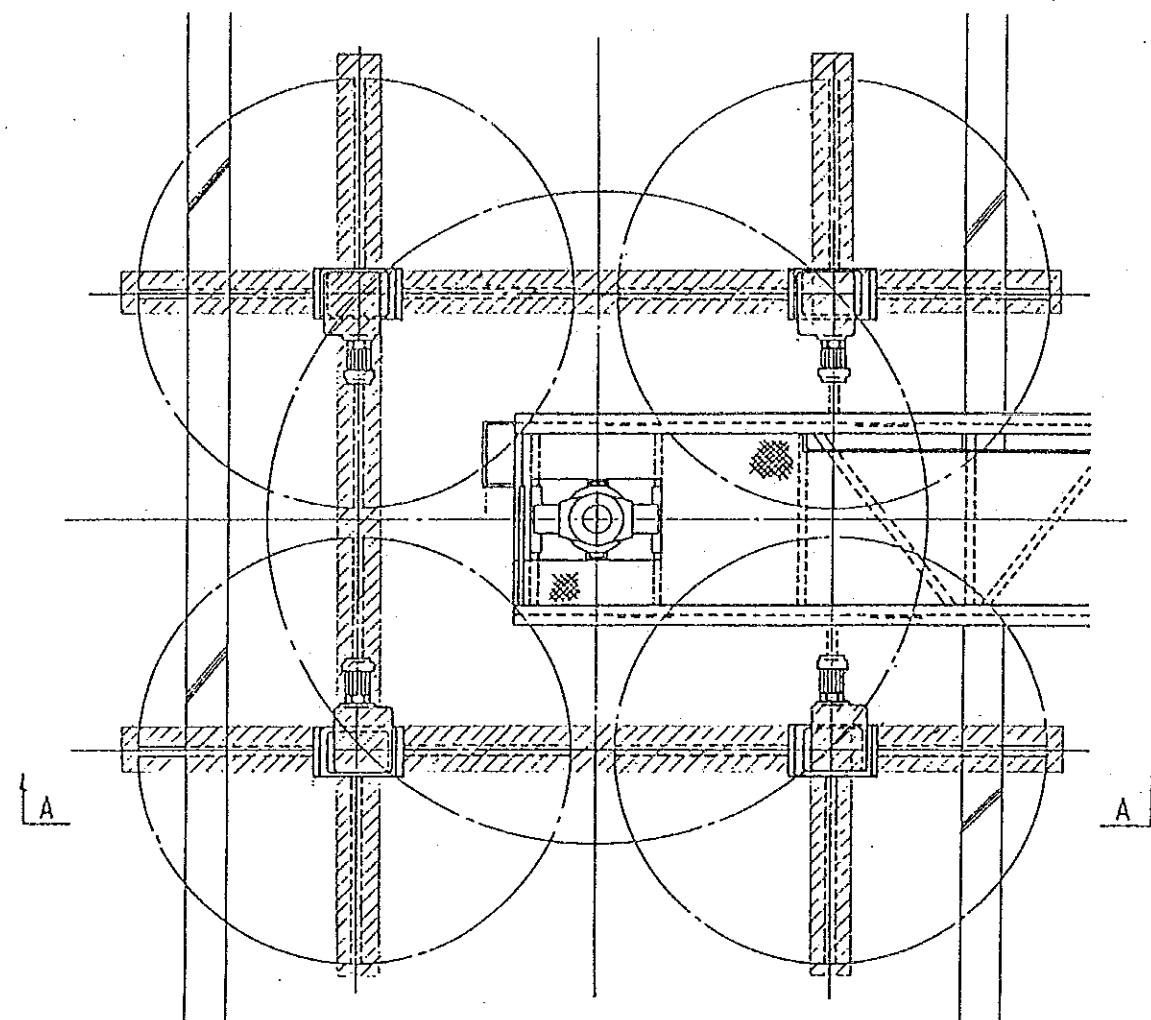
shows the equipment and materials
to be improved under the project

THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING	SINGLE-LINE DIAGRAM OF SIMPLY WATER TREATMENT PLANT (2/3)	
AUG. '91	SCALE	DRAWING NO. 03-2
JAPAN INTERNATIONAL COOPERATION AGENCY		

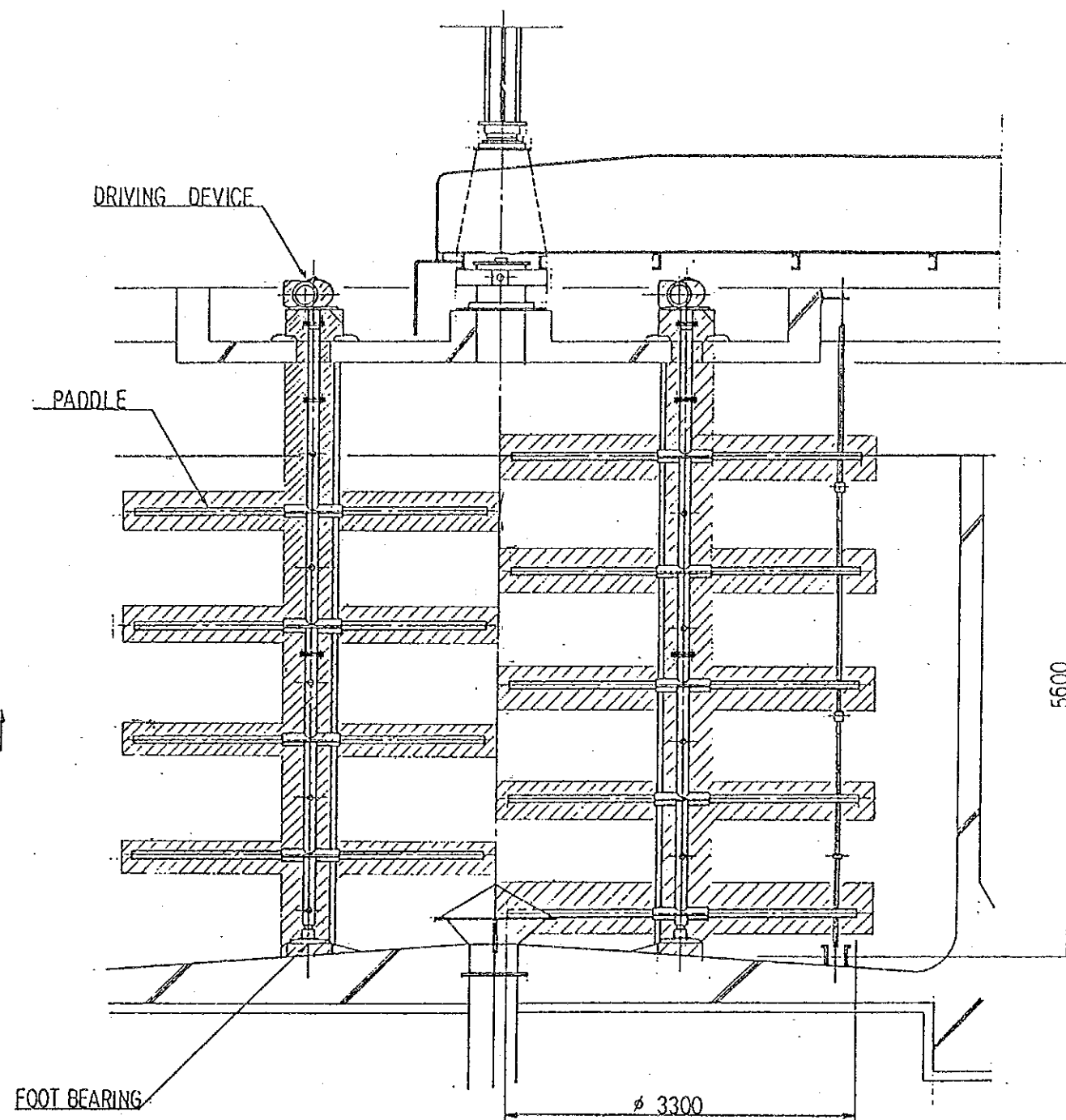


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to be improved under the project

THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING SINGLE-LINE DIAGRAM OF SIMLY WATER TREATMENT PLANT (3/3)		
AUG. '91	SCALE	DRAWING No. 03-3
JAPAN INTERNATIONAL COOPERATION AGENCY		



PLAN



SECTION A-A



shows the equipment and materials
to be improved under the project

THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING	ASSEMBLY DRAWING OF FLOCCULATOR (TYPICAL)	
AUG. '91	SCALE FREE	DRAWING 04
JAPAN INTERNATIONAL COOPERATION AGENCY		

2500 Chlorination Facilities

- 2501 Installation of chlorinator
- 2502 Installation of water supply pump
- 2503 Installation of pipes for water supply and solution
- 2504 Installation of lifting device
- 2505 Supply of gas mask and emergency kit
- 2506 Repair of floor in chlorine room

2400 Alum Dosing Facilities

- 2401 Repair of the existing alum tank
- 2402 Installation of measuring device
- 2403 Replacement of pipes for water supply and solution
- 2404 Construction of tank drainage
- 2405 Supply of hand-stirrer

2600 Distribution Pump Facilities

- 2601 Replacement of distribution pump

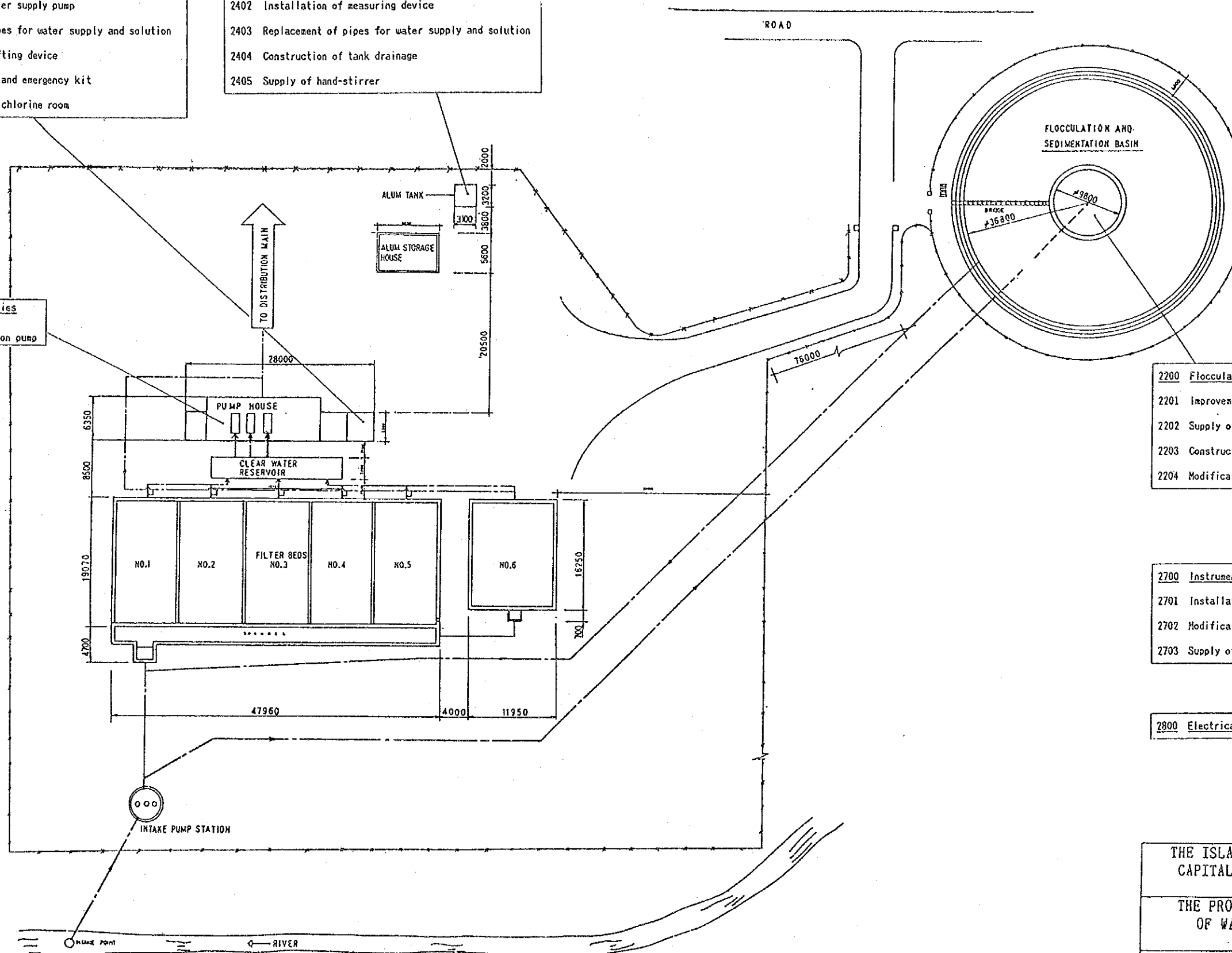
2200 Flocculation and Sedimentation Basin Facilities

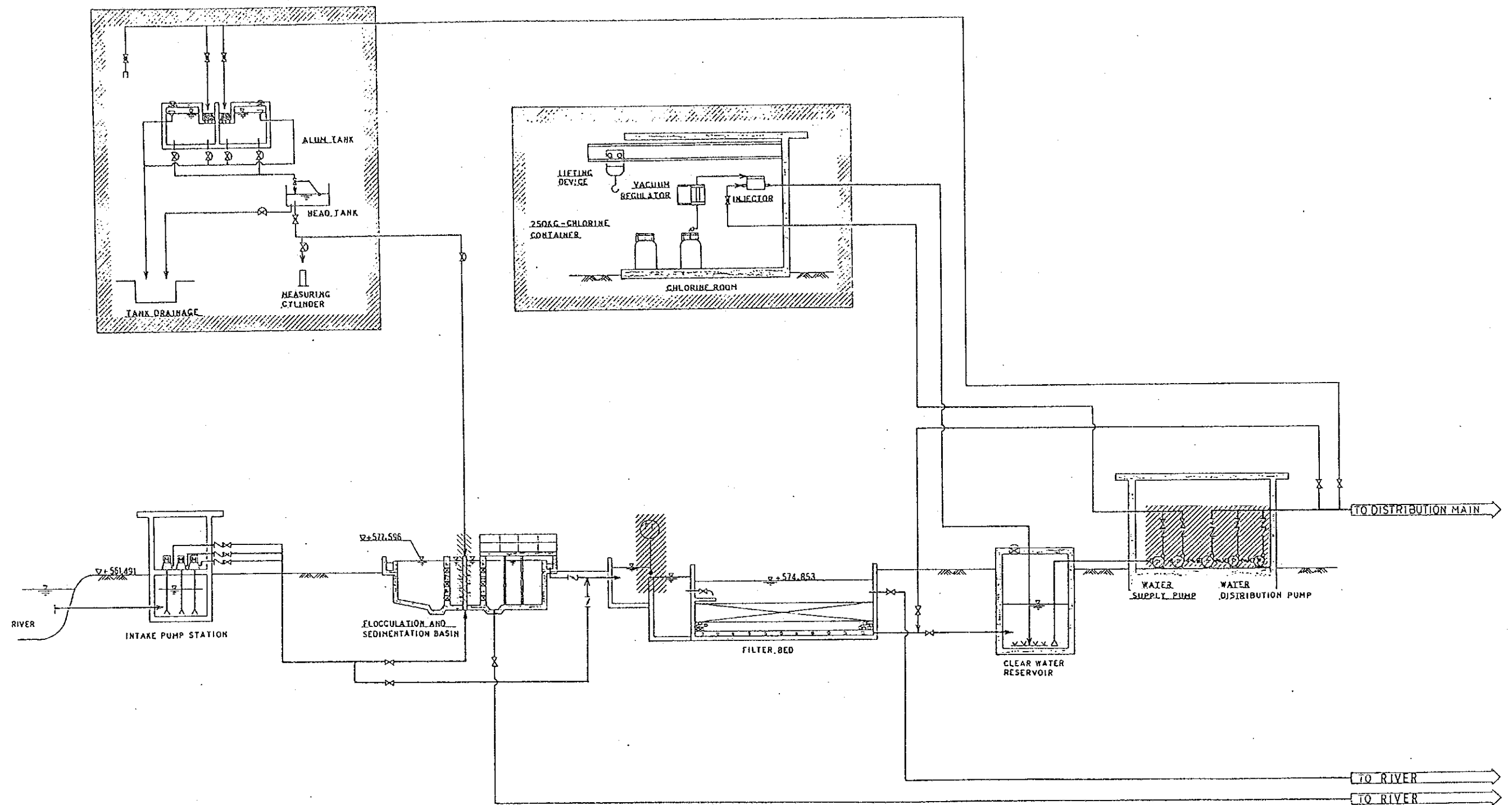
- 2201 Improvement of mixing and flocculation unit
- 2202 Supply of hand-scraper
- 2203 Construction of rain water drainage
- 2204 Modification of settled water pipes

2700 Instrument Facilities

- 2701 Installation of settled water flow meter
- 2702 Modification of the existing measuring tank
- 2703 Supply of water supply kit

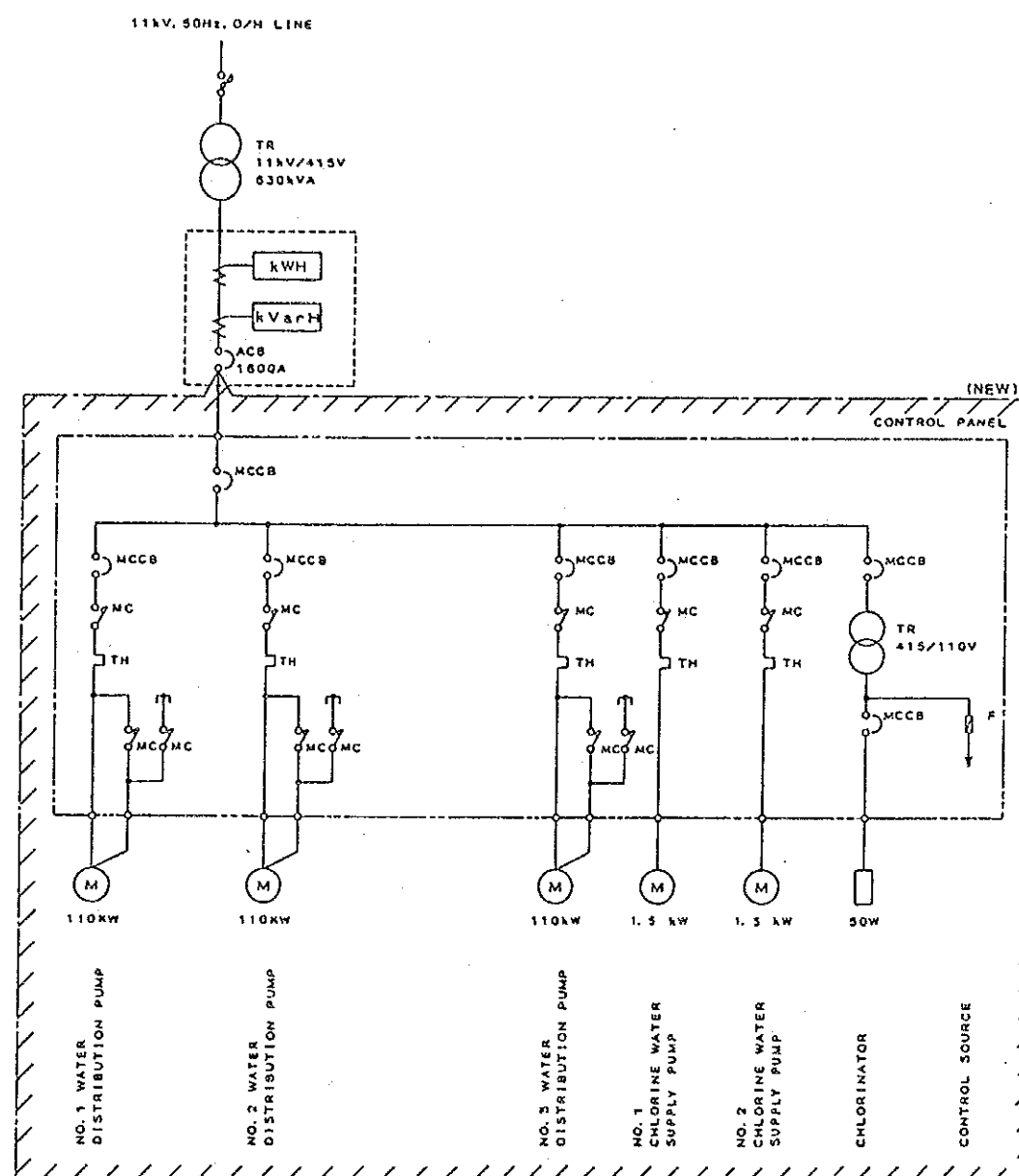
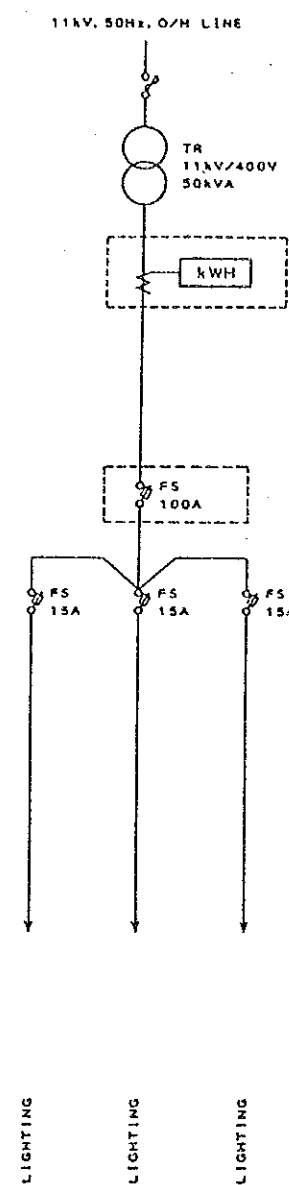
2800 Electrical Facilities





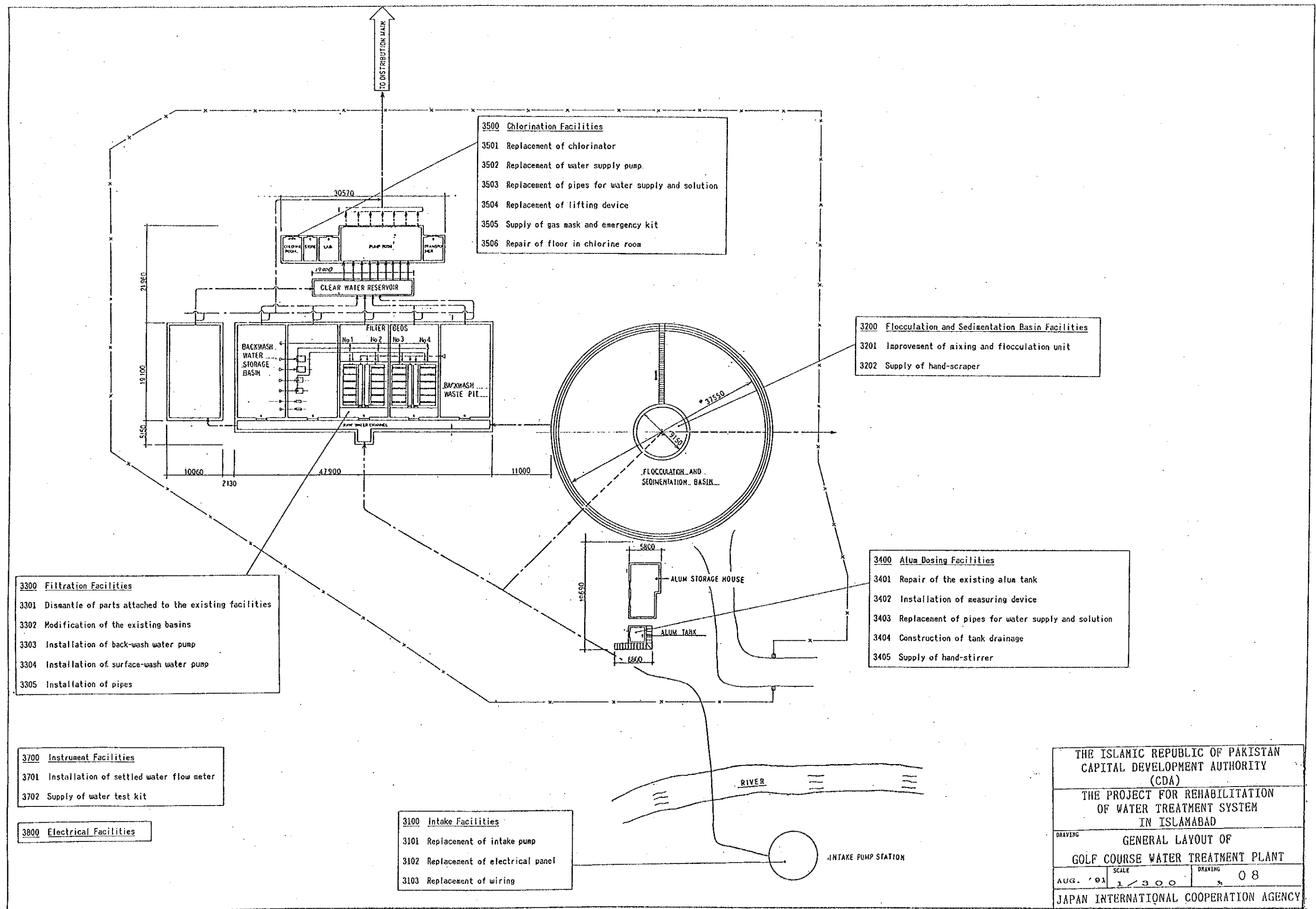
▨ shows the equipment and materials to be improved under the project.

THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING	FLOW DIAGRAM OF KORANG WATER TREATMENT PLANT	
AUG. '91	SCALE	DRAWING 06
JAPAN INTERNATIONAL COOPERATION AGENCY		



shows the equipment and materials
to be improved under the project

THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING SINGLE-LINE DIAGRAM OF KORANG WATER TREATMENT PLANT		
AUG. '91	SCALE	DRAWING No. 07
JAPAN INTERNATIONAL COOPERATION AGENCY		



- 3300 Filtration Facilities**
- 3301 Dismantle of parts attached to the existing facilities
 - 3302 Modification of the existing basins
 - 3303 Installation of back-wash water pump
 - 3304 Installation of surface-wash water pump
 - 3305 Installation of pipes

- 3700 Instrument Facilities**
- 3701 Installation of settled water flow meter
 - 3702 Supply of water test kit

- 3800 Electrical Facilities**
- 3103 Replacement of wiring

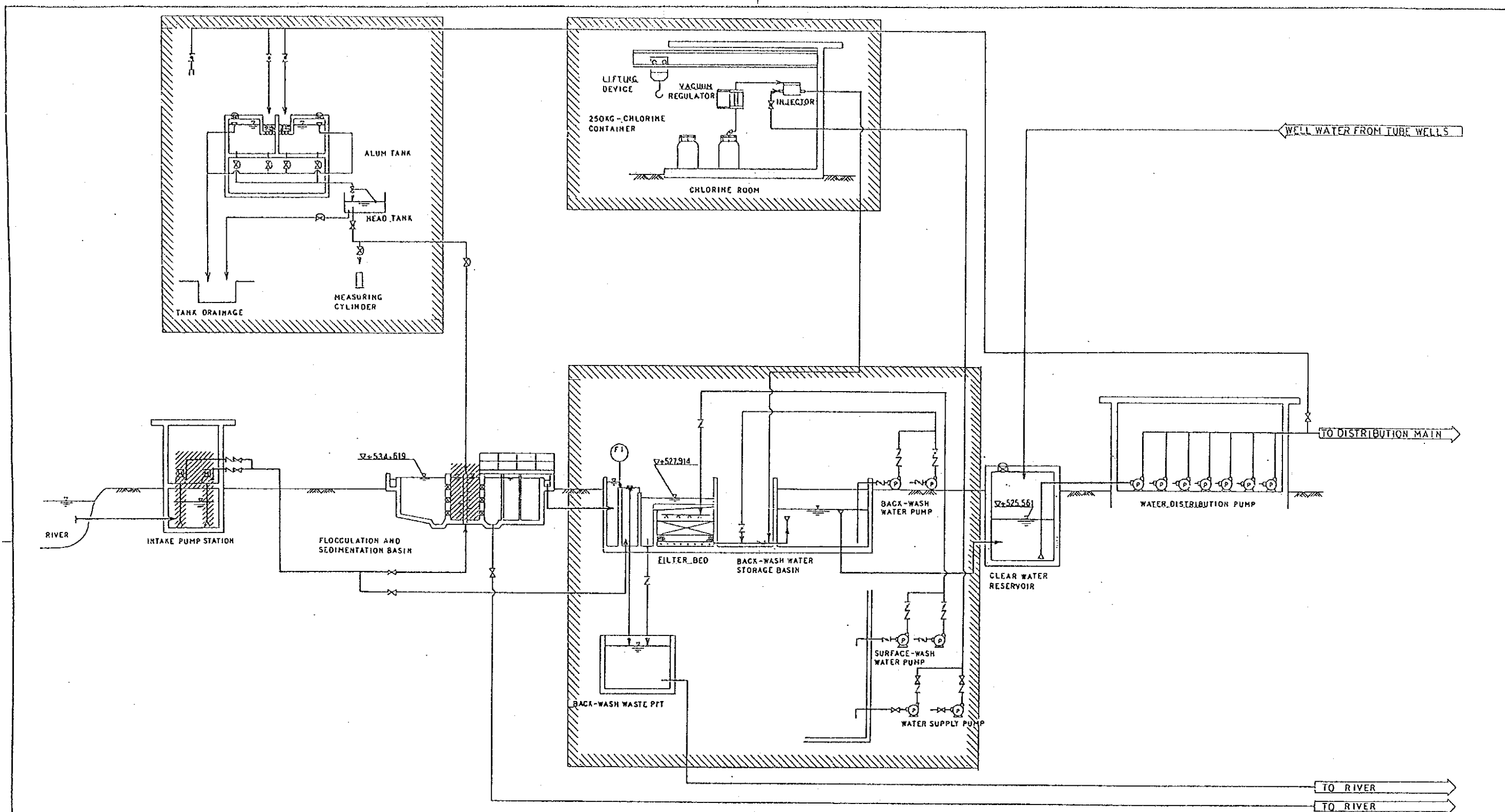
- 3100 Intake Facilities**
- 3101 Replacement of intake pump
 - 3102 Replacement of electrical panel
 - 3103 Replacement of wiring

- 3500 Chlorination Facilities**
- 3501 Replacement of chlorinator
 - 3502 Replacement of water supply pump
 - 3503 Replacement of pipes for water supply and solution
 - 3504 Replacement of lifting device
 - 3505 Supply of gas mask and emergency kit
 - 3506 Repair of floor in chlorine room

- 3200 Flocculation and Sedimentation Basin Facilities**
- 3201 Improvement of mixing and flocculation unit
 - 3202 Supply of hand-scraper

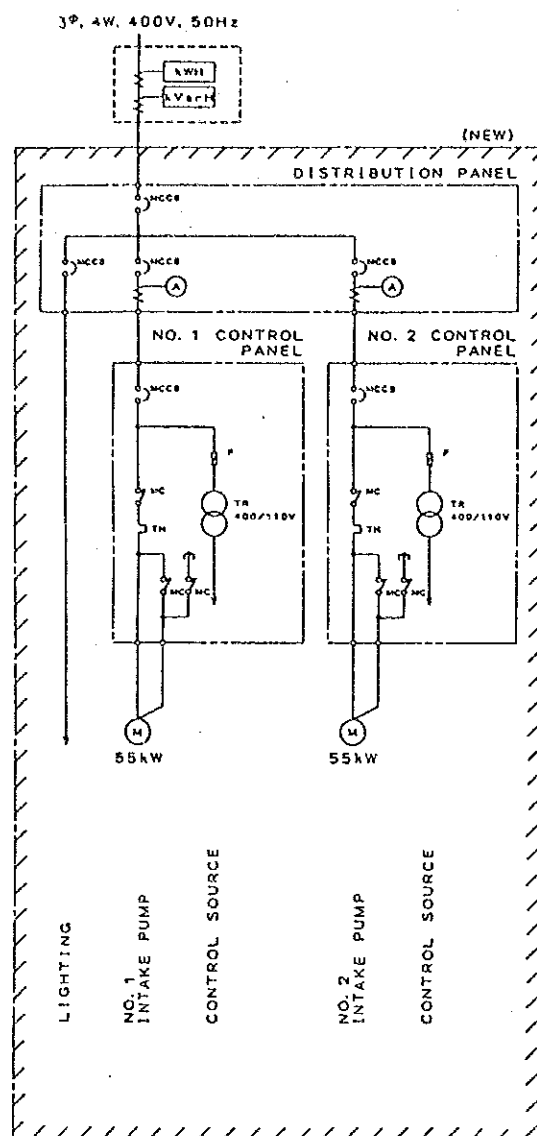
- 3400 Alum Dosing Facilities**
- 3401 Repair of the existing alum tank
 - 3402 Installation of measuring device
 - 3403 Replacement of pipes for water supply and solution
 - 3404 Construction of tank drainage
 - 3405 Supply of hand-stirrer

THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING	GENERAL LAYOUT OF GOLF COURSE WATER TREATMENT PLANT	
AUG. '91	SCALE 1/300	DRAWING 08
JAPAN INTERNATIONAL COOPERATION AGENCY		

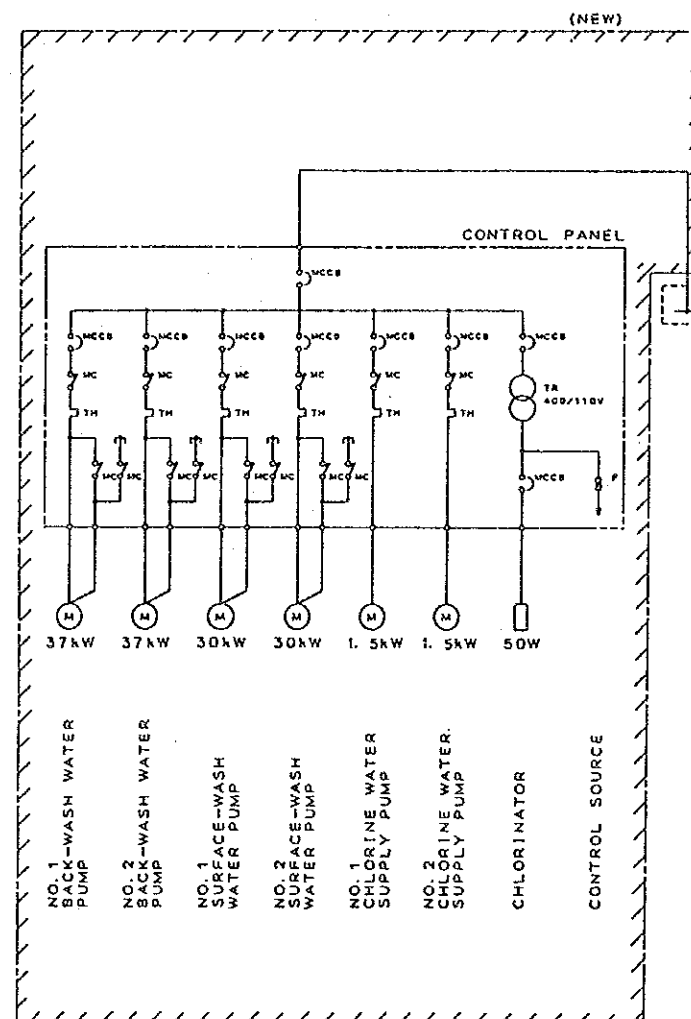


shows the equipment and materials to be improved under the project.

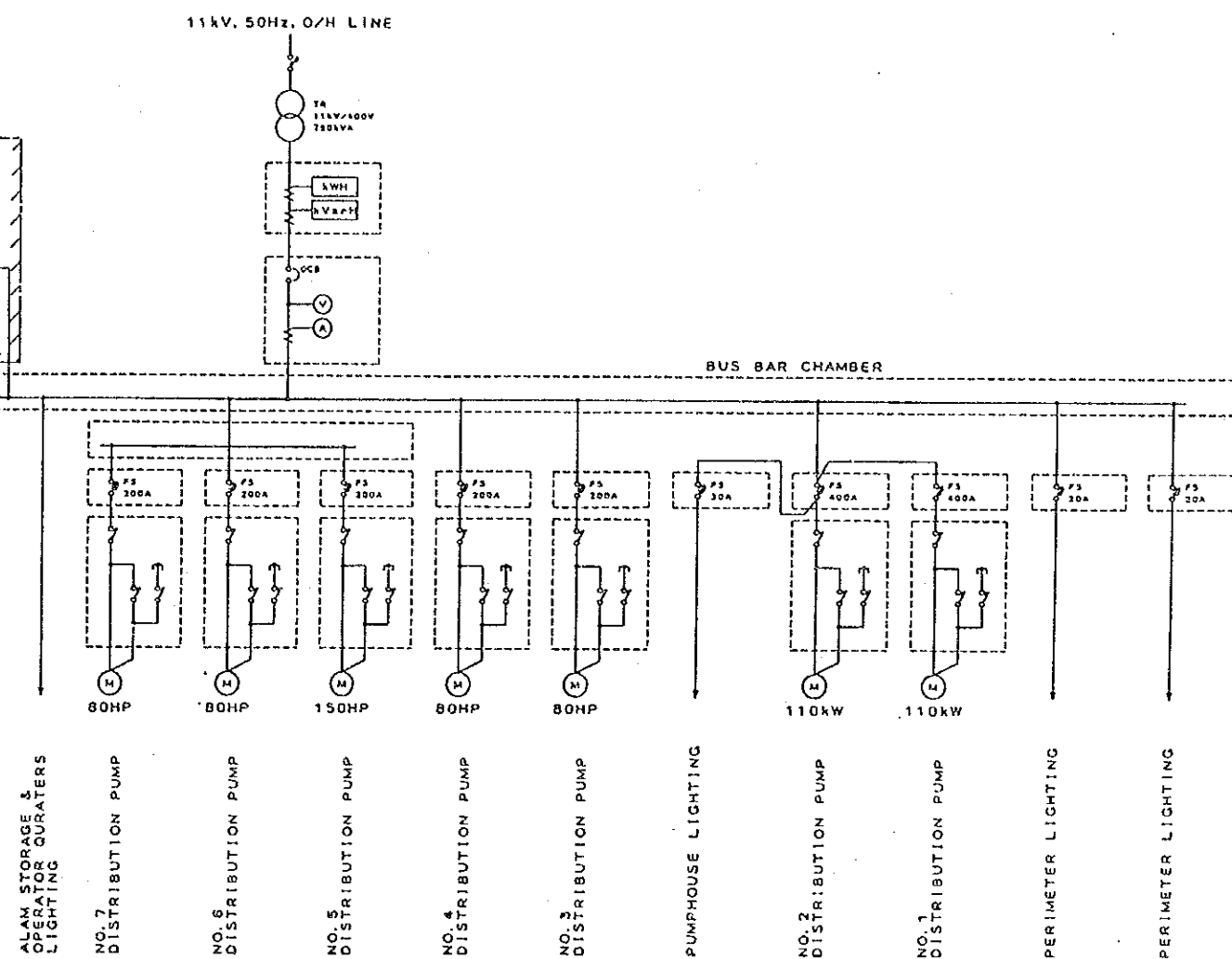
THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING FLOW DIAGRAM OF GOLF COURSE WATER TREATMENT PLANT		
AUG. '91	SCALE	DRAWING No. 09
JAPAN INTERNATIONAL COOPERATION AGENCY		



WATER INTAKE

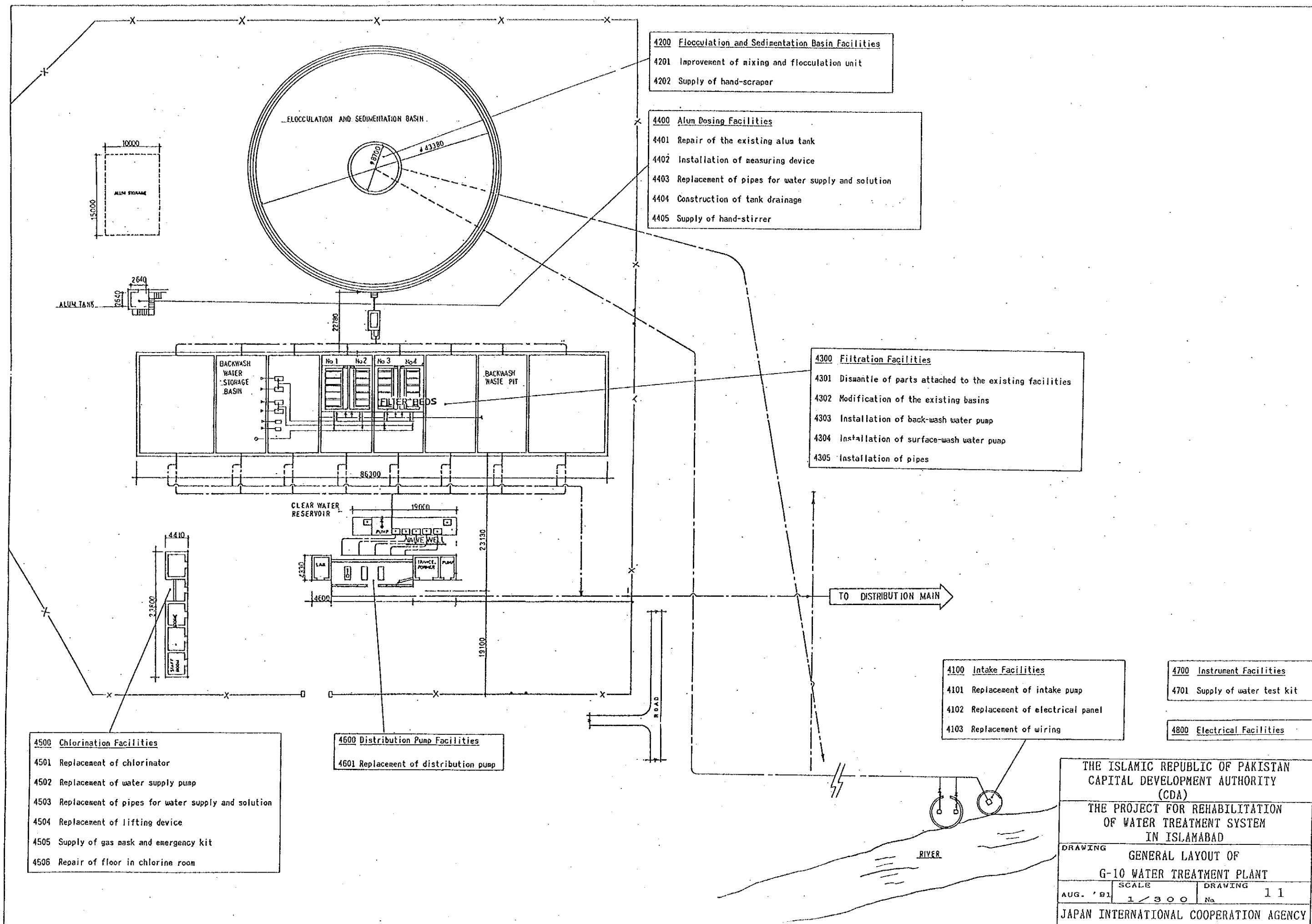


WATER TREATMENT



shows the equipment and materials to be improved under the project

THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING	SINGLE-LINE DIAGRAM OF GOLF COURSE WATER TREATMENT PLANT	
AUG. '91	SCALE	DRAWING 10
JAPAN INTERNATIONAL COOPERATION AGENCY		



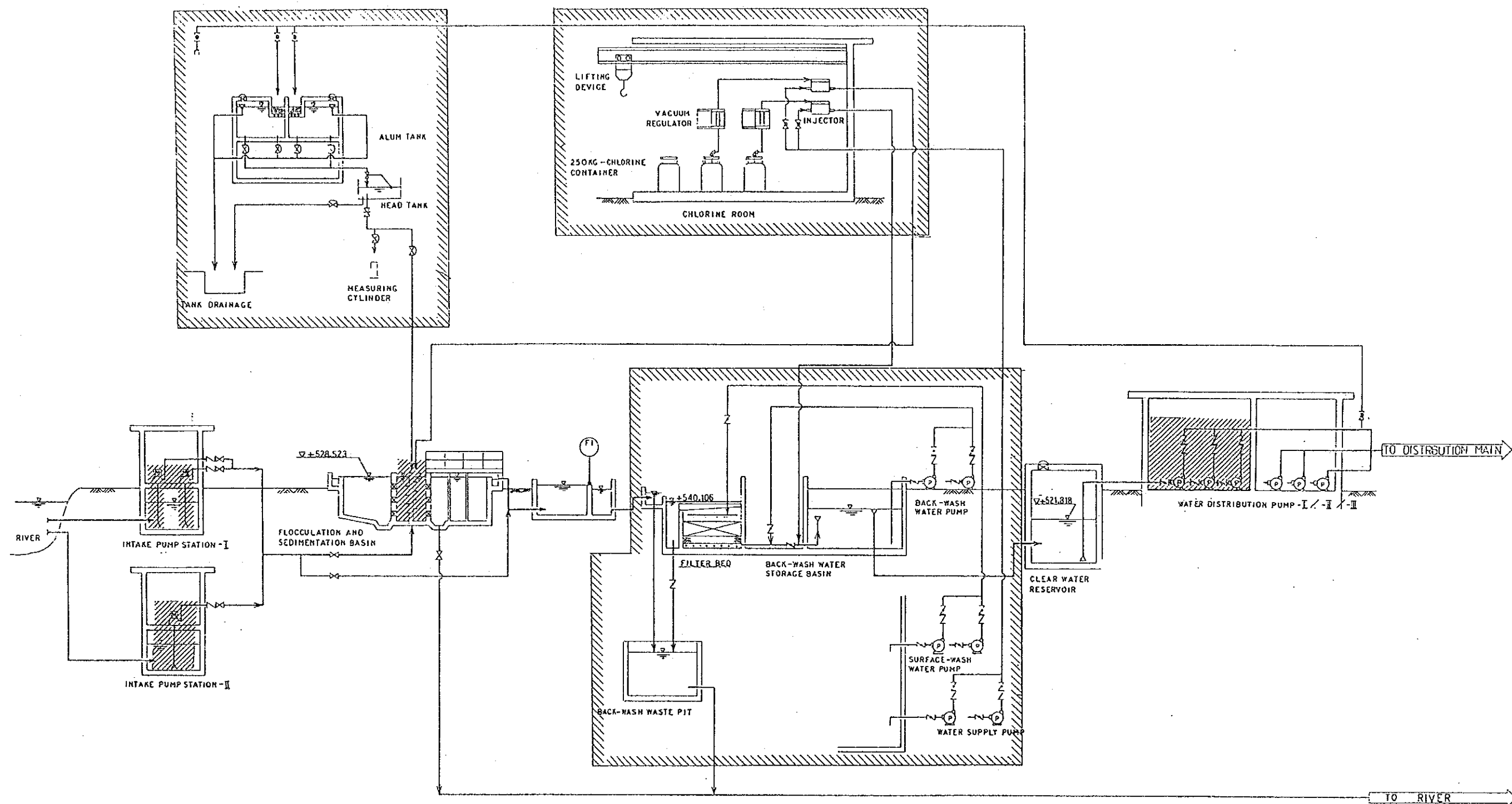
THE ISLAMIC REPUBLIC OF PAKISTAN
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THE PROJECT FOR REHABILITATION
OF WATER TREATMENT SYSTEM
IN ISLAMABAD

DRAWING
GENERAL LAYOUT OF
G-10 WATER TREATMENT PLANT

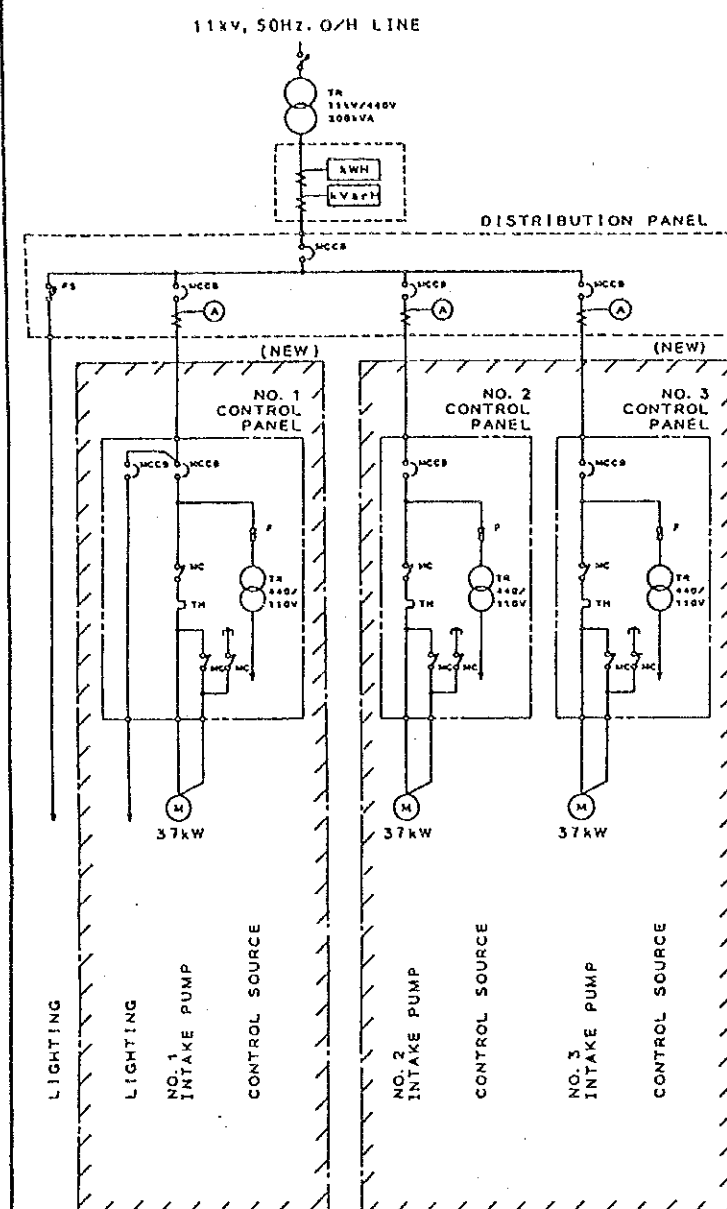
AUG. '91	SCALE 1 / 300	DRAWING No. 11
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JAPAN INTERNATIONAL COOPERATION AGENCY

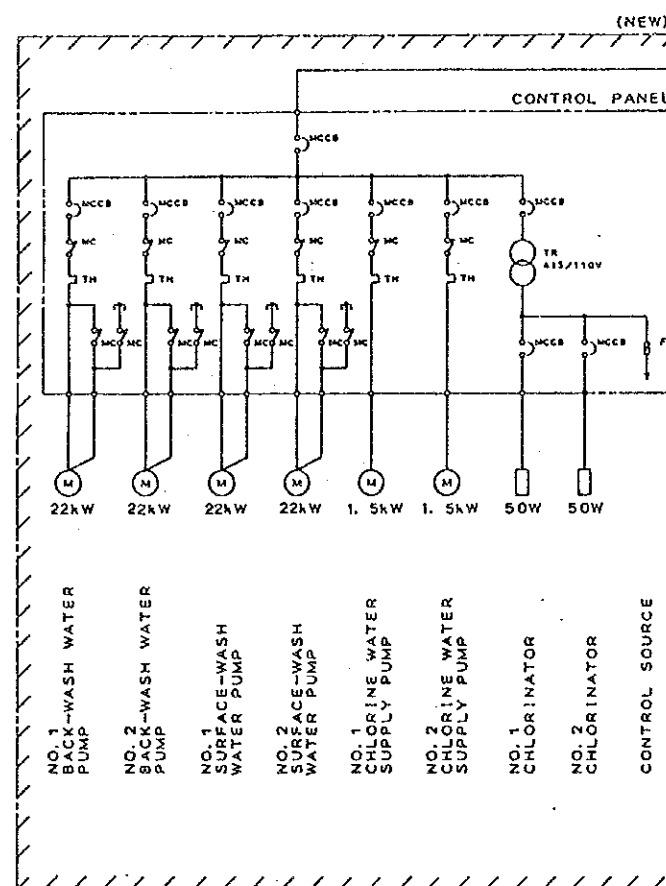


▨ shows the equipment and materials to be improved under the project.

THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING	FLOW DIAGRAM OF G-10 WATER TREATMENT PLANT	
AUG. '91	SCALE	DRAWING No. 1 2
JAPAN INTERNATIONAL COOPERATION AGENCY		



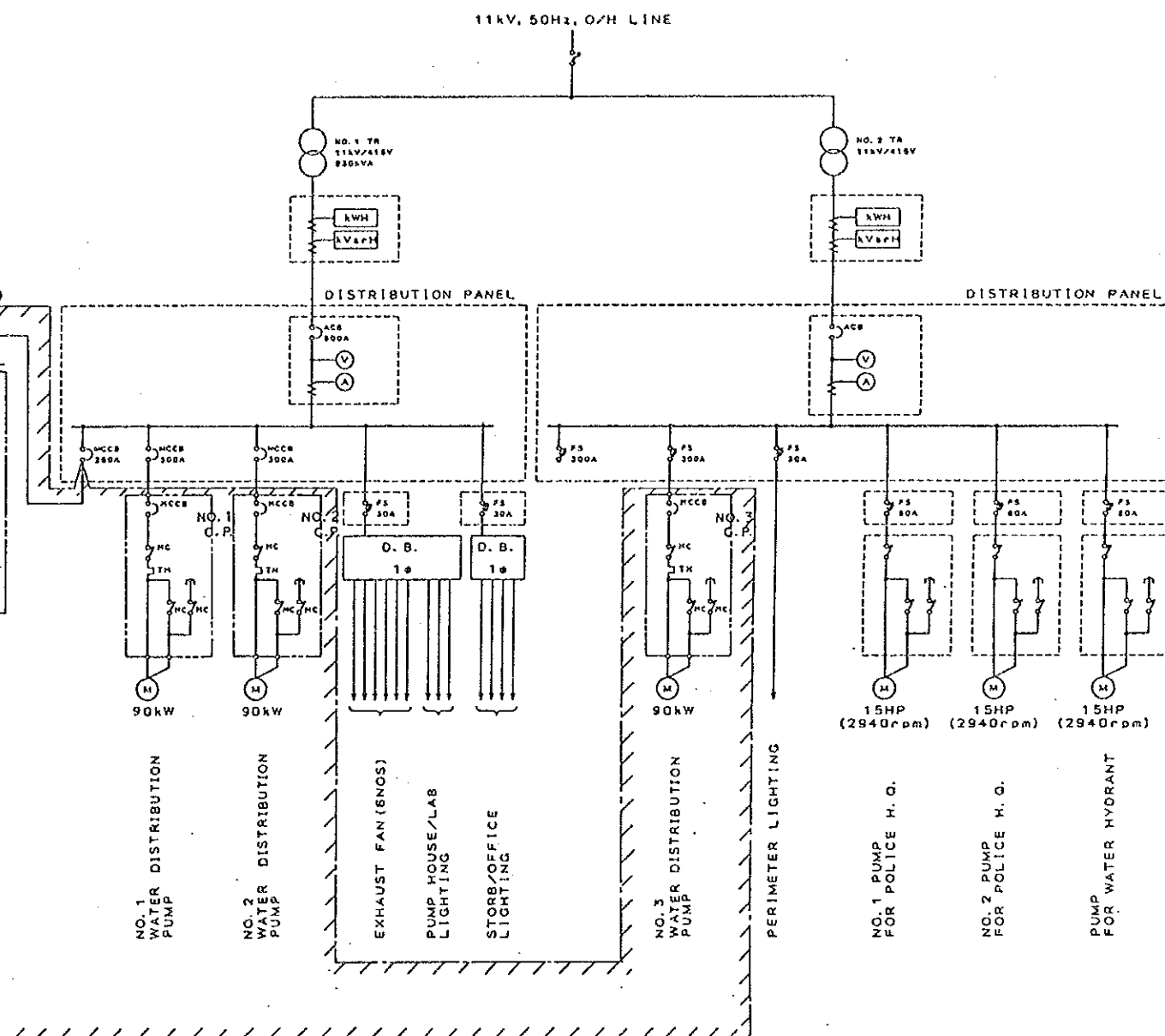
WATER INTAKE



WATER TREATMENT



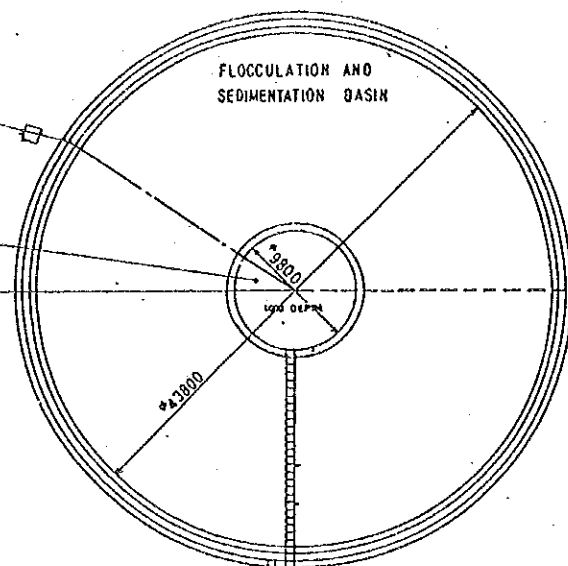
shows the equipment and materials
to be improved under the project



THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)			
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD			
DRAWING SINGLE-LINE DIAGRAM OF G-10 WATER TREATMENT PLANT			
AUG. '91	SCALE	DRAWING No.	13
JAPAN INTERNATIONAL COOPERATION AGENCY			

- 5200 Flocculation and Sedimentation Basin Facilities
- 5201 Improvement of mixing and flocculation unit
- 5202 Supply of hand-scraper
- 5203 Repair of water leakage of the basin

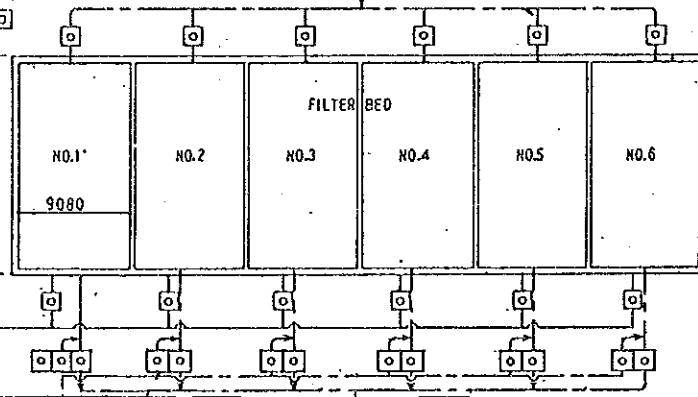
DRAIN
TO RIVER



56300

FLOW MEASURING TANK

57500

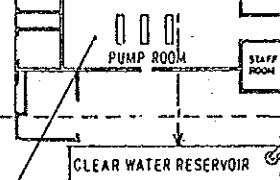


WASH-OUT
TO RIVER

- 5500 Chlorination Facilities
- 5501 Replacement of chlorinator
- 5502 Installation of water supply pump
- 5503 Replacement of pipes for water supply and solution
- 5504 Replacement of lifting device
- 5505 Supply of gas mask and emergency kit
- 5506 Repair of floor in chlorine room

5600 Distribution Pump Facilities

- 5601 Replacement of distribution pump



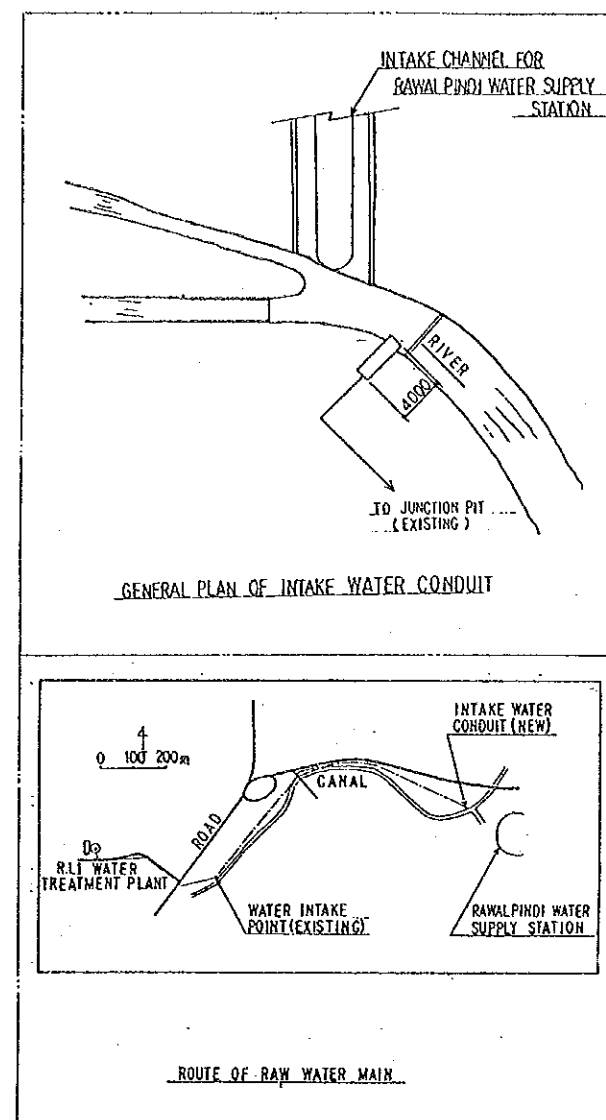
ALUM
TANK
3200
4300

TO DISTRIBUTION MAIN

- 5400 Alum Dosing Facilities
- 5401 Repair of the existing alum tank
- 5402 Installation of measuring device
- 5403 Replacement of pipes for water supply and solution
- 5404 Construction of tank drainage
- 5405 Supply of hand-stirrer

- 5700 Instrument Facilities
- 5701 Installation of settled water flow meter
- 5702 Supply of water test kit

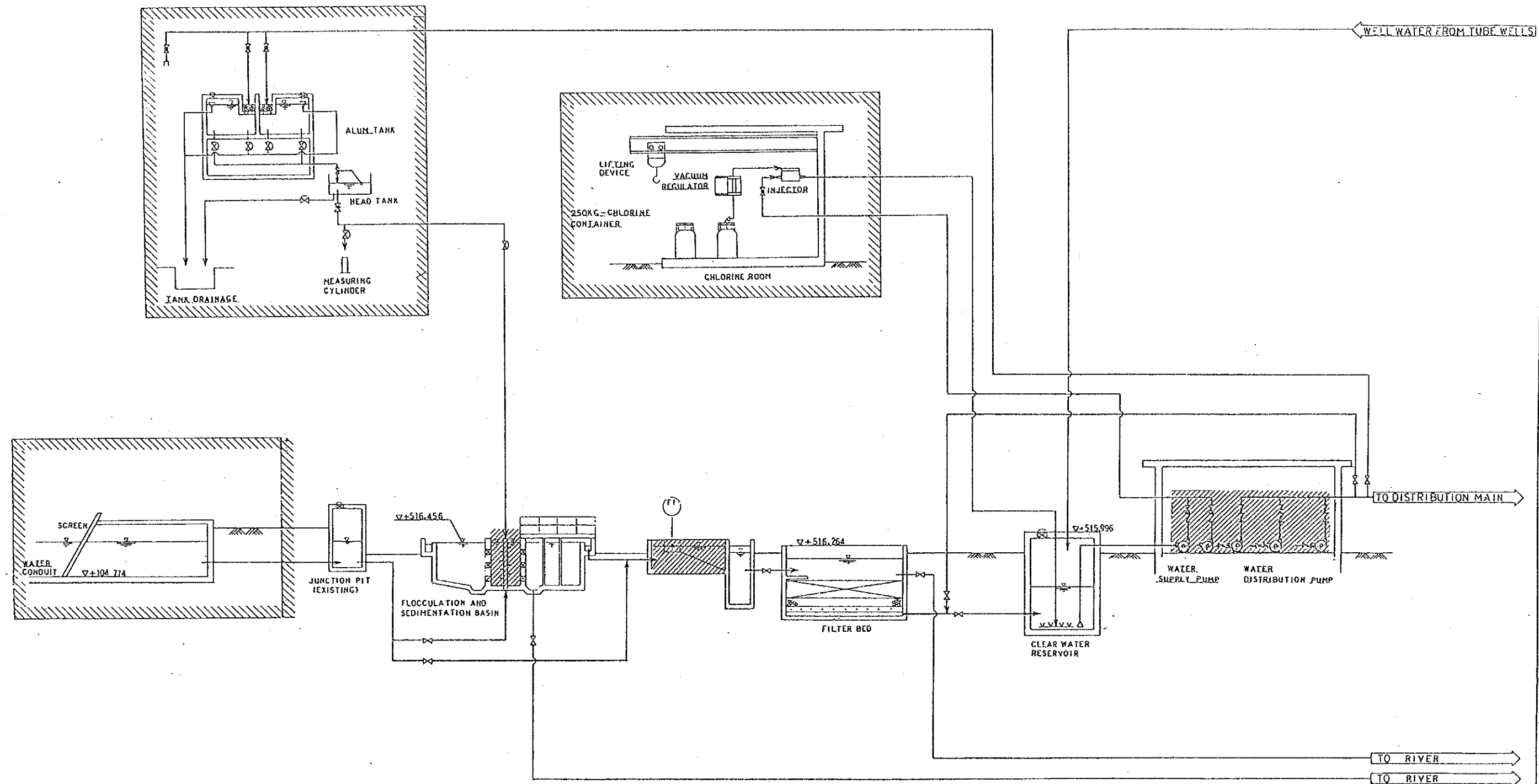
5800 Electrical Facilities



- 5100 Intake and Raw Water Main Facilities
- 5101 Construction of intake channel
- 5102 Installation of screen
- 5103 Installation of raw water main

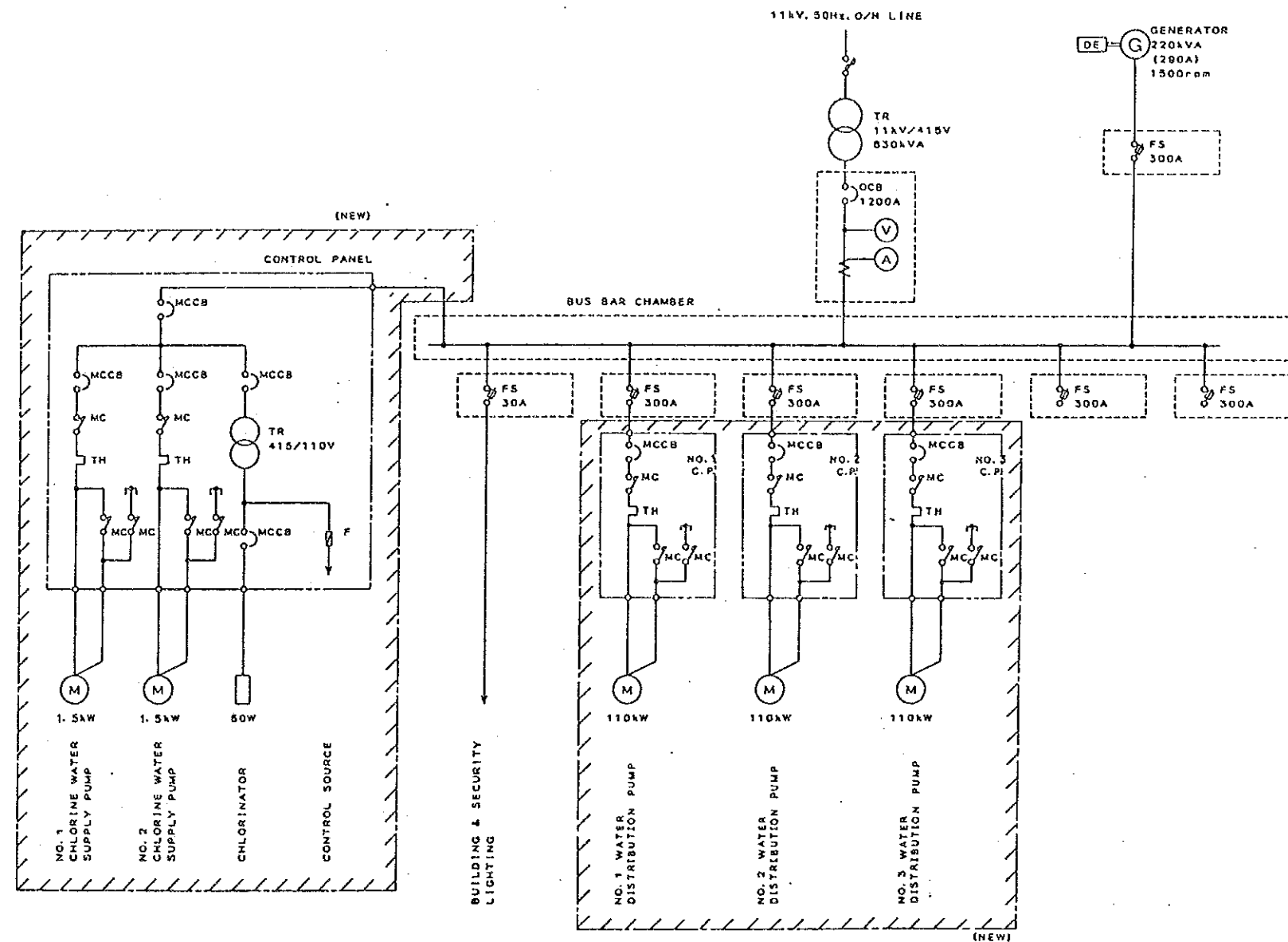
THE ISLAMIC REPUBLIC OF PAKISTAN
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(CDA)
THE PROJECT FOR REHABILITATION
OF WATER TREATMENT SYSTEM
IN ISLAMABAD

DRAWING
GENERAL LAYOUT OF
R.L.1 WATER TREATMENT PLANT
AUG. '91 SCALE 1/300 DRAWING 14
JAPAN INTERNATIONAL COOPERATION AGENCY



shows the equipment and materials to be improved under the project.

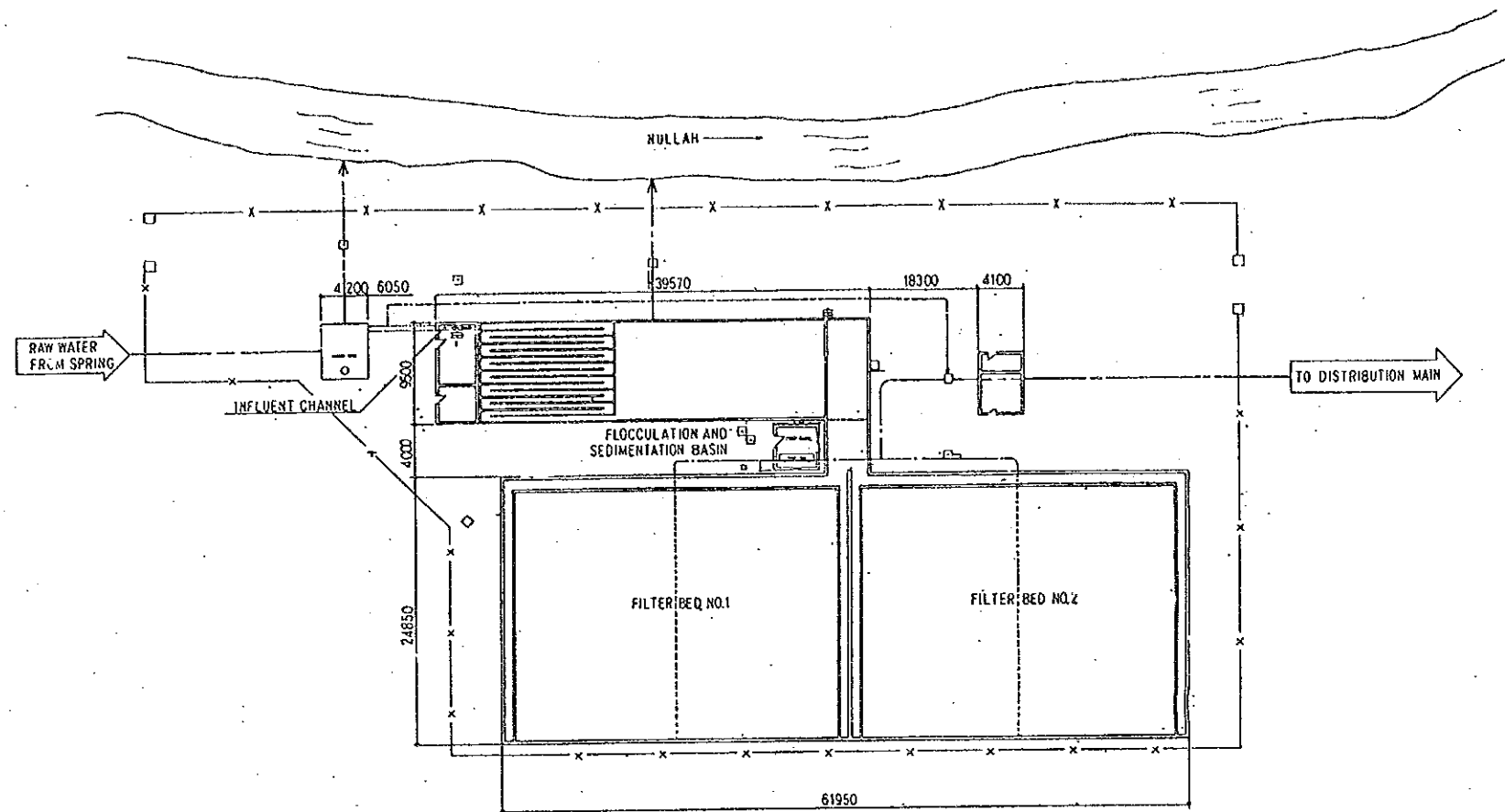
THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING FLOW DIAGRAM OF R.L.1 WATER TREATMENT PLANT		
AUG. '91	SCALE	DRAWING No. 15
JAPAN INTERNATIONAL COOPERATION AGENCY		



WATER TREATMENT

shows the equipment and materials to be improved under the project

THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING	SINGLE-LINE DIAGRAM OF R.L.1 WATER TREATMENT PLANT	
AUG. '91	SCALE	DRAWING 1/6
JAPAN INTERNATIONAL COOPERATION AGENCY		



6100 Raw Water Receiving Well Facilities
6101 Replacement of raw water by-pass valve

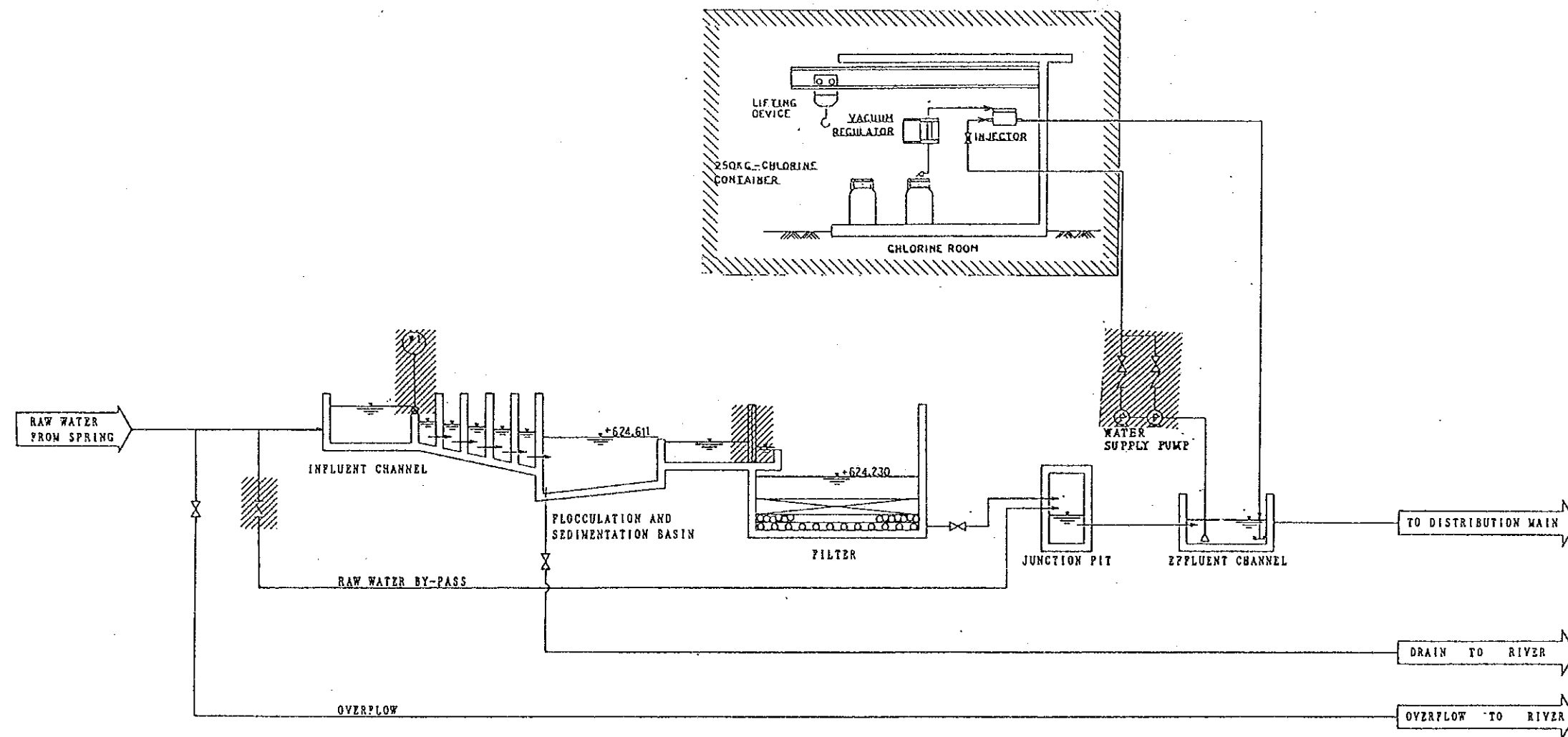
6300 Filtration Facilities
6301 Improvement/repair of inlet water stop

6500 Chlorination Facilities
6501 Dismantle and installation of chlorination facility
6502 Installation of water supply pump
6503 Installation of pipes for water supply and solution
6504 Installation of lifting device
6505 Supply of gas mask and emergency kit

6700 Instrument Facilities
6701 Installation of raw water flow meter
6702 Supply of water test kit

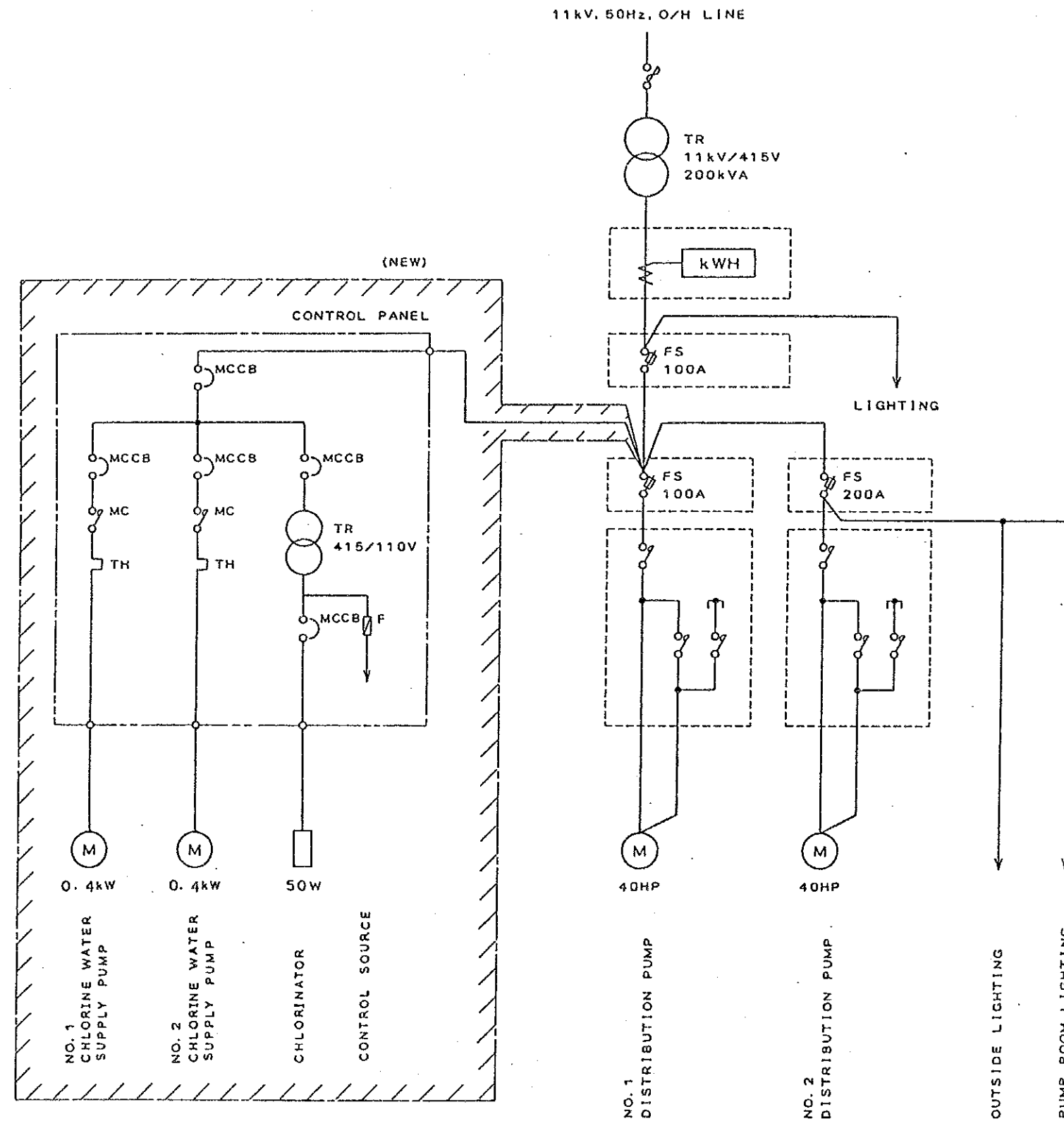
6800 Electrical Facilities

THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING GENERAL LAYOUT OF SAIDPUR WATER TREATMENT PLANT		
AUG, '91	SCALE 1 / 300	DRAWING No. 17
JAPAN INTERNATIONAL COOPERATION AGENCY		



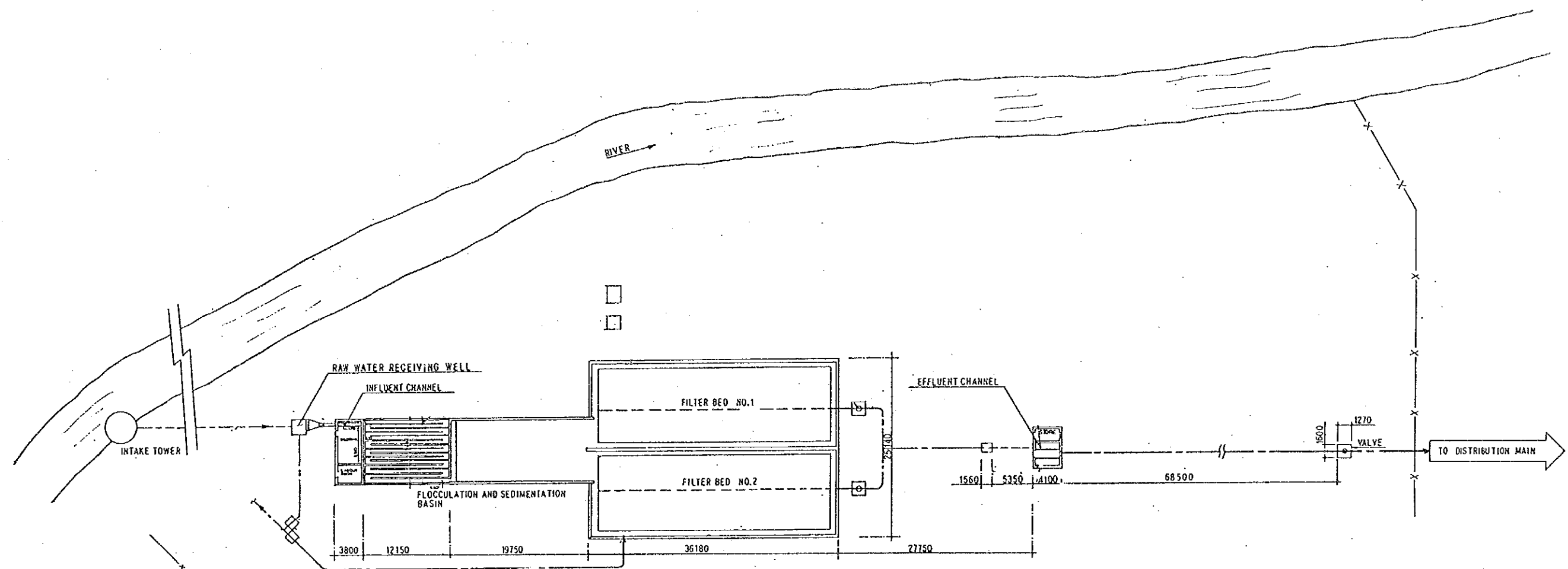
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THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING	FLOW DIAGRAM OF SAIDPUR WATER TREATMENT PLANT	
AUG. '81	SCALE	DRAWING No. 18
JAPAN INTERNATIONAL COOPERATION AGENCY		



shows the equipment and materials to be improved under the project

THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER-TREATMENT SYSTEM IN ISLAMABAD		
DRAWING SINGLE-LINE DIAGRAM OF SAIDPUR WATER WORKS		
AUG. '91	SCALE	DRAWING No. 19
JAPAN INTERNATIONAL COOPERATION AGENCY		



7100 Raw Water Receiving well Facilities

7101 Improvement of flow control function

7300 Filtration Facilities

7301 Improvement/repair of inlet water stop

7400 Alum Dosing Facilities

7401 Installation of alum dosing facilities

7500 Chlorination Facilities

7501 Disassemble and installation of the chlorination facility

7502 Installation of water supply pump

7503 Installation of pipes for water supply and solution

7504 Installation of lifting device

7505 Supply of gas mask and emergency kit

7700 Instrument Facilities

7701 Installation of raw water flow meter

7702 Supply of water test kit

7800 Electrical Facilities

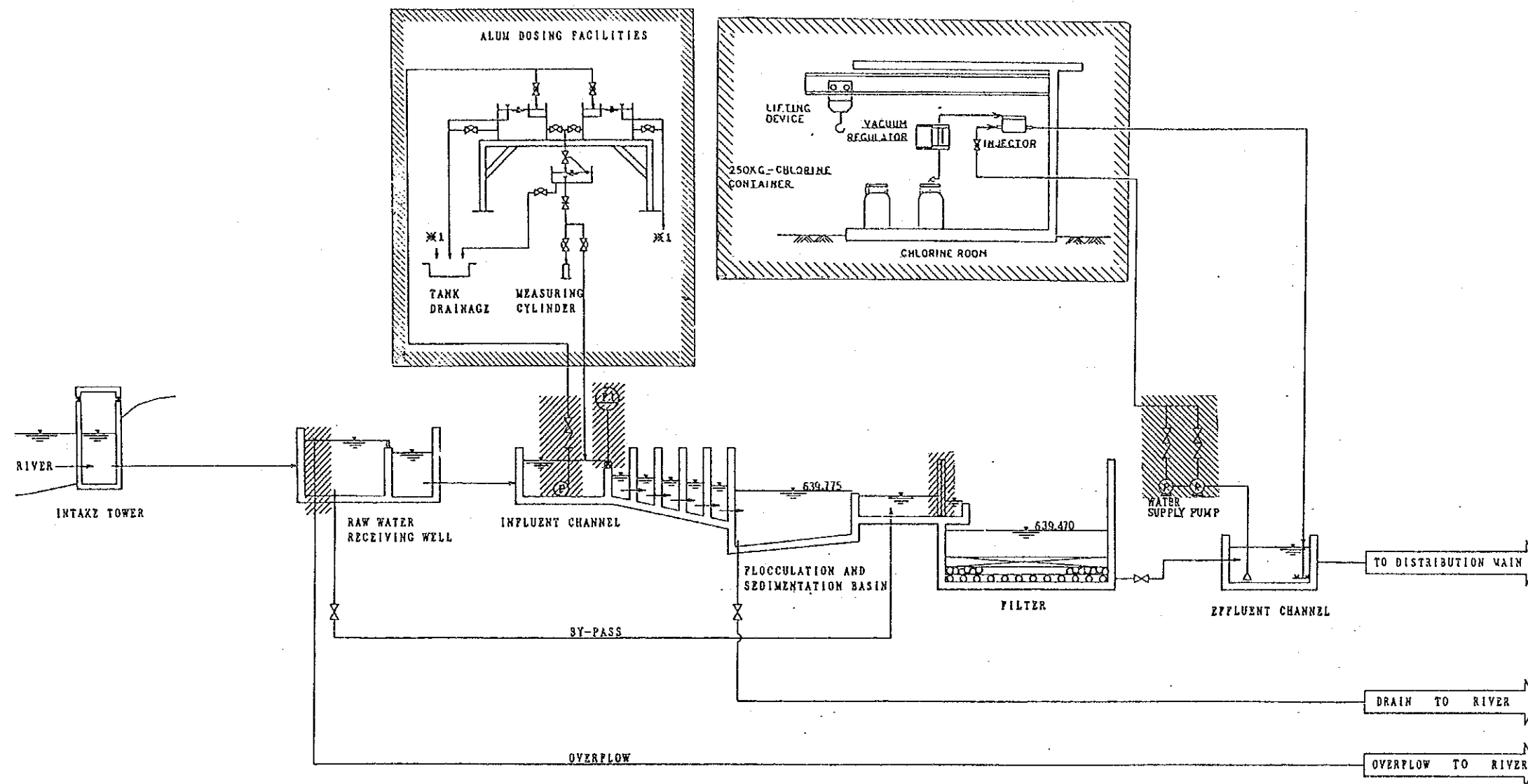
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(CDA)

THE PROJECT FOR REHABILITATION
OF WATER TREATMENT SYSTEM
IN ISLAMABAD

DRAWING GENERAL LAYOUT OF
NOORPUR WATER TREATMENT PLANT

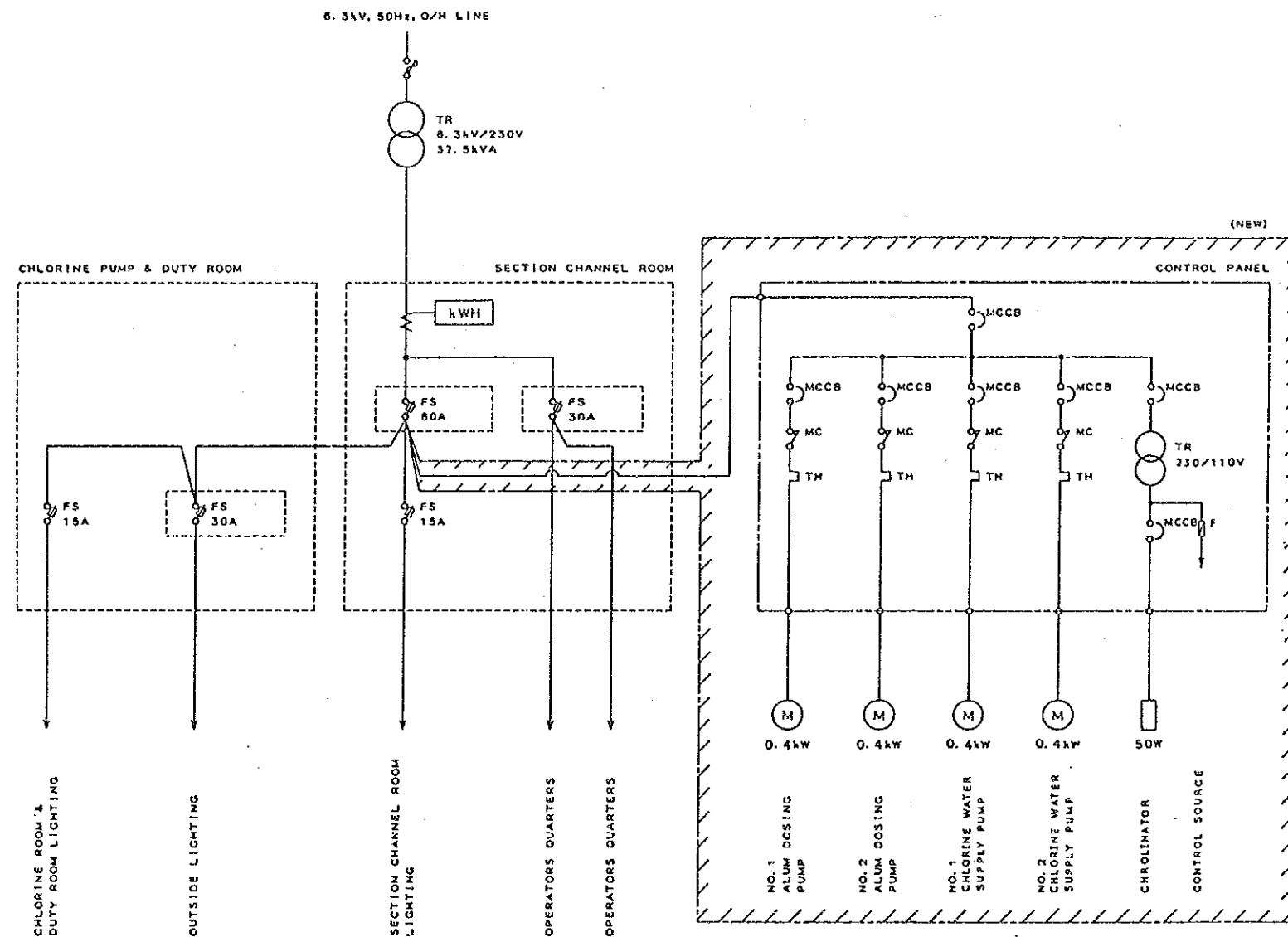
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JAPAN INTERNATIONAL COOPERATION AGENCY



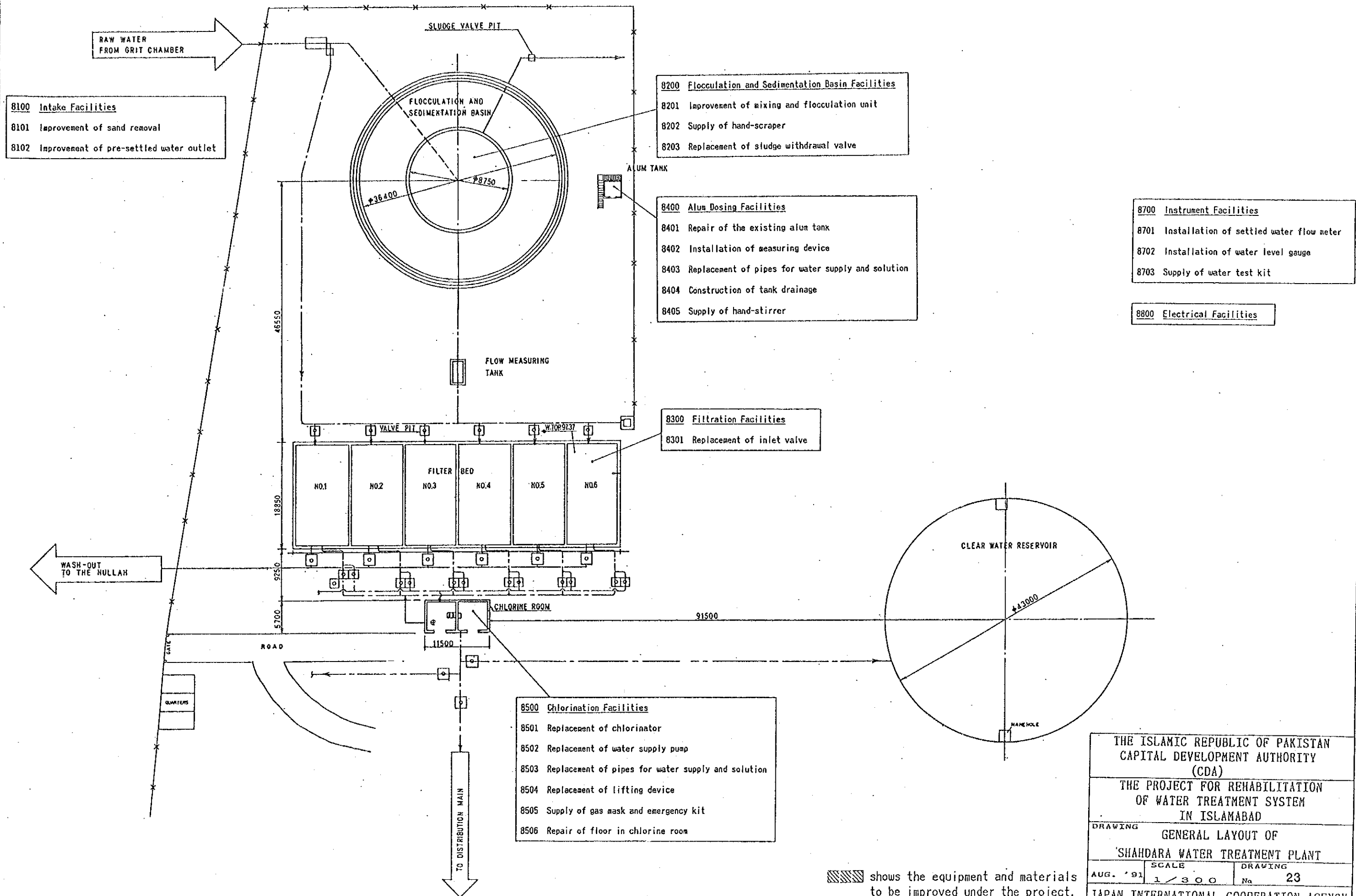
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THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING FLOW DIAGRAM OF NOORPUR WATER TREATMENT PLANT		
AUG. '91	SCALE	DRAWING No. 21
JAPAN INTERNATIONAL COOPERATION AGENCY		

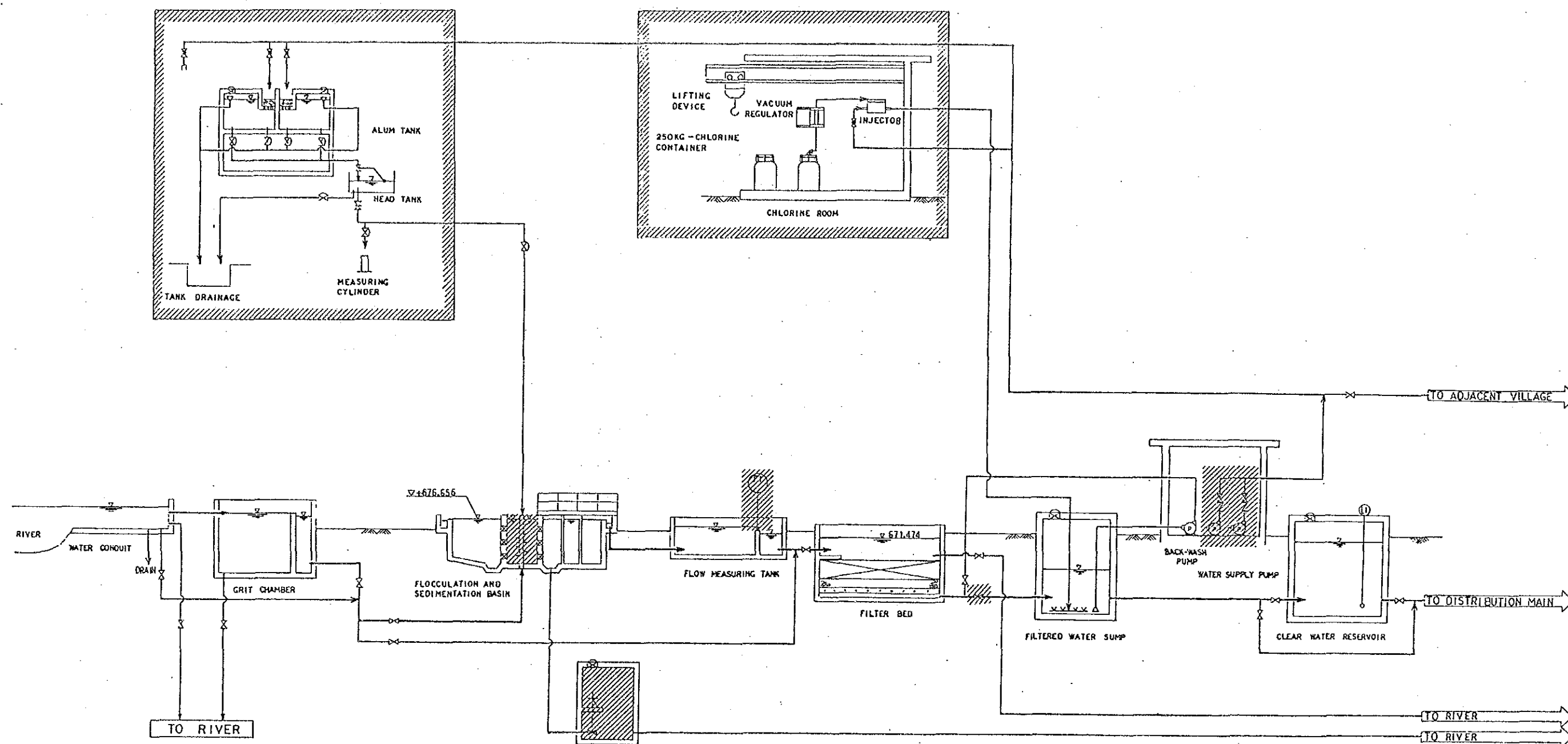


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THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING SINGLE-LINE DIAGRAM OF NOORPUR WATER TREATMENT PLANT		
AUG. '91	SCALE	DRAWING No. 22
JAPAN INTERNATIONAL COOPERATION AGENCY		

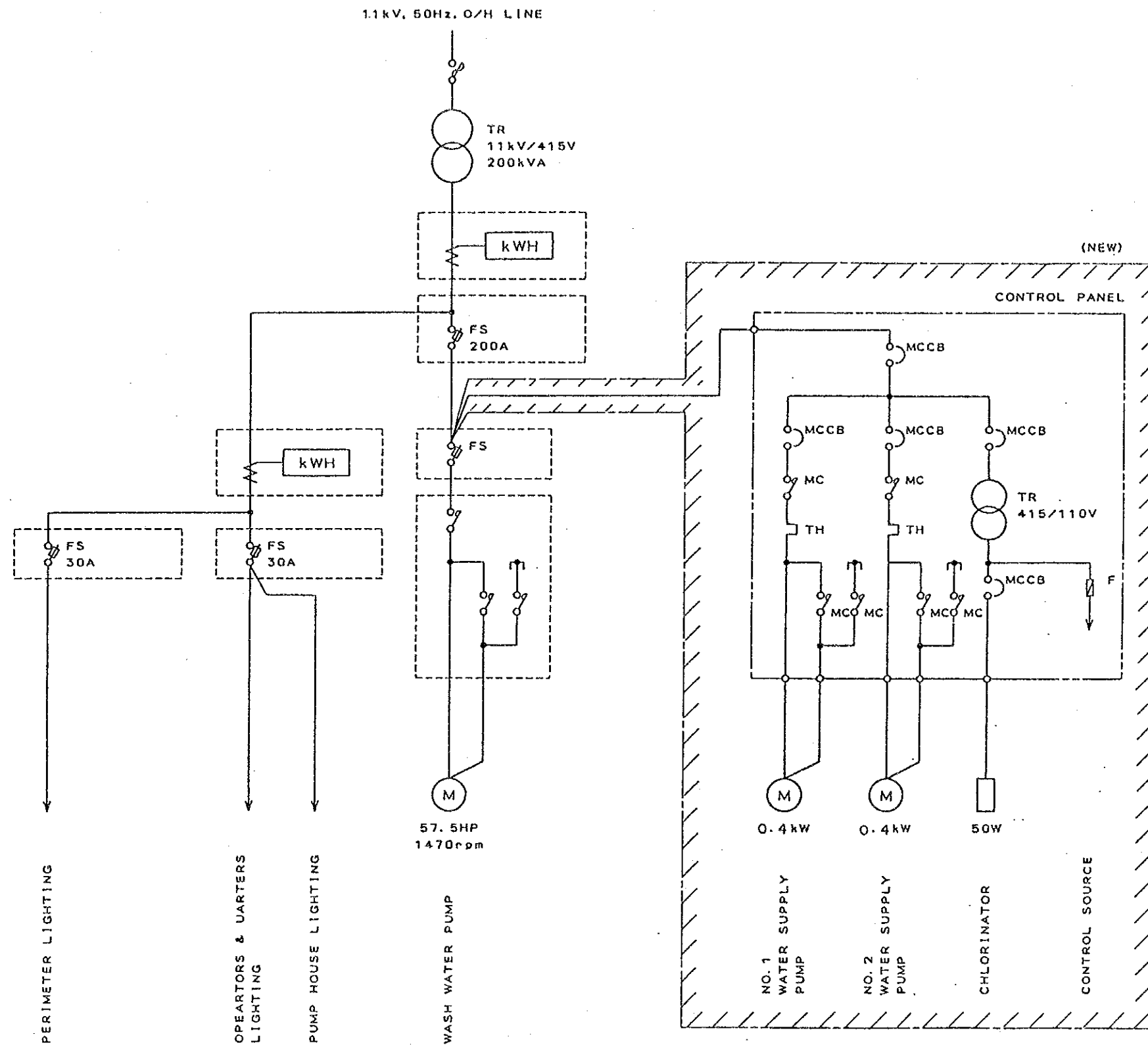


THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING GENERAL LAYOUT OF SHAHDARA WATER TREATMENT PLANT		
AUG. '91	SCALE 1 / 300	DRAWING No. 23
JAPAN INTERNATIONAL COOPERATION AGENCY		



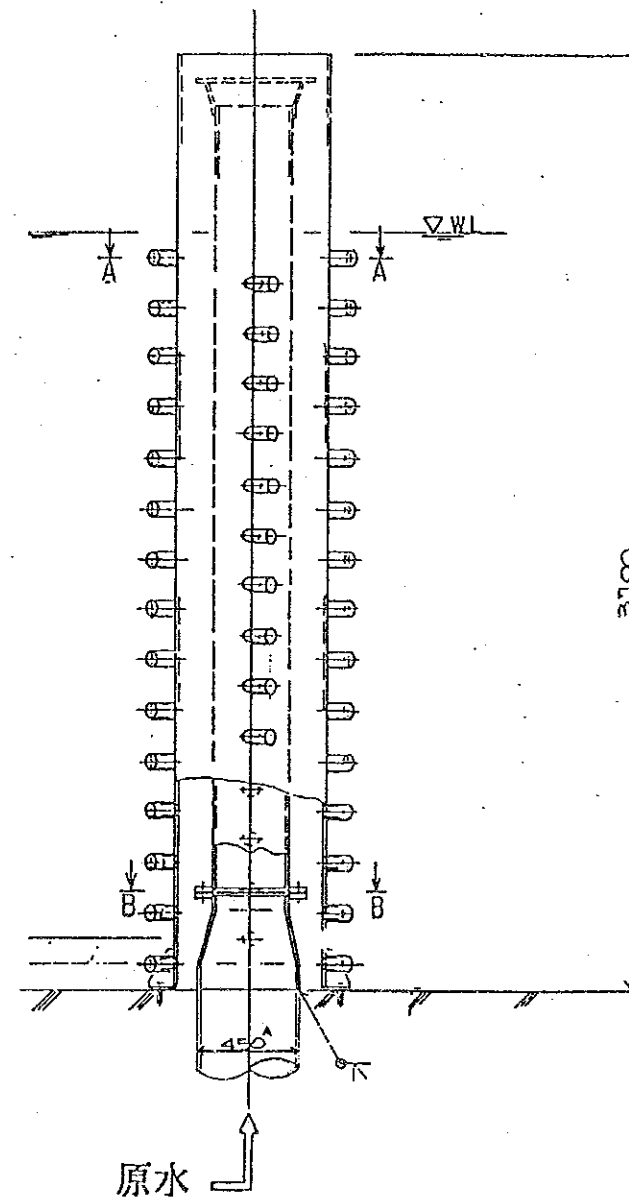
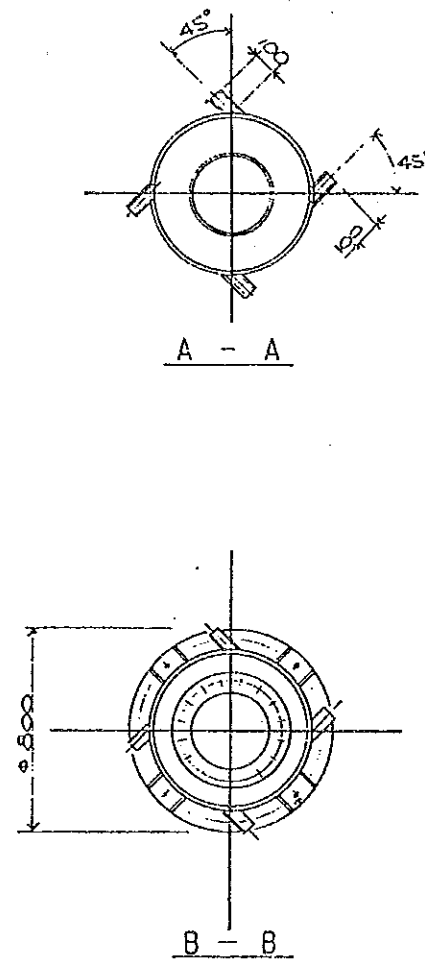
▨ shows the equipment and materials to be improved under the project.

THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING FLOW DIAGRAM OF SHAHDARA WATER TREATMENT PLANT		
AUG. '81	SCALE	DRAWING No. 24
JAPAN INTERNATIONAL COOPERATION AGENCY		



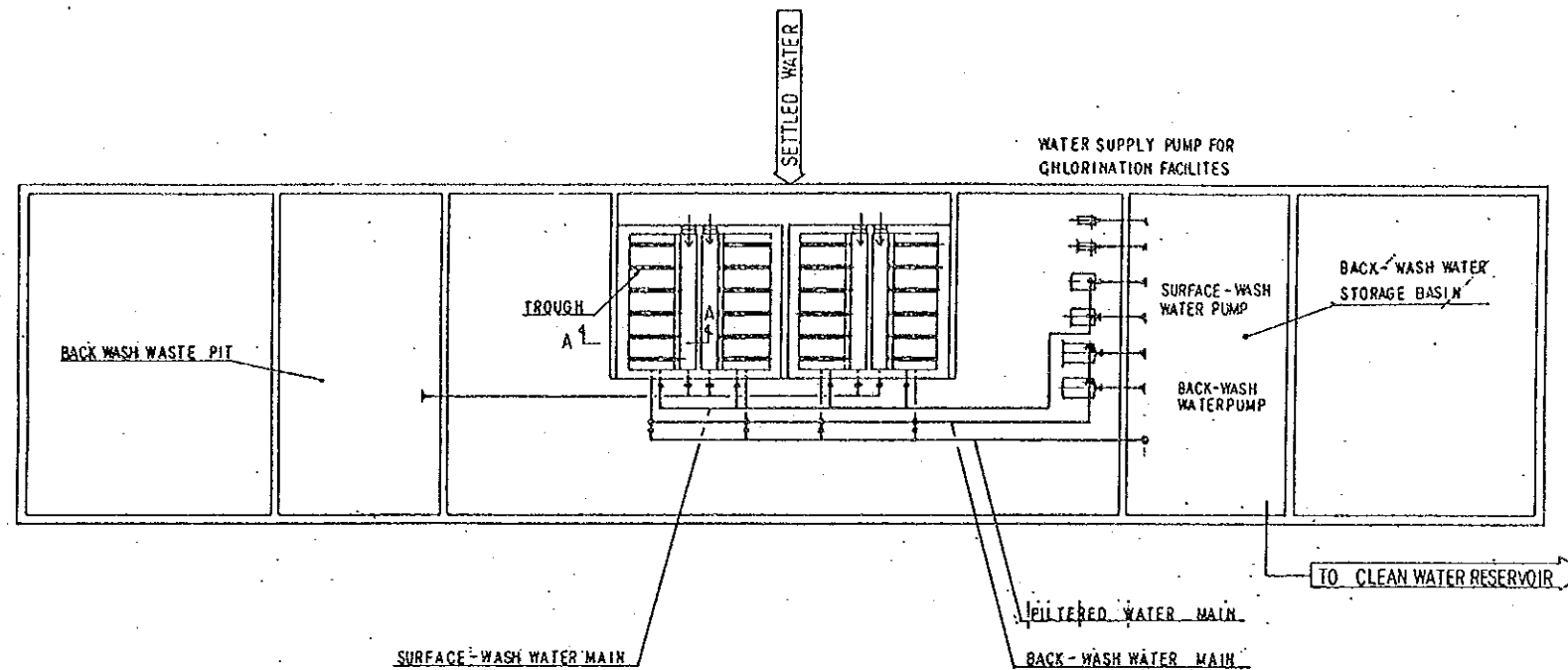
shows the equipment and materials
to be improved under the project

THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING SINGLE-LINE DIAGRAM OF SHAHDARA WATER TREATMENT PLANT		
AUG. '81	SCALE	DRAWING No. 25
JAPAN INTERNATIONAL COOPERATION AGENCY		

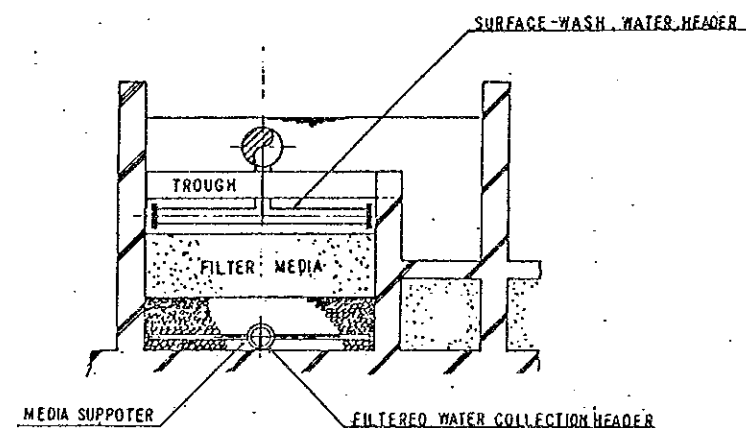


外形図

THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING NOZZLE TYPE MIXING AND FLOCCULATION UNIT(TYPICAL)		
AUG. '91	SCALE	DRAWING No. 26
JAPAN INTERNATIONAL COOPERATION AGENCY		



PLAN



SECTION A-A (S. 1/40)

THE ISLAMIC REPUBLIC OF PAKISTAN CAPITAL DEVELOPMENT AUTHORITY (CDA)		
THE PROJECT FOR REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD		
DRAWING	MODIFICATION PLAN OF FILTER BEDS (TYPICAL)	
AUG. '91	SCALE	DRAWING No. 27
JAPAN INTERNATIONAL COOPERATION AGENCY		

4-5 Implementation Plan

4-5-1 Implementation Policies

CDA will be the responsible agency for the Project implementation. CDA entrusts the director water supply. The implementation system is shown in Fig 4-2.

Preparation of the detailed design, assisting CDA with tendering, and Project construction supervision will be provided by a Japanese consultant company.

The major portion of the project is shown in the section 4-4-4, "Summary of the Facility Design". The Government of Pakistan will bear expenses for required documents relating to the material import.

Necessary undertaking of the Government of Pakistan must be completed at latest one month prior to the commencement of the Project construction in accordance with the detailed design drawing and the scope of works for the project.

Because of a nature of the Project, that is, portions of the project are installation of facilities, the Project construction should be undertaken as a complete turn-key contract base by a water treatment facility manufacturer through open tendering. The manufacturer will be selected as a result of open tendering based on discussions between the Japanese consultant company and CDA.

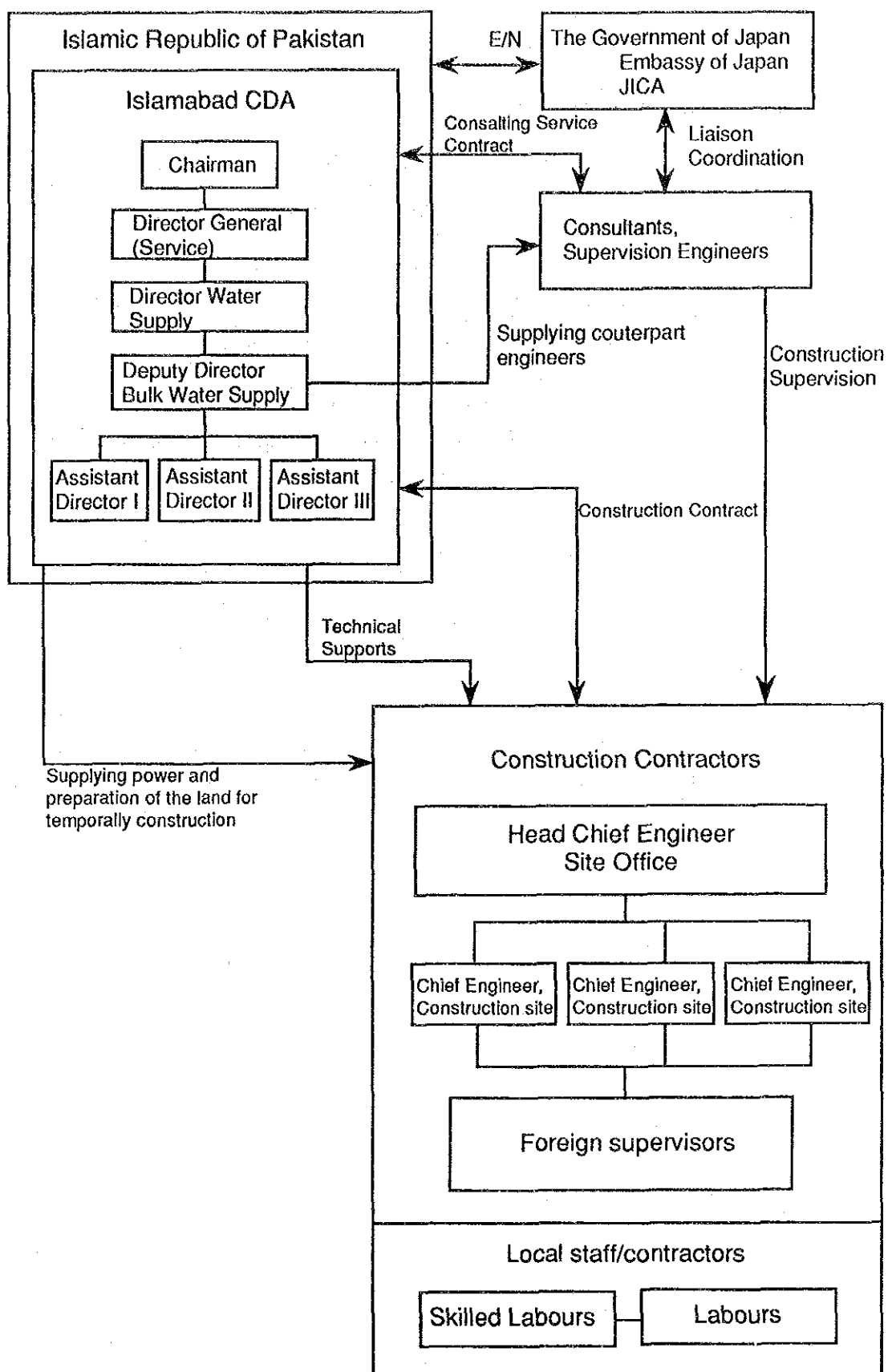


Fig. 4-2 Organization chart for Implementation of the Project

4-5-2 Implementation Method and Condition

Since the project is an improvement of the existing water treatment plant, the construction method and schedule should be determined so as to minimize the length of suspension of water supply due to the implementation of the project.

There are noticeable dry and rainy seasons. February to March and July to August are the significant rainy seasons. Therefore, the project construction schedule should be prepared by taking into account these rainfall.

Most of people are Moslem in Pakistan and they used to fast for about 30 days in the holy month(Ramadan) every year, (it will fall in early March in 1992). Working efficiency is supposed to be decrease during this period, thus this must be considered in the working schedule. The transportation from Japan takes about one month by sea to Karachi. Then the cargo should be transported to Islamabad along 1500km of distance by inland transportation, which sometimes takes about one month.

4-5-3 Construction and Supervisory Plan

(1) Detailed Design

The detailed design for the project is to be prepared based on the Basic Design. The detailed design prepared by the consultant should be approved by CDA.

(2) Tendering

Contract documents for the Project prepared by the consultant must be approved by CDA. The consultant will assist CDA by making the tender announcement, accepting tender applications from contractors, issuing tender documents to the tender participants, accepting tender documents from the participants, and evaluating the tendering. After selecting a successful Japanese contractor, CDA will make a contract agreement with the contractor.

(3) Construction Supervision

The consultant will evaluate and approve the tender documents submitted after tendering by the selected contractor and will assist CDA with the procurement of Project use materials and equipment in order to start the Project construction as early as possible.

The consultant will hold a series of meetings with CDA officials and the contractor prior to commencement of the Project construction works, witness the shipments of Project use materials and equipment going to the Project sites, and provide the contractor with instruction related to the construction works, equipment installation, test operations, and post-installations inspections.

Additionally, the consultant will control the Project's construction schedule, be responsible for quality control, and exert an effort to complete the project's construction by the scheduled completion date for the Project.

4-5-4 Procurement Plan

The methods of procurement of materials used in the project have been studied by comparing to procure in Pakistan and to procure in Japan as mentioned below, and the summary of procurement plan is presented in Table 4-14.

(1) Reinforcing Rod(iron)

In the Pakistan, domestic supply of reinforcing rod is much less than the demands. Most of demands are catered by the imported. The price of reinforcing rod in Pakistan which includes import tax, generally tends to be high. Therefore, reinforcing rod made in Japan is adopted.

(2) Cement

Ready mixed concrete are available in Pakistan and the price is lower than the imported from Japan. Then cement made in Pakistan is adopted.

(3) Plywood

In this work, plywood is used for mold of concrete structure for the filters. Plywood made in Pakistan is not uniform and demands for the construction purpose are small because most structures in Pakistan are made of bricks. Therefore, plywood made in Japan is adopted.

(4) Pump

Small sized or general purpose type of pumps are available in Pakistan and some pumps to be used in the project would be a small sized, However, since reliability on delivery time and quality of steel materials has not been confirmed, pumps made in Japan in adopted.

(5) Pipe (steel)

While there is an iron manufacturing company that produces steel pipes. Most steel pipes consumed in Pakistan are of the imported due to the limited availability of the home made. The market price of the steel pipes would be higher than those made in Japan because the market price includes the import tax. Therefore steel pipes made in Japan are adopted.

(6) Pipes (PVC)

PVC pipes are manufactured in Pakistan from imported vinyl chloride monomer. The market price is costly because it includes the import tax for monomer. PVC pipes made in Japan are adopted because of price.

(7) Valve

The valves, most of which are imported from China and East European countries, are locally available. However, the specifications are limited and some specifications required for the Project are not available. Therefore, the valves made in Japan are adopted.

(8) Instrument

Most parts of the instrumentation are imported and have different standards. The availability is very limited in the market due to low production rate. Therefore, instruments made in Japan are adopted.

(9) Electric Equipment

The control panels to be used for the Project are very special and must be manufactured by the shop drawings. Therefore it is impossible to use ones that are available locally.

(10) Construction Tools

The construction tools, such as transformer, welding machine, water pump etc, in the local lease market are not reliable. Tools are supplied from Japan.

(11) Construction Machines

Construction machines, such as concrete mixers, cranes, trucks etc. are available in the local lease market and their quality are judged to be in good conditions. Therefore, construction machines are supplied from the local market.

Table 4-14 Summary of Material Procurement

	Item	Procure in Japan	Procure in Pakistan
1	Reinforcing rod	x	
2	Cement		x
3	Plywood	x	
4	Pump	x	
5	Steel pipe	x	
6	PVC Pipe	x	
7	Valve	x	
8	Instrument	x	
9	Electrical equipment	x	
10	Construction Tool	x	
11	Construction machine		x

4-5-5 Implementation Schedule

The construction schedule have been prepared by taking into account the following three aspects (the schedule is shown in Fig. 4-3):

(1)Rainfall

According to the rainfall data recorded in Islamabad rainy seasons fall in February to March and July to August. Outdoor works such as earth works and concrete structures should avoid the above rainy seasons.

(2)Ramadan

In 1992 and 1993, the Ramadan will fall in the following time; early March to early April, in 1992 and middle February to middle March, in 1993.

(3)Construction Period

The construction period should be determined based on the following conditions:

- i) As a result of the study, the project implementation will be divided into two phases and plants to be rehabilitate in each phase are shown below:

phase 1: Simly, Korang, Shahdara

phase 2: Golf Course, G-10, R.L.1, Noorpur, Saidpur
- ii) The construction work in each phase takes 12 months including manufacturing, procurement, transportation, construction and test run.
- iii) Detailed design period in each phase takes 4 months excluding construction period.

4-5-6 Scope of Works

This section describes the scope of works necessary for the implementation of the project.

(1) Scope of works to be executed by Japan's Grant Aid

Scope of works to be carried out by Japan's grant aid are as follow:

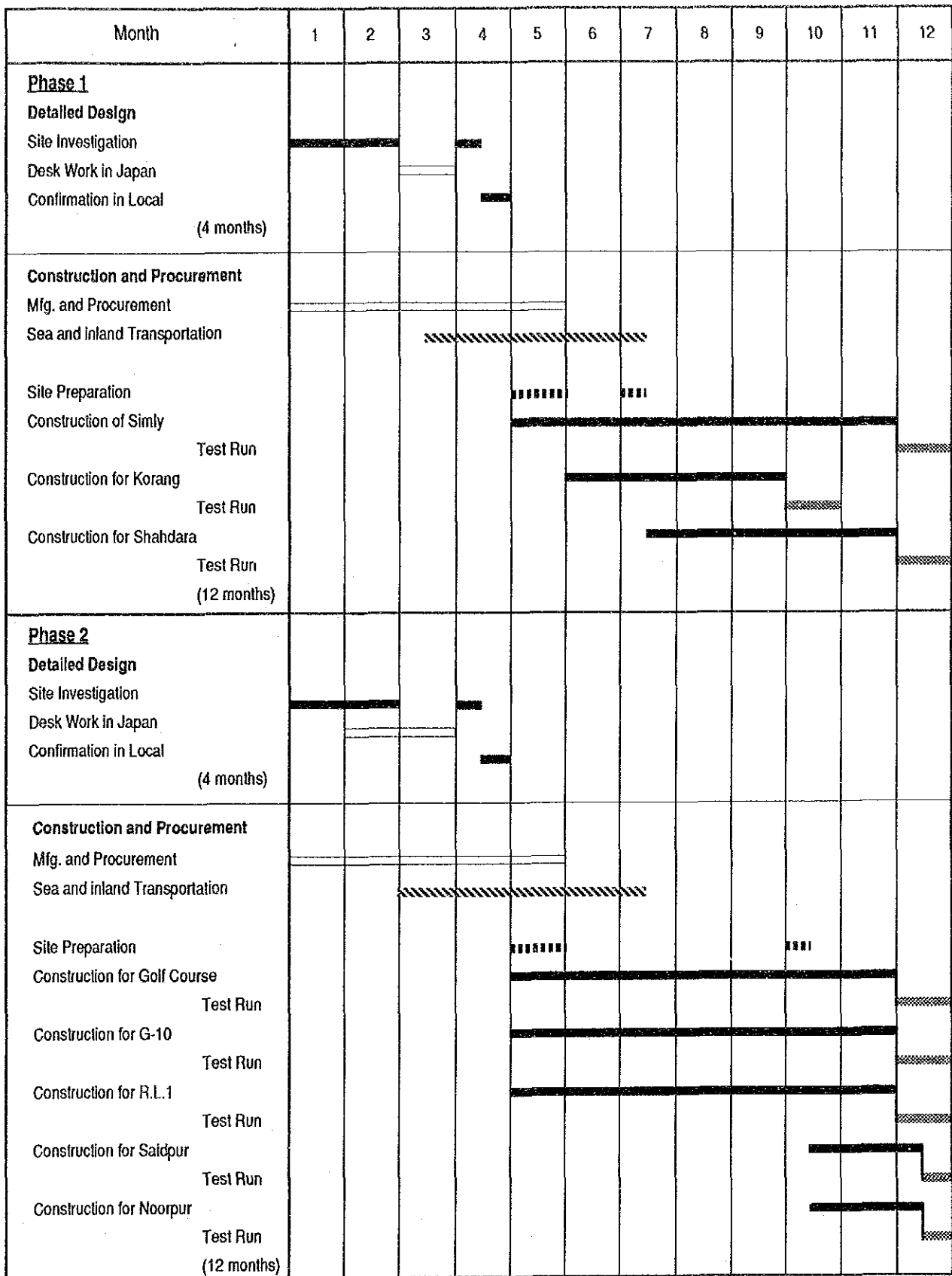
- i) To design the adequate improvement works for eight water treatment plants.
- ii) To procure the construction materials.
- iii) To contract the contractor to construct the project.
- iv) To supervise the construction works.

(2) Undertaking of the Government of Pakistan

Other scope than the mentioned above necessary for the implementation of the project are to be done and all the expenses necessary to carry out such scope are to be borne by the Government of Pakistan. The scope to be undertaken by the Government of Pakistan are as follow:

- i) To prepare lands and structures that are needed for the implementation of the Project.
- ii) To provide facilities for distribution of electricity leading up to the site including in application to WAPDA, if necessary.
- iii) To ensure prompt unloading tax exemption and customs clearance of the Project goods at the port of disembarkation
- iv) To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contracts such facilities as may be necessary for their entry into Pakistan and stay therein for the performance of their work.
- v) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Pakistan with respect to the supply of the products and services under the verified contracts.
- vi) To bear all the expenses, other than those to be borne by the Grant Aid, necessary for the execution of the Project.

Fig. 4-3 Project Implementation Schedule



Note: Construction and Procurement period starts after the detailed design period in each phase.

Chapter 5 Project Evaluation and Conclusion

CHAPTER 5 PROJECT EVALUATION AND CONCLUSION

The project aims to improve the water treatment capacity of the existing water treatment plants in Islamabad by implementing the rehabilitation works for the deteriorated facilities in the plants. The following effects are expected after the implementation of the project.

- The water producing capacity will increase to 164,400 m³/day from existing 137,000 m³/day.
- Presently deteriorated quality of the treated water is improved and safe, clean water is supplied.
- The above effects benefit the population of about 300,000 who are presently receiving water from water treatment plants.
- The rehabilitated water producing capacity by the existing water treatment plants will help the achievement of the Water Supply Master Plan of CDA, which meets to the policies of both the Seventh Five Year Plan (1988-1993) and the Perspective Plan (1988-2003).

As such, effects by the implementation of the project are expected to contribute to the improvement of the living and social conditions of the residents of Islamabad. In addition, the levels of operation and management of Pakistani side are judged to be capable to implement the project in terms of technically and financially. Consequently, it is concluded that the implementation of the project through the Japan's grant aid program is appropriate.

In addition, it is recommended to implement the following policies by CDA in order to secure the stable water treatment operation and to maintain the capacity of the facility:-

- To prepare and implement the replacement plan for each facility as well as to execute daily inspection and repairing of the facilities.

- To incorporate the costs for such replacement and repairing into the annual budget for the operation.
- To establish financial sources for the above budget. Revision of the water tariff system may be one of the possible policies.
- To provide training courses for the operators to upgrade their skill.
- To enforce the wastewater treatment in the basins of the water source rivers in order to prevent further water quality pollution.

Appendices

Appendix-1	Lists of Members of the Study Team
Appendix-2	Study Schedule
Appendix-3	Persons met by the Study Team
Appendix-4	Minutes of Meetings
Appendix-5	Consideration on Water Quality of the Treated Water
Appendix-6	Chlorine Demand Test
Appendix-7	Consideration on the Performance of Medium Rate Sand Filtration

Appendix-1 Lists of Members of the Study Team

LIST OF THE MEMBERS OF THE BASIC DESIGN TEAM
FOR THE BASIC DESIGN STUDY ON THE PROJECT
FOR REHABILITATION OF WATER TREATMENT SYSTEM
IN ISLAMABAD

Akihiro Mitarai	Team Leader Resident Representative, Pakistan Office Japan International Cooperation Agency
Eiji Inui	Project Coordinator, First Basic Design Study Division Grant Aid Study & Design Department Japan International Cooperation Agency
Akira Takechi	Member, Water Supply Planning Engineer Pacific Consultants International
Toshifumi Okaga	Member, Water Supply System Engineer Pacific Consultants International
Masami Kondo	Member, Mechanical Engineer Pacific Consultants International
Ryohei Kawanishi	Member, Electrical and Instrumental Eng. Pacific Consultants International
Terutoshi Ozawa*	Member, Cost Estimator Pacific Consultants International

* ; works only in Japan.

LIST OF THE MEMBERS OF THE BASIC DESIGN TEAM
FOR THE DRAFT FINAL REPORT EXPLANATION

Masashi Fujita	Team Leader First Basic Design Study Division Grant Aid Study & Design Department Japan International Cooperation Agency
Akira Takechi	Member, Water Supply Planning Engineer Pacific Consultants International
Toshifumi Okaga	Member, Water Supply System Engineer Pacific Consultants International

Appendix-2 Study Schedule

Schedule for the Basic Design Study Mission

Feb 25	Leaving Tokyo
Feb 26	Arriving at Islamabad Courtesy call at the Embassy of Japan, JICA office and CDA.
Feb 27	Explanation on Inception Report to CDA
Feb 28	Preliminary survey on Simly WTP.
Mar 1	Internal meeting.
Mar 2	Preliminary Survey on R.L.1, Golf Course, Shahdara and Korang WTPs.
Mar 3	Preliminary Survey on G-10, Noorpur and Saidpur WTPs.
Mar 4	Internal meeting, data collection at CDA.
Mar 5	Site inspection of Saidpur WTP Data collection at EAD, CDA.
Mar 6	Site inspection of Golf Course WTP Discussion on minutes with CDA.
Mar 7	Site inspection of Golf Course and Noorpur WTP Signing of the Minutes of discussions.
Mar 8	Internal meeting
Mar 9	Site inspection of Simly WTP Data collection at CDA.
Mar 10	Site inspection of Simly WTP Data collection at Statistic office.
Mar 11	Site inspection of G-10 WTP Data collection at CDA.
Mar 12	Site inspection of R.L.1 WTP.

Mar 13 Site inspection of Shahdara WTP

Mar 14 Site inspection of Korang WTP

Mar 15 Internal meeting

Mar 16 Data collection at CDA.

Mar 17 Visiting sewerage treatment plant.

Mar 18 Data collection at CDA.

Mar 19 Visiting Rawalpindi WTP.

Mar 20 Briefing outline of study findings to CDA.

Mar 21 Report to the Embassy of Japan and JICA Office.

Mar 22 Leaving Islamabad for Singapore

Mar 23 Leaving Singapore for Tokyo

Mar 24 Arriving at Tokyo.

WTP : water treatment plant

Schedule for the Draft Report Explanation Mission

July 2	Leaving Tokyo.
July 3	Arriving at Islamabad Meeting at JICA Pakistan Office. Courtesy Call at the Embassy of Japan.
July 4	Courtesy Call and meeting with CDA.
July 5	Internal meeting.
July 6	Explanation and discussion on the Draft Report with CDA.
July 7	Explanation and discussion on the Draft Report with CDA Field reconnaissance for reconsideration of R.L.1 conduction route.
July 8	Explanation and discussion on the Draft Report with CDA Site inspection of G-10 water intake pump.
July 9	Discussion with CDA on minutes of meeting.
July 10	Signing of the Minutes of Discussions Additional survey for Simly and R.L.1 water treatment plants.
July 11	Report to JICA Pakistan Office, the Embassy of Japan and EAD.
July 12	Leaving Islamabad for Karachi
July 13	Leaving Karachi, arriving at Tokyo

Appendix-3 Persons met by the Study Team

LIST OF PERSONS MET

EMBASSY OF JAPAN, PAKISTAN

RYOSUKE HARAGUCHI
FIRST SECRETARY
YUTAKA SUMITA
FIRST SECRETARY
KOUICHI MURASE
ECONOMY ATTACHE

JICA, PAKISTAN OFFICE

AKIHIRO MITARAI
RESIDENT REPRESENTATIVE
MASATO TOGAWA
ASSISTANT RESIDENT REPRESENTATIVE
HIROSHI YOSHIMURA
ASSISTANT RESIDENT REPRESENTATIVE

CDA

MUHAMMAD RAFIQ AHMAD
MEMBER (ENGINEERING)

TAYEB ALI SHAIKH
DIRECTOR GENERAL (SERVICE)

SAMI ULLAH JAN
DIRECTOR WATER SUPPLY

SIDIQ ABID
DEPUTY DIRECTOR BULK WATER SUPPLY

ABDUL WAHEED KHAN
DEPUTY DIRECTOR WATER DISTRIBUTION

SHAGQAT ELAHI
DEPUTY DIRECTOR WATER METER

A.R.BUTT
ASSISTANT DIRECTOR

MOHI-UDDIN JAMEELI
DIRECTOR WATER & SEWERAGE

MUHAMMAD ASLAM
SCIENTIFIC OFFICER

MAQBOOL ILAHI
DEPUTY DIRECTOR GENERAL PLANNING WING

S.Z.H.ZAICH

ACCOUNTS OFFICER

JAMIL REHMAN
DEPUTY DIRECTOR PROCUREMENT

FATEH MUHAMMAD
DEPUTY DIRECTOR WATER AND SEWERAGE DEVELOPMENT

SHAUKAT
DEPUTY DIRECTOR TUBE WELL

MUHAMMAD TAHIR
SUB ENGINEER, SUB-DIV I (NOORPUR, G/C, SHAHDARA)

MUHAMMAD INAM AKWTAR
SUB ENGINEER, SUB-DIV III (G-10, SAIDPUR, R.L.1)

MINISTRY OF DEFENSE

SARFRAS MAHMOOD SHAHID
DEPUTY DIRECTOR, PAKISTAN METEOROLOGICAL DEPT.
AZMAT
METEOROLOGIST

EAD

AKHTAL IQBAL
BUDGET OFFICER

MINISTRY OF PLANNING

ABDUL QAYUM
DEPUTY CHIEF, PHYSICAL PLANNING AND HOUSING

MINISTRY OF HOUSING AND WORKS

MUHAMMAD HUMAYUN KHAN
CIVIL ENGINEER, ENVIRONMENT AND URBAN AFFAIRS DEV.

Appendix-4 Minutes of Meetings

MINUTES OF DISCUSSIONS
THE BASIC DESIGN STUDY ON THE PROJECT FOR
REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD
THE ISLAMIC REPUBLIC OF PAKISTAN

In response to the request of the Government of the Islamic Republic of Pakistan, the Government of Japan decided to conduct a Basic Design Study on the Project for Rehabilitation of Water Treatment System in Islamabad (hereinafter referred to as "the Project"), and the Japan International Cooperation Agency (JICA) sent the study team, headed by Mr. Akihiro Mitarai, Resident Representative, Pakistan Office, JICA, from February 25th to March 24th 1991. The team had a series of discussions with the authorities concerned of the Government of Pakistan and conducted a field survey in the Project areas.

As a result of the discussions and field survey, both parties confirmed the main items described on the attached sheets. The team will proceed the works and prepare the Basic Design Study Report.

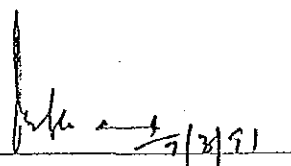
Islamabad, March 7th, 1991



Mr. Akihiro Mitarai

Leader

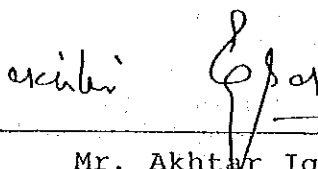
for the Basic Design Study Team
JICA



Mr. Muhammad Rafiq Ahmad

Member(Engineering)

Capital Development Authority,
Islamabad



Mr. Akhtar Iqbal

Deputy Secretary

Economic Affairs Division
Islamabad

Appendix-4

ATTACHMENT

1. Objective

The objective of the Project is to keep smooth safe water supply in Islamabad and ensure the standards of living of the inhabitants.

2. Project sites

The Project sites are the eight water treatment plants in Islamabad.

3. Executing agency

Capital Development Authority is responsible for the administration and execution of the Project.

4. Necessary items for the realization of the Project requested by the Government of Pakistan

After discussions with the Basic Design Study Team, the following items were judged necessary for the realization of the Project.

- 1) Rehabilitation of eight water treatment plants in Islamabad, as following with priority.

Simly water treatment plant

Korang water treatment plant

Golf Course water treatment plant

G-10 water treatment plant

R.L.1 water treatment plant

Saidpur water treatment plant

Noorpur water treatment plant

Shadra water treatment plant

- 2) Provision of equipment and materials for water treatment plants

- 3) Provision of services for the implementation of the Project

However, the final components of the Project may differ from the above items, if it is judged necessary after further studies in Japan.

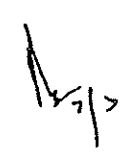
5. Grant Aid system extended by the Government of Japan

- (1) The Government of Pakistan has understood the system of Japanese Grant Aid explained by the Team.
- (2) The Government of Pakistan will take necessary measures, described in Annex I for smooth implementation of the Project, on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

7/3

6. Schedule of the Study

- (1) JICA will prepare the draft report in English and dispatch a mission in order to explain its contents around June 1991.
- (2) In case that the contents of the report is accepted in principle by the Pakistan side, JICA will complete the final report and send it to the Government of Pakistan by August 1991.



ANNEX I

UNDERTAKINGS BY THE GOVERNMENT OF PAKISTAN

1. To provide data and information necessary for the Project.
2. To provide the land for temporary site office, warehouse and stock yard during the implementation period.
3. To ensure speedy unloading, tax exemption and custom clearance at the port of disembarkation and prompt inland transportation of products purchased for the Project.
4. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contracts such facilities as may be necessary for their entry into the Islamic Republic of Pakistan and stay therein for the performance of their work.
5. To exempt Japanese nationals involved in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in Pakistan with respect to the supply of equipment/machines and services under the verified contracts.
6. To bear the following commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement:
 - i) Advising commission of Authorization to Pay (A/P).
 - ii) Payment commission.
7. To bear all expenses, other than those to be borne by the Grant, necessary for the execution of the Project.
8. To provide proper arrangements for the construction, such as water supply, electricity and drainage of the Project.
9. To assign exclusive counterpart engineers/technicians for the Project.
10. To secure the stoppage of water supply during construction period when necessary.
11. To provide convenience to allow Japanese consultants and constructors to use freely the workshops of other facilities/equipment of Capital Development Authority in Islamabad not covered by the Grant when necessary, and to provide consumed materials for the equipment.
12. To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant.

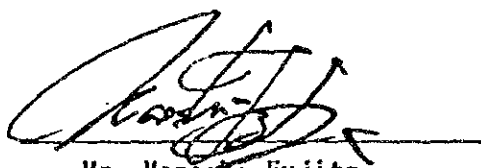
MINUTES OF DISCUSSIONS
BASIC DESIGN STUDY ON THE PROJECT
FOR
REHABILITATION OF WATER TREATMENT SYSTEM IN ISLAMABAD
IN
THE ISLAMIC REPUBLIC OF PAKISTAN
(CONSULTATION ON DRAFT REPORT)

In February, 1991, the Japan International Cooperation Agency (JICA) dispatched a Basic Design Study team on the Project for Rehabilitation of Water Treatment System in Islamabad (hereinafter referred to as "the Project") to the Islamic Republic of Pakistan, and through discussions, field survey, and technical examination of the results in Japan, has prepared the draft report of the study.

In order to explain to and consult with the Pakistani side on the components of the draft report, JICA sent to Pakistan a study team, which is headed by Mr. Masashi Fujita, First Basic Design Study Division, Grant Aid Study and Design Department, JICA, and is scheduled to stay in the country from July 3 to July 12, 1991.

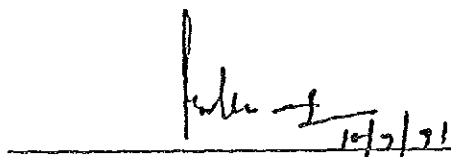
As a result of discussions, both parties confirmed the main items described on the attached sheets.

Islamabad, July 10, 1991



Mr. Masashi Fujita

Leader
Draft Report Explanation Team
JICA



Mr. Muhammad Rafiq Ahmad
Member (Engineering)
Capital Development Authority
Islamabad

ATTACHMENT

1. Components of Draft Report

The Government of Pakistan has agreed and accepted in principle the components of the Draft Report proposed by the team.

2. Japan's Grant Aid system

- (1) The Government of Pakistan has understood the system of Japanese Grant Aid explained by the team.
- (2) The Government of Pakistan will take the necessary measures, described in Annex I, for smooth implementation of the Project on condition that the Grant Aid assistance by the Government of Japan is extended to the Project.

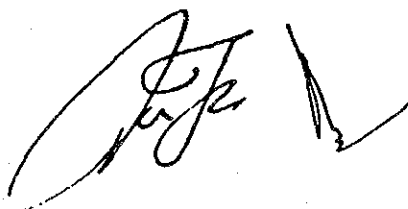
3. Further schedule

The team will make the Final Report in accordance with the confirmed items, and send it to the Government of Pakistan by the end of September, 1991.

Handwritten signature and initials in black ink, located below the text of the third section.

Annex I: Necessary measures to be taken by the Government of Pakistan in case Japan's Grant Aid is executed.

1. To secure the site for the Project.
2. To provide the land for temporary site office, warehouse and stock yard during the implementation period.
3. To clear, level and reclaim the site prior to commencement of the construction.
4. To construct the access road to the site prior to commencement of the construction.
5. To provide proper arrangement for the construction, such as water supply, electricity and drainage of the Project.
6. To secure the stoppage of water supply during the construction period, when necessary.
7. To assign exclusive counterpart engineers/officers for the Project.
8. To bear the following commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement:
 - 1) Advising commission of Authorization to Pay (A/P).
 - 2) Payment commission.
9. 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.
10. To accord Japanese nationals whose services may be required in connection with the supply of products and the services under the verified contracts such facilities as may be necessary for their entry into Pakistan and stay therein for the performance of their work.
11. To maintain and use properly and effectively the facilities constructed and equipment purchased under the Grant.
12. To bear all the expenses other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment.

A handwritten signature in black ink, appearing to be a stylized 'P' followed by a flourish.

**Appendix-5 Consideration on Water Quality of the Treated
Water**

Consideration on Water Quality of the Treated Water

(1) Turbidity

Annual fluctuations of the turbidity in the raw and treated water in Simly and G-10 Water Treatment Plants are shown in Fig. 1 and 2. The turbidity of the treated water in both plants have a range from 3 to 20 degree. The trend that turbidity increases in two rainy seasons, that is February to April and June to October, is obvious.

In comparison of Simly and G-10, Simly has a smaller range turbidity, because it intakes water from Simly dam, where suspended materials are supposed to be settled during retention time. Turbidity in treated water of G-10 varies along with the fluctuation of the turbidity in raw water. This may suggest possible failure in operation for removing suspended materials from raw water. The same has happened in Simly in January to February, 1991, too.

Frequency distribution of the turbidity in the treated water in both Plants are presented in Fig. 3 and 4. In Simly, turbidity of treated water exceeds 5 degree in 70 % of days a year and 25 % in G-10, moreover, they exceeds 10 degree in 3 to 4 %. While, we can not discuss on the other plants due to unavailability of data, they are supposed to be in the same conditions because they also intake water from dam and rivers, same as Simly and G-10, and employ more incomplete treatment than Simly and G-10. However, the treated water quality of Saidpur may be better than others because it takes water from springs.

(2) Water Quality other than Turbidity

Some water quality indices other than turbidity are shown in Table 1. In some treatment plants, positive results for coliform bacteria test have been experienced. This suggests possible failure in disinfection operation, perhaps, low dosing rate of Chlorine.

No particular problems are found in other indices.

Table 1 Water Quality of the Treated Water

Name of Plants	pH	Conduc- tivity (μ S/cm)	Chloride (mg/l)	Alkalinity (mg/l)	Hard- ness (mg/l)	Ammono- nium (mg/l)	Nitrite (mg/l)	T.S. (mg/l)	Res. Chlorine (mg/l)	Coliform
Simly	8	369	30	128	150	nd	nd	235	0.5	1/10
G-10	8	514	28	180	200	nd	nd	400	0.3	1/5
R.L.1	8	794	34	280	310	nd	nd	542	0.5	1/16
Golf Course	7.7	611	36	224	240	nd	nd	410	0.4	2/8
Shahdara	7.7	610	24	192	290	nd	nd	409	0.3	0/3
Saidpur	7.5	722	34	284	320	nd	nd	483	0.2	0/3
Noorpur	7.7	566	18	196	244	nd	nd	380	0.3	0/3

nd: Not Detected

* ; (Numbers of positive results/Numbers of tests)

Fig. 1 Turbidity of raw and treated water of Simly Treatment Plant

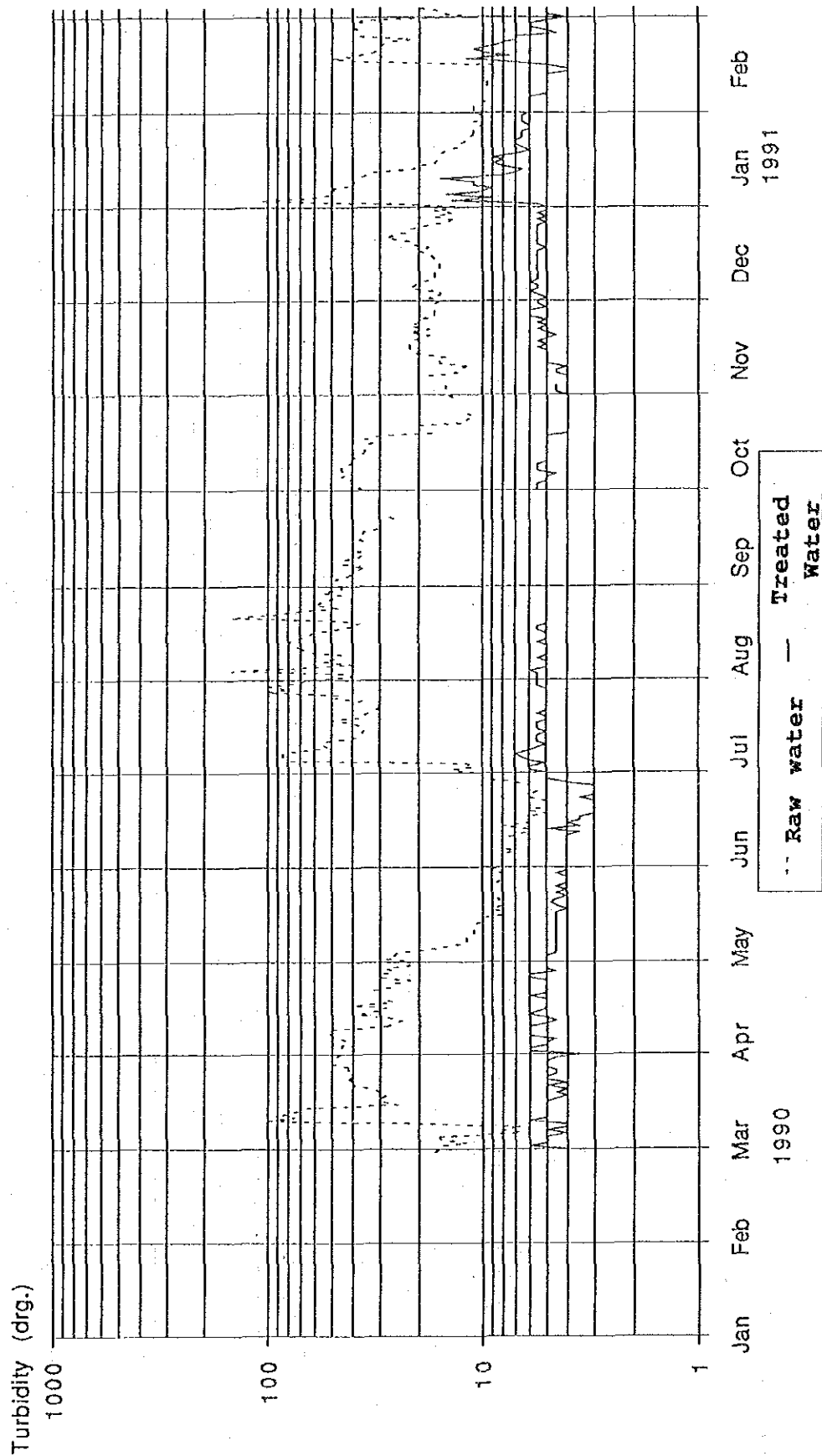


Fig. 2 Turbidity of raw and treated water of G10 Treatment Plant

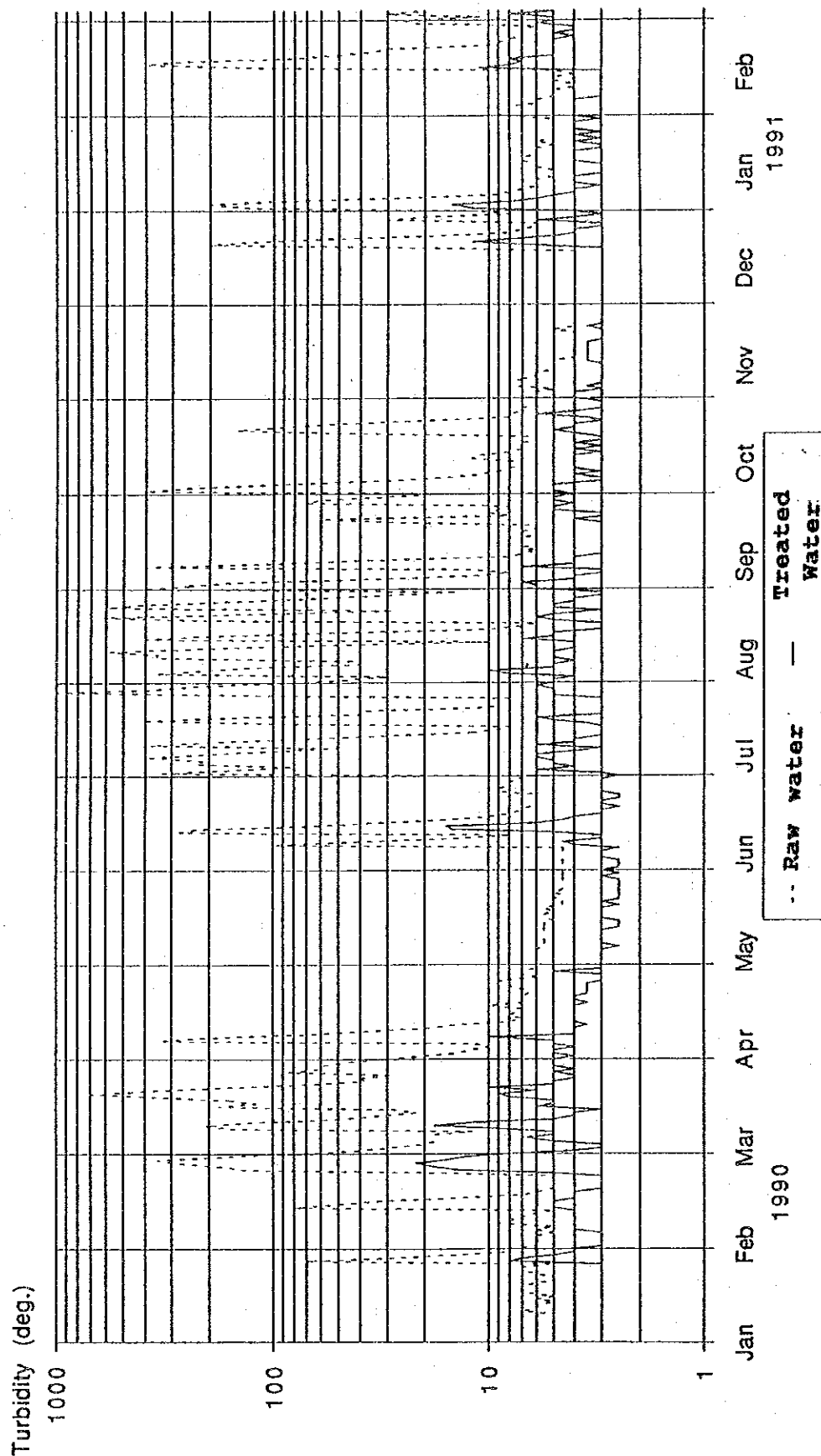


Fig. 3 Frequency distribution of turbidity of Simly treated water

Turbidity (deg)

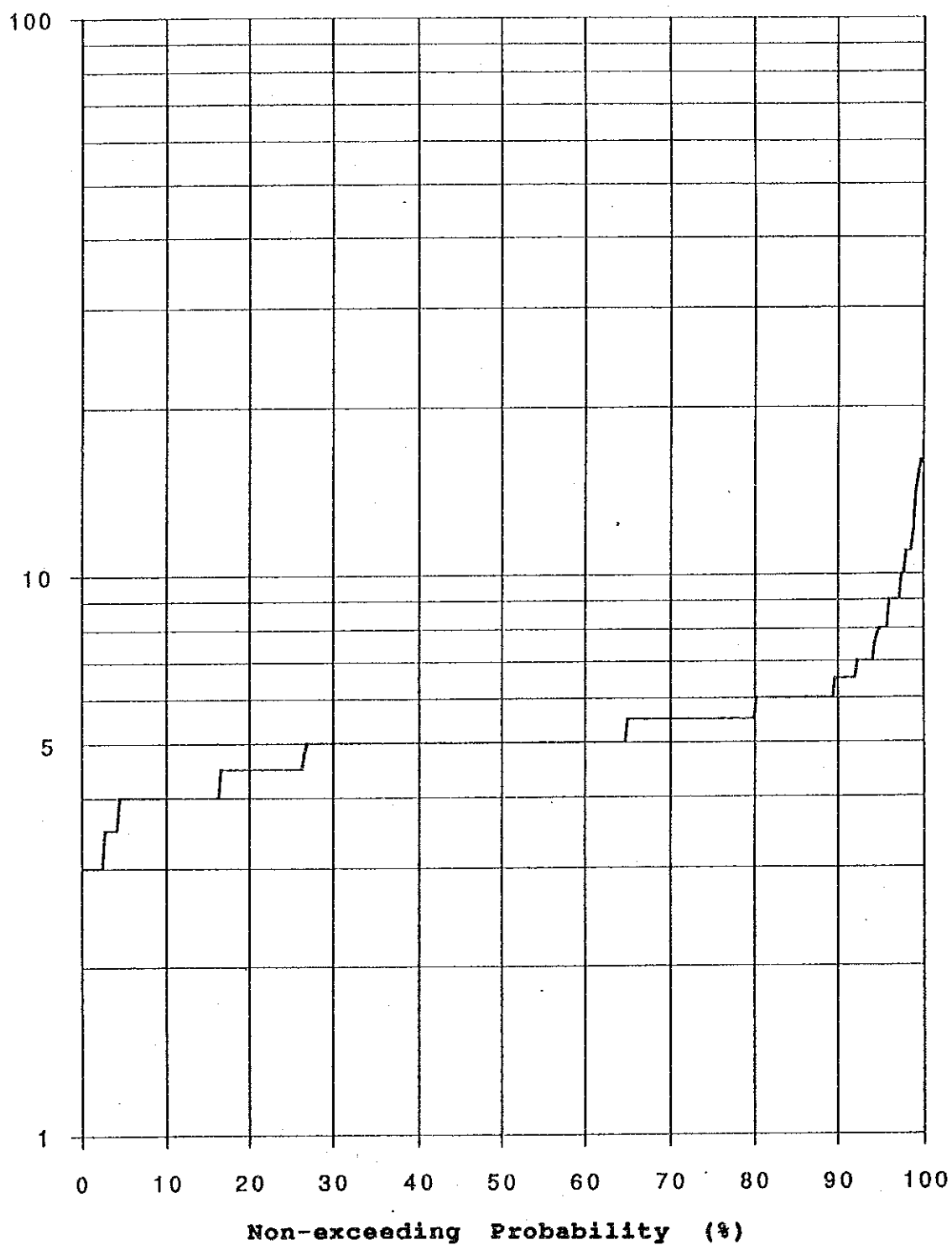
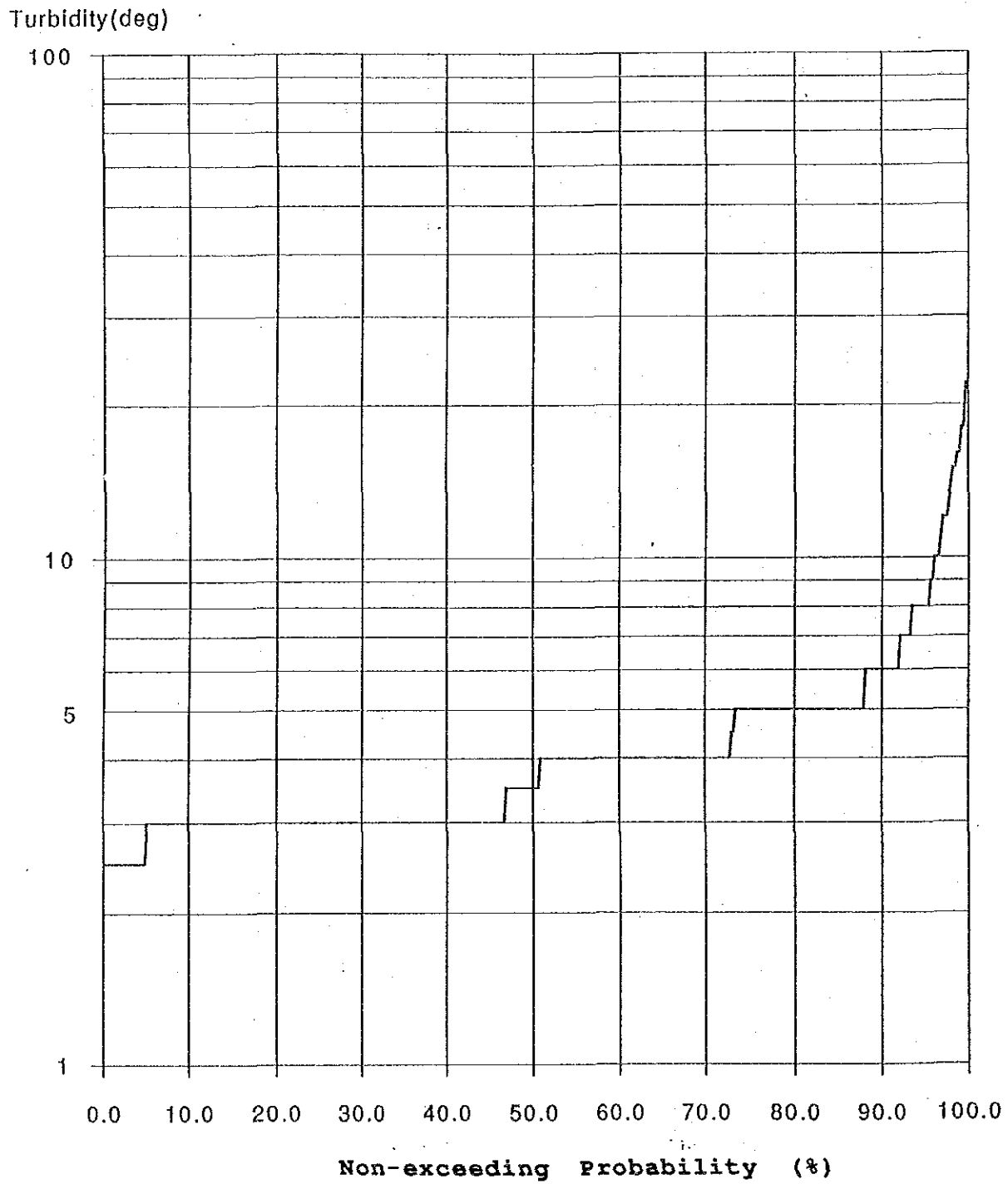


Fig. 4 Frequency Distribution of Turbidity of G10 treated water



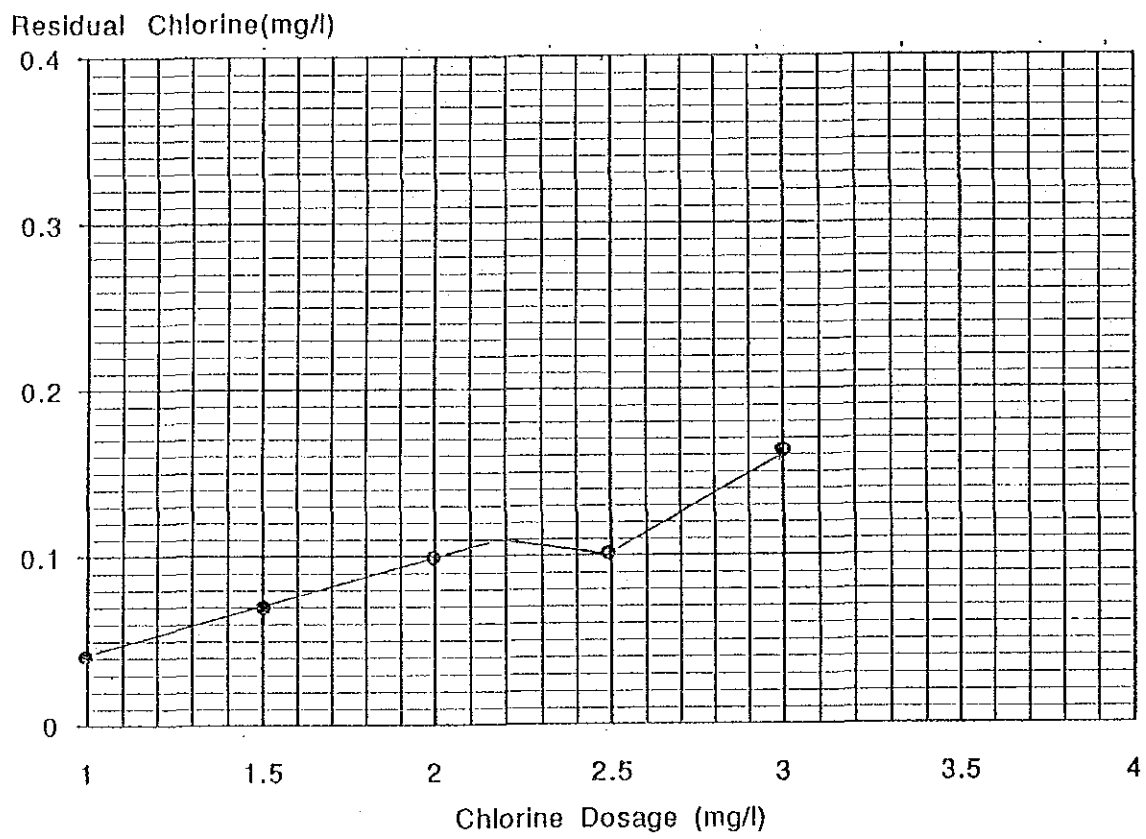
Appendix-6 Chlorine Demand Test

Chlorine Demand Test

Chlorine demand tests were conducted for raw water of each plant and chlorine dosing rates were determined as follow:

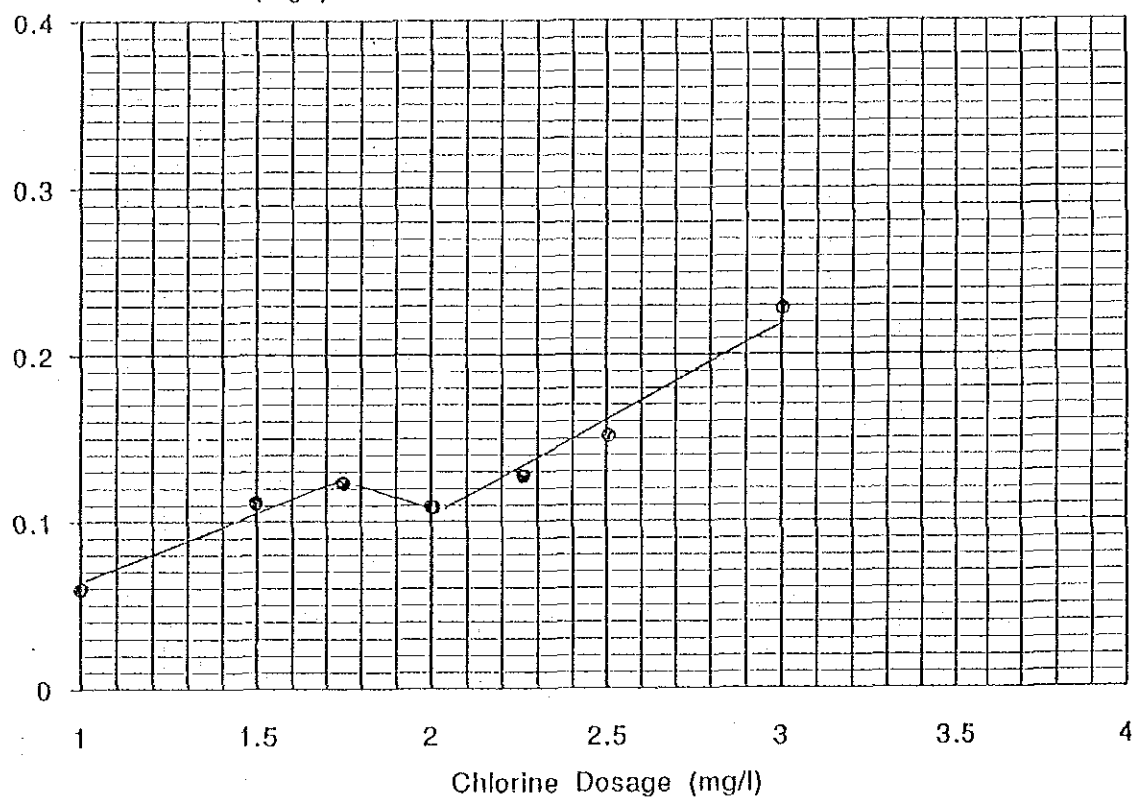
<u>Plant Name</u>	<u>Dosing Rate (mg/l)</u>
Simly	2.5
Korang	2.0
G-10 pre	2.5
post	1.5
Golf Course	2.0
Shahdara	2.0
Noorpur	1.5
Saidpur	1.5

Chlorine Demand (Simly)



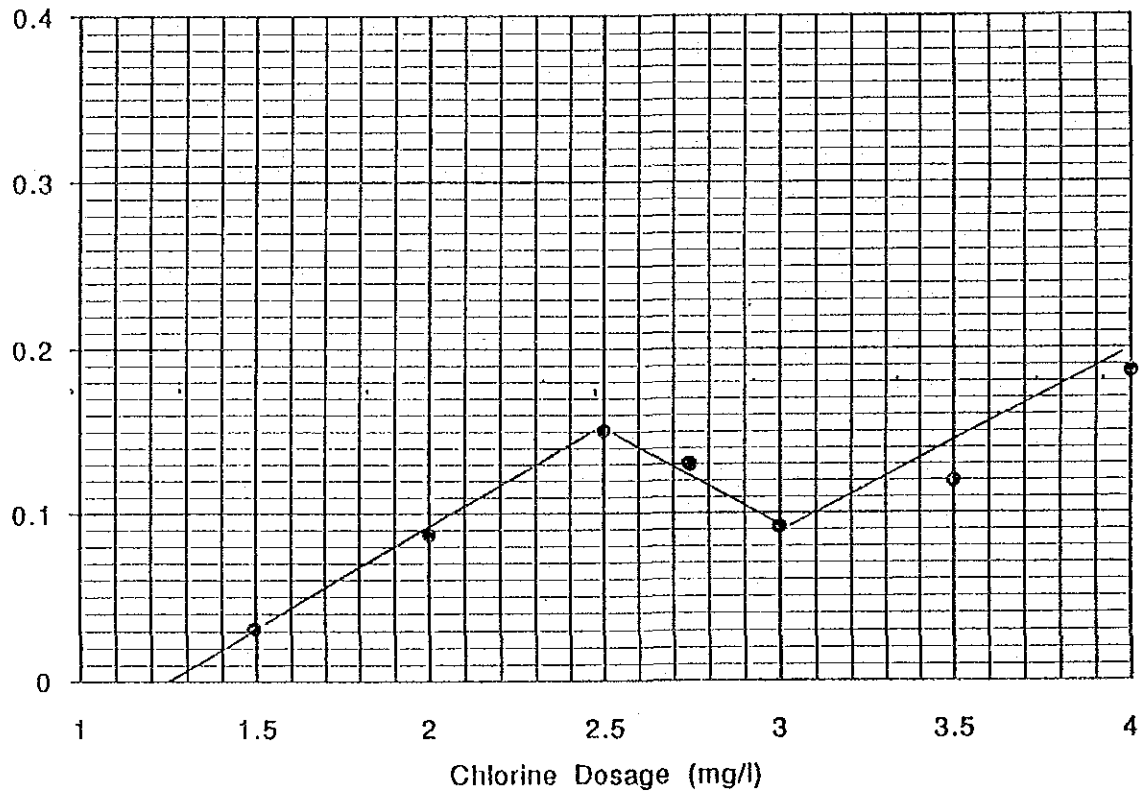
Chlorine Demand (Korang)

Residual Chlorine(mg/l)



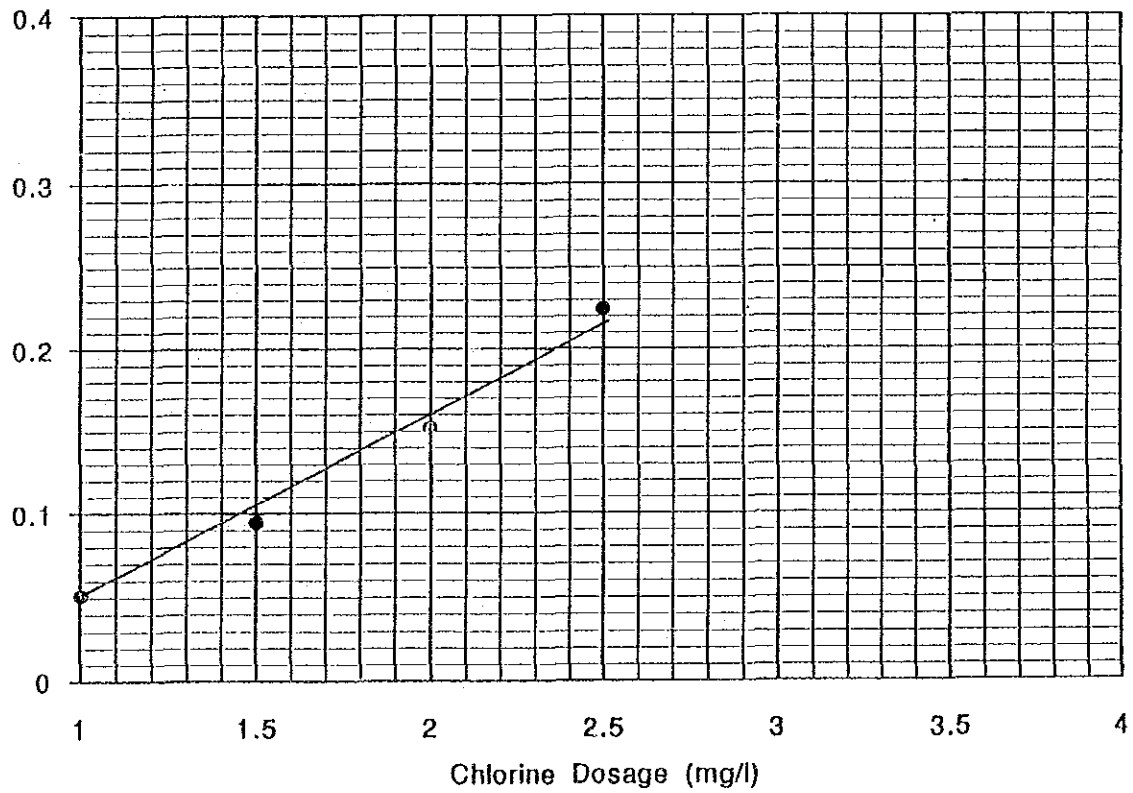
Chlorine Demand (G-10, Pre-chlorination)

Residual Chlorine(mg/l)

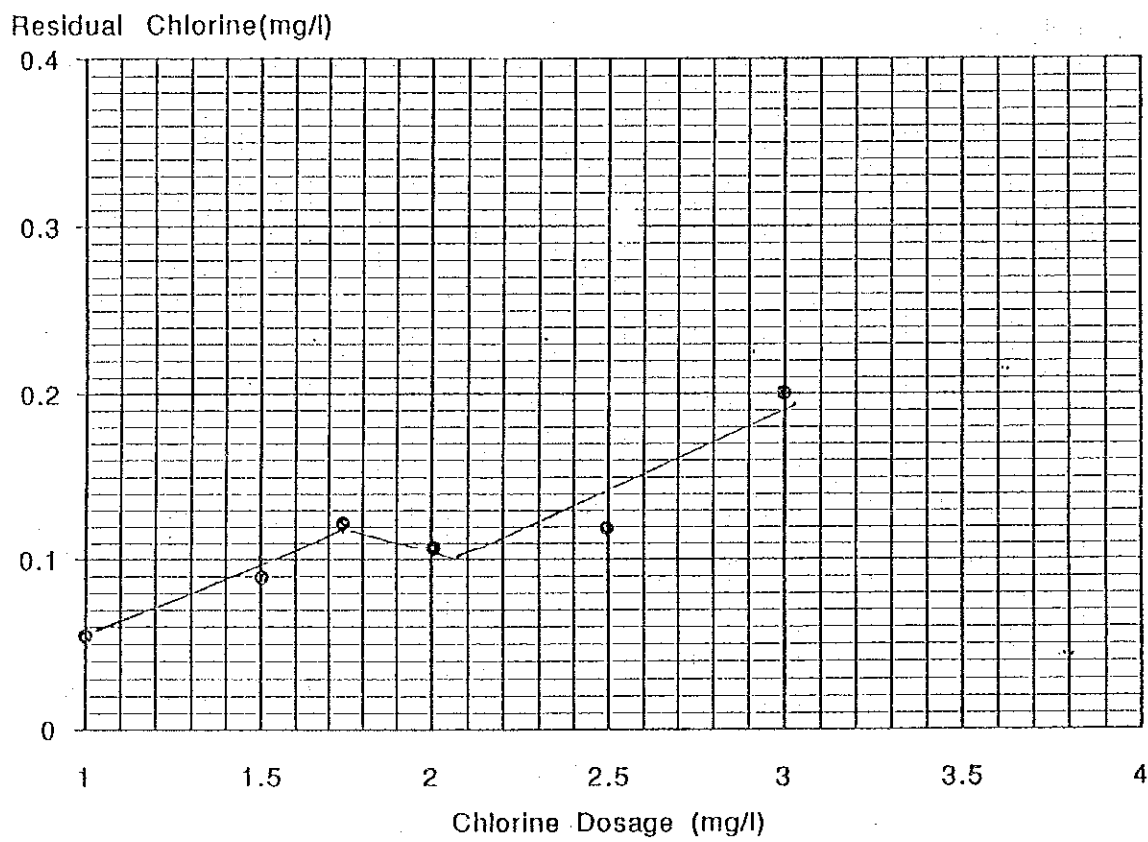


Chlorine Demand (G-10, Post-chlorination)

Residual Chlorine(mg/l)

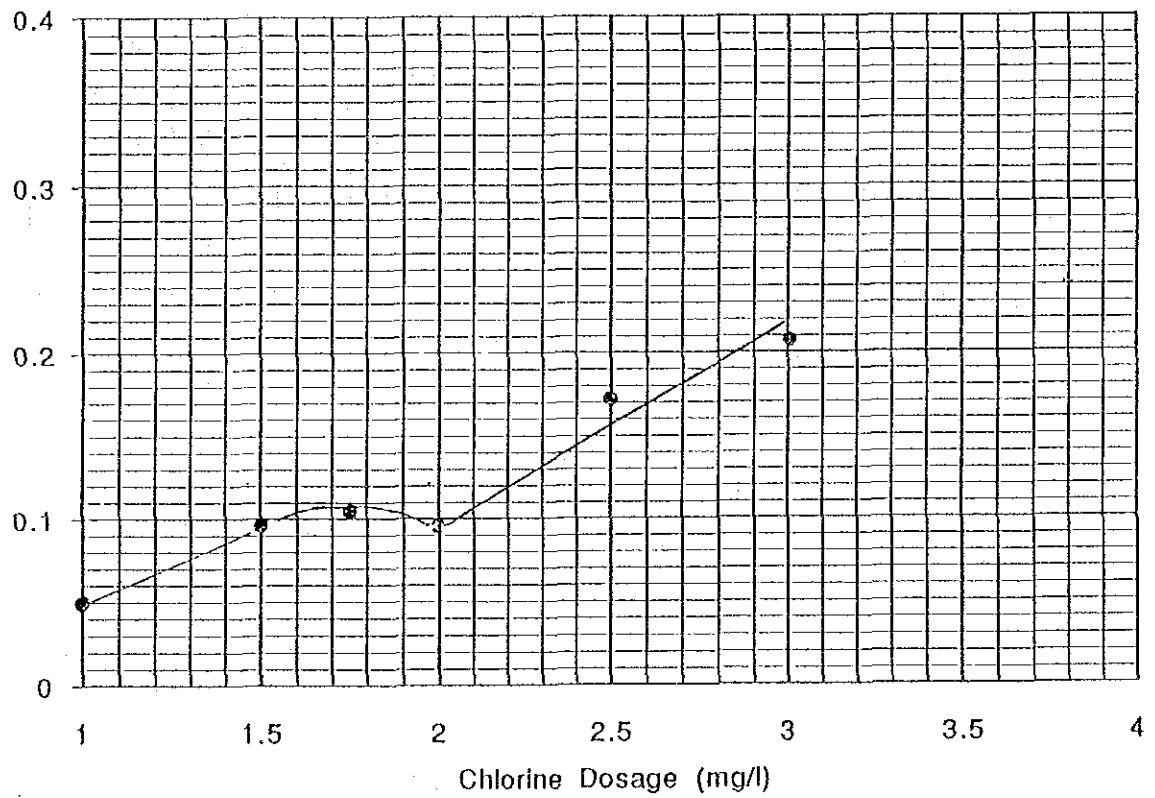


Chlorine Demand (Golf Course)

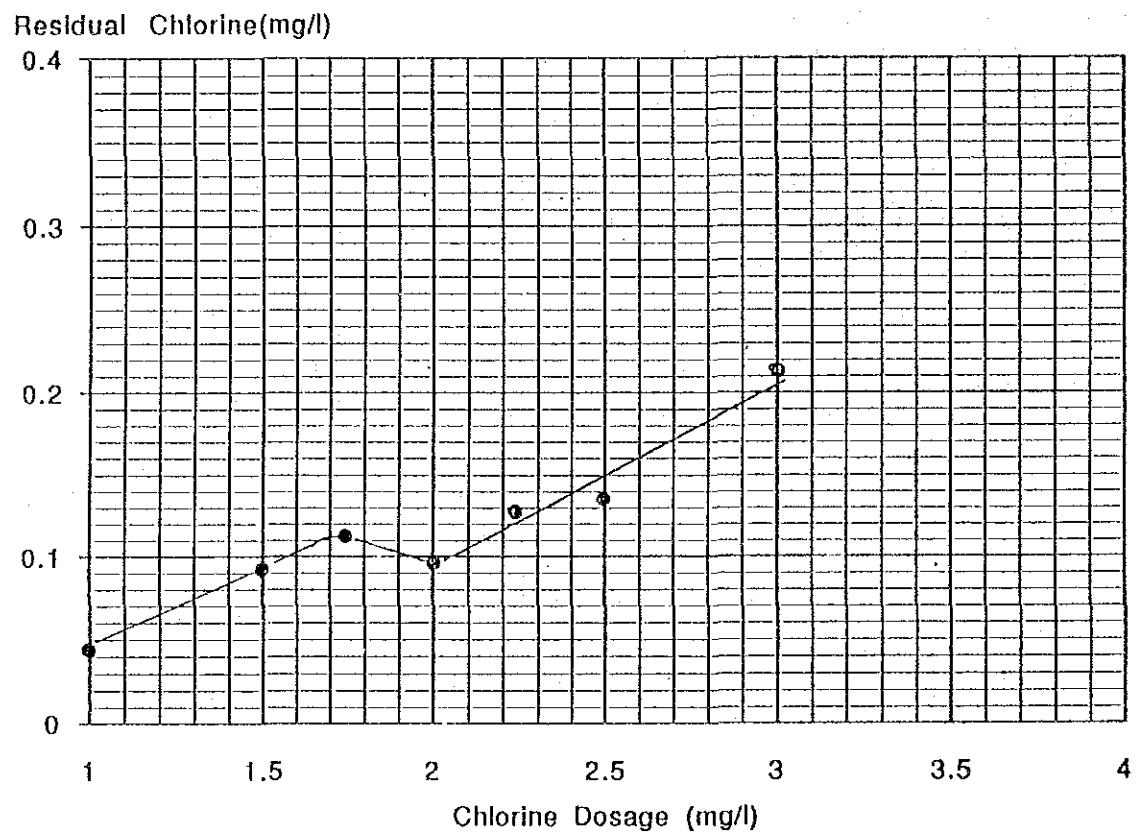


Chlorine Demand (R.L.1)

Residual Chlorine(mg/l)

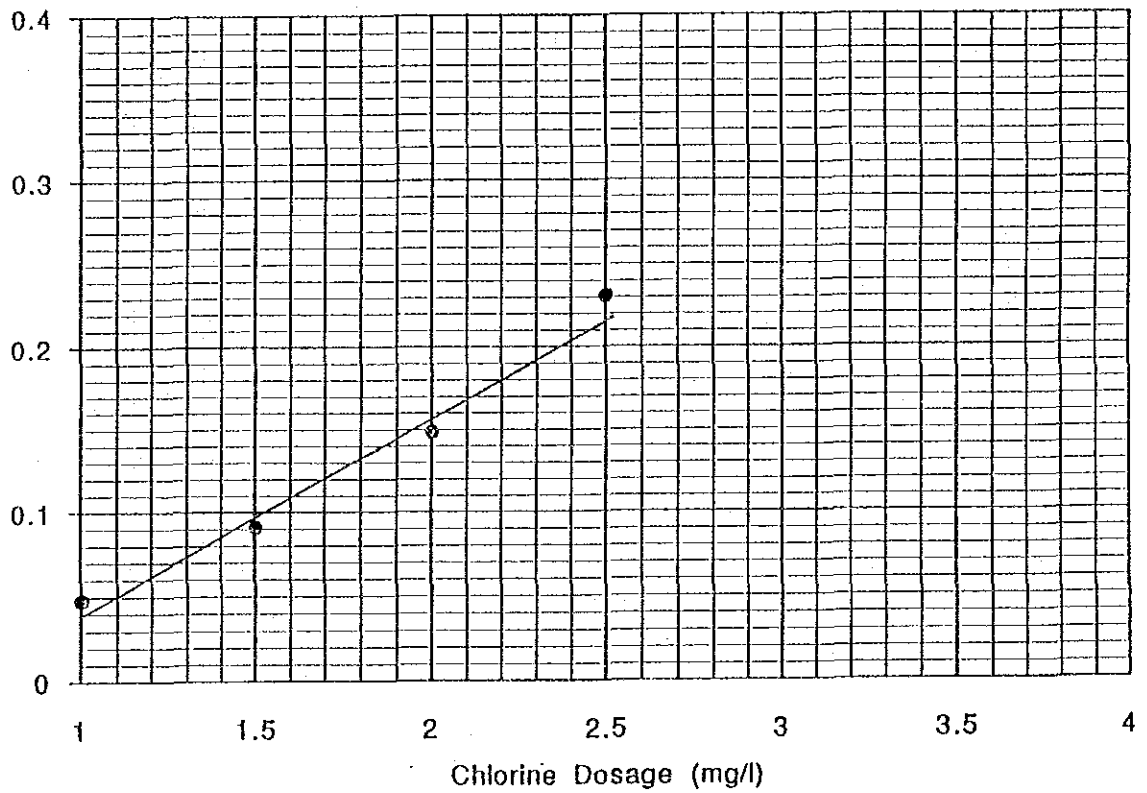


Chlorine Demand (Shahdara)



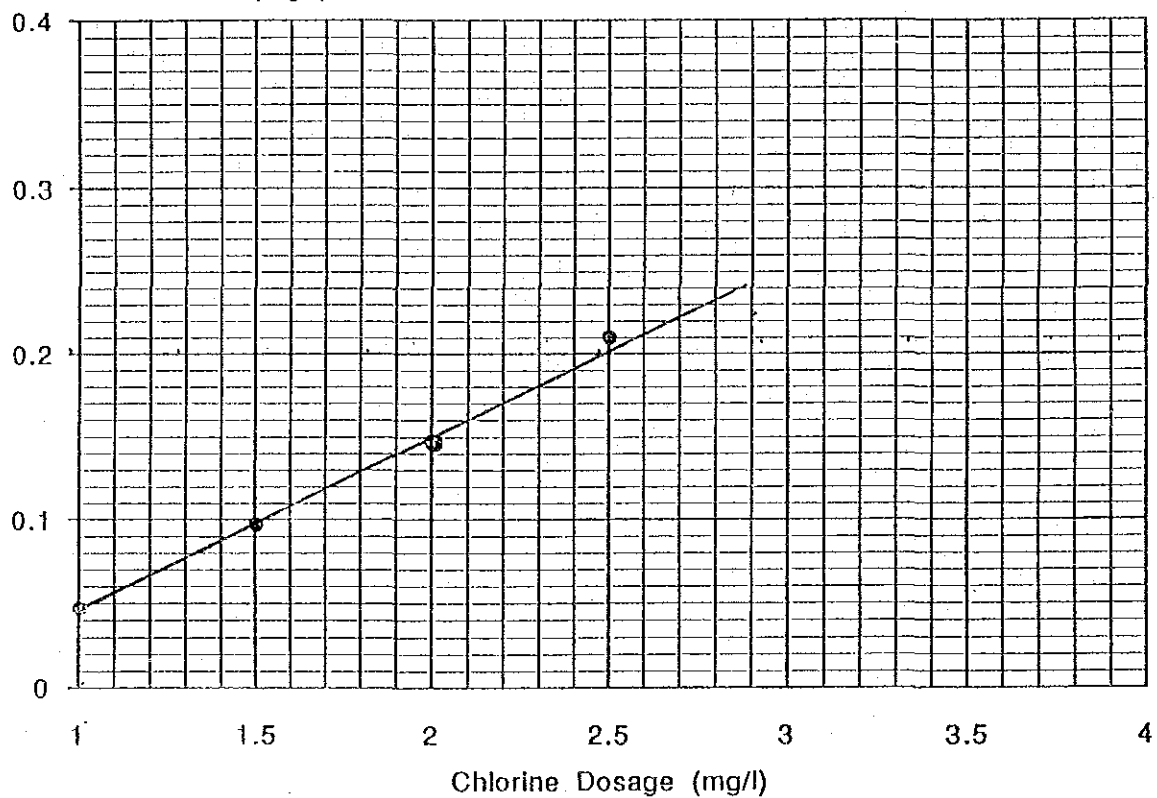
Chlorine Demand (Noorpur)

Residual Chlorine(mg/l)



Chlorine Demand (Saldpur)

Residual Chlorine(mg/l)



**Appendix-7 Consideration on the Performance of Medium
Rate Sand Filtration**

Consideration on the Performance of Medium Rate Sand Filtration

A unique filtration method; with 10 to 20 m/day of filtration rate and applying backwash, is employed in Korang, Golf Course, G-10, R.L.1 and Shahdara water treatment plants. This is classified as a type between rapid sand filtration and slow sand filtration. This type is called Medium rate sand filtration in this study. This type is supposed to have been introduced to the operation because it can double the filtration rate compared to slow sand filtration with same area of filter bed by applying smaller backwash than rapid sand filtration.

This type is very unique, so standards/criteria or examples for the designing have been hardly found. This could be considered as of body-filtration type rather than surface-filtration, judging from its filtration rate and a fact that backwash is applied. If it is a body-filtration, filtration performance can be evaluated by backwash efficiency. Therefore, it is evaluated by conforming the knowledges on the body-filtration.

Backwash performance depends on backwash flow rate ($\text{m}^3/\text{m}^2/\text{sec}$). While necessary backwash flow rate is said to be $0.6 \text{ m}^3/\text{m}^2/\text{sec}$ (ref. Japanese Water Supply Facility Design Standards), the actual backwash flow rate applied in medium rate sand filtration in the existing plants is only $0.05 \text{ m}^3/\text{m}^2/\text{sec}$. This is much smaller than the necessary for conventional rapid sand filtration. Thus it can be presumed that it is impossible to backwash the filter bed if suspended materials is loaded to the filter beds at similar rate as in rapid sand filtration. Therefore, to continue the operation of medium rate sand filtration, it is necessary to keep the suspended solid loading rate very low compared to the rapid filtration.

On the other hand, low speed filtration would have such merits that removal ratio would be higher than the rapid

one and that the capacity of the backwash pump remains smaller than that required in rapid sand filtration.

The possible modification methods of the medium sand filtration may be as follow:

- i) To change to slow sand filtration.
- ii) Not to change filtration rate, but increase the capacity of backwash pump to same capacity as one required in rapid sand filtration.
- iii) To change to rapid sand filtration.

Among the above, the first idea is not practical because of the limitation in availability of land and the second one is too costly because required pump capacity is directly proportional to area of filter bed. Then, remaining possibility is the third one to change to rapid filtration, but it may be costly, too. Therefore, the modification of the existing system by changing to rapid sand filtration should be limited in the plant where rapid filtration is only type that can purify the raw water to the required water quality level.

To evaluated the above necessity, turbidity removal in filtration process has been investigated. Based on the standards operation method of the rapid sand filtration, it is judged that rapid sand filtration is necessary when the turbidity removal in filtration process exceeds 4 degree.

Results of the investigation are presented in the Table below. For R.L.1 plant, the case where the existing water conduction through open channel is changed to underground conduction is considered in the investigation because it is proposed in the rehabilitation plan to prevent the contamination of raw water by wastewater. Also, the case, where inlet water is improved by the modification of sand settling pond is considered for Shahdara plant, which is also proposed in the rehabilitation plan.

Turbidity removals in Golf Course and G-10 plants are estimated as much as 6.0 and 7.6 degree because of bad quality of raw water. Therefore, it is necessary to change the existing system to rapid sand filtration in these plants. For Shahdara and R.L.1 plants, it is not considered to be necessary to be changed if improving raw water quality. For Korang, it is not necessary to be changed if the coagulation is enforced.

(unit : degree)

Name of Plant	Raw Water Turbidity	Water intake/ Sand Settling	Turbidity Inlet of Sedimentation	Turbidity Inlet of Filtration (a) *3	Turbidity Outlet of Filtration (b)	Turbidity Removal in Filtration (a)-(b)
Korang	27		27	5.4	5	0.4
Golf Course	40		40	11	5	6
G-10	42		42	12.6	5	7.6
R.L.1	45		45	13.5	5	8.6
	45	Piping *1	30	6	5	1
Shahdara	40		40	8	5	3
	40	Settling Pond *2	30	6	5	1

*1 : After modification of the conduction, raw water quality is considered same as the quality of Rawal Lake, which is assumed same as Simly dam

*2 : Removal efficiency in the settling pond is assumed at 33 %.

*3 : Removal efficiency in sedimentation process is assumed at 80 % based on operational experiences in Japan. It is assumed at 70 % in Golf Course and G-10 Plants, considering the low efficiency in coagulation process due to the contamination by organic materials.

