Water and Sanitation Agency in Lahore
Lahore Development Authority
ISLAMIC REPUBLIC OF PAKISTAN

PREPARATORY SURVEY REPORT
ON
URGENT REHABILITATION PROJECT
FOR SEWARAGE AND DRAINAGE SYSTEM IN LAHORE
(Retrieval of Sewerage and Drainage System in Lahore City (Phase-II))
IN
THE ISLAMIC REPUBLIC OF PAKISTAN

March 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

CTI ENGINEERING INTERNATIONAL CO. LTD.

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PREFACE

Japan International Cooperation Agency (JICA) conducted the preparatory survey on urgent rehabilitation project for sewerage and drainage system in Lahore in the Islamic Republic of Pakistan.

JICA sent to Pakistan a survey team from August 26th to September 24th, 2009.

The team held discussion with the official concerned of the government of Pakistan, and conducted a field survey at the study area. After the team returned to Japan, further studied were made. Then, a mission was sent to Pakistan in order to discuss a draft final outline design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement o friendly relation between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Islamic Republic of Pakistan for their close cooperation extended to the teams.

March 2010

Kikuo NAKAGAWA

Director General, Global Environmental Department

Japan International Cooperation Agency

March 2010

Letter of Transmittal

We are pleased to submit to you the preparatory survey report on urgent rehabilitation project for sewerage and drainage system in Lahore in the Islamic Republic of Pakistan.

This survey was conducted by CTI Engineering International Co., Ltd., under a contract to JICA, during the period from August 2009 to March 2010. In conducting the survey, we have examined the feasibility and rationale of the project with due consideration to the present situation of Pakistan and formulated the most appropriate outline design for the project under Japan's Grant Aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

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Masakazu MAEDA
Chief Consultant
Preparatory survey team on
Urgent Rehabilitation Project for Sewerage and Drainage System in Lahore in the Islamic Republic of Pakistan

Summary

1. Background of the Project

Lahore, the capital city of Punjab, is the second largest city in Pakistan. The city has a population of about 7.2 million and plays an important role in the country's economy. However, urban infrastructures such as roads, water supply facilities, and sewerage and drainage systems have not been improved to cope with the development and expansion of the city. Particularly, the silted or choked sewer lines and drainage channels are serious hazards to the urban environment. The situation aggravates in the monsoon season causing flooding in many places and resulting in not only impediment to traffic and business but also degradation of sanitary environment.

The Water and Sanitation Agency (WASA), one of the constituent agencies of the Lahore Development Authority (LDA), is in charge of operation and maintenance of sewerage and drainage systems in downtown Lahore. De-silting operations are presently being carried out mostly by manual labor to address the emergency need and, practically, any effective and efficient action is taken to improve the system and facilities in accordance with the medium and long-term plans.

In Lahore City, there are about 223 km of sewer lines and 41 km of drainage channels. These were originally designed as separate systems. However, sewer pipes are connected to drains at various points and a large amount of sewage constantly enters storm water drains at various points and is ultimately disposed into the Ravi River.

People are complaining about the stench generated from wastewater in open channels, which are full of sludge and garbage. Flood is attributed to the reduction of flow capacity of sanitary sewers and storm water drainage channels, which are silted up and clogged with solid waste. In addition, pumping stations do not have sufficient drainage capacity to cope with heavy rains.

Under the above circumstances, in the "Integrated Master Plan for Lahore - 2021" prepared by the Lahore Development Authority (LDA) in November 2002, the improvement of sewerage and drainage systems was set as the issue of immediate concern. Based on the M/P, the Government of the Islamic Republic of Pakistan (GOP) requested the Government of Japan (GOJ), in 2004, to extend Japan's Grant Aid for "*The Project for the Retrieval of Sewerage and Drainage System in Lahore City in the Republic of Pakistan*" (hereinafter referred to as "the Project"), aiming to mitigate inundation damage and to improve sanitary conditions at the frequently inundated areas administered in Lahore by the Water and Sanitation Agency (WASA) and which formerly served as the center of political and commercial activities. In response to the request, the Japan International Cooperation Agency (JICA) implemented the Project, which had the following components:

- Procurement of cleaning equipment for drainage pipes and drainage channels; and
- Installation of six (6) new drainage pumps (3 pumping station x 2 pumps each) and one (1) automatic trash rake system.

Some degree of improvement of inundation condition has been recognized as the effect of the Project. However, massive inundation damage occurred in August 2008 leading to the recognition that the sewerage and drainage system in Lahore City is not yet sufficient and that additional improvement with the renovation of existing but deteriorated drainage pumps is the most urgently required.

Under the above circumstances, the GOP again made a request to the GOJ, in July 2007, for the renovation and procurement of necessary equipment for the Project under Japan's Grant Aid to recover the drainage capacity of the system in Lahore City that had declined to 55% of the original design. The contents of this request are as shown below.

Pumping Station	Requested Contents	
	Renovation of Existing Pumps	Installation of New Automatic Trash Rake System
Shad Bagh	4	1
Gulshan-E-Ravi	8	-
Multan Road	4	1
TOTAL	16	2

2. Contents of the Project

JICA dispatched a Preparatory Survey Team to Pakistan for the outline design study from August 26 to September 18, 2009. The team continued the study and evaluation of field survey results upon its return to Japan and then explained the basic design outline to the authorities concerned in Pakistan from January 20 to 28, 2010.

The criteria for prioritization of equipment to be procured in the Project and selected through discussions between the JICA study team and WASA are as follows:

- Inundation record in Lahore City;
- Degree of degradation and deterioration of each equipment;
- Effectiveness of pump renewal at each pumping station; and
- Amount of garbage flow into each pumping station.

The overall plan and contents of the Grant-Aid Project are to be studied in consideration of the following situations confirmed in the Preparatory Survey:

- It is necessary to upgrade the total drainage capacity of the pumping stations (Shad Bagh, Khokhar Road and Siddique Pura) to enhance the drainage capacity of the whole Shad Bagh Pumping Station, because three (3) pumping stations are at the same site and have the same catchment areas.
- There is a vacant space for the installation of three (3) pumps for the Shad Bagh and Khokhar Road pumping stations. The installation of new pumps at the vacant space is reasonable and could facilitate easier construction work.
- Trash inflow quantity to the Multan Road Pumping Station is less than those inflowing to the Shad Bagh and Khokhar Road pumping stations which are too massive.

- Two (2) of the eight (8) existing pumps requested to be replaced in the Gulshan-E-Ravi Pumping Station where there are fourteen (14) existing pumps are kept in better condition than the others so that priority to replace these two pumps is not so high.

In consideration of the above-described results of the Preparatory Survey, the equipment identified through the preparatory survey in Pakistan and the technical examination in Japan are confirmed as follows:

Pumping Station	Requested Contents	Contents Agreed for the Project
Shad Bagh	Renovation of Existing Pumps: 4 units Installation of New Automatic Trash Rake System: 1 unit	Renovation of Existing Pumps: 4 units Installation of New Automatic Trash Rake System: 1 unit
Khokhar Road	No Request	Installation of New Pumps: 2 units Installation of New Automatic Trash Rake System: 1 unit
Gulshan-E-Ravi	Renovation of Existing Pumps: 8 units	Renovation of Existing Pumps: 6 units
Multan Road	Renovation of Existing Pumps: 4 units Installation of New Automatic Trash Rake System: 1 unit	Renovation of Existing Pumps: 4 units
TOTAL	Renovation of Existing Pumps: 16 units Installation of New Automatic Trash Rake System: 2 units	Renovation of Existing Pumps: 16 units Installation of New Automatic Trash Rake System: 2 units

3. The Implementation Period and Project

The implementation period of the Project is estimated to be 4.5 months for signing and detailed engineering design, and 21.5 months for procurement, manufacturing and installation of equipment. The Project to be completed under the Japan's Grant Aid scheme is estimated to cost JPY 1,238 million (i.e., JPY 1,229 million from GOJ and JPY 9 million from GOP).

4. Project Evaluation and Recommendation

To be benefited directly with the implementation and realization of the Project are about three (3) million residents in the 105 km^2 total catchment area of the Shad Bagh, Gulshan-E-Ravi and Multan Road pumping stations. The Project is expected to have the following effects:

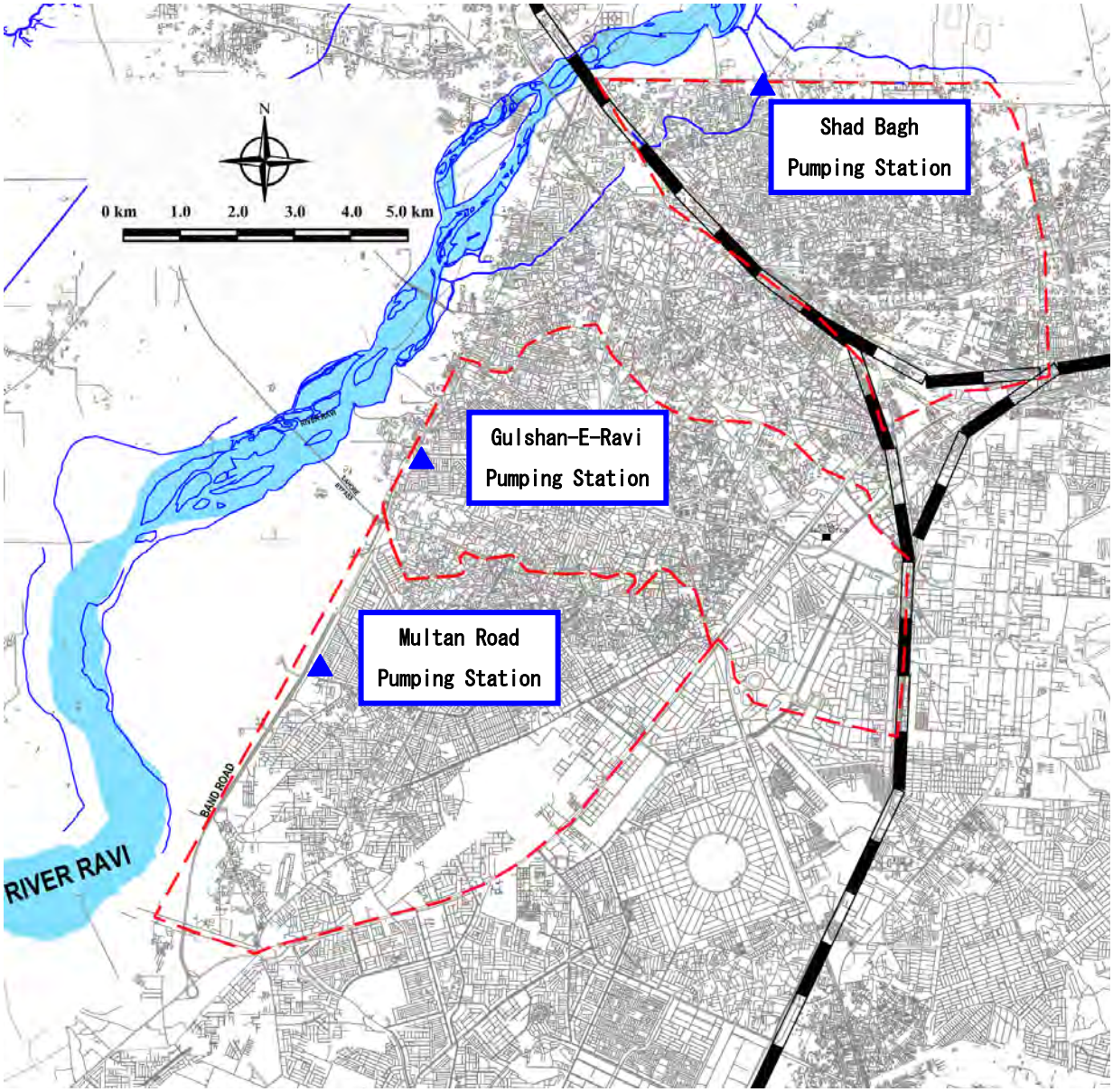
Present Condition	Inputs under Grant Aid	Project Effects
- Inundation and debasement of social environment and sanitation often happen due to heavy rainfall in the monsoon season because of the degradation of drainage capacity of the decrepit drainage pumps. - Spare parts of pumps could not be procured because parts of too old pumps are no longer available commercially. - Disposed massive trash in drainage channels which could not be removed efficiently make the condition of drainage pumps deteriorate.	- Procurement and installation of 16 pumps and related equipment, and 2 automatic trash rake systems. - Appurtenant works for the above installation works.	- Drainage capacity of pumping stations will increase to 38% and inundation damage will be mitigated. - Inundation duration will shorten to approx. 3 hours (60%) and inundation depth will reduce to about 13 cm (90%). - Worker environment concerning safety and sanitation will improve with the installation of Automatic Trash Rake Systems.

With regard to the O&M system of WASA, the system structure and staff ability are assumed to be fine; however, financial management conditions leave some aspects to be improved. For the sustainable and independent management of WASA, continuous trials and enforcement of regulations are necessary to reduce the number of customers “without water meter” and thus increase the income.

As mentioned above, the Project will contribute to the mitigation of inundation conditions and the improvement of sanitary environment, and the Project output will be significant. Since any particular problem will be encountered in the Project’s implementation, the positive impacts will be more with the execution of proper measures for trash disposal. Therefore, it is concluded that implementation of the Project under Japan’s Grant Aid is appropriate.

Contents

Location Map



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Catchment Area of Pumping Station (Present)

Name of Pumping Station

Location of Pumping Station

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Abbreviations

A/P	:	Authorization to Pay
AAGR	:	Annual Average Growth Rate (%)
B/A	:	Banking Arrangement
CIF	:	Cost, Insurance and Freight
DFID	:	Department for International Development
DMD of WASA	:	Deputy Managing Director of WASA
E/N	:	Exchange of Notes
EAD	:	Economic Affairs Division
EIA	:	Environmental Impact Assessment
EOJ	:	Embassy of Japan in Pakistan
FOB	:	Free-on-Board
GOP	:	Government of Pakistan
HUD & PHED	:	Housing, Urban Development and Public Health Engineering Department
IBRD	:	International Bank for Reconstruction and Development
IEE	:	Initial Environmental Examination
L/A	:	Loan Agreement
LDA	:	Lahore Development Authority
M/M	:	Man-Month
MD of WASA	:	Managing Director of WASA
N/V	:	Note Verbal
NGO	:	Non-Governmental Organization
O&M	:	Operation and Maintenance
ODA	:	Official Development Assistance
PDD	:	Planning and Development Department
PEPA	:	Pakistan Environmental Protection Agency
PEPD	:	Punjab Environmental Protection Division
PMU	:	Project Management Unit
PQ	:	Pre-Qualification
R/D	:	Record of Discussions
SDO	:	Subdivision Office, Subdivision Officer
SWMD	:	Solid Waste Management Department
TOR	:	Terms of Reference
UNDP	:	United Nations Development Programme
WASA	:	Water and Sanitation Agency in Lahore
XEN	:	Executive Engineer

Chapter 1 Background of the Project

1-1 Present Situation and Issues

Lahore City, the capital of Punjab, is the second largest city in Pakistan. The city has a population of about 7.2 million and plays an important role in the country's economy. Lahore City receives about 700mm of annual precipitation on average, and 60% of annual precipitation concentrates in the monsoon season from June to August. Inundation disasters occur in many places in the monsoon season due to the flat terrain and insufficient sewerage and drainage system, resulting in not only impediment to traffic and business but also degradation of sanitary environment.

Improvement projects of sewerage and drainage systems in Lahore City started in the 1930's and equipment such as drainage pumping stations have been constructed gradually with support from donors since the first master plan (M/P) of water supply and sewerage and drainage systems were studied in 1969. In the "*Integrated Master Plan for Lahore-2021*" prepared by the Lahore Development Authority (LDA) on November 2002, the improvement of sewerage and drainage systems was set as the issue of immediate concerned. Actually, however, the improvement of drainage lines had not developed like the plan and the adequate maintenance works for existing facilities had not been implemented because of the lack of equipment, so that the negative impacts on traffic, socioeconomic and sanitary conditions have occurred with inundation disasters.

To improve the situation, the Government of the Islamic Republic of Pakistan (GOP) requested the Government of Japan (GOJ), in 2004, to extend Japan's Grant Aid for "*The Project for the Retrieval of Sewerage and Drainage System in Lahore City in the Republic of Pakistan*" (hereinafter referred to as "the Project"), aiming to mitigate inundation damage and to improve sanitary conditions at the frequently inundated areas administered by the Water and Sanitation Agency in Lahore (WASA) which formerly served as the center of political and commercial activities. In response to the request, the Japan International Cooperation Agency (JICA) had implemented the Project, which had the following components:

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Under the above circumstances, the GOP again made a request to the GOJ, in July 2007, for the renovation and procurement of necessary equipment as shown in Table 1.1 for the project

under Japan's Grant Aid to recover the drainage capacity of the system in Lahore City that had declined to 55% of the original design.

Table 1.1 Requested Contents of from GOP

Pumping Station	Requested Contents	
	Renovation of Existing Pumps	Installation of New Automatic Trash Rake System
Shad Bagh	4	1
Gulshan-E-Ravi	8	-
Multan Road	4	1
TOTAL	16	2

1-2 Natural Conditions

1-2-1 Meteorology and Hydrology

As shown in Fig. 1.1, annual rainfall for the last 15 years (1994-2008) fluctuated widely and 60-80% of them concentrated from June to August in the monsoon season. The average daily precipitation in the monsoon season was 10mm/day, approximately (refer to Fig. 1.2). On the other hand, daily precipitations of more than 80mm/day occurred once every year, at least, during monsoon season in maximum daily precipitation of each month (refer to Fig. 1.3).

The maximum daily precipitation for the last 15 years was 189.7mm/day on August 24, 1996. This year also recorded the second highest annual rainfall for the 15 years. From 1947 to 2008, daily precipitations of more than 180mm/day were recorded in 1954, 1958, 1964, 1976, 1980 and 1996. There is no record of the precipitation after 1996 up to the present.

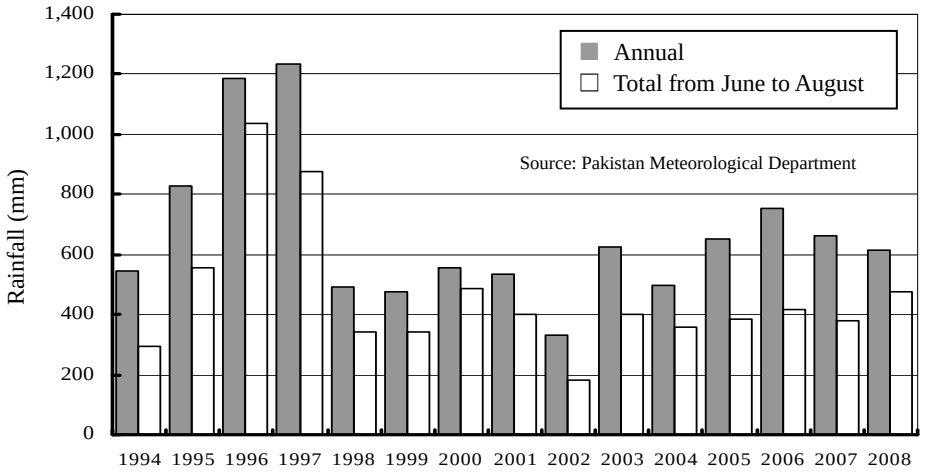


Fig. 1.1 Annual Rainfall in Lahore City

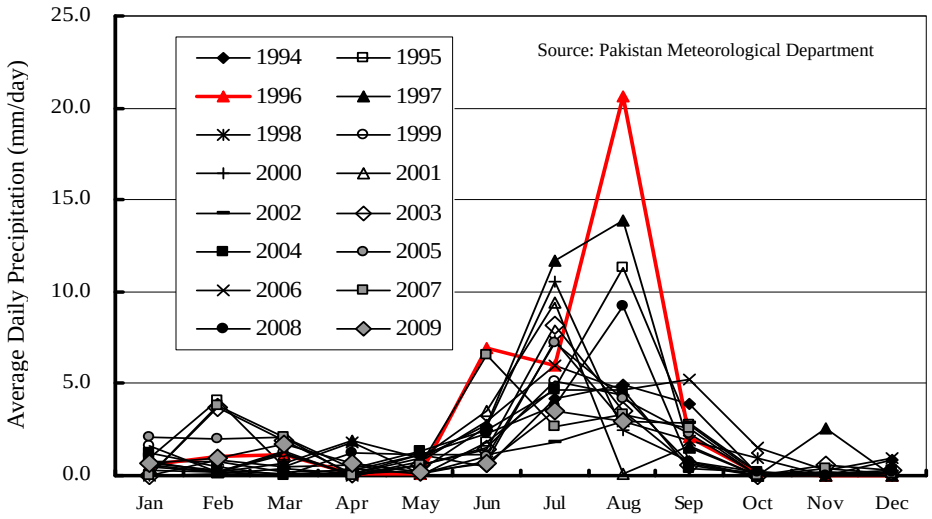


Fig. 1.2 Average Daily Precipitation in Lahore City (1994-2008)

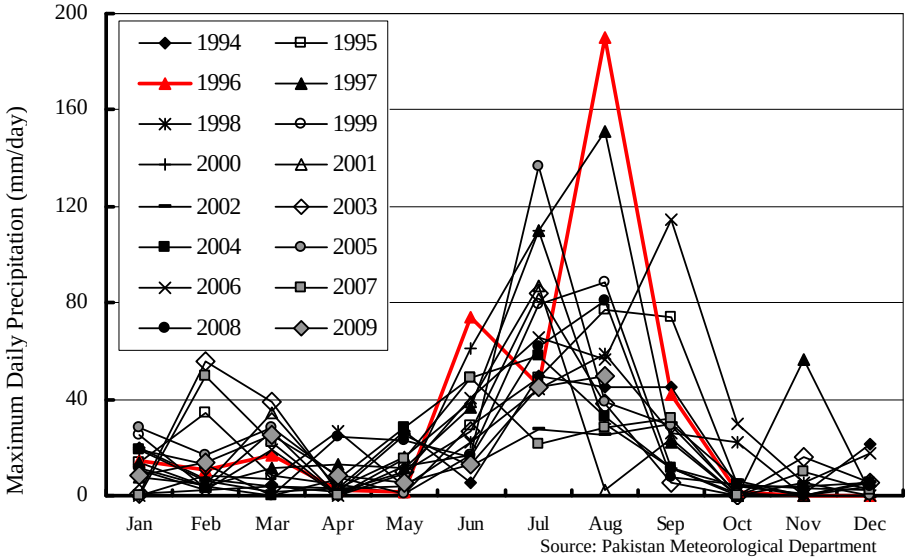


Fig. 1.3 Maximum Daily Precipitation in Lahore City (1994-2008)

In general, temperature fluctuations between summer and winter appear, apparently. The hottest period is from May to July with the highest temperature of about 40 degrees centigrade, and the coldest period is from December to January with the lowest temperature of below zero degree centigrade.

As the general meteorological condition, wind condition of 60% a year is moderate and the number of days that strong winds occur is not so much.

1-2-2 Inundation Condition

Inundation disasters in Lahore City are basically caused by internal flooding, and flooding from the Ravi River had not happened in the last 15 years, even during the recorded highest daily precipitation in 1996.

The latest significant precipitation was recorded as 49.4mm/day at the Jali Road Monitoring Point on August 12, 2009. The following photos show the inundation condition at Queens Road and Mozang Chungi in the catchment area of Gulshan-E-Ravi Pumping Station.

[Queens Road]

[Mozang Chungi]

Photo 1.1 Inundation Condition at Catchment Area of Gulshan-E-Ravi Pumping Station (August 11, 2009)

In recent years, heavy rainfall in June 2007 and in July and August 2008 caused inundation at various sites throughout Lahore City for a long time (refer to Table 1.2).

Table 1.2 Inundation Condition in Lahore City in 2007 and 2008

Monitoring Point (Station Name・Number[*1])		Inundation Condition									
		Jun.17,2007 (40.5mm/日)		Jun.29,2007 (49.2mm/日)		Jul.12,2008 (25.0mm/日)		Jul.13,2008 (61.8mm/日)		Aug.13,2008 (80.7mm/日)	
		Duration (hrs)	Depth (m)	Duration (hrs)	Depth (m)	Duration (hrs)	Depth (m)	Duration (hrs)	Depth (m)	Duration (hrs)	Depth (m)
Lakshmi Chowk	1	9.00	0.62	11.30	0.84	8.50	1.04	12.00	0.36	9.00	0.78
Thoronton Road	4	9.50	0.58	10.80	0.81	6.50	0.25	6.50	-[*2]	10.30	0.62
Empress Road	32	7.00	0.15	-[*2]	-	-	-	-	-	9.25	0.22
Cooper Road	5	8.00	0.21	11.50	0.30	8.50	0.30	8.50	0.08	10.00	0.35
GPO	2,6	4.50	0.34	8.00	0.30	6.00	0.23	8.80	0.13	9.00	0.25
Plaza Cinema	10	12.00	0.42	11.00	0.53	9.00	0.15	6.50	-	9.25	0.40
Nabha Road	11	8.50	0.54	9.50	0.53	4.30	-	6.50	0.30	9.25	0.31
Chuburgi	18	4.50	0.15	8.00	0.15	12.30	-	6.80	-	-	-
Lake Road	19	8.50	0.72	8.50	0.08	12.50	-	6.80	-	9.00	0.15
Aik-Moria Pul	43	6.00	0.45	8.00	0.23	5.50	0.25	5.30	0.61	-	-
Aziz Road	45	4.50	0.32	6.00	0.20	12.00	0.46	7.00	0.46	7.00	0.42
Chowk Na-Khuda	47	5.50	0.15	8.80	0.41	10.50	-	7.50	0.46	3.00	0.25
Sheranwala Gate Pully	48	6.75	0.15	7.00	0.15	5.50	0.15	3.50	0.15	2.50	0.10
Outside Bhatti Gate	49	6.75	0.32	8.50	0.91	7.50	0.30	6.00	0.76	-	-
Scheme More	62	3.00	-	8.30	0.13	-	-	5.00	-	-	-

Note: [*1] Refer to Fig. 1.4 for the number of monitoring points.
[*2] Missing data

Inundation durations and depths shown above have caused negative impacts not only to road traffic and socioeconomic conditions but also to daily living conditions and sanitation with the accumulation of a mixture of rainwater and domestic wastewater in the low-lying areas. Therefore, improvement of the system together with the procurement and installation of

necessary drainage equipment is urgently necessary to resolve and mitigate the negative effects of inundation.

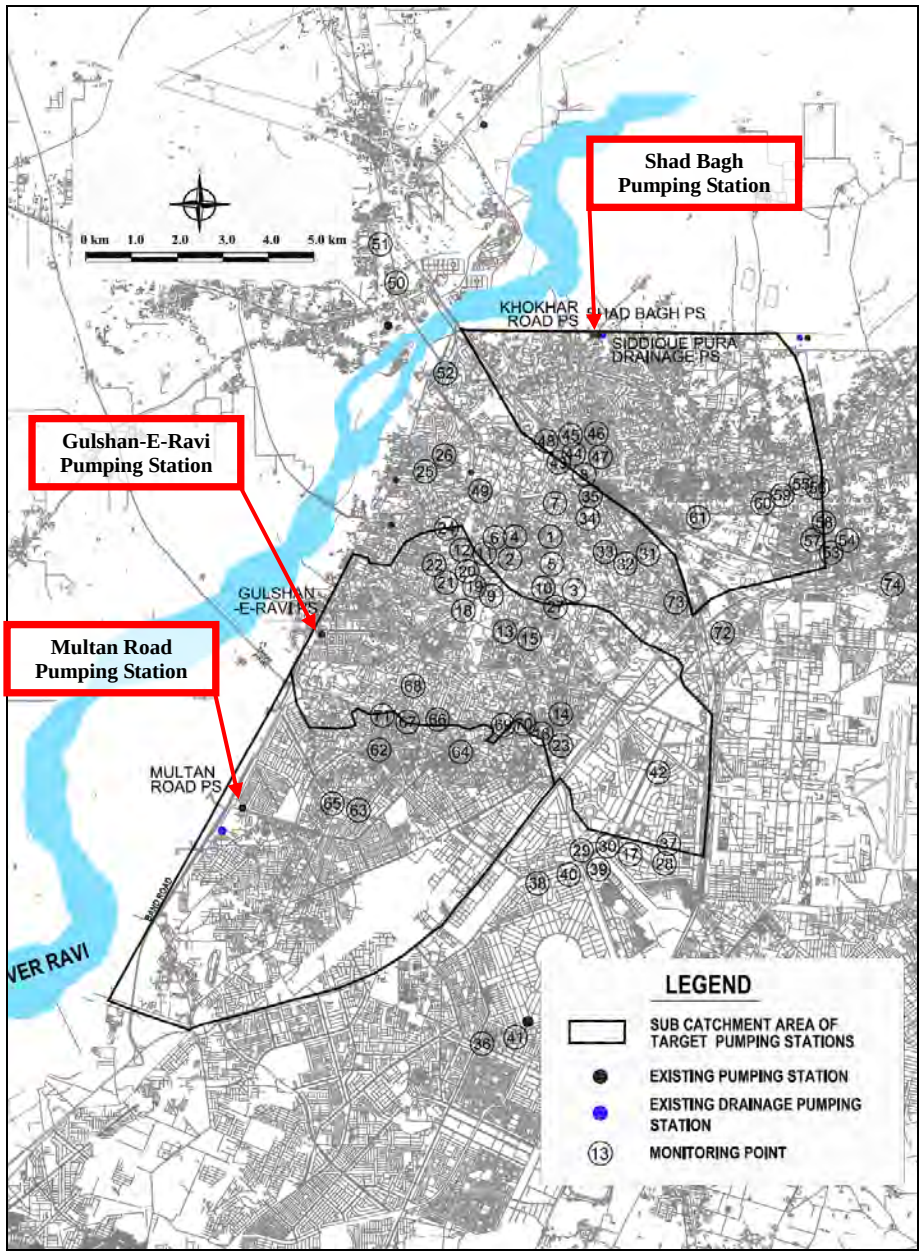


Fig. 1.4 Monitoring Points of Inundation in Lahore City

1-3 Environmental and Social Considerations

1-3-1 Initial Environmental Examination

The "*Pakistan Environmental Protection Act of 1997*" and the "*Pakistan Environmental Agency (Review of IEE & EIA) Regulations in 2000*" stipulates the necessity of IEE (Initial Environmental Examination) or EIA (Environmental Impact Assessment). WASA carried out the IEE study on "*The Project for the Retrieval of Sewage and Drainage System in Lahore City*" in August 2004, and the IEE was approved by the PEPD (Punjab Environment Protection Department) in September 2004. Since the environmental conditions for the Project are almost

the same as the conditions in the IEE study in 2004, the issued IEE Certificate is valid for the Project.

1-3-2 Environmental Impact of the Project

Factory wastewater and domestic wastewater are discharged into the Ravi River without treatment and this might affect the water environment. WASA is now studying a plan to construct six (6) wastewater treatment plants to cope with this issue. Since the amount of pollution load will not change between before and after Project implementation, the negative impact on the environment is considered will to be nil or very small.

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Overall Goal and Project Purpose

The Ministry of Environment had set objectives for the provisional access of drinking water supply to 90% and sewage to 70% of the entire population of Pakistan by 2015 in the National Environmental Policy (2005~2015) formulated in 2005. On the other hand, Lahore Development Authority (LDA) had prepared the "*Integrated Master Plan for Lahore-2021*" setting the year 2021 as the target year, and it had proposed various projects with the aim of improving the urban environment to cope with city development. The LDA considers that development and improvement of sewerage and drainage facilities are the urgent issues to be solved. The "Urgent Rehabilitation Project for Sewerage and Drainage System in Lahore [Retrieval of Sewerage and Drainage System in Lahore City (Phase II)]", hereinafter referred to as "the Project", has thus the following objectives to attain the overall goal mentioned below:

- Overall Goal:
  To reduce inundation damage in Lahore City, secure the people's life and socioeconomic activities, and improve sanitary and hygienic environment.

The "*Urgent Rehabilitation Project for Sewerage and Drainage System in Lahore [Retrieval of Sewerage and Drainage System in Lahore City (Phase II)]*", hereinafter referred to as "the Project", has the following objectives to attain the overall goal mentioned above:

- Project Objective:
  The objective of the Project is to improve the capacity of the sewerage and drainage system, mitigate inundation damage, and improve sanitary and hygienic environment at repeatedly inundated areas in Lahore City.

2-1-2 Basic Concept of the Project

To attain the Project objective mentioned above, the replacement of old disposal pumps and trash rake system(s) shall be carried out in the Shad Bagh Pumping Station (Shad Bagh, Khokhar Road), Gulshan-E-Ravi Pumping Station and Multan Road Pumping Station. As a result of replacement, discharge capacities of the three pumping stations will increase, and inundation damage minimized.The procurement and installation of the following equipment will be implemented under Japan's Grant Aid:

1) Shad Bagh Pumping Station (Shad Bagh):

   Pump Equipment: 4 units
   Automatic Trash Rake System: 1 unit

2) Shad Bagh Pumping Station (Khokhar Road):

   Pump Equipment: 2 units

Automatic Trash Rake System: 1 unit

3) Gulshan-E-Ravi Pumping Station:

Pump Equipment: 6 units

4) Multan Road Pumping Station:

Pump Equipment: 4 units

2-2 Outline Design of Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy

The contents and outline design of the requested Japanese assistance shall be studied based on the request by the Government of Pakistan and results of the preparatory survey (Basic Design). Since the Government of Pakistan had requested the improvement of Shad Bagh Pumping Station (including Shad Bagh Pumping Station and Khokhar Road Pumping Station), Gulshan-E-Ravi Pumping Station and Multan Road Pumping Station, the locations, specifications and so on of the objective equipment in those requests shall be followed, in principle.

However, Japan's Grant-Aid is supposed to be extended to projects where grant-aid is urgently necessary in the present situation. Therefore, the requested items are to be reviewed based on the policy for Japan's Grant Aid.The criteria for prioritization of equipment to be procured in the Project are to be selected as follows through discussions between the JICA study team and WASA:

- Inundation record in Lahore City;
- Degree of degradation and deterioration of each equipment;
- Effectiveness of pump renewal at each pumping station; and
- Amount of garbage flow into each pumping station.

WASA and JICA are carrying out the "*The Preparatory Study on Lahore Water Supply, Sewerage and Drainage Improvement Project*". The plan established in that study shall be taken into consideration to avoid duplication of input.

(2) Policy on Natural Condition

Lahore City receives about 700mm of annual precipitation on average and it varies from 300 to 1200mm year by year. For the determination of pumping capacity, the target is generally set by the design storm.

However, WASA does not have the data and instead determines the pumping capacity by calculating the inflow of sewer pipes and drainage channels to a pumping station and inundation condition in its catchment area. The sewerage and drainage system in Lahore City has been gradually improved responding to the necessity; however, due to the unplanned

measures, the sewerage and drainage system in Lahore City is complicated and intertwined, and this makes it difficult to divide the drainage districts.

Based on the situation described above and following the methodology adopted by WASA, pump effectiveness shall be checked against the flow capacities of inflow and outflow.

(3) Policy on Socio-Economic Conditions

Neither land acquisition nor house relocation will occur in the Project because the project area within each pumping station under the jurisdiction of WASA is limited. There will be no negative socio-economic impact.

The objective pumping stations have a role not only to drain rainwater but also to discharge sewage water. Since sewage water is generated independently of rainfall, all pumping equipment at any pumping station shall not be stopped to keep discharging sewage water.The design and installation plan have to take the conditions above into consideration.

(4) Policy on Procurement/Construction

i) Approval/License of Project Implementation

The Project has to be approved by the Government of Pakistan under Procedure PC-I before the Government of Japan holds a cabinet meeting, and this Project was approved in accordance with PC-I in September 2007. However, if the project cost to be borne by Pakistan changes by more than 15% of the originally estimated cost, WASA shall have to obtain another approval again. The procedure will require two (2) months, approximately.

ii) Inland Transportation Method, and Location of Customs Clearance and Hand-Over

Equipment procured outside of Pakistan shall be disembarked at the Karachi Port and transported by means of inland transportation from the Karachi Port to Lahore City. There are two options of inland transportation: by railway and by road. There are two dry ports in Lahore City, one is for the railway which is located in the vicinity of Mughalpura Station east of the city, and the other is for road transportation which is located in Tokar Naiz Baig southwest of the city.

Usually, transportation by railway is slightly cheaper than by road, although there is a disadvantage that it can convey only the items that can be loaded in standard-sized containers. Thus, for the transportation of items that exceed the standard size of a container, it is better to utilize the road transportation, and WASA utilizes road transportation by trailer in many cases. Customs clearance at the dry port is possible in either mode of transportation.

Although there are many contractors for inland transportation from Karachi to Lahore, government organizations utilize the government-affiliated agent called NLC (National Logistic Cell) in many cases. NLC receives support from the army of Pakistan to prevent accidents during transportation, and safety control which utilizes the GPS and other reliable systems.

WASA recommends the use of NLC and the Customs clearance in Lahore based on experiences, and since there are many merits such as the convenience on Customs procedure in Lahore, Customs clearance will be in Lahore. The inland transportation will be on the road using trucks and trailers, basically.

iii) Local Procurement Condition

General construction materials, such as soil materials, aggregates, cement, reinforcing bar, steel pipes and structural steels, are available in Pakistan. However, pump equipment, automatic trash rake systems, electrical facilities and their accessories are very difficult to procure in Pakistan.

Locally available materials shall be used for the construction as much as possible to minimize the construction cost. The procurement plan shall also consider the future improvement plan to avoid the duplication of investment.

(5) Policy on the Applicability of Local Engineer/Company

i) Engineer for Installation of Pump, Machinery and Electrical Equipment

Some local engineers capable of supervising general construction work are available, but local engineers knowledgeable in the installation of pump, machinery and electrical equipment to be procured in the Project are not available. Therefore, engineers for such special installation work shall be dispatched separately from Japan.

ii) Policy on the Applicability of Local Company

There are some local contractors, and they have experience in construction work involving Japan's Grant Aid projects and basic skills on general construction works such as roads, drainage channels and simple concrete structures. Therefore, local contractors shall be involved as subcontractors for the general construction components to reduce project cost.

(6) Policy on the Operation and Maintenance Condition of Implementing Agency

The Planning and Evaluation Directorate of WASA is the implementing agency for the Project. After completion of the Project, the subdivision office in each town where a pumping station is located under the Operation and Maintenance Directorate of WASA will be responsible for the pumping station. WASA owns and operates more than 100 units of pumps, and it has adequate knowledge on operation and maintenance of pumping stations.

To determine the specifications of the objective equipment and facilities, the specification of existing pumps and easiness of maintenance shall be prioritized. To establish the test run and initial operation guidance plan, the capabilities on operation and maintenance of the implementing agency shall be considered.

(7) Policy on the Determination of Planning Scale of the Objective Equipment

i) Type and Capacity of Pump Equipment

The Government of Pakistan had mainly requested the replacement of old existing pumps. In order to determine the type and capacity of the objective pump equipment, those of the

existing pumps shall be considered since WASA does not design pump capacity by the design storm but by calculating the inflow and inundation condition.

Pump effectiveness after the Project shall be evaluated by the Cover Rate (Cover Rate = Pump Capacity / Required Drainage Capacity).

ii) Type of Automatic Trash Rake System

The old and existing manual trash rake systems shall be dismantled and replaced by new Automatic Trash Rake Systems. The type of Automatic Trash Rake System shall be the same or similar to the existing automatic trash rake systems in the other pumping stations for reasons of easiness of operation and maintenance.

(8) Policy on the Procurement Plan

Since this is a kind of equipment procurement project, the procurement method is an open bidding by Japanese trading companies or manufacturers. The bidder is required to have an aftercare service system. Implementation of the Project requires engineers to supervise the installation and test run, and provide initial operation guidance on the equipment.

The origin of procured equipment includes Japan, Pakistan and other third countries, but the supplier has to have a branch or a service branch in Pakistan or neighboring country for the aftercare service. The selection of equipment shall take into consideration not only the cost and quality of the equipment but also the usefulness and satisfaction of the recipient. The equipment that could be easily operated and maintained by the personnel of WASA shall be selected with reference to the existing equipment as well as their management and maintenance systems.

(9) Policy on the Implementation Schedule

The Project includes manufacturing, shipping, transportation, installation and testing of equipment. During the installation of equipment, a part of the pumping station has to be closed and the operation stopped, and then the drainage capacity of the pumping station turned down. This may make the inundation condition worse and to avoid this negative impact, the installation of pump equipment and automatic trash rake systems shall be executed mainly in the dry season.

It is estimated that the Project will require a term of 21.5 months from the selection of suppliers up to the hand-over of equipment.

2-2-2 Basic Plan (Equipment Plan)

Based on the results of the Basic Plan Study, the Basic Plan for the requested Japanese assistance are as summarized below.

(1) Overall Plan

i) Requests and Alternatives

In consideration of the results of the discussions with the Pakistani counterpart, site investigations and the analyses after investigation, the alternative plan shown in Fig. 2.1 is concluded as the Basic Plan since this plan is adequate for the request of the counterpart from the technical viewpoint and easiness of maintenance after installation and start-up operation.

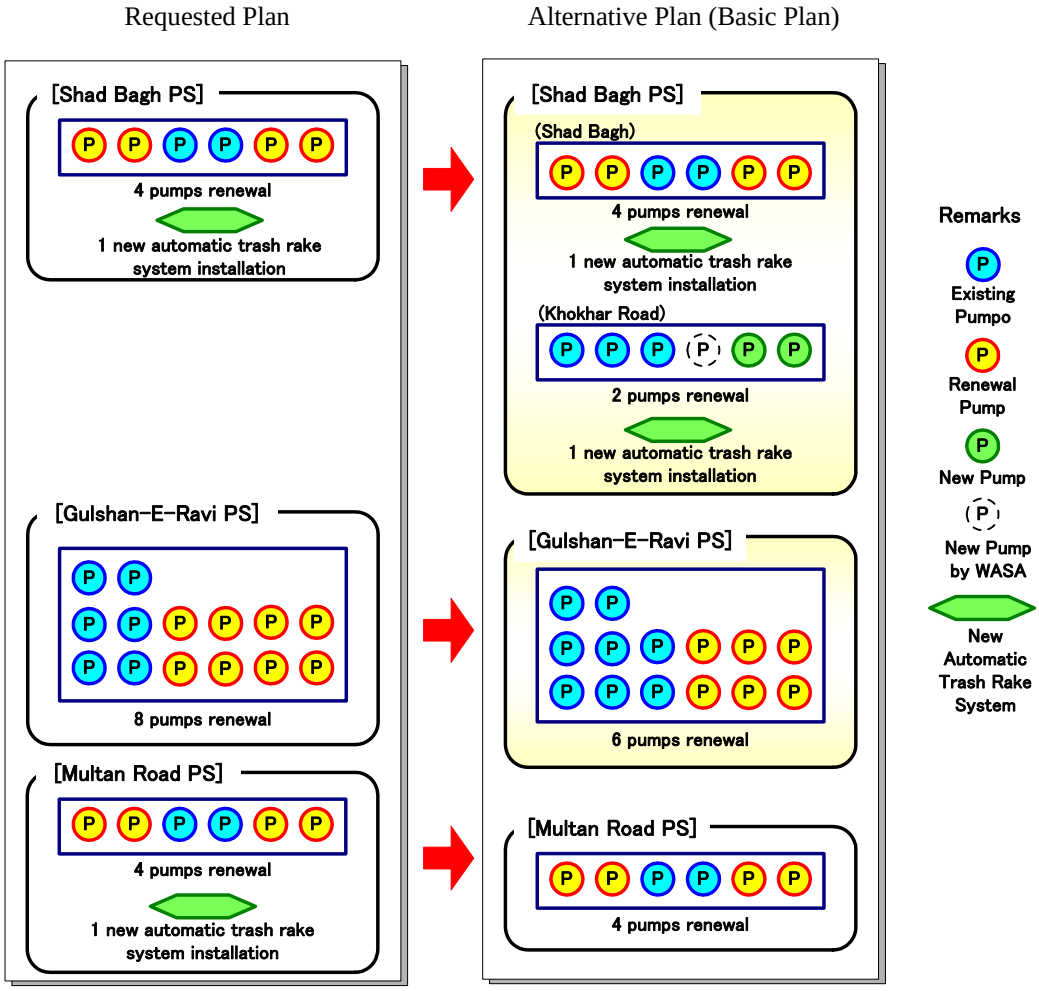


Fig. 2.1 Requested and Alternative Plan

ii) Upgrade Plan of Shad Bagh Pumping Station (Shad Bagh, Khokhar Road, Siddique Pura)

The cover rate of arranged drainage capacity to total necessary drainage capacity will be only 44% with the update of Shad Bagh Pumping Station (only Shad Bagh). Therefore, it is necessary to upgrade the drainage capacity of one or some of the pumping stations (Shad Bagh, Khokhar Road and Siddique Pura) to enhance the drainage capacity of the whole Shad Bagh Pumping Station.

The cost to upgrade Shad Bagh and Siddique Pura pumping stations will not be reasonable with the large-scale expansion of buildings because these stations have no space for

additional pump installation. On the other hand, additional pump installation in Khokhar Road Pumping Station, a part of Shad Bagh Pumping Station, will be reasonable since this station has an available space for the installation of three (3) additional pumps and does not need the expansion of its building. Therefore, it is concluded that the cover rate of drainage capacity could be improved to 54% with the installation of two (2) additional pumps at the available space of Khokhar Road Pumping Station.

1) Shad Bagh Pumping Station

Although only four (4) of the six (6) existing pumps installed in 1982 at Shad Bagh Pumping Station have the degraded drainage capacity of about 60% of the original, repair of these pumps would be impossible without the provision of spare parts. Therefore, the renewal/replacements of these four (4) decrepit pumps shall be designed.

As for the two (2) pumps granted under Japan's Grant Aid for "*The Project for the Retrieval of Sewerage and Drainage System in Lahore City*," their upgrade and replacements are not needed.

2) Khokhar Road Pumping Station

Although the Khokhar Road Pumping Station has an available space for the installation of three (3) new pumps, the installation of two (2) new pumps is adequate for the Project since another pump is to be granted by the State Government of Punjab.

3) Siddique Pura Pumping Station

No upgrade and renovation of the Siddique Pura Pumping Station in the Project is necessary for the following reasons:

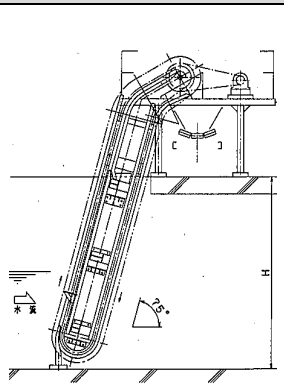
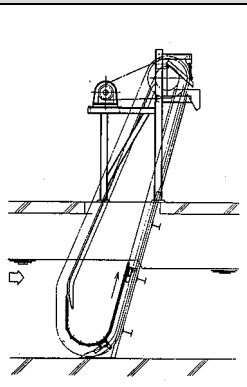
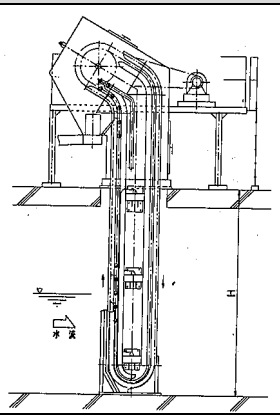
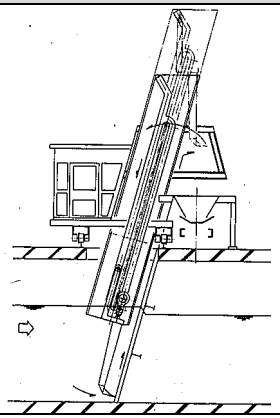
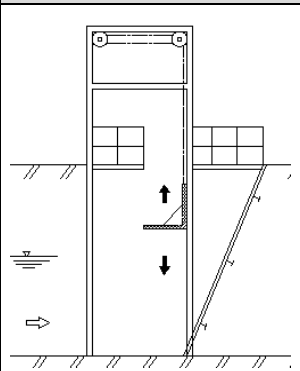
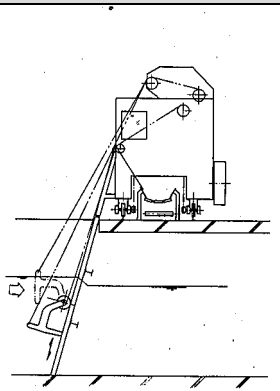
- The upgrade of existing pumps has not been requested since the pumps are relatively new.
- There is no space for the installation of new pumps.

4) Upgrade Plan of Automatic Trash Rake Systems

Garbage of more than 5 tons/day flows in the same channel through the Shad Bagh and Khokhar Road pumping stations. The blockage or interlocking of pumps and impellers by inflowing garbage causes the degradation of drainage capacity of the pumps since the existing manual trash rake systems of these stations have broken down. Therefore, the installation of automatic trash rake systems shall be designed for the Shad Bagh and Khokhar Road pumping stations.

In the Project, the Continuous Raking - Bar Screen Type of Automatic Trash Rake System, which is easier to maintain because of its simple structure and can scrape large trash, is suitable as the upgraded rake system considering the results of the study in Table R 2-2.1. The rake system of this type was installed at the Main Outfall Pumping Station in "*The Project for the Retrieval of Sewerage and Drainage System in Lahore City*," and WASA had approved the effectiveness of this rake system.

Table 2.1 Comparative Table of Automatic Trash Rake System

	Fixed Type					Movable Type
	Continuous Raking Type			Intermittent Raking Type		
	Bar Screen Type	Catenary Type	Net Type	Telescopic Arm Type	Lifting Table Type	Trash Car Type
Figures						
Existing Pumping Station	■ Main Outfall	—	—	—	■ Shad Bagh ■ Khokhar Road ■ Gulshan-e-Ravi	■Shad Bagh
Mechanism	The trash caught in the front screen is removed continuously by rakes attached at fixed intervals.	The rake is attached in the endless chain made to hung vertically at a fixed interval. The trash pushed by the rake at the screen side is removed continuously.	A net frame is attached in an endless chain. The injection water from the backside of net flushes the trash away.	A rake held by the telescopic arm rakes the trash repeatedly. A high space on the base is required due to the mechanical structure.	The tray installed in front of screen lifts the trash by manual operation. The dust lifted to the ground is removed by manpower.	The rake attached in the electronic vehicle moves on the rail between several waterways.
Disposal Capacity	- Since it is in continuous motion, throughput is large. - Largerefuse can be removed.	- It is suitable for thin refuse disposal. - The stake biting power of rake is weak in the lower part.	- Throughput is large due to continuous motion. - It is suited for fine and adhesive trash.	- It cannot operate continuously but throughput is small. - Removal of bulky trash is impossible.	- Since it cannot operate continuously, throughput is small. - Human power work is required to remove trash from the tray.	- The throughput per time is small. - The rake biting power is small, and trash larger than the size of the rake cannot be removed.
Operation & Maintenance	- The underwater part is maintenance-free. - The mechanism of drive parts is simple. - The chain stroke needs to be adjusted periodically.	- The condition of the bottom needs to be checked periodically. - Operation will become impossible if trash accumulates gradually.	- With the sprocket in the underwater part, maintenance is troublesome. - It tends to catch fine trash.	- Maintenance is complicated. - A bruise should occur earlier in order that the power cable will fluctuate along with the motion of rake.	- It is easy to deposit the trash on the bottom of the tray, and periodical maintenance is required.	- Since the mechanism is complicated, maintenance check takes time. - Compulsive descent of rake cannot be performed.
Application in the Project	- Actual performance of existing rake system in the Main Outfall PS is very good. - Applicable to the Project **Most appropriate (Applied)**	Since this type cannot respond to large trash, it is unsuitable. **Applicable**	Unsuitable for the Project, because big trash flows in. **Not applicable**	- Since the waterway is deep, equipment scale will be large. - Space is not enough for this type. **Not applicable**	-Unsuitable to indoor equipment. **Applicable**	It is difficult to deal with the quantity of trash that flows continuously at the time of rain. **Not applicable**

iii) Upgrade Plan of Gulshan-E-Ravi Pumping Station

The fourteen (14) existing pumps in Gulshan-E-Ravi Pumping Station are as follows:

- 8 pumps granted by England in 1982
- 4 pumps made in Germany and installed in 2000
- 2 pumps in "*The Project for the Retrieval of Sewerage and Drainage System in Lahore City*" granted by Japan's Grant Aid

The eight (8) pumps granted by England, P-1, P-2, P-3, P-4, P-7, P-8, P-11, P-12, were requested to be replaced since pumps of this type are not manufactured currently, and they could neither be repaired nor the spare parts replaced.

According to the result of site investigation, five (5) of the 8 pumps, P-3, P-4, P-7, P-11 and P-12, whose drainage capacities have become low shall be replaced. Furthermore, Pump P-2 also needs to be replaced since wearing of the inside is terrible, the pump frequently breaks down, and it seems that it will stop perfectly in the near future although high drainage capacity is still performed, relatively.

As for the remaining two (2) pumps, P-1 and P-8, it is concluded that the necessity for replacement is not urgent since high drainage capacity is still performed stably and wearing of the inside has been slight despite the approximately 30 years of operation after installation.

For the Gulshan-E-Ravi Pumping Station, therefore, replacements for the six (6) pumps, P-2, P-3, P-4, P-7, P-11 and P-12, shall be designed for the Project.

iv) Upgrade Plan of Multan Road Pumping Station

1) Upgrade Plan of Pumps

Of the six (6) existing pumps in the Multan Road Pumping Station, the drainage capacity of the four (4) of the pumps granted by England in 1982 had deteriorated by aging. In the near future, the operation of these four (4) pumps may stop perfectly.

On the other hand, the other two (2) pumps granted for "*The Project for the Retrieval of Sewerage and Drainage System in Lahore City*" under the Japan's Grant Aid in 2006 have been kept in fine condition.

For the Multan Road Pumping Station, therefore, replacements for the four (4) pumps granted by England in 1982 are adequate for the Project.

2) Upgrade Plan of Automatic Trash Rake Systems

Based on the actual measurements at the site, the amount of garbage of about 0.5 tons/day flowing into the Multan Road Pumping Station is less than the one flowing into the Khokhar Road Pumping Station and can be removed simply by manual labor. Therefore, the requested installation of automatic trash rake system in the Multan Road Pumping Station shall be dismissed as procured equipment for the Project due to the low urgency.

(2) Common Plan of Equipment and Facilities in Each Pumping Station

i) Specifications of Each Equipment installed in Pumping Station

The main specifications of pumps and the related equipment outline of collateral civil and architectural works of the Project are given in Table 2.2. Specifications of pumps and related equipment are set in common except the case specifically described.

Table 2.2 Specifications of Equipment installed in Each Pumping Station

Equipment	Specifications	Collateral Works
(1) Pump	Vertical axial flow type Drainage Capacity: SB/MR/GR: 68m^3/min, KR: 95m^3/min Lifting Head: 11m	Pump Foundation
(2) Motor	SB: Vertical type/three-phase wound rotor motor, 180kW, 415V KR: Vertical type/three-phase wound rotor motor, 245kW, 415V GR/MR: Vertical type motor with three phase squirrel cage, 180kW, 3300V	Motor Mount
(3) Inlet Pipe	SB/MR/GR: steel pipe, D700mm KR: steel pipe (including absorb bell-mouth ring), D900mm	SB/MR: 1. Foundation for bottom of vertical pipe 2. Pipe mount 3. Finishing of floor and wall-penetration 4. Discharge basin 5. Table for valve control KR/GR: 1. Foundation for bottom of vertical pipe 2. Pipe mount 3. Table for valve control
(4) Suction Valve	SB/MR/GR: gate type, D700mm KR: gate type, D900mm	
(5) Drainage Pipe	SB/MR/GR: steel pipe, D600mm KR: steel pipe, D800mm	
(6) Check Valve	SB/MR/GR: swing type, D600mm KR: swing type, D800mm	
(7) Electrical Panel	SB: Self-standing and metal enclosed indoor panel, distribution panel KR: Self-standing and metal enclosed indoor panel GR/MR: Self-standing and metal enclosed indoor panel	Panel Foundation
(8) Wiring: Electrical Transformer	SB: main cable KR/MR: use existing wiring from existing Bus Bar GR: electrical transformer (interior type, 11kW/3.3kV, 1.5kVA), main cable	SB/GR: cable trench GR: foundation for electric transformer
(9) Ventilation System	Air supply blower: 415V, 2.2kW Air drain blower: 415V, 3.7kW SB: 3sets; GR: 4sets; MR: 3sets	

Note: SB: Shad Bagh Pumping Station; KR: Khokhar Road Pumping Station; MR: Multan Road Pumping Station; GR: Gulshan-E-Ravi Pumping Station

ii) Specifications of Automatic Trash Rake Systems

Main specifications and collateral civil works of automatic trash rake systems are given in the following table.

Table 2.3 Specifications of Automatic Trash Rake Systems

Equipment	Specifications	Scale			Collateral Civil Works	Electrical Equipment
		Pumping Station	Size of Channel	Angle		
Automatic trash rake system	Type: Automatic continuous rake; Pitch of screen bar: 65mm~75mm	Shad Bagh	W2.9m x H7.5m x 2sets	75°	Foundation Works	Electric Panel
		Khokhar Road	W2.9m x H7.7m x 3sets	75°		Wring

iii) Distribution Plan of Pumps and Related Equipment

The overall distribution plan of pumps and related equipment for each pumping station in the Project are shown in Table 2.4.

Table 2.4 Distribution Plan of Pumps and Related Equipment

(unit: number)

Equipment	Total Number	Shad Bagh		Gulshan-E-Ravi	Multan Road
		Shad Bagh	Khokhar Road		
(1) Pump	16	4	2	6	4
(2) Motor	16	4	2	6	4
(3) Inlet Pipe	16	4	2	6	4
(4) Suction Valve	16	4	2	6	4
(5) Drainage Pipe (horizontal)	16	4	2	6	4
(6) Check Valve (Flap Valve)	16	4	2	6	4
(7) Electrical Panel	16	4	2	6	4
(8) Electrical Transformer	2	-	-	2	-
(9) Main Cable	2	1	-	1	-
(10) Active Ventilation System	3	1	-	1	1
(11) Automatic Trash Rake System	2	1	1	-	-

iv) Renovation Plan of Discharge Basin [Shad Bagh Pumping Station (Shad Bagh), Multan Road Pumping Station]

In the Shad Bagh (Shad Bagh) and Multan Road pumping stations, the drainage mouths of the pumps are kept in artesian condition since the outlets are connected to the drainage channels (pipes) directly. The site investigation had confirmed that the fixing parts of pipes and pumps have been damaged by repeated water hammer phenomena that happened due to frequent pump stop caused by trash inflow to the existing pumps and sudden closure of check valves caused by adverse flow from the drainage line.

As the countermeasure for this problem, the following renovation plan shall be designed to improve the durability of pipes and pumps in the Shad Bagh (Shad Bagh) and Multan Road pumping stations:

- Drainage mouths of vertical drainage pipes connecting to the pumps shall be removed upward.
- Drainage basins shall be constructed to enable the discharge of water to the drainage pit with free water surface.

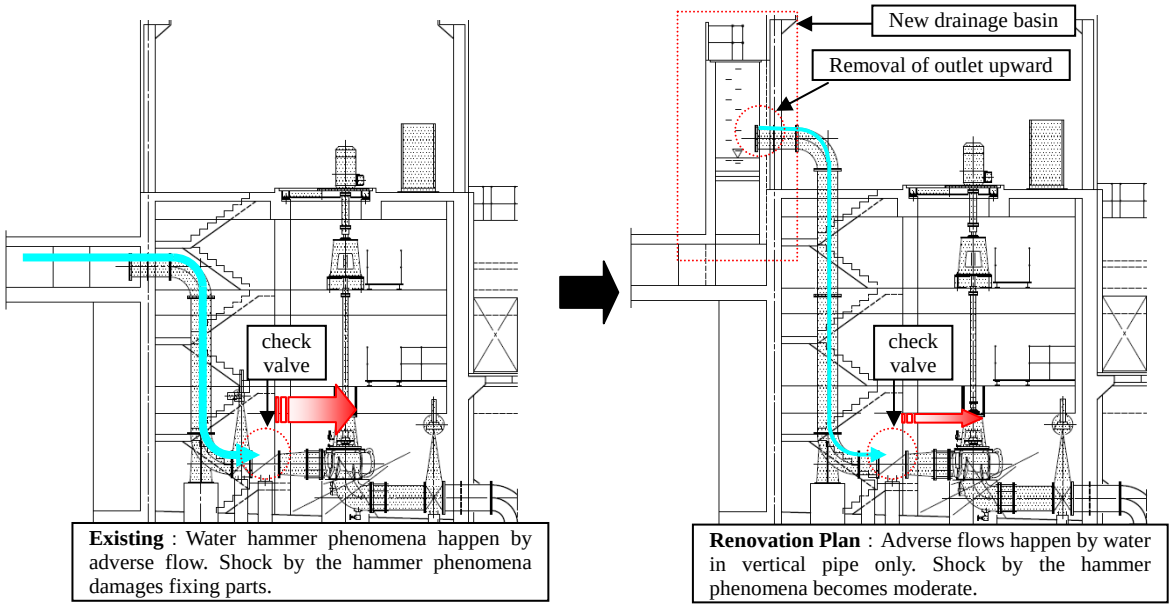


Fig. 2.2 Renovation Plan of Drainage Basin

This renovation of drainage basin will make the quantity of adverse flow by pump stop very small, from the vertical pipe only, and drainage suction valves become redundant since the adverse flow can be drained through a new drainage pipe installed around the pump. Totally, this renovation will result in the reduction of maintenance cost due to the life extension of pumps and the simplification of repair works.

(3) Equipment and Facilities Plan in Shad Bagh Pumping Station

i) Shad Bagh Pumping Station (Shad Bagh)

The following upgrades shall be designed for the Project to enhance the summarized drainage capacity of the three (3) pumping stations in the Shad Bagh Pumping Station:

- Renewal of four (4) of the six (6) existing pumps (Drainage capacity of new pumps: 40cfs = 60m^3/min); and
- Installation of automatic trash rake system.

1) Pumps and Related Facilities

- Main body (including shafts and joints, etc.) of the four (4) pumps (P-1, P-2, P-3 and P-4) and pipe parts (inlet pipes, suction valves, pipes, joints, vertical and horizontal drainage pipes, etc.) shall be replaced with new ones.
- Motors, control panels and main cables shall be replaced with new ones.

2) Automatic Trash Rake System

New automatic trash rake system for the Shad Bagh Pumping Station shall be installed after removal of the existing manual trash rake system to minimize the volume of civil works. The new rake system shall be installed at triple pits for the rake system by the inlet basins of pumps.

At the same time with the rake systems' replacement, fixing parts (anchor volts, etc.) shall be also installed. In consideration of the results of pulling test implemented as appropriate, the existing foundation like the deteriorated reinforced concrete and bricks shall be strengthened.

3) Revision of Structure of Drainage Basin

As in the above-described revision to "open drainage system" that discharges water to the drainage basin to prevent the adverse flow phenomena from the existing pressured culvert, drainage pipes shall be removed upward, and the drainage basin shall be also renovated.

At the drainage line in Shad Bagh Pumping Station (Shad Bagh), a new drainage basin made of reinforced concrete shall be constructed on the existing pressured culvert, along the exterior wall of the pumping station. The new drainage basin shall be jointed with the chipped upper slab of the existing pressured culvert.

Dimensions of the drainage basin shall be designed as 1.5m in height and 2.0m in length based on the size of the existing basin, and wall height of the drainage basin shall be set as 4.84m in consideration of pressure loss by the friction between the inside of culvert and adverse slope of the existing drainage pipe, so that the discharge mouth of the culvert is 2m higher than the inlet, approximately.

4) Upgrade Plan of Other Equipment and Facilities

- All active ventilation systems shall be replaced.
- Concrete foundations of scrapped pumps shall be demolished, and new concrete foundations (fixed with anchor volts) shall be placed based on size of the new pumps.
- Parts of floor slab and exterior wall shall be demolished and reinforced in consideration of the removal of drainage mouths, which are currently set beneath of the control room's floor, higher than the floor level of the control room.

ii) Shad Bagh Pumping Station (Khokhar Road)

Installation of two (2) new pumps with drainage capacities of 56cfs ($95m^3$/min) and automatic trash rake system shall be designed for the enhancement of total drainage capacity of the three (3) pumping stations in the Shad Bagh Pumping Station.

1) Pumps and Related Facilities

Upgraded equipment and facilities of the Project shall be designed as inlet pipes and bell-mouths connected inlet basin, suction valves, inlet pipes, pumps, drainage pipes until interior flanges of existing wall and flap valves.

- Main body (including shafts and joints, etc.) of the two (2) pumps (P-1 and P-2) and pipe parts (bell-mouths, inlet pipes, inlet suction valves, pipes, joints, vertical and horizontal drainage pipes, etc.) shall be installed newly.
- Motors, control panels and main cables shall be installed newly.

2) Automatic Trash Rake System

New automatic trash rake system for Shad Bagh (Khokhar Road) Pumping Station shall be installed after removal of the existing manual trash rake system. The new rake system shall be installed at double pits for the rake system by inlet basins of the pumps.

At the same time as the rake system's replacement, fixing parts (anchor volts, etc.) shall be also installed. In consideration of the results of pulling test implemented as appropriate, existing foundations like deteriorated reinforced concrete and bricks shall be strengthened.

3) Upgrade Plan of Other Equipment and Facilities

New concrete foundations (fixed with anchor volts) shall be placed based on size of the new pumps.

(4) Equipment and Facilities Plan for Gulshan-E-Ravi Pumping Station

Replacements for the six (6) pumps, which indicate significant deterioration, wearing and performance decline among the existing 8 pumps, with drainage capacities of 40cfs ($68m^3$/min), shall be designed to enhance the total drainage capacity of Gulshan-E-Ravi Pumping Station.

i) Pump and Related Facilities

- Main body (including shafts and joints, etc.) of the six (6) pumps (P-2, P-3, P-4, P-7, P-11 and P-12) and pipe parts (inlet pipes, suction valves, pipes, joints, horizontal drainage pipes, etc.) shall be replaced with new ones.
- Vertical pipes forwarder than elbow only shall be replaced with new ones in consideration of relative better condition.
- Motors, control panels, main cables for all pumps and electrical transformer shall be replaced with new ones.

ii) Upgrade Plan of Other Equipment and Facilities

- All active ventilation systems shall be replaced with new ones.
- Concrete foundations of scrapped pump shall be demolished, and new concrete foundations (fixed with anchor volts) shall be placed based on the size of new pumps.

(5) Equipment and Facilities Plan of Multan Road Pumping Station

Replacements for the four (4) pumps, which indicate significant deterioration, wearing and performance decline among the existing 6 pumps, with drainage capacities of 40cfs ($68m^3$/min), shall be designed to enhance the drainage capacity of the Multan Road Pumping Station.

i) Pump and Related Facilities

- Main body (including shafts and joints, etc.) of the four (4) pumps (P-1, P-2, P-3 and P-4) and pipe parts (inlet pipes, suction valves, pipes, joints, vertical and horizontal drainage pipes, etc.) shall be replaced with new ones.
- Motors, control panels and main cables shall be replaced with new ones.

ii) Revision of Structure of Drainage Basin

As in the revision of Shad Bagh Pumping Station (Shad Bagh) to "open drainage system" that discharges water to the drainage basin to prevent the adverse flow phenomena from the existing pressured culvert, discharge mouths of drainage pipes shall be removed upward, and the drainage basins shall be also renovated.

At the drainage line in Multan Road Pumping Station, a new drainage basin made of reinforced concrete shall be constructed on the existing pressured culvert, along the exterior wall of the pumping station. The new drainage basin shall be jointed with the chipped upper slab of the existing pressured culvert.

In this case, dimensions of the drainage basin shall be designed as 1.5m in height and 2.0m in length based on the size of the existing basin, and wall height of the basin shall be set as 5.03m in consideration of pressure loss by friction between inside of the culvert.

iii) Upgrade Plan of Other Equipment and Facilities

- All active ventilation systems shall be replaced with new ones.
- Concrete foundations of scrapped pumps shall be demolished, and new concrete foundations (fixed with anchor volts) shall be placed based on size of the new pumps.
- Parts of floor slab and exterior wall shall be demolished and reinforced in consideration of the removal of drainage mouths, which are currently set beneath the control room's floor, higher than the floor level of the control room.

(6) Preparation Plan of Spare Parts

i) Selection Standard for Spare Parts

The equipment requested for the Project is almost similar to the ones owned by WASA, so that it is assumed that WASA is familiar with them. Local traders used to agent contracts with foreign suppliers, so that problems regarding maintenance and procurement of spare parts are assumed to be less. However, the minimum stock of spare parts imported from foreign suppliers shall be prepared because imported parts are expensive and procurement will take a long time.

Therefore, in the Project, spare parts for one (1) year from the start of pump operation shall be prepared in consideration of the guarantee period of pumps, usually set as one (1) year, based on the request from WASA.

ii) Spare Parts for Each Equipment

Based on the study described above, the spare parts for each equipment are as shown in the following table.

Table 2.5 Spare Parts List

Spare Parts	Pumping Station	Number	
For Pump Equipment Impeller, Shaft, Pump sleeve, Bearing unit, Upper bearing, Lower bearing, Gland packing, O-Ring, Gasket, Electric bearing	Shad Bagh (Shad Bagh)	4 units	Total: 16 units
	Shad Bagh (Kokhar Road)	2 units	
	Gulshan-E-Ravi	6 units	
	Multan Road	4 units	
For Automatic Trash Rake System Spare motor, Link	Shad Bagh (Shad Bagh & Kokhar Road)	2 units	

2-2-3 Outline Design Drawings

The Outline Design Drawings are attached at the end of this report. The List of Drawings is given in the following table.

Table 2.6 List of Drawings

Drawing No.	Drawing Title
	Shad Bagh Pumping Station (Shad Bagh)
SB-01	Plan (Control Room)
SB-02	Plan (Pump Room)
SB-03	Profile
SB-04	Profile of Automatic Trash Rake System
	Shad Bagh Pumping Station (Kokhar Road)
KR-01	Plan (Control Room)
KR-02	Plan (Pump Room)
KR-03	Profile
KR-04	Profile of Automatic Trash Rake System
	Gulshan-E-Ravi Pumping Station
GR-01	Plan (Control Room)
GR-02	Plan (Pump Room)
GR-03	Profile
	Multan Road Pumping Station
MR-01	Plan (Control Room)
MR-02	Plan (Pump Room)
MR-03	Profile

2-2-4 Implementation Plan

The Project is an “Equipment Procurement Project” not only for the procurement of equipment and for handing them over to the Pakistani counterpart, but also for the installation of

equipment. In particular, pumps and related facilities, and automatic trash rake systems shall be handed over to the counterpart after installation, implementation of operation check and brief O&M lecture. It is, therefore, necessary for the supplier to guarantee quality control and management, from the design of equipment and manufacture, and schedule management until installation and operation check after installation. Thus, it is important to plan that hand-over be completed exactly on schedule with the guaranteed installation of equipment by the Japanese side.

(1) Implementation Policy

i) Procurement Policy

Pumps, automatic trash rake systems and related electrical facilities shall be procured in Japan to guarantee quality and performance of the equipment. Pipe materials and active ventilation systems that will be installed in the pumping stations, and common materials for civil works like cement, reinforcing bars, aggregates and earth materials, etc., shall be procured from local production facilities.

It is necessary that mechanical technicians of the supplier(s) shall be dispatched to supervise equipment installation and to lecture on the basic control method through On-the-Job (OJT) training for the pumps and the automatic trash rake systems.

ii) Construction Policy

Civil works of the Project consist of the installation of pumps and the automatic trash rake systems, and the replacement of drainage basins and drainage pipes. The installation works include electrical works and adjustment works after installation. It is, therefore, necessary to dispatch Japanese engineers for the electrical works of installation since it is certain that these works could not be executed by local engineers.

On the other hand, replacement works of the drainage basins and drainage pipes are common civil works. Some of the local contractors who had worked as subcontractors of Japanese contractors in Japan's Grant Aid projects will also be able to work in the Project. It is, however, difficult to guarantee strict construction management with only the local contractors keeping watch over the schedule and ensuring the construction quality for the connection of pumps and other facilities. Therefore, Japanese civil works supervisors shall be dispatched to supervise the local contractor with regard to quality and schedule control.

(2) Implementation Conditions

i) Considerations on Procurement

The location of handing over of the procured equipment will be each pumping station, and the inland transportation cost from Karachi Port to Lahore City will be borne by the Japanese side for the following reasons:

- Equipment procured by the Project shall be handed over after completion of installation, test run and initial operation guidance at each pumping station.

- Customs clearance shall be done in Lahore, since there are many merits such as the convenience on Customs procedure in Lahore. WASA recommends the Customs clearance in Lahore based on their experiences in terms of smooth implementation.
- Inland transportation shall be on the road using trucks and trailers because of convenience and versatility, and WASA's experience.

ii) Considerations for Construction

1) Installation Work on Pumps

Replacement work on pumps and installation work on automatic trash rake systems in the Project shall be implemented in the dry season to minimize performance decline of the drainage pumps, since the renewal and installation works will be implemented in the operating pumping stations. Furthermore, the works shall be implemented at half pumping station divided temporarily by rotation to enable drainage with half drainage capacity at least in emergency situation.

It is required to complete the necessary replacements and installation works while in the dry season from October to May in the following year by implementing the work in multiple pumping stations at the same time based on the construction order of pumps and automatic trash rake systems.

a) Shad Bagh Pumping Station (Shad Bagh, Khokhar Road)

In Shad Bagh Pumping Station, the three (3) pumping stations of Shad Bagh, Khokhar Road and Siddique Pura are adjacent and can complement each other since the canals for sewage water flowing into them confluent at just in-front of the stations' intake mouth. When the drainage basin in Shad Bagh Pumping Station is constructed, all drainage lines shall be drained and kept in dry condition by stopping all pumps since the drainage basins are confined.

The following procedures of the work are adequate to keep the total drainage capacity as much as possible:

- Firstly, new installation works of pumps in Khokhar Road Pumping Station shall be implemented since the works can be implemented without the construction of drainage basin.
- Then, replacement works in Shad Bagh Pumping Station shall be implemented.
- Siddique Pura Pumping Station shall stand-by to cover the decline of drainage capacity in consideration of the lack of drainage capacity while replacement work is being implemented in Shad Bagh Pumping Station and the emergency flood in dry season during the implementation work.

b) Gulshan-E-Ravi Pumping Station

For the Gulshan-E-Ravi Pumping Station where six (6) of the 14 existing pumps will be replaced, each batch of three (3) pumps shall be replaced by rotation to mitigate the influence of drainage capacity decline due to the replacement work. Thus, there is no problem regarding drainage capacity decline with the implementation of replacement work in the dry

season.

c) Multan Road Pumping Station

For the Multan Road Pumping Station, four (4) of the 6 existing pumps will be replaced. In the dry season, replacement work on pumps in the temporarily divided pumping station shall be implemented by rotation to minimize the influence of drainage capacity decline.

2) Installation Work of Automatic Trash Rake Systems

Installation work on automatic trash rake systems includes basically the following items:

- Removal works of existing machinery
- Reinforcing works of screen installation parts
- Installation works of new machinery
- Operation check, etc.

In addition, reinforcing work on existing inlet channels of the rake systems shall be implemented to ensure the stability of the rake systems.

Installation work on the rake systems shall be implemented at the same time as the replacement work on pumps in consideration of the schedule of temporary works for pump installation, to minimize the influence of drainage capacity decline while doing the work.

3) Removal Work of Existing Pumps and Trash Rake Systems

In consideration of the request from the Pakistani counterpart, the existing pumps and trash rake systems shall be removed carefully to enable transport and reuse. The removed equipment shall be handed over to the Pakistani counterpart before transportation.

(3) Scope of Work

All installation of replacement works of pumps, related facilities and trash rake systems will be implemented in the existing pumping stations, so that necessary items for the works like project area, electricity, water and drainage have to be assured beforehand.

i) Installation Work of Pumps

Although WASA and local contractors are assumed to have basic knowledge regarding equipment installation, thoughtful consideration on accuracy, quality and schedule control of installation works is needed because of the accidents that happened in the past similar installation works.

In the Project, the supplier has to ensure the quality of equipment until operation check after installation since it is planned that all processes from contract execution with the supplier to the assured handing over shall proceed seamlessly. It is, therefore, necessary for the Japanese side to handle the procurement and installation works of the equipment for smooth hand-over within the limited construction schedule. Installation works by the Japanese side are as shown in Table 2.7.

Table 2.7 Japanese Side's Burden regarding Installation Works of Pumps

Site	Works to be borne by Japanese Side
All Pumping Stations	- Procurement and installation of main pumps and drive motors - Procurement and installation of inlet pipes and valves - Installation and wiring of control panel - Adjustment and test operation after installation
Shad Bagh Pumping Station (Shad Bagh)	- Procurement and installation of vertical and horizontal drainage pipes - Procurement and installation of check valves - Procurement and installation of breakers - Wiring from breakers to control panel - Procurement and installation of active ventilation systems
Shad Bagh Pumping Station (Khokhar Road)	- Procurement and installation of inlet pipes of inlet basins and bell-mouths - Procurement and installation of vertical and horizontal drainage pipes - Procurement and installation of check valves - Wiring from breakers to control panel
Gulshan-E-Ravi Pumping Station	- Procurement and installation of horizontal drainage pipes - Procurement and installation of check valves - Procurement and installation of 2 electric transformers - Wiring from electric transformers to control panel - Procurement and installation of active ventilation systems
Multan Road Pumping Station	- Procurement and installation of vertical and horizontal drainage pipes - Procurement and installation of check valves - Wiring from breakers to control panel - Procurement and installation of active ventilation systems

ii) Installation Work on Automatic Trash Rake Systems

Installation work on the automatic trash rake systems shall be implemented by the Japanese side in consideration of following:

- Planning, considering that adequate safety and certain construction works are needed for the installation of rake systems and screens.
- Supplier's management for manufacturing and installation is integrant.
- It is required to ensure consistent schedule and quality management from manufacturing to installation, the same as with pumps.

Also, removal work on the existing trash rake systems shall be borne by the Japanese side for the following reasons:

- Installation work shall be implemented under consistent responsibility management by the supplier to avoid damage to the existing system foundation.
- Removal and installation works shall be implemented as a seamless process since all existing systems could not be stopped completely while doing the work.
- Consistent schedule management by the supplier is needed to complete the whole removal and installation work on rake systems within the limited period of the Project.

Removed equipment shall be handed over to WASA at the site, and shall be discarded under the responsibility of WASA.

The works listed in Table 2.8 are required for the actual installation of rake systems.

Table 2.8 Installation Works of Trash Rake Systems by the Japanese Side

Site	Works by Japanese Side
Shad Bagh Pumping Station (Shad Bagh)	- Removal works of existing systems - Sectional renovation of building (opening of floor slab and standing wall) - Procurement and installation of automatic trash rake systems - Installation and wiring of control panel - Adjustment and test operation
Shad Bagh Pumping Station (Khokhar Road)	

(4) Procurement and Construction Supervision Plan

i) Consultant's Supervision Plan

1) Contents of Work

While the Contractor procures and installs equipment, the Consultant supervises whether the quality and schedule control, preparation, and installation works are in due course. The main contents of the Consultant's supervision are as follows:

a) Deliberations with the Contractor;
b) Inspection at the factory before loading, and at the port before shipment;
c) Deliberations and arrangements with WASA and other relevant organizations;
d) Inspection of the procurement progress of equipment;
e) Confirmation and follow-up of the progress of Customs clearance of equipment;
f) On-site inspection of the work done by the recipient country;
g) Inspection of equipment and installation works;
h) Issue of certificate; and
i) Presentation of report.

2) Engineers for the Supervision Services

The Project consists of the procurement and installation of equipment, and construction works related to the installation of equipment. Qualified engineers shall be engaged in project supervision to provide better engineering services during the entire project period. The dispatch of engineers is planned in such a way that one (1) Japanese engineer will be assigned for a long–term stay as resident supervisor to maintain consistent services during the whole project period and two (2) local engineers will be employed as support staff of the Japanese resident engineer. In addition, experts shall be dispatched to the project site from time to time according to the schedule of spot engineering services.

The proposed engineers for the supervision services are as follows:

Table 2.9 Consultant's Engineers for the Supervision Services

Consultant's Staff		Work Contents
Work in Pakistan	Resident Engineer (Resident Supervisor for Procurement, Installation and Construction)	One (1) Japanese engineer is assigned as resident supervisor to maintain consistent services during the whole project period. He arrives at the site together with the procured equipment and supervises the entire procurement process, as well as the installation works of pumps and automatic trash rake systems. He also supervises relevant construction works and arranges regular meetings with the Contractor and/or the Client.
	Consultant's Project Manager (Chief Supervisor for Procurement Control)	He is responsible for overall project management. He holds meetings and negotiates with the Client, the Contractor or other relevant organizations at commencement, key periods and completion of the Project. He also attends inspections and delivery.
	Mechanical/Electrical Engineer	He is dispatched to the project site at the time of installation of pumps and automatic trash rake systems, and give instructions to the Contractor on how to install equipment in a proper way. He also inspects test runs and issues approval if the test results are satisfactory.
	Assistant Engineer (2 Engineers)	Two (2) local engineers supports the Resident Engineer and takes charge of quality and scheduling control during the installation work of equipment and construction works.
Work in Japan	Inspection Engineer 1	He inspects and checks the design documents and drawings prior to manufacture.
	Inspection Engineer 2	He inspects the products at the factory and before shipment.

ii) Contractor's Procurement Management Plan

The contractor shall assign the following personnel, which includes one (1) Japanese procurement and installation manager and two (2) other Japanese engineers for procurement management and installation works.

Table 2.10 Contractor's Procurement Management Engineers

Contractor's Staff		Work Contents
Work in Pakistan	Contractor's Project Manager (Procurement and Installation Manager) / Mechanical Engineer	He is in charge of the whole procurement and installation process, which includes procurement management of equipment, negotiation with the staff of recipient country for kickoff meeting and other meetings, Customs clearance, scheduling and safety management of installation works, and handing over of equipment. He also works as the Mechanical Engineer in charge of installation and quality control for pump equipment and automatic trash rake systems. He is responsible for the arrangement of equipment, test run and initial operation guidance to local engineers after the installation.
	Civil Engineer	He is in charge of the whole civil works related to installation of equipment. He manages the construction works, construction schedule, quality control and safety control.
	Electric Engineer	He is in charge of quality control on electrical systems for all of the pumps and automatic trash rake systems procured. He is also responsible for the arrangement of equipment, test run and initial operation guidance.
Work in Japan	Inspection Engineer 1	He inspects and checks the design documents and drawings prior to manufacture.
	Inspection Engineer 2	He inspects the products at the factory and before shipment.

(5) Quality Control Plan

i) Quality Control Plan for Procurement

Before the manufacture of equipment, the supplier and manufacturer(s) shall meet to discuss the details of specifications and the quality control method for each item of equipment.

It shall be noted that factory inspection is to be conducted before shipment to ensure the quantity, quality and performance of the equipment, and particular attention needs to be paid to packing method in order that no damage is given to the equipment during transportation. With regard to inland transportation from the port of disembarkation to the final destination, the transportation method and schedule shall be submitted in advance by the supplier.

Since the equipment is sensitive to dust and high temperature, it shall not be stored under the blazing sun. A responsible person from the supplier shall stay constantly with the equipment to keep careful watch over it.

Necessary arrangements are required to take an immediate action if some defective equipment is found by the inspection and test run, which will be conducted after the installation of equipment.

ii) Quality Control Plan for Civil Works

The quality of main construction materials and construction works shall be controlled under the following conditions. The test shall be decided based on the "Civil Work Quality Control Standard" of the Ministry of Land, Infrastructure and Transport, Government of Japan.

Table 2.11 Quality Control Tests for Civil Works

Work Items	Test Items	Standards	Test Frequency
Concrete	Compressive Strength Test	JIS A 1108	Twice a day (in the morning and in the afternoon) at one site
	Slump Test	JIS A 1101	Once every casting or agitator for site mixed and ready mixed
	Salt Content Test	JIS A 5308	Once a week
	Air Content	JIS A 1116	Twice a day (in the morning and in the afternoon) at one site
	Cement Material	JIS R 5210	Before construction work and material change
Aggregate	Sieve Analysis	JIS A 1102	Once a month
Embankment/ Backfill	Compaction Test	JIS A 1210	Before construction work and material change
	Grain Size Analysis	JIS A 1204	
	Field Density Test	JIS A 1214	Three places at once in every 1,000 m^3

Construction materials and construction works shall be controlled under the following conditions:

1) Concrete

Concrete shall have the specified strength, durability and water-tightness, and dispersion of quality of concrete shall be small. The standard strength of concrete shall be based on 28-day Compressive Strength. The method of compressive strength test shall satisfy JIS A1108 and 1132 or equivalent. A sample of mixed concrete shall be picked up twice a

day, and the strength tests of 7 days and 28 days shall be carried out for every sample. At the time of concrete-placing, slump test shall be carried out in site and the slump value shall be confirmed within the specified value.

2) Placing and Curing of Concrete

Since the concrete placing work is performed in the tropics, temperature control of concrete shall be performed adequately and temperature of pouring concrete at the time of placing shall be lower than the standard (35^{o}C). Concrete shall be placed using the method that can possibly avoid the separation of materials, and adequately compacted with vibrators at placing and immediately after placing. After the placing of concrete, the surface of concrete shall be kept wet for at least five (5) days.

3) Cement

Portland cement shall be used for the construction and its quality shall conform to JIS R5210 or equivalent.

4) Aggregates

Aggregates shall be clean, strong and durable, and shall have adequate grain sizes. Aggregates shall be confirmed not to include contaminations such as dust, sludge, organic substance, salinity and so on. Especially, fine aggregates shall not include thin or slender pieces of stone. Unit weight of oven-dried aggregate shall be not less than 2.5 g/cm^{3}.

5) Reinforcing Bar

Reinforcing bar shall have the specified strength. Deformed bar may be used as reinforcing bar in case of not specified. The material test of reinforcing bar shall be carried out according to instructions of the Consultant before use.

(6) Procurement Plan

The equipment for the Project will be, in principle, procured in Japan except piping materials, active ventilation systems and common construction materials for pumping stations that can be procured in the recipient country. The origins of equipment are given in the following table.

Table 2.12 Origin of Equipment to be Procured

Classification	Name of Equipment	Procured in Japan	Procured in Third Country	Procured in Pakistan
Pumps and related Equipment	Pump, Motor & Accessories	adopted	adopt*	-
	Valves	adopted	-	-
	Piping Materials	adopted	-	adopted
	Control Panel	adopted	-	-
	Electrical Materials	adopted	-	-
	Ventilation System		-	adopted
	Automatic Trash Rake System	adopted	-	-
Construction Materials	Cement, Reinforcing Bars, Aggregates, Others	-	-	adopted

* Procurement of equipment manufactured by a Japanese company in a third country is available under the agreement with WASA.

(7) Technical Assistance Plan

The present condition of existing pumps and automatic trash rake systems procured through "*The Project for the Retrieval of Sewerage and Drainage System in Lahore City*" has been confirmed during the field survey. It is considered that the present operation and maintenance (O&M) of the equipment is good, but there are some pumping stations where O&M works are insufficient.

The specifications of pumps and automatic trash rake systems procured through the Project shall be the same as those of existing equipment. Therefore, neither special training nor introduction of advanced techniques is required for the O&M of new equipment.

Although it is basically not necessary to carry out technical guidance services (Soft Component) for the Project, initial operation guidance and on-the-job training (OJT) on O&M for local engineers by the engineers dispatched by the contractor is needed. OJT shall be carried out for a month during test run.

(8) Implementation Schedule

The implementation period of the Project will comprise 4.5 months for signing of E/N and G/A, detailed design and preparation of tender documents, and 21.5 months for procurement and installation of equipment. The following figure shows further details.

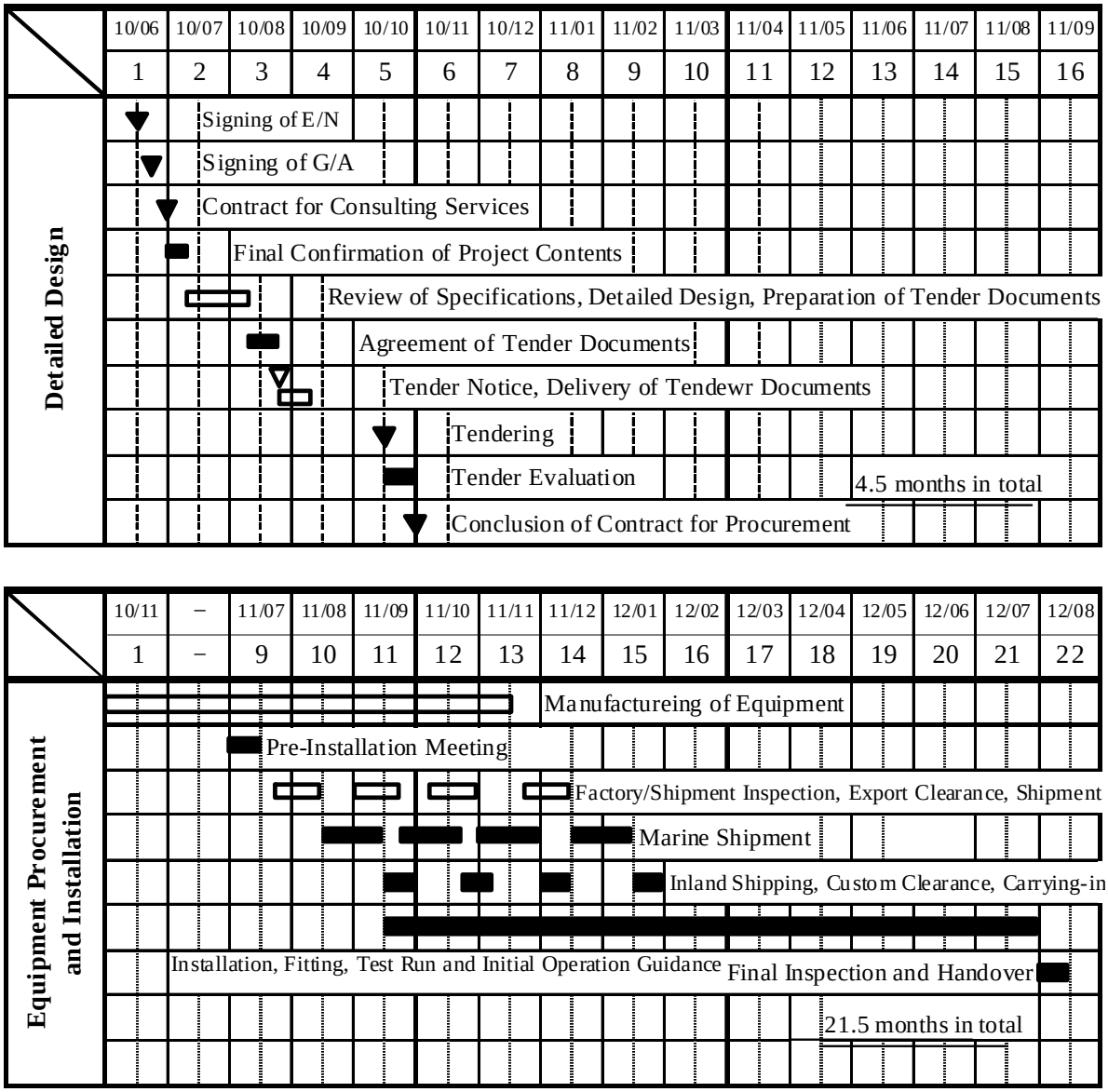


Fig. 2.3 Implementation Schedule

2-3 Obligations of Recipient Country

Based on the Minutes of Discussions agreed upon by the JICA Study Team and the Pakistani side on September 5, 2009, the undertakings required of the Pakistani side for the smooth implementation of the Project are as follows:

(1) To secure safety by any means of people concerned during implementation of the Project on condition that the Grant-Aid by the Government of Japan is carried out;

(2) To exempt Japanese nationals from taxes including Value-Added-Tax (VAT), General Sales Tax (GST), Customs duties, and any other taxes and fiscal levies which may be imposed in Pakistan with respect to the supply of products and services under the Project, and to take necessary procedures for tax exemption;

(3) To provide data and information necessary for the Project;

(4) To secure land and to clear, level and reclaim the sites when needed;

(5) To provide facilities for the distribution of electricity, water supply, drainage and other incidental facilities to the Project site;

(6) To bear the advising commission of the Authorization to Pay (A/P) and payment commission to the Japanese bank for banking services based on the Banking Arrangement (B/A);

(7) To ensure prompt unloading and Customs clearance of the equipment purchased under the Grant-Aid at the port of disembarkation in Pakistan;

(8) To arrange the acquisition of visa and other formalities that may be necessary for the entry of Japanese nationals into Pakistan and stay therein for the performance of the work;

(9) To maintain and use the equipment properly and effectively with suitable number of personnel assigned for the operation and maintenance and to bear all expenses other than those covered under the Grant-Aid;

(10) To bear all expenses, other than those to be borne by the Grant-Aid necessary for construction of the facilities, as well as for transportation and installation of the equipment;

(11) To use the equipment exclusively for the Project, and shall not be re-exported from Pakistan;

(12) To provide office space for the Consultant and the Contractor at WASA's facility or building;

(13) To bear the electric bills during/after test run and initial operation guidance;

(14) To maintain access roads to each pumping station during the Project period; and

(15) To bear all works and expenses necessary for disassembly, transportation, relocation, recycle and reuse or disposal of dismantled equipment, such as pump, trash rake and other accessories.

2-4 Project Operation Plan

The Operation and Maintenance (O&M) Wing of WASA consists of six (6) regional offices in six (6) towns, Shalimar, Aziz Bhatti, Vishtar, Allama Iqbal, Ravi and Gunj Buksh, and the Drainage Division. The Deputy Managing Director (DMD) of the Operation and Maintenance Wing supervises the Directors of the regional offices. Each regional office has a few executive engineers (XENs) managing the subdivisions.

The subdivision officer of Datangar in O&M-2 under the Ravi Town regional office operates Shad Bagh Pumping Station (Shad Bagh and Kokhar Road). The subdivision officer of Sabzazar in O&M-1 under the Allama Iqbal Town regional office operates Multan Road Pumping Station. The subdivision officer of Krishan (SDO) in O&M-1 under the Gunj Buksh Town regional office operates Gulshan-E-Ravi Pumping Station.

WASA has enough number of O&M staff to manage the existing pumping stations and it also has enough skill, knowledge and experience to operate and maintain its equipment. WASA will thus be able to manage the pumping stations and equipment procured in the Project after the completion of the Project with its present organization. It is, therefore, concluded that there is no necessity to reinforce or reorganize WASA and to recruit new personnel.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

The contents of cost based on the scopes of work by Pakistan are allocated as follows.

Table 2.13 Pakistani Rupee Estimation of Initial Cost to be Borne by the Recipient Country

Item	Cost Estimate in million Japanese Yen (million Rs.)
Advising Commission of A/P & B/A and Payment, etc.	8.65 (6.41)
Total	8.65 (6.41)

Note: Exchange Rate: 1.0 Rs.= 1.35 Japanese Yen (as of December 2009)
Rs.: Pakistani Rupee

2-5-2 Operation and Maintenance Cost

WASA shall be responsible for the Operation and Maintenance (O&M) of pumping stations improved by the Project and shall bear the cost of O&M works. Since O&M cost for equipment procured by the Project will not increase after the Project, there will be no negative impact to WASA's financial condition as described below.

(1) Operation Cost

Electric fee occupies the majority of operation costs of pumping stations. Most of the electric power consumed is for the operation of pumping equipment.

Two (2) pumps are added in Shad Bagh Pumping Station (Khokhar Road), and fourteen (14) existing pumps in the other pumping stations are replaced in the Project. Therefore, the discharge efficiency of pumping stations will drastically improve.

In terms of electric power consumption, the amount after the Project will be less than before the Project due to the improved drainage capacity. Therefore, the operation cost will not increase after the Project.

(2) Maintenance Cost

Only two (2) units of pump equipment and two (2) units of Automatic Trash Rake Systems are added by the Project in Shad Bagh Pumping Station (Shad Bagh and Khokhar Road). This is considered as small change of WASA's management compared to the total number of pump equipment managed by WASA.

WASA has enough number of staff to operate and maintain the pump equipment and automatic trash rake systems procured and installed by the Project. Therefore, it is not necessary to add

new staff to WASA since maintenance cost will not increase after the Project.

(3) Expected Serviceable Lifetime of Pump Equipment

Serviceable lifetime of the pump equipment considered 15-16 years in general. In consideration of the O&M condition of pumping stations, most of the pump equipment owned by WASA are operated for 10-20 years. If good maintenance is provided to the pump equipment, the serviceable lifetime will become longer than expected.

On the condition that WASA keeps providing proper operation and good maintenance, the serviceable lifetime of the pump equipment procured by the Project is estimated to be 20 years.

2-6 Remarks on the implementation of the Project

The following obligations of the recipient country, which were described in the Minutes of Discussion (M/D) regarding the Draft Basic Design Report, concern operational management for the smooth implementation of the Project and should be observed carefully and periodically to keep the time frame of implementation.

(1) Security

The security situation in Lahore City is assumed to have deteriorated considerably considering the recent condition in the whole of Pakistan, although Lahore City is relatively safer than the other areas. Therefore, the security of all entities concerned in the Project should be assured by the Government of Pakistan throughout the whole period of the Project.

(2) Tax Exemption

As described in the M/D with regard to the preparatory survey for the outline design, the Government of Pakistan has to facilitate the exemption of Japanese nationals from taxes including Value-Added-Tax (VAT), General Sales Tax (GST), Customs duties, and any other taxes and fiscal levies which may be imposed in Pakistan with respect to the supply of products and services under the Project, and to take the necessary procedures for tax exemption.

The Government of Pakistan and WASA shall facilitate and support the necessary applications and procedures that have to be performed by the Japanese side.

(3) Customs Procedure at the Dry Port in Lahore City

It is assumed that Customs procedures on the procured equipment and import clearance will be implemented at the Dry Port in Lahore City. Although projects implemented with Japan's Grant Aid had passed through the same Customs procedures at the Dry Port, the procedure might be delayed due to the application for tax exemption.

For the smooth progress of the Project, the support of WASA to facilitate the procedures and applications will be required.

(4) Disposal of Dismantled Equipment

Dismantled equipment (existing pumps and trash rake systems, accessory equipment) will be

handed over to WASA at the site. WASA shall bear all arrangements and expenses for the disposal, transportation and recycling of dismantled equipment.

Chapter 3 Project Evaluation and Recommendations

3-1 Project Effect

3-1-1 Direct Effect

To be benefited directly with the implementation and realization of the Project are about three (3) million residents in the 105km^2 total catchment area of Shad Bagh, Gulshan-E-Ravi and Multan Road pumping stations. The Project is expected to have the following direct effects:

- Total drainage capacity at the three pumping stations will increase from 25.5m^3/s to 35.2m^3/s, accounting for 38%. (If an additional pump is installed at the Khokhar Road Pumping Station with funds from WASA, the total drainage capacity will be 36.7m^3/s, accounting for 44%.)
- With the effect described above, improvement of the inundation condition is expected, since the inundation duration will be shortened by 3 hours and inundation depth will be reduced by 13 cm.

Numerical direct effects have been calculated as discussed below.

(1) Enhancement of Drainage Capacity

Present and improved drainage capacities after the Project, and cover rate (pump capacity / required drainage capacity) of each pumping station are shown in Table 3.1

With the Project, the total drainage capacity of the 3 pumping stations will increase from 25.5m^3/s to 35.2m^3/s, accounting for 38% and the cover rate of pump capacity versus the required drainage capacity will improve to 66% from the present 47%.

Table 3.1 Present and After-Project Cover Rate

Pumping Station	Required Capacity (m^3/s)	Present (2009)			After Project		
		Number of Pumps	Drainage Capacity (m^3/s)	Cover Rate	Number of Pumps (Replace / New Installation)	Drainage Capacity (m^3/s)	Cover Rate
Shad Bagh (SB+KR+SP)	27.8	6+3+3 =12	10.3	37%	6+5[*1)]+3=14 (4+2+0)	15.1	54%
Gulshan-E-Ravi	18.7	14	10.4	56%	14 (6)	13.6	73%
Multan Road	7.2	6	4.7	66%	6 (4)	6.5	90%
Total	**53.7**	**32**	**25.5**	**47%**	**34 (16)**	**35.2**	**66%**

Note: [*1] Excluding the new pump to be installed with funds from WASA inimitably.

(2) Improvement of Inundation Condition

The increment of pump capacity by the project involving the installation of 2 new pumps and replacement of 14 pumps will be 9.7m^3/s. This increment is about 1.5 times of the one by "*The Project for Rehabilitation of Sewerage and Drainage System in Lahore City in Islamic Republic of Pakistan*" in 2004 to 2006, which was 6.6m^3/s.

Results of the brief inundation analysis focusing on the inundation duration and inundation depth based on a simple prerequisite that the inundation area after the Project will be the same as the one before the Project are shown in Table 3.2.

Table 3.2 Results of Brief Inundation Analysis at Monitoring Point (Chuburgi [18])

Rainfall (mm)	Before Project		After Project		Remarks (Date of Rainfall)
	Inundation duration (hr)	Inundation Depth (cm)	Inundation duration (hr)	Inundation Depth (cm)	
40.5	4.5	15	1.8	2	June 17, 2007
49.2	8.0	15	5.3	2	June 29, 2007
61.8	6.8	No Measurement	4.1	No Analysis	July 13, 2008

As the direct effects of the Project, the inundation duration which is currently estimated to be about 5-8 hours will shorten to about 2-5 hours (about 60% shortening), and the inundation depth which is 15 cm at present will be reduced to 2 cm (about 90% reduction).

3-1-2 Indirect Effect

The Project is expected to have the following indirect effects:

- Problems of worker environment concerning safety and sanitation will be reduced by safety improvement of trash removal works, reduction of worker's obligation and improvement of sanitary condition due to the installation of Automatic Trash Rake Systems.

The project effects will come out in the target year 2013, that is, after one year of project operation. The project effects can be indicated by the mitigated and improved inundation condition through the enhanced drainage capacity. With regard to inundation damage, inundation depth, inundation area, inundation duration and length of time for draining, they should be observed carefully and recorded at the time of each heavy rain.

From the above considerations, should the project be properly implemented, the present situation will certainly be improved. The project effects are as summarized in Table 3.3.

Table 3.3 Summary of Project Effects

Present Condition	Inputs under Grant Aid	Project Effects
- Inundation and debasement of social environment and sanitation often happen due to heavy rainfall in the monsoon season because of the degradation of drainage capacity of the decrepit drainage pumps. - Spare parts of pumps could not be procured because parts of too old pumps are no longer available commercially. - Disposed massive trash in drainage channels which could not be removed efficiently make the condition of drainage pumps worse.	- Procurement and installation of 16 pumps and related equipment, and 2 automatic trash rake systems. - Appurtenant works for the above installation works.	- Drainage capacity of pumping stations will increase to 38% and inundation damage will be mitigated. - Inundation duration will be shortened to approx. 3 hours (60%) and inundation depth will be reduced to about 13cm (90%). - Worker environment concerning safety and sanitation will be improved with the installation of Automatic Trash Rake Systems.

3-2 Recommendations

With the aim of ensuring project effects and sustainability, it is important to note that the Pakistani side shall secure the budget to cover the cost for operation and maintenance of facilities and equipment, and shall promote public awareness on solid waste management through public educational campaigns.

After 2005, the water rate and effluent charges which comprise the main portion of WASA's income increased by 4% to 5% annually due to the increment of customers and the improvement of collection of charges. On the other hand, the expenditure of WASA increased by 12% to 18% annually, but the total balance has been in the red. Main sources of the expenditure increment are assumed as follows:

- Increment of employment cost for management and O&M staffs due to the expansion of service area of water supply.
- Increment of electricity fee due to the operation of drainage pumps.

The electricity fee for drainage pumps may reduce as the consequence of rainfall and employment cost; however, it will continuously increase since new customers for water supply and sewerage system will continue to increase.

WASA had started the following concrete measures for increment of income to ensure the budget for O&M, and some degree of effect has been secured:

(1) Water supply system of "without water meter" accounting for 60% of total shall be upgraded to "with water meter."

(2) Fee collection activities on fee delinquents shall be reinforced.

(3) Connection of illegal water distribution pipes and water theft shall be prevented.

However, measure (1) is now actually stopping because of shortage of procurement budget for the meters. Furthermore, 3,000 of 15,000 new supply points contracted in 2008 have not set the meters yet.

For sound management without support from the State Government of Punjab, the three (3) measures described above shall be continued and further enhancement of measures to reduce the “customer without water meter” shall be accelerated.

On the other hand, maintenance works of the sewerage and drainage system in Lahore City are strongly concerned with solid waste from households. To alter resident’s state of consciousness regarding waste disposal, it is very important to implement and continue educational campaign activities to enhance public awareness on sanitary environment, and to enhance local monitoring of unreasonable waste disposal. Such campaigns need to continue under the leadership of WASA.

The project includes technical guidance services on the procured equipment which will be provided through On-the-Job Training of competent personnel of WASA at the beginning of operation. The guidance services will certainly satisfy the requirements for producing project effect, so that technical assistance from other donors will not be needed.

Appendices

Appendix 1 List of Members of the JICA Preparatory Survey Team

Preparatory Survey for the Outline Design

Name	Designation	Affiliation
1) Mr. Kazuya SUZUKI	Team Leader	Director, Environmental Management Division 1, Environmental Management Group, Global Environment Dept., JICA
2) Mr. Kentaro YOSHIDA	Project Coordinator	Environmental Management Division 1, Environmental Management Group, Global Environment Dept., JICA
3) Mr. Ryoichiro ORII	Sewage and Drainage Planner	Environmental Management Division 1, Environmental Management Group, Global Environment Dept., JICA
4) Mr. Masakazu MAEDA	Chief Consultant / Sewage and Drainage Planner	CTI Engineering International Co., Ltd.
5) Mr. Tatsuo KITAMI	Facility Planner	CTI Engineering International Co., Ltd.
6) Mr. Akio ONODERA	Equipment Planner	CTI Engineering International Co., Ltd.
7) Mr. Satoshi TAKATA	Cost Estimator/ Construction and Procurement Planner	CTI Engineering International Co., Ltd.

Briefing on Draft Basic Design Report

Name	Designation	Affiliation
1) Mr. Kazuya SUZUKI	Team Leader	Director, Environmental Management Division 1, Environmental Management Group, Global Environment Dept., JICA
2) Mr. Kentaro YOSHIDA	Project Coordinator	Environmental Management Division 1, Environmental Management Group, Global Environment Dept., JICA
3) Mr. Masakazu MAEDA	Chief Consultant/ Sewage and Drainage Planner	CTI Engineering International Co., Ltd.
4) Mr. Akio ONODERA	Equipment Planner	CTI Engineering International Co., Ltd.

Appendix 2 Survey Schedule

Preparatory Survey for the Outline Design

Item No.	Date	Day	Activity			
			Mr. Suzuki Mr. Yoshida	Mr. ORII	Mr. Maeda	Mr. Kitami Mr. Onodera Mr. Takata
1	8/26	Wed		F/F Mission (Lahore Water Supply, Sewerage and Drainage Improvement Project)	Tokyo -> Bangkok -> Lahore	
2	8/27	Thu			Meeting at WASA, Site Survey	
3	8/28	Fri			Site Survey	
4	8/29	Sat			Site Survey	
5	8/30	Sun			Data Arrangement and Internal Meeting	
6	8/31	Mon	Tokyo -> Bangkok -> Islamabad		Site Survey	
7	9/1	Tue	Mr. Suzuki, Mr. Yoshida: Islamabad -> Lahore 10:00 Courtesy Call to Water & Sanitation Agency, Lahore (WASA) 11:00 Courtesy Call to Planning & Development Department (P&D), The Urban Unit, Housing, Urban Development and Public Health Engineering Department (HUD/PHED), 14:00 Internal Meeting			Site Survey
8	9/2	Wed	08:30 Field visit Shad Bagh Pumping Station, Gulshan-e-Ravi Pumping Station, Multan Road Pumping Station, Main Outfall Pumping Station			
9	9/3	Thu	09:00 Discussion on M/D with WASA			Site Survey
10	9/4	Fri	09:00 Discussion on M/D with HUD/PHED and WASA Mr. ORII: Lahore -> Islamabad -> Bangkok -> Tokyo			Site Survey
11	9/5	Sat	11:00 Discussion on M/D with HUD/PHED and WASA Signing of the M/D Lahore -> Islamabad		Site Survey	
12	9/6	Sun	Report Preparation		Data Arrangement and Internal Meeting	
13	9/7	Mon	9:30 M/D with Economic Affairs Division（EAD） 14:00 Report to JICA 16:00 Report to EOJ		Site Survey	
14	9/8	Tue	Islamabad -> Bangkok -> Tokyo		Site Survey	
15	9/9	Wed			Site Survey	
16	9/10	Thu			Site Survey	
17	9/11	Fri			Site Survey	
18	9/12	Sat			Site Survey	
19	9/13	Sun			Data Arrangement and Internal Meeting	
20	9/14	Mon			Site Survey	
21	9/15	Tue			Site Survey	
22	9/16	Wed			Lahore -> Islamabad Report to EAD, EOJ and JICA Islamabad -> Lahore	Site Survey
23	9/17	Thu			Lahore -> Bangkok -> Tokyo	Data Arrangement and Internal Meeting
24	9/18	Fri				Lahore -> Bangkok -> Tokyo

Briefing of Draft Basic Design Report

No	Date	Day	Activity			
			Mr. Suzuki	Mr. Yoshida	Mr. Maeda	Mr. Onodera
1	1/20	Wed	Other Project		Tokyo -> Bangkok	
2	1/21	Thu			Bangkok -> Lahore	
3	1/22	Fri	Discussion on DF/R, M/D with WASA	Other Project	Discussion on DF/R, M/D with WASA	
4	1/23	Sat	11:00 Discussion on Draft of M/D with Joint Secretary of HUD & PHED 14:00 Site Survey			
5	1/24	Sun	Data Arrangement and Internal Meeting			
6	1/25	Mon	Secondery Discussion with WASA			
7	1/26	Tue	11:00 Signing of the M/D			
			Lahore -> Karachi -> Bangkok	Lahore -> Islamabad		
8	1/27	Wed	Other Project	Report to EAD, Embassy of Japan, JICA Pakistan Office Islamabad -> Bangkok		
9	1/28	Thu	Other Project	Bangkok -> Tokyo		

Appendix 3 List of Parties Concerned in the Recipient Country

Name	Designation	Affiliation
Water and Sanitation Agency in Lahore (WASA), Lahore Development Authority		
Dr. Javed Iqbal	Managing Director	
Mr. Syed Iqtidar Ali Shah	Deputy Managing Director	Engineering
Mr. Asif Javed Qureshi	Deputy Managing Director	Finance Administration / Revenue Wing
Engr. Syed Zahid Aziz (Mr.)	Director	Planning and Evaluation (P&E)
Mr. Masaud Ahmad Ghazu	Director	Planning and Design (P&D)
Mr. Jamshed Butt	Director	Drainage
Mr. Muhammad Tanveer	Deputy Director	P&E
Mr. Aslam Niazi	Executive Engineer	Operation and Management – 1, Allama Iqbal Town
Mr. Sarfraz Hussain	Executive Engineer	Operation and Management – 2, Ravi Town
Mr. Tariq Mahmood	Executive Engineer	Operation and Management – 1, Gunj Buksh Town
Mr. Muhammad Saleem Ashraf	Sub Division Officer	Shad Bagh Pumping Station
Mr. Amjad Ali	Sub Division Officer	Multan Road Pumping Station
Mr. Mohammed Ashraf	Sub Engineer	Gulshan-e-Ravi Pumping Station
Lahore Development Authority		
Mr. Omer Rasul	Director General	
Government of the Punjab		
Mr. Ubaid Rubbani	Member Social Infrastructure	Planning & Development Department (P&D)
Mr. Nasim Riaz	Chief of Section ECA	P&D
Mr. Amjad Duraiz	Assistant Chief ECA-II	P&D
Mr. Shaukat Ali	Additional Secretary (Tech)	Urban Development and Public Health Engineering Department (HUD/PHED)
Mr. Muazzam	Deputy Secretary	HUD/PHED
Ministry of Economic Affairs and Statistics		
Mr. Zafar Hasan Reza	Joint Secretary (ADB/Japan)	Economic Affairs Division
Embassy of Japan		
Mr. Shigeki NAKANISHI	First Secretary	
Mr. AKIRA Goto	Second Secretary	
JICA Pakistan Office		
Mr. TOMOHARU Otake	Resident Representative	
Mr. TSUTOMU Shimizu	Deputy Resident Representative (Preparatory Survey of the Outline Design)	
Mr. Toshiya SATO	Deputy Resident Representative (Explanation of Draft Basic Design Report)	
Mr. JUNYA Hiroshima	Staff	
Mr. Mahmood A. Jilani	Deputy Resident Representative/ Chief Program Officer	