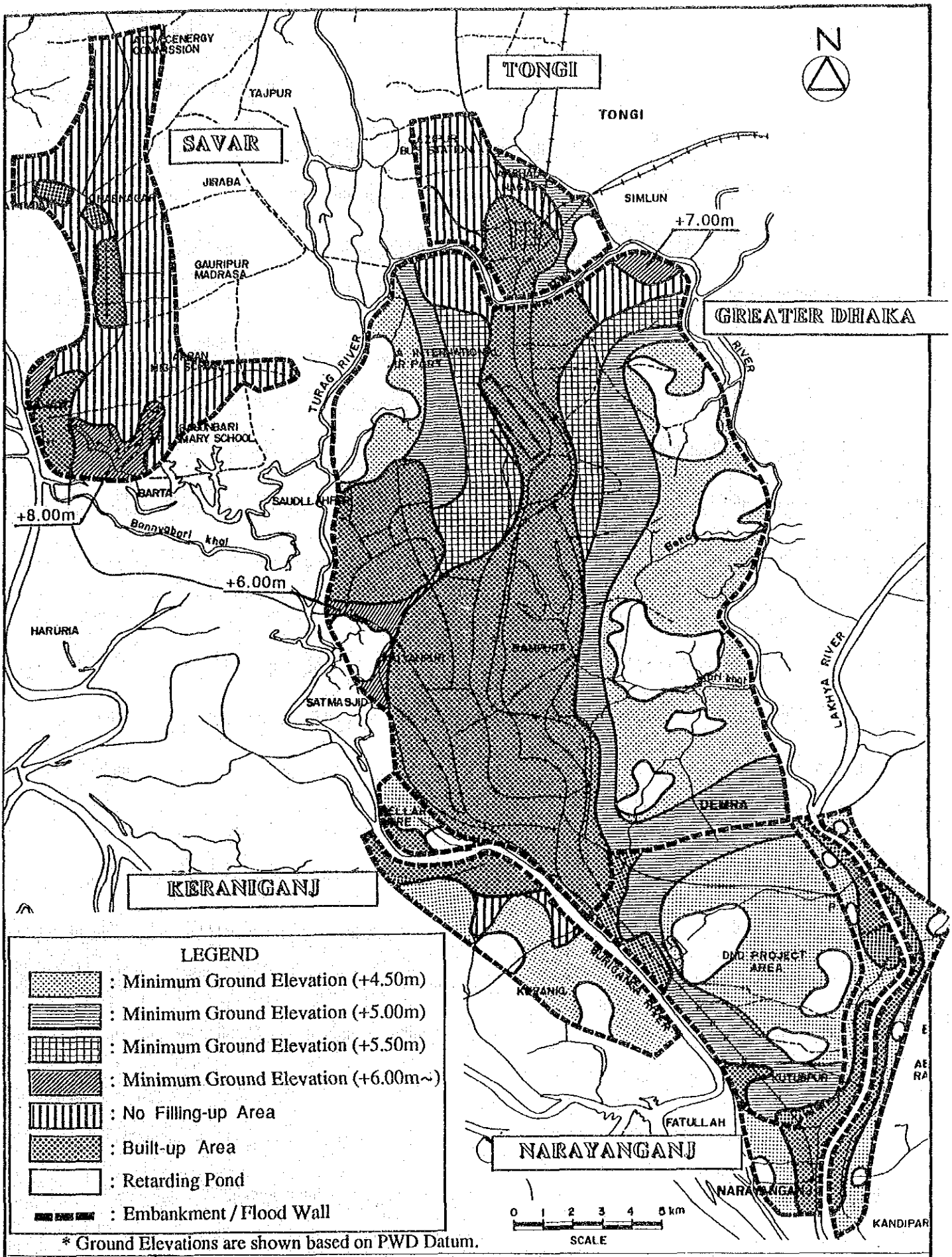

* Ground Elevations are shown based on PWD Datum.

FIG. H.28 GUIDELINE OF FUTURE LOWLAND DEVELOPMENT

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

JICA

SUPPORTING REPORT I

OPERATION AND MAINTENANCE

SUPPORTING REPORT I
OPERATION AND MAINTENANCE

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SUPPORTING REPORT I: OPERATION AND MAINTENANCE

1. General

Operation and maintenance (O/M) works include daily or periodical actions/activities that are necessary to prevent the deterioration of a facility and thus guarantee its effectiveness.

The work required is closely related to the type of facility e.g.pump station, embankment, etc.and its design. So the O/M demand of the project facility has to be considered from the very beginning of the planning process and every effort should be made to simplify and minimize the O/M requirement. In addition, the quality of the construction works will have a great influence on the O/M works necessary and the life span of the construction. Infact, proper O/M would ensure that the life span of the facility is adhered to as planned.

Neglected O/M and the consequent failure of the flood control facility can lead to even greater damage to life and property than there would have been without the construction of the facility. Once completed, the embankment makes encourages people to settle in low lying areas where formerly they would not have settled because of high risk of flooding. Further, in the case of failure of pump stations, the embankment can easily function as a trap of storm water run-off and wastewater causing water logging or internal flooding.

Only a proper O/M of all the highly complex system of this protection project would ensure the realization of due benefits for which the project was initiated.

2. Existing Condition

2.1 Flood Mitigation and Stormwater Drainage Facilities

2.1.1 Embankment

Most existing flood mitigation facilities i.e. embankment, concrete flood wall, road-cum-embankment have been constructed around the Greater Dhaka and Narayanganj areas after the 1988 floods.

Some sections of the embankment along the western part of the Greater Dhaka have not been completed due to settlement and failure of the embankment.

The existing burrow pits are less than even 5 m apart from the toe of the embankment and sometimes over 5 m deep. This affects overall embankment stability and is a likely cause for some local embankment failure. The use of different type of soils, disregarding their different physical/mechanical characteristics concerning stability, created weak sections, which especially attracted rats, causing piping. Compaction by mechanical means, other than by human and the filling's own weight, was generally not provided.

Human settlements on the embankment, not just during the time of flood, cattle grazing, foot paths along the slopes etc. also affect the embankment though the damage is relatively small.

Thus rehabilitation/repair of the constructed embankments is required in order to ensure their safety and effectiveness.

2.1.2 Drainage System:

The existing drainage system, in general, consists of a network of local open drains known as khals, totalling approximately 437 km in length and pump stations at two(2) locations, namely Narinda in Old Dhaka and Demra in DND area.

In addition, drainage pipes with total length of more than 110 km is provided for the central Dhaka area of 60 km^2.

Narinda pumping station drains almost the entire Old Dhaka area of 4.23 km^2.
Total design discharge capacity is 9.6 m3/s.

Demra pumping station serves both for stormwater drainage and as an irrigation facility for the DND project area of approximately 57 km^2. Total design discharge capacity is 14.52 m3/sec.

This existing drainage system is regarded as inadequate for proper drainage. It is further limited by excessive siltation, dumping of solid waste and interference in the form of roads, settlements and buildings.

The required O/M works thus become difficult to define and separate from necessary repair and improvement works.

2.2 Institution and Organization of O/M Works

2.2.1 Institutional Aspects of Flood Protection/Drainage

1) Embankment

The number of institutions, be they ministries, departments, agencies or commitees, related directly or indirectly with flood control measures and drainage runs in to dozens. Fragmented or overlapping responsibility add to a lack of coordination, not only in planning and implementation, but also regarding O/M. After the floods of 1987 and 1988, the situation was aggravated because the major flood control facilities were constructed in an ad-hoc Jashion, often by executive orders.

Because of the scale of the works, manpower needed and lack of time, the works were and are being executed by different institutions, these include the army, DCC and BWDB. Although the construction is still on going in some sections of the embankment and the contractors will be responsible for the O/M works for another 6 months after completion, it is necessary to decide about the future responsible institution beforehand. This has not been done yet and thus this decision is urgently needed.

2) Stormwater Drainage

The drainage system can be regarded as the second part of the whole flood mitigation system. DWASA has only recently, in March 1989, been handed over the responsibility for the drainage system of Dhaka municipal area (DCC) from DPHE, but because DPHE manpower also was transfered, the work of DWASA is well organized relying mainly on contractors to clean and maintain pipes and khals.

In the remaining municipalities of Tongi and Narayanganj the local authorities are responsible for O/M of drainage. However, in the DND area, which still remains as an agricultural development area, BWDB is responsible for both irrigation and drainage.

3) Road-Cum-Embankment, Flood Wall, etc.

Raised roads and tracks for flood protection and flood protection walls have been constructed by DCC, RAJUK, RHD and the Railroad Authority. Coordination hardly exists. It is said that because two concerned institutions belong to different

ministries, the exchange of information takes so much time along the hierarchical path that in most cases the construction is completed before such an exchange has taken place.

RAJUK implements and partly finances road construction, but transfers the facility after completion to DCC, so that within the area DCC and RHD are the only bodies responsible for raised roads' O/M, though at present the only road with flood protectional aspect maintained by RHD is Demra Road.

2.2.2 Existing Organizations

1) BWDB:

BWDB, with a personnel of over 20,000 people, is responsible for the planning, construction and O/M of flood protection and irrigation projects nationwide. Within the BWDB there was no separate O/M Department until an analysis of the organizational weaknesses of BWDB was initiated by the World Bank. The newly named department was soon to be mainly concerned with construction works and no O/M budget-plan exists. For the next fiscal year such a plan is to be included, but up to now, no specifications concerning its composition exist. Roughly 2.5% of the total project performance costs are said to be spent for O/M works.

The existing part of the embankment constructed under the responsibility of BWDB, extending from Tongi to Mirpur Bridge, is still maintained by contractors supervised by BWDB engineers.
The present organization is shown in Fig I.1.

2) DWASA:

DWASA is responsible for the water supply and drainage system of Dhaka City. The O/M of the drainage system is organized by the Drainage Circle belonging to the Engineering Department of DWASA.

The present organization of the Drainage Circle is shown in Fig. I.2.
The drainage system consists of approx. 130 km of pipes ranging from 1' - 10' (less than 10% of the total length are pipes > 5') and two dozens khals with a total length of 53 km.

Dhaka is divided into 2 sub-divisions and 9 sub-zones, 1 supervisor (work-assistant) and 2 cleaners are assigned to each. These cleaning teams are

concerned with work related to complaints by local residents or wards and during the rainy season in the case of emergencies, up to 10 or more cleaners join them. The main task of cleaning and repairing is done by contractors, generally small in size. Contracts do not exceed Tk. 1 lakh. The number of contractors involved is between 30-40. They are selected by tendering.

They start work by the middle-end of April till May with simple tools like shovels and buckets. The work is supervised regularly by the Circle by means of estimation of the volume of sludge removed. This is left in the street to dry before it is transported to dumping sites. An inspection of the pipes themselves is done at a final stage. This cleaning work has to be done under extremely difficult and health hazardous conditions. Not all of the sludge can be removed by use of only simple tools leading to quick blockage during heavy rains.

The annual budget of the Circle is Tk. 70-80 lakh.

3) DCC:

DCC is in charge of most of the raised roads within the city, especially the road from Joar Sahara to Saidabad, which together with the railway dike north of Joar Sahara and Demra Road is an important flood protection facility facing east towards the Balu River. Construction of Joar Sahara-Saidabad Road was done mainly by RAJUK (12 out of 13 km) and after completion it was handed over to DCC. The area of the city is divided into different divisions by DCC and two of them are concerned with the O/M of this raised road. It is difficult to estimate the actual effort on the O/M of the raised roads. The annual budget for each division is around Tk. 200 lakh, mainly personnel costs.

4) RHD:

The same difficulty as with DCC, exists regarding the O/M works concerning flood protection facilities done by RHD, we face because there is only an appr. 6 km stretch (Demra Road) having such characteristics. An O/M team within the Road Circle consists of 1 supervisor, 1 assistant and 10-15 labourers equipped with simple tools and one truck. One team generally covers a 20-25 km stretch of road without considering any special maintenance needed for raised roads. The personnel costs of a team amount to appr. Tk. 3.5 lakh per year. The cost for equipment maintenance and operation of the truck arises to about Tk. 1.5 lakh.

The construction of another raised road from Tongi to Savar has been started, involving large earth moving works in frequently flooded areas requiring special maintenance.

2.3 Faced Problems

2.3.1 Khals

Misuse is in most cases linked with trespassing on public land (khas). In this regard DWASA is facing severe problems because of the increasing pressure to settle on public lands close to the khals as land becomes more scarce in the inner city. Up to now, DWASA has to report misuses to local leaders or the police, but the law enforcement has proved to be mostly insufficient or only led to temporary improvement of the situation.

DWASA aims to become the actual owner of the land close to the khals. 30-100 feet (according to the size of the khal) on each side are estimated to be appropriate for enforcing the regulations more effectively. For 5 khals, such land acquisition has been approved by the ministry responsible and it has now become a problem of funding land acquisition.

2.3.2 Embankment

Besides cattle grazing, the embankment's evident misuses, are the existence of a part of Mirpur-Boro bazar and a settlement of around 1500 people in the Mohammud Pur area on the embankment.

In the case of the bazar, up to now nobody seemed to have interfered regarding the use of the embankment. The bazar authority paid Tk. 1 lakh to DCC as an annual market tax. The authority assumes that the whole market will be soon moved to another more spacious location and that by that measure the use of the embankment would be very limited in time. They say that any orders given by DCC to abandon the embankment would of course immediately be followed.

The settlement has a more complicated background. The settlers were forcefully pushed out of the area they formerly occupied close to the actual site by housing societies, who are now rapidly developing the area after the construction of the embankment. Most of the squatter have been in existence for over 5 years, and their residents are mainly employed on the construction sites of the embankment. Because

they refused resettlement, the ward administration tolerated the settlement to avoid social unrest. BWDB will thus face difficulties enforcing regulations in the parts of the embankment now under the supervision of DCC, because of the resettlement problem involved.

3. Proposed Improvement Plan

3.1 Required Operation and Maintenance Work

3.1.1 Flood Mitigation Facilities

1) General

To sustain the expected beneficial effects of the existing and proposed flood mitigation facilities, the following operation and maintenance work (O/M) shall be carried out daily or periodically depending on the actual conditions.

(1) Embankment/Road-cum-embankment

a) Inspection and repairing of erosion by wave action, water flow, storm rainfall, etc. as erosion control works.
b) Inspection and repairing of seepage, sliding, failure, settlement, etc. as stability control works
c) Inspection of land use according to the regulation
d) Clearing/cutting grass on the maintenance road and the embankment.

(2) Flood wall

a) Inspection and repairing of damage by traffic vehicle, etc. as damage control work
b) Inspection and repairing work to ensure structural stability
c) Inspection of land use

(3) Regulators

a) Inspection and repairing of regulator
b) Inspection and maintenance of outlet/inlet condition

2) Required Operation and Maintenance Equipment

Provision of the following equipment is required to satisfactorily implement the above-mentioned O & M work:

(1) Inspection and supervision vehicles
- Jeeps and Motorbikes

(2) Trucks for repairing works

(3) Tamping machine

(4) Grass-cutting implements & cleaning equipment

3.1.2 Stormwater Drainage System

1) General

To sustain the beneficial effects of the existing and proposed drainage system of the study area the following major O&M work shall be done:

(1) Cleaning of drainage pipes
(2) Dredging of deposits and removal of garbage from the khals.
(3) Operation and maintenance of pump stations.
(4) Operation and maintenance of control gates.
(5) Land use control, in cooperation with the agencies concerned, to maintain the regulating ponds and khal areas as planned, and to assure the required elevation of new land development.

2) Required Operation and Maintenance Equipment

No special equipment except for small pump units are provided at present.

Provision of the following equipment is required to satisfactorily implement the above-mentioned O&M work:

(1) Garbage trolley (mechanically operated)
(2) Trucks for sludge transportation
(3) Cleaning equipment (small, mechanically operated)
(4) Cleaning equipment (truck mounted)
(5) Small pumps for discharging
(6) Supervision vehicles
- Jeeps
- Pickup Trucks

3) Operation and Maintenance of Drainage Pipe and Pump Station

(1) Cleaning of Drainage Pipe

All the drainage pipes will be cleaned once a year.

The cleaning will be made manually and by cleaning machine.

(2) Operation Rule of Pump Station

The pump operation period begins when the flood water level of the rivers reaches design operation water level. The period is usually the flood season from early July to mid-October.

During the flood season, the water level of the regulating ponds shall be maintained below the design water level to meet the coming storm runoffs.

(3) Maintenance of Pump Station

Major maintenance work at the pump station is as follows:

a) Daily maintenance (during pump operation)

- check electric current of motor
- check temperature of motor bearing
- check vibration of pump and motor

b) Every six (6) months maintenance

- check pump sealing components
- check motor lubrication oil
- check gauge and indicator
- check insulation of motor

c) Annual maintenance

- check electric panel
- check motor of automatic trash rake

d) Every three (3) to four (4) years maintenance

- replace gauge and indicator
- replace parts of electric panel
- replace parts of automatic trash rake

3.2 Land Use Regulation

The following land use controls are required to sustain effective functioning of the structural flood mitigation and drainage facilities proposed in Supporting Report G and H.

3.2.1 Flood Mitigation Facilities

1) Maintenance of Embankment

The stability of embankment shall be ensured against external forces and foundation failure, both under normal and critical conditions of loading.

Periodic maintenance of embankment is very necessary to confirm the design section of the embankment and to repair other potential damage due to external factors.

These works require some additional space along both sides of the embankment.

In order to facilitate maintenance and to check any adverse activities detrimental to embankment stability whether intentional and unintentional, it is proposed to reserve land of minimum 30 m width from the toe of embankment along both sides. Land use in these reserved areas shall be regulated to ensure against encroachment and other activities detrimental to the embankment. Land acquisition is the best means to regulate land use of this reserved space. If land acquisition is impractical, other means of land use regulation need to be considered for this reserved area.

2) Maintenance of Flood Wall

As with embankment in order to facilitate maintenance and repair, and to control activities detrimental to the flood walls, a minimum of 3 m space slhould be reserved and its land use regulated.

3) Operation and Maintenance of Gates

In order to facilitate the operation and maintenance of gates, right of way/access space for vehicles and yard for storage of accessories and other equipment, it is necessary to acquire the land required.

3.2.2 Stormwater Drainage System

1) Preservation of Regulating Pond Area

The proposed regulating pond areas shall be preserved to assure the planned effects of pump drainage.

2) Preservation of Khal Areas

The existing khal areas are subject to reclamation or encroachment of settlement/buildings.

The minimum khal sections and land space to be maintained are shown in Supporting Report H. In addition, inspection road widths shall be maintained on one or both banks of the khal.

3) Control of Land Fill Elevation for Urban Development

Pressure of urban development in the low-lying areas will continue to grow after completion of the Project.

Land fill elevation shall be controlled in conformity with the proposed design high water level inside the protection dikes or roads.

3.3 Required Organization

3.3.1 Required Organization for Construction

The required organization for construction of the proposed flood protection and stormwater drainage works is shown in Fig. I 3.

3.3.2 Required Organization for Operation and Maintenance

The required organization for the operation and maintenance of the flood mitigation and drainage systems in the study area after completion of the proposed project is shown in Fig.I.3.

3.3.3 Job-staff Member

The job assignment of each staff member is described below:

Superintending Engineer:	1)	Controlling officer of project
	2)	Policy planner of project
	3)	Monitoring
	4)	Evaluation
	5)	Overall quantity control & supervision of work
Executive Engineer:	1)	Engineer in charge of field
	2)	Responsible for planning, design, estimating of project
	3)	Tendering of work
	4)	Field supervision, controls subordinate field officer & staff
	5)	Quality control
	6)	Control of financial matters
	7)	Progress report
Sub-Divisional Engineer:	1)	Preparation of estimates
	2)	Field supervision of work
	3)	Control of direct field supervisions
	4)	Quality control
	5)	Measurement of work
	6)	Custody of project materials & tools
	7)	Progress report
Sub-Divisional Engineer (Electrical):	1)	In charge of pump station & equipment
	2)	Operation of pumps
	3)	Supervision of maintenance work of pumps & equipment
	4)	Custody of equipment, tools & plants

Sub-Asst. Engineer:	1)	Supervision of work
	2)	Preparation of estimate & drawing
	3)	Measurement of work
	4)	Implementation of work guidelines
Sub-Asst. Engineer (Electrical):	1)	Supervision of pump operation
	2)	Maintenance of pumps
	3)	Record keeping on pump operations & maintenance
Work-Assistant:	1)	Primary supervisor of work
	2)	Records of field progress & problems
Cleaner:	1)	Minor cleaning of drainage pipes
	2)	Cleaning of catchpits, manholes & attending to problems

3.3.4 Training and Local Participation

The participation of local residents/farmers with actual operating/maintaining or supervising/reporting tasks is an interesting approach. In rural areas such a decentralisation and participation approach has been tried, but within a city, with its totally different social structure, it still needs to be analyzed and it cannot be foreseen if it can be successfully implemented. In any case, political support is necessary if an Infrastructure Maintenance Committee or a similar body is to be effectively incorporated within the O/M works.

Proper O/M can only be done when everybody involved develops an attitude of personal responsibility for the work being done. Training can be given not only regarding skills, but also to change behavior in this sense. It is only logical that besides engineers, kalashis and contractors'staff who are also beneficiaries of the facilities are involved. The training must be conducted at regular intervals and it must be well structured. Such a training programme is soon to be developed under UNDP assistance on behalf of BWDB.

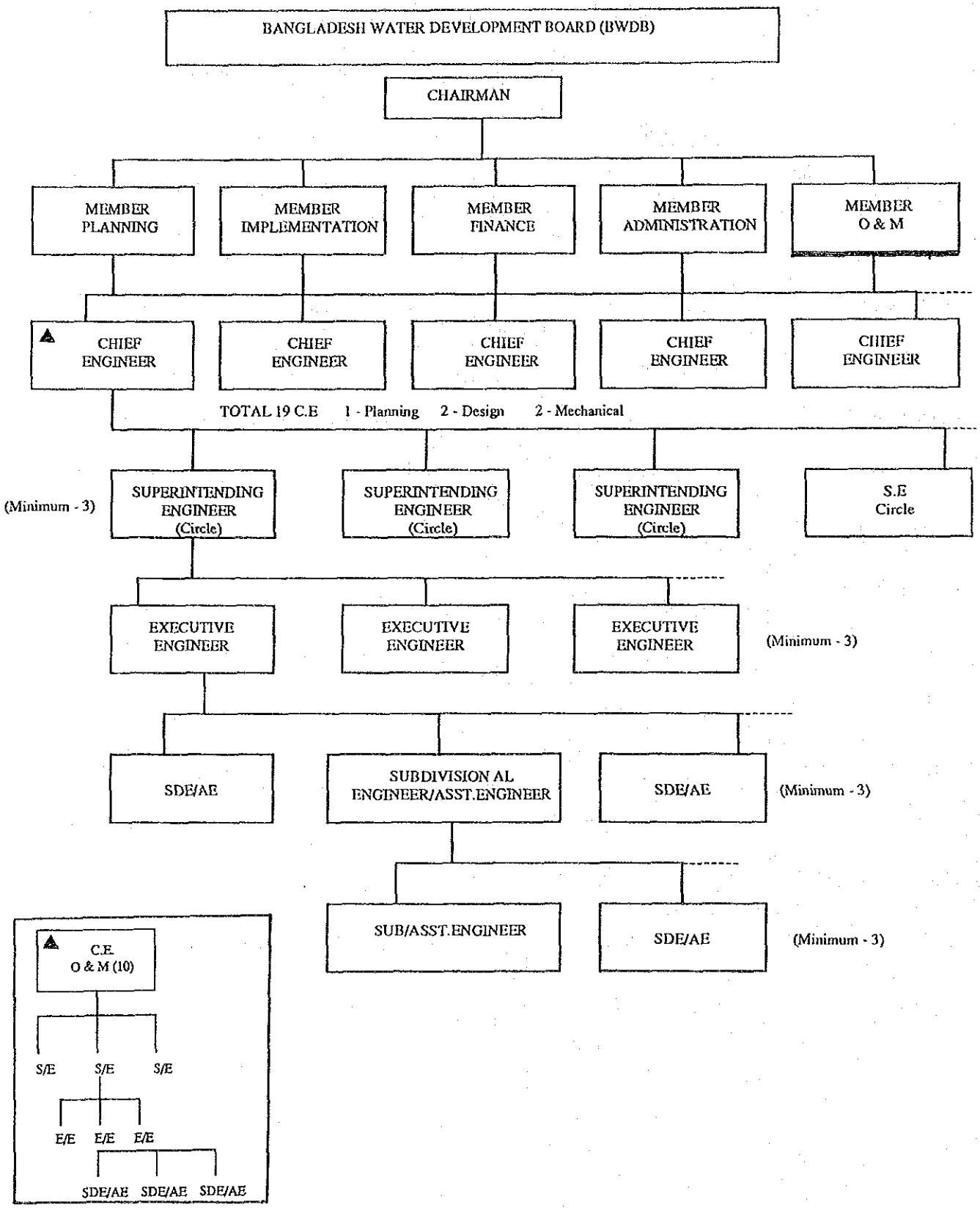

FIG. I.1 ORGANIZATION CHART OF BWDB

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

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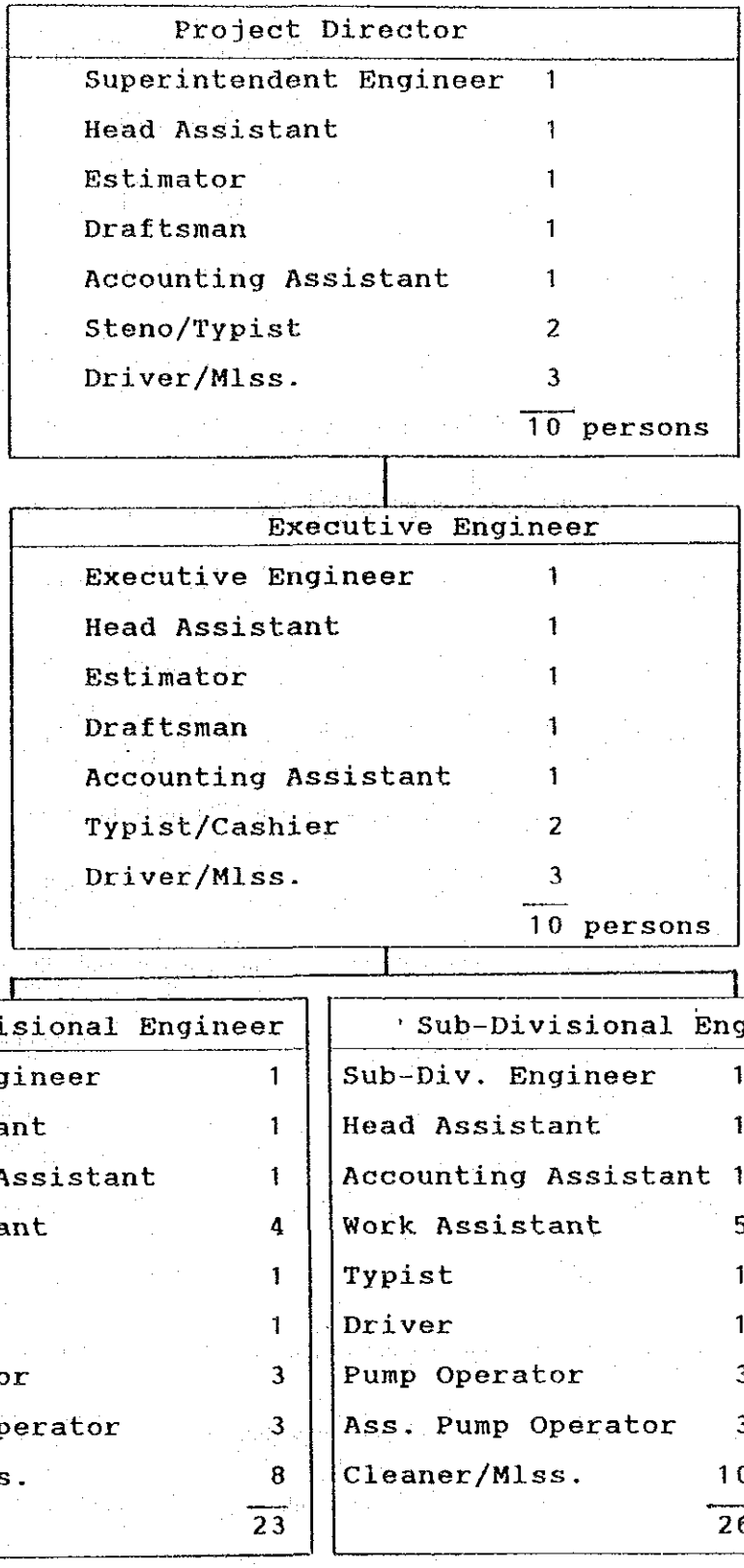
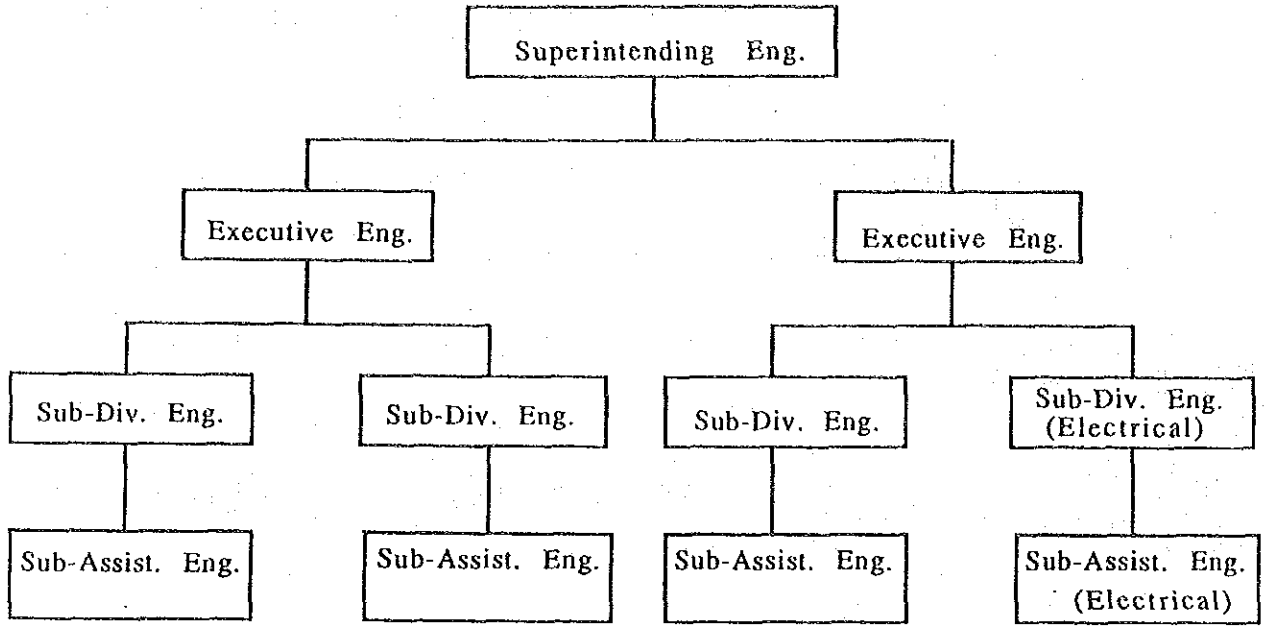


FIG. I.2 PRESENT ORGANIZATION OF DWASA DRAINAGE CIRCLE

1) PROPOSED ORGANIZATION FOR CONSTRUCTION



2) PROPOSED ORGANIZATION FOR OPEARATION AND MAINTENACE

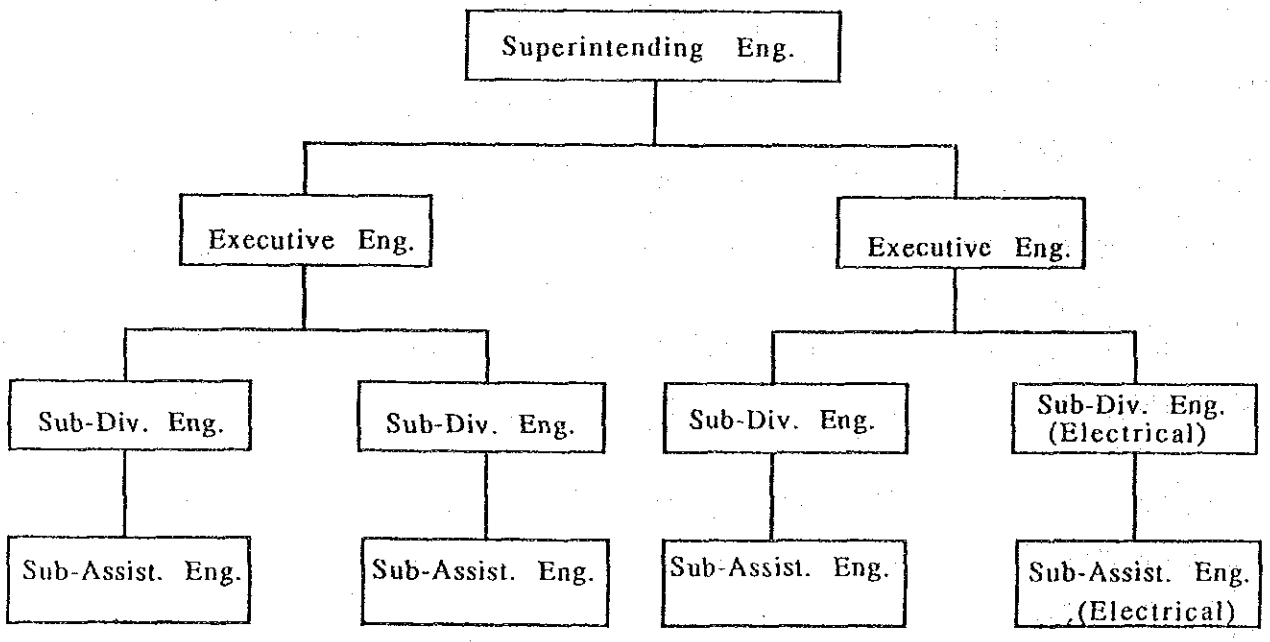


FIG. I.3 PROPOSED ORGANIZATION FOR CONSTRUCTION, OPERATION AND MAINTENANCE

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

JICA

SUPPORTING REPORT J

PROJECT COST

SUPPORTING REPORT J
PROJECT COST

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SUPPORTING REPORT J: PROJECT COST

1. General

The project cost is to be utilized for the assessment of economic and financial viability and preparation of a funding schedule for the Government. The cost is made basically with refer to Schedule of Rates of BWDB (Bangladesh Water Development Board) and current market prices for construction materials, equipment and labour rates prevailing in Dhaka.

2. Basic Conditions of Cost Estimates

The project cost is composed of:

1)	Direct cost:	(1)	Construction work
		(2)	Procurement and installation of equipment
2)	Indirect cost:	(1)	Land acquisition and compensation cost for house resettlement
		(2)	Administration cost
		(3)	Engineering service cost
3)	Contingency:	(1)	Physical contingency

These are referred to the following assumption.

(1) The estimated cost is made on the condition that the all construction works are to be contracted to general contractors by international tendering.

(2) The base of costs are fully shown under the economic conditions prevailing in March 1991.

(3) The exchange rates of foreign currencies are accepted follows.

US$1.00 = 36 Tk = 137 Yen

(4) The cost is divided into foreign and local currency portions, based on the following conditions;

a) The foreign currency portion

- Expense of expatriate personnel
- Overhead and profit of foreign firms
- Imported equipment, materials and supplies

b) The local currency portion

- The construction materials which is available in local market
- The salary and wages for local personnel
- Overhead and profit of local firms
- Tariff & taxes

(5) A constant allowance of 15% is added to each item of the direct construction.

(6) Administration cost is assumed at 3% of direct construction cost.

(7) Engineering services is estimated at 10% of direct construction cost.

(8) Physical contingency is considered at 25% of total direct construction cost.

(9) Construction costs of Previous JICA Proposal, Previous/On-going projects by GOB, JICA and IBRD are converted from the costs estimated at 1989 price to 1991 price by using price escalation rate of respectively 16.6% and 12.4% during the past 2 year period of 1989~1990. While, the 1991 costs are referred to "UPDATING STUDY ON STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY" by JICA.

3. Estimation of Unit Cost

The unit costs by work item are calculated from the material cost (refer to Table J.1), labour cost (refer to Table J.2), and equipment cost by analyzing the data on the similar works implemented in recent years as well as taking into consideration the local conditions in Dhaka area.

The unit cost calculated by typical work item are listed in Table J.3. The unit construction cost diagrams by type or scale of facilities, such as concrete flood wall, sluice gate and pumping station are illustrated on Figs. J.1 and J.2.

4. Land Acquisition Cost

The price of land is variable due to not only its location and land use but also government price or market price. In this study, the unit land costs by project area and facility are given in Table J.4 based on the current market price, the values of which may be 2 to 3 times of the government land prices from DCO (Deputy Commission Office). Breakdown of land acquisition cost by the project area is shown in Table J.5.

5. Estimated Project Cost

The total project cost is estimated with an amount of Tk. 61,208 million, (F/C : Tk. 21,502 million, L/C : Tk. 39,707 million) at March 1991 price as shown follows.

Project Cost

(Unit : million Tk.)

Item		F/C	L/C	Total
I.	Structural Measures			
A.	Direct Cost	15,487.4	13,343.6	28,831.0
(1)	Construction Cost	(15,487.4)	(13,343.6)	(28,831.0)
B.	Indirect Cost	1,548.7	22,074.8	23,623.5
(1)	Land Acquisition Cost	(-)	(19,875.4)	(19,875.4)
(2)	Administration Cost	(-)	(865.0)	(865.0)
(3)	Engineering Service Cost	(1,548.7)	(1,334.4)	(2,883.1)
C.	Physical Contingency	3,872.0	3,335.9	7,207.9
	Total :	20,908.1	38,754.3	59,662.4
II.	Non-Structural Measures			
A.	Direct Cost	439.5	598.5	1,038.0
(1)	Construction Cost	(439.5)	(598.5)	(1,038.0)
B.	Indirect Cost	44.0	204.1	248.1
(1)	Land Acquisition Cost	(-)	(113.1)	(113.1)
(2)	Administration Cost	(-)	(31.2)	(31.2)
(3)	Engineering Service Cost	(44.0)	(59.8)	(103.8)
C.	Physical Contingency	110.0	149.6	259.6
	Total :	593.5	952.2	1,545.7
	Grand Total	21,501.6	39,706.5	61,208.1

The project costs by the project area and their breakdown are shown in Tables J.6 and J.7.(1) to J.7.(8).

Table J.1 UNIT PRICES OF TYPICAL MATERIAL

Item	Description	Unit	Price (Tk) in 1991	Foreign Currency (%)	Local Currency (%)
Bricks		1000 pcs	3,000	20	80
Ready mixed concrete (1:3:5)	100 kg/cm^2	m^3	2,800	40	60
Ready mixed concrete (1:2:4)	210 kg/cm^2	do	3,000	45	55
Cement (50 kg/bag)	Portland	bag	240	60	40
Sand	use of concrete	m^3	480	15	85
Crushed stone		do	1,100	15	85
Riprap (Gravel)	50-150 mm	do	1,100	15	85
Brick Chips		do	1,100	15	85
Deformed Bar	SD 30	t	30,000	50	50
Steel sheet pile		do	30,000	100	0
Structural steel		do	25,000	100	0
Timber	Low Class	m^3	25,000	0	100
Timber	High Class	do	19,000	80	20
Gasoline		L	14.5	90	10
Diesel oil		do	14.0	90	10

Table J.2 LABOUR WAGES

Type of Labour	Labour Wages (Tk) (1991 Price)
1. Common Labourer	75
2. Mason and Plasterer	165
3. Reinforcement Worker	135
4. Concrete Worker	115
5. Pavement Worker	125
6. Carpenter	165
7. Painter	130
8. Welder	190
9. Foreman	215
10. Chief Foreman	325
11. Car Driver and Operator	140
12. Heavy Equipment Operator	255
13. Boat Man	110
14. Boat Captain	180
15. Mechanic	200
16. Electrician	200
17. Plumber	220
18. Surveyor	250

Table J.3 Unit Construction Cost of General Items

Item	Description	Unit	Price (Tk.)	Foreign (%)	Local (%)
Banking	Machine with Manpower	m3	530	40	60
Excavation	Backhoe	m3	310	60	40
	Man power	do.	140	0	100
Dredging	Khal improvement	do.	240	60	40
Back filling	Backhoe	do.	310	60	40
	Man power	do.	110	0	100
Compaction	Compaction roller	do.	150	60	40
Foundation work	Sand piling	m	626	70	30
Concrete work	100 kg/cm2	m3	3,500	40	60
	200 kg/cm2	do.	5,500	45	55
Reinforcement work	-	Kg	35	70	30
Form work	-	m2	980	50	50
Brick work	-	m3	3,400	30	70
Road pavement	Gash stone	m2	510	40	60
Sodding	-	do.	60	0	100

Table J.4 UNIT PRICE OF LAND BY PROJECT AREA

Unit: Tk/m^2

Project Area	Flood Protection	Storm Water Drainage	
		Khal Improvement	Regulation Pond
G. Dhaka West	—	450	450
G. Dhaka East	Embankment 350 Sub-Embankment 250	250	250
Narayanganj DND	520	520	520
Narayanganj West	520	520	520
Narayanganj East	520	520	520
Tongi	270	270	270
Savar	220	220	—
Keraniganj	340	340	340

Table J.5 Breakdown of Land Acquisition Cost by Project Area

Project Area	1. G. Dhaka West			2. G. Dhaka East			3. Narayanganj DND			4. Narayanganj West		
Description	Required Area (1000 m2)	Unit Price	Cost (1000 Tk)	Required Area (1000 m2)	Unit Price	Cost (1000 Tk)	Required Area (1000 m2)	Unit Price	Cost (1000 Tk)	Required Area (1000 m2)	Unit Price	Cost (1000 Tk)
1. Flood Protection												
a. Embankment	370	450	166,500	2,270	350	794,325	58	520	30,368	615	520	319,696
b. Sub-embankment	-	-	-	904	250	226,000	-	-	-	-	-	-
Sub-Total	370		166,500	3,173.5		1,020,325	58		30,368	615		319,696
2. Storm Water Drainage												
a. Khal Improvement	437		275,690	1,680		555,160	908.0	520	472,160	122	520	63,440
b. Retarding Pond	7,700	450	3,465,000	18,840	250	4,710,000	6,810	520	3,541,200	1,700	520	884,000
Sub-Total	8,137		3,740,690	20,520		5,265,160	7,718		4,013,360	1,822		947,440
3. Evacuation Facilities												
a. Evacuation Center	-	-	-	-	-	-	-	-	-	-	-	-
b. Road Improvement	-	-	-	-	-	-	-	-	-	11.0	520	5,720
Sub-Total	-		-	-		-	-		-	11.0	520	5,720
4. Total			3,907,190			6,285,485			4,043,728			1,272,856

Project Area	5. Narayanganj East			6. Tongi			7. Savar			8. Keraniganj		
Description	Required Area (1000 m2)	Unit Price	Cost (1000 Tk)	Required Area (1000 m2)	Unit Price	Cost (1000 Tk)	Required Area (1000 m2)	Unit Price	Cost (1000 Tk)	Required Area (1000 m2)	Unit Price	Cost (1000 Tk)
1. Flood Protection												
a. Embankment	991.7	520	515,684	1,009.3	270	272,511	623.1	220	137,082	1636.75	340	556,495
b. Sub-embankment	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total	991.7		515,684	1,009.3		272,511	623.1		137,082	1,636.75		556,495
2. Storm Water Drainage												
a. Khal Improvement	141	520	73,320	425	270	114,750	662	220	145,640	506	340	172,040
b. Retarding Pond	1,300	520	676,000	2,650	270	715,500	-	-	-	2,920	340	992,800
Sub-Total	1,441		749,320	3,075		830,250	662		145,640	3,426		1,164,840
3. Evaciation Facilities												
a. Evacuation	-	-	-	-	-	-	9.0	220	1,980	18.0	340	6,120
b. Road Improvement	-	-	-	22.0	270	5,940	118.8	220	26,136	198.0	340	67,320
Sub-Total	-		-	22.0		5,940	127.8		28,116	216.0		73,440
4. Total			1,265,004			1,108,701			310,838			1,794,775

Table J.6(1) Summary of Project Cost

(Unit: million TK)

Project Area	G. Dhaka West			G. Dhaka East			Narayanganj DND			Narayanganj West		
	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total
I. Structural Measures												
1) Construction Cost	2,746.2	2,163.3	4,909.5	6,217.6	5,384.5	11,602.1	1,460.7	1,064.0	2,524.7	697.8	552.3	1,250.1
2) Physical Contingency	686.6	540.8	1,227.4	1,554.4	1,346.1	2,900.5	365.2	266.0	631.2	174.4	138.1	312.5
3) Land Acquisition Cost	-	3,907.2	3,907.2	-	6,285.5	6,285.5	-	4,043.8	4,043.8	-	1,267.1	1,267.1
4) Engineering Cost	274.6	216.4	491.0	621.8	538.4	1,160.2	146.1	106.4	252.5	69.8	55.2	125.0
5) Administration Cost	-	147.3	147.3	-	348.1	348.1	-	75.7	75.7	-	37.5	37.5
6) Previous/On-going Projects	-	-	(3,351.2)	-	-	(226.1)	-	-	(138.5)	-	-	-
Sub-Total	3,707.4	6,975.0	10,682.4	8,393.8	13,902.6	22,296.4	1,972.0	5,555.9	7,527.9	942.0	2,050.2	2,992.2
			(3,351.2)			(226.1)			(138.5)			
II. Non-Structural Measures												
1) Construction Cost	-	-	-	-	-	-	-	-	-	10.0	15.0	25.0
2) Physical Contingency	-	-	-	-	-	-	-	-	-	2.5	3.8	6.3
3) Land Acquisition Cost	-	-	-	-	-	-	-	-	-	-	5.7	5.7
4) Engineering Cost	-	-	-	-	-	-	-	-	-	1.0	1.5	2.5
5) Administration Cost	-	-	-	-	-	-	-	-	-	-	0.8	0.8
Sub-Total										13.5	26.8	40.3
Total	3,707.4	6,975.0	10,682.4	8,393.8	13,902.6	22,296.4	1,972.0	5,555.9	7,527.9	955.5	2,077.0	3,032.5
			(3,351.2)			(226.1)			(138.5)			

Project Area	Narayanganj East			Tongi			Savar			Keraniganj		
	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total
I. Structural Measures												
1) Construction Cost	932.0	781.8	1,713.8	1,129.4	966.0	2,095.4	644.3	755.1	1,399.4	1,659.4	1,676.6	3,336.0
2) Physical Contingency	233.0	195.5	428.5	282.4	241.5	523.9	161.1	188.8	349.9	414.9	419.1	834.0
3) Land Acquisition Cost	-	1,265.0	1,265.0	-	1,102.8	1,102.8	-	282.7	282.7	-	1,721.3	1,721.3
4) Engineering Cost	93.2	78.2	171.4	112.9	96.6	209.5	64.4	75.5	139.9	165.9	167.7	333.6
5) Administration Cost	-	51.4	51.4	-	62.9	62.9	-	42.0	42.0	-	100.1	100.1
6) Previous/On-going Projects	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total	1,258.2	2,371.9	3,630.1	1,524.7	2,469.8	3,994.5	869.8	1,344.1	2,213.9	2,240.2	4,084.8	6,325.0
II. Non-Structural Measures												
1) Construction Cost	-	-	-	20.0	30.0	50.0	148.5	202.5	351.0	261.0	351.0	612.0
2) Physical Contingency	-	-	-	5.0	7.5	12.5	37.2	50.6	87.8	65.3	87.7	153.0
3) Land Acquisition Cost	-	-	-	-	5.9	5.9	-	28.1	28.1	-	73.4	73.4
4) Engineering Cost	-	-	-	2.0	3.0	5.0	14.9	20.2	35.1	26.1	35.1	61.2
5) Administration Cost	-	-	-	-	1.5	1.5	-	10.5	10.5	-	18.4	18.4
Sub-Total				27.0	47.9	74.9	200.6	311.9	512.5	352.4	565.6	918.0
Total	1,258.2	2,371.9	3,630.1	1,551.7	2,517.7	4,069.4	1,070.4	1,656.0	2,726.4	2,592.6	4,650.4	7,243.0

Grand Total (I)			59,662.4
			(3,915.8)
Grand Total (I)+(II)			61,208.1
			(3,915.8)

Table J.6(2) Summary of Construction and Land Acquisition Costs

Unit : Million TK

Area	Facility	I. Strucrual Measure							II. Non Structual Measure			Grand Total (I+II)	Remarks (*Previous/On-going)
		A. Construction Cost			B. Land Acqisition Cost			Total	A. Construction Cost	B. Land Acqisition Cost	Total		
		Flood Mitigation	Stormwater Drainage	Total	Flood Mitigation	Stormwater Drainage	Total	(A+B)			(A+B)		
Greater Dhaka	West	1,564.6	3,344.9	4,909.5	166.5	3,740.7	3,907.2	8,816.7	-	-	-	8,816.7	*GOB Project : 2,294.2 JICA Project : 794.5 IBRD Project : 462.5 Total : 3,551.2
	East	4,138.8	7,463.3	11,602.1	1,020.3	5,265.2	6,285.5	17,887.6	-	-	-	17,887.6	JICA Project : 226.1
Narayanganj	DND	535.9	1,988.8	2524.7	30.4	4,013.4	4,043.8	6,568.5	-	-	-	6,568.5	*GOB Project : 138.5
	West	694.4	555.7	1250.1	319.7	947.4	1,267.1	2,517.2	25.0	5.7	30.7	2,547.9	
	East	1,245.8	468.0	1,713.8	515.7	749.3	1,265.0	2,978.8	-	-	-	2,978.8	
Tongi		1,086.7	1,008.7	2095.4	272.5	830.3	1,102.8	3,198.2	50.0	5.9	55.9	3,254.1	
Savar		871.7	527.7	1399.4	137.1	145.6	282.7	1,682.1	351.0	28.1	379.1	2,061.2	
Keraniganj		2,198.5	1,137.5	3336	556.5	1,164.8	1,721.3	5,057.3	612.0	73.4	685.4	5,742.7	
Total		12,336.4	16,494.6	28,831.0	3,018.7	16,856.7	19,875.4	48,706.4	1,038.0	113.1	1,151.1	49,857.5	

Note : Costs of Previous/on-going Projects in the Remarks are at 1991 price,converted from 1989 price,which includes Construction Cost, Contingency, Land Acquisition, Engineering Cost and Administration Costs.

Table J.6(3) Bill of Quantities and Construction Cost of Flood Mitigation Facilities (Structural Measure)

Unit : million TK

Facility		Embankment						Sub-Embankment			Road cum Embankment			Flood Wall					
		Rehabilitation			Construction									Rehabilitation			Construction		
Area		F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total
Greater Dhaka	West			16.7 km			6.3 km			-			-			44.7 km			3.0 km	
		271.4	294.4	565.8	142.1	167.7	309.8							14.1	14.1	28.2	40.5	40.5	81.0
	East		-				26.7 km			11.3 km			-			-			-
					1,230.0	1,523.2	2,753.2	331.4	497.0	828.4									
Narayanganj	DND		-				-			-			-			20.2 km			10.0 km	
														21.2	21.2	42.4	103.5	103.5	207.0
	West		-				6.1 km			-			4.3 km			-			10.5 km	
					68.0	102.1	170.1				43.0	64.6	107.6				59.1	72.2	131.3
	East		-				6.6 km			-			6.5 km			-			26.0 km	
					99.8	149.8	249.6				62.3	93.5	155.8				209.8	209.8	419.6
Tongi			-				13.0 km			-			6.2 km			-			2.2 km	
					303.0	362.0	665.0				21.8	32.8	54.6				12.5	12.9	25.4
Savar			-				9.3 km			-			-			-			-	
					276.7	358.6	635.3												
Keraniganj			-				23.3 km			-			-			-			3.7 km	
					702.5	994.5	1,697.0										62.4	67.5	129.9
Total				16.7 km			91.3 km			11.3 km			17.0 km			24.9 km			55.4 km	
		271.4	294.4	565.8	2,822.1	3,657.9	6,480.0	331.4	497.0	828.4	127.1	190.9	318.0	35.3	35.3	70.6	487.8	506.4	994.2

Note:

1)Previous JICA Proposal:Proposed facilities in the UPDATING STUDY ON STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY (Feb.1990)

2)Additional proposal:Proposed Facilities by this Study.

(Contd.)

Unit : million TK

Facility / Area		Sluice Gate: Previous JICA Proposal F/C	L/C	Total	Sluice Gate: Additional Proposal F/C	L/C	Total	Total (A) F/C	L/C	Total	Land Acquisition (B) L/C	Grand Total (A+B) F/C	L/C	Total
Greater Dhaka	West	5 plcs			6 plcs						37.0 ha			
		52.7	28.3	81.0	324.2	174.6	498.8	845.0	719.6	1,564.6	166.5	845.0	886.2	1,731.2
	East	-			5 plcs						317.4 ha			
					362.2	195.0	557.2	1,923.6	2,215.2	4,138.8	1,020.3	1,923.6	3,235.5	5,159.1
Narayanganj	DND	-			2 plcs						5.8 ha			
					186.2	100.3	286.5	310.9	225.0	535.9	30.4	310.9	255.4	566.3
	West	-			7 plcs						61.5 ha			
					185.5	99.9	285.4	355.6	338.8	694.4	319.7	355.6	658.5	1,014.1
	East	-			12 plcs						99.2 ha			
					273.5	147.3	420.8	645.5	600.3	1,245.8	515.7	645.5	1,116.0	1,761.5
Tongi		-			7 plcs						100.9 ha			
					222.1	119.6	341.7	559.4	527.3	1,086.7	272.5	559.4	799.8	1,359.2
Savar		-			3 plcs						62.3 ha			
					153.7	82.7	236.4	430.3	441.4	871.7	137.1	430.3	578.5	1,008.8
Keraniganj		-			10 plcs						163.7 ha			
					241.5	130.1	371.6	1,006.4	1,192.1	2,198.5	556.5	1,006.4	1,748.6	2,755.0
Total		5 plcs			52 plcs						847.8 ha			
		52.7	28.3	81.0	1,948.9	1,049.5	2,998.4	6,076.7	6,259.7	12,336.4	3,018.7	6,076.7	9,278.5	15,355.2

3): On-Going Project (JICA)

①	Sluice Gate : 1 place A=12.5m2	: 59.3
②	Contingency/Engineering Fee	: 11.9
		71.2 million TK (G.Dhaka West)

Table J.6(4) Bill of Quantities and Construction Cost of Flood Mitigation Facilities (Non-Structural Measure)

Area / Facility		Evacuation Center			Evacuation Road Improvement			Total (A)			Land Acquisition			Total (B)			Grand Total (A+B) (Structual & Non Structual)		
		F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total
Greater Dhaka	West	-			-						-								
										-						-	845.0	886.2	1,731.2
	East	-			-						-								
										-						-	1,923.6	3,235.5	5,159.1
Narayanganj	DND				-						-								
										-						-	310.9	255.4	566.3
	West	-			2.5 km						1.1 ha								
					10.0	15.0	25.0	10.0	15.0	25.0	-	5.7	5.7	10.0	20.7	30.7	355.6	679.5	1,035.1
	East	-			-						-								
										-						-	645.5	1,116.0	1,761.5
Tongi		-			5.0 km						2.2 ha								
					20.0	30.0	50.0	20.0	30.0	50.0	-	5.9	5.9	20.0	35.9	55.9	579.4	835.7	1,415.1
Savar		3 plcs			27.0 km						12.8 ha								
		40.5	40.5	81.0	108.0	162.0	270.0	148.5	202.5	351.0	-	28.1	28.1	148.5	230.6	379.1	578.8	809.1	1,387.9
Keraniganj		6 plcs			45.0 km						21.6 ha								
		81.0	81.0	162.0	180.0	270.0	450.0	261.0	351.0	612.0	-	73.4	73.4	261.0	424.4	685.4	1,267.4	2,173.0	3,440.4
Total		9 plcs			79.5 km						113.1 ha								
		121.5	121.5	243.0	318.0	477.0	795.0	439.5	598.5	1,038.0			113.1	439.5	711.6	1,151.1	6,516.2	9,990.4	16,506.6

Table J.6(5) Bill of Quantities & Cost of Stormwater Drainage Facilities

		Pump Station				Khal Improvement						Drainage Pipe				Total (A)		
		Provious JICA	Additional			Provious JICA			Additional			Provious JICA			Additional			
		-	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	F/C	L/C	Total	-	F/C	L/C	Total
Greater Dhaka	West	-	2	73.2 m3/S			16.2 km			26.5 km			8.1 km					
			1,129.8	543.5	1,673.3	228.4	261.4	489.8	321.2	367.7	688.9	221.8	271.1	492.9		1,901.2	1,443.7	3,344.9
	East	-	3	179.1 m3/S			16.4 km			56.0 km			8.9 km		-			
			2,769.4	1,357.9	4,127.3	714.5	845.6	1,560.1	624.9	739.6	1,364.5	185.2	226.2	411.4		4,294.0	3,169.3	7,463.3
Narayanganj	DND		1	50.2 m3/S						38.0 km			-		-			
			818.3	396.7	1,215.0			-	331.5	442.3	773.8					1,149.8	839.0	1,988.8
	West	-	3	16.2 m3/S						6.4 km			-		-			
			306.5	153.3	459.8			-	35.7	60.2	95.9					342.2	213.5	555.7
	East	-	4	12.5 m3/S						7.4 km			-		-			
			247.1	114.3	361.4			-	39.4	67.2	106.6					286.5	181.5	468.0
Tongi		-	2	25.2 m3/S						22.0 km			-					
			451.3	236.1	687.4			-	118.7	202.6	321.3					570.0	438.7	1,008.7
Savar		-		-						30.0 km			-		-			
								-	213.9	313.8	527.7					213.9	313.8	527.7
Keraniganj		-	1	27.7 m3/S						22.5 km			-		-			
			475.9	233.4	709.3			-	177.2	251.0	428.2					653.0	484.5	1,137.5
Total		-	16	384.1 m3/S			32.6 km			208.8 km			17.0 km		-			
			6,198.3	3,035.2	9,233.5	942.9	1,107.0	1,758.1	1,862.5	2,444.4	4,306.9	407.0	497.3	904.3		9,410.6	7,084.0	16,494.6

Note:

On-Going Project [JICA]

①	Pump Station	20 m3/S :	528.7	(G. Dhaka West : 528.7, G. Dhaka East : -)
②	Khal Improvement	3.8 km :	204.1	(" : 25.0, " : 179.1)
	Sub		732.8	(" : 553.7, " : 179.1)
③	Contingency/Engineering Fee	:	146.6	(" : 110.8, " : 35.8)
④	Land Acquisition 4.4 ha	:	70.0	(" : 58.8, " : 11.2)
	Total (million TK)	:	949.4	(" : 723.3, " : 226.1)

(Contd.)

		Land Acqisition			Land Acqisition Total (B)	Grand Total (A+B)		
		Retarding pond	Khal					
			JICA	Additional				
		L/C	L/C	L/C	L/C	F/C	L/C	Total
Greater Dhaka	West	770.0 ha	7.6 ha	36.1 ha	813.7 ha			
		3,465.0	113.2	162.5	3,740.7	1,901.2	5,184.4	7,085.6
	East	1884.0 ha	6.2 ha	161.8 ha	2,052.0 ha			
		4,710.0	150.7	404.5	5,265.2	4,294.0	8,434.5	12,728.5
Narayanganj	DND	681.0 ha	-	90.8 ha	771.8 ha			
		3,541.2		472.2	4,013.4	1,149.8	4,852.4	6,002.2
	West	170.0 ha	-	12.2 ha	182.2 ha			
		884.0		63.4	947.4	342.2	1,160.9	1,503.1
	East	130.0 ha	-	14.1 ha	144.1 ha			
		676.0		73.3	749.3	286.5	930.8	1,217.3
Tongi		265.0 ha	-	42.5 ha	307.5 ha			
		715.5		114.8 ha	830.3	570.0	1,269.0	1,839.0
Savar		-	-	66.2 ha	66.2 ha			
				145.6	145.6	213.9	459.4	673.3
Keraniganj		292.0 ha	-	50.6 ha	342.6 ha			
		992.8		172.0	1,164.8	653.0	1,649.3	2,302.3
Total		4192.0 ha	13.8 ha	474.3 ha	4680.1 ha			
		14,984.5	263.9	1,608.3	16,856.7	9,410.6	23,940.7	33,351.3

Table J.7(1) Breakdown of Project Cost (Greater Dhaka West)

Unit: 1,000 Tk

Item	Unit	Unit Price			Quantity	Construction Cost (Tk)		
		Total	F/C (%)	L/C (%)		F/C	L/C	Total
A. Construction Cost								
I. Flood Protection								
1. Rehabilitation -Embankment(R)								
a. Banking	m^3	0.53	40	60	784,000	166,208	249,312	415,520
b. Foundation	m	0.626	70	30	240,000	105,168	45,072	150,240
Sub-total						271,376	294,384	565,760
-Flood wall(R)	m	6.0	50	50	4,700	14,100	14,100	28,200
2. Embankment								
a. Banking	m^3	0.53	40	60	470,000	99,640	149,460	249,100
b. Foundation	m	0.626	70	30	97,000	42,505	18,217	60,722
Sub-total						142,145	167,677	309,822
3. Flood wall	m	27.0	50	50	3,000	40,500	40,500	81,000
4. Sluice Way								
a. Previous JICA Proposal								
Gate 10.2 m^2	set	21,571	65	35	1	14,021	7,550	21,571
" 4.8 "	"	52,470	65	35	3	34,106	18,364	52,470
" 6.3 "	"	6,996	65	35	1	4,547	2,449	6,996
b. Addtional Proposal	"							
Gate 6.9 m^2	"	24,400	65	35	1	15,860	8,540	24,400
" 28.6 "	"	109,800	65	35	1	71,370	38,430	109,800
" 16.0 "	"	70,400	65	35	1	45,760	24,640	70,400
" 51.0 "	"	163,200	65	35	1	106,080	57,120	163,200
" 11.3 "	"	53,100	65	35	1	34,515	18,585	53,100
" 18.1 "	"	77,900	65	35	1	50,635	27,265	77,900
Sub-total						376,894	202,943	579,837
Total of I						845,015	719,604	1,564,619
II. Storm Water Drainage								
1. Pump Station P - 65.2 m^3/s								
a. Construction	L.S.	710,700	50	50	1	355,350	355,300	710,700
b. Equipment	L.S.	736,800	85	15	1	626,280	110,520	736,800
Sub-total						981,630	465,870	1,447,500
P -8.0 m3/s								
a. Construction	L.S	125,000	50	50	1	62,500	62,500	125,000
b. Equipment	L.S	100,800	85	15	1	85,680	15,120	100,800
Sub-total						148,180	77,620	225,800
Total of 1						1,129,810	543,490	1,673,300
2. Khal Improvement								
a. Previous JICA Proposal	Km		46.6	53.4	16.2	228,420	261,417	489,837
b. Addtional Proposal	Km		46.6	53.4	26.5	321,200	367,700	688,900
Sub-total						549,620	629,117	1,178,737
3. Drainage pipe								
a. Previous JICA Proposal	Km		45.0	55.0	8.1	221,773	271,095	492,868
Total of II						1,901,203	1,443,702	3,344,905
Total of A						2,746,218	2,163,306	4,909,524

Item	Unit	Unit Price			Quantity	Construction Cost (Tk)		
		Total	F/C (%)	L/C (%)		F/C	L/C	Total
B Land Acquisition Cost								
1. Flood Protection	m^2	0.45	---	100	370,000	---	166,500	166,500
2. Storm Water Drainage								
a. Previous JICA Proposal	m^2	1.49	---	100	76,000	---	113,240	113,240
b. Addtional Proposal	m^2	0.45	---	100	8,061,000	---	3,627,450	3,627,450
Sub-total							3,740,690	3,740,690
Total of B							3,907,190	3,907,190
C Previous/On-going Project								
1. GOB Project								2,294,152
2 JICA Project								794,500
3. IBRD Project								462,504
Total of C								3,551,156

NOTE:
1) Previous JICA Proposal :Proposed facilities in the UPDATING STUDY ON STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY (FEB.1990)
2) additional Proposal :Proposed facilities in this Study
3) Costs of Previous JICA Proposal are converted to 1991 price from 1989 price
4) Costs of Previous/On-going Projects are at 1991 price,converted from 1989 price,which include Construction cost, Physical contingency,Land acquisition cost,Engneering cost,and Administration cost.

Table J.7(2) Breakdown of Project Cost (Greater Dhaka East)

Unit: 1,000 Tk

Item	Unit	Unit Price			Quantity	Construction Cost (Tk)		
		Total	F/C (%)	L/C (%)		F/C	L/C	Total
A. Construction Cost								
I. Flood Protection								
1. Embankment								
a. Banking	m^3	0.53	40	60	4,385,000	929,620	1,394,430	2,324,050
b. Foundation	m	0.626	70	30	613,080	300,409	128,747	429,156
Sub-total						1,230,029	1,523,177	2,753,206
2. Sub-Embankment								
Banking	m^3	0.53	40	60	1,563,100	331,377	497,066	828,443
3. Sluice Way								
Gate 79.7 m^2	set	233,700	65	35	1	151,905	81,795	233,700
" 45.8 "	"	111,800	65	35	1	72,670	39,130	111,800
" 49.2 "	"	116,800	65	35	1	75,920	40,880	116,800
" 14.7 "	"	67,000	65	35	1	43,550	23,450	67,000
" 10.1 "	"	27,900	65	35	1	18,135	9,765	27,900
Sub-total						362,180	195,020	557,200
Total of I						1,923,586	2,215,263	4,138,849
II. Storm Water Drainage								
1. Pump Station								
P - 103.5m^3/s								
a. Construction	L.S.	1,189,100	50	50	1	594,550	594,550	1,189,100
b. Equipment	L.S.	1,085,700	85	15	1	922,845	162,855	1,085,700
Sub-total						1,517,395	757,405	2,274,800
P - 35.0 m^3/s								
a. Construction	L.S.	439,700	50	50	1	219,850	219,850	439,700
b. Equipment	L.S.	432,800	85	15	1	367,880	64,920	432,800
Sub-total						587,730	284,770	872,500
P - 40.6 m^3/s								
a. Construction	L.S.	482,000	50	50	1	241,000	241,000	482,000
b. Equipment	L.S.	498,000	85	15	1	423,300	74,700	498,000
Sub-total						664,300	315,700	980,000
Total of 1.						2,769,425	1,357,875	4,127,300
2. Khal Improvement								
a. Previous JICA Proposal	km	—	45.8	45.2	16.4	714,525	845,583	1,560,108
b. Additional Proposal	km	—	45.8	45.2	56.0	624,900	739,600	1,364,500
Sub-total						1,339,425	1,585,183	2,924,608
3. Drainage pipe								
a. Previous JICA Proposal	km		45.0	55.0	8.9	185,161	226,204	411,365
Total of II						4,294,011	3,169,262	7,463,273
Total of A						6,217,597	5,384,525	11,602,122

Item	Unit	Unit Price			Quantity	Construction Cost (Tk)		
		Total	F/C (%)	L/C (%)		F/C	L/C	Total
B. Land Acquisition Cost								
1. Flood Protection								
a. Embankment	m^3	0.35	---	100	2,269,500	—	794,325	794,325
b. Sub-Emb.	m^3	0.25	---	100	904,000	—	226,000	226,000
Sub-total	m^3				3,173,500	—	1,020,325	1,020,325
2. Storm Water Drainage								
a. Previous JICA Proposal	m^2	2.43	---	100	62,000	—	150,660	150,660
b. Additional Proposal	m^2	0.25	---	100	20,458,000	—	5,114,500	5,114,500
Sub-total						—	5,265,160	5,265,160
Total of B						—	6,285,485	6,285,485
C. Previous / On-going Project								
1. JICA Project								226,087
Total of C								226,087

NOTE:
1) Previous JICA Proposal :Proposed facilities in the UPDATING STUDY ON STORM WATER DRAINAGE SYSTEM IMPROVEMENT PROJECT IN DHAKA CITY(FEB.1990)
2) Additional Proposal :Proposed facilities in this Study
3) Costs of Previous JICA Proposal are converted to 1991 price from 1989 price
4) Costs of Previous/On-going Projects are at 1991 price,converted from 1989 price,which include Construction cost, Physical contingency,Land acquisition cost,Engneering cost,and Administration cost.

Table J.7(3) Breakdown of Project Cost (Narayanganj DND)

Unit: 1,000 Tk

Item	Unit	Unit Price			Quantity	Construction Cost		
		Total	F/C (%)	L/C (%)		F/C	L/C	Total
A. Construction Cost								
I. Flood Protection								
1. Rehabilitation a. Flood Wall (R)	m	2.10	50	50	20,200	21,200	21,200	42,400
2. Flood Wall T-type	m	20.70	50	50	10,000	103,500	103,500	207,000
3. Sluice Way								
Gate - 42.2 m^2	set	141,500	65	35	1	91,975	49,525	141,500
" - 45.3 "	"	145,000	65	35	1	94,250	50,750	145,000
Sub-total						186,225	100,275	286,500
Total of I						310,925	224,975	535,900
II. Storm Water Drainage								
1. Pump Station P - 50.2 m^3/s								
a. Construction	L.S	612,600	50	50	1	306,300	306,300	612,600
b. Equipment	L.S	602,400	85	15	1	512,040	90,360	602,400
Sub-total						818,340	396,660	1,215,000
2. Khal Improvement	km	20,363	43	57	38.0	331,496	442,305	773,801
Total of II						1,149,836	838,965	1,988,801
Total of A						1,460,761	1,063,940	2,524,701
B. Land Acquisition Cost								
1. Flood Protection	m^2	0.52	—	100	58,400	—	30,368	30,368
2. Storm Water Drainage	m^2	0.52	—	100	7,718,000	—	4,013,360	4,013,360
Total of B						—	4,043,728	4,043,728
C. Previous/On-going Project								
1.GOB Project	—		—	—	—	—	138,521	138,521
Total of C						—	138,521	138,521

NOTE:
1) Costs of Previous/On-going Projects are at 1991 price,converted from 1989 price,which include Construction cost, Physical contingency,Land acquisition cost,Engneering cost,and Administration cost.

Table J.7(4) Breakdown of Project Cost (Narayanganj West)

Unit: 1,000 Tk

Item	Unit	Unit Price			Quantity	Construction Cost (Tk)		
		Total	F/C (%)	L/C (%)		F/C	L/C	Total
A. Construction Cost								
I. Flood Protection								
1. Embankment Banking	m^3	0.53	40	60	321,000	68,052	102,078	170,130
2. Road-Cum-Emb. Banking	m^3	0.53	40	60	203,000	43,036	64,554	107,590
3. Flood Wall I-Type	m	12.50	45	55	10,500	59,062	72,188	131,250
4. Sluice Way								
Gate 8.9 m^2	set	43,200	65	35	1	28,080	15,120	43,200
" 11.0 "	"	52,500	65	35	1	34,125	18,375	52,500
" 3.6 "	"	18,600	65	35	1	12,090	6,510	18,600
" 8.2 "	"	39,900	65	35	1	25,935	13,965	39,900
" 4.4 "	"	22,100	65	35	1	14,365	7,735	22,100
" 15.2 "	"	68,600	65	35	1	44,590	24,010	68,600
" 8.3 "	"	40,500	65	35	1	26,325	14,175	40,500
Sub-total						185,510	99,890	285,400
Total of I						355,660	338,710	694,370
II. Storm Water Drainage								
1. Pump Station								
P-1: 7.1 m^3/s								
a. Civil Work	L.S.	110,000	50	50	1	55,000	55,000	110,000
b. Equipment	L.S.	89,000	85	15	1	75,650	13,350	89,000
Sub-total						130,650	68,350	199,000
P-2: 2.8 m^3/s								
a. Civil Work	L.S.	38,800	50	50	1	19,400	19,400	38,800
b. Equipment	L.S.	42,400	85	15	1	36,040	6,360	42,400
Sub-total						55,440	25,760	81,200
P-3: 6.3 m^3/s								
a. Civil Work	L.S.	92,200	50	50	1	46,100	46,100	92,200
b. Equipment	L.S.	87,400	85	15	1	74,290	13,110	87,400
Sub-total						120,390	59,210	179,600
Total of 1.						306,480	153,320	459,800
2. Khal Improvement	km	14,983	37	63	6.4	35,697	60,194	95,891
Total of II.						342,177	213,514	555,691
Total of A						697,837	552,224	1,250,061

Item	Unit	Unit Price			Quantity	Construction Cost (Tk)		
		Total	F/C (%)	L/C (%)		F/C	L/C	Total
B. Land Acquisition Cost								
1. Flood Protection	m^2	0.52	—	100	614,800	—	319,696	319,696
2. Storm Water Drainage	m^2	0.52	—	100	1,822,000	—	947,440	947,440
Total of B						—	1,267,136	1,267,136
C. Evacuation Facilities								
C.1 Construction Cost								
1. Road Improvement	km	10,000	40	60	2.5	10,000	15,000	25,000
C.2 Land Acquisition Cost	m^2	0.52	—	100	11,000	—	5,720	5,720
Total of C						10,000	20,720	30,720

Table J.7(5) Breakdown of Project Cost (Narayanganj East)

Unit: 1,000 Tk

Item	Unit	Unit Price			Quantity	Construction Cost (Tk)		
		Total	F/C (%)	L/C (%)		F/C	L/C	Total
A. Construction Cost								
I. Flood Protection								
1. Embankment Banking	m^3	0.53	40	60	471,000	99,852	149,778	249,630
2. Road-Cum-Emb. Banking	m^3	0.53	40	60	294,000	62,328	93,492	155,820
3. Flood Wall								
T-Type	m	24.40	50	50	14,000	170,800	170,800	341,600
I-Type	"	6.50	50	50	12,000	39,000	39,000	78,000
Sub-total						209,800	209,800	419,600
4. Sluice Way								
Gate 4.1 m^2	set	20,700	65	35	2	26,910	14,490	41,400
" 2.6 "	"	13,700	65	35	2	17,810	9,590	27,400
" 10.4 "	"	49,500	65	35	2	64,350	34,650	99,000
" 8.0 "	"	39,200	65	35	2	50,960	27,440	78,400
" 6.9 "	"	33,900	65	35	2	44,070	23,730	67,800
" 11.3 "	"	53,400	65	35	2	69,420	37,380	106,800
Sub-total						273,520	147,280	420,800
Total of I						645,500	600,350	1,245,850
II. Storm Water Drainage								
1. Pump Station								
P - 1.2 m^3/s								
a. Construction	L.S.	17,200	50	50	1	8,600	8,600	17,200
b. Equipment	L.S.	18,200	85	15	1	15,470	2,730	18,200
Sub-total						24,070	11,330	35,400
P - 2.7 m^3/s								
a. Construction	L.S.	37,400	50	50	1	18,700	18,700	37,400
b. Equipment	L.S.	40,900	85	15	1	34,765	6,135	40,900
Sub-total						53,465	24,835	78,300
P - 4.4 m^3/s								
a. Construction	L.S.	60,120	50	50	1	30,060	30,060	60,120
b. Equipment	L.S.	66,600	85	15	1	56,610	9,990	66,600
Sub-total						86,670	40,050	126,720
P - 4.2 m^3/s								
a. Construction	L.S.	57,000	50	50	1	28,500	28,500	57,000
b. Equipment	L.S.	64,000	85	15	1	54,400	9,600	64,000
Sub-total						82,900	38,100	121,000
Total of 1.						247,105	114,315	361,420
2. Khal Improvement	km	14,409	37	63	7.4	39,435	67,189	106,624
Total of II						286,540	181,504	468,044
Total of A						932,040	781,854	1,713,894

Item	Unit	Unit Price			Quantity	Construction Cost (Tk)		
		Total	F/C (%)	L/C (%)		F/C	L/C	Total
B. Land Acquisition Cost								
1. Flood Protection	m^2	0.52	—	100	991,700	—	515,684	515,684
2. Storm Water Drainage	m^2	0.52	—	100	1,441,000	—	749,320	749,320
Total of B						—	1,265,004	1,265,004

NOTE:
1) Road-Cum-Emb.: Road-Cum-Embankment

Table J.7(6) Breakdown of Project Cost (Tongi)

Unit: 1,000 Tk

Item	Unit	Unit Price			Quantity	Construction Cost (Tk)		
		Total	F/C (%)	L/C (%)		F/C	L/C	Total
A. Construction Cost								
I. Flood Protection								
1. Embankment								
a. Banking	m^3	0.53	40	60	1,022,000	216,664	324,996	541,660
b. Foundation	m	0.626	70	30	197,000	86,325	36,997	123,322
Sub-total						302,989	361,993	664,982
2. Road-Cum-Emb. Banking	m^3	0.53	40	60	103,000	21,836	32,754	54,590
3. Flood Wall								
I-Type	m	3.90	45	55	1,200	2,106	2,574	4,680
T-Type	m	20.70	50	50	1,000	10,350	10,350	20,700
Sub-total						12,456	12,924	25,380
4. Sluice Way								
Gate 15.6 m^2	set	68,600	65	35	1	44,590	24,010	68,600
" 13.5 "	"	62,100	65	35	1	40,365	21,735	62,100
" 12.3 "	"	57,400	65	35	1	37,310	20,090	57,400
" 14.0 "	"	64,200	65	35	1	41,730	22,470	64,200
" 9.2 "	"	44,000	65	35	1	28,600	15,400	44,000
" 5.4 "	"	28,000	65	35	1	18,200	9,800	28,000
" 3.4 "	"	17,400	65	35	1	11,310	6,090	17,400
Sub-total						222,105	119,595	341,700
Total of I						559,386	527,266	1,086,652
II. Storm Water Drainage								
1. Pump Station								
P - 13.5 m^3/s								
a. Construction	L.S.	195,000	50	50	1	97,500	97,500	195,000
b. Equipment	L.S.	169,500	85	15	1	144,075	25,425	169,500
Sub-total						241,575	122,925	364,500
P - 11.7 m^3/s								
a. Construction	L.S.	185,000	50	50	1	92,500	92,500	185,000
b. Equipment	L.S.	137,900	85	15	1	117,215	20,685	137,900
Sub-total						209,715	113,185	322,900
Total of 1.						451,290	236,110	687,400
2. Khal Improvement	km	14,606	37	63	22.0	118,681	202,640	321,321
Total of II						569,971	438,750	1,008,721
Total of A						1,129,357	966,016	2,095,373

Item	Unit	Unit Price			Quantity	Construction Cost (Tk)		
		Total	F/C (%)	L/C (%)		F/C	L/C	Total
B. Land Acquisition Cost								
1. Flood Protection	m^2	0.27	—	100	1,009,300	—	272,511	272,511
2. Storm Water Drainage	m^2	0.27	—	100	3,075,000	—	830,250	830,250
Total of B						—	1,102,761	1,102,761
C. Evacuation Facilities								
C.1 Construction Cost								
1. Road Improvement	km	10,000	40	60	5.0	20,000	30,000	50,000
C.2 Land Acquisition Cost	m^2	0.27	---	100	22,000	---	5,940	5,940
Total of C						20,000	35,940	55,940

Table J.7.(7) Breakdown of Project Cost (Savar)

Unit: 1,000 Tk

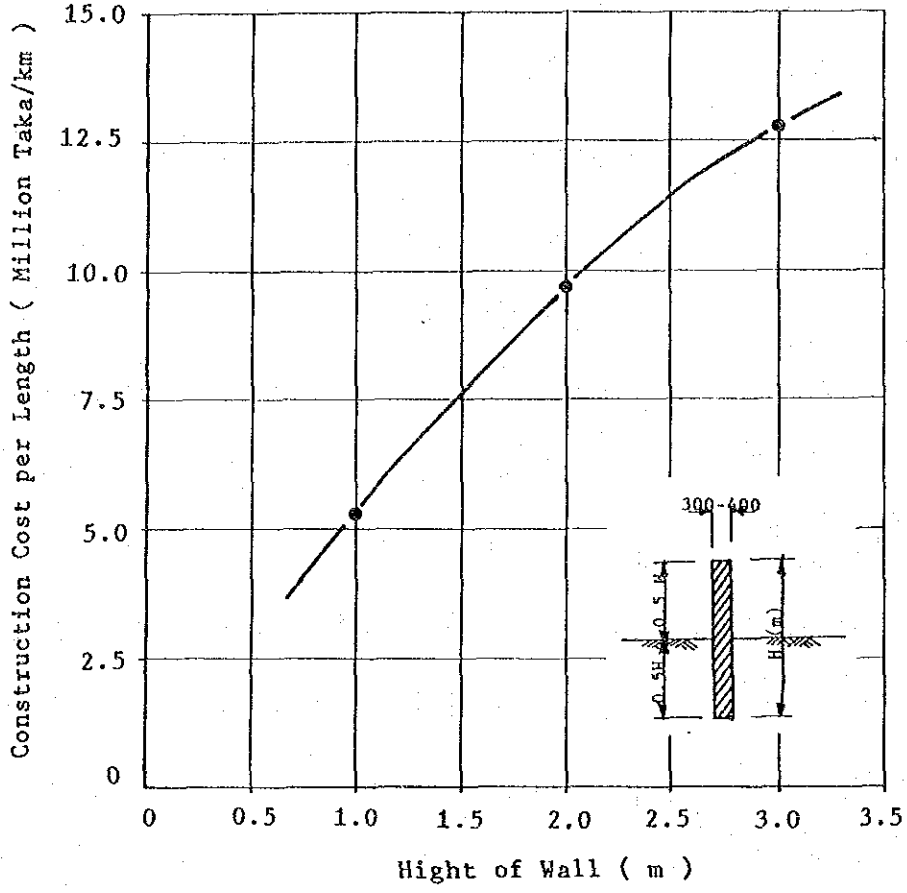
Item	Unit	Total	Unit Price F/C (%)	Unit Price L/C (%)	Quantity	Construction Cost (Tk) F/C	Construction Cost (Tk) L/C	Construction Cost (Tk) Total
A. Construction Cost								
I. Food Protection								
1. Embankment								
a. Banking	km	1	40	60	1,057,000	224,084	336,126	560,210
b. Foundation	m	1	70	30	120,000	52,584	22,536	75,120
Sub-Total						276,668	358,662	635,330
2. Sluice Way								
Gate 16.4 m2	set	72,700	65	35	1	47,255	25,445	72,700
" 9.4 "	"	45,500	65	35	1	29,575	15,925	45,500
" 31.5 "	"	118,200	65	35	1	76,830	41,370	118,200
Sub-Total						153,660	82,740	236,400
Total of I						430,328	441,402	871,730
II. Storm Water Drainage								
1. Khal Improvemet	km	17,590	41	59	30.0	213,945	313,753	527,698
Total of II						213,945	313,753	527,698
Total of A						644,273	755,155	1,399,428
B. Land Acquisition Cost								
1. Flood Protection	m2	0.22	—	100	623,100	—	137,082	137,082
2. Storm Water Drainage	m2	0.22	—	100	662,000	—	145,640	145,640
Total of B								282,722
C. Evacuation Facilities								
C.1 Construction Cost								
1. Evacuation Center	No.	27,000	50	50	3	40,500	40,500	81,000
2. Road Improvement	Km	10,000	40	60	27.0	108,000	162,000	270,000
Sub-total						148,500	202,500	351,000
C.2 Land Acquisition Cost								
1. Evacuation Center	m2	0.22	—	100	9,000	—	1,980	1,980
2. Road Improvement	m2	0.22	—	100	118,800	—	26,136	26,136
Sub-total						—	28,116	28,116
Total of C						148,500	230,616	379,116

Table J.7(8) Breakdown of Project Cost (Keraniganj)

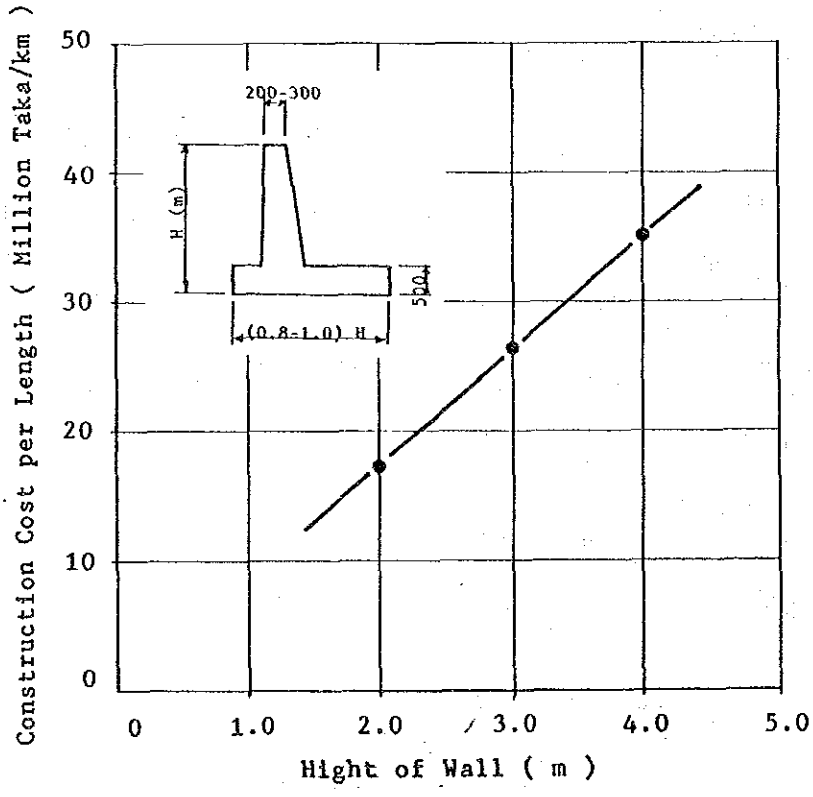
Unit: 1,000 Tk

Item	Unit	Unit Price			Quantity	Construction Cost (Tk)		
		Total	F/C (%)	L/C (%)		F/C	L/C	Total
A. Construction Cost								
I. Flood Protection								
1. Embankment								
a. Banking	m^3	0.53	40	60	3,053,000	647,236	970,854	1,618,090
b. Foundation	m	0.626	70	30	126,000	55,213	23,663	78,876
Sub-total						702,449	994,517	1,696,966
2. Flood Wall								
T-Type	m	35.11	48	52	3,700	62,355	67,552	129,907
3. Sluice Way								
Gate 7.6 m^2	set	37,100	65	35	1	24,115	12,985	37,100
" 8.9 "	"	43,500	65	35	1	28,275	15,225	43,500
" 12.6 "	"	58,300	65	35	1	37,895	20,405	58,300
" 12.4 "	"	57,600	65	35	1	37,440	20,160	57,600
" 24.7 "	"	100,100	65	35	1	65,065	35,035	100,100
" 1.0 "	"	15,000	65	35	5	48,750	26,250	75,000
Sub-total						241,540	130,060	371,600
Total of I						1,006,374	1,192,099	2,198,473
II. Storm Water Drainage								
1. Pump Station								
P - 27.7 m^3/s								
a. Construction	L.S.	363,000	50	50	1	181,500	181,500	363,000
b. Equipment	L.S.	346,300	85	15	1	294,355	51,945	346,300
Sub-total						475,855	233,445	709,300
2. Khal Improvement	km	19,032	41	59	22.5	177,168	251,047	428,215
Total of II						653,023	484,492	1,137,515
Total of A						1,659,397	1,676,591	3,335,988
B. Land Acquisition Cost								
1. Flood Protection	m^2	0.34	—	100	1,636,750	—	556,495	556,495
2. Storm Water Drainage	m^2	0.34	—	100	3,426,000	—	1,164,840	1,164,840
Total of B						—	1,721,335	1,721,335

Item	Unit	Unit Price			Quantity	Construction Cost (Tk)		
		Total	F/C (%)	L/C (%)		F/C	L/C	Total
C. Evacuation Facilities								
C.1 Construction Cost								
1. Evacuation Center	No.	27,000	50	50	6	81,000	81,000	162,000
2. Road Improvement	km	10,000	40	60	45.0	180,000	270,000	450,000
Sub-total						261,000	351,000	612,000
C.2 Land Acquisition Cost								
1. Evacuation Center	m^2	0.34	—	100	18,000	—	6,120	6,120
2. Road Improvement	m^2	0.34	—	100	198,000	—	67,320	67,320
Sub-total						—	73,440	73,440
Total of C						26,100	424,440	685,440

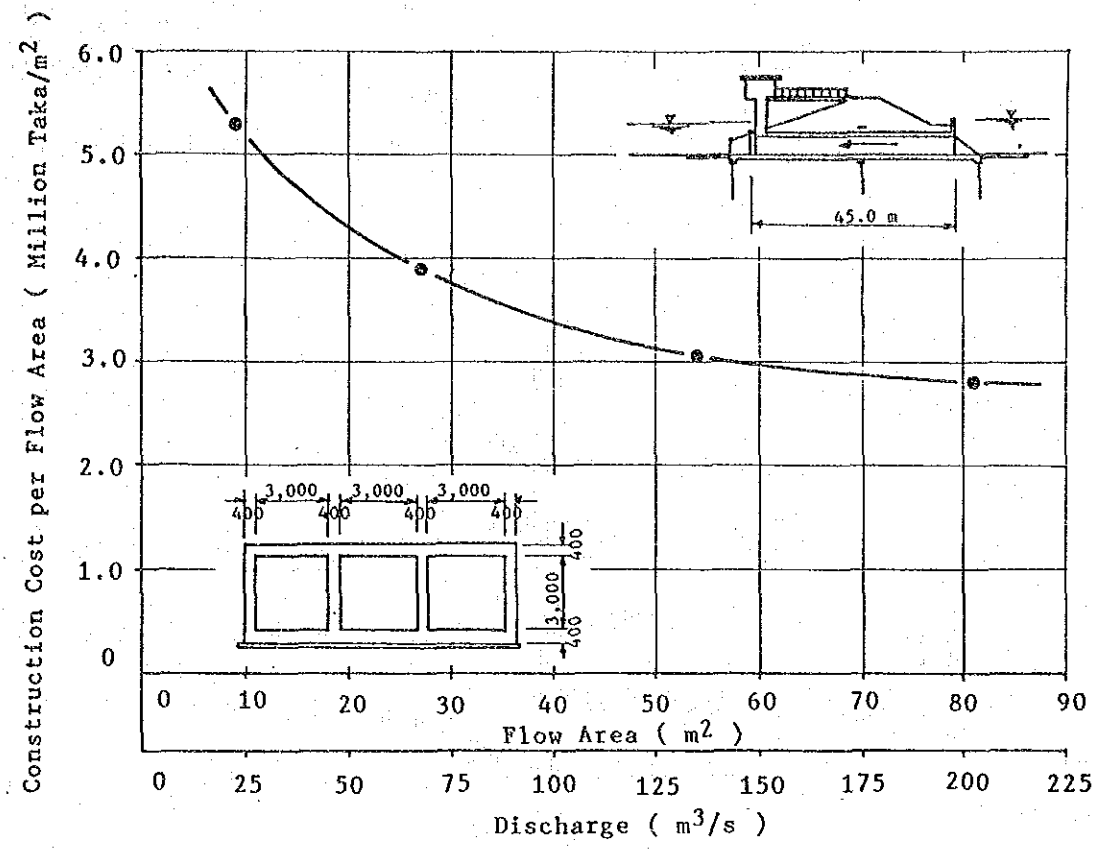


CONCRETE FLOOD WALL (I-TYPE)

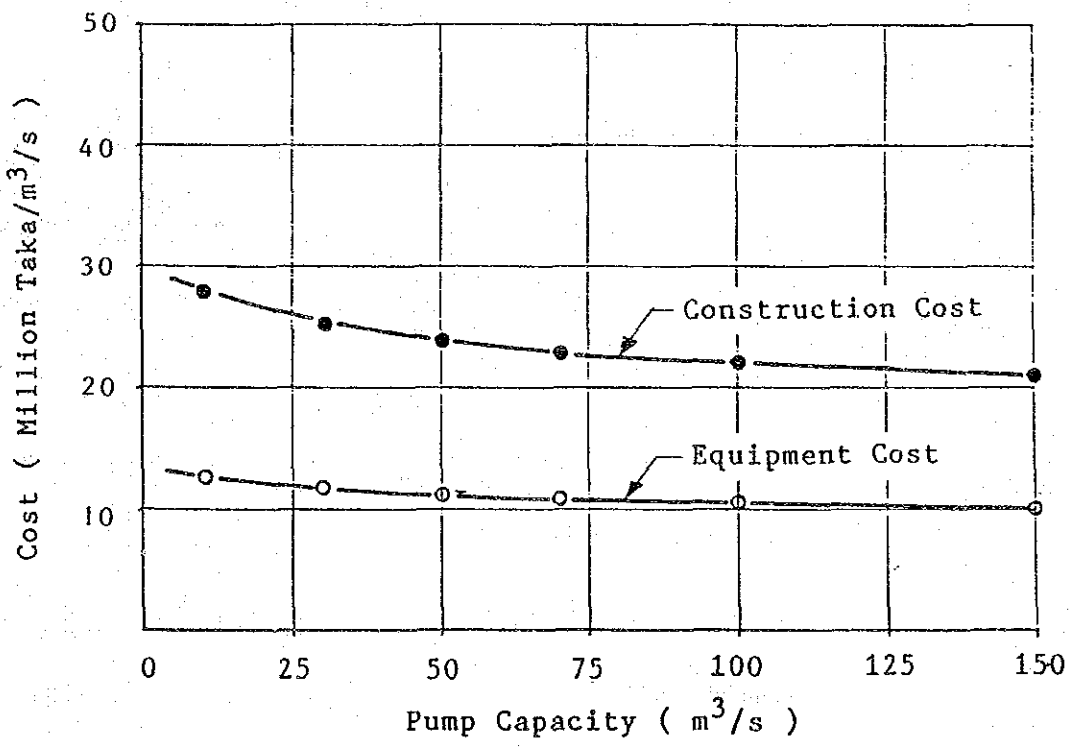


CONCRETE FLOOD WALL (T-TYPE)

FIG. J-1 | UNIT CONSTRUCTION COST DIAGRAM OF CONCRETE FLOOD WALL



SLUICE GATE



PUMPING STATION

FIG. J-2 UNIT CONSTRUCTION COST DIAGRAM OF SLUICE GATE AND PUMPING STATION