

SUPPORTING REPORT (1)

ANNEX 10 : CONSTRUCTION PLAN AND COST ESTIMATE

**THE STUDY ON STORM WATER DRAINAGE PLAN
FOR THE COLOMBO METROPOLITAN REGION
IN
THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA**

FINAL REPORT

VOLUME III : SUPPORTING REPORT (1)

ANNEX 10 : CONSTRUCTION PLAN AND COST ESTIMATE

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CHAPTER 1 CONSTRUCTION PLAN

1.1 Basic Conditions for Construction Planning

1.1.1 Natural Conditions

(1) Location

The study area is a principal part of the Colombo Metropolitan Region as shown in Figure 1.1.1. It extends approximately between lat. 6° 36' N and 7° 10' N and between long. 79° 50' E and 80° 05' E.

(2) Climate

The study area is located in the southwestern quarter of the country, which is classified as a Wet Zone. The records of mean monthly rainfall and number of rainy days (more than 10mm/day) of the meteorological stations of each basin for the last 30 years of are summarized below. The average annual rainfall and annual rainy days of the study area are 2,280 mm and 68 days, respectively. There are two rainy seasons of April-May and October-November.

Mean Monthly Rainfall

(Unit: mm)

Basin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Ja Ela	51	67	112	234	298	165	94	91	211	339	326	121	2,108
Kalu Oya	56	54	93	239	356	209	130	108	262	369	293	148	2,316
Greater Colombo	60	64	109	236	353	212	121	103	236	343	322	145	2,303
Bolgoda	62	70	117	264	336	203	129	110	253	348	335	169	2,397
Average	57	64	108	243	336	197	119	103	240	349	319	146	2,281

Number of Rainy Days (more than 10mm/day)

(Unit: day)

Basin	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Ja Ela	2	3	3	9	7	4	3	5	6	8	8	5	64
Kalu Oya	2	2	2	7	7	7	5	6	8	9	7	6	68
Greater Colombo	3	3	2	6	8	8	4	5	7	10	6	6	68
Bolgoda	4	3	2	8	8	6	5	5	8	8	7	7	71
Average	3	3	2	8	8	6	4	5	7	9	7	6	68

Meteorological Station:

Ja Ela Basin: Katunayake

Kalu Oya Basin: Angoda

Greater Colombo Basin: Colombo

Bolgoda Basin: Ratmalana

(3) General Topography

The study area consists of marsh, lowlands and hilly areas. The marshes lie in the downstream end of the study area and have an elevation of 0 m to 2 m above MSL. The lowlands extend along the river course and have an elevation of 2 m to 5 m above MSL. On the other hand, the hilly areas are located at an elevation of more than 10 m above MSL. The ground in the marshes and lowlands is too soft to permit heavy vehicular traffic.

1.1.2 General Working Conditions

(1) Workable days

The annual net workable days for construction work are determined based on the above-mentioned rainfall records, number of national holidays in Sri Lanka, and the following criteria.

- 1) Work is suspended on Sunday and national holidays.
- 2) Work is suspended by rainfall as follows:
 - 10 mm - 20 mm/day : 0.5 days
 - More than 20 mm/day : 1 day

The workable days are calculated as follows:

Workable Days

(Unit: days)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
23	21	23	17	18	21	23	23	22	20	18	22	21

(2) Access to the sites

1) Ja Ela Basin

Major access from the center of Colombo City to the Ja Ela basin is via Negombo Road. Some of the access routes from Negombo Road to each construction site do not have sufficient width (less than 6 m) and their pavement conditions are not sufficient for heavy vehicles.

2) Kalu Oya Basin

Major access from the center of Colombo City to the Kalu Oya basin is also via Negombo Road. The access from Negombo Road to each construction site is also via municipal roads. Some of the bridges over the Old Negombo Canal, which are to be replaced, do not have enough width for heavy vehicles.

3) Greater Colombo Basin

Since most of the construction sites are located in the urbanized area, there is no difficulty of access to the construction sites, except for the access to the outlet of the existing Mutwal tunnel and the proposed new Mutwal tunnel.

4) Bolgoda Basin

Major accesses from the center of Colombo City are Baseline Road, Horana Road and High Level Road. Some of the access routes from those main roads to each construction site do not have sufficient width (less than 6 m) and their pavement conditions are not sufficient for heavy vehicles.

1.1.3 Site Conditions of Each Basin

Site conditions such as existence of obstacles for the construction works, traffic condition of the roads of each basin, etc. are explained hereunder.

(1) Ja Ela Bain

The proposed construction sites are situated in the rural areas and house relocation for construction works will be not difficult because of sufficient open spaces. There are many trees along the rivers that will hinder the construction works to some extent. Traffic density on Negombo Road is very high in the daytime.

(2) Kalu Oya Basin

The proposed construction site along Old Negombo Canal at the downstream end is partly located near the residential area. There are many trees on both sides of the canal that will hinder the construction works. Traffic density on Negombo Road is very high in the daytime.

(3) Greater Colombo Basin

The proposed construction sites of the Maradadua pumping station and North Lock pumping station are located in the center of Colombo City. It is necessary to take measures for traffic control and protection of existing facilities.

The proposed construction site of Gotatuwa pumping station has enough open space for construction works. However, there exist a number of houses along the proposed outlet channel from Gotatuwa pumping station to Kelani River.

The proposed construction site of the Madiwela South diversion canal is mostly located in the rural area. However, the planned crossing site of the diversion canal and High Level Road is located in the urbanized area and a number of houses and buildings exist there. The traffic density on High Level Road is very high in the daytime.

The inlet and outlet of the existing Mutwal tunnel and the proposed new Mutwal tunnel are occupied by a number of houses. The sites along the Wellawatta and Kirillapone canal are also occupied by a number of houses. It will be necessary to take measures for relocation and reinforcement of a number of existing facilities for the construction works.

(4) Bolgoda Basin

The proposed construction sites along Weras Ganga and tributaries are mostly located in lowlands that cannot support heavy vehicular traffic. It is necessary to construct a temporary access road to the area for disposal of dredged material.

1.1.4 Availability of Construction Resources

(1) Labor

There are many contractors in the CMC area that can supply all fields of skilled workers and common workers. Labor force can be procured through such local contractors.

(2) Construction Material

1) Earth material for embankment/back filling

Earth material for embankment and back filling is usually required to be transported from borrow pits in the hilly areas located in the eastern part of the study area. The hauling distances are about 10 km.

2) Rubble stone and crushed stone for aggregate

These materials are usually purchased from local stone suppliers. The quarry sites for rock material are also located in the eastern part of the study area.

3) Sand

River sand of the Kelani River, the Kalu Ganga and their tributaries can be used for construction. They are usually purchased from local sand suppliers.

4) Cement

Cement is produced in the local factories at Puttalam, Galle and Trincomalee and is readily available through private traders in Colombo District. Imported cement is also available in the local market.

5) Ready Mixed Concrete

There are seven major suppliers of ready mixed concrete such as International Construction Consortium LTD., in the Colombo Metropolitan Region. Ready mixed concrete can be delivered within one hour from those suppliers. Each supplier has a concrete plant with a production capacity of 30 to 70 m³/hour, 15 to 30 agitator trucks of 5 ton class and 2 to 4 concrete pump cars.

6) Concrete Products

Reinforced concrete products are available ready-made or made-to-order. Pre-cast concrete pipes less than 1,500 mm in diameter are available from domestic manufacturers. Arched concrete pipe, kerb stone and pre-cast concrete beams for bridges (the max. span length, 15m) are also available. Reinforced concrete troughs, manholes, and gully boxes can be purchased on a made-to-order basis.

7) Steel Materials

Steel sheet pile, reinforcing bar and other steel materials are usually imported from foreign countries. Only reinforcing bar is available in the local market. However, it will have to be required imported for a large-scale civil construction project.

(3) Construction Equipment

Major equipment such as excavators, bulldozers, loaders, trucks, mobile cranes, pile drivers, graders, rollers, and generators can be rented from private companies. These rental companies are in the Colombo District.

Equipment and plants for construction of the new Mutwal Tunnel and dredging of Weras Ganga will need to be imported.

1.1.5 Mode of Construction

The construction works will be executed by contractors capable of executing the works properly. The selection of the contractors will be executed through international competitive bidding (ICB) complying with the regulations of the Government of Sri Lanka and the guidelines of international financing agencies. It is intended to utilise local contractors in order to reduce the construction cost and to develop the capacity of local contractors in Sri Lanka.

1.1.6 Land Acquisition

Land acquisition is necessary for the construction works. The Ministry of Land is responsible for land acquisition and SLLRDC will cooperate with the Ministry.

1.2 Construction Period

(1) Progress Rate of Works

Monthly progress rates or unit construction periods of the major work items are assumed as shown in Table 1.2.1 referring to the actual results of similar works such as Greater Colombo Flood Control and Environment Improvement Project (GCFC&EIP).

(2) Construction Period

Construction periods of each project proposed in the Master Plan are assumed to be three to four years taking into account work volumes of the proposed projects and construction periods of similar past projects.

The assumed construction periods are as follows:

Assumed Construction Periods of the Proposed Projects

Component Project	Period
1. Ja Ela Basin Stormwater Drainage Plan	
1) Ja Ela Channel Improvement (B= 60m, L= 7 km)	3 years
2) Dandungam Oya Channel Improvement (B=80km, L=9.9km)	4 years
2. Kalu Oya Basin Stormwater Drainage Plan	
1) Old Negombo Canal Improvement (B=40m, L=4.5km)	3 years
2) Kalu Oya Channel Improvement (B=50m, L=5km)	3 years
3. Greater Colombo Basin Stormwater Drainage Project	
1) Restoration of the Existing Mutwal Tunnel	3 years
2) Construction of Madiwela South Diversion Canal	4 years
3) New Mutwal Tunnel Construction	3 years
4. Bolgoda Basin Stormwater Drainage Plan	
1) Improvement of Weras Ganga and Tributaries, Improvement of Urban Drainage	3 years
2) Improvement of Tributaries in Weras Ganga Basin	3 years

CHAPTER 2 COST ESTIMATES

2.1 Basic Conditions

(1) Composition of Project Cost

The financial project cost comprises the following cost items.

- 1) Construction cost
- 2) Land acquisition and compensation cost
- 3) Engineering service cost
- 4) Administration cost
- 5) Price escalation
- 6) Physical contingency
- 7) Tax

(2) Price Level and Foreign Exchange Rate

All costs are estimated at the price level on August 30, 2002.

The exchange rate is set as follows:

$$\text{US\$1.0} = \text{Rs. } 96.26 = \text{¥118.94}$$

(3) Foreign and Local Currency Portion

All costs are estimated by separating the foreign currency portion (FC) and local currency portion (LC) based on the ratio of the imported and local materials and equipment and also by referring to similar projects such as GCFC&EIP Phase III.

(4) Construction Cost

The construction cost comprises direct construction cost and preparatory work cost. The direct construction cost is estimated on the unit cost basis. The unit costs are estimated based on the current prices of construction resources and the construction plan. The unit construction cost for the urban drainage is based on the data of current similar projects such as GCFC&EIP Phase III.

The preparatory work cost is estimated at 10 % of the direct construction cost.

(5) Land Acquisition and Compensation Cost

1) Land Acquisition

Land acquisition cost is estimated by the required land area and its unit cost. The unit cost of land is estimated based on the data from the Chief Valuer's Department of the Ministry of Finance.

The applied unit costs are as follows:

Unit Cost of Land

(Unit: Rs./m²)

Basin		Urban	Rural
Ja Ela Basin		1,900	20
Kalu Oya Basin		1,900	50
Greater Colombo Basin	CMC area	12,000	200
		* 20,000	
	Other areas	2,200	200
Bolgoda Basin	Weras Ganga Basin	2,200	200
	Other areas	600	20

Note: *: Primary commercial area

2) Compensation

Compensation cost includes the cost for compensation for house relocation and properties affected by project implementation. The compensation cost is assumed to be 20% of the land acquisition cost for the master plan study.

(6) Engineering Service Cost

The engineering service cost includes costs for field investigations, basic and detailed design including preparation of pre-qualification documents and tender documents, assistance for pre-qualification and tendering, and construction supervision. The engineering service cost is assumed to be 15% of the construction cost referring to the similar projects.

(7) Administration Cost

The Government's administration cost for the project implementation is assumed to be 2 % of the total of the construction cost, engineering service cost, and land acquisition and compensation cost. The rate is referred to the "JBIC SAPROF for Lunawa Lake Environment Improvement and Community Development Project, February 2001 (the Lunawa Project)".

(8) Price Escalation

The following price escalation rates were applied to the SAPROF study for the Lunawa Project.

- 1) 0.8% per annum for foreign currency (FC)
- 2) 2.8% per annum for local currency (LC)

The above price escalation rate for local currency was determined based on the following price index data up to the year 1999.

Colombo Consumer's Price Index (1997-1999)

Year	1997	1998	1999
Colombo Consumer's Price Index (CCPI) (% change)	9.6	9.4	4.7

Source: Central Bank of Sri Lanka Annual Report - 2001

The future price index is projected by Central Bank of Sri Lanka as follows:

Projected Colombo Consumer's Price Index (2002-2006)

Year	2002	2003	2004	2005	2006
CCPI (% change)	9.0	6.0	5.5	4.5	3.8

Source: Central Bank of Sri Lanka Annual Report - 2001

According to the above projections, the long-term escalation rate may be presumed to decline to below 3.0 %.

Consequently, the price escalation rates to be applied to the present Study are set at the same rates as those of the SAPROF study for the Lunawa Project.

(9) Physical Contingency

Physical contingency is set as follows referring to the SAPROF study for the Lunawa Project:

- 1) 10% of the construction cost, land acquisition and compensation cost
- 2) 5% of the equipment procurement cost, engineering service cost, and administration cost

(10) Tax

Tax is estimated as follows based on the current tax system of Sri Lanka:

- 1) 30% for the construction cost
- 2) 40% for the equipment procurement cost
- 3) 20% for the engineering service cost

2.2 Project Cost

The following alternative cases are studied for each basin and the project cost of each case is estimated based on the basic conditions mentioned in the previous section 2.1.

Alternative Cases for Each Basin

Case No.	Measures
Ja Ela Basin	
J1	Ja Ela Channel Improvement (B=45m), Dandugam Oya Channel Improvement (B=65m)
J2	Ja Ela Channel Improvement (B=50m), Dandugam Oya Channel Improvement (B=70m)
J3	Ja Ela Channel Improvement (B=55m), Dandugam Oya Channel Improvement (B=75m)
J4	J1 + Kotugoda-Seeduwa Diversion Channel
J5	Ja Ela Channel Improvement (B=60m), Dandugam Oya Channel Improvement (B=80m)
J6	Ja Ela Channel Improvement (B=80m), Dandubam Oya Channel Improvement (B=100m)
Kalu Oya Basin	
K1	Channel Improvement of Kalu Oya main stream (B=40m)
K2	Channel Improvement of Kalu Oya main stream (B=45m)
K3	Channel Improvement of Kalu Oya main stream (B=50m)
K4	Wattala Pumping Station (Q=10m ³ /s)
K5	Wattala Pumping Station (Q=20m ³ /s)
K6	Wattala Pumping Station (Q=30m ³ /s)
K7	Kalu Oya - Old Negombo Diversion + Improvement of Old Negombo Canal (B=30m)
K8	Improvement of Old Negombo Canal Option (B=30m)
K9	Improvement of Old Negombo Canal Option (B=35m)
K10	Improvement of Old Negombo Canal Option (B=40m)
Greater Colombo Area	
G1	Maradana P/S (5m ³ /s) and Improvement of Galle Face Outfall
G2	Maradana P/S (10m ³ /s) and Improvement of Galle Face Outfall
G3	North Lock Pumping Station (10 m ³ /s)
G4	North Lock Pumping Station (15 m ³ /s)
G5	Gotatuwa Pumping Station (30 m ³ /s)
G6	Gotatuwa Pumping Station (40 m ³ /s)
G7	Madiwela South Diversion Canal
G8	Restoration of Existing Mutwal Tunnel
G9	New Mutwal Tunnel (D=3m)
G10	New Mutwal Tunnel (D=4m)
G11	Improvement of Welawatta (B=30m) and Kirillapone Canals (B=25m)
Bolgoda Basin	
B1	Dredging of Weras Ganaga (B=20m), Channel Improvement of tributaries and Urban Drainage
B2	Dredging of Weras Ganaga (B=40m), Channel Improvement of tributaries and Urban Drainage
B3	Dredging of Weras Ganaga (B=60m), Channel Improvement of tributaries and Urban Drainage

(1) Construction Cost

The daily labor wages, hourly rental costs of equipment and basic prices of construction materials are shown in Tables 2.2.1, 2.2.2, and 2.2.3, respectively.

The unit construction costs are estimated based on those basic prices as shown in Table 2.2.4.

The construction costs of the alternative cases are estimated as shown in Tables 2.2.5 to 2.2.8.

(2) Land Acquisition Cost

The required land area is estimated for the channel sections, standard area for a pumping station, assumed plant area for the tunnel construction, etc.

The required land areas for the alternative cases and their acquisition costs are shown in Table 2.2.9.

(3) Project Cost

1) Alternative Cases

The project costs of the alternative cases of each basin are estimated for the planning scales of 1 in 50-year, 1 in 25-year, and 1 in 10-year events. They are shown in Tables 2.2.10 to 2.2.13.

2) Proposed Plans

Breakdowns of the project costs of the proposed storm water drainage plans for the respective basins are shown in Table 2.2.14 and summarized below.

Project Cost of the Proposed Plan

Basin	Case Selected	Planning Scale	Retention Area (ha)	Project Cost (million Rs.)
Ja Ela Basin	J5	50-year	876	3,679
Kalu Oya Basin	K13	50-year	449	2,463
Greater Colombo Basin	G19	50-year	380	4,389
Bolgoda Basin	B2	50-year	295	5,102

2.3 Operation and Maintenance Cost

(1) Maintenance Cost of the Canals

Annual maintenance cost of the canal per kilometer is estimated based on the data in SLLRDC as follows:

Annual Maintenance Cost per Kilometer of Canals

(Unit: million Rs./km)

Work	Canal 5-10m wide	Canal of 10-30m wide
Dredging	0.20	0.60
Surface clearing	0.60	0.60
Canal bank maintenance	0.20	0.20
Total	1.00	1.40

Source: SLLRDC

According to SLLRDC, the annual maintenance cost in 2001 of the Greater Colombo Canal System of GCFC&EIP Phase I, of which the total length is 44 km, was Rs. 66

million. This figure corresponds to about 1% of the construction cost of GCFC&EIP Phase I.

Considering the above, the annual operation and maintenance cost of canals is assumed to be 1 % of the construction cost.

(2) Maintenance Cost of the Other Civil Structures

The annual operation and maintenance costs for the other civil structures are also assumed to be 1% of the construction cost.

(3) Operation and Maintenance (O&M) Cost of the Pumping Stations

Annual O&M cost of pumping stations including personnel expenses, power costs and costs for materials and equipment for O&M works is assumed to be 2.5% of the electrical and mechanical facility cost of the pumping station referring to the data of similar projects.

Tables

Table 1.2.1 Typical Work Progress Rates of Major Work Items

Work Item	Work Progress Rate / Unit Construction Period
1) Excavation (Channel Improvement)	4,000 - 7,000 m ³ /month
2) Excavation (Construction of New Channel)	10,000 - 14,000 m ³ /month
3) Dredging by Cutter Suction Dredger	4,000 - 6,000m ³ /month
4) Embankment	3,000 - 6,000 m ³ /month
5) Gabion (H= 4 m)	100 - 230 Lin.m/month
6) Permanent Steel Sheet Pile (H= 4 m)	50 - 80 Lin.m/month
7) Turfing (Channel Improvement)	500 - 1,000 m ² /month
8) Turfing (Construction of new Channel)	2,000 - 4,000 m ² /month
9) Box Culvert (L= 20 m)	6 - 9 month / unit
10) Bridge (W x L = 150 - 300 m ²)	8-15 month / bridge
11) Tunnel (D= 3-4 m)	1 - 2 m / day
12) Pumping Station (Q= 10-50 m ³ /s)	12 - 18 month / unit
13) Urban Drainage (Concrete Flume with Cover Slab)	20 - 30 m / month

Note: Derived from the record of similar projects

Table 2.2.1 Daily Labor Wages

(Unit: Rs./day)

Description	FC	LC	Total
Foreman	0	585	585
Foreman (Bridge)	0	850	850
Bridge Builder	0	800	800
Equipment Operator	0	520	520
Assistant Equipment Operator	0	390	390
Driver	0	390	390
Rigger/Welder	0	390	390
Carpenter	0	390	390
Mason	0	390	390
Re-bar Worker	0	390	390
Concrete Worker	0	390	390
Common Labourer	0	270	270

Source: SLLRDC

Table 2.2.2 Hourly Cost of Construction Equipment

(Unit: Rs./hr)

Plant & Equipment	Capacity	FC	LC	Total
Bulldozer	6 t	730	180	910
Bulldozer	15 t	1,660	420	2,080
Bulldozer	21 t	3,090	770	3,860
Wheel loader	1.4 m ³	1,030	260	1,290
Backhoe	1.2 m ³	1,890	470	2,360
Backhoe	0.6 m ³	1,530	380	1,910
Backhoe	0.4 m ³	980	240	1,220
Backhoe wheel type	0.3 m ³	1,030	260	1,290
Crawler Clamshell	0.4 m ³	3,270	820	4,090
Grab dredger	0.6 m ³	4,160	1,040	5,200
Cutter Suction Dredger	50 m ³ /hr	20,960	5,240	26,200
Dump Truck	11 t	1,620	410	2,030
Cargo Truck	11 t	2,020	500	2,520
Cargo Truck	6 t	1,440	360	1,800
Ordinary Truck	4 t	900	230	1,130
Crawler Crane	50 t	6,750	1,690	8,440
Crawler Crane	80 t	9,600	2,400	12,000
Truck Crane	5 t	1,180	300	1,480
Truck Crane	25 t	3,330	830	4,160
Vibro Hammer	47-49 t	250	60	310
Pile excavator	dia 900	7,220	1,810	9,030
Pile Hammer	2.5 t	10,750	2,690	13,440
Concrete breaker	30 kg	630	160	790
Motor Grader	4 m	1,260	320	1,580
Asphalt finisher	2.5-6 m	5,570	1,390	6,960
Sprayer		620	160	780
Macadam Roller	10-12 t	1,260	320	1,580
Tire Roller	8-20 t	510	130	640
Rammer	60 kg	60	20	80
Vibrating Roller	3 t	310	80	390
Concrete Pump Car	60 m ³ /hr	5,490	1,370	6,860
Concrete Vibrator	45 mm dia	110	30	140
Air Compressor	7 m ³ /min	410	100	510
Generator	100 kVA	1,260	320	1,580
Generator (Welder)	20 kVA	590	150	740
Generator	10 kVA	390	100	490
Barge	7 m ³	6,120	1,530	7,650
Tug boat	40 HP	730	180	910
Pump dia 150		470	120	590
Pump dia 100		350	90	440
Pump dia 50		110	30	140

Source: SLLRDC

Table 2.2.3 Basic Prices of Construction Materials

(Unit: Rs.)

Material	Unit	FC	LC	Total
Light Oil	liter	19	8	27
Heavy Oil	liter	23	10	33
Petrol	liter	35	15	50
Sandy Clay	m ³	276	118	394
Rubble Stone 6"-9"	m ³	433	186	619
Gravel	m ³	433	186	619
Crushed Stone	m ³	867	371	1,238
Brick	no.	1	1	2
Turfing	m ²	59	25	84
Gabion 2 x 1 x 1	No.	3,961	1,698	5,659
Gabion 1.5 x 1 x 1	No.	3,056	1,309	4,365
Gabion 1 x 1 x 1	No.	2,363	1,012	3,375
Geotextile Filter	m ²	142	61	203
Cement	kg	6	2	8
Sand	m ³	417	179	596
Aggregate 20 mm	m ³	867	371	1,238
Reinforcement bar	kg	30	13	43
Binding wire	kg	43	19	62
Plywood t = 12 mm	m ²	374	160	534
Square wood	m ³	11,813	5,062	16,875
Ready Mix Concrete 15	m ³	3,347	1,434	4,781
Ready Mix Concrete 20	m ³	3,623	1,552	5,175
Ready Mix Concrete 30	m ³	3,938	1,687	5,625
Ready Mix Concrete 40	m ³	4,410	1,890	6,300
Precast RC pipe 300 mm L = 2.5 m	No.	1,465	628	2,093
Precast RC pipe 350 mm L = 2.5 m	No.	1,713	734	2,447
Precast RC pipe 450 mm L = 2.5 m	No.	2,323	996	3,319
Precast RC pipe 750 mm L = 2.5 m	No.	4,311	1,848	6,159
Precast RC pipe 900 mm L = 2.5 m	No.	5,418	2,322	7,740
Precast RC pipe 1200 mm L = 2.5 m	No.	8,269	3,544	11,813
Precast RC pipe 1500 mm L = 2.5 m	No.	11,025	4,725	15,750
Kerb Stone 150 x 300	m	284	121	405
Paving Slab 450 x 450 x 50 mm (without R/F)	No.	79	34	113
Cover Slab 800 x 1000 x 100 mm (with R/F)	pc	945	405	1,350
Cover Slab 700 x 1000 x 70 mm (with R/F)	pc	630	270	900
PVC Pipe 25 mm dia	m	39	17	56
PVC Pipe 50 mm dia	m	134	57	191
PVC Pipe 100 mm dia	m	807	346	1,153
PVC water stop 250 mm	m	1,142	489	1,631
PVC water stop 200 mm	m	945	405	1,350
Upvc pipe 25 mm dia	m	39	17	56
Steel Plate	kg	32	13	45
Angle	kg	32	13	45
Sheet pile	kg	36	16	52
H-Shape Steel	kg	36	16	52
Channel Steel	kg	36	16	52
Covering Plate	kg	158	68	226
Timber planks t = 18 mm	m ²	1,024	439	1,463
Timber planks t = 12 mm	m ²	678	290	968
Asphalt	kg	4	2	6
Asphalt Concrete	ton	4,102	1,758	5,860
Propane Gas	kg	24	10	34
Bamboo L = 4 m	Piece	140	60	200
Pre-tension PC Beam 16 m	Piece	34,590	14,830	49,420
Pre-tension PC Beam 15 m	Piece	31,080	13,320	44,400
Pre-tension PC Beam 14 m	Piece	27,750	11,890	39,640
Pre-tension PC Beam 13 m	Piece	24,970	10,700	35,670
Pre-tension PC Beam 12 m	Piece	22,620	9,690	32,310
Pre-tension PC Beam 11 m	Piece	19,560	8,380	27,940
Pre-tension PC Beam 10 m	Piece	17,130	7,340	24,470
Pre-tension PC Beam 9 m	Piece	16,040	6,880	22,920

Source: SLRDC, JICA Study Team

Table 2.2.4 Unit Construction Cost (1/2)

Item	unit	FC	LC	Total
1. Channel Improvement				
1) Excavation (normal)	m3	180	70	250
2) Excavation (rural area)	m3	130	50	180
3) Excavation (underwater)	m3	450	140	590
4) Dredging by cutter suction dredger	m3	810	210	1,020
5) Embankment (L = 10 km)	m3	590	190	780
6) Embankment (L = 100 m)	m3	200	60	260
7) Material Disposal	m3	300	100	400
8) Bank Protection (Gabion) H = 3 m	m *1)	23,450	10,600	34,050
9) Bank Protection (Gabion) H = 2 m	m *1)	15,630	7,070	22,700
10) Bank Protection (Gabion) H = 1.5 m	m *1)	11,730	5,300	17,030
11) Bank Protection (Steel sheet pile)	m *1)	91,700	39,280	130,980
12) Bank Protection (Turfing)	m2	80	40	120
13) Removal of existing structure	m3	2,930	1,250	4,180
14) Miscellaneous (side drain, etc.)	m *1)	5,030	2,480	7,510
15) Care of Water and Dewatering	m *1)	1,650	2,770	4,420
16) Temporary Shoring by Sheet Pile, L = 6 m	m *1)	19,380	7,460	26,840
2. Bridge				
1) Road bridge (urban area)	m2 *2)	87,500	37,500	125,000
2) Road bridge (rural area)	m2 *2)	74,000	31,000	105,000
3) Railway bridge	unit	11,900,000	5,100,000	17,000,000
3. Box Culvert				
1) Box culvert (road crossing)	m3 *3)	17,140	7,340	24,480
2) Box culvert (non road crossing)	m3 *3)	9,790	4,200	13,990
4. Flood Protection Wall				
1) Wet Masonry Wall (H = 1.0 m)	m	11,040	2,760	13,800
5. Gate				
1) Slide Gate (excl. sluiceway)	m2	877,000	79,000	956,000
2) Flap Gate	m2	133,900	31,900	165,800
6. Periphery Canal				
1) Periphery Canal and Path Way	m	560	1,480	2,040
7. Pumping Station				
1) Pumping Station (Q = 5 m3/s)	unit	447,000,000	76,000,000	523,000,000
2) Pumping Station (Q = 10 m3/s)	unit	890,000,000	148,000,000	1,038,000,000
3) Pumping Station (Q = 15 m3/s)	unit	1,214,000,000	202,000,000	1,416,000,000
4) Pumping Station (Q = 20 m3/s)	unit	1,606,000,000	254,000,000	1,860,000,000
5) Pumping Station (Q = 30 m3/s)	unit	1,928,000,000	305,000,000	2,233,000,000
6) Pumping Station (Q = 40 m3/s)	unit	2,560,000,000	394,000,000	2,954,000,000
7) Pumping Station (Q = 50 m3/s)	unit	3,175,000,000	462,000,000	3,637,000,000
8. Tunnel				
1) Tunnel Construction (D = 3 m)	m	330,000	141,000	471,000
2) Tunnel Construction (D = 4 m)	m	367,000	157,000	524,000

Note:

*1) : unit cost per 1m length of channel improvement work

*2) : unit cost per (Length x Width)

*3) : unit cost per (Height x Width x Length)

Table 2.2.4 Unit Construction Cost (2/2)

Item	unit	FC	LC	Total
9. Urban Drainage				
1) Flume with Cover Slab B = 0.8, H = 0.8	m	39,560	16,950	56,510
2) Flume with Cover Slab B = 0.9, H = 0.9	m	43,320	18,570	61,890
3) Flume with Cover Slab B = 1.0, H = 1.0	m	47,090	20,180	67,270
4) Flume with Cover Slab B = 1.1, H = 1.1	m	50,860	21,790	72,650
5) Flume with Cover Slab B = 1.2, H = 1.2	m	54,620	23,410	78,030
6) Flume with Cover Slab B = 1.3, H = 1.3	m	58,390	25,020	83,410
7) Flume with Cover Slab B = 1.3, H = 1.4	m	62,160	26,640	88,800
8) Flume with Cover Slab B = 1.5, H = 1.5	m	67,110	28,760	95,870
9) Flume with Cover Slab B = 2.0, H = 1.5	m	76,220	32,670	108,890
10) Wet Masonry Channel B = 1.0, H = 1.0	m	21,840	5,460	27,300
11) Wet Masonry Channel B = 1.5, H = 1.0	m	22,240	5,560	27,800
12) Wet Masonry Channel B = 1.5, H = 1.5	m	26,480	6,620	33,100
13) Wet Masonry Channel B = 2.0, H = 1.5	m	26,880	6,720	33,600
14) Wet Masonry Channel B=3.0, H=1.5	m	27,680	6,920	34,600
15) Open Channel with Gabion B = 3.0, H = 1.5	m	48,000	12,000	60,000
16) Open Channel with Gabion B = 5.0, H = 1.5	m	49,360	12,340	61,700
17) Open Channel with Gabion B = 6.0, H = 1.5	m	50,320	12,580	62,900
18) Earth Open Channel B = 2.0, H = 1.5	m	8,480	2,120	10,600
19) Earth Open Channel B = 5.0, H = 1.5	m	10,800	2,700	13,500
20) Earth Open Channel B = 6.0, H = 1.5	m	11,760	2,940	14,700

Note:

*1) : unit cost per 1m length of channel improvement work

*2) : unit cost per (Length x Width)

*3) : unit cost per (Height x Width x Length)

Table 2.2.5 Direct Construction Costs of Alternative Cases in Ja Ela Basin (1/3)

Item	unit	Quantity	Unit Cost			Construction Cost		
			FC (Rs)	LC (Rs)	Total (Rs)	FC (Rs)	LC (Rs)	Total (Rs)
Case J1: Ja Ela Improvement (B = 45 m), Dandugam Oya Channel Improvement (B = 65 m)								
Ja Ela Improvement (B = 45 m)								
Channel Improvement								
Excavation (rural area)	m ³	95,200	130	50	180	12,376,000	4,760,000	17,136,000
Excavation (underwater)	m ³	23,800	450	140	590	10,710,000	3,332,000	14,042,000
Embankment	m ³	109,000	590	190	780	64,310,000	20,710,000	85,020,000
Material disposal	m ³	23,800	300	100	400	7,140,000	2,380,000	9,520,000
Bank Protection (Turfing)	m ²	147,000	80	40	120	11,760,000	5,880,000	17,640,000
Miscellaneous (side drain, etc.)	m	7,000	5,030	2,480	7,510	35,210,000	17,360,000	52,570,000
Sub-Total						141,506,000	54,422,000	195,928,000
Bridge								
Road bridge (Rural area)	m ²	1,800	73,500	31,500	105,000	132,300,000	56,700,000	189,000,000
Sub-Total						132,300,000	56,700,000	189,000,000
Total						273,806,000	111,122,000	384,928,000
Dandugam Oya Channel Improvement (B = 65 m)								
Channel Improvement								
Excavation (rural area)	m ³	360,600	130	50	180	46,878,000	18,030,000	64,908,000
Excavation (underwater)	m ³	90,100	450	140	590	40,545,000	12,614,000	53,159,000
Embankment	m ³	136,000	590	190	780	80,240,000	25,840,000	106,080,000
Material disposal	m ³	314,700	300	100	400	94,410,000	31,470,000	125,880,000
Bank Protection (Turfing)	m ²	279,000	80	40	120	22,320,000	11,160,000	33,480,000
Miscellaneous (side drain, etc.)	m	9,900	5,030	2,480	7,510	49,797,000	24,552,000	74,349,000
Sub-Total						334,190,000	123,666,000	457,856,000
Bridge								
Road bridge (Rural area)	m ²	4,100	73,500	31,500	105,000	301,350,000	129,150,000	430,500,000
Sub-Total						301,350,000	129,150,000	430,500,000
Total						635,540,000	252,816,000	888,356,000
Total of Case J1						909,346,000	363,938,000	1,273,284,000
Case J2: Ja Ela Improvement (B = 50 m), Dandugam Oya Channel Improvement (B = 70 m)								
Ja Ela Improvement (B = 50 m)								
Channel Improvement								
Excavation (rural area)	m ³	167,200	130	50	180	21,736,000	8,360,000	30,096,000
Excavation (underwater)	m ³	41,800	450	140	590	18,810,000	5,852,000	24,662,000
Embankment	m ³	119,000	590	190	780	70,210,000	22,610,000	92,820,000
Material disposal	m ³	90,000	300	100	400	27,000,000	9,000,000	36,000,000
Bank Protection (Turfing)	m ²	147,000	80	40	120	11,760,000	5,880,000	17,640,000
Miscellaneous (side drain, etc.)	m	7,000	5,030	2,480	7,510	35,210,000	17,360,000	52,570,000
Sub-Total						184,726,000	69,062,000	253,788,000
Bridge								
Road bridge (Rural area)	m ²	2,000	73,500	31,500	105,000	147,000,000	63,000,000	210,000,000
Sub-Total						147,000,000	63,000,000	210,000,000
Total						331,726,000	132,062,000	463,788,000
Dandugam Oya Channel Improvement (B = 70 m)								
Channel Improvement								
Excavation (rural area)	m ³	492,400	130	50	180	64,012,000	24,620,000	88,632,000
Excavation (underwater)	m ³	123,100	450	140	590	55,395,000	17,234,000	72,629,000
Embankment	m ³	135,000	590	190	780	79,650,000	25,650,000	105,300,000
Material disposal	m ³	480,500	300	100	400	144,150,000	48,050,000	192,200,000
Bank Protection (Turfing)	m ²	279,000	80	40	120	22,320,000	11,160,000	33,480,000
Miscellaneous (side drain, etc.)	m	9,900	5,030	2,480	7,510	49,797,000	24,552,000	74,349,000
Sub-Total						415,324,000	151,266,000	566,590,000
Bridge								
Road bridge (Rural area)	m ²	4,300	73,500	31,500	105,000	316,050,000	135,450,000	451,500,000
Sub-Total						316,050,000	135,450,000	451,500,000
Total						731,374,000	286,716,000	1,018,090,000
Total of Case J2						1,063,100,000	418,778,000	1,481,878,000

Table 2.2.5 Direct Construction Costs of Alternative Cases in Ja Ela Basin (2/3)

Case J3: Ja Ela Improvement (B = 55 m), Dandugam Oya Channel Improvement (B = 75 m)								
Ja Ela Improvement (B = 55 m)								
Channel Improvement								
Excavation (rural area)	m ³	264,800	130	50	180	34,424,000	13,240,000	47,664,000
Excavation (underwater)	m ³	66,200	450	140	590	29,790,000	9,268,000	39,058,000
Embankment	m ³	128,000	590	190	780	75,520,000	24,320,000	99,840,000
Material disposal	m ³	203,000	300	100	400	60,900,000	20,300,000	81,200,000
Bank Protection (Turfing)	m ²	147,000	80	40	120	11,760,000	5,880,000	17,640,000
Miscellaneous (side drain, etc.)	m	7,000	5,030	2,480	7,510	35,210,000	17,360,000	52,570,000
Sub-Total						247,604,000	90,368,000	337,972,000
Bridge								
Road bridge (Rural area)	m ²	2,200	73,500	31,500	105,000	161,700,000	69,300,000	231,000,000
Sub-Total						161,700,000	69,300,000	231,000,000
Total						409,304,000	159,668,000	568,972,000
Dandugam Oya Channel Improvement (B = 75 m)								
Channel Improvement								
Excavation (rural area)	m ³	692,700	130	50	180	90,051,000	34,635,000	124,686,000
Excavation (underwater)	m ³	173,100	450	140	590	77,895,000	24,234,000	102,129,000
Embankment	m ³	136,300	590	190	780	80,417,000	25,897,000	106,314,000
Material disposal	m ³	729,500	300	100	400	218,850,000	72,950,000	291,800,000
Bank Protection (Turfing)	m ²	279,000	80	40	120	22,320,000	11,160,000	33,480,000
Miscellaneous (side drain, etc.)	m	9,900	5,030	2,480	7,510	49,797,000	24,552,000	74,349,000
Sub-Total						539,330,000	193,428,000	732,758,000
Bridge								
Road bridge (Rural area)	m ²	4,700	73,500	31,500	105,000	345,450,000	148,050,000	493,500,000
Sub-Total						345,450,000	148,050,000	493,500,000
Total						884,780,000	341,478,000	1,226,258,000
Total of Case J3						1,294,084,000	501,146,000	1,795,230,000
Case J4: Case J1 + Kotugoda - Deeduwa Diversion								
Kotugoda - Deeduwa Diversion								
Channel Construction								
Excavation (rural area)	m ³	255,600	130	50	180	33,228,000	12,780,000	46,008,000
Excavation (underwater)	m ³	28,400	450	140	590	12,780,000	3,976,000	16,756,000
Embankment	m ³	2,000	590	190	780	1,180,000	380,000	1,560,000
Material disposal	m ³	282,000	300	100	400	600,000	200,000	800,000
Bank Protection (Turfing)	m ²	39,000	80	40	120	3,120,000	1,560,000	4,680,000
Miscellaneous (side drain, etc.)	m	3,100	5,030	2,480	7,510	15,593,000	7,688,000	23,281,000
Sub-Total						66,501,000	26,584,000	93,085,000
Bridge								
Road bridge (Rural area)	m ²	700	73,500	31,500	105,000	51,450,000	22,050,000	73,500,000
Sub-Total						51,450,000	22,050,000	73,500,000
Total						117,951,000	48,634,000	166,585,000
Total of Case J4						1,027,297,000	412,572,000	1,439,869,000
Case J5: Ja Ela Improvement (B = 60 m), Dandugam Oya Channel Improvement (B = 80 m)								
Ja Ela Improvement (B = 60 m)								
Channel Improvement								
Excavation (rural area)	m ³	295,000	130	50	180	38,350,000	14,750,000	53,100,000
Excavation (underwater)	m ³	66,200	450	140	590	29,790,000	9,268,000	39,058,000
Embankment	m ³	128,000	590	190	780	75,520,000	24,320,000	99,840,000
Material disposal	m ³	233,200	300	100	400	69,960,000	23,320,000	93,280,000
Bank Protection (Turfing)	m ²	147,000	80	40	120	11,760,000	5,880,000	17,640,000
Miscellaneous (side drain, etc.)	m	7,000	5,030	2,480	7,510	35,210,000	17,360,000	52,570,000
Sub-Total						260,590,000	94,898,000	355,488,000
Bridge								
Road bridge (Rural area)	m ²	2,400	73,500	31,500	105,000	176,400,000	75,600,000	252,000,000
Sub-Total						176,400,000	75,600,000	252,000,000
Total						436,990,000	170,498,000	607,488,000

Table 2.2.5 Direct Construction Costs of Alternative Cases in Ja Ela Basin (3/3)

Dandugam Oya Channel Improvement (B = 80 m)								
Channel Improvement								
Excavation (rural area)	m ³	751,000	130	50	180	97,630,000	37,550,000	135,180,000
Excavation (underwater)	m ³	174,000	450	140	590	78,300,000	24,360,000	102,660,000
Embankment	m ³	136,400	590	190	780	80,476,000	25,916,000	106,392,000
Material disposal	m ³	788,600	300	100	400	236,580,000	78,860,000	315,440,000
Bank Protection (Turfing)	m ²	279,000	80	40	120	22,320,000	11,160,000	33,480,000
Miscellaneous (side drain, etc.)	m	9,900	5,030	2,480	7,510	49,797,000	24,552,000	74,349,000
Sub-Total						565,103,000	202,398,000	767,501,000
Bridge								
Road bridge (Rural area)	m ²	5,000	73,500	31,500	105,000	367,500,000	157,500,000	525,000,000
Sub-Total						367,500,000	157,500,000	525,000,000
Total						932,603,000	359,898,000	1,292,501,000
Total of Case J5						1,369,593,000	530,396,000	1,899,989,000
Case J6: Ja Ela Improvement (B = 80 m), Dandugam Oya Channel Improvement (B = 100 m)								
Ja Ela Improvement (B = 80 m)								
Channel Improvement								
Excavation (rural area)	m ³	415,300	130	50	180	53,989,000	20,765,000	74,754,000
Excavation (underwater)	m ³	66,200	450	140	590	29,790,000	9,268,000	39,058,000
Embankment	m ³	128,000	590	190	780	75,520,000	24,320,000	99,840,000
Material disposal	m ³	354,000	300	100	400	106,200,000	35,400,000	141,600,000
Bank Protection (Turfing)	m ²	147,000	80	40	120	11,760,000	5,880,000	17,640,000
Miscellaneous (side drain, etc.)	m	7,000	5,030	2,480	7,510	35,210,000	17,360,000	52,570,000
Sub-Total						312,469,000	112,993,000	425,462,000
Bridge								
Road bridge (Rural area)	m ²	3,200	73,500	31,500	105,000	235,200,000	100,800,000	336,000,000
Sub-Total						235,200,000	100,800,000	336,000,000
Total						547,669,000	213,793,000	761,462,000
Dandugam Oya Channel Improvement (B = 100 m)								
Channel Improvement								
Excavation (rural area)	m ³	982,000	130	50	180	127,660,000	49,100,000	176,760,000
Excavation (underwater)	m ³	173,200	450	140	590	77,940,000	24,248,000	102,188,000
Embankment	m ³	137,000	590	190	780	80,830,000	26,030,000	106,860,000
Material disposal	m ³	1,019,000	300	100	400	305,700,000	101,900,000	407,600,000
Bank Protection (Turfing)	m ²	279,000	80	40	120	22,320,000	11,160,000	33,480,000
Miscellaneous (side drain, etc.)	m	9,900	5,030	2,480	7,510	49,797,000	24,552,000	74,349,000
Sub-Total						664,247,000	236,990,000	901,237,000
Bridge								
Road bridge (Rural area)	m ²	6,300	73,500	31,500	105,000	463,050,000	198,450,000	661,500,000
Sub-Total						463,050,000	198,450,000	661,500,000
Total						1,127,297,000	435,440,000	1,562,737,000
Total of Case J6						1,674,966,000	649,233,000	2,324,199,000

Table 2.2.6 Direct Construction Costs of Alternative Cases in Kalu Oya Basin (1/3)

Item	unit	Quantity	Unit Cost			Construction Cost		
			FC (Rs.)	LC (Rs.)	Total (Rs.)	FC (Rs.)	LC (Rs.)	Total (Rs.)
Case K1:Kalu Oya Improvement (B = 40 m)								
Channel Improvement								
Excavation (Rural Area)	m ³	90,400	180	70	250	16,272,000	6,328,000	22,600,000
Excavation (Underwater)	m ³	22,600	450	140	590	10,170,000	3,164,000	13,334,000
Embankment	m ³	90,000	590	190	780	53,100,000	17,100,000	70,200,000
Material disposal	m ³	23,000	300	100	400	6,900,000	2,300,000	9,200,000
Bank Protection (Turfing)	m ²	105,000	80	40	120	8,400,000	4,200,000	12,600,000
Miscellaneous (side drain, etc.)	m	5,000	5,030	2,480	7,510	25,150,000	12,400,000	37,550,000
Sub-Total						119,992,000	45,492,000	165,484,000
Bridge								
Road bridge (Rural area)	m ²	2,360	73,500	31,500	105,000	173,460,000	74,340,000	247,800,000
Sub-Total						173,460,000	74,340,000	247,800,000
Gate								
Slide Gate	m ²	150	877,000	79,000	956,000	131,550,000	11,850,000	143,400,000
Civil Works (40% of the above)	LS					52,620,000	4,740,000	57,360,000
Sub-Total						184,170,000	16,590,000	200,760,000
Total of Case K1						477,622,000	136,422,000	614,044,000
Case K2: Kalu Oya Improvement (B = 45 m)								
Channel Improvement								
Excavation (Rural Area)	m ³	136,800	180	70	250	24,624,000	9,576,000	34,200,000
Excavation (Underwater)	m ³	34,200	450	140	590	15,390,000	4,788,000	20,178,000
Embankment	m ³	93,000	590	190	780	54,870,000	17,670,000	72,540,000
Material disposal	m ³	78,000	300	100	400	23,400,000	7,800,000	31,200,000
Bank Protection (Turfing)	m ²	105,000	80	40	120	8,400,000	4,200,000	12,600,000
Miscellaneous (side drain, etc.)	m	5,000	5,030	2,480	7,510	25,150,000	12,400,000	37,550,000
Sub-Total						151,834,000	56,434,000	208,268,000
Bridge								
Road bridge (Rural area)	m ²	2,650	73,500	31,500	105,000	194,775,000	83,475,000	278,250,000
Sub-Total						194,775,000	83,475,000	278,250,000
Gate								
Slide Gate	m ²	170	877,000	79,000	956,000	149,090,000	13,430,000	162,520,000
Civil Works (40% of the above)	LS					59,636,000	5,372,000	65,008,000
Sub-Total						208,726,000	18,802,000	227,528,000
Total of Case K2						555,335,000	158,711,000	714,046,000
Case K3: Kalu Oya Improvement (B = 50 m)								
Channel Improvement								
Excavation (Rural Area)	m ³	192,800	180	70	250	34,704,000	13,496,000	48,200,000
Excavation (Underwater)	m ³	48,200	450	140	590	21,690,000	6,748,000	28,438,000
Embankment	m ³	94,000	590	190	780	55,460,000	17,860,000	73,320,000
Material disposal	m ³	147,000	300	100	400	44,100,000	14,700,000	58,800,000
Bank Protection (Turfing)	m ²	105,000	80	40	120	8,400,000	4,200,000	12,600,000
Miscellaneous (side drain, etc.)	m	5,000	5,030	2,480	7,510	25,150,000	12,400,000	37,550,000
Sub-Total						189,504,000	69,404,000	258,908,000
Bridge								
Road bridge (Rural area)	m ²	2,950	73,500	31,500	105,000	216,825,000	92,925,000	309,750,000
Sub-Total						216,825,000	92,925,000	309,750,000
Gate								
Slide Gate	m ²	190	877,000	79,000	956,000	166,630,000	15,010,000	181,640,000
Civil Works (40% of the above)	LS					66,652,000	6,004,000	72,656,000
Sub-Total						233,282,000	21,014,000	254,296,000
Total of Case K3						639,611,000	183,343,000	822,954,000

Table 2.2.6 Direct Construction Costs of Alternative Cases in Kalu Oya Basin (2/3)

Item	unit	Quantity	Unit Cost			Construction Cost		
			FC (Rs.)	LC (Rs.)	Total (Rs.)	FC (Rs.)	LC (Rs.)	Total (Rs.)
Case K4: Wattala Pumping Station (Q = 10 m³/s)								
Pumping Station								
Pumping Station Q=10m ³ /s	LS	1				890,000,000	148,000,000	1,038,000,000
Sub-Total						890,000,000	148,000,000	1,038,000,000
Gate								
Slide Gate	m ²	5	877,000	79,000	956,000	4,385,000	395,000	4,780,000
Sub-Total						4,385,000	395,000	4,780,000
Total of Case K4						894,385,000	148,395,000	1,042,780,000
Case K5: Wattala Pumping Station (Q = 20 m³/s)								
Pumping Station								
Pumping Station Q=20m ³ /s	LS	1				1,606,000,000	254,000,000	1,860,000,000
Sub-Total						1,606,000,000	254,000,000	1,860,000,000
Gate								
Slide Gate	m ²	10	877,000	79,000	956,000	8,770,000	790,000	9,560,000
Sub-Total						8,770,000	790,000	9,560,000
Total of Case K5						1,614,770,000	254,790,000	1,869,560,000
Case K6: Wattala Pumping Station (Q = 30 m³/s)								
Pumping Station								
Pumping Station Q=30m ³ /s	LS	1				1,928,000,000	305,000,000	2,233,000,000
Sub-Total						1,928,000,000	305,000,000	2,233,000,000
Gate								
Slide Gate	m ²	15	877,000	79,000	956,000	13,155,000	1,185,000	14,340,000
Sub-Total						13,155,000	1,185,000	14,340,000
Total of Case K6						1,941,155,000	306,185,000	2,247,340,000
Case K7: Kalu Oya - Old Negombo Diversion (B = 30 m)								
Diversion Channel								
Channel Improvement/Construction								
Excavation (Rural Area)	m ³	241,800	180	70	250	43,524,000	16,926,000	60,450,000
Embankment	m ³	0	590	190	780	0	0	0
Material disposal	m ³	241,800	300	100	400	72,540,000	24,180,000	96,720,000
Bank Protection (Turfing)	m ²	34,800	80	40	120	2,784,000	1,392,000	4,176,000
Miscellaneous (side drain, etc.)	m	1,200	5,030	2,480	7,510	6,036,000	2,976,000	9,012,000
Sub-Total						124,884,000	45,474,000	170,358,000
Bridge								
Road bridge (Rural area)	m ²	600	73,500	31,500	105,000	44,100,000	18,900,000	63,000,000
Road bridge (Urban area)	m ²	1,050	87,500	37,500	125,000	91,875,000	39,375,000	131,250,000
Sub-Total						135,975,000	58,275,000	194,250,000
Total						260,859,000	103,749,000	364,608,000
Improvement of Old Negombo Canal (B = 30 m)								
Channel Improvement								
Excavation (Rural Area)	m ³	44,100	180	70	250	7,938,000	3,087,000	11,025,000
Excavation (Underwater)	m ³	11,000	450	140	590	4,950,000	1,540,000	6,490,000
Embankment	m ³	50,400	590	190	780	29,736,000	9,576,000	39,312,000
Material disposal	m ³	11,000	300	100	400	3,300,000	1,100,000	4,400,000
Bank Protection (Turfing)	m ²	10,700	80	40	120	856,000	428,000	1,284,000
Miscellaneous (side drain, etc.)	m	2,400	5,030	2,480	7,510	12,072,000	5,952,000	18,024,000
Sub-Total						58,852,000	21,683,000	80,535,000
Bridge								
Road bridge (Rural area)	m ²	900	73,500	31,500	105,000	66,150,000	28,350,000	94,500,000
Sub-Total						66,150,000	28,350,000	94,500,000
Total						125,002,000	50,033,000	175,035,000
Total of Case K7						385,861,000	153,782,000	539,643,000
Case K8: Improvement of Old Negombo Canal (B = 30 m)								
Channel Improvement								
Excavation (Rural Area)	m ³	82,800	180	70	250	14,904,000	5,796,000	20,700,000
Excavation (Underwater)	m ³	20,700	450	140	590	9,315,000	2,898,000	12,213,000
Embankment	m ³	94,500	590	190	780	55,755,000	17,955,000	73,710,000

Table 2.2.6 Direct Construction Costs of Alternative Cases in Kalu Oya Basin (3/3)

Item	unit	Quantity	Unit Cost			Construction Cost		
			FC (Rs.)	LC (Rs.)	Total (Rs.)	FC (Rs.)	LC (Rs.)	Total (Rs.)
Material disposal	m ³	20,700	300	100	400	6,210,000	2,070,000	8,280,000
Bank Protection (Turfing)	m ²	20,100	80	40	120	1,608,000	804,000	2,412,000
Miscellaneous (side drain, etc.)	m	4,500	5,030	2,480	7,510	22,635,000	11,160,000	33,795,000
Sub-Total						110,427,000	40,683,000	151,110,000
Bridge								
Road bridge (Rural area)	m ²	900	73,500	31,500	105,000	66,150,000	28,350,000	94,500,000
Sub-Total						66,150,000	28,350,000	94,500,000
Total of Case K8						176,577,000	69,033,000	245,610,000
Case K9: Improvement of Old Negombo Canal (B = 35 m)								
Channel Improvement								
Excavation (Rural Area)	m ³	115,200	180	70	250	20,736,000	8,064,000	28,800,000
Excavation (Underwater)	m ³	28,800	450	140	590	12,960,000	4,032,000	16,992,000
Embankment	m ³	94,500	590	190	780	55,755,000	17,955,000	73,710,000
Material disposal	m ³	49,500	300	100	400	14,850,000	4,950,000	19,800,000
Bank Protection (Turfing)	m ²	20,100	80	40	120	1,608,000	804,000	2,412,000
Miscellaneous (side drain, etc.)	m	4,500	5,030	2,480	7,510	22,635,000	11,160,000	33,795,000
Sub-Total						128,544,000	46,965,000	175,509,000
Bridge								
Road bridge (Rural area)	m ²	1,050	73,500	31,500	105,000	77,175,000	33,075,000	110,250,000
Sub-Total						77,175,000	33,075,000	110,250,000
Total of Case K9						205,719,000	80,040,000	285,759,000
Case K10: Improvement of Old Negombo Canal (B = 40 m)								
Channel Improvement								
Excavation (Rural Area)	m ³	180,400	180	70	250	32,472,000	12,628,000	45,100,000
Excavation (Underwater)	m ³	45,100	450	140	590	20,295,000	6,314,000	26,609,000
Embankment	m ³	94,500	590	190	780	55,755,000	17,955,000	73,710,000
Material disposal	m ³	131,000	300	100	400	39,300,000	13,100,000	52,400,000
Bank Protection (Turfing)	m ²	20,100	80	40	120	1,608,000	804,000	2,412,000
Miscellaneous (side drain, etc.)	m	4,500	5,030	2,480	7,510	22,635,000	11,160,000	33,795,000
Sub-Total						172,065,000	61,961,000	234,026,000
Bridge								
Road bridge (Rural area)	m ²	1,200	73,500	31,500	105,000	88,200,000	37,800,000	126,000,000
Sub-Total						88,200,000	37,800,000	126,000,000
Total of Case K10						260,265,000	99,761,000	360,026,000

Table 2.2.7 Direct Construction Costs of Alternative Cases in Greater Colombo Basin (1/4)

Item	unit	Q'ty	Unit Cost			Construction Cost		
			FC (Rs.)	LC (Rs.)	Total (Rs.)	FC (Rs.)	LC (Rs.)	Total (Rs.)
Case G1: Maradana Pumping Station and Improvement of Galle Face Outfall (Q = 5 m³/s)								
Channel Improvement/Construction								
Excavation (urban area)	m ³	8,900	180	70	250	1,602,000	623,000	2,225,000
Embankment	m ³	1,500	590	190	780	885,000	285,000	1,170,000
Material disposal	m ³	7,400	300	100	400	2,220,000	740,000	2,960,000
Bank protection (Gabion)	m	390	23,450	10,600	34,050	9,145,500	4,134,000	13,279,500
Care of water and dewatering	m	195	1,650	2,770	4,420	321,750	540,150	861,900
Miscellaneous (side drain, etc.)	m	200	5,030	2,480	7,510	1,006,000	496,000	1,502,000
Sub-Total						15,180,250	6,818,150	21,998,400
Box Culvert								
Box culvert (non road crossing)	m ³	540	9,790	4,200	13,990	5,286,600	2,268,000	7,554,600
Sub-Total						5,286,600	2,268,000	7,554,600
Gate								
Slide Gate (excl. sluiceway)	m ²	22	877,000	79,000	956,000	19,294,000	1,738,000	21,032,000
Sub-Total						19,294,000	1,738,000	21,032,000
Pumping Station								
Pumping Station Q = 5 m ³ /s	LS	1				447,000,000	76,000,000	523,000,000
Sub-Total						447,000,000	76,000,000	523,000,000
Other (Reservoir)								
Reinforced concrete	m ³	150	12,000	5,170	17,170	1,800,000	775,500	2,575,500
Formwork	m ²	50	670	380	1,050	33,500	19,000	52,500
Miscellaneous (15% of above)	LS	1				275,000	119,200	394,200
Sub-Total						2,108,500	913,700	3,022,200
Total of Case G1						488,869,350	87,737,850	576,607,200
Case G2: Maradana Pumping Station and Improvement of Galle Face Outfall (Q = 10 m³/s)								
Channel Improvement/Construction								
Excavation (urban area)	m ³	8,900	180	70	250	1,602,000	623,000	2,225,000
Embankment	m ³	1,500	590	190	780	885,000	285,000	1,170,000
Material disposal	m ³	7,400	300	100	400	2,220,000	740,000	2,960,000
Bank protection (Gabion)	m	390	23,450	10,600	34,050	9,145,500	4,134,000	13,279,500
Care of water and dewatering	m	195	1,650	2,770	4,420	321,750	540,150	861,900
Miscellaneous (side drain, etc.)	m	200	5,030	2,480	7,510	1,006,000	496,000	1,502,000
Sub-Total						15,180,250	6,818,150	21,998,400
Box Culvert								
Box culvert (non road crossing)	m ³	540	9,790	4,200	13,990	5,286,600	2,268,000	7,554,600
Sub-Total						5,286,600	2,268,000	7,554,600
Gate								
Slide Gate (excl. sluiceway)	m ²	22	877,000	79,000	956,000	19,294,000	1,738,000	21,032,000
Sub-Total						19,294,000	1,738,000	21,032,000
Pumping Station								
Pumping Station Q = 10 m ³ /s	LS	1				890,000,000	148,000,000	1,038,000,000
Sub-Total						890,000,000	148,000,000	1,038,000,000
Other (Reservoir)								
Reinforced concrete	m ³	150	12,000	5,170	17,170	1,800,000	775,500	2,575,500
Formwork	m ²	50	670	380	1,050	33,500	19,000	52,500
Miscellaneous (15% of above)	LS	1				275,000	119,200	394,200
Sub-Total						2,108,500	913,700	3,022,200
Total of Case G2						931,869,350	159,737,850	1,091,607,200
Case G3: North Lock Pumping Station (Q = 10 m³/s)								
Pumping Station								
Pumping Station Q = 10 m ³ /s	LS	1				890,000,000	148,000,000	1,038,000,000
Sub-Total						890,000,000	148,000,000	1,038,000,000
Sluiceway								
Box culvert (non road crossing)	m ³	150	9,790	4,200	13,990	1,468,500	630,000	2,098,500
Slide Gate	m ²	5	877,000	79,000	956,000	4,385,000	395,000	4,780,000
Sub-Total						5,853,500	1,025,000	6,878,500
Gate								
Slide Gate	m ²	15	877,000	79,000	956,000	13,155,000	1,185,000	14,340,000
Sub-Total						13,155,000	1,185,000	14,340,000
Total of Case G3						909,008,500	150,210,000	1,059,218,500

Table 2.2.7 Direct Construction Costs of Alternative Cases in Greater Colombo Basin (2/4)

Item	unit	Q'ty	Unit Cost			Construction Cost		
			FC (Rs.)	LC (Rs.)	Total (Rs.)	FC (Rs.)	LC (Rs.)	Total (Rs.)
Case G4: North Lock Pumping Station (Q = 15 m³/s)								
Pumping Station								
Pumping Station Q = 15 m ³ /s	LS	1				1,214,000,000	202,000,000	1,416,000,000
Sub-Total						1,214,000,000	202,000,000	1,416,000,000
Sluiceway								
Box culvert (non road crossing)	m ³	240	9,790	4,200	13,990	2,349,600	1,008,000	3,357,600
Slide Gate	m ²	8	877,000	79,000	956,000	7,016,000	632,000	7,648,000
Sub-Total						9,365,600	1,640,000	11,005,600
Gate								
Slide Gate (excl. sluiceway)	m ²	15	877,000	79,000	956,000	13,155,000	1,185,000	14,340,000
Sub-Total						13,155,000	1,185,000	14,340,000
Total of Case G4						1,236,520,600	204,825,000	1,441,345,600
Case G5: Gotatuwa Pumping Station (Q = 30 m³/s)								
Pumping Station								
Pumping Station Q = 30 m ³ /s	LS	1				1,928,000,000	305,000,000	2,233,000,000
Sub-Total						1,928,000,000	305,000,000	2,233,000,000
Sluiceway								
Box culvert (road crossing)	m ³	450	17,140	7,340	24,480	7,713,000	3,303,000	11,016,000
Gate	m ²	15	877,000	79,000	956,000	13,155,000	1,185,000	14,340,000
Sub-Total						20,868,000	4,488,000	25,356,000
Channel Improvement/Construction								
Excavation (rural area)	m ³	10,100	130	50	180	1,313,000	505,000	1,818,000
Embankment	m ³	26,900	590	190	780	15,871,000	5,111,000	20,982,000
Material disposal	m ³	3,200	300	100	400	960,000	320,000	1,280,000
Bank Protection (Turfing)	m ²	36,000	85	40	125	3,060,000	1,440,000	4,500,000
Miscellaneous (side drain, etc.)	m	2,700	5,030	2,480	7,510	13,581,000	6,696,000	20,277,000
Sub-Total						34,785,000	14,072,000	48,857,000
Bridge								
Road bridge (Rural area)	m ²	500	74,000	31,000	105,000	37,000,000	15,500,000	52,500,000
Sub-Total						37,000,000	15,500,000	52,500,000
Total of Case G5						2,020,653,000	339,060,000	2,359,713,000
Case G6: Gotatuwa Pumping Station (Q = 40 m³/s)								
Pumping Station								
Pumping Station Q = 40 m ³ /s	LS	1				2,560,000,000	394,000,000	2,954,000,000
Sub-Total						2,560,000,000	394,000,000	2,954,000,000
Sluiceway								
Box culvert (road crossing)	m ³	600	17,140	7,340	24,480	10,284,000	4,404,000	14,688,000
Gate	m ²	20	877,000	79,000	956,000	17,540,000	1,580,000	19,120,000
Sub-Total						27,824,000	5,984,000	33,808,000
Channel Improvement/Construction								
Excavation (rural area)	m ³	28,900	130	50	180	3,757,000	1,445,000	5,202,000
Embankment	m ³	26,900	590	190	780	15,871,000	5,111,000	20,982,000
Material disposal	m ³	4,500	300	100	400	1,350,000	450,000	1,800,000
Bank Protection (Turfing)	m ²	36,000	80	40	120	2,880,000	1,440,000	4,320,000
Miscellaneous (side drain, etc.)	m	2,700	5,030	2,480	7,510	13,581,000	6,696,000	20,277,000
Sub-Total						37,439,000	15,142,000	52,581,000
Bridge								
Road bridge (Rural area)	m ²	720	74,000	31,000	105,000	53,280,000	22,320,000	75,600,000
Sub-Total						53,280,000	22,320,000	75,600,000
Total of Case G6						2,678,543,000	437,446,000	3,115,989,000

Table 2.2.7 Direct Construction Costs of Alternative Cases in Greater Colombo Basin (3/4)

Item	unit	Q'ty	Unit Cost			Construction Cost		
			FC (Rs.)	LC (Rs.)	Total (Rs.)	FC (Rs.)	LC (Rs.)	Total (Rs.)
Case G7: Madiwela South Diversion								
Channel Construction								
Excavation (urban area)	m ³	1,061,000	180	70	250	190,980,000	74,270,000	265,250,000
Material disposal	m ³	1,061,000	300	100	400	318,300,000	106,100,000	424,400,000
Care of water and dewatering	m	9,600	1,650	2,770	4,420	15,840,000	26,592,000	42,432,000
Miscellaneous (side drain, etc.)	m	9,600	5,030	2,480	7,510	48,288,000	23,808,000	72,096,000
Special Traffic Control Measure (10% of above)						57,340,800	23,077,000	80,417,800
Sub-Total						630,748,800	253,847,000	884,595,800
Closing Bund								
Embankment	m ³	13,600	590	190	780	8,024,000	2,584,000	10,608,000
Bank Protection (Turfing)	m ²	2,500	80	40	120	200,000	100,000	300,000
Bank Protection (Stone Pitching)	m ³	760	6,220	1,730	7,950	4,727,200	1,314,800	6,042,000
Spillway (B x H = 5 x 1 m , RC)	m ³	60	12,000	5,170	17,170	720,000	310,200	1,030,200
Care of water and dewatering	m	200	1,650	2,770	4,420	330,000	554,000	884,000
Miscellaneous (side drain, etc.)	m	200	5,030	2,480	7,510	1,006,000	496,000	1,502,000
Sub-Total						15,007,200	5,359,000	20,366,200
Drop Structure								
Drop Structure (L = 30 m, H = 1.5 m)	LS	1	21,000,000	14,000,000	35,000,000	21,000,000	14,000,000	35,000,000
Sub-Total						21,000,000	14,000,000	35,000,000
Bridge								
Road bridge (Urban area)	m ²	4,600	87,500	37,500	125,000	402,500,000	172,500,000	575,000,000
Road bridge (Rural area)	m ²	2,480	74,000	31,000	105,000	183,520,000	76,880,000	260,400,000
Sub-Total						586,020,000	249,380,000	835,400,000
Total of Case G7						1,252,776,000	522,586,000	1,775,362,000
G8: Restoration of Existing Mutuwal Tunnel								
Tunnel Restoration								
Excavation (Manual)	m ³	700	3,360	1,280	4,640	2,352,000	896,000	3,248,000
Material disposal (Manual)	m ³	700	4,000	2,400	6,400	2,800,000	1,680,000	4,480,000
Removal of existing structure	m ³	500	5,860	2,500	8,360	2,930,000	1,250,000	4,180,000
Care of water and dewatering	m	500	3,300	5,540	4,420	1,650,000	2,770,000	4,420,000
Miscellaneous (side drain, etc.)	m	500	10,060	4,960	7,510	5,030,000	2,480,000	7,510,000
Reinforced concrete	m ³	250	12,000	5,170	17,170	3,000,000	1,292,500	4,292,500
Formwork	m ²	1,200	670	380	1,050	804,000	456,000	1,260,000
Sub-Total						18,566,000	10,824,500	29,390,500
Box Culvert								
Box culvert (road crossing)	m ³	4,800	17,140	7,340	24,480	82,272,000	35,232,000	117,504,000
Sub-Total						82,272,000	35,232,000	117,504,000
Total of Case G8						100,838,000	46,056,500	146,894,500

Table 2.2.7 Direct Construction Costs of Alternative Cases in Greater Colombo Basin (4/4)

Item	unit	Q'ty	Unit Cost			Construction Cost		
			FC (Rs.)	LC (Rs.)	Total (Rs.)	FC (Rs.)	LC (Rs.)	Total (Rs.)
Case G9: New Mutuwal Tunnel (D = 3 m)								
Tunnel Construction								
Tunnel Construction (Dia = 3 m)	m	740	330,000	141,250	471,250	244,200,000	104,525,000	348,725,000
Sub-Total						244,200,000	104,525,000	348,725,000
Channel Construction (concrete)								
Excavation (urban area)	m ³	9,300	180	70	250	1,674,000	651,000	2,325,000
Embankment	m ³	2,600	590	190	780	1,534,000	494,000	2,028,000
Material disposal	m ³	6,600	300	100	400	1,980,000	660,000	2,640,000
Reinforced concrete	m ³	1,080	12,000	5,170	17,170	12,960,000	5,583,600	18,543,600
Formwork	m ²	4,270	670	380	1,050	2,860,900	1,622,600	4,483,500
Miscellaneous (side drain, etc.)	m	230	5,030	2,480	7,510	1,156,900	570,400	1,727,300
Care of water and dewatering	m	230	1,650	2,770	4,420	379,500	637,100	1,016,600
Temporary Sheet Pile, L = 6 m	m	460	19,380	7,460	26,840	8,914,800	3,431,600	12,346,400
Sub-Total						31,460,100	13,650,300	45,110,400
Total of Case G9						275,660,100	118,175,300	393,835,400
Case G10: New Mutuwal Tunnel (D = 4 m)								
Tunnel Construction								
Tunnel Construction (Dia = 4 m)	m	740	367,000	156,750	523,750	271,580,000	115,995,000	387,575,000
Sub-Total						271,580,000	115,995,000	387,575,000
Channel Construction (concrete)								
Excavation (urban area)	m ³	9,300	180	70	250	1,674,000	651,000	2,325,000
Embankment	m ³	2,700	590	190	780	1,593,000	513,000	2,106,000
Material disposal	m ³	6,600	300	100	400	1,980,000	660,000	2,640,000
Reinforced concrete	m ³	1,070	12,000	5,170	17,170	12,840,000	5,531,900	18,371,900
Formwork	m ²	4,270	670	380	1,050	2,860,900	1,622,600	4,483,500
Miscellaneous (side drain, etc.)	m	230	5,030	2,480	7,510	1,156,900	570,400	1,727,300
Care of water and dewatering	m	230	1,650	2,770	4,420	379,500	637,100	1,016,600
Temporary Sheet Pile, L = 6 m	m	460	19,380	7,460	19,380	8,914,800	3,431,600	12,346,400
Sub-Total						31,399,100	13,617,600	45,016,700
Total of Case G10						302,979,100	129,612,600	432,591,700
Case G11: Improvement of Welawatta (B = 30 m) and Kirillapone (B = 25 m) Canal								
Channel Construction (Gabion wall)								
Excavation (urban area)	m ³	71,100	180	70	250	12,798,000	4,977,000	17,775,000
Embankment	m ³	16,200	590	190	780	9,558,000	3,078,000	12,636,000
Material disposal	m ³	54,900	300	100	400	16,470,000	5,490,000	21,960,000
Bank protection (Gabion)	m	4,060	23,450	10,600	34,050	95,207,000	43,036,000	138,243,000
Miscellaneous (side drain, etc.)	m	2,000	5,030	2,480	7,510	10,060,000	4,960,000	15,020,000
Care of water and dewatering	m	2,031	1,650	2,770	4,420	3,350,490	5,624,762	8,975,252
Sub-Total						147,443,490	67,165,762	214,609,252
Channel Construction (SP channel)								
Excavation (urban area)	m ³	20,100	180	70	250	3,618,000	1,407,000	5,025,000
Material disposal	m ³	20,100	300	100	400	6,030,000	2,010,000	8,040,000
Bank protection (Steel sheet pile)	m	2,080	91,700	39,280	130,980	190,736,000	81,702,400	272,438,400
Miscellaneous (side drain, etc.)	m	1,000	5,030	2,480	7,510	5,030,000	2,480,000	7,510,000
Care of water and dewatering	m	1,039	1,650	2,770	4,420	1,715,010	2,879,138	4,594,148
Sub-Total						207,129,010	90,478,538	297,607,548
Bridge								
Road bridge (Urban area)	m ²	2,290	87,500	37,500	125,000	200,375,000	85,875,000	286,250,000
Railway bridge	LS	2	11,900,000	5,100,000	17,000,000	23,800,000	10,200,000	34,000,000
Sub-Total						224,175,000	96,075,000	320,250,000
Total of Case G11						578,747,500	253,719,300	832,466,800

Table 2.2.8 Direct Construction Costs of Alternative Cases in Bolgoda Basin (1/3)

Item	unit	Q'ty	Unit Cost			Construction Cost		
			FC (Rs.)	LC (Rs.)	Total (Rs.)	FC (Rs.)	LC (Rs.)	Total (Rs.)
Case B1: Improvement of Weras Ganga (Dredging width = 20 m) and Tributaries, Urban Drainage Improvement								
1. Weras Ganga Dredging								
Channel Improvement								
Dredging by Cutter Suction Dredger	m ³	71,050	810	210	1,020	57,550,500	14,920,500	72,471,000
Miscellaneous (side drain, etc.)	m	750	5,030	2,480	7,510	3,772,500	1,860,000	5,632,500
Preparation of Disposal Area	LS		35% of the above			21,463,050	5,873,175	27,336,225
Sub-total						82,786,050	22,653,675	105,439,725
Flood Protection Wall with Gate								
Wet Masonry Wall (H = 1.0)	m	2,300	11,040	2,760	13,800	25,392,000	6,348,000	31,740,000
Box culvert (non road crossing)	m ³	620	9,790	4,200	13,990	6,069,800	2,604,000	8,673,800
Flap gate	m ²	20.6	133,900	31,900	165,800	2,758,340	657,140	3,415,480
Sub-total						34,220,140	9,609,140	43,829,280
Retention Area								
Periphery Canal and Path way	m	10,400	560	1,480	2,040	5,824,000	15,392,000	21,216,000
Sub-total						5,824,000	15,392,000	21,216,000
Total of 1.						122,830,190	47,654,815	170,485,005
2. Nugegoda - Rattanaipitiya Ela Improvement								
Channel Improvement								
Excavation (normal)	m ³	172,000	180	70	250	30,960,000	12,040,000	43,000,000
Excavation (underwater)	m ³	5,400	450	140	590	2,430,000	756,000	3,186,000
Embankment (L = 10 km)	m ³	14,000	590	190	780	8,260,000	2,660,000	10,920,000
Disposal of excavated material	m ³	177,500	300	100	400	53,250,000	17,750,000	71,000,000
Gabion Work (H = 3 m)	m	2,480	23,450	10,600	34,050	58,156,000	26,288,000	84,444,000
Gabion Work (H = 2 m)	m	3,080	15,630	7,070	22,700	48,140,400	21,775,600	69,916,000
Turfing	m ²	10,900	80	40	120	872,000	436,000	1,308,000
Removal of existing structure	m ³	130	2,930	1,250	4,180	380,900	162,500	543,400
Miscellaneous	m	11,300	5,030	2,480	7,510	56,839,000	28,024,000	84,863,000
Care of Water and Dewatering	m	11,300	1,650	2,770	4,420	18,645,000	31,301,000	49,946,000
Sub-total						277,933,300	141,193,100	419,126,400
Bridge								
Road Bridge (urban area)	m ²	1,820	87,500	37,500	125,000	159,250,000	68,250,000	227,500,000
Sub-total						159,250,000	68,250,000	227,500,000
Retention Area								
Periphery Canal and Path way	m	5,200	560	1,480	2,040	2,912,000	7,696,000	10,608,000
Sub-total						2,912,000	7,696,000	10,608,000
Total of 2.						440,095,300	217,139,100	657,234,400
3. Bolgoda Canal Improvement								
Channel Improvement								
Excavation (normal)	m ³	60,900	180	70	250	10,962,000	4,263,000	15,225,000
Excavation (underwater)	m ³	6,800	450	140	590	3,060,000	952,000	4,012,000
Embankment (L = 10 km)	m ³	7,700	590	190	780	4,543,000	1,463,000	6,006,000
Disposal of excavated material	m ³	67,800	300	100	400	20,340,000	6,780,000	27,120,000
Turfing	m ²	5,900	80	40	120	472,000	236,000	708,000
Removal of existing structure	m ³	200	2,930	1,250	4,180	586,000	250,000	836,000
Miscellaneous	m	2,000	5,030	2,480	7,510	10,060,000	4,960,000	15,020,000
Care of Water and Dewatering	m	2,000	1,650	2,770	4,420	3,300,000	5,540,000	8,840,000
Sub-total						53,323,000	24,444,000	77,767,000
Bridge								
Road Bridge (urban area)	m ²	210	87,500	37,500	125,000	18,375,000	7,875,000	26,250,000
Sub-total						18,375,000	7,875,000	26,250,000
Retention Area								
Periphery Canal and Path way	m	4,400	560	1,480	2,040	2,464,000	6,512,000	8,976,000
Sub-total						2,464,000	6,512,000	8,976,000
Total of 3.						74,162,000	38,831,000	112,993,000
4. Boralessgamuwa North Improvement								
Channel Improvement								
Excavation (normal)	m ³	38,000	180	70	250	6,840,000	2,660,000	9,500,000
Embankment (L = 10 km)	m ³	16,300	590	190	780	9,617,000	3,097,000	12,714,000
Disposal of excavated material	m ³	38,000	300	100	400	11,400,000	3,800,000	15,200,000
Gabion Work (H = 3 m)	m	400	23,450	10,600	34,050	9,380,000	4,240,000	13,620,000
Turfing	m ²	8,700	80	40	120	696,000	348,000	1,044,000
Removal of existing structure	m ³	100	2,930	1,250	4,180	293,000	125,000	418,000
Miscellaneous	m	2,850	5,030	2,480	7,510	14,335,500	7,068,000	21,403,500
Care of Water and Dewatering	m	2,850	1,650	2,770	4,420	4,702,500	7,894,500	12,597,000
Sub-total						57,264,000	29,232,500	86,496,500
Bridge								
Road Bridge (urban area)	m ²	470	87,500	37,500	125,000	41,125,000	17,625,000	58,750,000
Sub-total						41,125,000	17,625,000	58,750,000
Culvert								
Box Culvert (road crossing)	m ³	150	17,140	7,340	24,480	2,571,000	1,101,000	3,672,000
Sub-total						2,571,000	1,101,000	3,672,000
Total of 4.						100,960,000	47,958,500	148,918,500

Table 2.2.8 Direct Construction Costs of Alternative Cases in Bolgoda Basin (2/3)

Item	unit	Q'ty	Unit Cost			Construction Cost		
			FC (Rs.)	LC (Rs.)	Total (Rs.)	FC (Rs.)	LC (Rs.)	Total (Rs.)
5. Boraesgamuwa South Improvement								
Channel Improvement								
Excavation (normal)	m ³	13,600	180	70	250	2,448,000	952,000	3,400,000
Excavation (underwater)	m ³	3,900	450	140	590	1,755,000	546,000	2,301,000
Embankment (L = 10 km)	m ³	2,000	590	190	780	1,180,000	380,000	1,560,000
Disposal of excavated material	m ³	17,600	300	100	400	5,280,000	1,760,000	7,040,000
Turfing	m ²	1,300	80	40	120	104,000	52,000	156,000
Removal of existing structure	m ³	200	2,930	1,250	4,180	586,000	250,000	836,000
Miscellaneous	m	1,000	5,030	2,480	7,510	5,030,000	2,480,000	7,510,000
Care of Water and Dewatering	m	1,000	1,650	2,770	4,420	1,650,000	2,770,000	4,420,000
Sub-total						18,033,000	9,190,000	27,223,000
Bridge								
Road Bridge (rural area)		450	74,000	31,000	105,000	33,300,000	13,950,000	47,250,000
Sub-total						33,300,000	13,950,000	47,250,000
Total of 5.						51,333,000	23,140,000	74,473,000
6. Maha Ela Improvement								
Channel Improvement								
Excavation (normal)	m ³	75,000	180	70	250	13,500,000	5,250,000	18,750,000
Excavation (underwater)	m ³	67,500	450	140	590	30,375,000	9,450,000	39,825,000
Embankment (L = 10 km)	m ³	18,400	590	190	780	10,856,000	3,496,000	14,352,000
Disposal of excavated material	m ³	142,500	300	100	400	42,750,000	14,250,000	57,000,000
Turfing	m ²	10,700	80	40	120	856,000	428,000	1,284,000
Removal of existing structure	m ³	150	2,930	1,250	4,180	439,500	187,500	627,000
Miscellaneous	m	4,200	5,030	2,480	7,510	21,126,000	10,416,000	31,542,000
Care of Water and Dewatering	m	4,200	1,650	2,770	4,420	6,930,000	11,634,000	18,564,000
Sub-total						126,832,500	55,111,500	181,944,000
Bridge								
Road Bridge (rural area)	m ²	1,430	74,000	31,000	105,000	105,820,000	44,330,000	150,150,000
Sub-total						105,820,000	44,330,000	150,150,000
Total of 6.						232,652,500	99,441,500	332,094,000
7. Ratmalana Moratuwa Improvement								
Channel Improvement								
Excavation (normal)	m ³	13,200	180	70	250	2,376,000	924,000	3,300,000
Embankment (L = 10 km)	m ³	2,900	590	190	780	1,711,000	551,000	2,262,000
Disposal of excavated material	m ³	13,200	300	100	400	3,960,000	1,320,000	5,280,000
Turfing	m ²	1,850	80	40	120	148,000	74,000	222,000
Removal of existing structure	m ³	200	2,930	1,250	4,180	586,000	250,000	836,000
Miscellaneous	m	1,300	5,030	2,480	7,510	6,539,000	3,224,000	9,763,000
Care of Water and Dewatering	m	1,300	1,650	2,770	4,420	2,145,000	3,601,000	5,746,000
Sub-total						17,465,000	9,944,000	27,409,000
Bridge								
Road Bridge (urban area)	m ²	240	87,500	37,500	125,000	21,000,000	9,000,000	30,000,000
Sub-total						21,000,000	9,000,000	30,000,000
Urban Drainage								
Flume with Cover Slab B = 0.8, H = 0.8	m	490	39,560	16,950	56,510	19,384,400	8,305,500	27,689,900
Flume with Cover Slab B = 0.9, H = 0.9	m	662	43,320	18,570	61,890	28,677,840	12,293,340	40,971,180
Flume with Cover Slab B = 1.0, H = 1.0	m	556	47,090	20,180	67,270	26,182,040	11,220,080	37,402,120
Flume with Cover Slab B = 1.1, H = 1.1	m	836	50,860	21,790	72,650	42,518,960	18,216,440	60,735,400
Flume with Cover Slab B = 1.2, H = 1.2	m	1,790	54,620	23,410	78,030	97,769,800	41,903,900	139,673,700
Flume with Cover Slab B = 1.3, H = 1.3	m	854	58,390	25,020	83,410	49,865,060	21,367,080	71,232,140
Flume with Cover Slab B = 1.3, H = 1.4	m	464	62,160	26,640	88,800	28,842,240	12,360,960	41,203,200
Flume with Cover Slab B = 1.5, H = 1.5	m	592	67,110	28,760	95,870	39,729,120	17,025,920	56,755,040
Flume with Cover Slab B = 2.0, H = 1.5	m	148	76,220	32,670	108,890	11,280,560	4,835,160	16,115,720
Wet Masonry Channel B = 1.0, H = 1.0	m	1,076	21,840	5,460	27,300	23,499,840	5,874,960	29,374,800
Wet Masonry Channel B = 1.5, H = 1.0	m	724	22,240	5,560	27,800	16,101,760	4,025,440	20,127,200
Wet Masonry Channel B = 1.5, H = 1.5	m	656	26,480	6,620	33,100	17,370,880	4,342,720	21,713,600
Wet Masonry Channel B = 2.0, H = 1.5	m	216	26,880	6,720	33,600	5,806,080	1,451,520	7,257,600
Wet Masonry Channel B = 3.0, H = 1.5	m	128	27,680	6,920	34,600	3,543,040	885,760	4,428,800
Open Channel with Gabion B = 3.0, H = 1.5	m	46	48,000	12,000	60,000	2,208,000	552,000	2,760,000
Open Channel with Gabion B = 5.0, H = 1.5	m	642	49,360	12,340	61,700	31,689,120	7,922,280	39,611,400
Open Channel with Gabion B = 6.0, H = 1.5	m	100	50,320	12,580	62,900	5,032,000	1,258,000	6,290,000
Earth Open Channel B = 2.0, H = 1.5	m	320	8,480	2,120	10,600	2,713,600	678,400	3,392,000
Earth Open Channel B = 5.0, H = 1.5	m	104	10,800	2,700	13,500	1,123,200	280,800	1,404,000
Earth Open Channel B = 6.0, H = 1.5	m	712	11,760	2,940	14,700	8,373,120	2,093,280	10,466,400
Sub-total						461,710,660	176,893,540	638,604,200
Total of 7.						500,175,660	195,837,540	696,013,200
Total of Case B1						1,522,208,650	670,002,455	2,192,211,105

Table 2.2.8 Direct Construction Costs of Alternative Cases in Bolgoda Basin (3/3)

Item	unit	Q'ty	Unit Cost			Construction Cost		
			FC (Rs.)	LC (Rs.)	Total (Rs.)	FC (Rs.)	LC (Rs.)	Total (Rs.)
Case B2: Improvement of Weras Ganga (Dredging width = 40 m) and Tributaries, Urban Drainage Improvement								
1. Weras Ganga Dredging								
Channel Improvement								
Dredging by Cutter Suction Dredger	m ³	142,100	810	210	1,020	115,101,000	29,841,000	144,942,000
Miscellaneous (side drain, etc.)	m	1,500	5,030	2,480	7,510	7,545,000	3,720,000	11,265,000
Preparation of Disposal Area	Ls		35% of the above			42,926,100	11,746,350	54,672,450
Sub-total						165,572,100	45,307,350	210,879,450
Flood Protection Wall with Gate								
Wet Masonry Wall (H=1.0)	m	2,300	11,040	2,760	13,800	25,392,000	6,348,000	31,740,000
Box culvert (non road crossing)	m ³	620	9,790	4,200	13,990	6,069,800	2,604,000	8,673,800
Flap gate	m ²	20.6	133,900	31,900	165,800	2,758,340	657,140	3,415,480
Sub-total						34,220,140	9,609,140	43,829,280
Retention Area								
Periphery Canal and Path way	m	10,400	560	1,480	2,040	5,824,000	15,392,000	21,216,000
Sub-total						5,824,000	15,392,000	21,216,000
Total 1.						205,616,240	70,308,490	275,924,730
2. Nugegoda-Rattanapitiya Ela								
	Same as B1					440,095,300	217,139,100	657,234,400
3. Bolgoda Canal								
	Same as B1					74,162,000	38,831,000	112,993,000
4. Boralesgamuwa North								
	Same as B1					100,960,000	47,958,500	148,918,500
5. Boralesgamuwa South								
	Same as B1					51,333,000	23,140,000	74,473,000
6. Maha Ela								
	Same as B1					232,652,500	99,441,500	332,094,000
7. Ratmalana Moratuwa								
	Same as B1					500,175,660	195,837,540	696,013,200
Total of Case B2								
						1,604,994,700	692,656,130	2,297,650,830
Case B3: Improvement of Weras Ganga (Dredging width = 60 m) and Tributaries, Urban Drainage								
1. Weras Ganga Improvement								
Channel Improvement								
Dredging by Cutter Suction Dredger	m ³	213,150	810	210	1,020	172,651,500	44,761,500	217,413,000
Miscellaneous (side drain, etc.)	m	2,250	5,030	2,480	7,510	11,317,500	5,580,000	16,897,500
Preparation of Disposal Area	Ls		35% of the above			64,389,150	17,619,525	82,008,675
Sub-total						248,358,150	67,961,025	316,319,175
Bridge								
Road Bridge (urban area)	m ²	600	87,500	37,500	125,000	52,500,000	22,500,000	75,000,000
Sub-total						52,500,000	22,500,000	75,000,000
Flood Protection Wall with Gate								
Wet Masonry Wall (H = 1.0)	m	2,300	11,040	2,760	13,800	25,392,000	6,348,000	31,740,000
Box culvert (non road crossing)	m ³	620	9,790	4,200	13,990	6,069,800	2,604,000	8,673,800
Flap gate	m ²	20.6	133,900	31,900	165,800	2,758,340	657,140	3,415,480
Sub-total						34,220,140	9,609,140	43,829,280
Retention Area								
Periphery Canal and Path way	m	10,400	560	1,480	2,040	5,824,000	15,392,000	21,216,000
Sub-total						5,824,000	15,392,000	21,216,000
Total of 1.						340,902,290	115,462,165	456,364,455
2. Nugegoda-Rattanapitiya Ela								
	Same as B1					440,095,300	217,139,100	657,234,400
3. Bolgoda Canal								
	Same as B1					74,162,000	38,831,000	112,993,000
4. Boralesgamuwa North								
	Same as B1					100,960,000	47,958,500	148,918,500
5. Boralesgamuwa South								
	Same as B1					51,333,000	23,140,000	74,473,000
6. Maha Ela								
	Same as B1					232,652,500	99,441,500	332,094,000
7. Ratmalana Moratuwa								
	Same as B1					500,175,660	195,837,540	696,013,200
Total of Case B3								
						1,740,280,750	737,809,805	2,478,090,555

Table 2.2.9 Land Acquisition Cost by Construction Site

No.	Alternative Measures	Unit Cost (Rs./m ²)	Area (m ²)	Land Acquisition Cost (Rs.)
Ja Ela Basin				
J1	Ja Ela Channel Improvement (B = 45 m)	20	102,700	6,042,000
	Dandugam Oya Channel Improvement (B = 65 m)		199,400	
J2	Ja Ela Channel Improvement (B = 50 m)	20	132,600	7,780,000
	Dandugam Oya Channel Improvement (B = 70 m)		256,400	
J3	Ja Ela Channel Improvement (B = 55 m)	20	166,000	9,528,000
	Dandugam Oya Channel Improvement (B = 75 m)		310,400	
J4	J1	20	302,000	7,210,000
	Kotugoda - Seeduwa Diversion Channel		58,500	
J5	Ja Ela Channel Improvement (B = 60 m)	20	181,100	10,244,000
	Dandugam Oya Channel Improvement (B = 80 m)		331,100	
J6	Ja Ela Channel Improvement (B = 80 m)	20	241,500	13,106,000
	Dandugam Oya Channel Improvement (B = 100 m)		413,800	
Kalu Oya Basin				
K1	Channel Improvement of Kalu Oya mainstream (B = 40 m)	50	95,900	4,795,000
K2	Channel Improvement of Kalu Oya mainstream (B = 45 m)	50	121,200	6,060,000
K3	Channel Improvement of Kalu Oya mainstream (B = 50 m)	50	148,400	7,420,000
K4	Wattala Pumping Station (Q = 10 m ³ /s)	50	1,250	62,500
K5	Wattala Pumping Station (Q = 20 m ³ /s)	50	2,400	120,000
K6	Wattala Pumping Station (Q = 30 m ³ /s)	50	2,750	137,500
K7	Kalu Oya - Old Negombo Diversion Canal + Improvement of Old Negombo Canal (B = 30 m)	50	115,520	5,776,000
K8	Improvement of Old Negombo Canal Option (B = 30 m)	50	117,600	5,880,000
K9	Improvement of Old Negombo Canal Option (B = 35 m)	50	138,600	6,930,000
K10	Improvement of Old Negombo Canal Option (B = 40 m)	50	159,600	7,980,000
Greater Colombo Area				
G1	Maradana P/S (5 m ³ /s) and Improvement of Galle Face Outfall	20,000	1,170	23,400,000
G2	Maradana P/S (10 m ³ /s) and Improvement of Galle Face Outfall	20,000	2,420	48,400,000
G3	North Lock Pumping Station (10 m ³ /s)	12,000	1,250	15,000,000
G4	North Lock Pumping Station (15 m ³ /s)	12,000	1,800	21,600,000
G5	Gotatuwa Pumping Station (30 m ³ /s)	200	118,420	23,684,000
G6	Gotatuwa Pumping Station (40 m ³ /s)	200	118,870	23,774,000
G7	Madiwela South Diversion Canal	200	197,700	93,000,000
		2,200	24,300	
G8	Restoration of Existing Mutwal Tunnel	12,000	2,220	26,640,000
G9	New Mutwal Tunnel (D = 3 m)	12,000	4,500	54,000,000
G10	New Mutwal Tunnel (D = 4 m)	12,000	4,500	54,000,000
G11	Improvement of Welawatta (B = 30 m) and Kirillapone Canal (B = 25 m)	12,000	19,600	235,200,000
Bolgoda Basin				
B1	Improvement of Weras Ganga (B = 20 m) and Tributaries, and Urban Drainage	200	367,000	99,800,000
		2,200	12,000	
B2	Improvement of Weras Ganga (B = 40 m) and Tributaries, and Urban Drainage	200	367,000	99,800,000
		2,200	12,000	
B3	Improvement of Weras Ganga (B = 60 m) and Tributaries, and Urban Drainage	200	367,000	99,800,000
		2,200	12,000	

Note : Unit Cost is derived from the data of the Valuation Department

Table 2.2.10 Project Costs of Alternative Cases in Ja Ela Basin

Ja Ela Basin (50-year)

Base Case

(Unit: millionRs.)

Case	J1	J2	J3	J4	J5	J6
1. Construction Cost	1,401	1,630	1,975	1,584	2,090	2,557
2. Land Acquisition & Compensation Cost	423	425	427	425	428	432
3. Engineering Service (15% of Construction Cost)	210	245	296	238	313	383
4. Administration Cost (2% of the above)	41	46	54	45	57	67
Total of (1+2+3+4)	2,075	2,346	2,752	2,291	2,888	3,439
5. Price Escalation	54	59	68	58	71	82
6. Physical Contingency	195	220	258	215	270	321
7. Tax	462	538	652	523	690	844
Project Cost	2,785	3,163	3,729	3,087	3,919	4,687

Case for reduced retention area

(Unit: millionRs.)

Case	J1	J2	J3	J4	J5	J6
1. Construction Cost	1,401	1,630	1,975	1,584	2,090	2,557
2. Land Acquisition & Compensation Cost	318	256	236	375	223	185
3. Engineering Service (15% of Construction Cost)	210	245	296	238	313	383
4. Administration Cost (2% of the above)	39	43	50	44	53	63
Total of (1+2+3+4)	1,968	2,173	2,557	2,240	2,679	3,188
5. Price Escalation	49	52	59	56	62	72
6. Physical Contingency	184	203	238	210	250	296
7. Tax	462	538	652	523	690	844
Project Cost	2,663	2,965	3,507	3,029	3,679	4,400

Ja Ela Basin (25-year)

Base Case

(Unit: millionRs.)

Case	J1	J2	J3	J4	J5	J6
1. Construction Cost	1,088	1,142	1,220	1,202	1,278	1,520
2. Land Acquisition & Compensation Cost	423	425	427	425	428	432
3. Engineering Service (15% of Construction Cost)	163	171	183	180	192	228
4. Administration Cost (2% of the above)	33	35	37	36	38	44
Total of (1+2+3+4)	1,708	1,774	1,867	1,843	1,936	2,224
5. Price Escalation	46	48	50	49	51	57
6. Physical Contingency	161	167	176	173	182	209
7. Tax	359	377	402	397	422	502
Project Cost	2,275	2,365	2,494	2,462	2,591	2,992

Case for reduced retention area

(Unit: millionRs.)

Case	J1	J2	J3	J4	J5	J6
1. Construction Cost	1,088	1,142	1,220	1,202	1,278	1,520
2. Land Acquisition & Compensation Cost	378	359	330	425	326	293
3. Engineering Service (15% of Construction Cost)	163	171	183	180	192	228
4. Administration Cost (2% of the above)	33	33	35	36	36	41
Total of (1+2+3+4)	1,663	1,706	1,767	1,843	1,831	2,083
5. Price Escalation	44	45	45	49	47	51
6. Physical Contingency	156	160	166	173	172	195
7. Tax	359	377	402	397	422	502
Project Cost	2,222	2,288	2,381	2,462	2,471	2,830

Ja Ela Basin (10-year)

Base Case

(Unit: millionRs.)

Case	J1	J2	J3	J4	J5	J6
1. Construction Cost	1,024	1,078	1,156	1,131	1,212	1,457
2. Land Acquisition & Compensation Cost	423	425	427	425	428	432
3. Engineering Service (15% of Construction Cost)	154	162	173	170	182	219
4. Administration Cost (2% of the above)	32	33	35	34	36	42
Total of (1+2+3+4)	1,633	1,699	1,792	1,759	1,859	2,150
5. Price Escalation	45	46	48	47	50	56
6. Physical Contingency	154	160	169	166	175	202
7. Tax	338	356	382	373	400	481
Project Cost	2,170	2,261	2,391	2,345	2,483	2,888

Case for reduced retention area

(Unit: millionRs.)

Case	J1	J2	J3	J4	J5	J6
1. Construction Cost	1,024	1,078	1,156	1,131	1,212	1,457
2. Land Acquisition & Compensation Cost	342	328	306	425	297	269
3. Engineering Service (15% of Construction Cost)	154	162	173	170	182	219
4. Administration Cost (2% of the above)	30	31	33	34	34	39
Total of (1+2+3+4)	1,551	1,599	1,668	1,759	1,725	1,984
5. Price Escalation	41	42	43	47	44	49
6. Physical Contingency	146	150	157	166	162	186
7. Tax	338	356	382	373	400	481
Project Cost	2,076	2,147	2,249	2,345	2,331	2,699

Table 2.2.11 Project Costs of Alternative Cases in Kalu Oya Basin (1/2)

Kalu Oya Basin (50-year)

Base Case

(Unit: million Rs.)

Case	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10
1. Construction Cost	675	785	905	1,147	2,057	2,472	594	270	314	396
2. Land Acquisition & Compensation Cost	320	321	323	314	314	314	321	321	322	323
3. Engineering Service (15% of Construction Cost)	101	118	136	172	308	371	89	41	47	59
4. Administration Cost (2% of the above)	22	24	27	33	54	63	20	13	14	16
Total of (1+2+3+4)	1,118	1,249	1,391	1,666	2,733	3,220	1,023	644	697	794
5. Price Escalation	30	32	35	37	56	64	29	21	22	24
6. Physical Contingency	106	118	131	118	185	216	97	62	67	76
7. Tax	223	259	299	455	819	984	196	89	104	131
Project Cost	1,476	1,658	1,856	2,276	3,792	4,484	1,345	816	890	1,025

Combined Case

(Unit: million Rs.)

Case	K11	K12	K13	K14	K15	K16	K17	K18	K19	K20
1. Construction Cost	946	1,100	1,301	1,539	3,418	1,269	990	1,071	1,895	4,367
2. Land Acquisition & Compensation Cost	327	329	332	334	327	326	328	329	339	339
3. Engineering Service (15% of Construction Cost)	142	165	195	231	513	190	148	161	284	655
4. Administration Cost (2% of the above)	28	32	37	42	85	36	29	31	50	107
Total of (1+2+3+4)	1,442	1,626	1,865	2,146	4,342	1,822	1,495	1,593	2,569	5,469
5. Price Escalation	37	40	45	52	87	45	38	40	60	111
6. Physical Contingency	136	153	175	201	320	171	141	150	240	509
7. Tax	312	363	429	508	1,296	419	327	354	625	1,441
Project Cost	1,927	2,182	2,515	2,906	6,045	2,456	2,001	2,136	3,495	7,529

Case for Reduced Retention Area

(Unit: million Rs.)

Case	K13	K14	K15	K16	K19	K20
1. Construction Cost	1,301	1,539	3,418	1,269	1,895	4,367
2. Land Acquisition & Compensation Cost	288	247	270	270	199	175
3. Engineering Service (15% of Construction Cost)	195	231	513	190	284	655
4. Administration Cost (2% of the above)	36	40	84	35	48	104
Total of (1+2+3+4)	1,820	2,058	4,285	1,764	2,425	5,301
5. Price Escalation	43	48	85	42	54	104
6. Physical Contingency	170	192	399	165	226	408
7. Tax	429	508	1,128	419	625	1,609
Project Cost	2,463	2,806	5,896	2,390	3,331	7,422

Kalu Oya Basin (25-year)

Base Case

(Unit: million Rs.)

Case	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10
1. Construction Cost	626	691	756	1,147	2,057	2,472	570	225	242	260
2. Land Acquisition & Compensation Cost	320	321	323	314	314	314	321	321	322	323
3. Engineering Service (15% of Construction Cost)	94	104	113	172	308	371	85	34	36	39
4. Administration Cost (2% of the above)	21	22	24	33	54	63	20	12	12	12
Total of (1+2+3+4)	1,060	1,138	1,216	1,666	2,733	3,220	995	591	613	634
5. Price Escalation	28	30	31	37	56	64	28	20	20	21
6. Physical Contingency	100	108	115	118	185	216	94	57	59	61
7. Tax	207	228	250	455	819	984	188	74	80	86
Project Cost	1,396	1,504	1,612	2,276	3,792	4,484	1,306	742	772	801

Combined Case

(Unit: million Rs.)

Case	K11	K12	K13	K14	K15	K16	K17	K18	K19	K20
1. Construction Cost	851	933	1,016	1,421	3,323	1,196	868	886	1,585	4,057
2. Land Acquisition & Compensation Cost	327	329	332	334	327	326	328	329	339	339
3. Engineering Service (15% of Construction Cost)	128	140	152	213	498	179	130	133	238	609
4. Administration Cost (2% of the above)	26	28	30	39	83	34	27	27	43	100
Total of (1+2+3+4)	1,331	1,431	1,530	2,007	4,231	1,736	1,353	1,375	2,206	5,105
5. Price Escalation	34	36	38	49	85	43	35	35	53	103
6. Physical Contingency	125	135	144	188	310	163	127	129	207	475
7. Tax	281	308	335	469	1,264	395	287	292	523	1,339
Project Cost	1,772	1,910	2,048	2,712	5,891	2,336	1,802	1,832	2,988	7,023

Case for Reduced Retention Area

(Unit: million Rs.)

Case	K12	K13	K14	K15	K16	K18	K19
1. Construction Cost	933	1,016	1,421	3,323	1,196	886	1,585
2. Land Acquisition & Compensation Cost	303	270	232	216	252	303	184
3. Engineering Service (15% of Construction Cost)	140	152	213	498	179	133	238
4. Administration Cost (2% of the above)	28	29	37	81	33	26	40
Total of (1+2+3+4)	1,404	1,467	1,903	4,119	1,660	1,348	2,047
5. Price Escalation	35	36	44	80	40	34	46
6. Physical Contingency	132	138	178	299	155	127	191
7. Tax	308	335	469	1,264	395	292	523
Project Cost	1,879	1,975	2,594	5,762	2,249	1,801	2,807

Table 2.2.11 Project Costs of Alternative Cases in Kalu Oya Basin (2/2)

Kalu Oya Basin (10-year)

Base Case

(Unit: million Rs.)

Case	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10
1. Construction Cost	619	685	750	1,147	2,057	2,472	566	219	236	254
2. Land Acquisition & Compensation Cost	320	321	323	314	314	314	321	321	322	323
3. Engineering Service (15% of Construction Cost)	93	103	112	172	308	371	85	33	35	38
4. Administration Cost (2% of the above)	21	22	24	33	54	63	19	11	12	12
Total of (1+2+3+4)	1,052	1,131	1,208	1,666	2,733	3,220	991	584	606	627
5. Price Escalation	28	30	31	37	56	64	28	20	20	21
6. Physical Contingency	100	107	114	118	185	216	94	56	58	60
7. Tax	204	226	247	455	819	984	187	72	78	84
Project Cost	1,384	1,493	1,601	2,276	3,792	4,484	1,300	732	762	792

Combined Case

(Unit: million Rs.)

Case	K11	K12	K13	K14	K15	K16	K17	K18	K19	K20
1. Construction Cost	838	921	1,003	1,404	3,310	1,185	855	873	1,569	4,041
2. Land Acquisition & Compensation Cost	327	329	332	334	327	326	328	329	339	339
3. Engineering Service (15% of Construction Cost)	126	138	150	211	497	178	128	131	235	606
4. Administration Cost (2% of the above)	26	28	30	39	83	34	26	27	43	100
Total of (1+2+3+4)	1,316	1,416	1,516	1,987	4,216	1,723	1,338	1,359	2,187	5,087
5. Price Escalation	34	36	38	49	84	43	35	35	53	103
6. Physical Contingency	124	133	143	186	309	162	126	128	205	473
7. Tax	277	304	331	463	1,260	391	282	288	518	1,334
Project Cost	1,751	1,889	2,027	2,686	5,869	2,319	1,781	1,810	2,962	6,997

Case for Reduced Retention Area

(Unit: million Rs.)

Case	K12	K13	K14	K15	K16	K17	K18
1. Construction Cost	921	1,003	1,404	3,310	1,185	855	873
2. Land Acquisition & Compensation Cost	261	222	202	156	240	262	234
3. Engineering Service (15% of Construction Cost)	138	150	211	497	178	128	131
4. Administration Cost (2% of the above)	26	28	36	79	32	25	25
Total of (1+2+3+4)	1,346	1,403	1,853	4,042	1,635	1,271	1,262
5. Price Escalation	33	33	43	77	39	32	31
6. Physical Contingency	126	131	173	292	153	119	118
7. Tax	304	331	463	1,260	391	282	288
Project Cost	1,810	1,899	2,533	5,671	2,219	1,704	1,699

Table 2.2.12 Project Cost of the Alternative Cases in Greater Colombo Basin

Greater Colombo Basin

Base Case

(Unit: million Rs.)

Case	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11
1.Construction Cost	634	1,201	1,165	1,585	2,596	3,428	1,953	161	433	476	916
2.Land Acquisition & Compensation Cost	232	262	222	230	232	233	316	236	269	269	486
3.Engineering Service (15% of Construction Cost)	95	180	175	238	389	514	293	24	65	71	137
4.Administration Cost (2% of the above)	19	33	31	41	64	83	51	8	15	16	31
Total of (1+2+3+4)	981	1,676	1,593	2,094	3,282	4,258	2,613	430	782	832	1,570
5. Price Escalation	23	36	34	43	64	81	63	15	23	24	45
6. Physical Contingency	73	118	111	143	222	284	244	41	74	79	149
7. Tax	248	473	461	628	1,024	1,355	644	53	143	157	302
Project Cost	1,325	2,304	2,199	2,908	4,592	5,977	3,565	539	1,022	1,092	2,066

Combined Case

(Unit: million Rs.)

Case	G12	G13	G14	G15	G16	G17	G18	G19	G20	G21	G22	G23	G24
1.Construction Cost	2,006	2,386	2,429	486	529	2,869	2,439	2,481	2,921	3,302	3,344	3,397	4,983
2.Land Acquisition & Compensation Cost	348	380	380	301	301	598	412	412	630	663	663	695	721
3.Engineering Service (15% of Construction Cost)	301	358	364	73	79	430	366	372	438	495	502	510	747
4.Administration Cost (2% of the above)	53	62	63	17	18	78	64	65	80	89	90	92	129
Total of (1+2+3+4)	2,707	3,187	3,237	877	927	3,975	3,281	3,332	4,069	4,549	4,599	4,694	6,580
5. Price Escalation	66	77	78	26	27	99	80	81	102	113	114	117	151
6. Physical Contingency	253	298	302	83	88	372	307	311	381	426	430	439	562
7. Tax	662	787	801	160	174	947	805	819	964	1,090	1,104	1,121	1,749
Project Cost	3,688	4,349	4,419	1,146	1,216	5,393	4,473	4,543	5,516	6,177	6,247	6,371	9,041

Case for reduced retention area 50-year

(Unit: million Rs.)

Case	G19	G20	G21	G22	G23	G24
1.Construction Cost	2,481	2,921	3,302	3,344	3,397	4,983
2.Land Acquisition & Compensation Cost	280	450	459	459	491	517
3.Engineering Service (15% of Construction Cost)	372	438	495	502	510	747
4.Administration Cost (2% of the above)	63	76	85	86	88	125
Total of (1+2+3+4)	3,197	3,886	4,341	4,391	4,485	6,372
5. Price Escalation	75	94	104	105	108	142
6. Physical Contingency	298	363	405	410	419	541
7. Tax	819	964	1,090	1,104	1,121	1,749
Project Cost	4,389	5,307	5,940	6,009	6,133	8,804

Case for reduced retention area 25-year

(Unit: million Rs.)

Case	G7	G10	G12	G13	G14	G15	G16	G19
1.Construction Cost	1,953	476	2,006	2,386	2,429	486	529	2,481
2.Land Acquisition & Compensation Cost	112	65	144	176	176	97	97	208
3.Engineering Service (15% of Construction Cost)	293	71	301	358	364	73	79	372
4.Administration Cost (2% of the above)	47	12	49	58	59	13	14	61
Total of (1+2+3+4)	2,405	624	2,499	2,979	3,029	669	719	3,123
5. Price Escalation	54	15	57	68	69	17	18	72
6. Physical Contingency	223	58	232	277	282	63	67	291
7. Tax	644	157	662	787	801	160	174	819
Project Cost	3,327	855	3,451	4,112	4,181	908	978	4,305

Case for reduced retention area 10-year

(Unit: million Rs.)

Case	G8	G9	G10
1.Construction Cost	161	433	476
2.Land Acquisition & Compensation Cost	32	65	65
3.Engineering Service (15% of Construction Cost)	24	65	71
4.Administration Cost (2% of the above)	4	11	12
Total of (1+2+3+4)	222	574	624
5. Price Escalation	6	14	15
6. Physical Contingency	21	54	58
7. Tax	53	143	157
Project Cost	302	785	855

Table 2.2.13 Project Costs of Alternative Cases in Bolgoda Basin

Bolgoda Basin**Base Case**

(Unit: million Rs.)

Case	B1	B2	B3
1. Construction Cost	2,411	2,527	2,735
2. Land Acquisition & Compensation Cost	1,013	1,013	1,013
3. Engineering Service (15% of Construction Cost)	362	379	410
4. Administration Cost (2% of the above)	76	78	83
Total of (1+2+3+4)	3,861	3,997	4,241
5. Price Escalation	106	109	114
6. Physical Contingency	364	377	399
7. Tax	796	834	903
Project Cost	5,128	5,317	5,657

Case for reduced retention area (50-year)

(Unit: million Rs.)

Case	B1	B2	B3
1. Construction Cost	2,411	2,527	2,735
2. Land Acquisition & Compensation Cost	828	828	828
3. Engineering Service (15% of Construction Cost)	362	379	410
4. Administration Cost (2% of the above)	72	75	79
Total of (1+2+3+4)	3,673	3,809	4,052
5. Price Escalation	98	101	106
6. Physical Contingency	346	358	381
7. Tax	796	834	903
Project Cost	4,912	5,102	5,442

Case for reduced retention area (25-year)

(Unit: million Rs.)

Case	B1	B2	B3
1. Construction Cost	2,410	2,526	2,734
2. Land Acquisition & Compensation Cost	828	828	828
3. Engineering Service (15% of Construction Cost)	362	379	410
4. Administration Cost (2% of the above)	72	75	79
Total of (1+2+3+4)	3,672	3,808	4,051
5. Price Escalation	98	101	106
6. Physical Contingency	345	358	381
7. Tax	795	834	902
Project Cost	4,911	5,100	5,440

Case for reduced retention area (10-year)

(Unit: million Rs.)

Case	B1	B2	B3
1. Construction Cost	2,409	2,525	2,733
2. Land Acquisition & Compensation Cost	828	828	828
3. Engineering Service (15% of Construction Cost)	361	379	410
4. Administration Cost (2% of the above)	72	75	79
Total of (1+2+3+4)	3,671	3,807	4,050
5. Price Escalation	98	101	106
6. Physical Contingency	345	358	381
7. Tax	795	833	902
Project Cost	4,909	5,099	5,438

Table 2.2.14 Breakdown of Project Cost of Proposed Case in Each Basin

Ja Ela Basin (50-year)

Case for reduced retention area (Retention Area: 876ha)

(Unit: million Rs.)

Case Cost Item	J5		
	FC	LC	Total
1. Construction Cost	1,507	583	2,090
Preparatory Works (10%)	137	53	190
Construction Cost	1,370	530	1,900
2. Land Acquisition & Compensation Cost	0	223	223
Land Acquisition	0	185	185
Compensation (20% of Land Acquisition Cost)	0	37	37
3. Engineering Service (15% of Construction Cost	219	94	313
4. Administration Cost (2% of the above)	0	53	53
Total of (1+2+3+4)	1,726	953	2,679
5. Price Escalation	21	41	62
6. Physical Contingency	162	88	250
7. Tax	0	690	690
Project Cost	1,908	1,771	3,679

Kalu Oya Basin (50-year)

Case for Reduced Retention Area (Retention Area: 449ha)

(Unit: million Rs.)

Case Cost Item	K13		
	FC	LC	Total
1. Construction Cost	990	311	1,301
Preparatory Works (10%)	90	28	118
Construction Cost	900	283	1,183
2. Land Acquisition & Compensation Cost	0	288	288
Land Acquisition	0	240	240
Compensation (20% of Land Acquisition Cost)	0	48	48
3. Engineering Service (15% of Construction Cost	137	59	195
4. Administration Cost (2% of the above)	0	36	36
Total of (1+2+3+4)	1,126	694	1,820
5. Price Escalation	14	30	43
6. Physical Contingency	106	65	170
7. Tax	0	429	429
Project Cost	1,246	1,217	2,463

Greater Colombo Basin (50year)

Case for Reduced Retention Area (Retention Area: 380ha)

(Unit: million Rs.)

Case Cost Item	G19		
	FC	LC	Total
1. Construction Cost	1,747	734	2,481
Preparatory Works (10%)	159	67	226
Construction Cost	1,588	668	2,256
2. Land Acquisition & Compensation Cost	0	280	280
Land Acquisition	0	234	234
Compensation (20% of Land Acquisition Cost)	0	47	47
3. Engineering Service (15% of Construction Cost	261	112	372
4. Administration Cost (2% of the above)	0	63	63
Total of (1+2+3+4)	2,008	1,189	3,197
5. Price Escalation	24	51	75
6. Physical Contingency	188	110	298
7. Tax	0	819	819
Project Cost	2,219	2,170	4,389

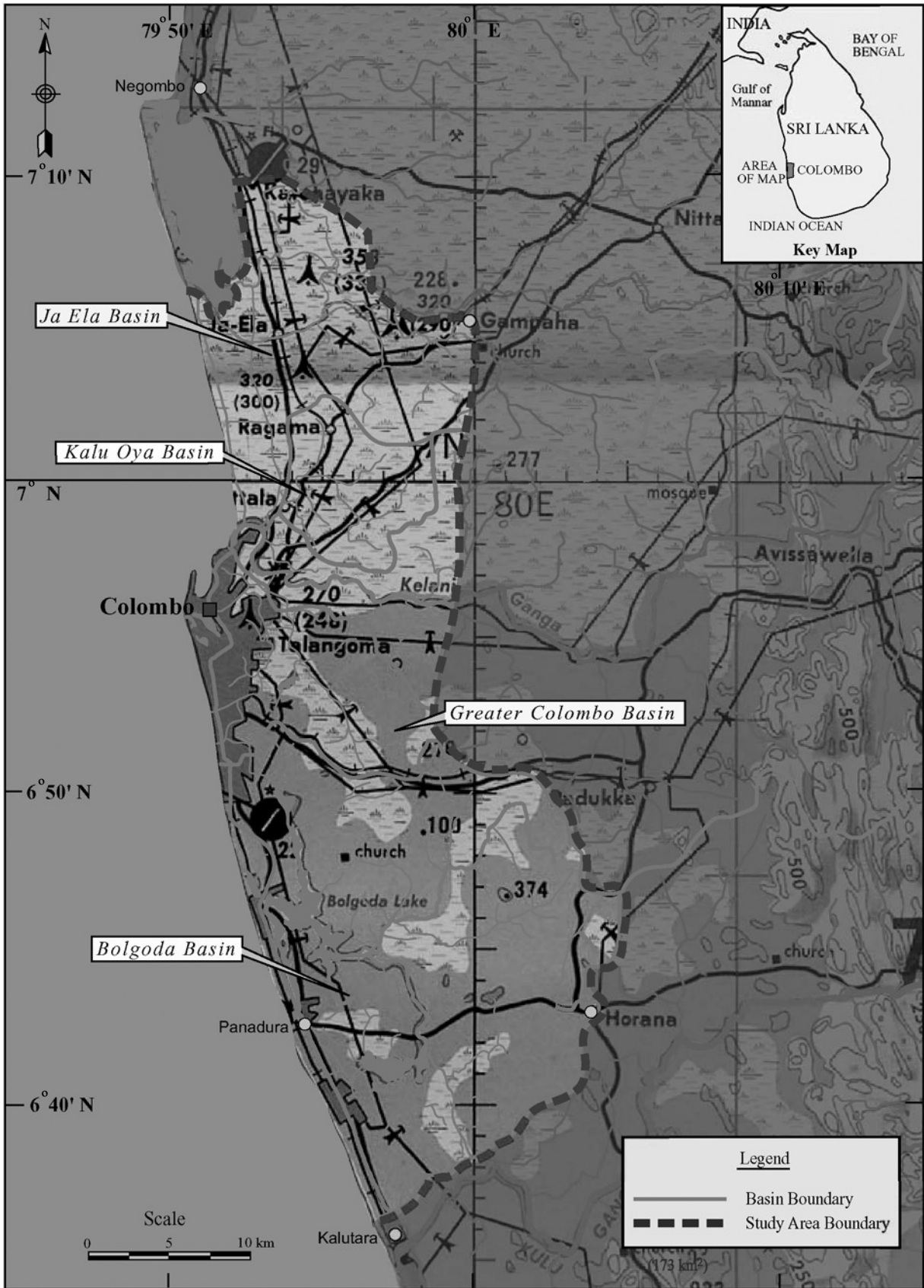
Bolgoda Basin (50year)

Case for Reduced Retention area (Retention Area: 295ha)

(Unit: million Rs.)

Case Cost Item	B2		
	FC	LC	Total
1. Construction Cost	1,765	762	2,527
Preparatory Works (10%)	160	69	230
Construction Cost	1,605	693	2,298
2. Land Acquisition & Compensation Cost	0	828	828
Land Acquisition	0	690	690
Compensation (20% of Land Acquisition Cost)	0	138	138
3. Engineering Service (15% of Construction Cost	265	114	379
4. Administration Cost (2% of the above)	0	75	75
Total of (1+2+3+4)	2,031	1,778	3,809
5. Price Escalation	24	76	101
6. Physical Contingency	190	168	358
7. Tax	0	834	834
Project Cost	2,245	2,857	5,102

Figures



The Study on Storm Water Drainage Plan
for the Colombo Metropolitan Region
in the Democratic Socialist Republic of Sri Lanka

Figure 1.1.1
Location Map

JAPAN INTERNATIONAL COOPERATION AGENCY

SUPPORTING REPORT (1)

ANNEX 11 : OPERATION AND MAINTENANCE

**THE STUDY ON STORM WATER DRAINAGE PLAN
FOR THE COLOMBO METROPOLITAN REGION
IN
THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA**

FINAL REPORT

VOLUME III : SUPPORTING REPORT (1)

ANNEX 11 : OERATION AND MAINTENANCE

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CHAPTER 1 CURRENT O&M SYSTEM

Basically, SLLRDC and the local authorities undertake the O&M work for rivers, canals and all other water channels used for storm water drainage purposes in the study area. However, the actual O&M system, including the activities, staff, equipment, and budget are considerably different within each organization. Therefore, it is illuminating to describe the current O&M system in the study area for each group, that is, SLLRDC, CMC and other local authorities.

1.1 SLLRDC

1.1.1 Current O&M activity

The SLLRDC has been improving main drainage canals and storm water drainage systems in the Greater Colombo area through undertaking of the Greater Colombo Flood Control and Environment Improvement Project (GCFC&EIP) Phase I, Phase II and Phase III since 1992. The total length of the main canals improved under the Phase I work is 44 km. The SLLRDC is conducting the regular maintenance activities including dredging, removal of surface weeds and minor repair of canal banks. It is, however, observed in certain canals that siltation and growth of weeds in the canals reduce the flow capacities. Furthermore, disruption to flow discharge due to sand bar formation at the river outlet is also a significant problem. As a countermeasure, the SLLRDC is constructing groins at the river outlets to the sea.

Meanwhile, improvement of the storm water drainage system (7 km of the total length) in the built-up area of CMC including surface drain channels and underground pipes was completed in 2001 under the GCFC&EIP Phase II. Subsequently, construction of the storm water drainage channels in Dehiwela/Mt. Lavinia MC was started under the GCFC&EIP Phase III. Regular O&M activities by the SLLRDC for these storm water drainage systems will be commenced shortly.

An O&M Manual for these drainage facilities was prepared during the project implementation period and the O&M system is also being built up at present. In addition to these canals and drainage channels developed under the GCFC&EIP, the SLLRDC has commenced recently to undertake the maintenance of existing minor channels connected to the main canal system. (refer to Table 1.1.1)

The O&M work is carried out from four Regional Offices by three means. First, each office has directly employed laborers and supervisors attached it. Other work is done by Contractors, working on a defined series of tasks, while plant intensive work (e.g.

dredging) will usually be managed by the SLLRDC's workshop, on request/order from the Regional Office.

1.1.2 Staff

Compared to other O&M organizations, the SLLRDC's organization for canal maintenance is well developed and the responsibilities of the various grades of staff are clearly defined. The responsible division for O&M activities, CD&M Division headed by DGM consists of the following staff.

Staff of CD&M Division of SLLRDC

(Unit: No. of Persons)

Staff	Total	Canal Maintenance	Canal Development
DGM(Deputy General Manager)	1	-	-
AGM(Assistant general Manager)	2	1	1
Chief Engineer(CE)	1	0	1
Other Engineers	10	4	6
Engineering Assistants	4	1	3
Project Coordinators	2	-	2
Other staff	119	-	-

Source: SLLRDC

As shown in Figure 1.1.1, senior managerial staff, that is the DGM (Deputy General Manager) and AGM (Assistant General Manager), are based in the Head Office of SLLRDC. The Regional Office Management Staff are expected to organize and manage the day to day O&M activities. Regional Offices are the most important parts of the organization in terms of the O&M activities. The manager of the Regional Office is responsible to AGM for ensuring that the canals or storm water drains are maintained as required by the standards. Table 1.1.2 gives a general list of the principal responsibilities of staff of the CD&M Division of SLLRDC.

1.1.3 Equipment available

Since, at present, the major O&M activity of the SLLRDC is to maintain the main drainage canals, the SLLRDC owns heavy dredging equipment in addition to conventional heavy construction equipment such as back hoes, excavators and dump trucks and also light equipment such as tractors and trailers. Furthermore, the SLLRDC recently purchased a suction/jetting machine, a winch machine and compact loaders especially for cleaning of the underground drainage channel system. The O&M equipment owned by SLLRDC is listed in Tables 1.1.3.

1.1.4 Financial arrangements

Although the SLLRDC has income from its land business, the entire budget required for the maintenance of canals and storm water drainage system is managed with the

funds provided by the central government (Treasury). The amounts by year are given below.

O&M Budget of SLLRDC Provided by the Government (Treasury)

(Unit: million Rs.)

Year	Budget for Canal Maintenance	Additional Allocation	Total
1999	30	-	30
2000	35	-	35
2001	40	20	60
2002 (approved)	42	17	59

Source: SLLRDC

The budget was allocated for the maintenance works on main canals improved under the GCFC&EIP Phase I. From 2001, additional budget is provided for the maintenance work on storm water drainage systems constructed under the GCFC&EIP Phase II and the existing minor canals connected to the main canals. However, it is reported that these amounts provided are not sufficient for implementing the entire duty.

1.2 CMC

1.2.1 Current O&M activity

Many storm water drainage systems exist in CMC area and the total channel length that is covered by CMC responsibility is about 350 km. The system includes small to middle scale open channels (so called secondary canals), underground systems including pipes and box culverts and roadside ditches. (refer to Table 1.1.1)

Despite the existing drainage systems, local flooding is reported at a number of places in CMC. It is obvious that most of the local floods are due to failure to maintain the network of drains. Actually, at most of the places where local flooding is observed during heavy rainfall, the gully openings on the road surface are totally blocked with silt and garbage or totally covered with asphalt pavement. It seems CMC is not conducting the proper O&M activities over the whole area they are responsible for.

1.2.2 Staff

The Municipal Engineer's Department headed by the Municipal Engineer is responsible for the water works services in CMC. This Department is divided into two divisions headed by the Deputy Municipal Engineer, the Water Supply Division and the Drainage Division that undertakes the development and maintenance of storm water drainage. At present 967 employees belong to this division as given below.

Man-Power Summary of the Drainage Division of CMC

Staff	No. of Persons
Senior Manager	1
Middle Managers	14
Other Professionals	21
Clerical, Typist and Allied Services	35
Drivers, Skilled Laborers, Laborers, Technical Grades	852
Casual and Daily Paid Employees	44
Total	967

Source: CMC Budget, 2002

1.2.3 Equipment available

CMC is responsible for maintaining drainage channels including underground pipes, roadside ditches and secondary canals in the municipal area. CMC owns several units of equipment for cleaning of underground pipes and channels such as a suction/jetting machine and a winch machine. The O&M equipment owned by CMC is shown in Table 1.1.4.

1.2.4 Financial arrangements

According to the CMC Budget for the year of 2002 published in 2001, approximately Rs.120 million is allocated to the Drainage Division-Storm Water. Out of this amount, Rs.19 million is allocated to maintenance of drains and storm water systems (employees' salaries, supplies and miscellaneous costs exclusively used for maintenance activity are not included). However, the actual expenditure in 2000 and 2001 indicated in the Budget is quite low compared to the budget amount.

Rs.60 million per year was allocated to the infrastructure outlay for both 2001 and 2002, while the actual expenditure in 2000 was about Rs.48 million (80 % of the budget). The details of budget allocation to specific items are given in Table 1.1.5. The CMC budget is furnished from its own revenue except for 50 % of the permanent employees' salary, which is reimbursed by the central government (Western Provincial Council).

1.3 Other MCs, UCs and PSs

1.3.1 Current O&M activity

The present situation of drainage facilities in the local authorities is more or less the same, that is, the drainage systems are not well developed and active O&M performance is not observed in the area. The main existing facilities are roadside ditches, small open channels and an underground system, which is not developed. Therefore, maintenance work carried out by most of the local authorities is manual

cleaning and minor repair of these facilities. Furthermore, owing to the limited work force and equipment, the current O&M works are on an ad-hoc basis, that is, the work is undertaken at places in the order of priorities where the need of O&M is suppressing the flow rate.

SLLRDC is now implementing the construction of storm water drainage systems in Dehiwela/Mt. Lavinia MC (DMMC) area. These systems are to be transferred to the DMMC after completion in 2004. In addition, a new project for development of storm water drainage is to be commenced shortly by SLLRDC in the area extending over the DMMC and the Moratuwa MC (MMC). This drainage system is also presumed to be transferred to the above two local authorities. However, the present O&M capability of the DMMC and the MMC is too poor to undertake the O&M activities for the new drainage system. (refer to Table 1.1.1)

1.3.2 Staff

In the MCs and UCs, the Engineer's Department headed by the Municipal Engineer or the Health Department is the responsible unit for drainage maintenance. DMMC which is a major MC in the study area has 6 engineers in the Municipal Engineer's Department and the total number of employees of the department is around 730 including permanent and temporary employees. In MMC, there is one engineer (Municipal Engineer) who is the head of the department and around 450 employees belong to the department. There are no Engineers in Kotte MC, the UCs or the PSs. The total staff for O&M of the responsible department or section in these organizations is generally from 40 to 100 persons. The staff allocation for O&M is shown in Table 1.1.6.

1.3.3 Equipment available

If some major works, such as canal dredging, is required for the main canal/river, which lies in the municipal territory, these works are implemented by SLLRDC or IRD by request from the local authority. This situation implies that these local authorities do not need to own much equipment for O&M works. Actually, equipment available in these authorities are only light equipment and vehicles such as tractors, trailers for earth moving and other vehicles, and this equipment is not for exclusive use for O&M of drainage. The O&M equipment available in the local authorities is shown in Table 1.1.7.

1.3.4 Financial arrangements

The budget data on drainage maintenance collected from each local government office is shown in Table 1.1.8. In the DMMC, MMC and KMC, total budgets of more than Rs. 100 million are allocated to recurrent expenditures such as personnel employment,

traveling expenses, supplies and so on. About 2 to 3 % (Rs. 4 to 6 million) of the total recurrent budget is allocated to maintenance works for the existing drainage.

Meanwhile, the entire recurrent budget scale of the other UCs and PSs is presumed to vary in the range from several million rupees to several tens of million rupees. The budget is allocated to employees' salary/supplies, minor construction/repair and the purchase of minor equipment and parts. The budget allocated to drainage maintenance is assumed to be about 5 to 6 % of the total budget for recurrent expenditures. The income source for the annual expenditures is basically their own revenue and only the permanent employees' salary is reimbursed by the central government (Western Provincial Council).

CHAPTER 2 OPERATION AND MAINTENANCE PLAN

2.1 Organizational Set-up with Staffing Plan

2.1.1 SLLRDC

SLLRDC's management capacity including the organizational set-up and staff for storm water drainage works has been developing especially through undertaking of the large scale storm water drainage projects in the Greater Colombo area. However, considering the future expansion of the coverage area and the work volume, further expansion of the organizational set-up and staff is proposed as below.

- 1) A new section is proposed within the existing CD&M divisions such as the Urban Drainage Maintenance Section, which undertakes O&M works for storm water drainage systems in built up areas and provision of technical guidance and staff training on O&M of storm water drainage systems to local authorities other than CMC. The proposed organization chart is shown in Figure 2.1.1.
- 2) As shown in Figure 2.1.1, it is proposed to set up the implementation part of the new section in the Kirimandara Mawatha and Colombo North Regional Offices, considering the location of the new urban drainage systems constructed by SLLRDC and that the actual O&M activities for the existing canals are also handled by the regional offices. Furthermore, it will be effective for the same implementation section in Kirimandara Mawatha office to initiate the local authorities into O&M works for storm water drainage system.
- 3) For the above new section, employment of one managerial staff member (AGM), a few engineers and several engineering assistants, including an O&M trainer, will be necessary for preparation of the work procedure and schedule and arrangement for the implementation. Furthermore, several supervisors who engage in supervision of the work on site, based on the work procedure and schedule, and training of operators for the operation of cleaning machines in the confined space, will be proposed. The proposed staff arrangement is shown below.

Staff Arrangement of the Proposed New Section in CD&M Division

Staff	No. of Person
AGM(Assistant general Manager)	1
Chief Engineer(CE)	1
Other Engineer	1
Engineering Assistants	3
O&M Supervisor	1
Other staff (utilize existing man power)	-

- 4) As a long term aspect, it is proposed to promote the expansion of the SLLRDC's organizational set-up so that SLLRDC can undertake overall works in the flood control/storm water drainage sector including planning, implementation, O&M and regulation/instruction activities on land filling, and further, to provide technical guidance, training and flood information for local authorities. For this purpose, the development of staff capacity at all levels including managers, engineers, technician/operators and other general staff will be necessary.

2.1.2 Local Authorities

In order to execute the O&M works of storm water drainage systems on a regular basis, the following organizational set-up and staff expansions are proposed.

- 1) The organization for the O&M system is basically established and a number of staff and work forces are available, however considering that, at present, the technical and operational staff which engage in the actual O & M works on site is in short supply, an increase in technical staff, supervisors and machine operators will be required. From the practical aspect, it is proposed at first to arrange the staff for O&M of the major urban drainage channels.
- 2) In local authorities other than CMC, an exclusive section for storm water drainage works is not currently established because the drainage facilities for which maintenance is required are not highly developed. However, considering the development of storm water drainage systems in the future, it is proposed to establish a section that exclusively undertakes storm water drainage works with the key staff as proposed below.

Staff Arrangement of the Proposed Section in Local Authorities

(Unit: No. of Persons)

Staff	CMC	Other local authorities
Managerial Staff (Engineer)	-	1
Technical Officer	1	1
Work Supervisors	2	2
O&M equipment Operators	2	2
Clerical staff	-	2

Especially, in the Dehiwela/Mt. Lavinia MC and the Moratuwa MC, since the construction of new drainage systems is going on and it is scheduled to be transferred to those local authorities from SLLRDC, establishment of the exclusive section with staff arrangement for handling O&M of storm water drainage will be an urgent issue.

2.2 Equipment Plan

2.2.1 SLLRDC

O&M equipment presently owned by SLLRDC is not adequate to handle the O&M works for the entire Greater Colombo Canal system and the responsible area as it will be extended in the future. Therefore, from the long-term aspect, it is proposed to procure some additional heavy equipment such as a dredger for maintenance of major canals in the above areas. Meanwhile, some O&M equipment for storm water drainage has been procured under the GCFC&EIP Phase II. Furthermore, as a short term plan, O&M equipment listed in Table 2.2.1 is scheduled to be procured under the on-going GCFCEIP-Phase III and the Lunawa Lake Environment Improvement & Community Development Project.

2.2.2 Local Authorities

In general, the major O&M work of local authorities is cleaning and minor repair of the existing small drain channels, however local authorities do not have a sufficient amount of equipment for regular maintenance work of these drainage facilities. Therefore, light equipment such as tractors, small back hoes and water pumps will be necessary to implement the proper O&M of the existing urban drainage systems.

Since CMC owns O&M equipment at present as shown in Table 1.1.4, it will be possible to allocate the required equipment for the O&M of the major urban drainage channels by utilizing the existing equipment.

Meanwhile, equipment presently owned by local authorities other than CMC is quite insufficient for undertaking the works on regular basis. As a short-term objective, it is proposed to procure equipment as given below to fulfill the minimum requirements for regular O&M activities.

O&M Equipment for Local Authorities (other than CMC)

Equipment	Nos.
Tractors with trailers	2
Mid sized dump trucks	1
Small to middle sized back hoe	1
Water pumps	2
Pick-up trucks	2

From the long-term aspect, possession of cleaning machines for underground pipes such as jetting machines, winch machines and conventional heavy equipment may be considered.

2.3 Financial Arrangements

2.3.1 SLLRDC

The financial source for all O&M activities of SLLRDC is provided by the Government budget. SLLRDC shall make due arrangements to acquire enough budget for required O&M works based on the work plan, staff employment/training plan and equipment plan. Based on the staff arrangement and equipment plan for the new section proposed for the SLLRDC, financial arrangements with the following extent are assumed to be required. Purchase cost of equipment shown in the previous section 2.2 is not counted as an annual O&M cost.

Annual Financial Arrangements for Routine O&M Works in SLLRDC

(Unit: 1,000 Rs.)

Item	Amount
1) Employees' salary, fuel, tools and miscellaneous (tel. bill, postage, etc.)	1,000
2) Minor construction and repair	3,000
3) Purchase of minor equipment and parts	3,000
Total	7,000

The above cost is roughly estimated for the proposed urban drainage section in CD&M Division. The estimate basis is given in Table 2.3.1.

2.3.2 Local Authorities

Since the CMC budget scale is quite large and clearly categorized compared to those of other local authorities, it will be easy to arrange the budget for the O&M staff and the equipment mentioned in the previous sections.

The annual budget for local authorities other than CMC allocated for drainage maintenance is too small to carry out the substantial regular works. At present, only the actual expenditure for permanent employees' salaries is reimbursed by the Western Provincial Council and all other expenditures have to be managed with their annual revenue.

Considering the small scale of revenue of the local authorities, it is proposed to review this financial arrangement by the Western Provincial Council so that the local authorities can achieve the funding for procurement of equipment and staff. This financial arrangement should be made together with preparation of a detailed procurement plan by local authorities, evaluation of the plan and audit by the Western

Provincial Council. Considering the actual budget scale of the local authorities, the rough budget amount for the proposed storm water drainage section is assumed as below for the initial stage of the establishment.

**Annual Financial Arrangements for O&M Routine Works in Local Authorities
(other than CMC)**

(Unit: 1,000 Rs.)

Item	Amount
1) Employees' salaries, fuel, tools and miscellaneous (tel. bill, postage, etc.)	1,000
2) Minor construction and repair	2,000
3) Purchase of minor equipment and parts	1,000
Total	4,000

Actually, the financial status is different for each local authority. The above cost is roughly estimated as an average amount. The estimate basis is given in Table 2.3.2.

Tables

Table 1.1.1 Existing O&M Work Demarcation by Each Organization (1/2)

Responsible Organization	Category of Drainage Facilities				
	Main Canal/River	Secondary Canal/River	Urban Drainage Connected to the Main or Secondary Canal/River	Underground Drainage	Road Surface and Side Ditch
Central Government					
1) SLLRDC	1) Canals improved under the GCFCEIP-Phase 1(43 km), 2) Lunawa Ela to be improved under the Lunawa Project, 3) Hamilton canal	1) Existing small to middle scale canals connected to the Greater Colombo canal system	1) Serpentine canal improved under the GCFCEIP-Phase 2 (1.6 km)	1) Drainage system in CMC developed under the GCFCEIP-Phase 2 (5 km)	
2) Irrigation Department Irrigation Department (ID) doesn't maintain the canals/riders for the storm water drainage purpose.)	1) Kelani River (Inter-provincial river)	1) Existing small to middle scale canals/riders connected to inter-provincial river, which are utilized for irrigation purpose			
3) Provincial Irrigation Department Provincial Irrigation Department (PID) doesn't maintain the canals/riders for the storm water drainage purpose.)	1) Ja-Ela, Weras Ganga and other major rivers/canals which have irrigation area. (provincial river)	1) Existing small to middle scale canals/riders in a province, which are utilized for irrigation purpose			
Local Government (Municipal Council, Urban Council, Pradesia Sabha)					
1) Colombo MC			1) Existing small open drains	1) Underground drainage together with the road gullies, manholes and catch pits	1) Road maintenance and cleaning together with side ditches
2) Dehiwala/Mt. Lavinia MC	1) Lunawa Ela (Dredging is implemented by SLLRDC on request from the MC.)		1) Existing small open drains, Drainage system developed under the GCFCEIP-Phase 3 and Lunawa Project will be transferred.	1) Small pipes for road crossing, Drainage system developed under the GCFCEIP-Phase 3 and Lunawa Project will be transferred.	1) Road maintenance and cleaning together with side ditches

Table 1.1.1 Existing O&M Work Demarcation by Each Organization (2/2)

Responsible Organization	Category of Drainage Facilities				
	Main Canal/River	Secondary Canal/River	Urban Drainage Connected to the Main or Secondary Canal/River	Underground Drainage	Road Surface and Side Ditch
Local Government (Municipal Council, Urban Council, Pradesia Sabha)					
3) Moratuwa MC	1) Lunawa Ela (Dredging is implemented by SLLRDC on request from the MC.)		1) Existing small open drains (2 km), 2) Drainage system developed under the Lunawa Project will be transferred.	1) Existing small pipes for road crossing, 2) Drainage system developed under the Lunawa Project will be transferred.	1) Road maintenance (163km) and cleaning together with side ditches (33 km)
4) Kotte MC			1) Existing small open drains	1) Existing small pipes for road crossing, 2) Under ground system is not developed.	1) Road maintenance and cleaning together with side ditches
5) Other UCs and PSs in the Study Area			1) Existing small open drains (2 km to 5 km)	1) Under ground system is not developed.	1) Road maintenance and cleaning together with side ditches (0.5 km to 20 km)

Definition :

Main Canal/River: Large scale canals or natural rivers directly flowing into the sea or the lake such as the Greater Colombo Canal System, Kelani River, Weras Ganga, Ja-Ela and so on

Secondary Canal/River: Middle to small scale canals and river branches connected to the Main Canal/River

Urban Drainage : Small scale open channel or open channel with cover slab connected to the Main Canal/River or Secondary Canal/River, which mainly functions as a storm water drain channel in a built up area

Underground Drainage : Underground drainage system composed of pipes or box culverts in a built up area

Table 1.1.2 Principal Maintenance Responsibilities in CD&M Division of SLLRDC

Position	Responsibility
Deputy General Manager (DGM)	1) Financial planning for the Division, 2) Identifying new works, 3) Policy and strategy planning, 4) Planning of construction works (not a maintenance function)
Assistant General Manager (AGM)	1) Implementation of policies, 2) Planning of construction works (delegated by DGM), 3) Annual program of maintenance works
Chief Engineer (CE)	1) Annual program of all maintenance works (delegated by AGM), 2) Forward planning of each Regional Office (Delegated to Engineer/Engineering Assistant)
Engineer, Engineering Assistant (EA)	1) Daily and weekly planning of canal maintenance works, 2) Daily allocation of staff
Supervisor	1) Supervision and measurement of work activities

Note :

At present, Chief Engineer is not assigned for the canal maintenance section, instead AGM undertakes the CE's duties.

Source : GCFC&EIP-Phase 2, O&M Manual

Table 1.1.3 List of O&M Equipment Owned by SLLRDC

Item	Capacity	No.	Year of Purchase
1) Dozer, Caterpillar D3	70 HP	2	1994
2) Wheeled Loader, Kawasaki 65Z	104 HP, 2 m ³	3	1981
3) Wheeled Loader, Kawasaki 60Z	95 HP, 1.4 m ³	40	1980
4) Poclain Excavator	50 HP, 0.4 m ³	1	1970
5) Loader / Backhoe, Kobelco	87 HP	1	1983
6) Link Belt Excavator	120 HP, 0.6 m ³	1	-
7) Low Trailer Lorry, Nissan	40 t	1	1994
8) Grab Dredger + Pontoon	0.5 m ³	3	1980
9) Grab backhoe excavator	0.5 m ³	1	-
10) Excavator, Kobelco 904	0.4 m ³	1	-
11) Cutter Suction Dredger	75 m ³ /h	1	1994
12) Cutter Suction Dredger	60 m ³ /h	1	-
13) Floating Dozer	15 t push	1	1985
14) Tractor	48 HP	-	1980
15) Tractor & Trailer	-	-	-
16) Tractor + Dozer Blade	-	-	-
17) Tipper lorry	-	-	-
18) Crane	25 t	1	1994
19) Fuchs Dredger + Pontoon		1	1983
20) Cutter Suction Pump	75 m ³ /h	1	1994
21) Dump Truck, Nissan	8 m ³	3	1994
22) Surface Weeder	50 Hp	1	1994
23) Excavator	0.4 m ³	1	1996
24) Dragline Excavator	0.75 m ³	1	1996
25) Grab bucket excavator with 20 t barge	0.4 m ³	3	1996
26) Amphibious Soft Terrain Excavator	0.4 m ³	1	1996
27) Wheeled Excavator	0.4 m ³	1	1996
28) Wheeled backhoe loader	-	2	1996
29) Vibrating Roller	10 t	1	1996
30) Skip Truck	3 m ³	6	1996
31) Skip	3 m ³	12	1996
32) Skip Barge	10 t	6	1996
33) Push Boats	35 Hp	4	1996
34) Amphibious Dredger	0.4 m ³	1	1996
35) Inspection Boat	25 Hp	4	1996
36) Half Body Truck	-	1	1998
37) 4-wheeled Tractor	45 Hp	6	1998
38) Tractor Tipping Trailer	3.5 t	6	1998
39) Waster Bouser	-	1	1998
40) Combination suction/jetting vehicle	8 m ³	1	2001
41) Sewer cleaning bucket and winch machine	10 kW	1	2001
42) Hoist unit and gantry	1 t	1	2001
43) Wheeled backhoe loader	65 kW	1	2001
44) 4-wheel agriculture tractor	45 HP	8	2001
45) Trailer for agriculture tractor	3.5 t	8	2001
46) 2-wheel mini tractor and trailer	-	4	2001
47) Portable generator	18 kVA	1	2001
48) Concrete mixer	10-12 ft ³	1	2001
49) Skid steer loader (Compact loader)	30 Hp / 0.2 m ³	2	2001
50) Diesel engine driven water pump	100 mm dia.	2	2001
51) Echo sounder	200 kHz / 0.35 m-120 m depth	2	2001

Source: SLLRDC

Table 1.1.4 List of O&M Equipment Owned by CMC

Item	Capacity	No.
Jetting machine		3
Sucker machine		3
Rodding machine (mobile type)		3
Winching machine set		2
Heavy duty rodding machine		5
Winching bucket		5
Water pump	6" dia.	5
Tractor with tipper trailer (4WD)		14
CCTV camera/monitor/etc. equipment		*
Generator	50, 175, 350, 400, 750 kVA	5
Rural single tractor (2WD)		15
Compressor		2
Drain plug set (100,150,225 & 300 mm)		7
Drain plug set (450 & 600 mm)		3
Excavator (JCB)	2 ft ³	1
Excavator (HITACHI)	4 ft ³	1
Track mounted crane	35 ton	1
Vehicles		-
Pick-up truck		3
Tipper lorry		7

Note : CCTV camera set is owned by the Project Division of CMC, not by
Drainage Division.

Source : Interview at CMC office

Table 1.1.5 Annual Budget of Drainage Division - Storm Water of CMC(Unit: x 10³ Rs.)

Items	Budget/2002	Budget/2001	Actual up to End Sep. 2001	Actual in 2000
1. Employees (Salaries, Wages, Allowances, Over Time, etc.)	8,620	7,375	1,046	1,402
2. Supplies (Fuel, Gas, Uniforms, Minor Tools, and Equipment, etc.)	960	975	217	154
3. Establishment & Miscellaneous (Telephone, Stationary, Postage, Advertisement, etc.)	178	195	33	49
4. Capital Assets Maintenance	21,800	21,150	2,061	106
1) Drains & Storm Water	19,000	18,000	1,624	81
2) Others (Roads, Buildings, etc.)	2,800	3,150	437	25
5. Capital Outlay				
1) Buildings, Machinery, Vehicles, etc.	29,560	40,860	0	4
6. Infrastructure Outlay				
1) Drains	60,000	59,500	0	48,312
Total Expenditure	121,118	130,055	3,357	50,027

Source: CMC Budget, 2002

Table 1.1.6 Manpower for Drainage O&M in Local Authorities

(Unit: Person)

Category of Staff	Local Authority				
	Dehiwala/Mt. Lavinia MC	Moratuwa MC	Kotte MC	Urban Councils	Pradeshiya Sabhas
Engineer	6 (Municipal Engineer)	1 (Municipal Engineer)	-	-	-
Technical Officer	-	-	-	1~ 3	1~ 3
Supervisor		3	3	1~ 4	1~ 4
Machine Operator		2	2	3~10 (Vehicle Driver)	1~ 5 (Vehicle Driver)
Mechanic		1	-	1~ 2	1~ 2
Skilled Labor	200 including common labor	254	53 (incl. common labor)	30~ 140	20~ 50
Common Labor		103	-	10~ 50	10~ 30
Clerk		63	1	0~ 3	0~ 3
Typist		7	1	0~ 3	0~ 3

Source : Local Authorities

Table 1.1.7 List of O&M Equipment Owned by Local Authorities

(Unit: Nos.)

Equipment	Local Authority				
	Dehiwala/Mt. Lavinia MC	Moratuwa MC	Kotte MC	Urban Councils	Pradeshiya Sabhas
Dredger	0	0	0	0	0
Jetting machine/ winching machine	0	0	0	0	0
Construction equipment such as back hoe, road roller, etc.	-	2	0	1	1
Heavy equipment such as dump truck, loader, etc.	-	18	0	0~ 2	0~ 1
Agriculture tractor/trailer	-	6	1	2~ 6	2~ 12
Vehicle including three wheel	-	5	2	1~ 4	1~ 4
Pump, portable generator	-	1	2	1	1~ 2
Others	-	-	Grass cutter	Grass cutter, Gully bouzer	Gully bozer

Source: Local Authorities

Table 1.1.8 Annual Budget for O&M of Local Authorities(Unit: x10³ Rs.)

Work Item	Local Authority				
	Dehiwala/Mt. Lavinia MC	Moratuwa MC	Kotte MC	Urban Councils	Pradeshiya Sabhas
1. Routine Works					
1) Employees salary, fuel, tools, etc. and miscellaneous (Tel. bill, postage, etc.)	152,000	97,313	3,786	3,500~17,300	2,000~6,000
2) Minor construction and repair	12,000	22,494	50	700~7,200	100~10,000
3) Purchase of minor equipment and parts	24,000	10,993	-	0~ 2,100	100~ 10,000
4) Others	14,000	-	232	-	-
2. Major Works including a large quantity of dredging, cleaning and major construction	-	-	-	-	-
Total	202,000	130,800	4,068	10,700~20,000	2,500~25,000

Note: The budget data except Kotte MC is presumed to give the total budget for the recurrent expenditure. The O&M budget for the storm water drainage is generally assumed at 2 to 3% for MC and 5 to 6% for UC and PS of the total recurrent budget.

Source: Local Authorities

**Table 2.2.1 O&M Equipment to be Procured by SLLRDC under JBIC Fund Project
(Lunawa Lake Environment Improvement Project) (1/2)**

No.	Equipment	Quantity	Purpose of Use	Where it Works	Who Bears O/M Cost
Machinery Equipment:					
1	Sucker Machine	1 No.	Cleaning of gullies	DMMC	DMMC
2	Winching Machine sets	2 Nos.	Cleaning of underground pipes more than 600 mm dia. and underground culvert	DMMC	DMMC
3	Winching Buckets set	2 Nos.	Cleaning of underground pipes more than 600 mm dia. and underground culvert	DMMC	DMMC
4	Water Pump	1 No.	To drain the water inside of underground pipes, culverts and manhole	DMMC	DMMC
5	Tractor with tipper trailer	3 Nos.	To haul sediments and garbage collected from cleaning of canals and drains	DMMC	DMMC
6	Jetting/Suction Machine	1 No.	Cleaning of underground pipes less than 600 mm dia.	DMMC	DMMC
7	150 mm sludge pump with suction(2 nos.) and delivery hoses(30 m)	1 No.	Cleaning of manholes	DMMC	DMMC
8	100, 150, 225 and 300 mm drain plug set	2 Nos.	In replacement of damaged underground pipes, the plug set is used to tentatively stop the drai water.	DMMC	DMMC
9	450 and 600 mm drain plug set	2 Nos.	In replacement of damaged underground pipes, the plug set is used to tentatively stop the drai water.	DMMC	DMMC
10	Man entry sewer trolleys	1 No.	For the visual inspection of silting condition of pipes and culverts	DMMC	DMMC
11	Survey Equipment set	1 No.	Ground survey works related	DMMC	DMMC
12	Tipper Lorry (Commercial, 10 ton, with HIAB type integral crane)	1 No.	To lift and transport the maintenance equipment	DMMC	DMMC
13	Bach hoe/shovels - skid steering	1 No.	Cleaning of canals	DMMC	DMMC
14	Baby shovels - skid steering	2 Nos.	Cleaning of drainage channel	DMMC	DMMC
15	Floating grab - shovel	1 No.	Canal dredging	DMMC	DMMC
16	Floating working platforms	1 lot	Canal dredging	DMMC	DMMC
Vehicles:					
17	4WD - Double cab	1 No.	To transport the manpower to working site	DMMC	DMMC

Note : Spare Parts are included.

Source: GCFC&EIP-Phase3 Project Office

**Table 2.2.1 O&M Equipment to be Procured by SLLRDC under JBIC Fund Project
(Lunawa Lake Environment Improvement Project) (2/2)**

No.	Equipment	Quantity	Purpose of Use	Where it Works	Who Bears O/M Cost
Machinery Equipment:					
1	Backhoe with dozer, 0.35 m ³ , long arm type, wheel type	1 No.	To maintain sea outfall sand bar at about MSL +1 m on constant basis, and excavate flood release channel when the lake water level tends to rise	MMC	MMC
2	Amphibious Soft Terrain Crawler Type Excavator, 0.4 m ³	1 No.	Dredging in lake and main canals where floating type equipment is required. (Maintenance dredging work to be carried out by SLLRDC on behalf of ULAs)	SLLRDC	SLLRDC
3	Mini Excavating Equipment, with attachment of backhoe and shovel, 0.35-0.4 m ³	2 Nos.	Cleaning of open drains (secondary and tertiary drains)	DMMC & MMC (1 unit for each ULA)	DMMC & MMC
4	Hoist Unit and Gantry, 1 ton	1 No.	To lift up at the shaft sediments collected from underground man-entry culverts and conduits	DMMC	DMMC
5	4--Wheel Agriculture Tractor, 33 kW	2 Nos.	To haul sediments and garbage collected from cleaning of canals and drains	DMMC & MMC (1 unit for each ULA)	DMMC & MMC
6	Trailer for 4 Wheel Tractor, Tipping Type, 2.5 M3 in spatial volume and 3.5 ton in capacity	2 Nos.	To haul sediments and garbage collected from cleaning of canals and drains, in combination with 4 above	DMMC & MMC (1 unit for each ULA)	DMMC & MMC
7	2-Wheel Agriculture Tractor, 7.5 kW, with trailer 1.2 m wide x 1.8 m long x 0.4 m height	2 Nos.	To haul sediments and garbage collected from cleaning of canals and drains	DMMC & MMC (1 unit for each ULA)	DMMC & MMC
8	Diesel Engine Driven Self Priming Pump, 100 mm dia.	2 Nos.	For dewatering of maintenance work area	DMMC & MMC (1 unit for each ULA)	DMMC & MMC
9	Diesel Generator, 18 kVA, trailer mounted	2 Nos.	For supply of power for concrete mixer, lighting and ventilation	DMMC & MMC (1 unit for each ULA)	DMMC & MMC
10	Portable Concrete Mixer, 0.4 m3, trailer mounted	2 Nos.	For production of concrete for repair of damages and construction of additional drainage structures where required	DMMC & MMC (1 unit for each ULA)	DMMC & MMC
11	Safety Equipment, such as Emergency Breathing, Gas Detector, Safety Ropes, etc	1 No.	Ensure safety of works in man-entry culverts and conduits	DMMC	DMMC
12	Inspection Flood Lamps, 18 W, Battery Supported	4 Nos.	For lighting work area in culverts and conduits	DMMC	DMMC
13	Portable Ventilation Blower Package, driven by Petrol Engine,, Duct Hose 200 mm, 8 m long x 2	1 No.	Ventilation during works in man-entry underground structures	DMMC	DMMC
14	Hand Tool Kits	2 Nos.	For repair of equipment	DMMC & MMC (1 unit for each)	DMMC & MMC
15	Survey Equipment	2 Nos.	To measure the angle of the alignment of the storm water systems	DMMC & MMC	DMMC & MMC
Vehicles:					
16	Pick-up Truck (Twin Cab, 4 WD)	2 Nos.	To transport the maintenance equipment and materials	DMMC & MMC	DMMC & MMC
17	Cabs (Light, not Tipping)	2 Nos.	To transport the light maintenance equipment	DMMC & MMC	DMMC & MMC
18	Tipper Lorry (Commercial, 2-3 ton, with Integral Crane)	2 Nos.	To lift and transport the maintenance equipment	DMMC & MMC	DMMC & MMC
19	4 WD Dumper, 5 ton	2 Nos.	To transport the dredging materials to disposal site	DMMC & MMC	DMMC & MMC
20	8 Man Mini-bus	2 Nos.	To transport the manpower to working site	DMMC & MMC	DMMC & MMC

Note : Spare Parts are included

Source: SAPROF Report for Lunawa Lake Environment Improvement Project

Table 2.3.1 Financial Arrangement for O&M Works of Proposed Urban Drainage Section of SLLRDC (CD&M Division)

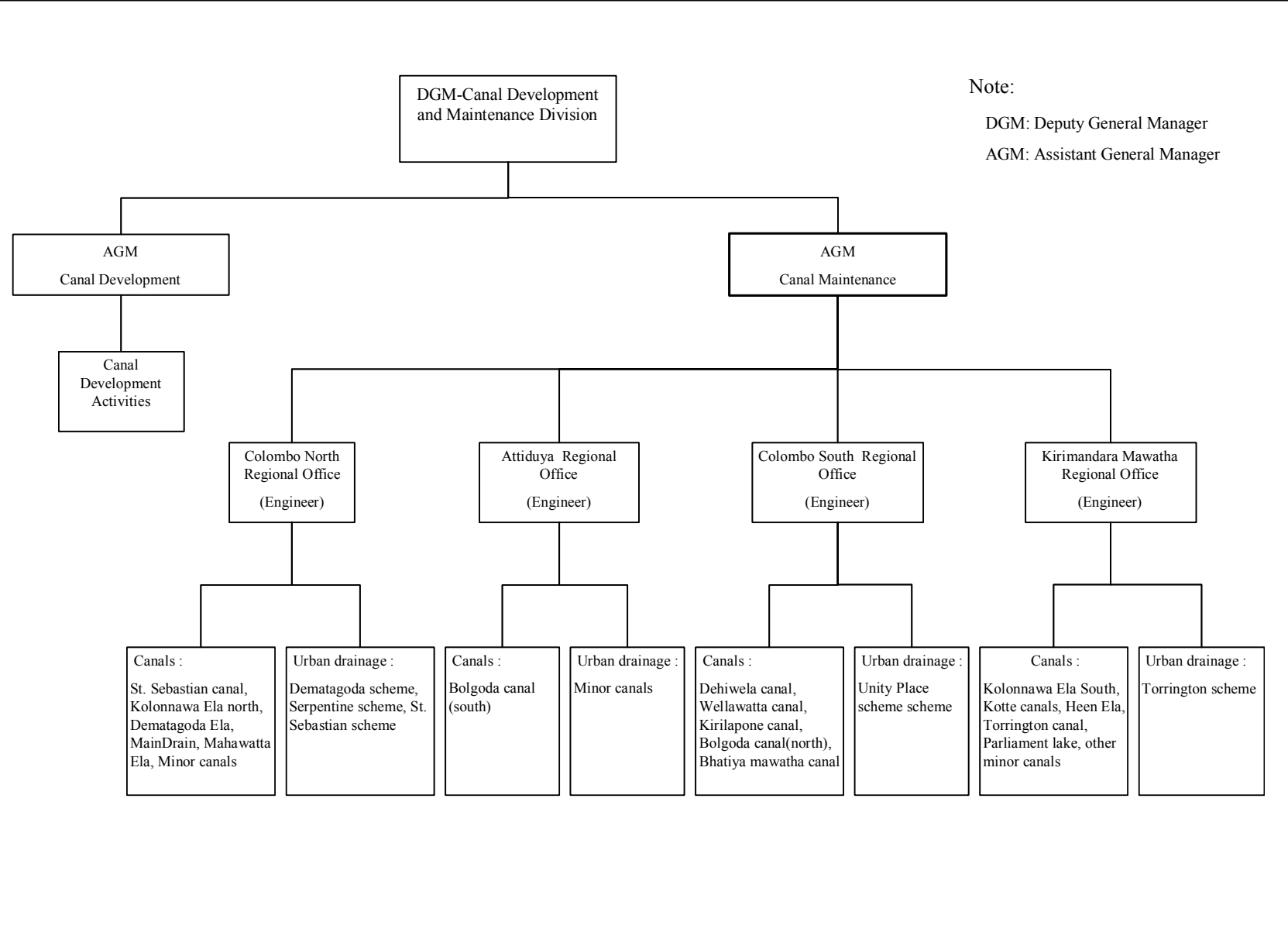
1) - a)	Employee's salary				
	Proposed Staff	No.	Salary (Rs.)	Period (month)	Amount (Rs.)
	Assistant General Manager (AGM)	1	12,000	12	144,000
	Chief Engineer (CE)	1	10,000	12	120,000
	Other Engineers	1	8,000	12	96,000
	Engineering Assistant (EA)	3	7,000	12	252,000
	O&M Supervisor	1	6,000	12	72,000
	Sub-total				Rs.684,000
1) -b)	Fuel				
	Rs. 50 x 20 liter/day x 20 days x 12 months				Rs.240,000
1) -c)	Miscellaneous (Utility and so on)				
	Rs. 5,000/month x 12 months				Rs.60,000
	Total of item 1)				Rs.984,000
					say (Rs.1,000,000)
2)&3)	Minor Construction/repair and Purchase of minor equipment and parts				
	Rs. 500,000/scheme/year			7 schemes	Rs.3,500,000
	for 5 schemes in GCFCEIP-Phase II and				
	for existing 2 urban drainage area covered by Kirimandara Mawatha office				
	and Colombo north office, respectively.				
	(rough assumption based on SLLRDC's actual operation)				
	Rs. 1,00,000/scheme/year (rough assumption)			2 schemes	Rs.2,000,000
	for 2 schemes in GCFCEIP-Phase III				
	(the channel density in a scheme area is higher than that of				
	GCFCEIP-phase II area)				
	Total of items 2) & 3)				Rs.5,500,000
					say (Rs.6,000,000)
	(the total is divided into 2) and 3) equally)				
	Total				(Rs.7,000,000)

Table 2.3.2 Financial Arrangement for O&M Works of Proposed Storm Water Drainage Section of Local Authorities Except CMC

1) - a)	Employee's salary				
	Proposed Staff	<u>No.</u>	<u>Salary (Rs.)</u>	<u>Period (month)</u>	<u>Amount (Rs.)</u>
	Managerial Staff (Engineer)	1	10,000	12	120,000
	Technical Officer	1	7,000	12	84,000
	Work Supervisor	2	6,000	12	144,000
	O&M Equipment Operator	2	5,000	12	120,000
	Clerical Staff	2	4,000	12	96,000
	Sub-total				Rs.564,000
1) -b)	Fuel				
	Rs. 50 x 20 liter/day x 20 days x 12 months				Rs.240,000
1) -c)	Miscellaneous (Utility and so on)				
	Rs. 5,000/month x 12 months				Rs.60,000
	Total of item 1)				Rs.864,000
					say (Rs.1,000,000)
2)	Minor construction/repair				
	It is assumed as an average referring the actual budget data of local authorities.				
					(Rs.2,000,000)
3)	Purchase of minor equipment and parts				
	It is assumed as an average referring the actual budget data of local authorities.				
					(Rs.1,000,000)
	Total				(Rs.4,000,000)

Figures

Figure 1.1.1
Organization Chart of Canal Development & Maintenance Division of SLLRDC



Note:
 DGM: Deputy General Manager
 AGM: Assistant General Manager

