C.4 Environmental Impact Assessment for Solid Waste Management

C.4.1 Project Description

C.4.1.1 Project Area and Components of the Project

Trang Cat Landfill Phase 3 will be located at the southern part of the landfill area approved by the Prime Minister. The total area for Phase 3 site is 32.7 ha (Figure C.3.4.1).

C.4.1.2 Planning Concept and Design Criteria

The landfill will be designed according to BATNEEC (Best Available Technology Not Entailing Excessive Cost). Affordability, self-sufficiency and step-wised improvement were important criteria of the design.

The landfill site will have the following facilities:

- Landfill site for non-hazardous solid waste (NHSW)
- Landfill site for hospital waste incineration residue (HWIR)
- Leachate treatment facility
- Site management office and isolation facility
- Workshop for the equipment maintenance and repair

Planning conditions for non-hazardous solid waste (NHSW) landfill are as follows:

- Area 27.5 ha
- Total capacity for waste 3.17×10^6 m^3
- Embankments (5 layers) 365.5×10^3 m^3
- Height 17 m (5m + 3m + 3 + 3m + 3 m)
- Liner
- Leachate collection system
- Leachate re-circulation system
- Gas collection system
- Weekly cover
- Lifetime of operations is about 10 years from 2005 – 2014

Planning conditions for hospital waste incineration residue (HWIR) landfill are as follows:

- Area 2 ha
- Height 3m

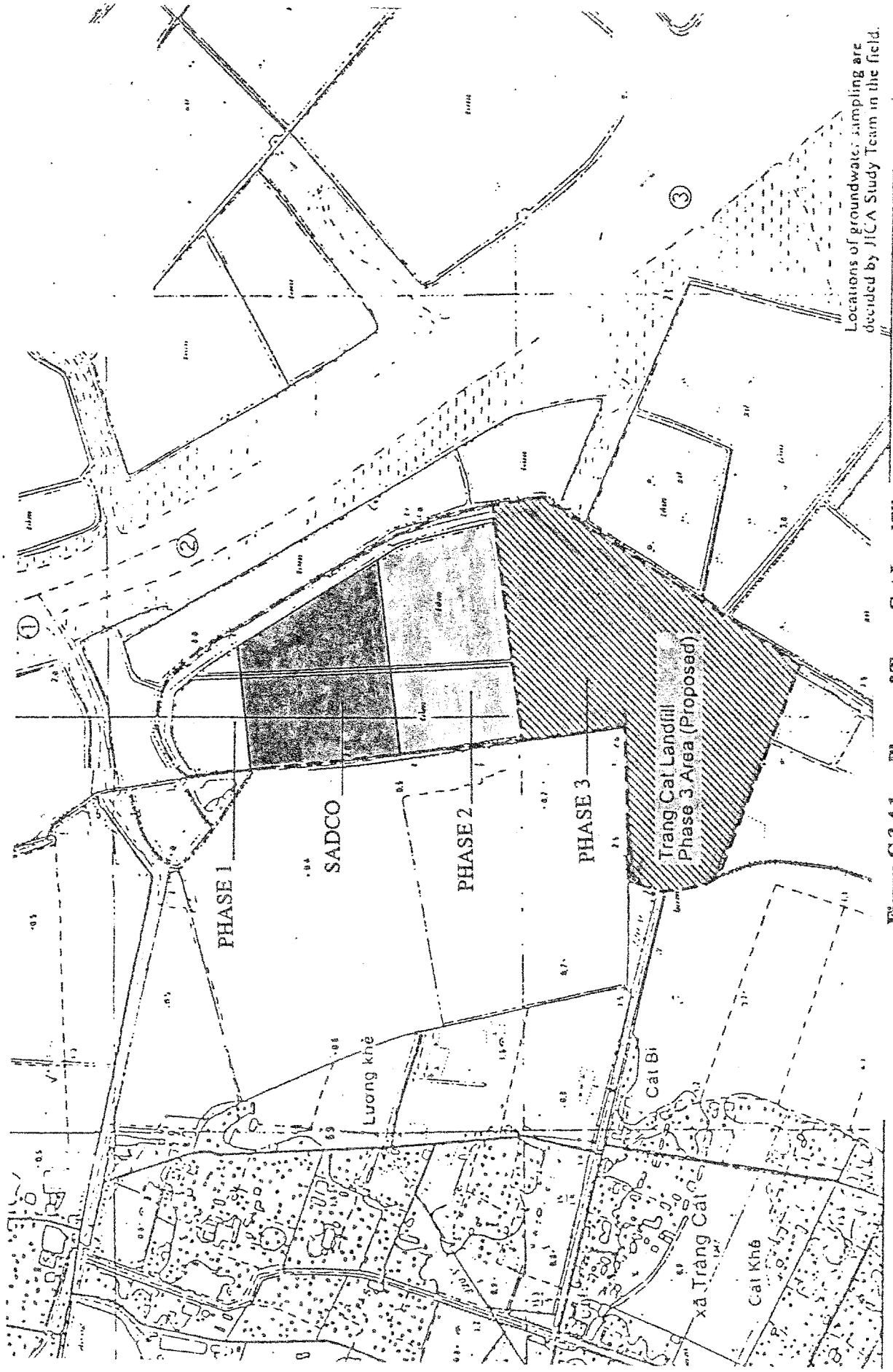

Figure C3.4.1 Phases of Trang Cat Landfill

C.4.2 Baseline Data Survey Results

C.4.2.1 Atmospheric Environment

C.4.2.1.1 Ambient Air Quality

Ambient air quality was measured by ENCEN at one point along the road to the landfill area (Figure C.3.4.2).

Air Quality in Trang Cat and Nam Hai Communes at Border Guard Station 34 on 23 November, 2000 (ENCEN)

Items	Dust	H_2S	NH_3	NO_2	CO	Odor
	(mg/m^3)	(mg/m^3)	(mg/m^3)	(mg/m^3)	(mg/m^3)	
Survey result	0.28	0.0010	0.013	0.006	3.0	Light
TCVN 5937-1995	0.3	0.008	0.2	0.1	40	-

The area is a rural area, and the air in the area is not polluted. There is no industry in the area and the traffic density is very low. The main pollution sources are present Trang Cat Landfill and the channel near the survey point.

Temperature, humidity and wind velocity and direction were surveyed every second hour from 20 to 23 November and from 23 to 29 November 2000. The wind direction was mostly from north-west and north-east. The detailed results are in Table C.3.4.1.

C.4.2.1.2 Offensive Odor

Odor was surveyed along the access road to Trang Cat Landfill, and light odor was detected. The main source of the odor was the polluted channel and the secondary source was the existing Trang Cat Landfill (Phase 1). Survey was done during dry season.

According to the people living in the area, odor is the strongest during rainy season. The odor is some time so offensive that people have to close the doors to avoid it. The offensive odor from existing Trang Cat Landfill Phase 1 is strong because landfill is not filled and covered in the proper way. Garbage trucks spread also odor when passing the villages.

C.4.2.1.3 Noise

The noise level and traffic volume were measured during 22-23 November at a roadside location along the only access road to Trang Cat Landfill (Figure C.3.4.1), which is used by solid waste collection trucks. Results are presented on the following table.

Noise Level along Access Road to Trang Cat Landfill at Border Guard Station 34 from 22 November to 23 November 2000, Distance from Measuring Point to Access Road is 25 m (ENCEN)

Time	Noise Level (dB(A))		Note
	3 times measure value	Average value	
10h	52, 54, 52	53.6	
11h	55,70*, 60	61.6	
12h	58, 62, 68*	62.6	
13h	52, 56, 60	56.0	
14h	50, 66*, 58	58.0	
15h	53, 58, 68*	59.7	
16h	58, 59, 66*	61.3	
17h	56, 67, 60	61.0	
18h	56, 60, 66*	61.3	
19h	55, 57, 66*	59.3	* the noise level when collect truck or Cong nong (small truck) passed by
20h	43, 45, 52	46.6	
21h	45, 62, 63*	50.0	
22h	42, 43, 44	43.0	
23h	41, 43, 44	42.6	
24h	41, 42, 43	42.3	
1h	41, 42, 43	42.3	
2h	42, 43, 44	43.0	
3h	41, 42, 43	42.5	
4h	50, 52, 55	52.3	
5h	52, 53, 57	54.0	
6h	49, 55, 58	53.0	
7h	52, 54, 53	53.0	
8h	52, 55, 58	55.0	
9h	62, 52, 53	55.6	

The data shows that the noise level is still low. This is mainly because the current traffic volume is relatively low. The measured traffic volume are presented later.

C.4.2.2 Terrestrial Environment

C.4.2.2.1 Geological Conditions of Trang Cat Landfill Site

The site has originally been flood area of Cam River. At the moment, there are mainly old fishing ponds and borrowed pits of clay for dyke material at the site. About 3-4m high dykes and some lower embankment surround the site across the area. The material of the dykes and the embankment are clay and gravely clay.

The bottom level of pond is about +2.4 - +2.9m. Water depth during investigations was about 1.0m. Ground level out site the dykes is between -2.2 - + 2.5m. The top level of dykes at the eastern side is +4.0m - +4.5m and at the western side is +3.0 - +3.5m.

As a part of the JICA Study, the geological conditions of the landfill site was investigated with rotary drilling and standard penetration test (SPT) in November 2000. Geological and chemical properties of soil have been determined with soil laboratory tests. The results of former investigations from June 1995 and from November 1998 have been also regarded.

Ten (10) new bore holes were drilled to the depth of 30 m. Soil samples have been obtained in connection with SPT tests, and in addition three undisturbed soil samples from one bore hole have been obtained.

In one bore hole, in-situ permeability values of the soil strata were measured by variable head test at 10 depth between 1.0 m and 19m from ground surface. Permeability of soil was K= 0.4- 9.4 x 10^{-7} cm/s. For groundwater sampling, two observation wells were installed to the depth of 40m. Groundwater level was at the depth of 1.6m from ground surface.

The soil under the backfill is from very soft to soft silt clay with some organic matter and shells of clams. These layers reach to the depth of about 23 - 24m. Soils below these layers are stiff sandy clay. Sand and gravel layers have been encountered at the depth of about 43m (old observation well).

Water content at silt clay is N= 34-43% and natural density γ_w= 16.8-17.7 kN/m^3. N-value of SPT in silt clay are N= 1- 1.5 and in stiff sandy clay N= 14. Internal friction angle of silt clay is φ= 5- 7^0 and cohesion c= 8- 9 kN/m^2. Deformation modulus has been estimated according to the laboratory tests for corresponding soils at the other sites. The value, E=2000kN/m^2, may be used in geotechnical calculation.

C.4.2.3 Aquatic Environment

C.4.2.3.1 Surface Water Quality

The previous water quality study of Cam River done by ENCEN in 1998 shows that during both dry season and rainy season, the concentrations of nitrate, grease and oil, coliform, SS, Mg, Fe and phenol are slightly elevated. Nevertheless, the concentrations of BOD, COD and heavy metals and under permissible levels.

Water Quality of Cam River at Dinh Vu Cross Section on 25 July 1998 (ENCEN)

N^0	Parameter and pollutant	Unit	Quality
1	pH value		7.43
2	DO	mg/l	5.32
3	COD	mg/l	18.0
4	BOD_5	mg/l	6.72
5	SS	mg/l	333
6	NO_3^-	mg/l	4.76
7	PO_4^{3-}	mg/l	0.17
8	NO_2^-	mg/l	0

9	NH_4^+	mg/l	0
10	C_6H_5OH	mg/l	0.012
11	CN^-	mg/l	0.018
12	Cr^{6+}	mg/l	0.0020
13	Fe^{3+}	mg/l	0.317
14	Zn^{2+}	mg/l	0.0872
15	Cd^{2+}	mg/l	0
16	Pb^{2+}	mg/l	0.0126
17	Cu^{2+}	mg/l	0.0065
18	Mn^{2+}	mg/l	0.1376
19	Grease and oil	mg/l	0.020
20	Coliform	MPN/ 100ml	8,100

To get the current water quality data from the Cam River a survey was carried out during high and low tide on 21 November 2000. Locations of sampling points are presented in Figure C.3.4.2:

- Cam River 1, upstream of the discharging point of treatment pond of Trang Cat landfill phase 1
- Cam River 2, upstream of Trang Cat landfill phase 3
- Cam River 3, downstream of Trang Cat landfill phase 3

Surface Water Quality at Three Locations from Cam River on 21 November 2000 during Low Tide and High Tide (ENCEN)

Parameter and pollutant	Unit	Cam River 1		Cam River 2		Cam River 3		TCVN 5942-1995
		low tide	high tide	Low tide	high tide	low tide	High tide	
Temp.	^0C	17	15	17	15	17	15	
pH value		7.33	7.35	7.41	7.45	7.38	7.40	5.5-9
EC	s/m	2.05	1.75	1.84	1.68	1.89	1.62	-
DO	mg/l	5.1	5.7	5.1	5.8	5.6	6.1	2
BOD	mg/l	10.4	8.1	8.0	7.2	8.1	7.6	25
COD	mg/l	29	26	23	23	20	18	35
Turbidity	NTU	100	100	100	100	80	90	-
Salinity	%	1.17	0.99	1.03	0.98	1.07	0.90	
Odor		Odor	light	Clear	odor	clear	Light	-
SS	mg/l	90	25	125	15	80	50	80
Total nitrogen	mg/l	3.20	4.12	5.32	4.76	4.05	4.27	-
NH_4^+ (N)	mg/l	0.012	0.005	0.012	0	0	0.005	1
NO_3^- (N)	mg/l	2.98	3.07	3.87	4.43	3.46	5.06	15
NO_2^- (N)	mg/l	0.05	0.08	0.08	0.06	0.03	0.09	0.05
Total phosphorous	mg/l	1.12	0.87	1.56	1.23	0.76	0.32	
SO_4^{2-}	mg/l	44	48	60	50	68	56	0.01
Zinc	mg/l	0.0164	0.0018	0.0052	0.0046	0.0039	0.0013	0.10
Cadmium	mg/l	0.0002	0.0001	0.0001	0.0002	0.0001	0.0001	0.01
Lead	mg/l	0.0040	0.0016	0.0036	0.0021	0.0029	0.0007	0.10

Copper	mg/l	0.0050	0.0010	0.0038	0.0032	0.0012	0.0010	0.02
Total Chromium	mg/l	0.0010	0.0007	0.0012	0.0007	0.0010	0.0008	-
Chromium VI	mg/l	0	0	0.0005	0.0003	0.0002	0	0.05
Arsenic	mg/l	0	0	0.0005	0.0001	0.0002	0	0.01
Mercury	mg/l	0	0	0.0001	0	0	0	0.005
Iron	mg/l	1.21	0.86	3.78	3.10	2.10	2.29	0.10
Cyanide	mg/l	0	0	0	0.0003	0	0	0.01
Grease and oil	mg/l	0.31	0.011	0.27	0.34	0.25	0.22	0
Coliform	MPN/100ml	100	80	300	200	250	200	1000
E. Coli	MPN/100ml	0	0	5	2	1	1	-

From the results, we can see that the concentrations of iron, oil and SS are high. The results were similar in the study on "Cam River State of Pollution" done by ENCEN in 1999. The sources of oil are ships and boats using the Cam River for transportation. Suspended solids are high in the background. Concentrations vary strongly according to the tide level.

Concentrations of COD and BOD are not very high although almost 50% wastewater from urban of Haiphong City and the leachate from Trang Cat landfill are discharged to the river. Dilution capacity of the Cam River is very good due to the big water volume and tidal regime.

C.4.2.3.2 Groundwater Quality

Groundwater quality was studied in five locations (Figure C.3.4.2)

- N_1 in the well of one household (Mr. Tuan) in the village near the landfill, depth of well about 20 m
- N_2 left side of proposed Phase 2, depth of well about 35 m
- N_3 right side in the project site, depth of well 10 m
- N_4 left side of proposed Phase 3, depth of well 43 m
- N_5 right side of proposed Phase 2, depth of well 9
-

Groundwater Quality at Five Locations on 20 November 2000 (ENCEN)

Parameter pollutant	Unit	N_1	N_2	N_3	N_4	N_5	TCVN 5942-1995
Temperature	^{0}C	18	18	16	20	20	
pH value		7.13	7.1	7.10	7.80	7.87	6.5-8.5

EC	s/m	0.61	0.57	0.65	0.23	2.25	-
DO	mg/l	5.2	5.4	4.3	3.0	3.5	-
BOD	mg/l	1.1	1.4	1.2	1.8	3.6	-
COD	mg/l	3	4	3	2.6	5.8	-
Turbidity	NTU	5	10	5	50	100	-
Salinity	%	0.30	0.31	0.28	0.16	1.3	-
Odor	mg/l	mild	mild	mild	clear	heavy	-
Suspended solids	mg/l	12	10	65	575	3084	-
Total nitrogen	mg/l	6.8	7.3	4.6	4.0	5.36	-
NH_4^+ (N)	mg/l	2.0	2.5	1.8	1.7	2.8	-
NO_3^- (N)	mg/l	2.15	2.91	2.00	1.90	3.12	45
NO_2^- (N)	mg/l	0.02	0.02	0	0.02	0.05	-
Total	mg/l	2.1	2.5	0.6	2.0	2.7	-
SO_4^{2-}	mg/l	3.0	0	0.75	2.5	90	200-400
Zinc	mg/l	0.0015	0.0010	0.051	0.0206	.0007	5
Cadmium	mg/l	0	0	0	0.0004	0.0009	-
Lead	mg/l	0.0015	0.0003	0.0002	0.0006	0.0003	0.05
Copper	mg/l	0.0010	0	0.0025	0	0	1.0
Total Chromium	mg/l	0.0003	0.0005	0	0.0003	0.0002	0.05
Chromium (VI)	mg/l	0.0001	0.0003	0	0.0002	0	0.05
Arsenic	mg/l	0.0002	0.0003	0	0.0003	0.0007	0.05
Mercury	mg/l	0.0001	0	0	0	0.0003	0.001
Iron	mg/l	7.62	10.52	8.76	0.27	0.12	1-5
Cyanide	mg/l	0	0	0	0.00005	0.0003	0.01
Grease and oil	mg/l	0	0	0	0	0	-
Coliform	MPN/1	3	5	2	5	200	3
E. Coli	MPN/1	0	0	0	0	5	0

Only iron concentrations were higher than the limit in groundwater standard, which is a common problem in groundwater of Haiphong.

C.4.2.3.3 Sediment Quality

Sediment samples from the Cam River were taken from the same points as water samples (see in Figure C.3.4.2).

- Cam River 1, upstream of the discharging point of treatment pond of Trang Cat landfill phase 1
- Cam River 2, upstream of Trang Cat landfill phase 3
- Cam River 3, downstream of Trang Cat landfill phase 3

Sediment Quality at Three Locations from the Cam River on 21 November 2000 (ENCEN)

Parameter and pollutant	Unit	Cam River 1	Cam River 2	Cam River 3
pH value	-	6.82	6.51	6.74
Sludge depth	m	0.5	0.8	0.5
Moisture content	%	46	48	49
Total Solid	%	54	52	51
Volatile solid	%	2.68	2.59	2.89
Apparent density	kg/m^3	2372	2291	1988
BOD	mg/kg	640	743	417
Total nitrogen	mg/kg	30.0	36.5	31.3
Total phosphorous	mg/kg	21.0	27.0	21.5
Zinc	mg/kg	85	332	99

Cadmium	mg/kg	0.5	0.7	0.7
Lead	mg/kg	44	52	24
Total Chromium	mg/kg	8.6	12.5	8.8
Chromium (VI)	mg/kg	2.0	2.9	2.0
Cyanide	mg/kg	0.6	1.5	1.0
Mercury	mg/kg	0.8	1.2	0.9
PCB	mg/kg	0	0.01	0
Copper	mg/kg	34.3	25.5	12.0

There is no Vietnam standard for sediment, and European standards of sediment quality are used. The results were within the limit of these standards.

Standard for Sediment Quality in Some European Countries

Parameter and pollutant	Unit	Germany	Switzerland
Cd	g/kg	30	20
Cr	mg/kg	1000	1200
Co	mg/kg	100	-
Cu	mg/kg	1000	1200
Pb	mg/kg	-	2000
Ni	mg/kg	10	200
Hg	mg/kg	-	25
Zn	mg/kg	3000	3000

Source: Environment handbook volume III 1995

C.4.2.4 Flora and Fauna

The following ecosystems can be found in Haiphong:

1) Human urban and rural settlements
2) Agricultural ecosystems, mainly rice fields and gardens
3) Terrestrial ecosystems such as limestone ecosystems, rocky mountain ecosystems and the limestone island Cat Ba
4) Wetland ecosystems, mangrove forest along the coast, particularly developed in the Dinh Vu island, literal zone around Cat Ba and Cat Hai island
5) Estuaries of Nam Trien and Cam River
6) Freshwater and brackish water ponds and lakes
7) Coastal beaches, muddy, sandy, rocky etc.

No rare or endangered species of flora or fauna were found in the proposed site. All species identified are typical for the Cam Estuary and the neighboring ecosystems. Various kinds of grass grow on the dikes, which surround the ponds.

In the Trang Cat area, a good mangrove forest links the ponds and the Cam Estuary. During dry season birds are nesting in mangrove forest and are preying from the ponds.

In the ponds of Trang Cat are grown fishes like carps, tilapia, red mullet and perch. Small crabs, prawns and shrimps are grown, too. Wild fauna which can be found from the ponds include fiddle crab, water snake, snail and frogs.

Water buffaloes, cows, pigs and goats can be found on the banks of the dikes surrounding the ponds.

In the gardens of the residential areas in Trang Cat are fruit trees and plants such as coconut, longan, various citrus trees, banana and papaya. There are also big trees surrounding the houses such as Japanese lilac, bamboo, rattan and sandal tree. The most important vegetables and plants that are grown for selling or for own use are chilly, basil, coriander, tamarind, sweet potatoes, tomatoes, bindweed and cabbage.

Rice is harvested twice a year, in May and October. The average output from the rice fields is 8-9 ton/ha.

C.4.2.5 Human Environment

C.4.2.5.1 General

ENCEN conducted a socio-economic survey in November 2000 in the area. Ten (10) local residents were intervied along the road to the landfill and another ten (10) interviews in the village near the landfill site. The detailed results of socio-economic survey conducted in November 2000 are presented in the Data Book. Background data has been collected from People's Committees of Trang Cat and Nam Hai communes.

C.4.2.5.2 Land Use and Infrastructure

(1) Land Use

Most recent land use and tenure data were collected from People's Committees of Trang Cat and Nam Hai communes. The results are summarized as follows:

Land Use Divided by Purpose of Use
in Nam Hai and Trang Cat communes in 1999

	Items	Trang Cat (ha)	Nam Hai (ha)
	Total	**2926.0**	**573.9**
I	Agriculture land	1088.1	360.7
I.1	Land use for annual short time planting	330.0	171.2
	Rice culture	247.8	171.2
	Land use for annual planting	82.2	-
I.2	Garden	66.0	37.7
I.3	Wetland for breeding fish and shrimp	692.0	151.8
II	Forestry land	730.7	-
III	Land for other purpose	355.6	123.4
III.1	Construction	6.4	6.5
III.2	Transportation	94.0	18.0
III.3	Irrigate works	106.0	22.6
III.4	Other	149.2	76.3
IV	Living land	29.2	30.9
V	Idle area	722.4	58.9

V.1	Idle land	689.2	4.51
V.2	Alluvium	8.84	7.8
V.3	River	24.4	46.59

Land Use Divided by Ownership in Nam Hai and Trang Cat Communes in 1999

Ownership items	Nam Hai (ha)	%	Trang Cat (ha)	%
Owned by Household	264.6	50	476.4	22.5
Owned by some other economic organizations	0	0	214.4	10
Owned by people's committee	183.0	38	214.0	62
Owned by other organization	37.4	7.7	124.9	2

Average Area per Person in Trang Cat Commune in 2000

Items		Area / person (m^2)	Area / person in working age (m^2)	Area / household (m^2)
1	Agriculture land	1470	2167	5282
2	Rice cultivate land	334	459	1203
3	Forest land	897	-	-
4	Living land	39	-	141

Average area per Person in Nam Hai Commune in 2000

Items		Area / person (m^2)	Area / person in working age (m^2)	Area / household (m^2)
1	Agriculture land	688	917	2227
2	Rice cultivate land	288	435	1056
3	Living land	185	279	678

Quality of Land in Trang Cat and Nam Hai Communes in 2000

No	Type of soil	Data
1	Soil layer (m)	0.70- 0.80
2	Cultivated level (m)	0.17- 0.20
3	Humus content (mg/100g)	1.70- 2.20
4	pH (KCL)	6.70- 7.00
5	P2O5 (mg/100g)	Stain
6	Soil composition	Heavy foam
7	Cl (%)	0.11- 0.40
8	Oil (mg/l)	1.50

(2) Infrastructure

According to the information given by Trang Cat and Nam Hai People's Committees in November 2000, Nam Hai commune has total 41 km of roads, including inter-village road, inter-commune road and road to the fields. There are four culverts for drainage. Trang Cat commune has total 47 km of roads including inter-village roads, inter-commune road and road to the field. There are eight culverts for drainage.

Both Nam Hai and Trang Cat communes have four power transfer stations and about 8.5 km of electric lines of 380/220V type. All households and the farmed ponds have electricity supply. On average, each family has to pay about 56,000 VND for electricity bill per month. Public lighting systems have not been constructed, yet.

Existing Construction
in Nam Hai and Trang Cat Communes in 2000

Construction	Trang Cat	Nam Hai
Commune's Construction		
Headquarter of people committee. 700m^2, 10 rooms and 1 meeting room	1	1
Co-operative's headquarter	1	1
Medicine station	1	1
Primary and secondary schools	3	2
House of culture and church	2	4
Military office	1	
Battalion 47	1	
Team 2 of Thanh To Farm	1	
Paper Factory		1

Road Network
in Nam Hai and Trang Cat Communes in 2000

No	Construction	Unit	Trang Cat	Nam Hai
1	Inter- commune road			
	1. Length	km	20	18
	2. Width	m	24	24
	(Asphalt surface road)			
2	Inter- village road			
	1. Length	km	10	9
	2. Width	m	3	3
	(Bitumen surface road)			
3	Lane and alley			
	1. Length	km	10	8
	2. Width	m	2	2
	(Concrete surface road)			
4	Road go to the field			
	1. Length	km	7	6
	2. Width	m		
	(Soil surface road)			

Water Supply Facilities
in Nam Hai and Trang Cat Communes in 2000

Facility	Trang Cat	Nam Hai
UNICEF well	1053	861
Tank for rain water	436	363
From water supply company	175	145
Shallow well	some	72

(3) Traffic

Trang Cat and Nam Hai communes are about 10-12 km from the center of Haiphong City. There is the main road from Rao Bridge to Cat Bi Airport and to Trang Cat Commune and Trang Cat Landfill.

The transportation route to the Trang Cat landfill site will follow the Lach Tray main road for the first 6 km from Rao Bridge, and then branch off about 6 km along a secondary road of a width about 4 to 5 meters. This secondary road has already been improved for the first 3.5 km, to the width of 20 m until the Cat Bi Airport crossing. The secondary road passes residential areas and a market. From Cat Bi

Airport crossing until the Cong Den (Black Sewer), the road is only about 3 m wide and the houses are very close to the road. The market has occupied the verges of the road and preventing the traffic. The local authorities have already started the relocation of the market to a more suitable place and the relocation of settlements has already taken place. For the time being, the people still continue to occupy the road for market.

The last 1.5-km of road, from the Cong Den (Black Sewer) to the landfill site follows a dyke road which have been widened up to at least 5 m and upgraded to heavier loads. This last part of the road mainly passes rice fields. On the southern side of the Trang Cat road, there is a drainage channel, which has several outlets to the rice fields. The channel is connected with the Cam River via the gates.

There is no significant improvement in quality of road in the last several years. The market is still located too close to the road and the road is still too narrow. However, during this time traffic density, the noise level and the risk caused by the traffic accident have increased. There is an urgent need of improve quality of road and safety of transportation.

The traffic density on the road to the landfill surveyed by ENCEN on 21 November 2000 is as follows:

Traffic Density of Road to Landfill at Border Guard Station 34 on 21 November 2000

Time (o'clock)	Collect truck		Cong nong		Motor Bike		Total
	Get out	Get in	Get out	Get in	Get out	Get in	
10-12	6	6	4	4	1	4	25
12-14	2	0	7	1	3	7	20
14-16	8	8	5	0	1	8	30
16-18	12	16	4	0	0	5	37
18-20	15	20	8	2	1	6	62
20-22	0	4	0	0	0	1	5
22-24	14	17	0	0	0	2	33
24-2	9	11	0	0	0	0	20
2-4	7	0	0	0	0	0	7
4-6	5	5	2	0	0	2	14
6-8	5	6	13	2	2	11	39
8-10	8	10	18	14	1	16	67
Total	102	103	61	10	9	62	

Note: Cong nong is a simple, common truck in rural area

From the result, we can see that, the traffic density in the project site is still low, and there were no traffic jams during the survey although the road is narrow (Figure C.3.4.3).

C.4.2.5.3 Main Economic Activities

(1) Industrial and Commercial Activities

Though the area is located near the center of City, there is not any significant industrial activity in the area other than a small paper factory in Nam Hai. There are markets and some small shops, but commercial activities are not significant.

(2) Agriculture

The main economic activities in this area are agriculture and aquaculture. According to the socio-economic survey in November 2000 the agricultural land per one person is about 360 m^2. Most of land is used for rice cultivation. The productivity is about 7.5 tons/ha/year in Trang Cat and 9.4 tons/ha/year in Nam Hai. This is the medium level in An Hai District. There is a target to increase productivity of rice cultivation, and to extend the agricultural field for vegetables and watermelons. However, the income from agriculture is rather small, approximately 80,000 VND/person/month, because the price of rice is about 1,700,000 VND/ton.

(3) Aquaculture

Haiphong Department of Fishery, An Hai Agricultural Department and Trang Cat and Nam Hai communes have provided the following figures concerning aquatic product culturing enterprise from the year 1995. Trang Cat and Nam Hai communes exploit a lot of aquatic products. Total yield of aquatic products in 1995 was 551.3 tons with the value of 4,560 million VND (equivalent to 54% of An Hai district and 15% of Haiphong City).

Income from aquaculture in Trang Cat and Nam Hai communes is as follows:

- Typically 3 - 6 million VND/ha/month, but can reach 11 - 15 million VND/ha/month
- Average income 420,000 VND/person/month, some one can get 600,000 - 800,000 VND/month

In Trang Cat, the ponds are surrounded by the dikes and bordered by the rice fields in the western side of the ponds. The water depth in the ponds is approximately one meter. The ponds are used for cultivation of tilapia, mullet, mud crabs, shrimps and seaweed. Once a month, during high tide, the outlets to the Cam River are opened to receive fresh water from the river as well as natural fishes.

According to the information provided by Trang Cat People's Committees in Trang Cat and Nam Hai communes, the production is follows:

- Seaweed production is 200tons/ha
- Shrimp production is 500kg/ha and the total product is 150 tons
- Sea-crap production is 300kg/ha and the total product is 100tons
- Total yield product of all kind of fish is 200 tons

- Total yield of mollusc is 150tons
- Income from aquaculture is 25 millions VND/ha/year

Income from Agriculture and Aquaculture in Nam Hai and Trang Cat Communes in 2000

Items	Unit	Trang Cat	Nam Hai
Income from 1 cultivated ha	VND	30,000,000	35,000,000
Income from 1 agricultural ha	VND	12,000,000	13,000,000
Income from cultivation per person	VND	4,200,000	4,000,000
Rice quantity / person / year	kg	217	239

Note: Agriculture lands and aquaculture lands are called in common cultivated land

C.4.2.5.4 Population

(1) Population and Occupation

The population in Nam Hai in the year 2000 was 6,730 people of which 52% are females. There are 2,826 people in working age, occupying 42% of population. 23% of population are Catholics. 1,600 people are working in agriculture, 700 people in fishing activities and 300 people in handicraft industry. Population growth rate is 1.1% in 2000.

The population in Trang Cat in the year 2000 was 7,900 of which 51% was female. There are 3,550 people in working age, occupying 45% of population. Population growth rate is 1.2% in 2000. 15% of the population are Catholics. Most of people are working in agriculture (90%).

Occupation of Households in Nam Hai and Trang Cat Communes according to Socio-economic Survey November 2000

Occupation	Along road	Inside village
Worker	1	0
Fish man	0	2
Farmers	5	4
Service and business	3	0
Retired	1	3
Unemployed	0	1
Total interviewed	10	10

Population of Trang Cat Commune from 1995 to 2010

Items	1995	2000	2005	2010
Population	6450	7900	8450	8950
Male	2967	3800	4141	4386
Female	3483	4100	4309	4564
Catholics	967	1185	1268	1343
People in working age	2902	3550	3820	4117
The rate of People in working age	45	45	45	46

Population of Nam Hai commune from 1995 to 2010

Items	1995	2000	2005	2010
Population	6350	6730	7010	7360
Male	3048	3231	3505	3680
Female	3302	3499	3505	3680
Catholics	1500	1550	1550	1754

People in working age	2660	2826	2826	3164
The rate of People in working age	42	42	42	43

(2) Education

In Nam Hai, there is one primary school with 6 classroom and 440 pupils, and three pre-primary schools with 16 classrooms and 1,050 pupils. Nam Hai and Trang Cat communes have implemented the program to make secondary school compulsory. Therefore, the level of education is higher than some other communes nearby. In Trang Cat, there is a primary and a secondary school with 1,600 pupils.

C.4.2.5.5 Housing

The situation of structure of houses, area of houses, area of the living land and ownership of living land in this area was surveyed in November 2000. In total 20 households, 10 living along road and 10 living in the village near the landfill, were interviewed. Houses were mainly private owned (10/10 household living along road and 9/10 household living in the village). The only type of the building structure was individual, single family housing. 17 houses had only one floor and 3 houses had two floors.

An average household occupies 270m^2 for the households along the access road and 458 m^2 for the households living in village. The land area per person is 58 m^2 for village and 54 m^2 for along road.

The average floor area was 56 m^2 for the households along the access road and 58 m^2 for the households living in village. The floor area per one person was about 7.2 m^2.

Most of the people have lived in the same place for a long time and the land where they live in was inherited from their ancestors. Those who have moved to the area have moved from another village in the same commune.

C.4.2.5.6 Household Economy

(1) Income

According to the result of the socio-economic survey in November 2000 all interviewed households living along road had a shop, but the income from shops was not the main income of the family.

Income per family per month is 1,366,667 VND in the households living in the village, and 914,999 VND in the household living along access road. The income per person per month is 172,000-182,000 VND (2,000,000VND/year). This figure is lower than the figures given by Trang Cat and Nam Hai people's committees, and also lower which can be calculated for the income per person from cultivate land, 4,300,000 VND per person per year, which can be considered more realistic figure. In comparison with the GDP of Haiphong (450USD/person), income is in medium

level but in comparison with the other rural area, this is higher due to the income from aquaculture.

Distribution of Monthly Income
of Households Nam Hai and Trang Cat Communes in 1995

Monthly Income (VND)	No of Households	%
over 3,000,000	5	4.6
2,000,000-3,000,000	2	1.9
1,800,000-2,000,000	1	0.9
1,600,000-1,800,000	1	0.9
1,400,000-1,600,000	6	5.6
1,200,000-1,400,000	9	8.3
1,000,000-1,200,000	9	8.3
800,000-1,000,000	15	13.9
600,000-800,000	29	26.9
400,000-600,000	21	19.4
200,000-400,000	8	7.4
less than 200,000	2	1.9

Source: EIA study at the proposal Landfill site Nam Hai and Trang Cat, Haiphong Vietnam. HPWSP 1995

Distribution of Monthly Íncome
in Households Nam Hai and Trang Cat Communes in 2000

Monthly income (VND)	Number of Households	%
over 3,000,000	1	6.25
2,000,000-3,000,000	2	12.5
1,800,000-2,000,000	1	6.25
1,200,000-1,400,000	1	6.25
1,000,000-1,200,000	4	25.0
800,000-1,000,000	2	12.5
600,000-800,000	1	6.25
400,000-600,000	1	6.25
200,000-400,000	2	12.5
200,000	1	6.25
	Total 17/20 interviewed households answered	

(2) Expenditure

Expenditures are mainly for food and for education; 450,000 VND per family for food and 228,571 VND per family for education. Electricity bill is about 56,000 VND per month, and other expenditure is 325,000 VND per month. 80% of them don't save money for big purchase because for them to earn enough for living is hard enough. Most of them do not think about paying for public utilities.

All the families living along the road had television, fan and bicycle, and 80% had motorbike, but more luxurious item where rare. Half of the families had telephone and video equipment, and two families had refrigerator.

In the village the households are slightly better off. All families had bicycle and fan and 90% had television. Half of the families had video equipment and refrigerator. 40 % of the families had cd player, electric cooker and motorbike. There was only one telephone, but on the other hand there was also one mobile phone.

C.4.2.5.7 Public Health

The information concerning health situation of Nam Hai and Trang Cat communes has been collected from heads of local health stations.

Diseases in Nam Hai and Trang Cat Communes in 1999 according to Health Stations

Diseases		Unit	Trang Cat	Nam Hai
1	Breathing diseases	Cases	530	232
2	Digest diseases	Cases	5	2
3	Ear, eyes, throat diseases	Cases	40	30
4	Influenza diseases	Cases	100	200
5	Decay teeth and pyorrhea diseases	Cases		150
6	Blood pressure and heart diseases	Cases	10	79
7	Insufficient blood diseases	Cases	some	some
8	Mental diseases	Cases	2	5
9	Gynecological diseases	Cases	140	115
10	Traffic accident	Cases	3	5

Data of the Health of Babies in Trang Cat and Nam Hai Communes in 1999 according to Health Stations

Items		Unit	Trang Cat	Nam Hai
1	Babies under 1 year age died	Babies	0	0
2	Babies under 5 years age died	Babies	5	0
3	Prenatal death	Babies	0	0
4	Birth rate	%	1.47	1.33
5	Death rate	%	0.26	0.21
6	Population growth rate	%	1.21	1.12
7	Diseases of Baby under 1 year age 1. Diarrhea 2 Breathing diseases 3. Malnourished 4. Insufficient Vitamins 5. Tetanus 6. Fever	 % % % % 	 5.3 13.3 30 few 0 few 	 0.84 15.3 26 few 0 Few

Note: % per total babies in Trang Cat and Nam Hai communes.

C.4.2.5.8 Water Supply, Sanitation and Solid Waste Management

In both communes the main water supply resource is UNICEF groundwater well, and the secondary is rainwater, some families use shallow well. Most of them use rainwater for drinking, cooking and groundwater for washing. Compared with the water supply situation of the year 1995, the number of the UNICEF groundwater wells has increased significantly (from 120 to 8,160) and the quality of water has improved. Very few household lack of water during dry season and very few households still have to use water from their ponds for cooking and drinking which was common habit five years ago. Some wealthy families buy water from the city and transport it to their houses by container. All interviewed people said that they

want to have water supply from the Water Supply Company and they are willing to pay for it.

All households have their own toilet, whereas five years ago, only 80 % of the households had their own toilet (EIA study at the proposal Landfill site Nam Hai and Trang Cat, Haiphong, Vietnam, 1995). 75% have flush toilet, and the rest have latrine. None of households has any treatment method for the wastewater and discharge wastewater directly into channels, rivers, ground or drain. Compared with the situation in year 1995 the quantity and quality of toilets is in a higher level, and the percentage of the families who have flush toilet has increased, but the way how wastewater is treated is still the same.

Solid waste management in the Nam Hai and Trang Cat areas is not common. Only 25 % of the interviewed households are serviced by URENCO. 15 % of the interviewed households throw their waste on vacant land, 10 % throw into channels, rivers or lakes, 10 % use for fertilizer, and the rest burn their solid waste. The average distance to the closest disposal place is about 12 meters. None of the interviewed had any concept about the separation of solid waste. 7 households have bamboo garbage bin, another 7 have plastic garbage bin and the rest do not have any garbage bin at all.

C.4.2.5.9 Willingness to Pay and Environmental Awareness

Answer to the questions whether they are willing to pay for treatment of their waste, half of the households said that they don't want to pay for wastewater and solid waste treatment because they can not afford it.

People in both communes are afraid of negative impacts of landfill. Although most of them said that they sympathized with government that there must be a landfill for solid waste in city and Trang Cat is reasonable area for it. However, many people have negative opinions. They said that it would be better to move the landfill to other area. If not, they and their children will die because of pollution. All interviewed wanted methods to control and operate the landfill and the road, and to reduce the effect of landfill.

In Nam Hai commune and Thon 1 area in Trang Cat commune near Trang Cat landfill they suffer from impacts of landfill especially in summer, when the wind is blowing from landfill. Tan Vu village and Cat Bi village are impacted during winter.

Trucks are not covered properly and much waste is dropped during transportation making the road dirty. All the interviewed households complain of it. Trucks drive with a high speed although the road is narrow and the houses and the market are near. This is increasing the possibility of accidents, which is the biggest fear of the households along the road.

Opinion about Adverse Impacts of Landfill to Health in Nam Hai and Trang Cat Communes

Items		Unit	Trang Cat	Nam Hai
Adverse effect				
Level of effect				
	1. Very uncomfortable	%	60	43.3
	2. Uncomfortable	%	60	33.3
	3. Neutral	%	39	20
	4. No effect	%	61	0
Reason				
	1. Smell	%	70 and 86	90 and 76
	2. Waste dropping during transportation	%	90	95
	3. Accident caused by the bad traffic conditions: The road is so narrow	%	95	96
	4. Vermin and pest	%	86	80
	5. Afraid of environment pollution	%	5	3
Level of awareness of effect				
	1. Significant effect	%	70	63
	2. Minor effect	%	20	16
	3. No effect	%	10	5
Diseases related to the effect				
	1 Breathing diseases	%	46	40
	2. Skin diseases	%	43	36
	3. Other	%	43	36

Table C.3.4.1 Microclimate of Trang Cat and Nam Hai Communes in Border Guard Station 34 from 10h am on 20 November 2000 to 10h am on 23 November 2000 (ENCEN)

Survey time	Temperature	Humidity	Wind velocity	Direction
	(^{0} C)	(H%)	(m/s)	
Date 11/20/00				
10h00-12h00	20	60	3-4	North-West
12h00-14h00	23	40	0.5-1.5	North-West
14h00-16h00	22	54	2-4	North-West
16h00-18h00	20	57	2-5	North-West
18h00-20h00	18	60	2-5	North-West
20h00-22h00	17	75	0.5	North-West
22h00-24h00	15	86	0.5	North-West
Date 11/21/00				
0h00-2h00	14	90	0.5	North-West
2h00-4h00	14	95	0.5	North-West
4h00-6h00	15	88	1 - 2	North-West
6h00-8h00	16	70	2 - 3	North-West
8h00-10h00	18	60	2 - 3	North-West
10h00-12h00	22	55	1 - 2	North-West
12h00-14h00	23	57	1 - 2	North-West
14h00-16h00	21	60	2.5 - 3	North-West
16h00-18h00	20	70	1.5 - 2	North-West
18h00-20h00	17	75	0.5 - 1	North-West
20h00-22h00	17	75	0.5 - 1	North-West
22h00-24h00	16	78	0.3 - 0.5	North-West
Date 11/22/00				
0h00-2h00	16	83	0.5	North- East
2h00-4h00	16	87	0.5	North- East
4h00-6h00	17	87	0.5	North- East
6h00-8h00	17	78	1 - 2	North- East
8h00-10h00	18	72	2 - 3	North- East
10h00-12h00	20	66	2 - 3	North- East
12h00-14h00	21	60	1 - 1.5	North- East
14h00-16h00	19	60	1.5 - 2	North-West
16h00-18h00	19	65	2 - 3	North-West
18h00-20h00	17	70	2 - 3	North-West
20h00-22h00	17	80	0.5 - 1	North-West

22h00-24h00	16	85	0.5 - 1	North-West
Date 11/23/00				
0h00-2h00	16	90	0.5	North-West
2h00-4h00	15	90	0.3	North-West
4h00-6h00	15	85	0.5	North-West
6h00-8h00	17	80	1.5	North-West
8h00-10h00	18	77	2 - 2.5	North-West
10h00-12h00	20	70	1 - 1.5	North-West

Microclimate of Trang Cat and Nam Hai Communse in 6 days Border Guard Station 34 from 10h am on 23 December 2000 to 10h am on 29 December 2000

Survey Time	Temperature (^{0} C)	Wind velocity (m/s)	Direction
Date 12/23/00			
10h00-12h00	23.7	00	00
12h00-14h00	25	1	North-East
14h00-16h00	31.2	5.1	North-East
16h00-18h00	26.3	4.5	North-East
18h00-20h00	23.8	00	00
20h00-22h00	22.7	00	00
22h00-24h00	18.7	00	00
Date 12/24/00			
0h00-2h00	18.4	3	North-East
2h00-4h00	18.1	1	North-East
4h00-6h00	17.8	00	00
6h00-8h00	18.8	00	00
8h00-10h00	18.9	2.1	North-East
10h00-12h00	21.1	4.0	North-East
12h00-14h00	24.7	3.5	East
14h00-16h00	26.1	4.0	East
16h00-18h00	25.6	2.0	South-East
18h00-20h00	21.1	2.0	South-East
20h00-22h00	18.7	00	00
22h00-24h00	18.5	00	00
Date 12/25/00			
0h00-2h00	17.3	00	00
2h00-4h00	17.4	00	00
4h00-6h00	16.9	00	00
6h00-8h00	16.7	00	00

8h00-10h00	17.1	00	00
10h00-12h00	21.7	6.4	North
12h00-14h00	25.4	1.0	North
14h00-16h00	23.7	5.8	South-East
16h00-18h00	22.8	6.7	South-East
18h00-20h00	21.1	3.0	South-East
20h00-22h00	20.0	00	00
22h00-24h00	20.4	1.0	North-East
Date 12/26/00			
0h00-2h00	20.5	2.0	North-East
2h00-4h00	17.6	2.0	North-East
4h00-6h00	19.7	2.0	North-East
6h00-8h00	20.0	4.2	North-East
8h00-10h00	20.4	5.5	North-East
10h00-12h00	22.3	10.4	North-East
12h00-14h00	23.3	7.6	North-East
14h00-16h00	25.1	3.3	South-East
16h00-18h00	24.7	8.1	South-East
18h00-20h00	23.8	4.2	East
20h00-22h00	25.2	3.0	00
22h00-24h00	22.1	1.0	North-East
Date 12/27/00			
0h00-2h00	21.2	2.0	North-East
2h00-4h00	21.0	2.0	North-East
4h00-6h00	19.8	2.0	North-East
6h00-8h00	20.8	4.2	North-East
8h00-10h00	21.2	5.5	North-East
10h00-12h00	22.3	10.4	North-East
12h00-14h00	22.1	7.6	North-East
14h00-16h00	23.1	3.3	North-East
16h00-18h00	22.2	8.1	North-East
18h00-20h00	22.4	4.2	North-East
20h00-22h00	21.7	3.0	North-East
22h00-24h00	21.5	1.0	North-East
Date 12/28/00			
0h00-2h00	21.1	00	00
2h00-4h00	20.6	00	00
4h00-6h00	21.2	00	00
6h00-8h00	20.7	00	00
8h00-10h00	20.9	00	00

10h00-12h00	22.1	1.0	North-East
12h00-14h00	23.6	1.0	North-East
14h00-16h00	24.5	2.0	East
16h00-18h00	23.9	1.0	South- East
18h00-20h00	22.7	1.0	South- East
20h00-22h00	22.0	00	00
22h00-24h00	21.0	00	00
Date 12/29/00			
0h00-2h00	21.1	2.0	North-East
2h00-4h00	22.0	1.0	North-East
4h00-6h00	21.7	00	00
6h00-8h00	20.9	2.0	North-East
8h00-10h00	21.0	1.0	North-East
10h00-12h00	22.3	4.2	North-East
12h00-14h00	24.6	3.0	North-East
14h00-16h00	26.2	3.0	North-East

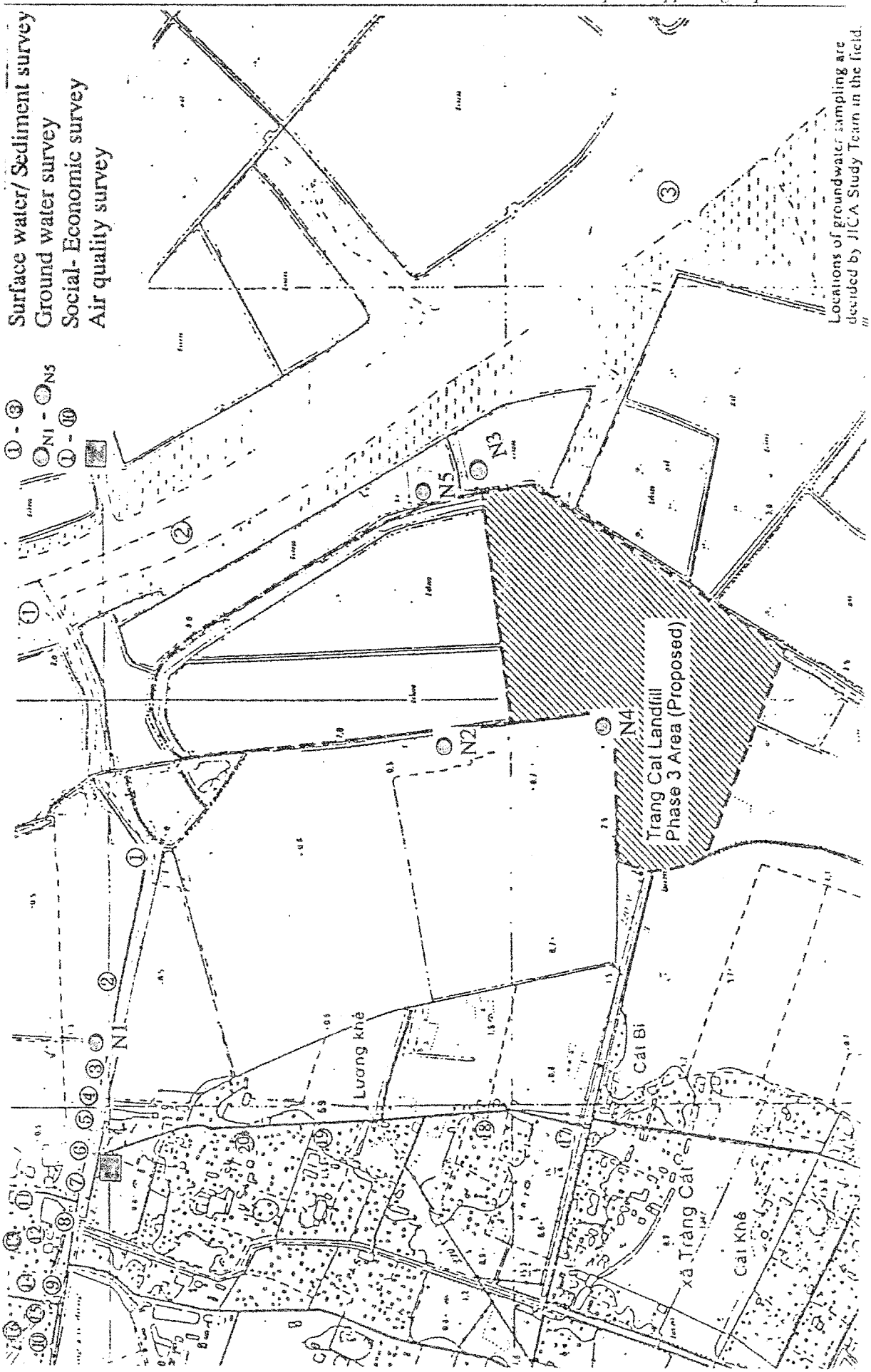

Figure C.3.4.2 Proposed Project Area and Sampling Points of EIA Surveys

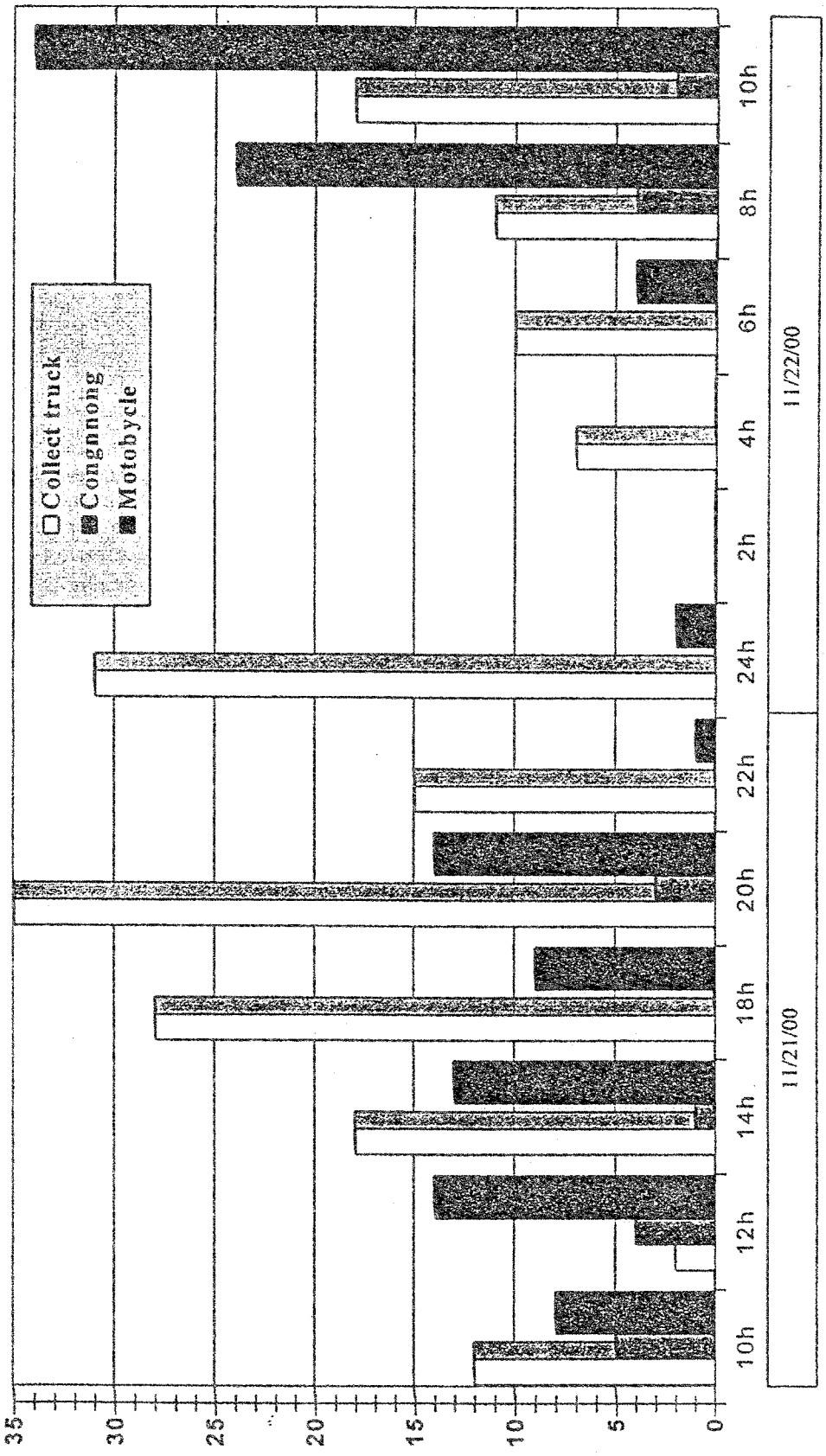

Figure C.3.4.3 Traffic Density at Project Site from 10th am of 11/21/00 to 10h am

C.4.3 Present Solid Waste Status

C.4.3.1 Present Solid Waste Management in Haiphong

C.4.3.1.1 Sanitary Condition

It is generally observed that the Haiphong City is kept clean and sanitary. However, the following problems are observed.

- Some people discharge their waste (household waste) on the streets before arrival of handcarts
- Some people discharge their waste (household waste) into rivers and canals
- Some people discharge demolition waste on streets and some open spaces. (This type of waste is much reused as construction material. However, dumped demolition waste stays on streets as waste until someone come to collect for reuse.)
- Waste collected by handcarts is dumped on streets for loading into vehicles. Such waste loading operation is insightful and unsanitary.
- All hazardous waste including medical waste and hazardous industrial waste are collected together with other non-hazardous waste, and disposed of landfill site without any treatment. There are risks that such hazardous waste would affect waste collectors and other people.

In Haiphong City, there have been no cases of diseases or accidents that have reportedly occurred in connection with solid waste management.

C.4.3.1.2 Waste Generation and Collection Service Level

There are three companies that provide solid waste management services in the 4 urban districts and Do Son Town. They are URENCO, Kien An Urban Works Company and Do Son Public Works Company.

It is estimated that these 3 companies collect a total of 471 ton/day of solid waste on average, 75% of 630 ton/day, the estimated total waste generated in the responsibility areas of the three companies.

In terms of population, average collection ratio in URENCO area and Kien An is 85%, while it is 13% in Do Son as shown below.

Waste Generation and Collection Ratios in Haiphong City

Companies	Generation	Collection Ratio in terms Quantity	Population
- URENCO	484 ton/day	76%	85%
- Kien An Urban Works Company	80 ton/day	76%	85%
- Do Son Public Company	66 ton/day	67%	13%
- Sub-Total	**630 ton/day**	**75%**	**81%**
- Other Areas in Haiphong City	347 ton/day	0%	0%
- Total	977 ton/day	48%	25%

Non-served places include 1) agricultural areas, 2) places inaccessible by collection vehicles, and 3) households who refuse waste collection service; for example, households near rivers refuse URENCO's service as they can easily dump waste into the rivers.

It does not necessarily mean that the waste that is not collected by SWM companies pollutes the environment. In general, the companies do not collect waste generated by farmers' houses. However, the farmers dispose of their waste by burying, burning, or sometimes giving animals as food.

Types of Waste Collected

Based on the waste collection survey and data obtained, the waste collection quantities by waste types are estimated as follows:

Type of Waste	Collection	Ratio
• Household waste	218 ton/day	46%
• Business waste	135 ton/day	29%
• Street waste	58 ton/day	12%
• Industrial waste	45 ton/day	10%
• Hospital waste	5 ton/day	1%
• Demolition waste	9 ton/day	2%
• Total	471 ton/day	100%

C.4.3.1.3 Treatment and Disposal

In Haiphong, there is no intermediate treatment of solid waste. All kinds of waste including medical waste and hazardous industrial waste is collected and disposed of at the city's landfill sites together with other types of waste.

Trang Cat Landfill Site is not a sanitary landfill though there are some engineering inputs such as leachate collection and treatment. The existing leachate treatment is not effective, and the leachate pollutes the Cam River where the leachate flows into. No cover soil is applied. This condition causes generation of occasional fires, smokes, rodents and dusts. The landfill site is not equipped with a gas ventilation system. This condition would poses risks of gas explosion. The Do Son landfill site however is equipped with a gas ventilation system

C.4.4 Environmental Impacts of the Project

C.4.4.1 Approach and Methodology

The improvement of solid waste management is important and visible action in Haiphong to keep the City clean, healthy and beautiful. However, all kind of construction works as well as activities related to these, will lead to certain cause (activity) and impacts on the environment.

In this EIA study, we will arrange and specify both the negative and positive environmental impacts on the physical, biological and human environment caused by the proposed solid waste management project.

This environmental impact assessment adopts a concise format, where the linkages between environmental issues (or potential impacts), management measures (or mitigation), net effect (or residual impacts) and management information (or monitoring) are made explicitly. A comprehensive summary of these factors and their linkages is presented in the tables.

The main impacts of the proposed project are described for design phase, construction phase, operation phase and closing-down phase. Alternative without the project implementation has been described, too.

C.4.4.2 Without Project Alternative

In any case, solid waste collection and disposal have to be arranged, other wise the streets and vacant lands would be full of garbage in short time. This kind of uncontrolled solid waste disposal would increase the environmental pollution much more than controlled solid waste treatment in proper landfill.

C.4.4.3 Environmental Impacts during Design Phase

The impacts during design phase are related to choosing the location of the landfill, design methods, and compensation issues. There is no need of resettlement, because the proposed area is fishponds, but the compensation have to paid to the fishing company.

The proposed project site is within the designated area approved by Prime Minister to be used as landfill area. There is already Trang Cat landfill phase 1 (5 ha) in the area, there is also reservation for Trang Cat landfill phase 2, and 17ha for SADCO sludge and septage treatment area. The remaining 32.7 ha is reserved for Trang Cat landfill phase 3.

The design of the landfill has to be done minimizing adverse environmental impacts including transportation, filling method, height of the filling, gas collection, leacheate collection and treatment, and covering.

During the design phase, soil condition should be evaluated by drilling bore holes and analyzing the cores specially from the viewpoints of soil permeability and bearing capacity. Also, detail survey should be carried out for the surcharge soil collection, transportation and design for placement . The surcharge will be placed in a trapezoidal shape, so that the surcharge can be kept stable. The side slopes should be 1:2.5.

C.4.4.4 Environmental Impacts during Construction Phase

According to the design, the constructing process will last for two years from 2004 to 2005 including the following works:

1. Collection of surchage soil.
2. Transportation of surchage soil to the landfill site.
3. Placement of surchage soil.
4. After 10 months surcharging, remove the soil.
5. Dredging and grading the surface
6. Construction of the liner systems (clay, synthetic, protection layer)
7. Construction of the dykes
8. Construction of internal roads
9. Construction of leachate treatment facility and the drainage systems to Cam River
10. Other civil works

The potential environmental impacts of these activities are as follows:

- Proposed soil collection site, Phu Luu Mountain landscape may change
- Mud may come out of surchage after placing in the ladfill site
- Landscape will change from the fishponds to landfill
- Fish ponds have to be dried before dredging, and there will be only temporary increase of turbidity in the Cam River
- Dredging of the bottom and construction of the dykes will increase traffic, noise and dust temporarily in the area

During the surcharging of the landfill site, a total of 240,000 m3 of soil will be brought from near by Phu Luu Mountain. Detail study should be carried out to make sure that there would be no adverse impact near the mountain site caused by this large soil displacement. In case negative impact is likely, alternative source should be selected. One possibility is to use the soil dredged from the An Kim Hai Channel rehabilitation and another is the soil to be obtained through Phoung Luu Lake excavation . Also proper schedule should be prepared for traffic for the transportation of this soil from the mountain site to the landfill site.

The overall impacts during construction of Trang Cat Landfill Phase 3 will be reasonably small, local and temporary. The impacts on air quality will be insignificant. Excavation of bottom works will be above upper aquifer and no

groundwater pollution is expected. Impacts on the Cam River during emptying of fishponds will insignificant and short-term.

C.4.4.5 Environmental Impacts during Operation Phase

The biggest environmental impacts from the Trang Cat Landfill Phase 3 will be during the operation phase, which according to the preliminary plan, will be about ten years from 2005 to 2014.

The main activities of the landfill are the following:

1. Transportation of waste by specific trucks or normal trucks
2. Filling work by cell method. Leveling and compacting the waste to increase the density of waste from 0.5 kg/cm3 to 0.85 kg/cm3
3. Soil cover for each cell
4. Collection of landfill gases
5. Leachate collection from landfill and treatment before discharging into the Cam River

Since a synthetic liner will be placed after compacting the existing soil, groundwater pollution potential is extremely low. The leakage of the synthetic layer is only 20 liter per day per hectare.

During the operation of the landfill transportation, filling and compacting will have the biggest impacts on air environment. Dust and offensive odor from landfill are long-term impacts, which, however, can be minimized with proper landfill management.

After treatment, leachate will have minor impacts on surface and sediment quality of the Cam River.

It would be very difficult to stop scavenging from the landfill. There is a risk that unofficial “recycling centers” continue outside the landfill area and pollute the surrounding of the landfill seriously.

Environment risks during the landfill operation are as follows:

- Burning and exploding of methane gas
- Leakage of leachate from the treatment ponds
- Diseases for the community
- People in the area protest and prevent the collect truck from accessing to the landfill

The waste can burn by itself or burned by propose causing explosion of methane. This risk happens only when the construction and operation are not implemented in proper way.

C.4.4.6 Closing-down Phase

After closing, there will be continuously leachate, which will impact on surface water and groundwater, if the leachate treatment process is not operated properly and the quality of treated water does not meet the standard when it is discharged into Cam River. Groundwater might be affected in a long run, if leachate will leak through the bottom layer.

Methane (CH_4) emission from the landfill will be the main pollution source of the air environment. If the concentrate of it is about 5-15% can cause explode.

Old landfill areas cannot be used for construction of houses of other heavy structures due to the risk of possible landslides, soil subsidence and gas explosions.

C.4.4.7 Environmental Consideration for Hospital Waste Management

C.4.4.7.1 Objectives

The major objective of the proposed project is the improvement in the standard of hospital waste management in terms of storage, collection and transportation, treatment and disposal. Among the anticipated environmental and occupational risks include direct contact with infectious waste, and the secondary pollution with dioxin generated through incineration and disposal of hospital waste. The project is planned, designed and proposed in a manner to minimize those possible risks.

C.4.4.7.2 Bio-hazards during Transportation

Once infectious waste is put into a carton box or a plastic bag, it will never be opened again. This is a primary measure to isolate the infectious waste. Secondarily, waste storage room in each hospital is locked to prevent other persons from contacting the waste. Thirdly, closed chamber of the collection vehicles will be locked except for loading and unloading. Complete isolation can be achieved in this way.

C.4.4.7.3 Emission Gas from Incinerator

Emission gas from the incinerator must comply with the industrial emission standard of Vietnam, Standard TCVN 5939-1995 and TCVN 5940-1995. Typical plastic waste contained in the infectious was is injection syringes and transfusion tubes and bags. These are made of high density polyethylene and polyvinyl chloride, respectively. When polyvinyl chloride is incinerated, hydrogen chloride or even phosgene ($COCl_2$), a kind of toxic gas, might be generated. Dioxin is also a highly toxic substance to be controlled carefully.

Complete combustion at adequately high temperature is a good way to prevent generation of such organic toxic gases. They are not generated at high temperature.

Even if they are generated, they will be decomposed at high temperature. Therefore, the incinerator with recombustion chamber is proposed in this plan, as such gas is decomposed in the recombustion chamber at more than 800 °C.

C.4.4.7.4 Dioxin in Ash

Dioxin may be contained in the incineration residue, though the amount may be small. The residue will be disposed of at the Infectious Waste Incineration Residue Landfill site that will be constructed in Trang Cat Landfill Phase 3 site. The ash is kept separately from other waste and its leachate is collected also separately. Even if the residue contains dioxin and other toxic substances, they are confined in the Infectious Waste Incineration Residue Landfill site.

C.4.4.8 Summary of the Environmental Impacts of Solid Waste Management Project

The proposed solid waste project is expected to bring the following positive impacts: (i) reduction of uncollected solid waste in the city, (ii) improvement of health condition, (iii) environmentally-sound disposal of collected waste, and (iv) safe management and disposal of medical waste.

The anticipated negative environmental impacts of the project are: (i) change of landscape from fishponds to landfill, (ii) noise and odor nuisance along the access road, (iii) Odor and pollution from landfill, (iv) increase of pollution load to the Cam River, and (v) risk of groundwater pollution.

The major environmental impacts for Trang Cat Landfill Phase 3 are presented more detailed in Table C.3.4.2.

Table C3.4.2 Summary of the Major Impacts and Mitigation Measure of Trang Cat Landfill Phase 3

Issue	Location	Major Impacts	Mitigation Measures	Net Effects	Monitoring
Land acquisition	Trang Cat	Area is already reserved for landfill. No need for land acquisition or resettlement.	Compensation for fishing co-operative for the ponds.	Long-tern permanent impacts	Monitoring of compensation
Construction of landfill	Trang Cat	Change from fish ponds to landfill needs excavation and bottom works.	Construction of liner system to prevent infiltration to groundwater, gas collection system and leachate collection and treatment system according to the design.	Short-term impacts	Construction management supervision
Access to landfill and transportation	Villages nearby	Traffic through the nearby villages is increasing. Possible spills from trucks. Construction of internal roads.	Garbage trucks have to be covered or be container type to avoid spills. Construction of internal roads according to the design.	Long-term temporary impacts	Supervision of loading and transportation Monitoring or air quality and noise
Operation of landfill	Trang Cat	Filling of the landfill	Filling according to the cell method. Cells should be covered systematically, at least weekly.	Long-term impacts	Supervision of filling work and covering
Major pollutants	Trang Cat	Among domestic solid waste there might be also industrial waste or hazardous waste.	Origin of solid waste should be known. Hazardous waste should be separated.	Occasional impacts	Monitoring content of solid waste
Leachate	Cam River	Leachate from landfill	Leachate will be collected and treated in treatment system before discharging to Cam River. Groundwater contamination is prevented with proper lining.	Long-term permanent impacts	Monitoring of treated leachate and Cam River water quality
Noise	Along roads, Trang Cat	Noise is short-term but frequent nuisance during transportation of solid waste along streets and roads	Avoid working during night time.	Long-term impacts	Supervision of solid waste transportation
Dust	Along roads, Trang Cat	Dust is short-term but frequent nuisance during transportation of solid waste along streets and roads and in landfill	Effective management of loading, transportation and unloading of solid waste. Workers should were protective clothing and masks.	Long-term impacts	Supervision of solid waste management and safety on work
Air emissions and offensive odor	Trang Cat	CO, CO_2, H_2S, NO_2 and especially CH_4 and offensive odor, generated from landfill process will have local, long-term impacts on air environment in Trang Cat area.	Burning and exploding methane has to be prevented with gas collection system. Weekly covering decreases odor.	Long-term impacts	Monitoring of air quality
Closing-down	Trang Cat	Landfill will have impacts decades after closing.	Landfill has to be covered properly. It is recommended plant trees and other vegetation on closed areas. Gas collection and leacheate collection and treatment has to be in operation	Long-term impacts	Monitoring of air, surface water, groundwater and leachate quality

C.4. 5 Mitigation Measures

C.4.5.1 Mitigation Measures during Design Phase

C.4.5.1.1 General Design Instructions

Environmental matters have to be integrated in all the design work and planning of the project, so that the environmental impact can be minimized in these stages.

According to the Vietnamese Construction Regulation Standard Article 3.3 Protection of Natural Resources and Environment construction projects should:

- Not cause adverse effect to environment, and technical regulations on scenery and environment protection should be observed
- Protect the natural preservation areas, and historical, cultural and architectural places
- Extracting natural resource must ensure the rationality and cause no obstacle to the next exploitation
- Respect traditional customs, practices, religions of people living in and around the construction area

C.4.5.1.2 Landfill Design Instructions

Detailed design should be done according to the principles presented in the facility plan and preliminary design in the Feasibility Study. The design should include:

- Outline design including: Design of main facilities, Land use plan, and Equipment and staffing
- Embankment design
- Liner design
- Design of leachate collection system
- Design of leachate treatment system
- Design of leachate re-circulation system
- Design of Gas collection system
- Design of Access road and on-site road
- Design of Environmental monitoring facility
- Design of other possible facilities

The following matters should be considered in the design:

(1) Protection Zones

The dyke separating Quyet Thang pond and Cam River belongs to the category national dyke and according to regulation, there must be at least 20 meter wide protection zone between dyke and construction.

There are no households inside the project site, which have to be resettled, but to minimize the adverse impacts on the villages nearby trees should be planted

between the landfill and villages. The width of the protection zone must be at least 20 meters.

The landfill area has to be surrounded by fence to prevent encroachment of the area and outsiders to come to the area.

(2) Leachate Treatment and Discharge

A treatment system including mixing pond, precipitation pond, aeration pond and aquatic plant pond has been proposed for treatment method. Due to the possible heavy metals in leachate aquatic plants are not recommended to be used for feeding of animals, but should be harvested and returned to the landfill.

Discharging point has to be selected so that the adverse impacts on the water quality of the Cam River can be minimized. Attention should be paid to the possible erosion of the river banks.

(3) Health and Safety

Location of supporting facilities as office, dining rooms and social rooms should be so designed that they are upwards from the prevailing wind to prevent odor, dust and noise.

(4) Public Relations

The content of the project and construction schedule should be informed to the people living in the vicinity of Trang Cat Landfill Phase 3. Good co-operation between local authorities, project affected people and employer are essential for the successful implementation of the project. There should be also public awareness campaigns to introduce proper solid waste management system.

C.4.5.2 Mitigation Measures during Construction Phase

C.4.5.2.1 Noise, Odor, Litter and Dust

Maximum permitted noise level in public and residential areas is given in Vietnamese standard TCVN 5949-1995. The strongest limitations are from 10 p.m. to 6 a.m. in the vicinity of hospitals, sanatoriums, libraries and kindergartens where maximum noise level is 40 dB.

It is extremely important to inform the local people in advance about the public nuisance during the excavation and construction works.

In construction sites dust, litter and public inconvenience has to be minimized by good construction management and site supervision. To minimize dust emissions caused by construction works, sprinkling the roads with water is recommended in the vicinity of construction sites.

Trees around the landfill are effective measures to mitigate water, air and soil pollution, and creating favorable condition for development of terrestrial plants in a balanced state.

C.4.5.2.2 Water and Sediment Quality

Before construction the existing fishponds have to be emptied by pumping. During the pumping erosion of the surroundings and especially the mangrove area has to be avoided.

During construction, oil and waste from transportation trucks and machines need to be collected and disposed in the suitable place to avoid water pollution.

C.4.5.2.3 Health and Safety

In all construction works local health and safety working methods and instruction given in Bidding Documents have to be followed up.

(1) Safety, Security and Protection of the Environment

The Contractor shall, throughout the execution and completion of the works and remedying of any defects therein:

- Have full regard for the safety of all persons entitled to be upon the site and keep the site and the works (so far as the same are not completed or occupied by the Employer) in an orderly state appropriate to the avoidance of danger to such persons.
- Provide and maintain at his own cost all lights, guards, fencing, warning signs and watching, when and where necessary or required by the Engineer or by any duly constituted authority, for the protection of the Works or for the safety and convenience of the public or others, and
- Take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation.

(2) Accidents and Insurance

The Employer has no responsibility for injuries that may be suffered by employees of the Contractor, unless such injury results from an act or default of the Employer. In such circumstances the injured person would be regarded as a “third party” to the Employer and the Employer would have the benefit of the Third Party insurance.

During the execution of the works the Contractor shall keep the site reasonably free from all unnecessary obstructions and shall store or dispose of any Contractor’s

equipment and surplus materials and clear away and remove from the site any wreckage, rubbish or temporary works no longer required.

The Contractor shall have on his staff at the Site an officer dealing only with questions regarding the safety and protection against accidents of all staff and labor. This officer shall be qualified for his work and shall have the authority to issue instructions and shall take protective measures to prevent accidents.

(3) Health and Safety

Due precautions shall be taken by the Contractor, and at his own cost, to ensure the safety of his staff and labor and, in collaboration with and to the requirements of the local health authorities, to ensure that medical staff, first aid equipment and stores, sick bay and suitable ambulance service are available at the camps, housing and on the Site at all times throughout the period of the Contract and that suitable arrangements are made for the prevention of epidemics and for all necessary welfare and hygienic requirements.

The Contractor is responsible to provide appropriate equipment, tools and protective clothing to the workers. The Contractor has to ensure that appropriate working methods are applied.

Anti-vibration mountings and noise insulation on equipment has to be used when possible. The Contractor has to provide and train how to use ear protectors for workers when noise level in the working place exceeds 85 dB.

The removed material from construction sites has to be handled, transported and disposed according to the safety instructions.

(4) Safety and Health during Construction

The Contractor has to follow strictly safety and health regulations during excavation and construction of the landfill.

A possibility to proper washing with clean water has to be arranged during and after the working.

Clean water and first aid kit has to be available to wash and treat the possible cuts and wounds.

C.4.5.2.4 Traffic and Transportation Arrangements

(1) Interference with Traffic and Adjoining Properties

All operations necessary for the execution and completion of the works and the remedying of any defects therein shall be carried on so as not to interfere unnecessarily or improperly with:

- The convenience of the public

- The access to, use and occupation of public or private roads and footpaths to or of properties whether in the possession of the Employer or of any other person.

The contractor shall use every reasonable means to prevent any of the roads or bridges communicating with or on the routes to the site from being damaged or injured by any traffic of the Contractor or any of his Subcontractors. In particular, the Contractor shall select routes, choose and use vehicles and restrict and distribute loads so that any such extraordinary traffic as will inevitably arise from the moving of materials, plant, Contractor's equipment or temporary works from and to the site shall be limited, as far as reasonably possible.

(2) Transportation of Construction Materials

The nuisance caused by transportation of construction materials has to be minimized by arranging transportation and construction on busy main streets only outside rush hours and in narrow streets in residential areas only during the day. The transportation has to be avoided between 10 p.m. to 6 a.m. and is allowed only on the request of traffic police. The noise level limitations given in the Vietnamese standard TCVN 5949-1995 have to be followed.

Careful planning of excavation and construction and transportation schedules, and planning and selection of routes, as well as choice of transportation vehicles will minimize dust.

Loads have to be covered tightly to minimize spread of dust and preventing dropping of material from the loads to the roads.

C.4.5.2.5 Working Time and Site Arrangements

(1) Site Regulations and Safety

The Employer and the Contractor shall establish Site regulations setting out the rules to be observed in the execution of the Contract at the Site and shall comply therewith. The Contractor shall prepare and submit to the Employer, with a copy to the Engineer, proposed Site regulations for the Employer's approval, which approval shall not be unreasonable withheld.

Such Site regulations shall include, but shall not be limited to, rules in respect of security, safety of the facilities, gate control, sanitation, medical care, and fire prevention.

Sign to show the name of the Project, the name of Employer and the name of Contractor has to locate in visible place in the construction site.

(2) Site Clearance

Site Clearance in course of Performance: In the course of carrying out the Contract, the Contractor shall keep the Site reasonably free from all unnecessary obstruction,

store or remove any surplus materials, clear away any wreckage, rubbish or temporary works from the Site, and remove any Contractor's Equipment no longer required for execution of the Contract.

Clearance of the Site after Completion: After Completion of all parts of the Facilities, the Contractor shall clear away and remove all wreckage, rubbish and debris of any kind from the Site, and shall leave the Site, and shall leave the Site and Facilities clean and safe.

(3) Watching and Lighting

The Contractor shall provide and maintain at its own expense all lighting, fencing, and watching when and where necessary for the proper execution and the protection of the Facilities, or for the safety of the owners and occupiers of adjacent property and for the safety of the public.

(4) Work at Night and on Holidays

Unless otherwise provided in the Contract, no work shall be carried out during the night and on public holidays of the country where the Site is located without prior written consent of the Employer, except where work is necessary or required to ensure safety of the Facilities or for the protection of life, or to prevent loss or damage to property, when the Contractor shall immediately advise the Engineer.

C.4.5.2.6 Public Relations

The Employer shall announce the rehabilitation works and new traffic arrangements during rehabilitation works to the public regionally in newspapers, TV and radio. Locally the announcement is given to the phuong representatives who will inform the residents. Loudspeakers can be used during the construction work to give the latest information in concerning areas. It is extremely important to inform the local people in advance about the public nuisance during the construction.

C.4.5.3 Mitigation Measures during Operation Phase

C.4.5.3.1 General

Project Implementing Organization has the responsibility to carry out all operation and maintenance works, and arrange them using proper methods avoiding noise, odor, litter, dust and traffic nuisance during the operation.

Same health and safety instructions as during the construction phase have to be followed also during operation of the landfill. A possibility to proper washing with clean water has to be arranged during and after working.

C.4.5.3.2 Operation and Management of Landfill

(1) Landfill Activities

To the operation and management of the landfill includes, as presented in the preliminary design:

- Landfill work plan and record keeping
- Landfill filling method
- Operation of major facilities including leachate collection and treatment, daily and periodical inspection, gas control and fire control
- Environmental monitoring plan including external monitoring and internal monitoring

(2) Operation and Management

- Operation and maintenance rules have to be set, in which are regulated what kind of waste can be filled in the landfill, the process for receiving, leveling, compacting waste and controlling gas collection system. There has to be regulations how to operate of leachate treatment system and soil covering
- Clear rules for maintenance operations have to be set. All personnel should have appropriate training for their tasks.
- Adequate telecommunication system must be installed for communication within the landfill area and communication with agencies as well as for use in emergency situations
- Regular safety inspections in all parts of the system has to be planned
- There has to be a plan to control speed of collect truck and force the diver to use propitiate cover method to avoid dropping the waste on the road. Co- ordination with the authorities of Nam Hai and Trang Cat commune to protect environment.
- Compaction of refuse had to done according to the instructions. Each waste layer should be allowed to settle before the next layer of waste is added.
- Roads and yards must be kept tidy
- Scavenging has to be controlled. However, recovery of secondary materials is recommended to minimize the amount of waste at the landfill and to get the recyclable into circulation.
- Installation of wheel cleaners to prevent mud and refuse to be picked up on the wheels of collection vehicles and carried back into roads.
- Monitoring of bird migration and reproduction of birds at the Trang Cat site in order to make necessary measures early enough to prevent bird strikes on aircraft

(3) Environmental Protection

- No waste should be tipped into water

- Leachate re-circulation is recommended to keep the refuse moist, so that the anaerobic biological activity can be maximized. Moreover, it will prevent the clay liner under the refuse from cracking and leachate infiltration into subsoil.
- Suitable screens or alternative measures should be provided to collect windblown refuse and papers
- Monitoring of groundwater and surface water and air emissions

(4) Health and Safety

- Accurate and complete records of all inspections, accidental discharges, unusual events, accidents and safety measures have to be taken
- Establish a reliable and workable scheme for dealing emergencies (accidents, fires, risk of explosion etc). Ensure safety for staff and familiarity with procedures and safety equipment.
- Obligatory use of ear protectors when noise level exceeds 85 dB.
- Installation of fire fighting facilities (firewater pumps, CO_2-systems and portable fire extinguishers). To equip the staff of the landfill with fire- fighting facility and train them the skill of fire safety. Operators responsible for fire fighting must be clearly identified
- To equip the operation worker with protection tools
- Sanitary and washing facilities with equipment and supplies (e.g. protective cream) allowing personnel to protect themselves from and/or wash away toxic and hazardous chemicals. Policy of encouraging employees to wash frequently

C.4.5.4 Closing-down Phase

The following mitigation measures are proposed for the landfill in post operation phase as follows:

Proper slopes:

- Before covering, the top layer of waste must be leveled with a proper slope to avoid settlement or stagnating raining water. The suggested slope is 1:3.

Proper cover layers:

- Gas drainage layer: The thickness of 0.5m, installed gas collecting pipe and ventilation pipe.
- Impermeable layer: the thickness of minimum 0.3-0.5 m. This layer preventing the raining water go through into the filling layer and preventing the gas emission to the environment.
- Top layer: The thickness of 1m. This soil cover layer can be used to plant the trees or grass.

Gas and surface water run-off collection system:

- Gas collection system must be in operation to control the emission of landfill gas.
- Drainage system for surface water run-off has to be constructed

Leachate treatment system:

- Leacheate collection and treatment has to be in operation

Landscaping

- After closing down the landfill will be 17 m high bare mountain. Trees, grass and other vegetation has to be planted on the area.
- During the first 5 years may occur soil subsidence, because the landfill is not in the stable state, yet. There might be need to recover and replant the area.
- With a good management it is possible to create from the old landfill green and beautiful park.

C.4.5.5 Impacts with the Proposed Mitigation Measures

The proposed mitigation measures were designed to satisfy relevant environmental laws and regulations. Hence, the environmental impacts will be sufficiently minimized to the acceptable levels as long as these measures are implemented as planned. Details of the mitigation measures should be designed in the Detailed Design Phase in order to reflect the details of the project design in the mitigation measures.

C.4.5.6 Summary of Mitigation Measures

Phase	Main mitigation measures	Responsible organization
Design	International and Vietnamese design criteria and standards to be used Outline of preliminary design has to be followed Works designed to implemented during dry season	Design Consultant
Construction	Minimize dust, odor, litter, noise and traffic emissions by good operation management and site supervision Appropriate working methods have to be followed Surface water and groundwater contamination has to prevented during construction Sites have to be kept clean and safe during and after the work Safety and health regulations has to be strictly followed Protective clothing and operational training for workers is essential Transportation has to be minimized and routes selected to avoid public nuisance Transportation during rush hours and night has to be avoided Construction sites and time has to be informed to the local people in advance	Contractor
O&M	Operation and Management regulations have to be followed including filling, gas and leachate collection and treatment Minimize odor, litter and noise emissions by good operation management and site supervision Appropriate working methods have to be followed Sites have to be kept clean and safe during and after the work Safety and health regulations have to be strictly followed Protective clothing and operational training for workers is essential	URENCO

C.4.6 Land Acquisition and Compensation

C.4.6.1 Land Acquisition

The proposed project site has been approved by the Prime Minister to be a landfill site. The estimated land acquisition and compensation cost for Trang Cat Landfill Phase 3 is 1.7 USD x 32.7 ha = 555,900 USD, which was estimated based on the land acquisition and compensation costs from the previous phases.

C.4.6.2 Compensations

C.4.6.2.1 General

Compensation is including the following items:

- Land use right expressed by the contract for hire between the pond owners and Trang Cat People's Committee
- Value of investments that the pond owners has put on the ponds
- Loss of yield from the area
- Loss of job

C.4.6.2.2 Compensation for Land Use Right

The contract for the land use right between Trang Cat people's Committee and partner group represented by Mr. Nguyen Van Loi has been signed on 10/30/1999. Base on this contract, Mr. Loi has to pay total 1,425,000,000NVD, and has right to use 60 ha for 5 years from 1999 to 2004. Of which 5 ha has been used for Trang cat landfill phase 1 already. So the remaining area is 55 ha of which 32.7ha will be used for the landfill phase 3.

The value that the project has to compensate for the land use right of 1 ha in 1 year is:

C_{ha}= 1,425,000,000 VND/ 60 ha/ 5years = 4,750,000 VND (per ha per year)

The value that the project has to compensate for the land use right of 32.7 ha for one year is:

C_1= 4,750,000 VND x 32.7 ha = 155,325,000 VND (per year) = 11,038 USD

C.4.6.2.3 Compensation for Investment

At present time there are the following structures:

The guard house area: 3 guard houses x 10m^2/ one = 30 m^2

Estimated value: 3 guard houses x10,000,000 VND/ one guard house = 30,000,000 VND

Draining gate

4 x 15,000,000VND/one = 60,000,000 VND

Four guard towers

Area of each tower: 2.4 x 1.5 = 3.6m

Estimate value: 4 x 4,000,000 /one tower =16,000,000 VND

Constructed dam around the area

The length of dam: 4 km

The volume of the soil use for one 1 m length: $5m^3$

The cost for one m^3 work is 15,000 VND

The total cost: 15,000 VND x 4,000m x $5m^3$ = 300,000,000 VND

The cost for cleaning up and improve the pond for farming purpose

20,000,000 x 55 = 110,000,000 VND

Total: from item 1 to item 5 is the compensation for the construction of 55ha

516,000,000 VND.

The compensation of one ha is

C = 516,000,000 VND/ 55 = 9,382,000 NVD (per one ha)

For 32.7 ha the value is

C_2 = 9,832,000 x32.7 = 306,791,000 VND = 21,802 USD

C.4.6.2.4 Compensation for Loss of Yield

Mr. Loi has right to use this land until year 2004. According to the estimation, provided by Trang Cat people's committee to ENCEN in 12/2000, the value brings to him from craps, shrimps, seaweed, fish cultivation is about 7,300,000 VND per ha per year. The profit that he will get from this is about 20% of it.

So the value that the project has to compensate for the loosing of aquaproduct in the area of one ha in one year for him is

C = 7,300,000VND - 20% = 5,840,000 VND per ha per year

So the value that the project has to compensate for the loosing of aqua- product in the area of 32.7 ha in one year for him is

C_3 = (7,300,000VND - 20%) x 32.7ha = 190,968,000 VND = 13,571 USD

C.4.6.2.5 Losing of Job

There are two kinds of jobs for aquaculture. The first is full time job for guards of the ponds, technicians, and feedings. There are 24 full time workers.

The second is part time job and average working time is 4 months per year. There are 120 part time workers.

According to the interviews the workers prefer to have new jobs instead of money compensation.

C.4.6.2.6 Total Compensation

Estimated land acquisition value is 556,000 USD.

Estimated total compensation for fish company will be:

C_1 = 11,038 USD (for 32.7 ha/year for land use right for year 2004)

C_2 = 21,802 USD (for 32.7ha in all the time for the investment of the Pond owner)

C_3 = 13,571 USD (for 32.7ha/year for losses of yield for year 2004)

The total compensation cost is estimated to be about 46,000 USD.

C.4. 7 Monitoring

C.4.7.1 Monitoring during Construction Phase

During construction phase will be carried out socio-economic survey and monitoring of air, noise, surface water and groundwater quality as follows:

Socio-economic survey:

- Twice per year
- Public opinion of at least 20 households about impact of construction works

Air Quality Monitoring during Construction Phase in 5 points in every 3 months

Criteria	Dust	H_2S	NH_3	CO	SO_2	Pb
Locations	(mg/m^3)	(mg/m^3)	(mg/m^3)	(mg/m^3)	(mg/m^3)	(mg/m^3)
1. Cat Bi Airport station (along the road) 2. Black Gate (along the road) 3. Landfill 4. Trang Cat commune 5. Nam Hai commune						

Noise level (dB(A)) Survey at the Access Road to Trang Cat Landfill during Construction Phase

Location: At border guard station 34

Frequency: Every 3 months

Time	dB(A)		
Every second hour during one day	Three measurements	Average	Remarks

Surface Water Quality Monitoring during Construction Phase in every 3 months

Locations:
Cam River 1, upstream of the discharging point of treatment pond of Trang Cat landfill phase 1
Cam River 2, upstream of Trang Cat landfill phase 3
Cam River 3, downstream of Trang Cat landfill phase 3

No	Parameter	Unit	Cam River 1	Cam River 2	Cam River 3	TCVN 5942-95
1	Temperature	^{0}C				
2	pH value					
3	EC	s/m				
4	DO	mg/l				
5	BOD	mg/l				
6	COD	mg/l				
7	Turbidity	NTU				
8	Salinity	%				
9	Odor	mg/l				
10	Suspended solids	mg/l				
11	Total nitrogen	mg/l				
12	NH_4^+ (N)	mg/l				
13	NO_3^- (N)	mg/l				
14	NO_2^- (N)	mg/l				
15	Total phosphorous	mg/l				
16	SO_4^{2-}	mg/l				
17	Zinc	mg/l				
18	Cadmium	mg/l				
19	Lead	mg/l				
20	Copper	mg/l				
21	Total Chromium	mg/l				
22	Chromium (VI)	mg/l				
23	Arsenic	mg/l				
24	Mercury	mg/l				
25	Iron	mg/l				
26	Cyanide	mg/l				
27	Grease and oil	mg/l				
28	Coliform	MPN/100ml				
29	E. Coli	MPN/100ml				

Groundwater Quality Monitoring during Construction Phase

Locations:

N_1 in the well of one household (Mr. Tuan) in the village near the landfill

N_2 left side of proposed Phase 2

N_3 right side in the project site

N_4 left side of proposed Phase 3

N_5 right side of proposed Phase 2

Frequency: Every 3 months

No	Parameter	Unit	N_1	N_2	N_3	N_4	N_5	TCVN 5944-95
1	Temperature	^0C						
2	pH value							
3	EC	s/m						
4	DO	mg/l						
5	BOD	mg/l						
6	COD	mg/l						
7	Turbidity	NTU						
8	Salinity	%						
9	Odor	mg/l						
10	Suspended solids	mg/l						
11	Total nitrogen	mg/l						
12	NH_4^+ (N)	mg/l						
13	NO_3^- (N)	mg/l						
14	NO_2^- (N)	mg/l						
15	Total phosphorous	mg/l						
16	SO_4^{2-}	mg/l						
17	Zinc	mg/l						
18	Cadmium	mg/l						
19	Lead	mg/l						
20	Copper	mg/l						
21	Total Chromium	mg/l						
22	Chromium (VI)	mg/l						
23	Arsenic	mg/l						
24	Mercury	mg/l						
25	Iron	mg/l						
26	Cyanide	mg/l						
27	Grease and oil	mg/l						
28	Coliform	MPN/100ml						
29	E. Coli	MPN/100ml						

C.4.7.2 Monitoring during Operation Phase

During operation phase will be carried out socio-economic survey and monitoring of air, noise, surface water and groundwater quality as follows:

Socio-economic survey:

- Once per year
- Public opinion of at least 20 households about impact of operation of landfill

Air Quality Monitoring during Operation Phase in every 3 months

Criteria	Dust	H_2S	NH_3	NO_2	Pb	CH_4	CO	SO_2	odor
Locations	(mg/ m^3)	(mg/m ^{3})	(mg/ m^3)	(mg/ m^3)	(mg/ m^3)	(mg/ m^3)	(mg/ m^3)	(mg/ m^3)	
1. Cat Bi Airport station (along the road) 2. Border guard station 34 3. Landfill 4. Trang Cat commune, the house nearest to landfill downwards the directions of wind 5. Nam Hai commune, the house nearest to landfill downwards the directions of wind 6. Office of landfill manager									

Noise level (dB(A)) Survey at the Access Road to Trang Cat Landfill during Operation Phase

Location: At border guard station 34

Frequency: Every 3 months

Time	dB(A)		
Every second hour during one day	Three measurements	Average	Remarks

Surface Water Quality Monitoring during Operation Phase in every 3 Months

Locations:
Cam River 1, upstream of the discharging point of treatment pond of Trang Cat landfill phase 1
Cam River 2, upstream of Trang Cat landfill phase 3
Cam River 3, downstream of Trang Cat landfill phase 3

No	Parameter	Unit	Cam River 1	Cam River 2	Cam River 3	TCVN 5942-95
1	Temperature	^0C				
2	PH value					
3	EC	s/m				
4	DO	mg/l				
5	BOD	mg/l				
6	COD	mg/l				
7	Turbidity	NTU				
8	Salinity	%				
9	Odor	mg/l				
10	Suspended solids	mg/l				
11	Total nitrogen	mg/l				
12	NH_4^+ (N)	mg/l				
13	NO_3^- (N)	mg/l				
14	NO_2^- (N)	mg/l				
15	Total phosphorous	mg/l				
16	SO_4^{2-}	mg/l				
17	Zinc	mg/l				
18	Cadmium	mg/l				

19	Lead	mg/l				
20	Copper	mg/l				
21	Total Chromium	mg/l				
22	Chromium (VI)	mg/l				
23	Arsenic	mg/l				
24	Mercury	mg/l				
25	Iron	mg/l				
26	Cyanide	mg/l				
27	Grease and oil	mg/l				
28	Coliform	MPN/100ml				
29	E. Coli	MPN/100ml				

Groundwater Quality Monitoring in Operation Phase in every 3 Months

Locations:

N_1 in the well of one household (Mr. Tuan) in the village near the landfill

N_2 left side of proposed Phase 2

N_3 right side in the project site

N_4 left side of proposed Phase 3

N_5 right side of proposed Phase 2

Frequency: 4 times per year

No	Parameter	Unit	N_1	N_2	N_3	N_4	N_5	TCVN 5944-95
1	Temperature	^0C						
2	PH value							
3	EC	s/m						
4	DO	mg/l						
5	BOD	mg/l						
6	COD	mg/l						
7	Turbidity	NTU						
8	Salinity	%						
9	Odor	mg/l						
10	Suspended solids	mg/l						
11	Total nitrogen	mg/l						
12	NH_4^+ (N)	mg/l						
13	NO_3^- (N)	mg/l						
14	NO_2^- (N)	mg/l						
15	Total phosphorous	mg/l						
16	SO_4^{2-}	mg/l						
17	Zinc	mg/l						
18	Cadmium	mg/l						
19	Lead	mg/l						
20	Copper	mg/l						
21	Total Chromium	mg/l						
22	Chromium (VI)	mg/l						
23	Arsenic	mg/l						
24	Mercury	mg/l						

25	Iron	mg/l						
26	Cyanide	mg/l						
27	Grease and oil	mg/l						
28	Coliform	MPN/100ml						
29	E. Coli	MPN/100ml						

Sediment Quality Monitoring during Operation Phase in every 3 Months

Locations:
Cam River 1, upstream of the discharging point of treatment pond of Trang Cat landfill phase 1
Cam River 2, upstream of Trang Cat landfill phase 3
Cam River 3, downstream of Trang Cat landfill phase 3

No	Parameter and pollutant	Unit	Cam River 1	Cam River 2	Cam River 3
1	pH value				
2	Sludge depth	m			
3	Moisture content	%			
3	Total Solid	%			
5	Volatile solid	%			
6	Apparent density	kg/m^3			
7	BOD	mg/kg			
8	Total nitrogen	mg/kg			
9	Total phosphorous	mg/kg			
10	Zinc	mg/kg			
11	Cadmium	mg/kg			
12	Lead	mg/kg			
13	Total Chromium	mg/kg			
14	Chromium (VI)	mg/kg			
15	Cyanide	mg/kg			
16	Mercury	mg/kg			
17	PCB	mg/kg			
18	Copper	mg/kg			

C.4.7.3 Closing-down Phase

Air Quality Monitoring during Closing-down Phase

Location: At the border guard station 34
Frequency: Every 6 months for first 5 years and 12 months for second 5 years

Location	H_2S	NH_3	NO_2	CH_4	SO_2	odor
	(mg/m^3)	(mg/m^3)	(mg/m^3)	(mg/m^3)	(mg/m^3)	
Border guard station 34						
Vietnamese Standard						

Effluent Quality Monitoring during Closing-down Phase

Location: Discharging point of Trang Cat landfill phase 3
Frequency: Every 6 months for first 5 years and 12 months for second 10 years

No	Parameter	Unit	N_1	TCVN 5945-95
1	Temperature	^0C		
2	pH value			
3	EC	s/m		
4	DO	mg/l		
5	BOD	mg/l		
6	COD	mg/l		
7	Turbidity	NTU		
8	Salinity	%		
9	Odor	mg/l		
10	Suspended solids	mg/l		
11	Total nitrogen	mg/l		
12	NH_4^+ (N)	mg/l		
13	NO_3^- (N)	mg/l		
14	NO_2^- (N)	mg/l		
15	Total phosphorous	mg/l		
16	SO_4^{2-}	mg/l		
17	Zinc	mg/l		
18	Cadmium	mg/l		
19	Lead	mg/l		
20	Copper	mg/l		
21	Total Chromium	mg/l		
22	Chromium (VI)	mg/l		
23	Arsenic	mg/l		
24	Mercury	mg/l		
25	Iron	mg/l		
26	Cyanide	mg/l		
27	Grease and oil	mg/l		
28	Coliform	MPN/100 ml		
29	E. Coli	MPN/100 ml		

Groundwater Quality Monitoring during Closing-down Phase

Locations:

N_1 in the well of one household (Mr. Tuan) in the village near the landfill

N_2 left side of proposed Phase 2

N_3 right side in the project site

N_4 left side of proposed Phase 3

N_5 right side of proposed Phase 2

Frequency**:** Every 6 months for first 5 years and 12 months for second 10 years

No	Parameter	Unit	N_1	N_2	N_3	N_4	N_5	TCVN 5944-95
1	Temperature	^0C						
2	PH value							
3	EC	s/m						
4	DO	mg/l						
5	BOD	mg/l						
6	COD	mg/l						
7	Turbidity	NTU						
8	Salinity	%						
9	Odor	mg/l						
10	Suspended solids	mg/l						
11	Total nitrogen	mg/l						
12	NH_4^+ (N)	mg/l						
13	NO_3^- (N)	mg/l						
14	NO_2^- (N)	mg/l						
15	Total phosphorous	mg/l						
16	SO_4^{2-}	mg/l						
17	Zinc	mg/l						
18	Cadmium	mg/l						
19	Lead	mg/l						
20	Copper	mg/l						
21	Total Chromium	mg/l						
22	Chromium (VI)	mg/l						
23	Arsenic	mg/l						
24	Mercury	mg/l						
25	Iron	mg/l						
26	Cyanide	mg/l						
27	Grease and oil	mg/l						
28	Coliform	MPN/100						
29	E. Coli	MPN/100						

C.4.7.4 Cost Estimates of Monitoring Program

Cost Estimation of Monitoring Program during Construction Phase

No	Survey	Unit price (USD)		Frequency (Times/ year)	Number of location/ household	Amount / year (USD)
1	Public hearing	30		2	20	1,200
2	Air quality survey	115		4	5	2,300
3	Surface water survey	368		4	3	4,416
4	Ground water survey	368		4	5	7,360
5	Noise survey	720		4	1	2,880
					Monitoring cost / year	18,156

Total 1 Monitoring cost for 2 years construction phase = 2 x 18,156 USD	**36,312**

Cost Estimation of Monitoring Program during Operation Phase

No	Survey	Unit price (USD)		Frequency (Times/ year)	Number of location/ household	Amount / year (USD)
1	Public hearing	30		1	20	600
2	Air quality survey	175		4	6	4,200
3	Surface water survey	368		4	3	4,416
4	Ground water survey	368		4	5	7,360
5	Sediment survey	335		4	3	4,020
6	Noise survey	720		4	1	2,880
					Monitoring cost / year	23,476
Total 2 Monitoring cost for 10 years operation phase = 10 x 23,476 USD						**234,760**

Cost Estimation of Monitoring Program during the First 5 Years during Closing-down Phase

No	Survey	Unit price (USD)		Frequency (Times/ year)	Number of location/ household	Amount / year (USD)
2	Air quality survey	120		2	1	240
3	Effluent survey	368		2	1	736
4	Groundwater survey	368		2	5	3,680
					Monitoring cost / year	4,656
Total 3 Monitoring of first 5 years after closing = 5 x 4,565 USD						**23,280**

Cost Estimation of Monitoring Program during the Second 10 years during Closing-down Phase

No	Survey	Unit price (USD)		Frequency (Times/ year)	Number of location/ household	Amount / year (USD)
2	Air quality survey	120		1	1	120
3	Discharge water	368		1	1	368
4	Ground water survey	368		1	5	1,840
					Monitoring cost / year	2,328
Total 4 Monitoring of second 10 years after closing = 10 x 2,328 USD						**23,280**

Total cost of Monitoring Program for 27 Years

Phase	Duration (years)	Cost / year (USD)	Total cost (USD)
Construction	2	18,156	36,312
Operation	10	23,476	234,760
Closing-down, first 5 years	5	4,656	23,280
Closing-down, next 10 years	10	2,328	23,280
Grand total			**317,632**

D. Detailed Data Base for Cost Estimation

D.1 Construction Cost

Cost estimation has been made based on the final facility plans for the selected priority projects. The detailed breakdown of construction cost for the selected priority projects are shown in Tables D.1 to D.3.

D.2 Project Cost

The project cost of the selected priority projects consists of the construction and procurement cost, land acquisition and compensation cost, engineering service cost, administration cost, physical contingency and price contingency.

The estimated total project cost is US $ 147.3 million comprising foreign currency portion of US $ 84.9 million and the local currency portion of US $ 62.4 million. Breakdown of the overall project cost is shown below:

Overall Project Cost (unit: 1,000US$)

Description	F.C (US$)	L.C (US$)	Total (US$)
Construction and Procurement Cost			
(1) An Kim Hai channel and Phuong			
Luu regulating lake	18,168.7	17,498.0	35,666.7
(2) West wastewater treatment area,			
Phase I, combined sewer area	35,026.4	15,327.3	50,355.1
(3) Solid waste management	8,956.8	3,386.0	12,342.8
Subtotal	62,151.9	36,211.3	98,364.6
Land Acquisition and House			
Compensation	0.0	6,467.0	6,467.0
Engineering Service Cost	5,949.2	4207.6	10,156.8
Administration Cost	0.0	3,449.7	3,449.7
Physical Contingency	6,810.0	5,033.5	11,843.5
Price Contingency	9,983.8	7,066.6	17,050.3
Total	84,895.0	62,435.7	147,332.4

Table D.1 Construction Cost for Drainage Priority Project

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
I	Main Component							
0.00	Preparatory Works	L.S	1		1,040,864		1,223,504	2,264,368
1.00	An Kim Hai Channel							
1.10	Channel excavation							
	1) Care of water during construction	L.S	1	84,450.60	84,451	47,946.60	47,947	132,397
	2) Bamboo coffering	m	5,897	0.00	0	14.30	84,327	84,327
	2) Steel sheet pile, type III, L=8m	m2	20,218	50.77	1,026,468	8.42	170,236	1,196,703
	3) Waling and strut	m	2,527	7.99	20,191	36.93	93,322	113,513
	4) Clearing the site	m2	126,740	0.11	13,941	0.05	6,337	20,278
	5) Common excavation in site	m3	164,500	0.76	125,020	0.43	70,735	195,755
	6) Disposal to spoil area	m3	164,500	3.23	531,335	2.06	338,870	870,205
	7) Miscellaneous, 5%	L.S	1		90,070		40,589	130,659
	Subtotal				1,891,476		852,362	2,743,838
1.20	Revetment works							
	1) Common excavation for revetment foundation	m3	194,050	0.76	147,478	0.43	83,442	230,920
	2) Disposal to spoil area	m3	194,050	3.23	626,782	2.06	399,743	1,026,525
	3) Bamboo pile, 80mm dia., 3m, 25no/m2	m	1,125,000	0.26	292,500	0.61	686,250	978,750
	4) Gravel bedding for footing, t=200mm	m3	3,000	0.11	330	11.38	34,140	34,470
	5) Levelling concrete	m3	1,500	10.25	15,375	37.49	56,235	71,610
	6) Concrete Grade 250/20, footing foundation	m3	5,000	14.23	71,150	47.94	239,700	310,850
	7) Gravel bedding for wet masonry, t=400mm	m3	83,000	0.11	9,130	11.38	944,540	953,670
	8) Concrete Grade 100/40 for base concrete	m3	16,500	10.25	169,125	37.49	618,585	787,710
	9) Wet masonry including jointing mortar, 1:1.25	m3	53,200	0.00	0	23.13	1,230,516	1,230,516
	10) Gravel filling	m3	20,000	0.11	2,200	11.38	227,600	229,800
	11) PVC pipe for weep hole, 50mm dia., L=0.9m	m	24,030	3.77	90,593	0.50	12,015	102,608
	12) Geotextile for weep hole, 300mmx300mm	m2	2,403	6.39	15,355	1.70	4,085	19,440
	13) Joint filler, t=10mm	m2	14,400	11.06	159,264	1.27	18,288	177,552
	14) Miscellaneous, 5%	L.S	1		79,964		227,757	307,721
	Subtotal				1,679,246		4,782,896	6,462,141

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
1.30	Maintenance road							
	1) Clearing the site	m2	140,000	0.11	15,400	0.05	7,000	22,400
	2) Stripping	m3	14,000	1.11	15,540	0.53	7,420	22,960
	3) Common excavation	m3	28,000	0.76	21,280	0.43	12,040	33,320
	4) Embankment	m3	54,635	0.48	26,225	2.16	118,012	144,236
	5) Disposal to spoil area	m3	28,000	3.23	90,440	2.06	57,680	148,120
	6) Subbase course, t=200mm	m3	4,000	0.62	2,480	14.11	56,440	58,920
	7) Base course, t=150mm	m3	3,000	0.90	2,700	14.85	44,550	47,250
	8) Prime coat	m2	60,000	0.01	600	0.25	15,000	15,600
	9) Asphalt pavement, t=50mm	m2	20,000	0.23	4,600	3.63	72,600	77,200
	10) Precast concrete kerbstone, 200x400mm	m3	40,000	2.23	89,200	8.03	321,200	410,400
	11) Sod facing	m2	0	0.00	0	2.95	0	0
	12) Miscellaneous, 5%	L.S	1		13,423		35,597	49,020
	Subtotal				281,888		747,539	1,029,427
1.40	Construction of tidal gate, Lach Tray River							
	1) Earthworks							
	a) Care of water during construction	L.S	1	1,082.70	1,083	614.70	615	1,697
	b) Steel sheet pile, type IV, L=10m	m2	800	53.83	43,064	8.42	6,736	49,800
	c) Waling & strut	m	80	7.99	639	36.93	2,954	3,594
	d) Clearing the site	m3	40	0.11	4	0.05	2	6
	e) Common excavation	m3	1,600	4.43	7,088	18.90	30,240	37,328
	f) Embankment and filling in structure site	m3	1,160	1.43	1,659	3.90	4,524	6,183
	g) Disposal to spoil area	m3	1,600	3.23	5,168	2.06	3,296	8,464
	h) Gravel bedding for gabion, t=200mm	m3	40	0.11	4	11.38	455	460
	i) Wet masonry including jointing mortar	m3	46	0.00	0	23.13	1,064	1,064
	j) Gravel bedding for wet masonry wall, t=200 mm	m3	30	0.11	3	11.38	341	345
	k) PVC pipe for weep hole, 50mm dia., L=0.9m	m	36	3.77	136	0.50	18	154
	l) Geotextile for weep hole, 300mmx300mm	m2	4	6.39	23	1.70	6	29
	2) Concrete works							
	a) Levelling concrete	m3	40	10.25	410	37.49	1,500	1,910

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	b) Concrete Grade 250/20, gate structure	m3	100	17.05	1,705	45.12	4,512	6,217
	c) Concrete Grade 300/20, operation deck	m3	15	16.85	253	52.47	787	1,040
	d) Formwork, gate structure	m2	2,000	0.57	1,140	16.27	32,540	33,680
	e) Formwork, operation deck	m2	60	0.57	34	16.27	976	1,010
	f) Reinforcement bar	kg	27,600	0.00	0	0.51	14,021	14,021
	3) Miscellaneous works							
	a) Handrailing,fixed	m	22	8.41	185	3.65	80	265
	b) Steel ladder to operation deck	m	4	7.81	31	6.76	27	58
	c) Staff gauge for water level	nos	2	244.80	490	32.81	66	555
	4) Piling							
	a) Supply of precast R.C. pile,350mmx350mm L=10m	m	1,000	0.89	890	43.71	43,710	44,600
	b) Driving concrete pile, 350mmx350mm L=10m	m	1,000	13.28	13,280	2.76	2,760	16,040
	c) Pile testing	nos	2	1,785.00	3,570	1,785.00	3,570	7,140
	5) Control house	m2	25	63.75	1,594	191.25	4,781	6,375
	6) Gate							
	a) Control gates and hoist, 3.0mx3.0m	nos	3	104,986.00	314,958	1,388.00	4,164	319,122
	b) Stoplog, 3.0mx3.0m	nos	6	25,537.00	153,222	4,376.00	26,256	179,478
	c) Water level gauge	nos	1	244.80	245	32.81	33	278
	d) Electrical system including generator	L.S	1	20,105.00	20,105	622.00	622	20,727
	7) Service road							
	a) Subbase course, t=200mm	m3	14	0.62	9	14.11	198	206
	b) Base course, t=150mm	m3	11	0.90	10	14.85	163	173
	c) Prime coat	m2	70	0.01	1	0.25	18	18
	d) Asphalt pavement, t=50mm	m2	4	0.23	1	3.63	15	15
	e) Precast concrete kerbstone, 200x400mm	m	50	2.23	112	8.03	402	513
	8) Miscellaneous, 5%	L.S	1		28,556		9,573	38,128
	Subtotal				599,670		201,023	800,694
1.50	Construction of tidal gate, Cam River							
	1) Earthworks							
	a) Care of water during construction	L.S	1	1,082.70	1,083	614.70	615	1,697
	b) Steel sheet pile, type IV, L=10m	m2	800	53.83	43,064	8.42	6,736	49,800
	c) Waling & strut	m	80	7.99	639	36.93	2,954	3,594

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	d) Clearing the site	m3	40	0.11	4	0.05	2	6
	e) Common excavation	m3	1,600	4.43	7,088	18.90	30,240	37,328
	f) Embankment and filling in structure site	m3	1,160	1.43	1,659	3.90	4,524	6,183
	g) Disposal to spoil area	m3	1,600	3.23	5,168	2.06	3,296	8,464
	h) Gravel bedding for gabion, t=200mm	m3	40	0.11	4	11.38	455	460
	i) Wet masonry including jointing mortar	m3	46	0.00	0	23.13	1,064	1,064
	j) Gravel bedding for wet masonry wall, t=200 mm	m3	30	0.11	3	11.38	341	345
	k) PVC pipe for weep hole, 50mm dia., L=0.9m	m	36	3.77	136	0.50	18	154
	l) Geotextile for weep hole, 300mmx300mm	m2	4	6.39	23	1.70	6	29
	2) Concrete works							
	a) Levelling concrete	m3	40	10.25	410	37.49	1,500	1,910
	b) Concrete Grade 250/20, gate structure	m3	100	17.05	1,705	45.12	4,512	6,217
	c) Concrete Grade 300/20, operation deck	m3	15	16.85	253	52.47	787	1,040
	d) Formwork, gate structure	m2	2,000	0.57	1,140	16.27	32,540	33,680
	e) Formwork, operation deck	m2	60	0.57	34	16.27	976	1,010
	f) Reinforcement bar	kg	27,600	0.00	0	0.51	14,021	14,021
	3) Miscellaneous works							
	a) Handrailing,fixed	m	22	8.41	185	3.65	80	265
	b) Steel ladder to operation deck	m	4	7.81	31	6.76	27	58
	c) Staff gauge for water level	nos	2	244.80	490	32.81	66	555
	4) Piling							
	a) Supply of precast R.C. pile,350mmx350mm							
	L=10m	m	1,000	0.89	890	43.71	43,710	44,600
	b) Driving concrete pile, 350mmx350mm							
	L=10m	m	1,000	13.28	13,280	2.76	2,760	16,040
	c) Pile testing	nos	2	1,785.00	3,570	1,785.00	3,570	7,140
	5) Control house	m2	25	63.75	1,594	191.25	4,781	6,375
	6) Gate							
	a) Control gates and hoist, 3.0mx3.0m	nos	3	104,986.00	314,958	1,388.00	4,164	319,122
	b) Stoplog, 3.0mx3.0m	nos	6	25,537.00	153,222	4,376.00	26,256	179,478

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	c) Water level gauge	nos	1	244.80	245	32.81	33	278
	d) Electrical system including generator	L.S	1	20,105.00	20,105	622.00	622	20,727
	7) Service road							
	a) Subbase course, t=200mm	m3	14	0.62	9	14.11	198	206
	b) Base course, t=150mm	m3	11	0.90	10	14.85	163	173
	c) Prime coat	m2	70	0.01	1	0.25	18	18
	d) Asphalt pavement, t=50mm	m2	4	0.23	1	3.63	15	15
	e) Precast concrete kerbstone, 200x400mm	m	50	2.23	112	8.03	402	513
	8) Miscellaneous, 5%	L.S	1		28,556		9,573	38,128
	Subtotal				599,670		201,023	800,694
1.60	Construction of discharge gate to Du Hang Lake							
	1) Earthworks							
	a) Care of water during construction	L.S	1	1,082.70	1,083	614.70	615	1,697
	b) Steel sheet pile, type IV, L=10m	m2	800	53.83	43,064	8.42	6,736	49,800
	c) Waling & strut	m	80	7.99	639	36.93	2,954	3,594
	d) Clearing the site	m3	40	0.11	4	0.05	2	6
	e) Common excavation	m3	1,600	4.43	7,088	18.90	30,240	37,328
	f) Embankment and filling in structure site	m3	1,160	1.43	1,659	3.90	4,524	6,183
	g) Disposal to spoil area	m3	1,600	3.23	5,168	2.06	3,296	8,464
	h) Gravel bedding for gabion, t=200mm	m3	40	0.11	4	11.38	455	460
	i) Wet masonry including jointing mortar	m3	46	0.00	0	23.13	1,064	1,064
	j) Gravel bedding for wet masonry wall, t=200 mm	m3	30	0.11	3	11.38	341	345
	k) PVC pipe for weep hole, 50mm dia., L=0.9m	m	36	3.77	136	0.50	18	154
	l) Geotextile for weep hole, 300mmx300mm	m2	4	6.39	23	1.70	6	29
	2) Concrete works							
	a) Levelling concrete	m3	40	10.25	410	37.49	1,500	1,910
	b) Concrete Grade 250/20, gate structure	m3	100	17.05	1,705	45.12	4,512	6,217
	c) Concrete Grade 300/20, operation deck	m3	15	16.85	253	52.47	787	1,040

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	d) Formwork, gate structure	m2	2,000	0.57	1,140	16.27	32,540	33,680
	e) Formwork, operation deck	m2	60	0.57	34	16.27	976	1,010
	f) Reinforcement bar	kg	27,600	0.00	0	0.51	14,021	14,021
	3) Miscellaneous works							
	a) Handrailing,fixed	m	22	8.41	185	3.65	80	265
	b) Steel ladder to operation deck	m	4	7.81	31	6.76	27	58
	c) Staff gauge for water level	nos	2	244.80	490	32.81	66	555
	4) Piling							
	a) Supply of precast R.C. pile,350mmx350mm L=10m	m	1,000	0.89	890	43.71	43,710	44,600
	b) Driving concrete pile, 350mmx350mm L=10m	m	1,000	13.28	13,280	2.76	2,760	16,040
	c) Pile testing	nos	2	1,785.00	3,570	1,785.00	3,570	7,140
	5) Control house	m2	25	63.75	1,594	191.25	4,781	6,375
	6) Gate							
	a) Control gates and hoist, 3.0mx3.0m	nos	3	104,986.00	314,958	1,388.00	4,164	319,122
	b) Stoplog, 3.0mx3.0m	nos	6	25,537.00	153,222	4,376.00	26,256	179,478
	c) Water level gauge	nos	1	244.80	245	32.81	33	278
	d) Electrical system including generator	L.S	1	20,105.00	20,105	622.00	622	20,727
	7) Service road							
	a) Subbase course, t=200mm	m3	14	0.62	9	14.11	198	206
	b) Base course, t=150mm	m3	11	0.90	10	14.85	163	173
	c) Prime coat	m2	70	0.01	1	0.25	18	18
	d) Asphalt pavement, t=50mm	m2	4	0.23	1	3.63	15	15
	e) Precast concrete kerbstone, 200x400mm	m	50	2.23	112	8.03	402	513
	8) Miscellaneous, 5%	L.S	1		28,556		9,573	38,128
	Subtotal				599,670		201,023	800,694
1.70	Demolishing existing outlet gate	L.S	1	906.00	906	1,132.00	1,132	2,038
	Subtotal				906		1,132	2,038
	Total				5,652,527		6,986,999	12,639,525
2.00	Phuong Luu Regulating Lake							
2.10	Phuong luu regulating lake							
	1) Earthwork							
	a) Care of water during construction	L.S	1	67,632.66	67,633	38,398.26	38,398	106,031
	b) Steel sheet pile, type III, L=8m	m2	480	50.77	24,370	8.42	4,042	28,411

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	c) Waling and strut	m	60	7.99	479	36.93	2,216	2,695
	d) Clearing the site	m2	280,000	0.11	30,800	0.05	14,000	44,800
	e) Stripping	m3	28,000	1.11	31,080	0.53	14,840	45,920
	f) Common excavation for lake	m3	672,000	0.74	497,280	0.32	215,040	712,320
	g) Disposal to spoil area	m3	672,000	3.28	2,204,160	1.55	1,041,600	3,245,760
	h) Miscellaneous	L.S	1		142,790		66,507	209,297
	Subtotal				2,998,592		1,396,642	4,395,234
	2) Revetment works							
	a) Common excavation for revetment foundation	m3	23,300	0.76	17,708	0.43	10,019	27,727
	b) Backfilling with stockpiled material	m3	40,000	1.43	57,200	3.90	156,000	213,200
	c) Bamboo pile, 80mm dia.,3m,25no/m2	m	140,625	0.26	36,563	0.61	85,781	122,344
	d) Gravel bedding for footing, t=200mm	m3	330	0.11	36	11.38	3,755	3,792
	e) Wet masonry including jointing mortar,1:1.5	m3	8,200	0.00	0	23.13	189,666	189,666
	f) Concrete Grade 100/40, for base concrete	m3	5,000	10.25	51,250	37.49	187,450	238,700
	g) Gravel layer of wet masonry	m3	12,330	0.11	1,356	11.38	140,315	141,672
	h) Levelling concrete	m3	165	10.25	1,691	37.49	6,186	7,877
	i) Concrete Grade 150/40 for revetment foundation	m3	550	13.11	7,211	38.60	21,230	28,441
	j) Miscellaneous	L.S	1		9,164		41,291	50,456
	Subtotal				192,454		867,119	1,059,574
	3) Road works							
	a) Subbase course, t=200mm	m3	5,550	0.62	3,441	14.11	78,311	81,752
	b) Base course, t=150mm	m3	4,160	0.90	3,744	14.85	61,776	65,520
	c) Prime coat	m2	16,170	0.01	162	0.25	4,043	4,204
	d) Asphalt pavement, t=50mm	m2	1,400	0.23	322	3.63	5,082	5,404
	e) Precast concrete kerbstone, 200x400mm	m	2,500	2.23	5,575	8.03	20,075	25,650
	f) Bridge, W12.0mxL15.0m	no	1	116,280.00	116,280	129,240.00	129,240	245,520
	g) Miscellaneous	L.S	1		6,476		14,926	21,402
	Subtotal				136,000		313,452	449,452
	4) Connection channel excavation							
	a) Clearing the site	m2	7,500	0.11	825	0.05	375	1,200
	b) Common excavation in site	m3	10,900	0.74	8,066	0.32	3,488	11,554
	c) Disposal to spoil area	m3	10,900	3.28	35,752	1.55	16,895	52,647

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	d) Miscellaneous	L.S	1		2,232		1,038	3,270
	Subtotal				46,875		21,796	68,671
	5) Revetment works, connection channel							
	a) Common excavation for revetment foundation	m3	9,700	0.76	7,372	0.43	4,171	11,543
	b) Disposal to spoil area	m3	9,700	3.28	31,816	1.55	15,035	46,851
	c) Bamboo pile, 80mm dia.,3m,25no/m2	m	18,750	0.26	4,875	0.61	11,438	16,313
	d) Gravel bedding for footing, t=200mm	m3	150	0.11	17	11.38	1,707	1,724
	e) Levelling concrete	m3	75	10.25	769	37.49	2,812	3,581
	f) Concrete Grade 250/20, footing foundation	m3	250	14.23	3,558	47.94	11,985	15,543
	g) Gravel bedding for wet masonry, t=400mm	m3	4,150	0.11	457	11.38	47,227	47,684
	h) Concrete Grade 100/40 for base concrete	m3	825	10.25	8,456	37.49	30,929	39,386
	i) Wet masonry including jointing mortar,1:1.25	m3	2,660	0.00	0	23.13	61,526	61,526
	j) Gravel filling	m3	1,000	0.11	110	11.38	11,380	11,490
	k) PVC pipe for weep hole, 50mm dia., L=0.9m	m	1,202	3.77	4,530	0.50	601	5,130
	l) Geotextile for weep hole, 300mmx300mm	m2	120	6.39	768	1.70	204	972
	m) Joint filler, t=10mm	m2	800	11.06	8,848	1.27	1,016	9,864
	n) Miscellaneous	L.S	1		3,579		10,002	13,580
	Subtotal				75,153		210,032	285,185
	6) Maintenance road							
	a) Clearing the site	m2	7,000	0.11	770	0.05	350	1,120
	b) Stripping	m3	7,000	1.11	7,770	0.53	3,710	11,480
	c) Embankment	m3	4,260	0.48	2,045	2.16	9,202	11,246
	d) Subbase course, t=200mm	m3	200	0.62	124	14.11	2,822	2,946
	e) Base course, t=150mm	m3	150	0.90	135	14.85	2,228	2,363
	f) Prime coat	m2	3,000	0.01	30	0.25	750	780
	g) Asphalt pavement, t=50mm	m2	1,000	0.23	230	3.63	3,630	3,860
	h) Precast concrete kerbstone, 200x400mm	m	2,000	2.23	4,460	8.03	16,060	20,520
	i) Miscellaneous	L.S	1		778		1,938	2,716
	Subtotal				16,342		40,689	57,031
	Total of 2.10				3,465,416		2,849,731	6,315,147

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
2.20	Box culvert, 3x(3.0mx2.0m),L=450m							
	1) Traffic diversion and detour							
	a) Traffic diversion and detour	L.S	1	3,580.50	3,581	3,538.50	3,539	7,119
	2) Care of water							
	a) Care of water during construction	L.S	1	10,827.00	10,827	6,147.00	6,147	16,974
	b) Steel sheet pile, type III, L=8m	m2	7,800	50.77	396,006	8.42	65,676	461,682
	c) Waling and strut	m	975	7.99	7,790	36.93	36,007	43,797
	3) Earthwork							
	a) Clearing the site	m2	4,800	0.11	528	0.05	240	768
	b) Stripping	m3	480	1.11	533	0.53	254	787
	c) Common excavation	m3	16,800	0.74	12,432	0.32	5,376	17,808
	d) Disposal to spoil area	m3	16,800	3.28	55,104	1.55	26,040	81,144
	e) Gravel bedding and layer	m3	820	0.11	90	11.38	9,332	9,422
	f) Demolishing existing roadway	m2	150	11.33	1,700	14.15	2,123	3,822
	4) Concrete works							
	a) Concrete Grade 250/20 for box culvert	m3	5,530	17.05	94,287	45.12	249,514	343,800
	b) Concrete Grade 250/20 for wing wall	m3	30	17.05	512	45.12	1,354	1,865
	c) Levelling concrete	m3	410	10.25	4,203	37.49	15,371	19,573
	d) Formwork for box culvert	m2	25,920	0.57	14,774	16.27	421,718	436,493
	e) Formwork for wing wall	m2	70	0.57	40	16.27	1,139	1,179
	f) Formwork for levelling concrete	m2	4,080	3.03	12,362	6.63	27,050	39,413
	g) Reinforcement bar, round	kg	90	0.00	0	0.52	46	46
	h) Reinforcement bar, deformed	kg	556,000	0.00	0	0.51	282,448	282,448
	5) Roadway pavement							
	a) Subbase course, t=500mm	m3	2,400	0.62	1,488	14.11	33,864	35,352
	b) Prime coat	m2	4,800	0.01	48	0.25	1,200	1,248
	c) Tack coat	m2	4,800	0.01	48	0.25	1,200	1,248
	d) Asphalt pavement, t=100mm	m2	480	0.46	221	7.26	3,485	3,706
	e) Precast concrete kerbstone,200x400mm	m	800	2.23	1,784	8.03	6,424	8,208
	6) Piling works							
	a) Supply of precast R.C. pile, 350mmx350mm							
	L=10m	m	23,000	0.89	20,470	43.71	1,005,330	1,025,800
	b) Driving concrete pile, 350mmx350mm							
	L=10m	m	23,000	13.28	305,440	2.76	63,480	368,920
	c) Pile test	nos	2	1,785.00	3,570	1,785.00	3,570	7,140

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	7) Gate							
	a) Control gates and hoist, 3.0mx2.0m	nos	3	69,991.00	209,973	925.00	2,775	212,748
	b) Stoplog, 3.0mx2.0m	nos	3	17,025.00	51,075	2,918.00	8,754	59,829
	c) Water level gauge	nos	1	244.80	245	32.81	33	278
	d) Electrical system including generator	L.S	1	20,105.00	20,105	622.00	622	20,727
	8) Miscellaneous, 5%	L.S	1		61,462		114,205	175,667
	Total of 2.20				1,290,696		2,398,315	3,689,011
	Total				4,756,112		5,248,046	10,004,157
	Total of I				11,449,502		13,458,549	24,908,051
II	Supplementary Component							
0.00	Preparatory Works	L.S	1		610,833		367,226	978,059
1.00	Supplementary Component, New Sewers							
	1) Main sewers	m	3,000	350.00	1,050,000	350.00	1,050,000	2,100,000
	2) Branch sewers	m	7,000	175.00	1,225,000	175.00	1,225,000	2,450,000
	Total				2,275,000		2,275,000	4,550,000
2.00	Supplementary Component, An Kim Hai channel bridges							
	1) Bridge, W7.0mxL12.0m	nos	3	54,264.00	162,792	60,312.00	180,936	343,728
	2) Bridge, W7.0mxL15.0m	nos	9	67,830.00	610,470	75,390.00	678,510	1,288,980
	3) Bridge, W7.0mxL20.0m	nos	3	90,440.00	271,320	100,520.00	301,560	572,880
	Total				1,044,582		1,161,006	2,205,588
3.00	Supplementary Component, Road Ancillary Works							
	1) Lighting	nos	650	1,067.00	693,550	33.00	21,450	715,000
	2) Fence	m	24,000	87.30	2,095,200	2.70	64,800	2,160,000
	3) Plantings	L.S	1	0.00	0	150,000.00	150,000	150,000
	Total				2,788,750		236,250	3,025,000
	Total of II				6,719,165		4,039,482	10,758,647
	Total				18,168,668		17,498,030	35,666,698

Table D.2 Construction Cost for Sewerage Priority Project

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
0.00	Preparatory Works	L.S	1		3,184,219		1,393,393	4,577,733
1.00	Trunk Sewer, Open Excavation							
1.10	Steel pipe, 100mm dia.,1-2m covering,L=230m							
	1) Care of water during construction	L.S	1	248.17	248	307.05	307	555
	2) Cutting of asphalt pavement	m	460	0.37	170	0.23	106	276
	3) Breaking and loading of asphalt pavement	m3	51	2.77	140	1.09	55	195
	4) Excavation of common soil	m3	531	0.76	404	0.43	228	632
	5) Supply and installation of steel pipe 100mm dia.	m	230	1.19	274	0.25	58	331
	6) Timber	m3	28	0.00	0	195.81	5,404	5,404
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	11,040	0.26	2,870	0.61	6,734	9,605
	8) Levelling concrete, t=100mm	m3	18	10.25	189	37.49	690	878
	9) Sand bedding	m3	253	1.37	347	3.39	858	1,204
	10) Backfilling	m3	253	1.43	362	3.90	987	1,348
	11) Disposal to spoil area	m3	582	3.23	1,880	2.06	1,199	3,078
	12) Gravel bedding	m3	28	0.11	3	11.38	314	317
	13) Asphalt pavement, t=50mm	m2	253	0.23	58	3.63	918	977
	14) Base course, t=150mm	m3	38	0.90	34	14.85	564	599
	15) Subbase course, t=200mm	m3	51	0.62	31	14.11	714	745
	16) Sheeting and bracing, D=2m,W=3m	m2	960	3.03	2,909	2.08	1,997	6,050
	17) Miscellaneous, 5%	L.S	1		496		1,057	1,610
	Subtotal				10,414		22,190	33,806
1.20	Steel pipe, 125mm dia.,1-2m covering,L=260m							
	1) Care of water during construction	L.S	1	280.54	281	347.10	347	628
	2) Cutting of asphalt pavement	m	520	0.37	192	0.23	120	312
	3) Breaking and loading of asphalt pavement	m3	57	2.77	158	1.09	62	221
	4) Excavation of common soil	m3	601	0.76	456	0.43	258	715
	5) Supply and installation of steel pipe 125mm dia.	m	260	25.19	6,549	3.55	923	7,472
	6) Timber	m3	31	0.00	0	195.81	6,109	6,109
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	12,480	0.26	3,245	0.61	7,613	10,858

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	8) Levelling concrete, t=100mm	m3	21	10.25	213	37.49	780	993
	9) Sand bedding	m3	260	1.37	356	3.39	881	1,238
	10) Backfilling	m3	260	1.43	372	3.90	1,014	1,386
	11) Disposal to spoil area	m3	658	3.23	2,125	2.06	1,355	3,480
	12) Gravel bedding	m3	31	0.11	3	11.38	355	358
	13) Asphalt pavement, t=50mm	m2	286	0.23	66	3.63	1,038	1,104
	14) Base course, t=150mm	m3	43	0.90	39	14.85	637	676
	15) Subbase course, t=200mm	m3	57	0.62	35	14.11	807	843
	16) Sheeting and bracing, D=2m,W=3m	m2	1,040	3.03	3,151	2.08	2,163	5,314
	17) Miscellaneous, 5%	L.S	1		862		1,223	2,085
	Subtotal				18,105		25,686	43,791
1.30	R.C. pipe, 300mm dia.,1-2m covering,L=300m							
	1) Care of water during construction	L.S	1	323.70	324	400.50	401	724
	2) Cutting of asphalt pavement	m	600	0.37	222	0.23	138	360
	3) Breaking and loading of asphalt pavement	m3	66	2.77	183	1.09	72	255
	4) Excavation of common soil	m3	693	0.76	527	0.43	298	825
	5) Supply and installation of R.C. pipe 300mm dia.	m	300	0.00	0	6.08	1,824	1,824
	6) Timber	m3	36	0.00	0	195.81	7,049	7,049
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	14,400	0.26	3,744	0.61	8,784	12,528
	8) Levelling concrete, t=100mm	m3	24	10.25	246	37.49	900	1,146
	9) Sand bedding	m3	330	1.37	452	3.39	1,119	1,571
	10) Backfilling	m3	330	1.43	472	3.90	1,287	1,759
	11) Disposal to spoil area	m3	759	3.23	2,452	2.06	1,564	4,015
	12) Gravel bedding	m3	36	0.11	4	11.38	410	414
	13) Asphalt pavement, t=50mm	m2	330	0.23	76	3.63	1,198	1,274
	14) Base course, t=150mm	m3	50	0.90	45	14.85	735	780
	15) Subbase course, t=200mm	m3	66	0.62	41	14.11	931	972
	16) Sheeting and bracing, D=2m,W=3m	m2	1,200	3.03	3,636	2.02	2,424	6,060
	17) Miscellaneous, 5%	L.S	1		621		1,457	2,078
	Subtotal				13,043		30,589	43,632
1.40	R.C. pipe, 300mm dia.,2-3m covering,L=620m							
	1) Care of water during construction	L.S	1	668.98	669	827.70	828	1,497

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	2) Cutting of asphalt pavement	m	1,240	0.37	459	0.23	285	744
	3) Breaking and loading of asphalt pavement	m3	161	2.77	447	1.09	176	622
	4) Excavation of common soil	m3	2,579	0.76	1,960	0.43	1,109	3,069
	5) Supply and installation of R.C. pipe 300mm dia.	m	620	0.00	0	6.08	3,770	3,770
	6) Timber	m3	124	0.00	0	195.81	24,280	24,280
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	37,200	0.26	9,672	0.61	22,692	32,364
	8) Levelling concrete, t=100mm	m3	62	10.25	636	37.49	2,324	2,960
	9) Concrete Grade250/20	m3	25	14.23	353	47.94	1,189	1,542
	10) Formwork	m2	124	3.08	382	6.63	822	1,204
	11) Backfilling	m3	2,418	1.43	3,458	3.90	9,430	12,888
	12) Disposal to spoil area	m3	2,740	3.23	8,851	2.06	5,645	14,497
	13) Asphalt pavement, t=50mm	m2	806	0.23	185	3.63	2,926	3,111
	14) Base course, t=150mm	m3	121	0.90	109	14.85	1,795	1,904
	15) Subbase course, t=200mm	m3	161	0.62	100	14.11	2,275	2,374
	16) Sheeting and bracing, D=3m,W=3m	m2	3,720	3.03	11,272	2.02	7,514	18,786
	17) Miscellaneous, 5%	L.S	1		1,928		4,353	6,281
	Subtotal				40,479		91,414	131,893
1.50	R.C. pipe, 400mm dia.,1-2m covering,L=620m							
	1) Care of water during construction	L.S	1	668.98	669	827.70	828	1,497
	2) Cutting of asphalt pavement	m	1,240	0.37	459	0.23	285	744
	3) Breaking and loading of asphalt pavement	m3	149	2.77	412	1.09	162	574
	4) Excavation of common soil	m3	1,637	0.76	1,244	0.43	704	1,948
	5) Supply and installation of R.C. pipe 400mm dia.	m	620	0.00	0	15.68	9,722	9,722
	6) Timber	m3	87	0.00	0	195.81	16,996	16,996
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	33,480	0.26	8,705	0.61	20,423	29,128
	8) Levelling concrete, t=100mm	m3	56	10.25	572	37.49	2,092	2,664
	9) Sand bedding	m3	744	1.37	1,019	3.39	2,522	3,541
	10) Backfilling	m3	744	1.43	1,064	3.90	2,902	3,966
	11) Disposal to spoil area	m3	1,786	3.23	5,767	2.06	3,678	9,446
	12) Gravel bedding	m3	87	0.11	10	11.38	988	997
	13) Asphalt pavement, t=50mm	m2	744	0.23	171	3.63	2,701	2,872
	14) Base course, t=150mm	m3	112	0.90	100	14.85	1,657	1,758

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	15) Subbase course, t=200mm	m3	149	0.62	92	14.11	2,100	2,192
	16) Sheeting and bracing, D=2m,W=3m	m2	2,480	3.02	7,490	2.08	5,158	12,648
	17) Miscellaneous, 5%	L.S	1		1,389		3,646	5,035
	Subtotal				29,163		76,563	105,726
1.60	R.C. pipe, 400mm dia.,2-3m covering,L=560m							
	1) Care of water during construction	L.S	1	604.24	604	747.60	748	1,352
	2) Cutting of asphalt pavement	m	1,120	0.37	414	0.23	258	672
	3) Breaking and loading of asphalt pavement	m3	157	2.77	434	1.09	171	605
	4) Excavation of common soil	m3	2,587	0.76	1,966	0.43	1,112	3,079
	5) Supply and installation of R.C. pipe 400mm dia.	m	560	0.00	0	15.68	8,781	8,781
	6) Timber	m3	118	0.00	0	195.81	23,027	23,027
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	36,960	0.26	9,610	0.61	22,546	32,155
	8) Levelling concrete, t=100mm	m3	62	10.25	631	37.49	2,309	2,941
	9) Concrete Grade250/20	m3	28	14.23	398	47.94	1,342	1,741
	10) Formwork	m2	112	3.08	345	6.63	743	1,088
	11) Backfilling	m3	2,296	1.43	3,283	3.90	8,954	12,238
	12) Disposal to spoil area	m3	2,744	3.23	8,863	2.06	5,653	14,516
	13) Asphalt pavement, t=50mm	m2	784	0.23	180	3.63	2,846	3,026
	14) Base course, t=150mm	m3	118	0.90	106	14.85	1,746	1,852
	15) Subbase course, t=200mm	m3	157	0.62	97	14.11	2,212	2,310
	16) Sheeting and bracing, D=3m,W=3m	m2	3,360	3.10	10,416	2.26	7,594	18,010
	17) Miscellaneous, 5%	L.S	1		1,867		4,502	6,370
	Subtotal				39,217		94,544	133,761
1.70	R.C. pipe, 400mm dia.,3-4m covering,L=420m							
	1) Care of water during construction	L.S	1	453.18	453	560.70	561	1,014
	2) Cutting of asphalt pavement	m	840	0.37	311	0.23	193	504
	3) Breaking and loading of asphalt pavement	m3	134	2.77	372	1.09	146	519
	4) Excavation of common soil	m3	2,957	0.76	2,247	0.43	1,271	3,519
	5) Supply and installation of R.C. pipe 400mm dia.	m	420	0.00	0	15.68	6,586	6,586
	6) Timber	m3	101	0.00	0	195.81	19,738	19,738

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	32,760	0.26	8,518	0.61	19,984	28,501
	8) Levelling concrete, t=100mm	m3	55	10.25	560	37.49	2,047	2,607
	9) Concrete Grade250/20	m3	29	14.23	418	47.94	1,409	1,828
	10) Formwork	m2	84	3.08	259	6.63	557	816
	11) Backfilling	m3	2,730	1.43	3,904	3.90	10,647	14,551
	12) Disposal to spoil area	m3	3,091	3.23	9,985	2.06	6,368	16,352
	13) Asphalt pavement, t=50mm	m2	672	0.23	155	3.63	2,439	2,594
	14) Base course, t=150mm	m3	101	0.90	91	14.85	1,497	1,588
	15) Subbase course, t=200mm	m3	134	0.62	83	14.11	1,896	1,980
	16) Sheeting and bracing, D=4m,W=3m	m2	3,360	3.14	10,550	2.33	7,829	18,379
	17) Soil improvement	m3	1,512	39.59	59,860	7.78	11,763	71,623
	18) Miscellaneous, 5%	L.S	1		4,888		4,747	9,635
	Subtotal				102,654		99,678	202,332
1.80	R.C. pipe, 500mm dia.,2-3m covering,L=1180m							
	1) Care of water during construction	L.S	1	1,273.22	1,273	1,575.30	1,575	2,849
	2) Cutting of asphalt pavement	m	2,360	0.37	873	0.23	543	1,416
	3) Breaking and loading of asphalt pavement	m3	354	2.77	981	1.09	386	1,366
	4) Excavation of common soil	m3	6,018	0.76	4,574	0.43	2,588	7,161
	5) Supply and installation of R.C. pipe 500mm dia.	m	1,180	0.00	0	21.88	25,818	25,818
	6) Timber	m3	271	0.00	0	195.81	53,143	53,143
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	84,960	0.26	22,090	0.61	51,826	73,915
	8) Levelling concrete, t=100mm	m3	142	10.25	1,451	37.49	5,309	6,760
	9) Concrete Grade250/20	m3	71	14.23	1,007	47.94	3,394	4,402
	10) Formwork	m2	236	3.08	727	6.63	1,565	2,292
	11) Backfilling	m3	5,074	1.43	7,256	3.90	19,789	27,044
	12) Disposal to spoil area	m3	6,372	3.23	20,582	2.06	13,126	33,708
	13) Asphalt pavement, t=50mm	m2	1,770	0.23	407	3.63	6,425	6,832
	14) Base course, t=150mm	m3	266	0.90	239	14.85	3,943	4,182
	15) Subbase course, t=200mm	m3	354	0.62	219	14.11	4,995	5,214
	16) Sheeting and bracing, D=3m,W=3m	m2	7,080	3.10	21,948	2.26	16,001	37,949
	17) Miscellaneous, 5%	L.S	1		4,181		10,521	14,703
	Subtotal				87,808		220,946	308,754

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
1.90	R.C. pipe, 500mm dia.,3-4m covering,L=600m							
	1) Care of water during construction	L.S	1	647.40	647	801.00	801	1,448
	2) Cutting of asphalt pavement	m	1,200	0.37	444	0.23	276	720
	3) Breaking and loading of asphalt pavement	m3	204	2.77	565	1.09	222	787
	4) Excavation of common soil	m3	4,590	0.76	3,488	0.43	1,974	5,462
	5) Supply and installation of R.C. pipe 500mm dia.	m	600	0.00	0	21.88	13,128	13,128
	6) Timber	m3	156	0.00	0	195.81	30,546	30,546
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	50,400	0.26	13,104	0.61	30,744	43,848
	8) Levelling concrete, t=100mm	m3	84	10.25	861	37.49	3,149	4,010
	9) Concrete Grade250/20	m3	48	14.23	683	47.94	2,301	2,984
	10) Formwork	m2	120	3.08	370	6.63	796	1,165
	11) Backfilling	m3	4,140	1.43	5,920	3.90	16,146	22,066
	12) Disposal to spoil area	m3	4,794	3.23	15,485	2.06	9,876	25,360
	13) Asphalt pavement, t=50mm	m2	1,020	0.23	235	3.63	3,703	3,937
	14) Base course, t=150mm	m3	153	0.90	138	14.85	2,272	2,410
	15) Subbase course, t=200mm	m3	204	0.62	126	14.11	2,878	3,005
	16) Sheeting and bracing, D=4m,W=3m	m2	4,800	3.14	15,072	2.33	11,184	26,256
	17) Soil improvement	m3	2,460	39.59	97,391	7.78	19,139	116,530
	18) Miscellaneous, 5%	L.S	1		7,726		7,457	15,183
	Subtotal				162,256		156,592	318,848
1.10	R.C. pipe, 600mm dia.,3-4m covering,L=380m							
	1) Care of water during construction	L.S	1	410.02	410	507.30	507	917
	2) Cutting of asphalt pavement	m	760	0.37	281	0.23	175	456
	3) Breaking and loading of asphalt pavement	m3	137	2.77	379	1.09	149	528
	4) Excavation of common soil	m3	3,146	0.76	2,391	0.43	1,353	3,744
	5) Supply and installation of R.C. pipe 600mm dia.	m	380	0.00	0	22.26	8,459	8,459
	6) Timber	m3	103	0.00	0	195.81	20,090	20,090
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	34,200	0.26	8,892	0.61	20,862	29,754
	8) Levelling concrete, t=100mm	m3	57	10.25	584	37.49	2,137	2,721
	9) Concrete Grade250/20	m3	34	14.23	487	47.94	1,640	2,126
	10) Formwork	m2	76	3.08	234	6.63	504	738

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	11) Backfilling	m3	2,698	1.43	3,858	3.90	10,522	14,380
	12) Disposal to spoil area	m3	3,283	3.23	10,605	2.06	6,763	17,368
	13) Asphalt pavement, t=50mm	m2	684	0.23	157	3.63	2,483	2,640
	14) Base course, t=150mm	m3	103	0.90	92	14.85	1,524	1,616
	15) Subbase course, t=200mm	m3	137	0.62	85	14.11	1,930	2,015
	16) Sheeting and bracing, D=4m,W=3m	m2	3,040	3.14	9,546	2.33	7,083	16,629
	17) Soil improvement	m3	1,710	39.59	67,699	7.78	13,304	81,003
	18) Miscellaneous, 5%	L.S	1		5,285		4,974	10,259
	Subtotal				110,985		104,459	215,444
1.11	R.C. pipe, 700mm dia.,2-3m covering,L=940m							
	1) Care of water during construction	L.S	1	1,014.26	1,014	1,254.90	1,255	2,269
	2) Cutting of asphalt pavement	m	1,880	0.37	696	0.23	432	1,128
	3) Breaking and loading of asphalt pavement	m3	395	2.77	1,094	1.09	430	1,524
	4) Excavation of common soil	m3	7,304	0.76	5,551	0.43	3,141	8,692
	5) Supply and installation of R.C. pipe 700mm dia.	m	940	0.00	0	36.82	34,611	34,611
	6) Timber	m3	301	0.00	0	195.81	58,900	58,900
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	101,520	0.26	26,395	0.61	61,927	88,322
	8) Levelling concrete, t=100mm	m3	169	10.25	1,734	37.49	6,343	8,078
	9) Concrete Grade250/20	m3	141	14.23	2,006	47.94	6,760	8,766
	10) Formwork	m2	282	3.08	869	6.63	1,870	2,738
	11) Backfilling	m3	5,828	1.43	8,334	3.90	22,729	31,063
	12) Disposal to spoil area	m3	7,699	3.23	24,866	2.06	15,859	40,726
	13) Asphalt pavement, t=50mm	m2	1,974	0.23	454	3.63	7,166	7,620
	14) Base course, t=150mm	m3	296	0.90	266	14.85	4,397	4,664
	15) Subbase course, t=200mm	m3	395	0.62	245	14.11	5,571	5,815
	16) Sheeting and bracing, D=3m,W=3m	m2	5,640	3.10	17,484	2.26	12,746	30,230
	17) Miscellaneous, 5%	L.S	1		4,550		12,207	16,757
	Subtotal				95,559		256,343	351,902
1.12	R.C. pipe, 800mm dia.,2-3m covering,L=550m							
	1) Care of water during construction	L.S	1	593.45	593	734.25	734	1,328
	2) Cutting of asphalt pavement	m	1,100	0.37	407	0.23	253	660
	3) Breaking and loading of asphalt	m3	242	2.77	670	1.09	264	934

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	pavement							
	4) Excavation of common soil	m3	4,598	0.76	3,494	0.43	1,977	5,472
	5) Supply and installation of R.C. pipe 800mm dia.	m	550	0.00	0	37.99	20,895	20,895
	6) Timber	m3	182	0.00	0	195.81	35,540	35,540
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	62,700	0.26	16,302	0.61	38,247	54,549
	8) Levelling concrete, t=100mm	m3	105	10.25	1,071	37.49	3,918	4,989
	9) Concrete Grade250/20	m3	94	14.23	1,331	47.94	4,482	5,813
	10) Formwork	m2	165	3.08	508	6.63	1,094	1,602
	11) Backfilling	m3	3,520	1.43	5,034	3.90	13,728	18,762
	12) Disposal to spoil area	m3	4,840	3.23	15,633	2.06	9,970	25,604
	13) Asphalt pavement, t=50mm	m2	1,210	0.23	278	3.63	4,392	4,671
	14) Base course, t=150mm	m3	182	0.90	163	14.85	2,695	2,859
	15) Subbase course, t=200mm	m3	242	0.62	150	14.11	3,415	3,565
	16) Sheeting and bracing, D=3m,W=3m	m2	3,300	3.10	10,230	2.26	7,458	17,688
	17) Miscellaneous, 5%	L.S	1		2,793		7,453	10,246
	Subtotal				58,659		156,515	215,174
1.13	R.C. pipe, 900mm dia.,2-3m covering,L=200m							
	1) Care of water during construction	L.S	1	215.80	216	267	267	483
	2) Cutting of asphalt pavement	m	400	0.37	148	0.23	92	240
	3) Breaking and loading of asphalt pavement	m3	92	2.77	255	1.09	100	355
	4) Excavation of common soil	m3	1,794	0.76	1,363	0.43	771	2,135
	5) Supply and installation of R.C. pipe 900mm dia.	m	200	9.21	1,842	41.91	8,382	10,224
	6) Timber	m3	70	0.00	0	195.81	13,707	13,707
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	24,000	0.26	6,240	0.61	14,640	20,880
	8) Levelling concrete, t=100mm	m3	40	10.25	410	37.49	1,500	1,910
	9) Concrete Grade250/20	m3	36	14.23	512	47.94	1,726	2,238
	10) Formwork	m2	60	3.08	185	6.63	398	583
	11) Backfilling	m3	1,280	1.43	1,830	3.90	4,992	6,822
	12) Disposal to spoil area	m3	1,886	3.23	6,092	2.06	3,885	9,977
	13) Asphalt pavement, t=50mm	m2	460	0.23	106	3.63	1,670	1,776
	14) Base course, t=150mm	m3	69	0.90	62	14.85	1,025	1,087
	15) Subbase course, t200mm	m3	92	0.62	57	14.11	1,298	1,355
	16) Sheeting and bracing,	m2	1,200	3.10	3,720	2.26	2,712	6,432

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	D=3m,W=3m							
	17) Miscellaneous, 5%	L.S	1		1,152		2,858	4,010
	Subtotal				24,190		60,023	84,213
1.14	R.C. pipe, 900mm dia.,3-4m covering,L=1320m							
	1) Care of water during construction	L.S	1	1,424.28	1,424	1,762.20	1,762	3,186
	2) Cutting of asphalt pavement	m	2,640	0.37	977	0.23	607	1,584
	3) Breaking and loading of asphalt pavement	m3	660	2.77	1,828	1.09	719	2,548
	4) Excavation of common soil	m3	16,170	0.76	12,289	0.43	6,953	19,242
	5) Supply and installation of R.C. pipe 900mm dia.	m	1,320	9.21	12,157	41.91	55,321	67,478
	6) Timber	m3	502	0.00	0	195.81	98,218	98,218
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	174,240	0.26	45,302	0.61	106,286	151,589
	8) Levelling concrete, t=100mm	m3	290	10.25	2,977	37.49	10,887	13,864
	9) Concrete Grade250/20	m3	422	14.23	6,011	47.94	20,250	26,261
	10) Formwork	m2	1,584	3.08	4,879	6.63	10,502	15,381
	11) Backfilling	m3	12,804	1.43	18,310	3.90	49,936	68,245
	12) Disposal to spoil area	m3	16,830	3.23	54,361	2.06	34,670	89,031
	13) Asphalt pavement, t=50mm	m2	3,300	0.23	759	3.63	11,979	12,738
	14) Base course, t=150mm	m3	495	0.90	446	14.85	7,351	7,796
	15) Subbase course, t=200mm	m3	660	0.62	409	14.11	9,313	9,722
	16) Sheeting and bracing, D=4m,W=3m	m2	10,560	3.14	33,158	2.33	24,605	57,763
	17) Soil improvement	m3	8,844	39.59	350,134	7.78	68,806	418,940
	18) Miscellaneous, 5%	L.S	1		27,271		25,908	53,179
	Subtotal				572,692		544,074	1,116,766
1.15	R.C. pipe, 1000mm dia.,2-3m covering,L=700m							
	1) Care of water during construction	L.S	1	755.30	755	934.50	935	1,690
	2) Cutting of asphalt pavement	m	1,400	0.37	518	0.23	322	840
	3) Breaking and loading of asphalt pavement	m3	336	2.77	931	1.09	366	1,297
	4) Excavation of common soil	m3	6,720	0.76	5,107	0.43	2,890	7,997
	5) Supply and installation of R.C. pipe 1000mm dia.	m	700	9.21	6,447	46.57	32,599	39,046
	6) Timber	m3	252	0.00	0	195.81	49,344	49,344
	7) Bamboo pile,80mm dia.,3m,	m	88,200	0.26	22,932	0.61	53,802	76,734

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	20nos/m2							
	8) Levelling concrete, t=100mm	m3	147	10.25	1,507	37.49	5,511	7,018
	9) Concrete Grade250/20	m3	182	14.23	2,590	47.94	8,725	11,315
	10) Reinforcement bar, deformed	kg	1,820	0.00	0	0.51	925	925
	11) Formwork	m2	280	3.08	862	6.63	1,856	2,719
	12) Backfilling	m3	4,550	1.43	6,507	3.90	17,745	24,252
	13) Disposal to spoil area	m3	7,056	3.28	23,144	1.55	10,937	34,080
	14) Asphalt pavement, t=50mm	m2	1,680	0.23	386	3.63	6,098	6,485
	15) Base course, t=150mm	m3	252	0.90	227	14.85	3,742	3,969
	16) Subbase course, t=200mm	m3	336	0.62	208	14.11	4,741	4,949
	17) Sheeting and bracing, D=3m,W=3m	m2	4,200	3.10	13,020	2.26	9,492	22,512
	18) Soil improvement	m3	2,380	39.59	94,224	7.78	18,516	112,741
	19) Miscellaneous, 5%	L.S	1		8,968		11,427	20,396
	Subtotal				188,333		239,974	428,307
1.16	R.C. pipe, 1000mm dia.,3-4m covering,L=1000m							
	1) Care of water during construction	L.S	1	1,079.00	1,079	1,335.00	1,335	2,414
	2) Cutting of asphalt pavement	m	2,000	0.37	740	0.23	460	1,200
	3) Breaking and loading of asphalt pavement	m3	520	2.77	1,440	1.09	567	2,007
	4) Excavation of common soil	m3	13,000	0.76	9,880	0.43	5,590	15,470
	5) Supply and installation of R.C. pipe 1000mm dia.	m	1,000	9.21	9,210	46.57	46,570	55,780
	6) Timber	m3	390	0.00	0	195.81	76,366	76,366
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	138,000	0.26	35,880	0.61	84,180	120,060
	8) Levelling concrete, t=100mm	m3	230	10.25	2,358	37.49	8,623	10,980
	9) Concrete Grade250/20	m3	450	14.23	6,404	47.94	21,573	27,977
	10) Reinforcement bar, deformed	kg	4,500	0.00	0	0.51	2,286	2,286
	11) Formwork	m2	1,400	3.08	4,312	6.63	9,282	13,594
	12) Backfilling	m3	9,900	1.43	14,157	3.90	38,610	52,767
	13) Disposal to spoil area	m3	13,520	3.28	44,346	1.55	20,956	65,302
	14) Asphalt pavement, t=50mm	m2	2,600	0.23	598	3.63	9,438	10,036
	15) Base course, t=150mm	m3	390	0.90	351	14.85	5,792	6,143
	16) Subbase course, t=200mm	m3	520	0.62	322	14.11	7,337	7,660
	17) Sheeting and bracing, D=4m,W=3m	m2	8,000	3.14	25,120	2.33	18,640	43,760
	18) Soil improvement	m3	7,200	39.59	285,048	7.78	56,016	341,064
	19) Miscellaneous, 5%	L.S	1		22,062		20,681	42,743

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	Subtotal				463,307		434,301	897,608
1.17	R.C. pipe, 1100mm dia.,2-3m covering,L=600m							
	1) Care of water during construction	L.S	1	647.40	647	801.00	801	1,448
	2) Cutting of asphalt pavement	m	1,200	0.37	444	0.23	276	720
	3) Breaking and loading of asphalt pavement	m3	300	2.77	831	1.09	327	1,158
	4) Excavation of common soil	m3	6,150	0.76	4,674	0.43	2,645	7,319
	5) Supply and installation of R.C. pipe 1100mm dia.	m	600	9.21	5,526	59.42	35,652	41,178
	6) Timber	m3	228	0.00	0	195.81	44,645	44,645
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	79,200	0.26	20,592	0.61	48,312	68,904
	8) Levelling concrete, t=100mm	m3	132	10.25	1,353	37.49	4,949	6,302
	9) Concrete Grade250/20	m3	168	14.23	2,391	47.94	8,054	10,445
	10) Reinforcement bar, deformed	kg	1,680	0.00	0	0.51	853	853
	11) Formwork	m2	240	3.08	739	6.63	1,591	2,330
	12) Backfilling	m3	3,900	1.43	5,577	3.90	15,210	20,787
	13) Disposal to spoil area	m3	6,450	3.28	21,156	1.55	9,998	31,154
	14) Asphalt pavement, t=50mm	m2	1,500	0.23	345	3.63	5,445	5,790
	15) Base course, t=150mm	m3	225	0.90	203	14.85	3,341	3,544
	16) Subbase course, t=200mm	m3	300	0.62	186	14.11	4,233	4,419
	17) Sheeting and bracing, D=3m,W=3m	m2	3,600	3.10	11,160	2.26	8,136	19,296
	18) Soil improvement	m3	2,340	39.59	92,641	7.78	18,205	110,846
	19) Miscellaneous, 5%	L.S	1		8,423		10,634	19,057
	Subtotal				176,888		223,306	400,194
1.18	R.C. pipe, 1100mm dia.,3-4m covering,L=900m							
	1) Care of water during construction	L.S	1	971.10	971	1,201.50	1,202	2,173
	2) Cutting of asphalt pavement	m	1,800	0.37	666	0.23	414	1,080
	3) Breaking and loading of asphalt pavement	m3	486	2.77	1,346	1.09	530	1,876
	4) Excavation of common soil	m3	12,393	0.76	9,419	0.43	5,329	14,748
	5) Supply and installation of R.C. pipe 1100mm dia.	m	900	9.21	8,289	59.42	53,478	61,767
	6) Timber	m3	369	0.00	0	195.81	72,254	72,254
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	129,600	0.26	33,696	0.61	79,056	112,752

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	8) Levelling concrete, t=100mm	m3	216	10.25	2,214	37.49	8,098	10,312
	9) Concrete Grade250/20	m3	432	14.23	6,147	47.94	20,710	26,857
	10) Reinforcement bar, deformed	kg	4,320	0.00	0	0.51	2,195	2,195
	11) Formwork	m2	1,350	3.08	4,158	6.63	8,951	13,109
	12) Backfilling	m3	9,000	1.43	12,870	3.90	35,100	47,970
	13) Disposal to spoil area	m3	12,879	3.28	42,243	1.55	19,962	62,206
	14) Asphalt pavement, t=50mm	m2	2,430	0.23	559	3.63	8,821	9,380
	15) Base course, t=150mm	m3	365	0.90	328	14.85	5,413	5,741
	16) Subbase course, t=200mm	m3	486	0.62	301	14.11	6,857	7,159
	17) Sheeting and bracing, D=4m,W=3m	m2	7,200	3.14	22,608	2.33	16,776	39,384
	18) Soil improvement	m3	7,020	39.59	277,922	7.78	54,616	332,537
	19) Miscellaneous, 5%	L.S	1		21,187		19,988	41,175
	Subtotal				444,924		419,748	864,673
1.19	R.C. pipe, 1200mm dia.,3-4m covering,L=880m							
	1) Care of water during construction	L.S	1	949.52	950	1,174.80	1,175	2,124
	2) Cutting of asphalt pavement	m	1,760	0.37	651	0.23	405	1,056
	3) Breaking and loading of asphalt pavement	m3	493	2.77	1,365	1.09	537	1,902
	4) Excavation of common soil	m3	12,813	0.76	9,738	0.43	5,510	15,247
	5) Supply and installation of R.C. pipe 1200mm dia.	m	880	9.21	8,105	67.52	59,418	67,522
	6) Timber	m3	370	0.00	0	195.81	72,411	72,411
	7) Bamboo pile,80mm dia.,3m, 20nos/m2	m	132,000	0.26	34,320	0.61	80,520	114,840
	8) Levelling concrete, t=100mm	m3	220	10.25	2,255	37.49	8,248	10,503
	9) Concrete Grade250/20	m3	449	14.23	6,386	47.94	21,515	27,902
	10) Reinforcement bar, deformed	kg	4,488	0.00	0	0.51	2,280	2,280
	11) Formwork	m2	1,408	3.08	4,337	6.63	9,335	13,672
	12) Backfilling	m3	8,800	1.43	12,584	3.90	34,320	46,904
	13) Disposal to spoil area	m3	13,306	3.28	43,642	1.55	20,624	64,266
	14) Asphalt pavement, t=50mm	m2	2,464	0.23	567	3.63	8,944	9,511
	15) Base course, t=150mm	m3	370	0.90	333	14.85	5,489	5,821
	16) Subbase course, t=200mm	m3	493	0.62	306	14.11	6,953	7,259
	17) Sheeting and bracing, D=4m,W=3m	m2	7,040	3.14	22,106	2.33	16,403	38,509
	18) Soil improvement	m3	7,392	39.59	292,649	7.78	57,510	350,159
	19) Miscellaneous, 5%	L.S	1		22,015		20,580	42,594
	Subtotal				462,307		432,175	894,482

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	Total				3,100,984		3,689,120	6,791,305
2.00	Trunk Sewer, Pipe Jacking Method							
2.10	R.C. pipe for jacking,800mm dia.,L=1300m							
	1) Care of water							
	a) Care of water during construction of vertical shaft	L.S	1	1,888.25	1,888	2,336.25	2,336	4,225
	b) Care of water during construction of pipe jacking	L.S	1	2,147.21	2,147	2,656.65	2,657	4,804
	2) Supply of R.C. pipe for jacking, 800mm dia.	m	1,340	0.00	0	40.60	54,404	54,404
	3) Pipe jacking, interval 40m							
	a) Excavation inside pipe	m	1,340	0.00	0	6.82	9,139	9,139
	b) Pipe jacking works in vertical shaft	m	1,340	218.33	292,562	20.40	27,336	319,898
	c) Ground works	m	1,340	20.95	28,073	12.73	17,058	45,131
	d) Disposal to spoil area	m	1,340	3.23	4,328	2.06	2,760	7,089
	4) Pipe laying in vertical shaft							
	a) Timber	m3	65	0.00	0	195.81	12,708	12,708
	b) Bamboo pile,80mm dia.,3m,20nos/m2	m	22,705	0.26	5,903	0.61	13,850	19,753
	c) Levelling concrete	m3	38	10.25	387	37.49	1,417	1,805
	d) Concrete Grade 250/20	m3	52	14.23	744	47.94	2,507	3,251
	e) Formwork	m2	198	3.08	610	6.63	1,314	1,925
	f) Soil improvement	m3	937	49.86	46,719	2.86	2,680	49,399
	g) Pipe laying	m	180	0.00	0	6.42	1,157	1,157
	5) Pipe construction joint							
	a) Mortar, 1:2, 0.0012m3/no	nos	552	0.00	0	0.08	43	43
	6) Injection work							
	a) Lubricant	m	1,340	75.43	101,076	5.51	7,383	108,460
	b) Backfill grout	m	1,340	66.90	89,646	10.47	14,030	103,676
	7) Temporary works							
	a) Supporting wall							
	I) Concrete Grade 250/20	m3	101	14.23	1,434	47.94	4,832	6,267
	ii) Formwork	m2	413	3.08	1,273	6.63	2,741	4,014
	iii) Reinforcement bar	kg	6,048	0.00	0	0.51	3,072	3,072
	iv) Breaking and loading of concrete	m3	101	2.77	279	1.09	110	389

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	v) Disposal to spoil area	m3	101	3.23	326	2.06	208	533
	b) Crane works	nos	34	1,402.68	47,691	328.45	11,167	58,858
	c) Foundation concrete							
	I) Concrete Grade 250/20	m3	118	14.23	1,675	47.94	5,643	7,317
	ii) Gravel bedding	m3	118	0.11	13	11.38	1,339	1,352
	d) Launching works							
	I) Portal for jacking	nos	34	943.18	32,068	34.86	1,185	33,253
	ii) Concrete Grade 250/20	m3	25	14.23	359	47.94	1,208	1,567
	iii) Formwork	m2	150	3.08	462	6.63	994	1,456
	iv) Breaking and loading of concrete	m3	25	2.77	70	1.09	27	97
	v) Disposal to spoil area	m3	25	3.23	81	2.06	52	133
	e) Jacking facility	nos	34	317.74	10,803	118.18	4,018	14,821
	f) Removal of leading edge	nos	34	15.59	530	10.48	356	886
	g) Cutting of face	nos	34	36.65	1,246	15.49	527	1,773
	8) Vertical shaft, interval 40m,5.3x2.6m,34nos							
	a) Cutting of asphalt pavement	m	537	0.37	199	0.23	124	322
	b) Breaking and loading of asphalt pavement	m3	94	2.77	260	1.09	102	362
	c) Excavation of common soil	m3	2,624	9.55	25,056	7.81	20,491	45,547
	d) Backfilling	m3	2,574	1.43	3,680	3.90	10,037	13,717
	e) Disposal to spoil area	m3	2,717	3.23	8,777	2.06	5,598	14,375
	f) Asphalt pavement, t=50mm	m2	469	0.23	108	3.63	1,701	1,808
	g) Base course, t=150mm	m3	70	0.90	63	14.85	1,044	1,107
	h) Subbase course, t=200mm	m3	94	0.62	58	14.11	1,322	1,380
	I) Steel sheet pile, type III, L=9m, 15d	m2	4,835	40.57	196,148	7.90	38,195	234,343
	j) Waling and strut, 15d	m	1,074	7.99	8,584	10.68	11,475	20,059
	9) Soil improvement	m3	10,452	49.86	521,137	2.86	29,893	551,029
	10) Miscellaneous, 5%	L.S	1		71,823		16,512	88,335
	Subtotal				1,508,289		346,752	1,855,041
2.20	R.C. pipe for jacking,900mm dia.,L=440m							
	1) Care of water							
	a) Care of water during construction of vertical shaft	L.S	1	323.70	324	400.50	401	724
	b) Care of water during construction of							

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	pipe jacking	L.S	1	830.83	831	1,027.95	1,028	1,859
	2) Supply of R.C. pipe for jacking, 900mm dia.	m	440	0.00	0	51.81	22,796	22,796
	3) Supply of intermediate jacking pipe, S&T	set	10	5,688.64	56,886	170.66	1,707	58,593
	4) Pipe jacking, stage 2, Interval 100m							
	a) Excavation inside pipe	m	440	0.00	0	7.93	3,489	3,489
	b) Pipe jacking works in vertical shaft	m	440	362.36	159,438	179.96	79,182	238,621
	c) Ground works	m	440	24.61	10,828	14.79	6,508	17,336
	d) Disposal to spoil area	m	440	3.23	1,421	2.06	906	2,328
	5) Pipe laying in vertical shaft							
	a) Timber	m3	11	0.00	0	195.81	2,056	2,056
	b) Bamboo pile,80mm dia.,3m,20nos/m2	m	3,630	0.26	944	0.61	2,214	3,158
	c) Levelling concrete	m3	6	10.25	63	37.49	229	291
	d) Concrete Grade 250/20	m3	9	14.23	125	47.94	422	547
	e) Formwork	m2	33	3.08	102	6.63	219	320
	f) Soil improvement	m3	160	49.86	7,953	2.86	456	8,409
	g) Pipe laying	m	28	0.00	0	6.42	177	177
	6) Pipe construction joint							
	a) Mortar, 1:2, 0.0013m3/no	nos	181	0.00	0	0.08	15	15
	7) Injection work							
	a) Lubricant, stage 2	m	440	102.80	45,232	8.47	3,727	48,959
	b) Backfill grout	m	440	76.43	33,629	11.38	5,007	38,636
	8) Temporary works							
	a) Supporting wall							
	I) Concrete Grade 250/20	m3	29	14.23	413	47.94	1,390	1,803
	ii) Formwork	m2	93	3.08	285	6.63	613	898
	iii) Reinforcement bar	kg	1,740	0.00	0	0.51	884	884
	iv) Breaking and loading of concrete	m3	29	2.77	80	1.09	32	112
	v) Disposal to spoil area	m3	29	3.23	94	2.06	60	153
	b) Crane works	nos	5	1,402.68	7,013	328.45	1,642	8,656
	c) Foundation concrete							
	I) Concrete Grade 250/20	m3	19	14.23	276	47.94	930	1,206
	ii) Gravel bedding	m3	19	0.11	2	11.38	221	223
	d) Launching works							
	I) Portal for jacking	nos	5	1,034.09	5,170	37.58	188	5,358
	ii) Concrete Grade 250/20	m3	4	14.23	61	47.94	206	267
	iii) Formwork	m2	25	3.08	77	6.63	165	242

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	iv) Breaking and loading of concrete	m3	4	2.77	12	1.09	5	17
	v) Disposal to spoil area	m3	4	3.23	14	2.06	9	23
	e) Jacking facility	nos	5	981.82	4,909	114.17	571	5,480
	f) Removal of leading edge	nos	5	15.59	78	10.48	52	130
	g) Cutting of face	nos	5	41.89	209	17.70	89	298
	h) Intermediate jacking facility, stage 2	nos	10	981.82	9,818	114.17	1,142	10,960
	9) Vertical shaft, interval 100m,5.5x2.9m,5nos							
	a) Cutting of asphalt pavement	m	84	0.37	31	0.23	19	50
	b) Breaking and loading of asphalt pavement	m3	16	2.77	44	1.09	17	62
	c) Excavation of common soil	m3	447	9.55	4,265	7.81	3,488	7,753
	d) Backfilling	m3	429	1.43	613	3.90	1,672	2,285
	e) Disposal to spoil area	m3	463	3.23	1,494	2.06	953	2,447
	f) Asphalt pavement, t=50mm	m2	80	0.23	18	3.63	290	308
	g) Base course, t=150mm	m3	12	0.90	11	14.85	178	189
	h) Subbase course, t=200mm	m3	16	0.62	10	14.11	226	236
	I) Steel sheet pile, type III, L=9m	m2	756	41.66	31,495	7.95	6,010	37,505
	j) Waling and strut	m	168	7.99	1,342	13.48	2,265	3,607
	10) Soil improvement	m3	3,696	49.86	184,283	2.86	10,571	194,853
	11) Miscellaneous, 5%	L.S	1		28,495		8,221	36,716
	Subtotal				598,389		172,647	771,036
2.30	R.C. pipe for jacking,1000mm dia.,L=1240m							
	1) Care of water							
	a) Care of water during construction of vertical shaft	L.S	1	1,003.47	1,003	1,241.55	1,242	2,245
	b) Care of water during construction of pipe jacking	L.S	1	2,330.64	2,331	2,883.60	2,884	5,214
	2) Supply of R.C. pipe for jacking, 1000mm dia.	m	1,240	0.00	0	57.58	71,399	71,399
	3) Supply of intermediate jacking pipe, S&T	set	26	6,615.90	172,013	198.49	5,161	177,174
	4) Pipe jacking, stage 2, Interval 100m							
	a) Excavation inside pipe	m	1,240	0.00	0	7.93	9,833	9,833
	b) Pipe jacking works in vertical	m	1,240	368.79	457,300	180.16	223,398	680,698

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	shaft							
	c) Ground works	m	1,240	24.61	30,516	14.79	18,340	48,856
	d) Disposal to spoil area	m	1,240	3.28	4,067	1.55	1,922	5,989
	5) Pipe laying in vertical shaft							
	a) Timber	m3	28	0.00	0	195.81	5,463	5,463
	b) Bamboo pile,80mm dia.,3m,20nos/m2	m	9,867	0.26	2,565	0.61	6,019	8,584
	c) Levelling concrete	m3	16	10.25	168	37.49	615	783
	d) Concrete Grade 250/20	m3	32	14.23	458	47.94	1,544	2,002
	e) Formwork	m2	100	3.08	308	6.63	664	972
	f) Soil improvement	m3	429	49.86	21,390	2.86	1,227	22,617
	g) Pipe laying	m	72	8.78	628	2.79	199	827
	6) Pipe construction joint							
	a) Mortar, 1:2, 0.0013m3/no	nos	510	0.00	0	0.08	43	43
	7) Injection work							
	a) Lubricant, stage 2	m	1,240	102.80	127,472	8.47	10,503	137,975
	b) Backfill grout	m	1,240	77.18	95,703	12.34	15,302	111,005
	8) Temporary works							
	a) Supporting wall							
	I) Concrete Grade 250/20	m3	87	14.23	1,244	47.94	4,190	5,434
	ii) Formwork	m2	277	3.08	852	6.63	1,834	2,686
	iii) Reinforcement bar	kg	5,244	0.00	0	0.51	2,664	2,664
	iv) Breaking and loading of concrete	m3	87	2.77	242	1.09	95	337
	v) Disposal to spoil area	m3	87	3.28	287	1.55	135	422
	b) Crane works	nos	13	1,402.68	18,235	328.45	4,270	22,505
	c) Foundation concrete							
	I) Concrete Grade 250/20	m3	52	14.23	734	47.94	2,474	3,208
	ii) Gravel bedding	m3	52	0.11	6	11.38	587	593
	d) Launching works							
	I) Portal for jacking	nos	13	1,352.28	17,580	48.06	625	18,204
	ii) Concrete Grade 250/20	m3	15	14.23	216	47.94	729	945
	iii) Formwork	m2	80	3.08	245	6.63	528	774
	iv) Breaking and loading of concrete	m3	15	2.77	42	1.09	17	59
	v) Disposal to spoil area	m3	15	3.28	50	1.55	24	73
	e) Jacking facility	nos	13	397.21	5,164	147.38	1,916	7,080
	f) Removal of leading edge	nos	13	15.59	203	10.48	136	339
	g) Cutting of face	nos	13	36.65	476	19.91	259	735
	h) Intermediate jacking facility, stage 2	nos	26	981.82	25,527	114.17	2,968	28,496

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	9) Vertical shaft, interval 100m,5.5x3.0m,13nos							
	a) Cutting of asphalt pavement	m	221	0.37	82	0.23	51	133
	b) Breaking and loading of asphalt pavement	m3	43	2.77	119	1.09	47	166
	c) Excavation of common soil	m3	1,394	9.55	13,316	7.81	10,889	24,205
	d) Backfilling	m3	1,340	1.43	1,916	3.90	5,227	7,143
	e) Disposal to spoil area	m3	1,437	3.28	4,714	1.55	2,228	6,942
	f) Asphalt pavement, t=50mm	m2	215	0.23	49	3.63	779	828
	g) Base course, t=150mm	m3	32	0.90	29	14.85	478	507
	h) Subbase course, t=200mm	m3	43	0.62	27	14.11	605	632
	I) Steel sheet pile, type III, L=9m	m2	2,210	41.66	92,069	7.95	17,570	109,638
	j) Waling and strut	m	442	7.99	3,532	13.48	5,958	9,490
	10) Soil improvement	m3	11,160	49.86	556,438	2.86	31,918	588,355
	11) Miscellaneous, 5%	L.S	1		82,966		23,748	106,714
	Subtotal				1,742,282		498,703	2,240,985
2.40	R.C. pipe for jacking,1100mm dia.,L=330m							
	1) Care of water							
	a) Care of water during construction of vertical shaft	L.S	1	194.22	194	240.30	240	435
	b) Care of water during construction of pipe jacking	L.S	1	712.14	712	881.10	881	1,593
	2) Supply of R.C. pipe for jacking, 1100mm dia.	m	330	0.00	0	71.04	23,443	23,443
	3) Supply of intermediate jacking pipe, S&T	set	12	7,438.65	89,264	223.16	2,678	91,942
	4) Pipe jacking, stage 4, Interval 150m							
	a) Excavation inside pipe	m	330	0.00	0	18.44	6,085	6,085
	b) Pipe jacking works in vertical shaft	m	330	510.50	168,465	342.42	112,999	281,464
	c) Ground works	m	330	28.33	9,349	17.27	5,699	15,048
	d) Disposal to spoil area	m	330	3.28	1,082	1.55	512	1,594
	5) Pipe laying in vertical shaft							
	a) Timber	m3	7	0.00	0	195.81	1,332	1,332
	b) Bamboo pile,80mm dia.,3m,20nos/m2	m	2,376	0.26	618	0.61	1,449	2,067
	c) Levelling concrete	m3	4	10.25	41	37.49	150	191

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	d) Concrete Grade 250/20	m3	8	14.23	114	47.94	384	497
	e) Formwork	m2	25	3.08	76	6.63	164	241
	f) Soil improvement	m3	102	49.86	5,101	2.86	293	5,393
	g) Pipe laying	m	17	8.78	145	2.79	46	191
	6) Pipe construction joint							
	a) Mortar, 1:2, 0.0014m3/no	nos	136	0.00	0	0.09	12	12
	7) Injection work							
	a) Lubricant, stage 4	m	330	115.95	38,264	9.77	3,224	41,488
	b) Backfill grout	m	330	86.69	28,608	13.17	4,346	32,954
	8) Temporary works							
	a) Supporting wall							
	I) Concrete Grade 250/20	m3	22	14.23	317	47.94	1,069	1,386
	ii) Formwork	m2	68	3.08	211	6.63	453	664
	iii) Reinforcement bar	kg	1,338	0.00	0	0.51	680	680
	iv) Breaking and loading of concrete	m3	22	2.77	62	1.09	24	86
	v) Disposal to spoil area	m3	22	3.28	73	1.55	35	108
	b) Crane works	nos	3	1,402.68	4,208	328.45	985	5,193
	c) Foundation concrete							
	I) Concrete Grade 250/20	m3	12	14.23	176	47.94	594	771
	ii) Gravel bedding	m3	12	0.11	1	11.38	141	142
	d) Launching works							
	I) Portal for jacking	nos	3	1,488.64	4,466	53.09	159	4,625
	ii) Concrete Grade 250/20	m3	4	14.23	54	47.94	182	236
	iii) Formwork	m2	20	3.08	61	6.63	131	192
	iv) Breaking and loading of concrete	m3	4	2.77	11	1.09	4	15
	v) Disposal to spoil area	m3	4	3.28	12	1.55	6	18
	e) Jacking facility	nos	3	397.21	1,192	147.38	442	1,634
	f) Removal of leading edge	nos	3	15.59	47	10.48	31	78
	g) Cutting of face	nos	3	52.36	157	22.13	66	223
	h) Intermediate jacking facility, stage 4	nos	12	1,077.27	12,927	117.03	1,404	14,332
	9) Vertical shaft, interval 100m,5.5x3.0m,13nos							
	a) Cutting of asphalt pavement	m	52	0.37	19	0.23	12	31
	b) Breaking and loading of asphalt pavement	m3	10	2.77	28	1.09	11	39
	c) Excavation of common soil	m3	266	9.55	2,540	7.81	2,077	4,618
	d) Backfilling	m3	256	1.43	366	3.90	998	1,364
	e) Disposal to spoil area	m3	276	3.28	906	1.55	428	1,334

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	f) Asphalt pavement, t=50mm	m2	51	0.23	12	3.63	186	198
	g) Base course, t=150mm	m3	8	0.90	7	14.85	114	121
	h) Subbase course, t=200mm	m3	10	0.62	6	14.11	145	152
	I) Steel sheet pile, type III, L=9m	m2	464	43.43	20,169	8.04	3,734	23,903
	j) Waling and strut	m	103	7.99	825	18.03	1,861	2,685
	10) Soil improvement	m3	3,168	49.86	157,956	2.86	9,060	167,017
	11) Miscellaneous, 5%	L.S	1		27,442		11,462	38,904
	Subtotal				576,284		240,706	816,990
2.50	R.C. pipe for jacking,1200mm dia.,L=2720m							
	1) Care of water							
	a) Care of water during construction of vertical shaft	L.S	1	1,305.59	1,306	1,615.35	1,615	2,921
	b) Care of water during construction of pipe jacking	L.S	1	5,869.76	5,870	7,262.40	7,262	13,132
	2) Supply of R.C. pipe for jacking, 1200mm dia.	m	2,720	0.00	0	77.43	210,610	210,610
	3) Supply of intermediate jacking pipe, S&T	set	76	8,997.74	683,828	269.94	20,515	704,344
	4) Pipe jacking, stage 4, Interval 150m							
	a) Excavation inside pipe	m	2,720	0.00	0	18.44	50,157	50,157
	b) Pipe jacking works in vertical shaft	m	2,720	511.30	1,390,736	337.58	918,218	2,308,954
	c) Ground works	m	2,720	28.33	77,058	17.27	46,974	124,032
	d) Disposal to spoil area	m	2,720	3.28	8,922	1.55	4,216	13,138
	5) Pipe laying in vertical shaft							
	a) Timber	m3	44	0.00	0	195.81	8,596	8,596
	b) Bamboo pile,80mm dia.,3m,20nos/m2	m	15,675	0.26	4,076	0.61	9,562	13,637
	c) Levelling concrete	m3	26	10.25	268	37.49	978	1,246
	d) Concrete Grade 250/20	m3	53	14.23	758	47.94	2,555	3,314
	e) Formwork	m2	167	3.08	515	6.63	1,109	1,624
	f) Soil improvement	m3	669	49.86	33,346	2.86	1,913	35,259
	g) Pipe laying	m	105	8.78	918	2.79	292	1,209
	6) Pipe construction joint							
	a) Mortar, 1:2, 0.0015m3/no	nos	1,119	0.00	0	0.10	109	109
	7) Injection work							
	a) Lubricant, stage 4	m	2,720	115.95	315,384	9.77	26,574	341,958

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	b) Backfill grout	m	2,720	90.93	247,330	14.58	39,658	286,987
	8) Temporary works							
	a) Supporting wall							
	I) Concrete Grade 250/20	m3	156	14.23	2,214	47.94	7,459	9,674
	ii) Formwork	m2	462	3.08	1,423	6.63	3,064	4,487
	iii) Reinforcement bar	kg	9,336	0.00	0	0.51	4,743	4,743
	iv) Breaking and loading of concrete	m3	156	2.77	431	1.09	170	601
	v) Disposal to spoil area	m3	156	3.28	510	1.55	241	752
	b) Crane works	nos	19	1,753.35	33,314	455.07	8,646	41,960
	c) Foundation concrete							
	I) Concrete Grade 250/20	m3	80	14.23	1,143	47.94	3,850	4,992
	ii) Gravel bedding	m3	80	0.11	9	11.38	914	923
	d) Launching works							
	I) Portal for jacking	nos	19	1,613.64	30,659	57.78	1,098	31,757
	ii) Concrete Grade 250/20	m3	26	14.23	367	47.94	1,237	1,604
	iii) Formwork	m2	135	3.08	415	6.63	893	1,308
	iv) Breaking and loading of concrete	m3	26	2.77	71	1.09	28	100
	v) Disposal to spoil area	m3	26	3.28	85	1.55	40	125
	e) Jacking facility	nos	19	397.21	7,547	147.38	2,800	10,347
	f) Removal of leading edge	nos	19	15.59	296	10.48	199	495
	g) Cutting of face	nos	19	57.60	1,094	24.34	462	1,557
	h) Intermediate jacking facility, stage 4	nos	76	1,270.46	96,555	122.83	9,335	105,890
	9) Vertical shaft, interval 150m,5.5x3.2m,19nos							
	a) Cutting of asphalt pavement	m	331	0.37	122	0.23	76	198
	b) Breaking and loading of asphalt pavement	m3	67	2.77	185	1.09	73	258
	c) Excavation of common soil	m3	1,806	9.55	17,245	7.81	14,103	31,349
	d) Backfilling	m3	1,740	1.43	2,488	3.90	6,786	9,275
	e) Disposal to spoil area	m3	1,873	3.28	6,142	1.55	2,903	9,045
	f) Asphalt pavement, t=50mm	m2	334	0.23	77	3.63	1,214	1,291
	g) Base course, t=150mm	m3	50	0.90	45	14.85	745	791
	h) Subbase course, t=200mm	m3	67	0.62	41	14.11	944	985
	I) Steel sheet pile, type III, L=9m	m2	2,975	43.43	129,222	8.04	23,922	153,144
	j) Waling and strut	m	661	7.99	5,283	18.03	11,921	17,204
	10) Soil improvement	m3	30,464	49.86	1,518,935	2.86	87,127	1,606,062
	11) Miscellaneous, 5%	L.S	1		231,312		90,579	321,891
	Subtotal				4,857,545		1,902,156	6,759,701

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
2.60	R.C. pipe for jacking,1650mm dia.,L=640m							
	1) Care of water							
	a) Care of water during construction of vertical shaft	L.S	1	312.91	313	387.15	387	700
	b) Care of water during construction of pipe jacking	L.S	1	1,629.29	1,629	2,015.85	2,016	3,645
	2) Supply of R.C. pipe for jacking, 1650mm dia.	m	640	0.00	0	131.38	84,083	84,083
	3) Supply of intermediate jacking pipe, S&T	set	16	14,745.45	235,927	442.38	7,078	243,005
	4) Pipe jacking, stage 4, Interval 200m							
	a) Excavation inside pipe	m	640	0.00	0	21.76	13,926	13,926
	b) Pipe jacking works in vertical shaft	m	640	795.39	509,050	360.15	230,496	739,546
	c) Ground works	m	640	33.28	21,299	20.62	13,197	34,496
	d) Disposal to spoil area	m	640	3.28	2,099	1.55	992	3,091
	5) Pipe laying in vertical shaft							
	a) Timber	m3	11	0.00	0	195.81	2,115	2,115
	b) Bamboo pile,80mm dia.,3m,20nos/m2	m	3,763	0.26	978	0.61	2,296	3,274
	c) Levelling concrete	m3	6	10.25	65	37.49	236	301
	d) Concrete Grade 250/20	m3	13	14.23	191	47.94	642	833
	e) Formwork	m2	43	3.08	131	6.63	282	414
	f) Soil improvement	m3	170	49.86	8,486	2.86	487	8,973
	g) Pipe laying	m	22	8.78	197	2.79	62	259
	6) Pipe construction joint							
	a) Mortar, 1:2, 0.0021m3/no	nos	264	0.00	0	0.14	36	36
	7) Injection work							
	a) Lubricant, stage 4	m	640	149.08	95,411	14.06	8,998	104,410
	b) Backfill grout	m	640	109.63	70,163	18.60	11,904	82,067
	8) Temporary works							
	a) Supporting wall							
	I) Concrete Grade 250/20	m3	46	14.23	657	47.94	2,215	2,872
	ii) Formwork	m2	140	3.08	431	6.63	927	1,357
	iii) Reinforcement bar	kg	2,772	0.00	0	0.51	1,408	1,408
	iv) Breaking and loading of concrete	m3	46	2.77	128	1.09	50	178

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	v) Disposal to spoil area	m3	46	3.28	152	1.55	72	223
	b) Crane works	nos	4	2,104.02	8,416	492.68	1,971	10,387
	c) Foundation concrete							
	I) Concrete Grade 250/20	m3	21	14.23	292	47.94	983	1,274
	ii) Gravel bedding	m3	21	0.11	2	11.38	233	236
	d) Launching works							
	I) Portal for jacking	nos	4	2,102.28	8,409	76.17	305	8,714
	ii) Concrete Grade 250/20	m3	8	14.23	114	47.94	384	497
	iii) Formwork	m2	40	3.08	122	6.63	263	385
	iv) Breaking and loading of concrete	m3	8	2.77	22	1.09	9	31
	v) Disposal to spoil area	m3	8	3.28	26	1.55	12	39
	e) Jacking facility	nos	4	476.62	1,906	174.30	697	2,604
	f) Removal of leading edge	nos	4	15.59	62	10.48	42	104
	g) Cutting of face	nos	4	94.26	377	39.83	159	536
	h) Intermediate jacking facility, stage 4	nos	16	2,334.09	37,345	154.74	2,476	39,821
	9) Vertical shaft, interval 200m,5.6x3.8m,4nos							
	a) Cutting of asphalt pavement	m	75	0.37	28	0.23	17	45
	b) Breaking and loading of asphalt pavement	m3	17	2.77	47	1.09	19	66
	c) Excavation of common soil	m3	426	9.55	4,064	7.81	3,324	7,388
	d) Backfilling	m3	413	1.43	590	3.90	1,610	2,200
	e) Disposal to spoil area	m3	443	3.28	1,452	1.55	686	2,138
	f) Asphalt pavement, t=50mm	m2	85	0.23	20	3.63	309	328
	g) Base course, t=150mm	m3	13	0.90	12	14.85	190	202
	h) Subbase course, t=200mm	m3	17	0.62	11	14.11	241	252
	I) Steel sheet pile, type III, L=9m	m2	602	45.87	27,595	8.17	4,915	32,510
	j) Waling and strut	m	150	7.99	1,202	24.33	3,659	4,861
	10) Soil improvement	m3	8,512	49.86	424,408	2.86	24,344	448,753
	11) Miscellaneous, 5%	L.S	1		73,192		21,538	94,729
	Subtotal				1,537,022		452,291	1,989,313
2.70	R.C. pipe for jacking,1800mm dia.,L=950m							
	1) Care of water							
	a) Care of water during construction of vertical shaft	L.S	1	507.13	507	627.45	627	1,135
	b) Care of water during							

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	construction of							
	pipe jacking	L.S	1	2,568.02	2,568	3,177.30	3,177	5,745
	2) Supply of R.C. pipe for jacking, 1800mm dia.	m	950	0.00	0	152.93	145,284	145,284
	3) Supply of intermediate jacking pipe, S&T	set	20	16,763.65	335,273	502.91	10,058	345,331
	4) Pipe jacking, stage 4, Interval 200m							
	a) Excavation inside pipe	m	950	0.00	0	23.05	21,898	21,898
	b) Pipe jacking works in vertical shaft	m	950	935.64	888,858	305.98	290,681	1,179,539
	c) Ground works	m	950	35.37	33,602	22.02	20,919	54,521
	d) Disposal to spoil area	m	950	3.28	3,116	1.55	1,473	4,589
	5) Pipe laying in vertical shaft							
	a) Timber	m3	15	0.00	0	195.81	2,839	2,839
	b) Bamboo pile,80mm dia.,3m,20nos/m2	m	5,046	0.26	1,312	0.61	3,078	4,390
	c) Levelling concrete	m3	8	10.25	86	37.49	315	401
	d) Concrete Grade 250/20	m3	18	14.23	260	47.94	877	1,138
	e) Formwork	m2	58	3.08	179	6.63	385	563
	f) Soil improvement	m3	238	49.86	11,857	2.86	680	12,537
	g) Pipe laying	m	29	8.78	255	2.79	81	336
	6) Pipe construction joint							
	a) Mortar, 1:2, 0.0023m3/no	nos	391	0.00	0	0.15	58	58
	7) Injection work							
	a) Lubricant, stage 4	m	950	174.16	165,452	15.70	14,915	180,367
	b) Backfill grout	m	950	118.37	112,452	20.11	19,105	131,556
	8) Temporary works							
	a) Supporting wall							
	I) Concrete Grade 250/20	m3	98	14.23	1,400	47.94	4,717	6,118
	ii) Formwork	m2	245	3.08	754	6.63	1,623	2,377
	iii) Reinforcement bar	kg	5,904	0.00	0	0.51	2,999	2,999
	iv) Breaking and loading of concrete	m3	98	2.77	273	1.09	107	380
	v) Disposal to spoil area	m3	98	3.28	323	1.55	153	475
	b) Crane works	nos	5	2,104.02	10,520	492.68	2,463	12,984
	c) Foundation concrete							
	I) Concrete Grade 250/20	m3	28	14.23	394	47.94	1,328	1,722
	ii) Gravel bedding	m3	28	0.11	3	11.38	315	318
	d) Launching works							
	I) Portal for jacking	nos	5	2,284.09	11,420	82.57	413	11,833
	ii) Concrete Grade 250/20	m3	11	14.23	159	47.94	537	696

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	iii) Formwork	m2	55	3.08	168	6.63	362	530
	iv) Breaking and loading of concrete	m3	11	2.77	31	1.09	12	43
	v) Disposal to spoil area	m3	11	3.28	37	1.55	17	54
	e) Jacking facility	nos	5	635.49	3,177	228.49	1,142	4,320
	f) Removal of leading edge	nos	5	15.59	78	10.48	52	130
	g) Cutting of face	nos	5	104.73	524	44.25	221	745
	h) Intermediate jacking facility, stage 4	nos	20	2,675.00	53,500	207.32	4,146	57,646
	9) Vertical shaft, interval 200m,5.8x4.1m,5nos							
	a) Cutting of asphalt pavement	m	99	0.37	37	0.23	23	59
	b) Breaking and loading of asphalt pavement	m3	24	2.77	66	1.09	26	92
	c) Excavation of common soil	m3	702	9.55	6,699	7.81	5,479	12,178
	d) Backfilling	m3	683	1.43	976	3.90	2,662	3,638
	e) Disposal to spoil area	m3	725	3.28	2,379	1.55	1,124	3,503
	f) Asphalt pavement, t=50mm	m2	119	0.23	27	3.63	432	459
	g) Base course, t=150mm	m3	18	0.90	16	14.85	266	282
	h) Subbase course, t=200mm	m3	24	0.62	15	14.11	336	351
	I) Steel sheet pile, type III, L=9m	m2	891	46.28	41,235	8.19	7,297	48,533
	j) Waling and strut	m	198	7.99	1,582	25.38	5,025	6,607
	10) Soil improvement	m3	13,680	49.86	682,085	2.86	39,125	721,210
	11) Miscellaneous, 5%	L.S	1		118,683		30,943	149,625
	Subtotal				2,492,337		649,796	3,142,133
	Total				13,312,149		4,263,050	17,575,199
3.00	Combined Sewer Overflow Control Structure							
3.10	Orifice type, gate type I, 22nos							
	1) Care of water during construction of CSO	L.S	1	1,661.66	1,662	2,055.90	2,056	3,718
	2) Care of water during construction of flap gate	L.S	1	1,661.66	1,662	2,055.90	2,056	3,718
	3) Cutting of asphalt pavement	m	458	0.37	169	0.23	105	275
	4) Breaking and loading of asphalt pavement	m3	57	2.77	158	1.09	62	221
	5) Excavation of common soil	m3	602	0.76	457	0.43	259	716
	6) Backfilling	m3	444	1.43	634	3.90	1,730	2,364
	7) Disposal to spoil area	m3	659	3.28	2,161	1.55	1,021	3,182

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	8) Gravel bedding	m3	12	0.11	1	11.38	132	133
	9) Concrete Grade 300/20	m3	71	16.85	1,196	52.47	3,725	4,922
	10) Reinforcing bar, deformed	kg	4,224	0.00	0	0.51	2,146	2,146
	11) Formwork	m2	829	0.57	473	16.27	13,488	13,960
	12) Asphalt pavement, t=50mm	m2	286	0.23	66	3.63	1,038	1,104
	13) Base course, t=150mm	m3	43	0.90	39	14.85	637	676
	14) Subbase course, t=200mm	m3	57	0.62	35	14.11	807	843
	15) Screen, W600mmxH600mm	nos	22	7,936.00	174,592	246.00	5,412	180,004
	16) Orifice, 100mm dia.	nos	22	0.00	0	2.29	50	50
	17) Grating cover, 600mmx900mm	nos	22	177.28	3,900	5.67	125	4,025
	18) Step, W=300mm	nos	110	0.00	0	0.85	94	94
	19) Manhole cover, 600mm dia.	nos	22	726.14	15,975	27.25	600	16,575
	20) Stoplog, W600xH300mm	nos	22	501.00	11,022	86.00	1,892	12,914
	21) Supply and installation of flap gate, 700mm dia.	nos	22	2,160.00	47,520	67.00	1,474	48,994
	22) Steel sheet piles,type III, L=6m,for CSO	m2	1,267	39.89	50,549	7.86	9,960	60,509
	23) Waling and strut, for CSO	m	211	7.99	1,687	8.93	1,886	3,574
	24) Steel sheet piles,type III, L=9m, for flap gate	m2	2,970	39.89	118,473	7.86	23,344	141,818
	25) Waling and strut, for flap gate	m	330	7.99	2,637	8.93	2,947	5,584
	26) Miscellaneous, 5%	L.S	1		21,753		3,852	25,606
	Subtotal				456,822		80,898	537,721
3.20	Gate type, type I, 22nos							
	1) Care of water during construction of CSO	L.S	1	1,661.66	1,662	2,055.90	2,056	3,718
	2) Care of water during construction of flap gate	L.S	1	1,661.66	1,662	2,055.90	2,056	3,718
	3) Cutting of asphalt pavement	m	510	0.37	189	0.23	117	306
	4) Breaking and loading of asphalt pavement	m3	72	2.77	200	1.09	79	279
	5) Excavation of common soil	m3	898	0.76	682	0.43	386	1,068
	6) Backfilling	m3	607	1.43	868	3.90	2,368	3,236
	7) Disposal to spoil area	m3	970	3.28	3,181	1.55	1,503	4,684
	8) Gravel bedding	m3	18	0.11	2	11.38	200	202
	9) Concrete Grade 300/20	m3	107	16.85	1,810	52.47	5,635	7,445
	10) Reinforcing bar, deformed	kg	6,468	0.00	0	0.51	3,286	3,286
	11) Formwork	m2	1,245	0.57	710	16.27	20,259	20,969

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	12) Asphalt pavement, t=50mm	m2	361	0.23	83	3.63	1,310	1,393
	13) Base course, t=150mm	m3	54	0.90	49	14.85	805	854
	14) Subbase course, t=200mm	m3	72	0.62	45	14.11	1,019	1,064
	15) R.C. pipe, 150mm dia.	m	22	0.00	0	3.42	75	75
	16) Screen, W900mmxH600mm	nos	22	11,904.00	261,888	368.00	8,096	269,984
	17) Gate, 150mm dia.	nos	22	1,632.00	35,904	51.00	1,122	37,026
	18) Grating cover, 900mmx1200mm	nos	22	354.56	7,800	11.34	249	8,050
	19) Step, W=300mm	nos	110	0.00	0	0.85	94	94
	20) Manhole cover, 600mm dia.	nos	22	726.14	15,975	27.25	600	16,575
	21) Stoplog, W900xH600mm	nos	22	1,503.00	33,066	258.00	5,676	38,742
	22) Supply and installation of flap gate,1200mm						0	0
	dia.	nos	22	3,995.00	87,890	124.00	2,728	90,618
	23) Steel sheet piles,type III, L=6m,for CSO	m2	1,531	39.89	61,080	7.86	12,035	73,115
	24) Waling and strut, for CSO	m	255	7.99	2,039	8.93	2,279	4,318
	25) Steel sheet piles,type III, L=9m, for flap gate	m2	2,970	39.89	118,473	7.86	23,344	141,818
	26) Waling and strut, for flap gate	m	330	7.99	2,637	8.93	2,947	5,584
	27) Miscellaneous, 5%	L.S	1		31,895		5,016	36,911
	Subtotal				669,788		105,340	775,129
3.30	Gate type, type II, 12nos							
	1) Care of water during construction of CSO	L.S	1	906.36	906	1,121.40	1,121	2,028
	2) Care of water during construction of							
	flap gate	L.S	1	906.36	906	1,121.40	1,121	2,028
	3) Cutting of asphalt pavement	m	278	0.37	103	0.23	64	167
	4) Breaking and loading of asphalt pavement	m3	39	2.77	109	1.09	43	152
	5) Excavation of common soil	m3	547	0.76	416	0.43	235	651
	6) Backfilling	m3	372	1.43	532	3.90	1,451	1,983
	7) Disposal to spoil area	m3	587	3.28	1,924	1.55	909	2,833
	8) Gravel bedding	m3	10	0.11	1	11.38	109	110
	9) Concrete Grade 300/20	m3	65	16.85	1,102	52.47	3,432	4,534
	10) Reinforcing bar, deformed	kg	3,912	0.00	0	0.51	1,987	1,987
	11) Formwork	m2	768	0.57	438	16.27	12,495	12,933
	12) Asphalt pavement, t=50mm	m2	197	0.23	45	3.63	714	760
	13) Base course, t=150mm	m3	30	0.90	27	14.85	440	466
	14) Subbase course, t=200mm	m3	39	0.62	24	14.11	556	580

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	15) R.C. pipe, 200mm dia.	m	12	0.00	0	3.68	44	44
	16) Screen, W900mmxH600mm	nos	12	11,904.00	142,848	368.00	4,416	147,264
	17) Gate, 200mm dia.	nos	12	1,773.00	21,276	55.00	660	21,936
	18) Grating cover, 900mmx1200mm	nos	12	354.56	4,255	11.34	136	4,391
	19) Step, W=300mm	nos	84	0.00	0	0.85	71	71
	20) Manhole cover, 600mm dia.	nos	12	726.14	8,714	27.25	327	9,041
	21) Stoplog, W900xH600mm	nos	12	1,503.00	18,036	258.00	3,096	21,132
	22) Supply and installation of flap gate,1500mm dia.	nos	12	9,859.00	118,308	305.00	3,660	121,968
	23) Steel sheet piles,type III, L=6m,for CSO	m2	835	39.89	33,316	7.86	6,565	39,881
	24) Waling and strut, for CSO	m	139	7.99	1,112	8.93	1,243	2,355
	25) Steel sheet piles,type III, L=9m, for flap gate	m2	1,620	39.89	64,622	7.86	12,733	77,355
	26) Waling and strut, for flap gate	m	180	7.99	1,438	8.93	1,607	3,046
	27) Miscellaneous, 5%	L.S	1		21,023		2,962	23,985
	Subtotal				441,482		62,199	503,681
3.40	Gate type, type III, 3 nos							
	1) Care of water during construction of CSO	L.S	1	226.59	227	280.35	280	507
	2) Care of water during construction of flap gate	L.S	1	226.59	227	280.35	280	507
	3) Cutting of asphalt pavement	m	79	0.37	29	0.23	18	48
	4) Breaking and loading of asphalt pavement	m3	13	2.77	36	1.09	14	50
	5) Excavation of common soil	m3	197	0.76	150	0.43	85	235
	6) Backfilling	m3	119	1.43	171	3.90	466	636
	7) Disposal to spoil area	m3	210	3.28	690	1.55	326	1,016
	8) Gravel bedding	m3	5	0.11	1	11.38	59	60
	9) Concrete Grade 300/20	m3	30	16.85	499	52.47	1,553	2,052
	10) Reinforcing bar, deformed	kg	1,776	0.00	0	0.51	902	902
	11) Formwork	m2	255	0.57	145	16.27	4,149	4,294
	12) Asphalt pavement, t=50mm	m2	65	0.23	15	3.63	235	250
	13) Base course, t=150mm	m3	10	0.90	9	14.85	146	154
	14) Subbase course, t=200mm	m3	13	0.62	8	14.11	183	191
	15) R.C. pipe, 250mm dia.	m	3	0.00	0	6.08	18	18
	16) Screen, W1200mmxH900mm	nos	3	23,808.00	71,424	736.00	2,208	73,632
	17) Gate, 250mm dia.	nos	3	1,949.00	5,847	61.00	183	6,030

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	18) Grating cover, 1200mmx1500mm	nos	3	531.83	1,595	16.83	50	1,646
	19) Step, W=300mm	nos	24	0.00	0	0.85	20	20
	20) Manhole cover, 600mm dia.	nos	3	726.14	2,178	27.25	82	2,260
	21) Stoplog, W1200xH900mm	nos	3	3,005.00	9,015	515.00	1,545	10,560
	22) Supply and installation of flap gate,1650mm dia.	nos	3	11,936.00	35,808	370.00	1,110	36,918
	23) Steel sheet piles,type III, L=6m,for CSO	m2	238	39.89	9,478	7.86	1,868	11,345
	24) Waling and strut, for CSO	m	40	7.99	316	8.93	354	670
	25) Steel sheet piles,type III, L=9m, for flap gate	m2	405	39.89	16,155	7.86	3,183	19,339
	26) Waling and strut, for flap gate	m	45	7.99	360	8.93	402	761
	27) Miscellaneous, 5%	L.S	1		7,719		986	8,705
	Subtotal				162,102		20,706	182,809
3.50	Gate type, type IV, 2 nos							
	1) Care of water during construction of CSO	L.S	1	151.06	151	186.90	187	338
	2) Care of water during construction of flap gate	L.S	1	151.06	151	186.90	187	338
	3) Cutting of asphalt pavement	m	53	0.37	20	0.23	12	32
	4) Breaking and loading of asphalt pavement	m3	9	2.77	24	1.09	10	34
	5) Excavation of common soil	m3	138	0.76	105	0.43	59	164
	6) Backfilling	m3	84	1.43	120	3.90	326	446
	7) Disposal to spoil area	m3	147	3.28	482	1.55	228	709
	8) Gravel bedding	m3	3	0.11	0	11.38	39	39
	9) Concrete Grade 300/20	m3	21	16.85	350	52.47	1,091	1,442
	10) Reinforcing bar, deformed	kg	1,240	0.00	0	0.51	630	630
	11) Formwork	m2	179	0.57	102	16.27	2,916	3,018
	12) Asphalt pavement, t=50mm	m2	43	0.23	10	3.63	157	167
	13) Base course, t=150mm	m3	7	0.90	6	14.85	97	102
	14) Subbase course, t=200mm	m3	9	0.62	5	14.11	123	128
	15) R.C. pipe, 300mm dia.	m	2	0.00	0	6.08	12	12
	16) Screen, W1200mmxH900mm	nos	2	23,808.00	47,616	736.00	1,472	49,088
	17) Gate, 300mm dia.	nos	2	2,302.00	4,604	72.00	144	4,748
	18) Grating cover, 1200mmx1500mm	nos	2	531.83	1,064	16.83	34	1,097
	19) Step, W=300mm	nos	16	0.00	0	0.85	14	14
	20) Manhole cover, 600mm dia.	nos	2	726.14	1,452	27.25	55	1,507

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	21) Stoplog, W1200xH900mm	nos	2	3,005.00	6,010	515.00	1,030	7,040
	22) Supply and installation of flap gate,1800mm dia.	nos	2	14,203.00	28,406	440.00	880	29,286
	23) Steel sheet piles,type III, L=6m,for CSO	m2	185	39.89	7,372	7.86	1,453	8,824
	24) Waling and strut, for CSO	m	26	7.99	211	8.93	236	447
	25) Steel sheet piles,type III, L=9m, for flap gate	m2	270	39.89	10,770	7.86	2,122	12,893
	26) Waling and strut, for flap gate	m	30	7.99	240	8.93	268	508
	27) Miscellaneous, 5%	L.S	1		5,464		689	6,152
	Subtotal				114,734		14,467	129,202
3.60	Gate type, type V, 2 nos							
	1) Care of water during construction of CSO	L.S	1	151.06	151	186.90	187	338
	2) Care of water during construction of flap gate	L.S	1	151.06	151	186.90	187	338
	3) Cutting of asphalt pavement	m	53	0.37	20	0.23	12	32
	4) Breaking and loading of asphalt pavement	m3	9	2.77	24	1.09	10	34
	5) Excavation of common soil	m3	147	0.76	112	0.43	63	175
	6) Backfilling	m3	89	1.43	127	3.90	346	473
	7) Disposal to spoil area	m3	156	3.28	510	1.55	241	752
	8) Gravel bedding	m3	3	0.11	0	11.38	39	39
	9) Concrete Grade 300/20	m3	22	16.85	371	52.47	1,154	1,525
	10) Reinforcing bar, deformed	kg	1,312	0.00	0	0.51	666	666
	11) Formwork	m2	192	0.57	109	16.27	3,117	3,227
	12) Asphalt pavement, t=50mm	m2	43	0.23	10	3.63	157	167
	13) Base course, t=150mm	m3	7	0.90	6	14.85	97	102
	14) Subbase course, t=200mm	m3	9	0.62	5	14.11	123	128
	15) R.C. pipe, 350mm dia.	m	2	0.00	0	15.68	31	31
	16) Screen, W1200mmxH900mm	nos	2	23,808.00	47,616	736.00	1,472	49,088
	17) Gate, 350mm dia.	nos	2	2,372.00	4,744	74.00	148	4,892
	18) Grating cover, 1200mmx1500mm	nos	2	531.83	1,064	16.83	34	1,097
	19) Step, W=300mm	nos	18	0.00	0	0.85	15	15
	20) Manhole cover, 600mm dia.	nos	2	726.14	1,452	27.25	55	1,507
	21) Stoplog, W1200xH900mm	nos	2	3,005.00	6,010	515.00	1,030	7,040
	22) Supply and installation of flap gate,2000mm							

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	dia.	nos	2	17,530.00	35,060	543.00	1,086	36,146
	23) Steel sheet piles,type III, L=6m,for CSO	m2	185	39.89	7,372	7.86	1,453	8,824
	24) Waling and strut, for CSO	m	26	7.99	211	8.93	236	447
	25) Steel sheet piles,type III, L=9m, for flap gate	m2	270	39.89	10,770	7.86	2,122	12,893
	26) Waling and strut, for flap gate	m	30	7.99	240	8.93	268	508
	27) Miscellaneous, 5%	L.S	1		5,807		717	6,524
	Subtotal				121,942		15,066	137,007
	Total				1,966,870		298,678	2,265,548
4.00	Manhole							
4.10	Manhole, type 1, 300mm-600mm, 2.5m, 68nos							
	1) Care of water during construction	L.S	1	5,103.67	5,104	6,314.55	6,315	11,418
	2) Cast iron cover, 600mm dia.	nos	68	726.14	49,378	27.25	1,853	51,231
	3) Concrete Grade 300/20	m3	34	16.85	571	52.47	1,779	2,350
	4) Reinforcement bar, deformed	kg	2,032	0.00	0	0.51	1,032	1,032
	5) Formworks	m2	961	0.57	548	16.27	15,635	16,183
	6) Concrete Grade 300/20, base wall	m3	102	16.85	1,719	52.47	5,352	7,071
	7) Formworks	m2	585	0.57	333	16.27	5,425	5,759
	8) Miscellaneous, 5%	L.S	1		2,883		1,870	4,752
	Subtotal				60,535		39,261	99,796
4.20	Manhole, type 2, 700mm-900mm, 3.0m, 30nos							
	1) Care of water during construction	L.S	1	2,265.90	2,266	2,803.50	2,804	5,069
	2) Cast iron cover, 600mm dia.	nos	30	726.14	21,784	27.25	818	22,602
	3) Concrete Grade 300/20	m3	20	16.85	332	52.47	1,034	1,366
	4) Reinforcement bar, deformed	kg	1,182	0.00	0	0.51	600	600
	5) Formworks	m2	509	0.57	290	16.27	8,281	8,572
	6) Concrete Grade 300/20, base wall	m3	66	16.85	1,112	52.47	3,463	4,575
	7) Formworks	m2	375	0.57	214	16.27	6,101	6,315
	8) Concrete Grade 300/20,PC plate	m3	7	16.85	125	52.47	388	513
	9) Reinforcement bar, deformed	kg	441	0.00	0	0.51	224	224
	10) Formworks	m2	37	0.57	21	16.27	602	623
	11) Miscellaneous, 5%	L.S	1		1,307		1,216	2,523
	Subtotal				27,451		25,531	52,982
4.30	Manhole, type 3, 1000mm-1200mm, 3.5m, 33nos							

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	1) Care of water during construction	L.S	1	2,492.49	2,492	3,083.85	3,084	5,576
	2) Cast iron cover, 600mm dia.	nos	33	726.14	23,963	27.25	899	24,862
	3) Concrete Grade 300/20	m3	27	16.85	455	52.47	1,417	1,872
	4) Reinforcement bar, deformed	kg	1,615	0.00	0	0.51	820	820
	5) Formworks	m2	653	0.57	372	16.27	10,624	10,997
	6) Concrete Grade 300/20, base wall	m3	102	16.85	1,724	52.47	5,368	7,091
	7) Formworks	m2	571	0.57	325	16.27	9,290	9,616
	8) Concrete Grade 300/20,PC plate	m3	12	16.85	209	52.47	651	860
	9) Reinforcement bar, deformed	kg	744	0.00	0	0.51	378	378
	10) Formworks	m2	45	0.57	26	16.27	732	758
	11) Miscellaneous, 5%	L.S	1		1,478		1,663	3,141
	Subtotal				31,044		34,926	65,971
4.40	Manhole, type 3, 800mm-1200mm, 5.0m, 50nos							
	1) Care of water during construction	L.S	1	3,776.50	3,777	4,672.50	4,673	8,449
	2) Cast iron cover, 600mm dia.	nos	50	726.14	36,307	27.25	1,363	37,670
	3) Concrete Grade 300/20	m3	56	16.85	950	52.47	2,959	3,910
	4) Reinforcement bar, deformed	kg	3,381	0.00	0	0.51	1,718	1,718
	5) Formworks	m2	1,413	0.57	805	16.27	22,990	23,795
	6) Concrete Grade 300/20, base wall	m3	185	16.85	3,117	52.47	9,707	12,824
	7) Formworks	m2	1,085	0.57	618	16.27	17,653	18,271
	8) Concrete Grade 300/20,PC plate	m3	19	16.85	317	52.47	986	1,303
	9) Reinforcement bar, deformed	kg	1,128	0.00	0	0.51	573	573
	10) Formworks	m2	69	0.57	39	16.27	1,123	1,162
	11) Miscellaneous, 5%	L.S	1		2,297		3,187	5,484
	Subtotal				48,228		66,931	115,158
4.50	Manhole, type 5, 1800mm, 5.0m, 8nos							
	1) Care of water during construction	L.S	1	604.24	604	747.60	748	1,352
	2) Cast iron cover, 600mm dia.	nos	8	726.14	5,809	27.25	218	6,027
	3) Concrete Grade 300/20	m3	9	16.85	150	52.47	467	617
	4) Reinforcement bar, deformed	kg	531	0.00	0	0.51	270	270
	5) Formworks	m2	226	0.57	129	16.27	3,677	3,806
	6) Concrete Grade 300/20, base wall	m3	46	16.85	768	52.47	2,393	3,161
	7) Formworks	m2	232	0.57	132	16.27	3,775	3,907
	8) Concrete Grade 300/20,PC plate	m3	4	16.85	74	52.47	231	305
	9) Reinforcement bar, deformed	kg	260	0.00	0	0.51	132	132
	10) Formworks	m2	24	0.57	14	16.27	390	404
	11) Miscellaneous, 5%	L.S	1		384		0	384
	Subtotal				8,065		12,300	20,365

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	Total				175,323		178,948	354,271
5.00	Manhole Type Pump							
5.10	Manhole pump 1							
	1) Care of water during construction	L.S	1	107.90	108	133.50	134	241
	2) Cutting of asphalt pavement	m	28	0.37	10	0.23	6	17
	3) Breaking and loading of asphalt pavement	m3	10	2.77	28	1.09	11	39
	4) Excavation of common soil	m3	150	9.55	1,433	7.81	1,172	2,604
	5) Soil improvement	m3	25	79.17	1,979	15.55	389	2,368
	6) Gravel bedding	m3	2	0.11	0	11.38	23	23
	7) Levelling concrete	m3	1	10.25	10	37.49	37	48
	8) Bamboo pile, 80mm dia., 3m, 20nos/m2	m	660	0.26	172	0.61	403	574
	9) Concrete Grade 300/20	m3	20	16.85	337	52.47	1,049	1,386
	10) Formwork	m2	150	0.57	86	16.27	2,441	2,526
	11) Reinforcement bar, deformed	kg	1,200	0.00	0	0.51	610	610
	12) Backfilling	m3	80	1.43	114	3.90	312	426
	13) Disposal to spoil area	m3	160	3.28	525	1.55	248	773
	14) Grating 1200mmx600mm	no	1	236.38	236	7.56	8	244
	15) Manhole cover, 600mm dia.	no	3	726.14	2,178	27.25	82	2,260
	16) Step, W=300mm	no	35	0.00	0	0.85	30	30
	17) R.C. pipe, 400mm dia.	m	1	0.00	0	15.68	16	16
	18) Asphalt pavement, t=50mm	m2	50	0.23	12	3.63	182	193
	19) Base course, t=150mm	m3	8	0.90	7	14.85	111	118
	20) Subbase course, t=200mm	m3	10	0.62	6	14.11	141	147
	21) Steel sheet pile, type III, L=10m	m2	160	39.89	6,382	7.86	1,258	7,640
	22) Waling and strut	m	32	7.99	256	8.93	286	541
	23) Miscellaneous, 5%	L.S	1		694		447	1,141
	Subtotal				14,573		9,393	23,966
5.20	Manhole pump 2							
	1) Care of water during construction	L.S	1	107.90	108	133.50	134	241
	2) Cutting of asphalt pavement	m	26	0.37	9	0.23	6	15
	3) Breaking and loading of asphalt pavement	m3	8	2.77	22	1.09	9	31
	4) Excavation of common soil	m3	50	9.55	478	7.81	391	868
	5) Soil improvement	m3	0	79.17	0	15.55	0	0
	6) Gravel bedding	m3	2	0.11	0	11.38	23	23
	7) Levelling concrete	m3	1	10.25	10	37.49	37	48
	8) Bamboo pile, 80mm dia., 3m,	m	480	0.26	125	0.61	293	418

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	20nos/m2							
	9) Concrete Grade 300/20	m3	11	16.85	185	52.47	577	763
	10) Formwork	m2	78	0.57	44	16.27	1,269	1,314
	11) Reinforcement bar, deformed	kg	660	0.00	0	0.51	335	335
	12) Backfilling	m3	25	1.43	36	3.90	98	133
	13) Disposal to spoil area	m3	58	3.28	190	1.55	90	280
	14) Grating 1200mmx600mm	no	1	236.38	236	7.56	8	244
	15) Manhole cover, 600mm dia.	no	3	726.14	2,178	27.25	82	2,260
	16) Step, W=300mm	no	16	0.00	0	0.85	14	14
	17) R.C. pipe, 400mm dia.	m	1	0.00	0	15.68	16	16
	18) Asphalt pavement, t=50mm	m2	40	0.23	9	3.63	145	154
	19) Base course, t=150mm	m3	6	0.90	5	14.85	89	95
	20) Subbase course, t=200mm	m3	8	0.62	5	14.11	113	118
	21) Steel sheet pile, type III, L=10m	m2	160	39.89	6,382	7.86	1,258	7,640
	22) Waling and strut	m	32	7.99	256	8.93	286	541
	23) Miscellaneous, 5%	L.S	1		514		263	778
	Subtotal				10,795		5,533	16,328
5.30	Manhole pump 3							
	1) Care of water during construction	L.S	1	107.90	108	133.50	134	241
	2) Cutting of asphalt pavement	m	26	0.37	9	0.23	6	15
	3) Breaking and loading of asphalt pavement	m3	8	2.77	22	1.09	9	31
	4) Excavation of common soil	m3	50	9.55	478	7.81	391	868
	5) Soil improvement	m3	0	79.17	0	15.55	0	0
	6) Gravel bedding	m3	2	0.11	0	11.38	23	23
	7) Levelling concrete	m3	1	10.25	10	37.49	37	48
	8) Bamboo pile, 80mm dia., 3m, 20nos/m2	m	480	0.26	125	0.61	293	418
	9) Concrete Grade 300/20	m3	11	16.85	185	52.47	577	763
	10) Formwork	m2	78	0.57	44	16.27	1,269	1,314
	11) Reinforcement bar, deformed	kg	660	0.00	0	0.51	335	335
	12) Backfilling	m3	25	1.43	36	3.90	98	133
	13) Disposal to spoil area	m3	58	3.28	190	1.55	90	280
	14) Grating 1200mmx600mm	no	1	236.38	236	7.56	8	244
	15) Manhole cover, 600mm dia.	no	3	726.14	2,178	27.25	82	2,260
	16) Step, W=300mm	no	16	0.00	0	0.85	14	14
	17) R.C. pipe, 400mm dia.	m	1	0.00	0	15.68	16	16
	18) Asphalt pavement, t=50mm	m2	40	0.23	9	3.63	145	154
	19) Base course, t=150mm	m3	6	0.90	5	14.85	89	95
	20) Subbase course, t=200mm	m3	8	0.62	5	14.11	113	118

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	21) Steel sheet pile, type III, L=10m	m2	160	39.89	6,382	7.86	1,258	7,640
	22) Waling and strut	m	32	7.99	256	8.93	286	541
	23) Miscellaneous, 5%	L.S	1		514		263	778
	Subtotal				10,795		5,533	16,328
5.40	Manhole pump 4							
	1) Care of water during construction	L.S	1	107.90	108	133.50	134	241
	2) Cutting of asphalt pavement	m	26	0.37	9	0.23	6	15
	3) Breaking and loading of asphalt pavement	m3	8	2.77	22	1.09	9	31
	4) Excavation of common soil	m3	55	9.55	525	7.81	430	955
	5) Soil improvement	m3	0	79.17	0	15.55	0	0
	6) Gravel bedding	m3	2	0.11	0	11.38	23	23
	7) Levelling concrete	m3	1	10.25	10	37.49	37	48
	8) Bamboo pile, 80mm dia., 3m, 20nos/m2	m	480	0.26	125	0.61	293	418
	9) Concrete Grade 300/20	m3	12	16.85	202	52.47	630	832
	10) Formwork	m2	86	0.57	49	16.27	1,399	1,448
	11) Reinforcement bar, deformed	kg	730	0.00	0	0.51	371	371
	12) Backfilling	m3	28	1.43	40	3.90	109	149
	13) Disposal to spoil area	m3	63	3.28	207	1.55	98	304
	14) Grating 1200mmx600mm	no	1	236.38	236	7.56	8	244
	15) Manhole cover, 600mm dia.	no	3	726.14	2,178	27.25	82	2,260
	16) Step, W=300mm	no	18	0.00	0	0.85	15	15
	17) R.C. pipe, 400mm dia.	m	1	0.00	0	15.68	16	16
	18) Asphalt pavement, t=50mm	m2	40	0.23	9	3.63	145	154
	19) Base course, t=150mm	m3	6	0.90	5	14.85	89	95
	20) Subbase course, t=200mm	m3	8	0.62	5	14.11	113	118
	21) Steel sheet pile, type III, L=10m	m2	0	39.89	0	7.86	0	0
	22) Waling and strut	m	0	7.99	0	8.93	0	0
	23) Miscellaneous, 5%	L.S	1		187		200	387
	Subtotal				3,919		4,205	8,124
5.50	Manhole pump 5							
	1) Care of water during construction	L.S	1	107.90	108	133.50	134	241
	2) Cutting of asphalt pavement	m	26	0.37	9	0.23	6	15
	3) Breaking and loading of asphalt pavement	m3	8	2.77	22	1.09	9	31
	4) Excavation of common soil	m3	60	9.55	573	7.81	469	1,042
	5) Soil improvement	m3	0	79.17	0	15.55	0	0
	6) Gravel bedding	m3	2	0.11	0	11.38	23	23

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	7) Levelling concrete	m3	1	10.25	10	37.49	37	48
	8) Bamboo pile, 80mm dia., 3m, 20nos/m2	m	480	0.26	125	0.61	293	418
	9) Concrete Grade 300/20	m3	12	16.85	202	52.47	630	832
	10) Formwork	m2	86	0.57	49	16.27	1,399	1,448
	11) Reinforcement bar, deformed	kg	730	0.00	0	0.51	371	371
	12) Backfilling	m3	30	1.43	43	3.90	117	160
	13) Disposal to spoil area	m3	68	3.28	223	1.55	105	328
	14) Grating 1200mmx600mm	no	1	236.38	236	7.56	8	244
	15) Manhole cover, 600mm dia.	no	3	726.14	2,178	27.25	82	2,260
	16) Step, W=300mm	no	18	0.00	0	0.85	15	15
	17) R.C. pipe, 400mm dia.	m	1	0.00	0	15.68	16	16
	18) Asphalt pavement, t=50mm	m2	40	0.23	9	3.63	145	154
	19) Base course, t=150mm	m3	6	0.90	5	14.85	89	95
	20) Subbase course, t=200mm	m3	8	0.62	5	14.11	113	118
	21) Steel sheet pile, type III, L=10m	m2	0	39.89	0	7.86	0	0
	22) Waling and strut	m	0	7.99	0	8.93	0	0
	23) Miscellaneous, 5%	L.S	1		190		203	393
	Subtotal				3,989		4,262	8,252
5.60	Manhole pump 1, mechanical & electrical equipment							
	1) Vertical detachable submersible pump,							
	150mm dia.,3m3/min,5m,5.5kw	set	2	7,055.00	14,110	218.00	436	14,546
	2) Check valve, 150mm dia.	set	2	4,409.00	8,818	137.00	274	9,092
	3) Gate valve, 150mm dia.	set	2	2,646.00	5,292	82.00	164	5,456
	4) Steel pipe, 150mm-200mm dia.	L.S	1	7,055.00	7,055	218.00	218	7,273
	5) Screen, W400mmxH400mm	set	1	3,528.00	3,528	109.00	109	3,637
	6) Electrical equipment and control panel	set	1	8,819.00	8,819	273.00	273	9,092
	Subtotal				47,622		1,474	49,096
5.70	Manhole pump 2, mechanical & electrical equipment							
	1) Vertical detachable submersible pump,							
	80mm dia.,0.6m3/min,5m,1.5kw	set	2	5,291.00	10,582	164.00	328	10,910
	2) Check valve, 80mm dia.	set	2	1,764.00	3,528	55.00	110	3,638

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	3) Gate valve, 80mm dia.	set	2	882.00	1,764	27.00	54	1,818
	4) Steel pipe, 80mm-125mm dia.	L.S	1	2,646.00	2,646	82.00	82	2,728
	5) Screen, W300mmxH300mm	set	1	2,646.00	2,646	82.00	82	2,728
	6) Electrical equipment and control panel	set	1	8,819.00	8,819	273.00	273	9,092
	Subtotal				29,985		929	30,914
5.80	Manhole pump 3, mechanical & electrical equipment							
	1) Vertical detachable submersible pump,							
	80mm dia.,0.6m3/min,3m,1.5kw	set	2	5,291.00	10,582	164.00	328	10,910
	2) Check valve, 80mm dia.	set	2	1,764.00	3,528	55.00	110	3,638
	3) Gate valve, 80mm dia.	set	2	882.00	1,764	27.00	54	1,818
	4) Steel pipe, 80mm-100mm dia.	L.S	1	2,646.00	2,646	82.00	82	2,728
	5) Screen, W300mmxH300mm	set	1	2,646.00	2,646	82.00	82	2,728
	6) Electrical equipment and control panel	set	1	8,819.00	8,819	273.00	273	9,092
	Subtotal				29,985		929	30,914
5.90	Manhole pump 4, mechanical & electrical equipment							
	1) Vertical detachable submersible pump,							
	100mm dia.,0.9m3/min,5.5m,3.7kw	set	2	5,732.00	11,464	178.00	356	11,820
	2) Check valve, 100mm dia.	set	2	2,205.00	4,410	68.00	136	4,546
	3) Gate valve, 100mm dia.	set	2	1,323.00	2,646	41.00	82	2,728
	4) Steel pipe, 100mm dia.	L.S	1	3,087.00	3,087	96.00	96	3,183
	5) Screen, W300mmxH300mm	set	1	2,646.00	2,646	82.00	82	2,728
	6) Electrical equipment and control panel	set	1	8,819.00	8,819	273.00	273	9,092
	Subtotal				33,072		1,025	34,097
5.10	Manhole pump 5, mechanical & electrical equipment							
	1) Vertical detachable submersible pump,							

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	125mm dia.,1.5m3/min,3m,7.5kw	set	2	6,173.00	12,346	191.00	382	12,728
	2) Check valve, 125mm dia.	set	2	3,528.00	7,056	109.00	218	7,274
	3) Gate valve, 125mm dia.	set	2	2,205.00	4,410	69.00	138	4,548
	4) Steel pipe, 125mm dia.	L.S	1	4,409.00	4,409	137.00	137	4,546
	5) Screen, W300mmxH300mm	set	1	2,646.00	2,646	82.00	82	2,728
	6) Electrical equipment and control panel	set	1	8,819.00	8,819	273.00	273	9,092
	Subtotal				39,686		1,230	40,916
5.11	Installation and others							
	1) Packing, freight and insurance	L.S	1	31,605.00	31,605	0.00	0	31,605
	2) Installation works	L.S	1	11,155.00	11,155	26,028.00	26,028	37,183
	3) Guidance engineer	L.S	1	90,909.00	90,909	0.00	0	90,909
	Subtotal				133,669		26,028	159,697
	Total				358,089		60,541	418,631
6.00	An Da Relay Pumping Station							
6.10	Pumping house structure							
	1) Care of water during construction	L.S	1	1,079.00	1,079	1,335.00	1,335	2,414
	2) Steel sheet pile, type IV, L=10m	m2	490	55.83	27,357	8.64	4,234	31,590
	3) Waling and strut	m	98	7.99	783	40.43	3,962	4,745
	4) Clearing the site	m2	3,800	0.11	418	0.05	190	608
	5) Embankment	m3	5,270	0.48	2,530	2.16	11,383	13,913
	6) Excavation of common soil	m3	3,110	0.76	2,364	0.43	1,337	3,701
	7) Disposal to spoil area	m3	3,110	3.28	10,201	1.55	4,821	15,021
	8) Soil improvement	m3	924	10.68	9,868	1.98	1,830	11,698
	9) Supply of precast R.C. pile, 300mmx300mm							
	6m	m	336	0.89	299	31.47	10,574	10,873
	10) Driving concrete pile,300mmx300mm, 6m	m	336	13.28	4,462	2.76	927	5,389
	11) Pile test	no	2	1,785.00	3,570	1,785.00	3,570	7,140
	12) Gravel bedding	m3	55	0.11	6	11.38	626	632
	13) Levelling concrete	m3	19	10.25	195	37.49	712	907
	14) Concrete Grade 300/20	m3	428	16.85	7,212	52.47	22,457	29,669
	15) Formwork	m2	1,680	0.57	958	16.27	27,334	28,291
	16) Reinforcement bar, deformed	kg	34,240	0.00	0	0.51	17,394	17,394
	17) Scaffolding	m2	547	3.64	1,991	1.84	1,006	2,998
	18) Steel supporting	m3	265	0.00	0	5.40	1,431	1,431
	19) R.C. pipe ,1100mm dia.	m	30	9.21	276	59.42	1,783	2,059
	20) Miscellaneous, 5%	L.S	1		3,678		5,845	9,524

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	Subtotal				77,246		122,751	199,997
6.20	Pumping house building and others							
	1) Control building	m2	42	63.75	2,678	191.25	8,033	10,710
	2) House for guard	m2	30	63.75	1,913	191.25	5,738	7,650
	3) Miscellaneous, 5%	L.S	1		230		689	918
	Subtotal				4,820		14,459	19,278
6.30	Pumping house yard							
	1) Plant trees	m2	3,200	0.00	0	4.00	12,800	12,800
	2) Fence	m	250	6.45	1,613	6.92	1,730	3,343
	3) Gate	no	1	46.13	46	85.00	85	131
	4) Lighting	no	5	2,060.00	10,300	412.00	2,060	12,360
	5) Asphalt pavement, t=50mm	m2	210	0.23	48	3.63	762	811
	6) Base course, t=150mm	m3	32	0.90	28	14.85	468	496
	7) Subbase course, t=200mm	m3	42	0.62	26	14.11	593	619
	8) U flume, W300mm	m	140	9.81	1,373	34.92	4,889	6,262
	9) Miscellaneous, 5%	L.S	1		672		1,169	1,841
	Subtotal				14,106		24,556	38,662
6.40	Mechanical equipment							
	1) Horizontal shaft sewage pump and motor							
	300mm dia.,11m3/min,5.5m,18.5kw	set	4	44,091.00	176,364	1,364.00	5,456	181,820
	2) Check valve,delivery,300mm dia.	set	4	7,055.00	28,220	218.00	872	29,092
	3) Sluice valve,suction and delivery,300mm dia.	set	8	3,968.00	31,744	123.00	984	32,728
	4) Steel pipe,300mm-700mm dia.	L.S	1	18,182.00	18,182	546.00	546	18,728
	5) Gate, W800mmxH800mm	set	1	26,455.00	26,455	818.00	818	27,273
	6) Screen, W800mmxH800mm	set	1	8,818.00	8,818	273.00	273	9,091
	7) Chain block, 1t, manual operation	set	1	17,637.00	17,637	545.00	545	18,182
	Subtotal				307,420		9,494	316,914
6.50	Electrical equipment							
	1) Transformer, 150kva	set	1	11,464.00	11,464	355.00	355	11,819
	2) Incoming panel	set	1	26,455.00	26,455	818.00	818	27,273
	3) Control panel	set	2	22,046.00	44,092	682.00	1,364	45,456
	4) Local panel	set	4	8,818.00	35,272	273.00	1,092	36,364
	Subtotal				117,283		3,629	120,912

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
6.60	Installation and others							
	1) Packing, freight and insurance	L.S	1	72,328.00	72,328	0.00	0	72,328
	2) Installation works	L.S	1	25,528.00	25,528	59,564.00	59,564	85,092
	3) Guidance engineer	L.S	1	72,727.00	72,727	0.00	0	72,727
	Subtotal				170,583		59,564	230,147
	Total				691,458		234,452	925,910
7.00	West Wastewater Treatment Plant							
7.10	Pumping station							
	1) Care of water during construction	L.S	1	1,618.50	1,619	2,002.50	2,003	3,621
	2) Steel sheet pile, type IV, L=10m	m2	830	64.48	53,518	9.07	7,528	61,047
	3) Waling and strut	m	166	7.99	1,326	57.93	9,616	10,943
	4) Excavation of common soil	m3	5,150	0.76	3,914	0.43	2,215	6,129
	5) Backfilling	m3	5,200	1.43	7,436	3.90	20,280	27,716
	6) Disposal to spoil area	m3	5,150	3.28	16,892	1.55	7,983	24,875
	7) Supply of precast R.C. pile, 300mmx300mm 6m	m	540	0.89	481	31.47	16,994	17,474
	8) Driving concrete pile, 300mmx300mm, 6m	m	540	13.28	7,171	2.76	1,490	8,662
	9) Pile testing	nos	2	1,785.00	3,570	1,785.00	3,570	7,140
	10) Soil improvement	m3	1,520	10.68	16,234	1.98	3,010	19,243
	11) Gravel bedding	m3	70	0.11	8	11.38	797	804
	12) Levelling concrete	m3	24	10.25	246	37.49	900	1,146
	13) Concrete Grade 300/20	m3	570	16.85	9,605	52.47	29,908	39,512
	14) Formwork	m2	2,100	0.57	1,197	16.27	34,167	35,364
	15) Reinforcement bar, deformed	kg	45,000	0.00	0	0.51	22,860	22,860
	16) Scaffolding	m2	1,430	3.64	5,205	1.84	2,631	7,836
	17) Steel supporting	m3	380	0.00	0	5.40	2,052	2,052
	18) Control building	m2	54	63.75	3,443	191.25	10,328	13,770
	19) Miscellaneous, 5%	L.S	1		6,593		8,916	15,510
	Subtotal				138,457		187,246	325,703
7.20	Aerated lagoon treatment process (AL)							
	1) Care of water during construction	L.S	1	701.35	701	867.75	868	1,569
	2) Excavation of common soil	m3	12,800	0.76	9,728	0.43	5,504	15,232
	3) Disposal to spoil area	m3	12,800	3.28	41,984	1.55	19,840	61,824
	4) Soil stabilization,t=300mm	m3	12,800	10.68	136,704	1.98	25,344	162,048
	5) Trimming of pond bottom	m2	31,100	0.02	622	0.02	622	1,244
	6) Protection of bottom, concrete, t=100mm	m3	1,040	14.23	14,799	47.94	49,858	64,657

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	7) Protection of bottom, gravel bedding, t=150mm	m3	1,560	0.11	172	11.38	17,753	17,924
	8) Trimming of slope	m2	12,800	0.07	896	0.59	7,552	8,448
	9) Riprap stone	m2	1,640	0.00	0	11.85	19,434	19,434
	10) Inlet works							
	a) Gravel bedding	m3	10	0.11	1	11.38	109	110
	b) Levelling concrete	m3	5	10.25	49	37.49	180	229
	c) Concrete Grade 300/20	m3	26	16.85	445	52.47	1,385	1,830
	d) Formwork	m2	160	0.57	91	16.27	2,603	2,694
	e) Reinforcement bar, deformed	kg	1,040	0.00	0	0.51	528	528
	f) Stoplog, W400mmxH1000mm	nos	8	1,113.00	8,904	191.00	1,528	10,432
	11) Outlet works							
	a) Gravel bedding	m3	10	0.11	1	11.38	109	110
	b) Levelling concrete	m3	5	10.25	49	37.49	180	229
	c) Concrete Grade 300/20	m3	26	16.85	445	52.47	1,385	1,830
	d) Formwork	m2	160	0.57	91	16.27	2,603	2,694
	e) Reinforcement bar, deformed	kg	1,040	0.00	0	0.51	528	528
	f) Stoplog, W400mmxH1000mm	nos	8	1,113.00	8,904	191.00	1,528	10,432
	12) Access slope, concrete,t=200mm	m3	168	16.85	2,831	52.47	8,815	11,646
	13) Miscellaneous, 5%	L.S	1		11,371		8,413	19,784
	Subtotal				238,788		176,670	415,458
7.30	Settling pond							
	1) Care of water during construction	L.S	1	2,643.55	2,644	3,270.75	3,271	5,914
	2) Excavation of common soil	m3	49,000	0.76	37,240	0.43	21,070	58,310
	3) Disposal to spoil area	m3	49,000	3.28	160,720	1.55	75,950	236,670
	4) Soil stabilization,t=300mm	m3	8,200	10.68	87,576	1.98	16,236	103,812
	5) Trimming of pond bottom	m2	22,000	0.02	440	0.02	440	880
	6) Trimming of slope	m2	5,800	0.07	406	0.59	3,422	3,828
	7) Riprap stone	m2	1,300	0.00	0	11.85	15,405	15,405
	8) Inlet works							
	a) Gravel bedding	m3	10	0.11	1	11.38	109	110
	b) Levelling concrete	m3	5	10.25	49	37.49	180	229
	c) Concrete Grade 300/20	m3	26	16.85	445	52.47	1,385	1,830
	d) Formwork	m2	160	0.57	91	16.27	2,603	2,694
	e) Reinforcement bar, deformed	kg	1,040	0.00	0	0.51	528	528
	f) Stoplog, W400mmxH1000mm	nos	8	1,113.00	8,904	191.00	1,528	10,432
	9) Outlet works							
	a) Gravel bedding	m3	10	0.11	1	11.38	109	110
	b) Levelling concrete	m3	5	10.25	49	37.49	180	229

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	c) Concrete Grade 300/20	m3	26	16.85	445	52.47	1,385	1,830
	d) Formwork	m2	160	0.57	91	16.27	2,603	2,694
	e) Reinforcement bar, deformed	kg	1,040	0.00	0	0.51	528	528
	f) Stoplog, W400mmxH1000mm	nos	8	1,113.00	8,904	191.00	1,528	10,432
	12) Access slope, concrete,t=200mm	m3	96	16.85	1,618	52.47	5,037	6,655
	13) Miscellaneous, 5%	L.S	1		15,481		7,675	23,156
	Subtotal				325,105		161,174	486,279
7.40	Chlorination tank							
	1) Care of water during construction	L.S	1	215.80	216	267.00	267	483
	2) Excavation of common soil	m3	500	0.76	380	0.43	215	595
	3) Backfilling	m3	200	1.43	286	3.90	780	1,066
	4) Disposal to spoil area	m3	250	3.28	820	1.55	388	1,208
	5) Bamboo pile, 80mm dia., 3m, 20nos/m2	m	58,800	0.52	30,576	2.12	124,656	155,232
	6) Gravel bedding	m3	200	0.11	22	11.38	2,276	2,298
	7) Levelling concrete	m3	100	10.25	1,025	37.49	3,749	4,774
	8) Concrete Grade 300/20	m3	520	16.85	8,762	52.47	27,284	36,046
	9) Formwork	m2	1,960	0.57	1,117	16.27	31,889	33,006
	10) Reinforcement bar	kg	31,200	0.00	0	0.51	15,850	15,850
	11) Miscellaneous, 5%	L.S	1		2,160		10,368	12,528
	Subtotal				45,364		217,721	263,086
7.50	Stormwater sedimentation pond							
	1) Care of water during construction	L.S	1	258.96	259	320.40	320	579
	2) Excavation of common soil	m3	4,700	0.76	3,572	0.43	2,021	5,593
	3) Disposal to spoil area	m3	4,700	3.28	15,416	1.55	7,285	22,701
	4) Soil stabilization,t=300mm	m3	1,400	10.68	14,952	1.98	2,772	17,724
	5) Trimming of pond bottom	m2	4,700	0.02	94	0.02	94	188
	6) Trimming of slope	m2	1,300	0.07	91	0.59	767	858
	7) Riprap stone	m2	1,300	0.00	0	11.85	15,405	15,405
	8) Inlet works							
	a) Gravel bedding	m3	2	0.11	0	11.38	19	20
	b) Levelling concrete	m3	1	10.25	9	37.49	34	43
	c) Concrete Grade 300/20	m3	6	16.85	101	52.47	315	416
	d) Formwork	m2	36	0.57	21	16.27	586	606
	e) Reinforcement bar, deformed	kg	240	0.00	0	0.51	122	122
	9) Outlet works							
	a) Gravel bedding	m3	2	0.11	0	11.38	19	20
	b) Levelling concrete	m3	1	10.25	9	37.49	34	43
	c) Concrete Grade 300/20	m3	6	16.85	101	52.47	315	416

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	d) Formwork	m2	36	0.57	21	16.27	586	606
	e) Reinforcement bar, deformed	kg	240	0.00	0	0.51	122	122
	12) Access slope, concrete,t=200mm	m3	24	16.85	404	52.47	1,259	1,664
	13) Miscellaneous, 5%	L.S	1		1,753		1,604	3,356
	Subtotal				36,803		33,679	70,481
7.60	Sludge drying bed							
	1) Care of water during construction	L.S	1	107.90	108	133.50	134	241
	2) Excavation of common soil	m3	1,600	0.76	1,216	0.43	688	1,904
	3) Backfilling	m3	800	1.43	1,144	3.90	3,120	4,264
	4) Disposal to spoil area	m3	1,600	3.28	5,248	1.55	2,480	7,728
	4) Soil stabilization,t=150mm	m3	6,800	10.68	72,624	1.98	13,464	86,088
	5) Trimming of bed	m2	45,000	0.02	900	0.02	900	1,800
	6) Gravel bedding	m3	410	0.11	45	11.38	4,666	4,711
	7) Concrete Grade 300/20	m3	1,530	16.85	25,781	52.47	80,279	106,060
	9) Formwork	m2	8,600	0.57	4,902	16.27	139,922	144,824
	10) Reinforcement bar, deformed	kg	61,200	0.00	0	0.51	31,090	31,090
	11) Coarse sand	m3	6,800	0.11	748	11.38	77,384	78,132
	12) Fine gravel	m3	9,000	0.11	990	11.38	102,420	103,410
	13) Coarse gravel	m3	320	0.11	35	11.38	3,642	3,677
	14) Perforated pipe,150mm dia.	m	3,500	12.31	43,085	2.19	7,665	50,750
	15) R.C. pipe, 200mm dia.	m	1,700	0.00	0	3.68	6,256	6,256
	16) Miscellaneous, 5%				7,841		23,705	31,547
	Subtotal				164,667		497,814	662,481
7.70	Building works							
	1) Operation building	m2	640	63.75	40,800	191.25	122,400	163,200
	2) Pump station building	m2	60	63.75	3,825	191.25	11,475	15,300
	3) O&M machine building	m2	240	63.75	15,300	191.25	45,900	61,200
	4) Electric panel house for AL	m2	40	63.75	2,550	191.25	7,650	10,200
	5) Sludge pump maintenance house	m2	40	63.75	2,550	191.25	7,650	10,200
	6) Building for chlorination	m2	20	63.75	1,275	191.25	3,825	5,100
	7) House for watchmen	m2	30	63.75	1,913	191.25	5,738	7,650
	8) Miscellaneous, 5%	L.S	1		3,411		10,232	13,643
	Subtotal				71,623		214,869	286,493
7.80	Splitter chamber							
	1) Care of water during construction	L.S	1	107.90	108	133.50	134	241
	2) Excavation of common soil	m3	50	0.76	38	0.43	22	60
	3) Backfilling	m3	10	1.43	14	3.90	39	53
	4) Disposal to spoil area	m3	50	3.28	164	1.55	78	242

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	5) Bamboo pile, 80mm dia., 3m, 20nos/m2	m	1,200	0.26	312	0.61	732	1,044
	6) Gravel bedding	m3	6	0.11	1	11.38	68	69
	7) Levelling concrete	m3	2	10.25	21	37.49	75	95
	8) Concrete Grade 300/20	m3	16	16.85	270	52.47	840	1,109
	9) Formwork	m2	110	0.57	63	16.27	1,790	1,852
	10) Reinforcement bar	kg	640	0.00	0	0.51	325	325
	11) Miscellaneous, 5%	L.S	1		49		205	255
	Subtotal				1,039		4,306	5,345
7.90	Gate of outfall							
	1) Care of water during construction	L.S	1	107.90	108	133.50	134	241
	2) Steel sheet pile, type III, L=10m	m2	150	39.89	5,984	7.86	1,179	7,163
	3) Waling and strut	m	15	7.99	120	8.93	134	254
	4) Gravel bedding	m3	5	0.11	0	11.38	51	52
	5) Levelling concrete	m3	2	10.25	24	37.49	86	110
	6) Concrete Grade 300/20	m3	12	16.85	209	52.47	651	860
	7) Formwork	m2	75	0.57	43	16.27	1,220	1,263
	8) Reinforcement bar, deformed	kg	488	0.00	0	0.51	248	248
	9) Stoplog, W1500mmxH1500mm	no	1	6,260.00	6,260	1,074.00	1,074	7,334
	10) Sluice gate, W1500mmXH1500mm	no	1	17,037.00	17,037	527.00	527	17,564
	11) Miscellaneous, 5%	L.S	1		1,489		265	1,754
	Subtotal				31,273		5,569	36,842
7.10	Wastewater treatment yard							
	1) Plant trees	m2	20,500	0.00	0	4.00	82,000	82,000
	2) Fence	m	1,720	6.45	11,094	6.92	11,902	22,996
	3) Gate	no	1	46.13	46	85.00	85	131
	4) Lighting	no	5	2,060.00	10,300	412.00	2,060	12,360
	5) Asphalt pavement, t=50mm	m2	3,400	0.23	782	3.63	12,342	13,124
	6) Base course, t=150mm	m3	510	0.90	459	14.85	7,574	8,033
	7) Subbase course, t=200mm	m3	680	0.62	422	14.11	9,595	10,016
	8) U flume, W300mm	m	1,800	9.81	17,658	34.92	62,856	80,514
	9) R.C. pipe, 300mm dia.	m	1,800	0.00	0	6.08	10,944	10,944
	10) Embankment	m3	17,000	0.48	8,160	2.16	36,720	44,880
	11)Turfing	m2	10,400	0.00	0	2.95	30,680	30,680
	12) Miscellaneous, 5%	L.S	1		2,446		13,338	15,784
	Subtotal				51,367		280,096	331,462
7.11	Operation and maintenance equipment							

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	1) Lawn tractor, 50ps	no	1	31,182.00	31,182	935.00	935	32,117
	2) Swamp bulldozer, 13ton	no	1	100,527.00	100,527	3,109.00	3,109	103,636
	3) Swamp tractor shovel,0.8m3	no	1	57,671.00	57,671	1,784.00	1,784	59,455
	4) Dump truck, 10t	no	1	82,450.00	82,450	2,550.00	2,550	85,000
	5) Wastewater examination equipment	L.S	1	136,364.00	136,364	4,091.00	4,091	140,455
	6) Spare parts for above items	L.S	1		40,820		1,247	42,067
	Subtotal				449,014		13,716	462,730
7.12	Equipment for screenings							
	1) Rack rake, automatic, W800mmxH2800mm	set	2	111,109.60	222,219	3,436.30	6,873	229,092
	2) Belt conveyor, W600mm,L15m	set	1	92,591.10	92,591	2,777.60	2,778	95,369
	3) Carrier,0.3m3	set	1	91,356.30	91,356	2,825.20	2,825	94,182
	4) Hopper,6m3	set	1	135,800.00	135,800	4,200.00	4,200	140,000
	5) Gate, W800mmxH800mmxL7600mm	set	6	18,518.50	111,111	572.60	3,436	114,547
	6) Stoplog, W1500mmxH1500mm	set	6	4,321.10	25,927	133.70	802	26,729
	7) Vertical shaft centrifugal pump, 600mm 45.1m3/min,9.3m,110kw	set	1	222,218.50	222,219	6,872.60	6,873	229,091
	8) Vertical shaft centrifugal pump, 400mm 22.5m3/min,9.3m,55kw	set	2	135,800.00	271,600	4,200.00	8,400	280,000
	9) Overhead crane	set	1	92,591.10	92,591	2,863.70	2,864	95,455
	Subtotal				1,172,823		36,186	1,209,009
7.13	Equipment for grit chamber							
	1) Rack rake, automatic, W800mmxH2800mm	set	2	111,109.60	222,219	3,436.30	6,873	229,092
	2) Belt conveyor, W600mm,L15m	set	1	92,591.10	92,591	2,777.60	2,778	95,369
	3) Carrier,0.3m3	set	1	91,356.30	91,356	2,825.20	2,825	94,182
	4) Hopper,6m3	set	1	135,800.00	135,800	4,200.00	4,200	140,000
	5) Gate, W800mmxH800mmxL7600mm	set	6	18,518.50	111,111	572.60	3,436	114,547
	6) Grit collector	set	1	154,318.50	154,319	4,772.60	4,773	159,091
	Subtotal				807,396		24,884	832,280
7.14	Equipment for aerated lagoon							
	1) Aerator,55kw	set	32	101,232.60	3,239,443	3,131.10	100,195	3,339,638
	2) Gate, W400mmxH400mm	set	8	2,037.00	16,296	63.00	504	16,800
	Subtotal				3,255,739		100,699	3,356,438

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
7.15	Equipment for settling pond							
	1) Dredge pump, 1.3m3/min,20m,7.5kw	set	1	47,530.00	47,530	1,470.00	1,470	49,000
	2) Gate, W400mmxH400mm	set	8	2,037.00	16,296	63.00	504	16,800
	Subtotal				63,826		1,974	65,800
7.16	Equipment for chlorination tank							
	1) Storage tank, 5m3	set	2	13,456.80	26,914	416.50	833	27,747
	2) Pump, 32lit/h,2kgf/cm2	set	4	4,074.00	16,296	126.00	504	16,800
	Subtotal				43,210		1,337	44,547
7.17	Piping							
	1) Ductile cast iron pipe,150mm-1000mm dia.	L.S	1	228,391.10	228,391	7,063.70	7,064	235,455
	2) R.C. pipe,400mm-1100mm dia.	L.S	1	265,427.40	265,427	8,208.90	8,209	273,636
	Subtotal				493,819		15,273	509,091
7.18	Electrical equipment							
	1) Transformer,500kva	set	1	38,579.80	38,580	1,193.50	1,194	39,773
	2) Generator,500kva	set	1	146,602.40	146,602	4,533.90	4,534	151,136
	3) Incoming panel	set	1	18,518.50	18,519	572.60	573	19,091
	4) Control panel	set	3	15,432.20	46,297	477.40	1,432	47,729
	5) Local panel	set	35	6,172.60	216,041	191.10	6,689	222,730
	6) Wiring and others	L.S	1	185,182.20	185,182	5,727.40	5,727	190,910
	Subtotal				651,221		20,148	671,369
7.19	Installation and others							
	1) Packing, freight and insurance	L.S	1	903,636.30	903,636	0.00	0	903,636
	2) Installation works	L.S	1	420,000.00	420,000	980,000.00	980,000	1,400,000
	3) Guidance engineer	L.S	1	636,363.70	636,364	0.00	0	636,364
	Subtotal				1,960,000		980,000	2,940,000
	Total				10,001,533		2,973,360	12,974,893
8.00	Supplementary works							
	1) Construction of precast R.C. pipe, 300mm	m	10,000	72.50	725,000	72.50	725,000	1,450,000
	2) Construction of precast R.C. pipe, 400mm	m	5,000	85.50	427,500	85.50	427,500	855,000
	3) Construction of precast R.C. pipe, 500mm	m	3,000	131.00	393,000	131.00	393,000	786,000

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
	4) Construction of precast R.C. pipe, 700mm	m	2,000	187.00	374,000	187.00	374,000	748,000
	5) Manhole	nos	270	734.00	198,180	734.00	198,180	396,360
	6) Manhole type pump	nos	5	23,621.00	118,105	23,621.00	118,105	236,210
	Total				2,235,785		2,235,785	4,471,570
	Total				35,026,410		15,327,328	50,355,060

Table D.3 Construction and Procurement Costs for Solid Waste Management Priority Project

No	Description	Unit	Quantity	F.C. Portion(US$)		L.C. Portion(US$)		Total(US$)
				Unit	Amount	Unit	Aount	
1.00	Waste Collection and Transport System							
	1) Procurement of collection vehicles, bins, handcarts and work shop equipment	L.S	1	3907000	3907000	0	0	3907000
	Subtotal				3907000		0	3907000
2.00	Trang Cat New Landfill Site							
	1) Civil works of Trang Cat new landfill site	L.S	1	3299000	3299000	3299000	3299000	6598000
	2) Procurement of heavy equipment	L.S	1	1411800	1411800	0	0	1411800
	Subtotal				4710800		3299000	8009800
3.00	Hospital Waste Treatment							
	1) Procurement of incineration plant	set	1	263000	263000	0	0	263000
	2) Site preparation and building	L.S	1	0	0	87000	87000	87000
	3) Procurement of medical waste collection vehicles	L.S	1	76000	76000	0	0	76000
	Subtotal				339000		87000	426000
	Total				8956800		3386000	12342800