APPENDIX-12

COST ESTIMATES

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A12.1 INTRODUCTION

This appendix is prepared to show the bases of the cost estimates explained in 13.6 Project Cost (Main Report, Master Plan). Summaries and break downs of the capital investments, operation & maintenance costs and the unit costs used in the cost estimations are shown in the following tables.

A12.2 CAPITAL INVESTMENT

The capital investment, direct construction costs, and its further breakdown for the Master Plan are shown in Table A12.1 to A12.3. The capital investment, direction construction costs for the improvement of the existing sewerage system are shown in Table A12.4 to A12.5. The capital investment, direction construction costs and its further breakdowns for the development of the proposed new sewerage system are shown in Table A12.6 to A12.10. The disbursement schedule of the MP and its breakdowns, and direct construction costs for the major sewers of the central system and rehabilitation of the inadequate existing collectors are shown in Table A12.11 to A12.16. Estimated unit construction costs of sewer mains are shown in Table A12.17 to A12.61. In these, renewal piping woks are estimated to be new piping on Table 12.52 and Table12.55. Construction costs for exact renewal piping woks are more expensive based on Japanese costs than new piping works. Therefore it is better to construct new pipe.
The construction costs of pumping stations assorted into civil, build, mechanical and electronic works are shown in Table A12.62 to A12.66. The construction costs of Luyanó WWTP are shown in Table A12.67 to A12.76.

A12.3 SETTING OF THE CONDITION FOR THE ESTIMATE OF PIPING WORKS

1.Geological feature

Geological feature in the study area is set as fine grained soil from the surface of the earth to 3.0 m depth and soft rock derived from shelf of coral lower of 3.0m considering result of hearing. Drainage is necessary for the reclaimed ground. And in the other places also drainage is thought to be necessary for shower on rainy days. So the drainage is set to need a half of quantity (days) assumed in Japan.

2.Breaking and removal for pavement

Sewer is set under not only roadway also sidewalk. Considering pavement of sidewalk is thin, the thickness is set 0.20m including thin asphalt and concrete below it.

3.Excavation and earth retaining

Now wall is not used to be expensive in Cuba. But the cost of wall will become cheaper as piping works increase and materials for temporary are used frequently here and there.
Fine grained soil belong 3.0m thickness from earth surface is excavated by backhoe, at once wood wall is set into both side of the ditch. Flat places 0.50m width are made at 3.0m depth on soft rock under 3.0m depth. Soft rock is broken by breaker instead of bucket of backhoe, dipped up by backhoe with bucket and loaded to dump truck. earth retaining is not used for soft rock, but considering the case of fine grained soil, earth retaining is set following.

Wood wall 50% width is used for 20% of total works length between 3.0m and 4.0m depth from earth face.
Wood wall 50% width is used for 10% of total works length, lower range from 4.0m.
The thickness of wood wall is 0.05m and wale thickness is 0.15m.
Spare width in ditch are 0.15m a side till 1,800mm outer diameter and 0.20m a side over 1,800mm outer diameter.

4.Sorts of pipes

High density polyethylene pipe is used for sewer without problem on the structure till 1,200mm outer diameter. Centrifugal concrete pipes are not made in Cuba now. But they will become to be made and used for larger diameter pipes ,considering in Cuba, since piping works and the demand of the pipe will increase.
The unit price of the centrifugal concrete pipe produced in Cuba is set 70% cost of Japanese ones.
Main drainage pipes have large diameter and needed structural strength to be set in shallow depth, so centrifugal concrete pipes are used for all main drainage pipes.
Since pressure pipes have high inner pressure, ductile cast iron pipes are used for them, though they are importations, considering adaptation for water hammer and corrosion. The price is set for 80% of Japanese price.
Pipe jacking method has not been used in Cuba, so tunnel method will be used in the case of open cut method is unsuitable. And the least section to be feasible is made for the execution section of tunnel method, and complete diameter is 1,500mm. In the case which necessary section is pretty smaller than 1,500mm, the section is made adding invert made of plain concrete.

5.Manhole

Now concrete products are not produced in Cuba. And two kind of manhole types are established for sewer in Cuba. One type is set standing concrete pipe on base concrete cast on site and put a circular slab made separately with iron lid on the top of the pipe.
Another type is classified under 3 size square substructure with 1,500mm, 1,700mm or 1,850mm side length. In addition these types are classified under 2 case on structure, one’s wall with appropriate height is cast concrete on site, another wall is set concrete blocks for build. Then a square slab made separately are put on them.
And concrete pipe is stood on the slab and also put a circular slab with iron lid on the top of the pipe.
As sewer works frequently are executed, the concrete products factory are built, and manhole is built constructing with them on site. But now there are not the concrete product, so manhole is estimated being built on site using abovementioned method with walls cast concrete on site.

6.Temporary yard for dug soil

Temporary yard for dug soil is put near the site. Since the mean distance between the yard and the site is 1km least now, so it is set at the place 2km away from the site being on the safe side. There the soil is not leveled because it is temporary.

7.Clearing surplus soil out

The place of clearing surplus soil out is appointed by Habana city agency, there is the point 25km away from center of city now. In future the place is not clear, it is set similar distance 25km away. There the soil is leveled because it is surplus soil.

8.Filling soil back

Filling soil back is executed stepping following 3 steps.

Step 1：Crashed soft rock is thrown down into the ditch by manpower from upper face of foundation to the height 0.30m above the top of pipe and compacted by manpower, and then bound by water .

Step 2：About the zone from 3.0m under earth face to the height 0.30m above the top of pipe, soft rock which is generated soil is crashed and thrown down by backhoe and tamped by tamper.

Step3： About the zone from earth face to 3.0m under excepting pavement zone 0.40m, soil is thrown down by machine and tamped by tamper. If there is rest soft rock, it primarily is used being crashed , and generated fine grained soil is set for the shortage. But considering there is soil not to be useful , 2/3 of the rest is set to apply, and purchasing soil is set for 1/3 of it.

9.The restoration of pavement

Crashed soft rock is strewn piled 0.20m thickness for foundation on the filling back soil and pressed by roller. Then concrete 0.15m thickness is put on that, middle density asphalt 35mm thickness is put, and high density asphalt 15mm thickness is put on them, so they are pavement 0.40m total thickness.

10.Pipe renewal works for Sur existing pipes

Sur existing pipes inner diameter are 1,950mm and 2,100mm. Pipe renewal works for them are set using the method of twisting renewal material around inner face of pipe, so the complete inner diameter become 1,750mm and 1,900mm.

Since this method is not executed now in Cuba, this method is not able to be estimated about Cuba. So this method is estimated for 90 % of setting new pipes for the case of Cuba, since in cases of Japan pipe renewal works for existing pipes cost is reported which is 70～80% of setting new pipes works. The inner diameter of new piping is set for 1,800mm for complete inner diameter 1,750mm,and 2,000mm for 1,900mm.

A12.4 SETTING OF THE CONDITION FOR THE ESTIMATE OF WASTE WATER TREATMENT PLANT (WWTP)WORKS AND PUMPING STATION(PS) WORKS

1.Treatment process of WWTP：conventional activated sludge process

2.Parts of works

Costs of works are calculated separating into 4 parts, civil, build, machine and electricity.

3.Civil

3-1 Basis of estimate

Civil works cost in principle is calculated multiplying amounts of materials and unit cost (include a part of common temporary works cost, site office expenses and head office expenses) calculated from PRECONS which is the standard estimate system in Cuba. This works cost for convenience is set as “Pure works

cost = direct works cost + common temporary works cost". The cost from PRECONS has a little total overhead charge. So the total overhead charge rates of this cost calculation is coincided with ones of Japanese estimate system considering the international bid. Therefore site office expenses is set for 25% of pure works cost, in addition head office expenses is set for 10% of the prime works cost, and total cost is the permanent works cost. But works costs for setting all sorts of lids, hardware, expansion joint and other small works are estimated multiplying the sub total and the rate. The sub total is calculated multiplying quantities and unit cost, and the coefficient is set considering from the result of other works examples.

3-2 Quantity

Quantities are terms taking off from design drawings directly and being multiplied concrete volume and coefficient led from the result of other works examples.

1） Terms taken off from design drawings directly

- Earth volume
- Foundation volume
- Concrete volume
- Scaffolding volume
- Timbering volume of digestion tank

2） Terms calculated from interrelation between concrete volume and themselves

- Reinforcement weight
- Form square measure
- Timbering volume (It is calculated as floor space dividing empty volume by mean height since it is calculated as floor space in PRECONS).

4.Build works

There are not cases of build works like control building or machine building of WWTP and PS in Cuba. So the data of works costs for WWTP and PS build works are not gotten. The data of works cost for rare office buildings show 250～400 USD/m^2 in case of 2.4～2.5m height. This is calculated on 100～167USD/empty m^3. Cuban buildings generally have slim structural members like posts and beams since earthquake has not occurred in Cuba, and have the bare inner and outer packing. But the objective machine buildings like blower building and dewatering machine building have large spans, massive posts and beams being demanded strength per area on the structure. And they are set ventilator and air conditioner for important utility, and inner and outer packing are demanded durability. So these buildings are spend larger costs than general office ones. Considering upper circumstances synthetically, the build works cost for WWTP and PS machine building in Cuba is set for 200USD/ empty m^3.

5.Machine works

The permanent works cost for machine works of WWTP and PS in Cuba is set for 60% of Japanese cost calculated for the total cost (include overhead expenses) with machine cost, and installation and piping works cost.

6.Electrical works

The permanent works cost for electrical works of WWTP in Cuba is set for 70% of Japanese cost calculated for the total cost (include overhead expenses) with machine

cost, and installation and cabling and wiring works cost. And the rate is set for 65% about PS works.

A12.5 OPERATION AND MENTENANCE COST

The annual operation and maintenance costs for the Master Plan are shown in Table A12.77. The necessary personnel numbers and personnel costs in headquarters and site offices for the proposed new sewer district development after each stage of the Master Plan are shown in A12.78 to A12.89. The operation costs of the pumping stations are shown in Table A12.90 to 91. The operational costs of Luyanó WWTP are shown in Table A12.92 to 103.

Table A12. 1 Capital Investment

(FC: US$, LC: Cuban Pesos)

		Rate %	First Stage		Second Stage		Third Stage		Master Plan	
			FC	LC	FC	LC	FC	LC	FC	LC
Direct Construction Cost	New Construction Works		36,965,000	22,830,000	29,857,000	17,295,000	27,497,000	17,011,000	94,319,000	57,136,000
	Rehabilitation Works		6,178,000	3,765,000	4,309,000	3,016,000	3,426,000	2,284,000	13,913,000	9,065,000
	Total of Direct Construction Cost		43,143,000	26,595,000	34,166,000	20,311,000	30,923,000	19,295,000	108,232,000	66,201,000
Indirect Construction Cost	Land Acquisition and Conpensation		0	0	0	0	0	0	0	0
	Administrative Expenses	3.0	0	798,000	0	609,000	0	579,000	0	1,986,000
	Engineering Services								0	0
	New Sewerage	10.0	3,697,000		2,986,000		2,750,000		9,433,000	0
		10.0		2,283,000		1,730,000		1,701,000	0	5,714,000
	Rehabilitation,Improvement of work	12.0	741,000		517,000		411,000		1,669,000	0
		12.0		452,000		362,000		274,000	0	1,088,000
	Sub-total		4,438,000	2,735,000	3,503,000	2,092,000	3,161,000	1,975,000	11,102,000	6,802,000
	Physical Contingency	10.0	4,314,000	2,660,000	3,417,000	2,031,000	3,092,000	1,930,000	10,823,000	6,621,000
	Total		8,752,000	6,193,000	6,920,000	4,732,000	6,253,000	4,484,000	21,925,000	15,409,000
Total Project Cost			51,895,000	32,788,000	41,086,000	25,043,000	37,176,000	23,779,000	130,157,000	81,610,000

Table A12. 2 Direct Construction Cost

(FC: US$, LC: Cuban Pesos)

				First Stage		Second Stage		Third Stage		Master Plan	
				FC	LC	FC	LC	FC	LC	FC	LC
Sewers	N	New Sewers in Luyano-Martin Perez Abajo Sewer District		23,964,000	15,976,000	14,765,000	9,843,000	21,281,000	14,187,000	60,010,000	40,006,000
	N	Central Sewerage System	Colector Sur Nuebo	1,003,000	668,000	0	0	0	0	1,003,000	668,000
	N		Pumped Main	976,000	650,000	0	0	0	0	976,000	650,000
	N		Interconnection	1,160,000	773,000	0	0	0	0	1,160,000	773,000
	R		Cross Connection	3,480,000	2,320,000	1,357,000	904,000	2,400,000	1,600,000	7,237,000	4,824,000
	R		Inadequate sewers	0	0	822,000	548,000	1,026,000	684,000	1,848,000	1,232,000
	R		Colector Sur	0	0	1,956,000	1,304,000	0	0	1,956,000	1,304,000
	N		Colector Sur A	0	0	3,271,000	2,181,000	0	0	3,271,000	2,181,000
	N: New Installation Works			27,103,000	18,067,000	18,036,000	12,024,000	21,281,000	14,187,000	66,420,000	44,278,000
	R: Rehabilitation Works			3,480,000	2,320,000	4,135,000	2,756,000	3,426,000	2,284,000	11,041,000	7,360,000
	Total construction cost of sewers			30,583,000	20,387,000	22,171,000	14,780,000	24,707,000	16,471,000	77,461,000	51,638,000
WWTP	N	New WWTP for Luyano-Martin Perez Abajo Sewer District		6,891,000	3,273,000	7,709,000	3,614,000	6,216,000	2,824,000	20,816,000	9,711,000
Pumping Stations	N	Matadero Pumping Station		2,971,000	1,490,000					2,971,000	1,490,000
	R	Casablanca PS		2,508,000	1,358,000					2,508,000	1,358,000
	R	Screens at Caballeria		190,000	87,000					190,000	87,000
Improvement	R	Transmission Tunnel after Casabalanca PS				174,000	260,000			174,000	260,000
Facilities	N	Re-pumping Station at Chivo				2,212,000	1,182,000			2,212,000	1,182,000
	N	Replacement of Outfall Sewer				1,900,000	475,000			1,900,000	475,000
Construction Works	N: New Construction Works			36,965,000	22,830,000	29,857,000	17,295,000	27,497,000	17,011,000	94,319,000	57,136,000
	R: Rehabilitation Works			6,178,000	3,765,000	4,309,000	3,016,000	3,426,000	2,284,000	13,913,000	9,065,000
Total Direction Construction Cost				43,143,000	26,595,000	34,166,000	20,311,000	30,923,000	19,295,000	108,232,000	66,201,000

Table A12. 3 Breakdown of the Direct Construction Cost

(FC: US$, LC: Cuban Pesos)

	Components		First Stage		Second Stage		Third Stage		Sewerage MP	
			FC	LC	FC	LC	FC	LC	FC	LC
Sewers	Luyanó-Martín Pérez Colector		19,234,000	12,822,000	7,554,000	5,036,000	8,515,000	5,677,000	35,303,000	23,535,000
	Luyanó Left Colector		4,730,000	3,154,000	7,211,000	4,807,000	12,766,000	8,510,000	24,707,000	16,471,000
	Total in the Luyanó Martín Pérez Sewer District		23,964,000	15,976,000	14,765,000	9,843,000	21,281,000	14,187,000	60,010,000	40,006,000
	The Central Sewerage System	Colector Sur Nuebo	1,003,000	668,000	0	0	0	0	1,003,000	668,000
		Pumped Main	976,000	650,000	0	0	0	0	976,000	650,000
		Interconnection	1,160,000	773,000	0	0	0	0	1,160,000	773,000
		Cross connection	3,480,000	2,320,000	1,357,000	904,000	2,400,000	1,600,000	7,237,000	4,824,000
		Inadequate sewers	0	0	822,000	548,000	1,026,000	684,000	1,848,000	1,232,000
		Colector Sur	0	0	1,956,000	1,304,000	0	0	1,956,000	1,304,000
		Colector Sur A	0	0	3,271,000	2,181,000	0	0	3,271,000	2,181,000
	New construction works		27,103,000	18,067,000	18,036,000	12,024,000	21,281,000	14,187,000	66,420,000	44,278,000
	Rehabilitation works		3,480,000	2,320,000	4,135,000	2,756,000	3,426,000	2,284,000	11,041,000	7,360,000
	Total construction cost of sewers		30,583,000	20,387,000	22,171,000	14,780,000	24,707,000	16,471,000	77,461,000	51,638,000
Luyanó WWTP	Conventional Activated Sludge Process Anaerobic Digestion Mechanical Dewatering	Civil works	2,327,000	775,000	2,384,000	795,000	2,326,000	776,000	7,037,000	2,346,000
		Architectural works	68,000	46,000	573,000	382,000	0	0	641,000	428,000
		Mechanical works	2,290,000	981,000	3,069,000	1,315,000	2,290,000	981,000	7,649,000	3,277,000
		Electrical works	2,206,000	1,471,000	1,683,000	1,122,000	1,600,000	1,067,000	5,489,000	3,660,000
		Total	6,891,000	3,273,000	7,709,000	3,614,000	6,216,000	2,824,000	20,816,000	9,711,000
Pumping Stations	Matadero PS	Civil works	499,000	166,000	0	0	0	0	499,000	166,000
		Architectural works	237,000	158,000	0	0	0	0	237,000	158,000
		Mechanical works	1,364,000	585,000	0	0	0	0	1,364,000	585,000
		Electrical works	871,000	581,000	0	0	0	0	871,000	581,000
		Total	2,971,000	1,490,000	0	0	0	0	2,971,000	1,490,000
	Casablanca PS (Rehabilitation works only)	Civil works	25,000	8,000	0	0	0	0	25,000	8,000
		Mechanical works	1,283,000	550,000	0	0	0	0	1,283,000	550,000
		Electrical works	1,200,000	800,000	0	0	0	0	1,200,000	800,000
		Total	2,508,000	1,358,000	0	0	0	0	2,508,000	1,358,000
	Screen at Caballeria (Rehabilitation works only)	Mechanical works	170,000	73,000					170,000	73,000
		Electrical works	20,000	14,000					20,000	14,000
		Total	190,000	87,000					190,000	87,000
Sewerage System after Casablanaca PS	Transmission Tunnel (Rehabilitation works only)	Civil works	0	0	174,000	260,000	0	0	174,000	260,000
	Chibo WWTP (Primary Treatment only)	Civil works	0	0	0	0	0	0	0	0
		Architectural works	0	0	0	0	0	0	0	0
		Mechanical works	0	0	0	0	0	0	0	0
		Electrical works	0	0	0	0	0	0	0	0
		Total	0	0	0	0	0	0	0	0
	Re-pumping Station	Civil works	0	0	100,000	33,000	0	0	100,000	33,000
		Architectural works	0	0	237,000	158,000	0	0	237,000	158,000
		Mechanical works	0	0	1,091,000	468,000	0	0	1,091,000	468,000
		Electrical works	0	0	784,000	523,000	0	0	784,000	523,000
		Total	0	0	2,212,000	1,182,000	0	0	2,212,000	1,182,000
	New Outfall Sewer	Civil works	0	0	1,900,000	475,000	0	0	1,900,000	475,000
Sub-total	New construction works		36,965,000	22,830,000	29,857,000	17,295,000	27,497,000	17,011,000	94,319,000	57,136,000
	Rehabilitation works		6,178,000	3,765,000	4,309,000	3,016,000	3,426,000	2,284,000	13,913,000	9,065,000
Total			43,143,000	26,595,000	34,166,000	20,311,000	30,923,000	19,295,000	108,232,000	66,201,000

Table A12. 4 Capital Investment for the Improvement of the Existing Sewerage System

(FC: US$, LC: Cuban Pesos)

		Rate %	First Stage		Second Stage		Third Stage		Existing Sys Improvement by M/P	
			FC	LC	FC	LC	FC	LC	FC	LC
Direct Construction Cost	New Construction Works		6,110,000	3,581,000	7,383,000	3,838,000	0	0	13,493,000	7,419,000
	Rehabilitation Works		6,178,000	3,765,000	4,309,000	3,016,000	3,426,000	2,284,000	13,913,000	9,065,000
	Total of Direct Construction Cost		12,288,000	7,346,000	11,692,000	6,854,000	3,426,000	2,284,000	27,406,000	16,484,000
Indirect Construction Cost	Land Acquisition and Conpensation		0	0	0	0	0	0	0	0
	Administrative Expenses	3.0	0	220,000	0	206,000	0	69,000	0	495,000
	Engineering Services								0	0
	New construction Works	10.0	611,000		738,000		0		1,349,000	0
		10.0		358,000		384,000		0	0	742,000
	Rehabilitation Works	12.0	741,000		517,000		411,000		1,669,000	0
		12.0		452,000		362,000		274,000	0	1,088,000
	Sub-total		1,352,000	810,000	1,255,000	746,000	411,000	274,000	3,018,000	1,830,000
	Physical Contingency	10.0	1,229,000	735,000	1,169,000	685,000	343,000	228,000	2,741,000	1,648,000
	Total		2,581,000	1,765,000	2,424,000	1,637,000	754,000	571,000	5,759,000	3,973,000
Grand Total			14,869,000	9,111,000	14,116,000	8,491,000	4,180,000	2,855,000	33,165,000	20,457,000

Table A12. 5 Direct Construction Cost for the Improvement of the Existing Sewerage System

(FC: US$, LC: Cuban Pesos)

				First Stage		Second Stage		Third Stage		Existing Sys Improvement by M/P	
				FC	LC	FC	LC	FC	LC	FC	LC
Sewers	N	Central Sewerage System	Colector Sur Nuebo	1,003,000	668,000	0	0	0	0	1,003,000	668,000
	N		Pumped Main	976,000	650,000	0	0	0	0	976,000	650,000
	N		Interconnection	1,160,000	773,000	0	0	0	0	1,160,000	773,000
	R		Cross connection	3,480,000	2,320,000	1,357,000	904,000	2,400,000	1,600,000	7,237,000	4,824,000
	R		Inadequate sewers	0	0	822,000	548,000	1,026,000	684,000	1,848,000	1,232,000
	R		Colector Sur	0	0	1,956,000	1,304,000	0	0	1,956,000	1,304,000
	N		Colector Sur A	0	0	3,271,000	2,181,000	0	0	3,271,000	2,181,000
	N	New Construction Works		3,139,000	2,091,000	3,271,000	2,181,000	0	0	6,410,000	4,272,000
	R	Rehabilitation Works		3,480,000	2,320,000	4,135,000	2,756,000	3,426,000	2,284,000	11,041,000	7,360,000
		Total of Sewers		6,619,000	4,411,000	7,406,000	4,937,000	3,426,000	2,284,000	17,451,000	11,632,000
Pumping Stations	N	Matadero Pumping Station		2,971,000	1,490,000	0	0	0	0	2,971,000	1,490,000
	R	Casablanca PS		2,508,000	1,358,000	0	0	0	0	2,508,000	1,358,000
	R	Screens at Caballeria		190,000	87,000	0	0	0	0	190,000	87,000
Improvement Facilities	R	Transmission Tunnel after Casabalanca PS		0	0	174,000	260,000	0	0	174,000	260,000
	N	Primary Treatment at Chivo		0	0	0	0	0	0	0	0
	N	Re-pumping Station at Chivo		0	0	2,212,000	1,182,000	0	0	2,212,000	1,182,000
	N	Outfall Sewer		0	0	1,900,000	475,000	0	0	1,900,000	475,000
	N	New Construction Works		2,971,000	1,490,000	4,112,000	1,657,000	0	0	7,083,000	3,147,000
	R	Rehabilitation Works		2,698,000	1,445,000	174,000	260,000	0	0	2,872,000	1,705,000
		Above Total		5,669,000	2,935,000	4,286,000	1,917,000	0	0	9,955,000	4,852,000
	N	New Construction Works		6,110,000	3,581,000	7,383,000	3,838,000	0	0	13,493,000	7,419,000
	R	Rehabilitation Works		6,178,000	3,765,000	4,309,000	3,016,000	3,426,000	2,284,000	13,913,000	9,065,000
Direct Construction Cost for improving the Existing Sewerage System				12,288,000	7,346,000	11,692,000	6,854,000	3,426,000	2,284,000	27,406,000	16,484,000

Table A12. 6 Capital Investment for the Development of the proposed New Sewerage System

(FC: US$, LC: Cuban Pesos)

Component		Rate %	First Stage		Second Stage		Third Stage		New Sewerage Construction by MP	
			FC	LC	FC	LC	FC	LC	FC	LC
Direct Construction Cost	New Construction Works		30,855,000	19,249,000	22,474,000	13,457,000	27,497,000	17,011,000	80,826,000	49,717,000
Indirect Construction Cost	Land Acquisition and Conpensation		0	0	0	0	0	0	0	0
	Administrative Expenses	3.0	0	577,000	0	404,000	0	510,000	0	1,491,000
	Engineering Services								0	0
	Foreign Currency portion	10.0	3,086,000		2,247,000		2,750,000		8,083,000	0
	Local Currency portion	10.0		1,925,000		1,346,000		1,701,000	0	4,972,000
	Sub-total		3,086,000	1,925,000	2,247,000	1,346,000	2,750,000	1,701,000	8,083,000	4,972,000
	Physical Contingency	10.0	3,086,000	1,925,000	2,247,000	1,346,000	2,750,000	1,701,000	8,083,000	4,972,000
	Total		6,172,000	4,427,000	4,494,000	3,096,000	5,500,000	3,912,000	16,166,000	11,435,000
Grand Total			37,027,000	23,676,000	26,968,000	16,553,000	32,997,000	20,923,000	96,992,000	61,152,000

Table A12. 7 Direct Construction Cost for the Development of the proposed New Sewerage System

(FC: US$, LC: Cuban Pesos)

Component			First Stage		Second Stage		Third Stage		New Sewerage Construction by MP	
			FC	LC	FC	LC	FC	LC	FC	LC
Sewers	N	Luyanó-Martín Pérez Colector	19,234,000	12,822,000	7,554,000	5,036,000	8,515,000	5,677,000	35,303,000	23,535,000
	N	Luyanó Left Colector	4,730,000	3,154,000	7,211,000	4,807,000	12,766,000	8,510,000	24,707,000	16,471,000
		Total of Sewers	23,964,000	15,976,000	14,765,000	9,843,000	21,281,000	14,187,000	60,010,000	40,006,000
WWTP	N	Luyanó WWTP	6,891,000	3,273,000	7,709,000	3,614,000	6,216,000	2,824,000	20,816,000	9,711,000
Total			30,855,000	19,249,000	22,474,000	13,457,000	27,497,000	17,011,000	80,826,000	49,717,000

Table A12. 8 Direct Construction Cost of New Colectors installed in Luyanó-Martin Pérez Sewer District

	Pipe		Pipe Dia.		Unit Cost: USD/100 m	Luyanó-Martín Pérez Colector		Luyanó Left Colector		Total	
			Outer	Inner		Length:m	Cost :USD	Length:m	Cost :USD	Length:m	Cost :USD
Open Cut		Lateral	φ250	φ216	26,829	104,980	28,165,085	107,000	28,707,030	211,980	56,872,115
		Main	φ250	φ216	26,829	5,000	1,341,450	3,660	981,942	8,660	2,323,392
			φ315	φ271	32,620	1,980	645,876	760	247,912	2,740	893,788
			φ400	φ343	47,460	3,670	1,741,782	1,720	816,312	5,390	2,558,094
			φ500	φ427	52,067	640	333,229	670	348,849	1,310	682,078
			φ630	φ535	57,954	720	417,269	560	324,542	1,280	741,811
			φ800	φ678	63,968	970	620,490	2,250	1,439,280	3,220	2,059,770
			φ1,000	φ851	73,375	0	0	120	88,050	120	88,050
			φ1,200	φ1,030	92,523	0	0	2,410	2,229,804	2,410	2,229,804
		Above Main Total				12,980	5,100,096	12,150	6,476,691	25,130	11,576,787
	Total by Open Cut Method					117,960	33,265,181	119,150	35,183,721	237,110	68,448,902
Tunnelling	Insert Pipe		Tunnel Inner Dia.	Insert Pipe Inner Dia.	Unit Cost: USD/100 m	Length:m	Cost :USD	Length:m	Cost :USD	Length:m	Cost :USD
	Plastic	Main	1,500	φ216	2,940	530	15,582	0	0	530	15,582
				φ271	3,608	0	0	0	0	0	0
				φ343	4,761	990	47,134	0	0	990	47,134
				φ427	6,705	0	0	0	0	0	0
				φ535	10,282	0	0	350	35,987	350	35,987
				φ678	14,096	2,550	359,448	330	46,517	2,880	405,965
				φ851	21,096	250	52,740	0	0	250	52,740
				φ1,030	28,395	1,070	303,827	570	161,852	1,640	465,679
		Insert pipe construction total				5,390	778,731	1,250	244,356	6,640	1,023,087
	Tunnel Const.			φ1,500	460,000	5,390	24,794,000	1,250	5,750,000	6,640	30,544,000
	Total by Tunneling Method					5,390	25,572,731	1,250	5,994,356	6,640	31,567,087
Total						123,350	58,837,912	120,400	41,178,077	243,750	100,015,989

Table A12. 9 Direct Construction Cost of Luyanó-Martín Pérez Colector

	Pipe		Pipe Dia. Outer	Pipe Dia. Inner	Unit Cost: USD/100	First Stage Length:m	First Stage Cost :USD	Sechond Stage Length:m	Sechond Stage Cost :USD	Third Stage Length:m	Third Stage Cost :USD	Total Length:m	Total Cost :USD
Open Cut	Plastic	Lateral	φ250	φ216	26,829	38,030	10,203,069	41,600	11,160,864	25,350	6,801,152	104,980	28,165,085
		Main	φ250	φ216	26,829	2,420	649,262	320	85,853	2,260	606,335	5,000	1,341,450
			φ315	φ271	32,620	1,040	339,248	940	306,628		0	1,980	645,876
			φ400	φ343	47,460	1,020	484,092		0	2,650	1,257,690	3,670	1,741,782
			φ500	φ427	52,067	640	333,229		0		0	640	333,229
			φ630	φ535	57,954	370	214,430	350	202,839		0	720	417,269
			φ800	φ678	63,968	970	620,490		0		0	970	620,490
			φ1,000	φ851	73,375	0	0		0		0	0	0
			φ1,200	φ1,030	92,523	0	0		0		0	0	0
			Above Main Total			6,460	2,640,751	1,610	595,320	4,910	1,864,025	12,980	5,100,096
	Total by Open Cut Method					44,490	12,843,820	43,210	11,756,184	30,260	8,665,177	117,960	33,265,181
Tunneling	Insert Pipe		Tunnel Inner Dia.	Insert Pipe Inner Dia.	Unit Cost: USD/100 m	Length:m	Cost :USD	Length:m	Cost :USD	Length:m	Cost :USD	Length:m	Cost :USD
	Plastic	Main	1,500	φ216	2,940	150	4,410	180	5,292	200	5,880	530	15,582
				φ271	3,608		0	0	0	0	0	0	0
				φ343	4,761		0	0	0	990	47,134	990	47,134
				φ427	6,705		0	0	0	0	0	0	0
				φ535	10,282		0	0	0	0	0	0	0
				φ678	14,096	2,550	359,448	0	0	0	0	2,550	359,448
				φ851	21,096	250	52,740	0	0	0	0	250	52,740
				φ1,030	28,395	1,070	303,827	0	0	0	0	1,070	303,827
		Insert pipe construction total				4,020	720,425	180	5,292	1,190	53,014	5,390	778,731
	Tunnel Const.			φ1,500	460,000	4,020	18,492,000	180	828,000	1,190	5,474,000	5,390	24,794,000
	Total by Tunneling Method					4,020	19,212,425	180	833,292	1,190	5,527,014	5,390	25,572,731
Total of Lunayo-Martin Perez Colector						48,510	32,056,245	43,390	12,589,476	31,450	14,192,191	123,350	58,837,912

Table A12. 10 Direct Construction Cost of Luyanó Left Colector

工法	Pipe		Pipe Dia. Outer	Pipe Dia. Inner	Unit Cost: USD/100	First Stage Length:m	First Stage Cost :USD	Sechond Stage Length:m	Sechond Stage Cost :USD	Third Stage Length:m	Third Stage Cost :USD	Total Length:m	Total Cost :USD
Open Cut	Plastic	Lateral	φ250	φ216	26,829	9,420	2,527,292	32,460	8,708,693	65,120	17,471,045	107,000	28,707,030
		Main	φ250	φ216	26,829	410	109,999	0	0	3,250	871,943	3,660	981,942
			φ315	φ271	32,620	270	88,074	0	0	490	159,838	760	247,912
			φ400	φ343	47,460	120	56,952	1,270	602,742	330	156,618	1,720	816,312
			φ500	φ427	52,067	0	0	230	119,754	440	229,095	670	348,849
			φ630	φ535	57,954	0	0	130	75,340	430	249,202	560	324,542
			φ800	φ678	63,968	0	0	1,480	946,726	770	492,554	2,250	1,439,280
			φ1,000	φ851	73,375	120	88,050	0	0	0	0	120	88,050
			φ1,200	φ1,030	92,523	2,410	2,229,804	0	0	0	0	2,410	2,229,804
			Above Main Total			3,330	2,572,879	3,110	1,744,562	5,710	2,159,250	12,150	6,476,691
	Total by Open Cut Method					12,750	5,100,171	35,570	10,453,255	70,830	19,630,295	119,150	35,183,721
Tunneling	Insert Pipe		Tunnel Inner Dia.	Insert Pipe Inner Dia.	Unit Cost: USD/100 m	Length:m	Cost :USD	Length:m	Cost :USD	Length:m	Cost :USD	Length:m	Cost :USD
	Plastic	Main	1,500	φ216	2,940	0	0	0	0	0	0	0	0
				φ271	3,608	0	0	0	0	0	0	0	0
				φ343	4,761	0	0	0	0	0	0	0	0
				φ427	6,705	0	0	0	0	0	0	0	0
				φ535	10,282	0	0	0	0	350	35,987	350	35,987
				φ678	14,096	0	0	330	46,517	0	0	330	46,517
				φ851	21,096	0	0	0	0	0	0	0	0
				φ1,030	28,395	570	161,852	0	0	0	0	570	161,852
		Insert pipe construction total				570	161,852	330	46,517	350	35,987	1,250	244,356
	Tunnel Const.			φ1,500	460,000	570	2,622,000	330	1,518,000	350	1,610,000	1,250	5,750,000
	Total by Tunneling Method					570	2,783,852	330	1,564,517	350	1,645,987	1,250	5,994,356
Total of Lunayo Left Colector						13,320	7,884,023	35,900	12,017,772	71,180	21,276,282	120,400	41,178,077

Table A12. 11 Disbursement Schedule

Unit: x 1,000

Year	Direct Construction Cost		Indirect Cost						Total Investment Cost	
			Admi. and Engineering Servi.		Physical Contingency		Indirect Cost Total			
	FC (USD)	LC (Peso)	FC (USD)	LC (Peso)	FC (USD)	LC (Peso)	FC (USD)	LC (Peso)	FC (USD)	LC (Peso)
2006	0	0	1,553	684	0	0	1,553	684	1,553	684
2007	0	0	1,553	684	0	0	1,553	684	1,553	684
2008	12,878	7,999	444	813	1,288	800	1,732	1,613	14,610	9,612
2009	14,483	8,784	1,320	1,199	1,448	878	2,768	2,077	17,251	10,861
2010	15,782	9,812	1,320	1,199	1,578	981	2,898	2,180	18,680	11,992
2011	4,480	2,986	350	331	448	299	798	630	5,278	3,616
2012	4,479	2,986	350	331	448	299	798	630	5,277	3,616
2013	6,099	3,946	350	331	610	395	960	726	7,059	4,672
2014	11,740	6,080	1,140	825	1,174	608	2,314	1,433	14,054	7,513
2015	7,368	4,313	1,140	825	737	431	1,877	1,256	9,245	5,569
2016	4,942	3,295	316	313	494	330	810	643	5,752	3,938
2017	4,941	3,295	316	313	494	330	810	643	5,751	3,938
2018	5,639	3,527	316	313	564	353	880	666	6,519	4,193
2019	7,661	4,500	316	313	766	450	1,082	763	8,743	5,263
2020	7,741	4,677	316	313	774	468	1,090	781	8,831	5,458

Table A12. 12 Breakdown of the Disbursement Schedule (Direct Construction Cost Only) of the First Stage Project

(FC: US$, LC: Cuban Pesos)

	Components		First Stage		2008		2009		2010	
			FC	LC	FC	LC	FC	LC	FC	LC
Sewers	Luyanó-Martín Pérez Colector		19,234,000	12,822,000	6,411,000	4,274,000	6,411,000	4,274,000	6,412,000	4,274,000
	Luyanó Left Colector		4,730,000	3,154,000	1,577,000	1,051,000	1,577,000	1,051,000	1,576,000	1,052,000
	Total in the Luyanó Martín Pérez Sewer District		23,964,000	15,976,000	7,988,000	5,325,000	7,988,000	5,325,000	7,988,000	5,326,000
	The Central Sewerage System	Colector Sur Nuebo	1,003,000	668,000	334,000	223,000	334,000	223,000	335,000	222,000
		Pumped Main	976,000	650,000			488,000	325,000	488,000	325,000
		Interconnection	1,160,000	773,000					1,160,000	773,000
		Cross connection	3,480,000	2,320,000	1,160,000	773,000	1,160,000	773,000	1,160,000	774,000
		Inadequate sewers	0	0						
		Colector Sur	0	0						
		Colector Sur A	0	0						
	New construction works		27,103,000	18,067,000	8,322,000	5,548,000	8,810,000	5,873,000	9,971,000	6,646,000
	Rehabilitation works		3,480,000	2,320,000	1,160,000	773,000	1,160,000	773,000	1,160,000	774,000
	Total of Sewers		30,583,000	20,387,000	9,482,000	6,321,000	9,970,000	6,646,000	11,131,000	7,420,000
Luyanó WWTP	Conventional Activated Sludge Process Anaerobic Digestion Mechanical Dewatering	Civil works	2,327,000	775,000	698,000	233,000	1,164,000	387,000	465,000	155,000
		Architectural works	68,000	46,000			68,000	46,000		
		Mechanical works	2,290,000	981,000			916,000	392,000	1,374,000	589,000
		Electrical works	2,206,000	1,471,000			882,000	588,000	1,324,000	883,000
		Total	6,891,000	3,273,000	698,000	233,000	3,030,000	1,413,000	3,163,000	1,627,000
Pumping Stations	Matadero PS	Civil works	499,000	166,000			399,000	133,000	100,000	33,000
		Architectural works	237,000	158,000			190,000	126,000	47,000	32,000
		Mechanical works	1,364,000	585,000			546,000	234,000	818,000	351,000
		Electrical works	871,000	581,000			348,000	232,000	523,000	349,000
		Total	2,971,000	1,490,000			1,483,000	725,000	1,488,000	765,000
	Casablanca PS (Rehabilitation works only)	Civil works	25,000	8,000	25,000	8,000				
		Mechanical works	1,283,000	550,000	1,283,000	550,000				
		Electrical works	1,200,000	800,000	1,200,000	800,000				
		Total	2,508,000	1,358,000	2,508,000	1,358,000				
	Screen at Caballeria (Rehabilitation works only)	Mechanical works	170,000	73,000	170,000	73,000				
		Electrical works	20,000	14,000	20,000	14,000				
		Total	190,000	87,000	190,000	87,000				
Sewerage System after Casablanaca PS	Transmission Tunnel (Rehabilitation works only)	Civil works	0	0						
	Chibo WWTP (Primary Treatment only)	Civil works	0	0						
		Architectural works	0	0						
		Mechanical works	0	0						
		Electrical works	0	0						
		Total	0	0						
	Re-pumping Station	Civil works	0	0						
		Architectural works	0	0						
		Mechanical works	0	0						
		Electrical works	0	0						
		Total	0	0						
	New Outfall Sewer	Civil works	0	0						
Sub-total	New construction works		36,965,000	22,830,000	9,020,000	5,781,000	13,323,000	8,011,000	14,622,000	9,038,000
	Rehabilitation works		6,178,000	3,765,000	3,858,000	2,218,000	1,160,000	773,000	1,160,000	774,000
Total			43,143,000	26,595,000	12,878,000	7,999,000	14,483,000	8,784,000	15,782,000	9,812,000

Table A12. 13 Breakdown of the Disbursement Schedule (Direct Construction Cost Only) of the Second Stage Project

(FC: US$, LC: Cuban Pesos)

	Components		Second Stage		2011		2012		2013		2014		2015	
			FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC
Sewers	Luyanó-Martín Pérez Colector		7,554,000	5,036,000	1,511,000	1,007,000	1,511,000	1,007,000	1,511,000	1,007,000	1,511,000	1,007,000	1,510,000	1,008,000
	Luyanó Left Colector		7,211,000	4,807,000	1,442,000	961,000	1,442,000	961,000	1,442,000	961,000	1,443,000	962,000	1,442,000	962,000
	Total in the Luyanó Martín Pérez Sewer District		14,765,000	9,843,000	2,953,000	1,968,000	2,953,000	1,968,000	2,953,000	1,968,000	2,954,000	1,969,000	2,952,000	1,970,000
	The Central Sewerage System	Colector Sur Nuebo	0	0										
		Pumped Main	0	0										
		Interconnection	0	0										
		Cross connection	1,357,000	904,000	272,000	181,000	272,000	181,000	271,000	181,000	271,000	181,000	271,000	180,000
		Inadequate sewers	822,000	548,000	164,000	110,000	164,000	110,000	164,000	110,000	165,000	109,000	165,000	109,000
		Colector Sur	1,956,000	1,304,000					652,000	435,000	652,000	435,000	652,000	434,000
		Colector Sur A	3,271,000	2,181,000	1,091,000	727,000	1,090,000	727,000	1,090,000	727,000				
	New construction works		18,036,000	12,024,000	4,044,000	2,695,000	4,043,000	2,695,000	4,043,000	2,695,000	2,954,000	1,969,000	2,952,000	1,970,000
	Rehabilitation works		4,135,000	2,756,000	436,000	291,000	436,000	291,000	1,087,000	726,000	1,088,000	725,000	1,088,000	723,000
	Total of Sewers		22,171,000	14,780,000	4,480,000	2,986,000	4,479,000	2,986,000	5,130,000	3,421,000	4,042,000	2,694,000	4,040,000	2,693,000
Luyanó WWTP	Conventional Activated Sludge Process Anaerobic Digestion Mechanical Dewatering	Civil works	2,384,000	795,000					715,000	239,000	1,192,000	398,000	477,000	158,000
		Architectural works	573,000	382,000							573,000	382,000		
		Mechanical works	3,069,000	1,315,000							1,228,000	526,000	1,841,000	789,000
		Electrical works	1,683,000	1,122,000							673,000	449,000	1,010,000	673,000
		Total	7,709,000	3,614,000					715,000	239,000	3,666,000	1,755,000	3,328,000	1,620,000
Pumping Stations	Matadero PS	Civil works	0	0										
		Architectural works	0	0										
		Mechanical works	0	0										
		Electrical works	0	0										
		Total	0	0										
	Casablanca PS (Rehabilitation works only)	Civil works	0	0										
		Mechanical works	0	0										
		Electrical works	0	0										
		Total	0	0										
	Screen at Caballeria (Rehabilitation works only)	Mechanical works												
		Electrical works												
		Total												
Sewerage System after Casablanaca PS	Transmission Tunnel (Rehabilitation works only)	Civil works	174,000	260,000					174,000	260,000				
	Chibo WWTP (Primary Treatment only)	Civil works	0	0										
		Architectural works	0	0										
		Mechanical works	0	0										
		Electrical works	0	0										
		Total	0	0										
	Re-pumping Station	Civil works	100,000	33,000					80,000	26,000	20,000	7,000		
		Architectural works	237,000	158,000							237,000	158,000		
		Mechanical works	1,091,000	468,000							1,091,000	468,000		
		Electrical works	784,000	523,000							784,000	523,000		
		Total	2,212,000	1,182,000					80,000	26,000	2,132,000	1,156,000		
	New Outfall Sewer	Civil works	1,900,000	475,000							1,900,000	475,000		
Sub-total	New construction works		29,857,000	17,295,000	4,044,000	2,695,000	4,043,000	2,695,000	4,838,000	2,960,000	10,652,000	5,355,000	6,280,000	3,590,000
	Rehabilitation works		4,309,000	3,016,000	436,000	291,000	436,000	291,000	1,261,000	986,000	1,088,000	725,000	1,088,000	723,000
Total			34,166,000	20,311,000	4,480,000	2,986,000	4,479,000	2,986,000	6,099,000	3,946,000	11,740,000	6,080,000	7,368,000	4,313,000

Table A12. 14 Breakdown of the Disbursement Schedule (Direct Construction Cost Only) of the Third Stage Project

(FC: US$, LC: Cuban Pesos)

	Components		Third Stage		2016		2017		2018		2019		2020	
			FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC
Sewers	Luyanó-Martín Pérez Colector		8,515,000	5,677,000	1,703,000	1,136,000	1,703,000	1,136,000	1,703,000	1,135,000	1,703,000	1,135,000	1,703,000	1,135,000
	Luyanó Left Colector		12,766,000	8,510,000	2,553,000	1,702,000	2,553,000	1,702,000	2,553,000	1,702,000	2,553,000	1,702,000	2,554,000	1,702,000
	Total in the Luyanó Martín Pérez Sewer District		21,281,000	14,187,000	4,256,000	2,838,000	4,256,000	2,838,000	4,256,000	2,837,000	4,256,000	2,837,000	4,257,000	2,837,000
	The Central Sewerage System	Colector Sur Nuebo	0	0										
		Pumped Main	0	0										
		Interconnection	0	0										
		Cross connection	2,400,000	1,600,000	480,000	320,000	480,000	320,000	480,000	320,000	480,000	320,000	480,000	320,000
		Inadequate sewers	1,026,000	684,000	206,000	137,000	205,000	137,000	205,000	137,000	205,000	137,000	205,000	136,000
		Colector Sur	0	0										
		Colector Sur A	0	0										
	New construction works		21,281,000	14,187,000	4,256,000	2,838,000	4,256,000	2,838,000	4,256,000	2,837,000	4,256,000	2,837,000	4,257,000	2,837,000
	Rehabilitation works		3,426,000	2,284,000	686,000	457,000	685,000	457,000	685,000	457,000	685,000	457,000	685,000	456,000
	Total of Sewers		24,707,000	16,471,000	4,942,000	3,295,000	4,941,000	3,295,000	4,941,000	3,294,000	4,941,000	3,294,000	4,942,000	3,293,000
Luyanó WWTP	Conventional Activated Sludge Process Anaerobic Digestion Mechanical Dewatering	Civil works	2,327,000	775,000					698,000	233,000	1,164,000	387,000	465,000	155,000
		Architectural works	0	0							0	0		
		Mechanical works	2,290,000	981,000							916,000	392,000	1,374,000	589,000
		Electrical works	1,600,000	1,067,000							640,000	427,000	960,000	640,000
		Total	6,217,000	2,823,000					698,000	233,000	2,720,000	1,206,000	2,799,000	1,384,000
Pumping Stations	Matadero PS	Civil works	0	0										
		Architectural works	0	0										
		Mechanical works	0	0										
		Electrical works	0	0										
		Total	0	0										
	Casablanca PS (Rehabilitation works only)	Civil works	0	0										
		Mechanical works	0	0										
		Electrical works	0	0										
		Total	0	0										
	Screen at Caballeria (Rehabilitation works only)	Mechanical works												
		Electrical works												
		Total												
Sewerage System after Casablanaca PS	Transmission Tunnel (Rehabilitation works only)	Civil works	0	0										
	Chibo WWTP (Primary Treatment only)	Civil works	0	0										
		Architectural works	0	0										
		Mechanical works	0	0										
		Electrical works	0	0										
		Total	0	0										
	Re-pumping Station	Civil works	0	0										
		Architectural works	0	0										
		Mechanical works	0	0										
		Electrical works	0	0										
		Total	0	0										
	New Outfall Sewer	Civil works	0	0										
Sub-total	New construction works		27,498,000	17,010,000	4,256,000	2,838,000	4,256,000	2,838,000	4,954,000	3,070,000	6,976,000	4,043,000	7,056,000	4,221,000
	Rehabilitation works		3,426,000	2,284,000	686,000	457,000	685,000	457,000	685,000	457,000	685,000	457,000	685,000	456,000
Total			30,924,000	19,294,000	4,942,000	3,295,000	4,941,000	3,295,000	5,639,000	3,527,000	7,661,000	4,500,000	7,741,000	4,677,000

Table A12. 15 Direct Construction Cost of the Major Sewers of the Central System and a Reference Alternative of Ruyanó Left Bank Area

	Collection System	Construction/ Rehabilitation	Construction Method	Pipe Material	Pipe Inner Dia.(mm)	Unit Cost (USD/100m)	Length (m)	Cost (USD)	Rounded Cost (USD)
1.	Colector Sur Nuevo	C	Open Cut	HP	1500	91300	1830	1670800	**1,671,000**
2.	Pumped Main	C	Open Cut	DIP	1350	159400	1020	1625900	**1,626,000**
3.	Interconnection	C	Open Cut	HDPE	1030	92500	100	92500	
		C	Tunnelling	HP	1500	460000	400	1840000	
	Sub total						500	1932500	**1,933,000**
4.	Colector Sur	R	Rehabilitation		1750	106900	1160	1240000	
					1900	124700	1620	2020100	
	Sub total						2780	3260100	**3,260,000**
5.	Colector Sur A	C	Open Cut	HP	1500	91300	580	529500	
		C	Tunnelling	HP	1500	460000	1070	4922000	
	Sub total						1650	5451500	**5,452,000**
Refernce Alternative of Ruyanó Left Bank Area									
5.	Colector Sur A	C	Open Cut	HP	1500	91300	580	529500	
		C	Tunnelling	HP	1500	460000	1440	6624000	
			Invert		1200	7700	370	28500	
	Total						2390	7182000	**7,182,000**

Table A12. 16 Direct Construction Cost for Rehabilitation of the Inadequate Existing Colectors

Colector	Dia. mm	*Ave. Depth m*	Unit Cost USD/100m	Length m	Cost USD	1st Stage USD	2nd Stage USD	3rd Stage USD
Cerro	675	*5.04*	92,523	294	272,018	0	272,018	
	1200	*4.80*	108,300	285	308,655	0	308,655	
	1350	*4.29*	118,800	380	451,440	0	451,440	
Centro Habana	450	*3.72*	63,968	314	200,860	0	0	200,860
	675	*4.57*	92,523	250	231,308	0	231,308	
	750	*4.88*	92,523	115	106,401	0	106,401	
Sur-1	900	*4.57*	96,100	210	201,810	0	0	201,810
Sur-3	350	*5.95*	57,954	229	132,715	0	0	132,715
	400	*4.07*	63,968	703	449,695	0	0	449,695
	750	*5.07*	92,523	783	724,455	0	0	724,455
Total					3,079,357	0	1,369,822	1,709,535
						0	**1,370,000**	**1,710,000**

Table A12.17 Open Cut Method Piping Construction Cost (Out D 250mm, Inner D 216mm、Per 100m) Excavation Width 1.20m, Excavation Depth 2.0m

Items	Specifications	Unit	Amount	Unit Price	Price
1.Cutting Pavement					
Cutting Concrete-pavement	Hammer t=200	m3	18.0	3.45	62
Concrete-wreck Lording	Backhoe 0.2m3	m3	18.0	0.53	9
Concrete-wreck Portage	Dumptruck 6m3 The First 1km	c-m3	0.18	108.97	19
Concrete-wreck Portage	Dumptruck 6m3 The Rest 24km	c-m3	0.18	610.08	109
Leveling Concrete-wreck	Bulldozer 15t L=50m	m3	18.0	1.03	18
Subtotal					217
2.Esrthwork					
Ordinary Soil Excavation	Backhoe 0.2m3 With Lording	m3	240	0.54	129
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	0.68	108.97	74
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	0.68	25.42	17
Surplus Soil Portage	Dumptruck 6m3 The First 1km	c-m3	1.38	108.97	150
Surplus Soil Portage	Dumptruck 6m3 The Rest 24km	c-m3	1.38	610.08	841
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	138	1.03	142
Backfilling 1	Throwing and Compacting by Human Pow	m3	57	9.14	520
Soft-rock Crushed(SRC)		m3	57	1.16	66
Compacting	Water Binding	m3	57	2.28	129
Backfillingsoil Lording	Backhoe 0.2m3	m3	68	0.53	36
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	0.68	108.97	74
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	0.68	25.42	17
Backfilling 3(Product)	Backhoe 0.2m3 Throw Down	m3	68	0.53	36
Throwing Down Backfilling 3	Backhoe 0.2m3 (SRC)	m3	34	0.60	20
SRC		m3	34	1.16	39
Tamping Soil	Tamper 60～100kg	m3	102	4.20	428
Subtotal					2,718
3.Foundation Work					
SRC		m3	28	1.16	32
Throwing Down SRC	Backhoe 0.2m3 Throw Down	m3	28	2.99	83
Compacting SRC	Human Power	m3	28	7.43	208
Compacting SRC	Water Binding	m3	28	2.28	63
Subtotal					386
4.Temporary Work					
Unwatering	Below 2m3/min	m3	600	0.38	228
Sheathing	Wood Sheet Pile、Wale、Beam	m2	400	18.64	7,456
Subtotal					7,684
5.Laying Work of Pipe					
High-density Polyethylene Pi	φ250-216 L=12m	m	97	5.66	549
Laying Pipe		m	97	1.87	181
Pipe Joint		pcs	9	2.89	26
Rubber Ring		pcs	18	0.76	13
Subtotal					769
6.Restoration Work of Pavement					
Restoration Work of Pavement		c-m2	1.2	2,626	3,151
Subtotal					3,151
7.Setting Manhole Work (2.5Place per 100m)					
Setting Manhole		place	2.5	494	1,235
Subtotal					1,235
1.～7.Total					16,160
8.Setting Work of House Inlet and Latelal (5% of Uper Construction Cost)		lot	1		808
1.～8.Total					16,968
9.Other Works (10% of Uper Construction Cost:		lot	1		1,696
Reset of Underground Installation and Side Ditch,Others)					
10.Pure Construction Cost	Direct CC+				18,664
	Common Temporary Work Cost				

Table A12.17 Continue

Items	Specifications	Unit	Amount	Unit Price	Price
11.Managing Cost at Site	25% of Pure CC	lot	1		4,666
12.The Cost of Works					23,330
13.General Construction Cost	15% of The Cost of Work	lot	1		3,499
Total Construction Cost					26,829

Table A12.18 Itemized account of Setting Manhole Work (Per 100 Place)

Items	Specifications	Unit	Amount	Unit Price	Price
Casting Leveling Concrete		m3	0.96	8.36	8
Leveling Concrete	175kg/cm2	m3	0.96	84.45	81
Leveling Concrete Form		m2	2.45	12.16	29
Reinforced Concrete	250kg/cm2	m3	2.51	95.07	238
Casting Base Concrete	100～300kg/cm2	m3	2.51	8.36	20
Plain Concrete	200kg/cm2	m3	1.20	88.51	106
Casting Invert Concrete	100～300kg/cm2	m3	1.20	8.36	10
Processing Steel Bar (Straight	SD30φ16 With bar	t	0.351	520.49	182
Placing Steel bar (Base)	Below φ16	t	0.351	128.90	45
Placing Form		m2	6.88	1.46	10
Mortaring fase on invert	Thickness 30mm	m2	12.79	15.18	194
Vertical Pipe	ID=1,200,H=1,030	pcs	10	122.72	1,227
Placing Vertical Pipe		pcs	10	103.24	1,032
Concrete Lid with Iron Lid		pcs	10	89.51	895
Placing Concrete Lid		pcs	10	86.96	869
Total per 10 Place					4,946
Total per 1 Place					494

Table A12.19 Restoration Work of Pavement (Per 100m2)

Items	Specifications	Unit	Amount	Unit Price	Price
Asphalt on Surface	1LT/m2	th-m2	0.10	210.00	21
Adhesive Asphalt	0.6LT/m2	th-m2	0.10	152.65	15
Midle Density Asphalt Concret	t=3.5cm	m2	100	5.44	544
High Density Asphalt Concret	t=1.5cm	m2	100	2.36	236
Concrete Paving		m3	15.0	7.33	109
Concrete	200kg/ccm2	m3	15.0	88.51	1,327
Rolling-fill on Subbed	Unscreened Crushed Stone t＝0.20m	c-m2	1.00	374.14	374
Total					2,626

Table A12.20 Open Cut Method Piping Construction Cost (Out D 315mm, Inner D 271mm、Per 100m) Excavation Width 1.20m, Excavation Depth 2.6m

Items	Specifications	Unit	Amount	Unit Price	Price
1.Cutting Pavement					
Cutting Concrete-pavement	Hammer t=200	m3	18.0	3.45	62
Concrete-wreck Lording	Backhoe 0.2m3	m3	18.0	0.53	9
Concrete-wreck Portage	Dumptruck 6m3 The First 1km	c-m3	0.18	108.97	19
Concrete-wreck Portage	Dumptruck 6m3 The Rest 24km	c-m3	0.18	610.08	109
Leveling Concrete-wreck	Bulldozer 15t L=50m	m3	18.0	1.03	18
Subtotal					217
2.Esrthwork					
Ordinary Soil Excavation	Backhoe 0.2m3 With Lording	m3	312	0.54	168
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	1.11	108.97	120
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	1.11	25.42	28
Surplus Soil Portage	Dumptruck 6m3 The First 1km	c-m3	1.46	108.97	159
Surplus Soil Portage	Dumptruck 6m3 The Rest 24km	c-m3	1.46	610.08	890
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	146	1.03	150
Backfilling 1	Throwing and Compacting by Human Pow	m3	61	9.14	557
Soft-rock Crushed(SRC)		m3	61	1.16	70
Compacting	Water Binding	m3	61	2.28	139
Backfillingsoil Lording	Backhoe 0.2m3	m3	111	0.53	58
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	1.11	108.97	120
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	1.11	25.42	28
Backfilling 3(Product)	Backhoe 0.2m3 Throw Down	m3	111	0.53	58
Throwing Down Backfilling 3	Backhoe 0.2m3 (SRC)	m3	55	0.60	33
SRC		m3	55	1.16	63
Tamping Soil	Tamper 60～100kg	m3	166	4.20	697
Subtotal					3,338
3.Foundation Work					
SRC		m3	29	1.16	33
Throwing Down SRC	Backhoe 0.2m3 Throw Down	m3	29	2.99	86
Compacting SRC	Human Power	m3	29	7.43	215
Compacting SRC	Water Binding	m3	29	2.28	66
Subtotal					400
4.Temporary Work					
Unwatering	Below 2m3/min	m3	600	0.38	228
Sheathing	Wood Sheet Pile、Wale、Beam	m2	520	18.64	9,692
Subtotal					9,920
5.Laying Work of Pipe					
High-density Polyethylene Pi	φ315-271 L=12m	m	97	8.52	826
Laying Pipe		m	97	1.87	181
Pipe Joint		pcs	9	4.83	43
Rubber Ring		pcs	18	1.54	27
Subtotal					1,077
6.Restoration Work of Pavement					
Restoration Work of Pavement		c-m2	1.2	2,626	3,151
Subtotal					3,151
7.Setting Manhole Work (2.5Place per 100m)					
Setting Manhole		pcs	2.5	618	1,545
Subtotal					1,545
1.～7.Total					19,648
8.Setting Work of House Inlet and Latelal (5% of Uper Construction Cost)		lot	1		982
1.～8.Total					20,630
9.Other Works (10% of Uper Construction Cost:		lot	1		2,063
Reset of Underground Installation and Side Ditch,Others)					
10.Pure Construction Cost	Direct CC+				22,693
	Common Temporary Work Cost				

Table A12.20 (Continued)

Items	Specifications	Unit	Amount	Unit Price	Price
11.Managing Cost at Site	25% of Pure CC	lot	1		5,673
12.The Cost of Works					28,366
13.General Construction Cost	15% of The Cost of Work	lot	1		4,254
Total Construction Cost					32,620

Table A12.21 Itemized account of Setting Manhole Work (Per 100 Place)

Items	Specifications	Unit	Amount	Unit Price	Price
Casting Leveling Concrete		m3	0.96	8.36	8
Leveling Concrete	175kg/cm2	m3	0.96	84.45	81
Leveling Concrete Form		m2	2.45	12.16	29
Reinforced Concrete	250kg/cm2	m3	2.51	95.07	238
Casting Base Concrete	100～300kg/cm2	m3	2.51	8.36	20
Plain Concrete	200kg/cm2	m3	1.44	88.51	127
Casting Invert Concrete	100～300kg/cm2	m3	1.44	8.36	12
Processing Steel Bar (Straight	SD30φ16 With bar	t	0.351	520.49	182
Placing Steel bar (Base)	Below φ16	t	0.351	128.90	45
Placing Form		m2	6.88	1.46	10
Mortaring fase on invert	Thickness 30mm	m2	13.17	15.18	199
Vertical Pipe	ID=1,200,H=1,220	pcs	10	122.72	1,227
Vertical Pipe	ID=1,200,H=410	pcs	10	61.21	612
Placing Vertical Pipe	ID=1,200,H=1,220	pcs	10	122.28	1,222
Placing Vertical Pipe	ID=1,200,H=410	pcs	10	41.09	410
Concrete Lid with Iron Lid		pcs	10	89.51	895
Placing Concrete Lid		pcs	10	86.96	869
Total per 10 Place					6,186
Total per 1 Place					618

Table A12.22 Restoration Work of Pavement(Per 100m2)

Items	Specifications	Unit	Amount	Unit Price	Price
Asphalt on Surface	1LT/m2	th-m2	0.10	210.00	21
Adhesive Asphalt	0.6LT/m2	th-m2	0.10	152.65	15
Midle Density Asphalt Concre	t=3.5cm	m2	100	5.44	544
High Density Asphalt Concret	t=1.5cm	m2	100	2.36	236
Concrete Paving		m3	15.0	7.33	109
Concrete	200kg/ccm2	m3	15.0	88.51	1,327
Rolling-fill on Subbed	Unscreened Crushed Stone t＝0.20m	c-m2	1.00	374.14	374
Total					2,626

Table A12.23 Open Cut Method Piping Construction Cost (Out D 400mm, Iner D 343mm, Each 100m) Excavation Width 2.20m, Excavation Depth 3.2m

Items	Specifications	Unit	Amount	Unit Price	Price
1.Cutting Pavement					
Cutting Concrete-pavement	Hammer t=200	m3	33.0	3.45	113
Concrete-wreck Lording	Backhoe 0.2m3	m3	33.0	0.53	17
Concrete-wreck Portage	Dumptruck 6m3 The First 1km	c-m3	0.33	108.97	35
Concrete-wreck Portage	Dumptruck 6m3 The Rest 24km	c-m3	0.33	610.08	201
Leveling Concrete-wreck	Bulldozer 15t L=50m	m3	33.0	1.03	33
Subtotal					399
2.Esrthwork					
Ordinary Soil Excavation	Backhoe 0.2m3 With Lording	m3	660	0.54	356
Soft Rock Excavation	Backhoe 0.2m3 With Breaker	m3	24	0.43	10
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	2.79	108.97	304
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	2.79	25.42	70
Surplus Soil Portage	Dumptruck 6m3 The First 1km	c-m3	2.42	108.97	263
Surplus Soil Portage	Dumptruck 6m3 The Rest 24km	c-m3	2.42	610.08	1,476
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	242	1.03	249
Backfilling 1	Throwing and Compacting by Human Powe	m3	129	9.14	1,179
Soft-rock Crushed(SRC)		m3	129	1.16	149
Compacting	Water Binding	m3	129	2.28	294
Backfillingsoil Lording	Backhoe 0.2m3	m3	279	0.53	147
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	2.79	108.97	304
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	2.79	25.42	70
Backfilling 3	Product Backhoe 0.2m3 Throw Down	m3	255	0.53	135
Throwing Down Backfilling 3	SRC Backhoe 0.2m3 Throw Down	m3	163	0.60	97
SRC		m3	139	1.16	161
Tamping Soil	Tamper 60～100kg	m3	418	4.20	1,755
Subtotal					7,019
3.Foundation Work					
SRC		m3	70	1.16	81
Throwing Down SRC	Backhoe 0.2m3 Throw Down	m3	70	2.99	209
Compacting SRC	Human Power	m3	70	7.43	520
Compacting SRC	Water Binding	m3	70	2.28	159
Subtotal					969
4.Temporary Work					
Unwatering	Below 2m3/min	m3	600	0.38	228
Sheathing	Wood Sheet Pile、Wale、Beam	m2	604	18.64	11,258
Subtotal					11,486
5.Laying Work of Pipe					
High-density Polyethylene P	φ400-343 L=12m	m	98.0	13.67	1,339
Laying Pipe		m	98.0	2.60	254
Pipe Joint		pcs	7	6.85	47
Rubber Ring		pcs	14	2.40	33
Subtotal					1,673
6.Restoration Work of Pavement					
Restoration Work of Pavement		c-m2	2.2	2,626	5,777
Subtotal					5,777
7.Setting Manhole Work (1.7Place per 100m)					
Setting Manhole		pcs	1.7	743	1,263
Subtotal					1,263
1.～7.Total					28,586
8.Setting Work of House Inlet and Latelal (5% of Uper Construction Cost)		lot	1		1,429
1.～8.Total					30,015
9.Other Works (10% of Uper Construction Cost:		lot	1		3,001
Reset of Underground Installation and Side Ditch,Others)					
10.Pure Construction Cost	Direct CC+				33,016
	Common Temporary Work Cost				

Table A12.23 (Continued)

Items	Specifications	Unit	Amount	Unit Price	Price
11.Managing Cost at Site	25% of Pure CC	lot	1		8,254
12.The Cost of Works					41,270
13.General Construction Cost	15% of The Cost of Work	lot	1		6,190
Total Construction Cost					47,460

Table A12.24 Itemized account of Setting Manhole Work (Per 100 Place)

Items	Specifications	Unit	Amount	Unit Price	Price
Casting Leveling Concrete		m3	0.96	8.36	8
Leveling Concrete	175kg/cm2	m3	0.96	84.45	81
Leveling Concrete Form		m2	2.45	12.16	29
Reinforced Concrete	250kg/cm2	m3	2.51	95.07	238
Casting Base Concrete	100～300kg/cm2	m3	2.51	8.36	20
Plain Concrete	200kg/cm2	m3	1.71	88.51	151
Casting Invert Concrete	100～300kg/cm2	m3	1.71	8.36	14
Processing Steel Bar (Straight	SD30φ16 With bar	t	0.351	520.49	182
Placing Steel bar (Base)	Below φ16	t	0.351	128.90	45
Placing Form		m2	6.88	1.46	10
Mortaring fase on invert	Thickness 30mm	m2	13.66	15.18	207
Vertical Pipe	ID=1,200,H=1,220+1,010	pcs	20	122.72	2,454
Placing Vertical Pipe	ID=1,200,H=1,220	pcs	10	122.28	1,222
Placing Vertical Pipe	ID=1,200,H=1,010	pcs	10	101.23	1,012
Concrete Lid with Iron Lid		pcs	10	89.51	895
Placing Concrete Lid		pcs	10	86.96	869
Total per 10 Place					7,437
Total per 1 Place					743

Table A12.25 Restoration Work of Pavement (Per 100m2)

Items	Specifications	Unit	Amount	Unit Price	Price
Asphalt on Surface	1LT/m2	th-m2	0.10	210.00	21
Adhesive Asphalt	0.6LT/m2	th-m2	0.10	152.65	15
Midle Density Asphalt Concr	t=3.5cm	m2	100	5.44	544
High Density Asphalt Concre	t=1.5cm	m2	100	2.36	236
Concrete Paving		m3	15.0	7.33	109
Concrete	200kg/ccm2	m3	15.0	88.51	1,327
Rolling-fill on Subbed	Unscreened Crushed Stone t＝0.20m	c-m2	1.00	374.14	374
Total					2,626

Table A12.26 Open Cut Method Piping Construction Cost (Out D 500mm, Inner D 427mm, Per 100m) Excavation Width 2.45m, Excavation Depth 3.8m

Items	Specifications	Unit	Amount	Unit Price	Price
1.Cutting Pavement					
Cutting Concrete-pavement	Hammer t=200	m3	36.8	3.45	126
Concrete-wreck Lording	Backhoe 0.2m3	m3	36.8	0.53	19
Concrete-wreck Portage	Dumptruck 6m3 The First 1km	c-m3	0.37	108.97	40
Concrete-wreck Portage	Dumptruck 6m3 The Rest 24km	c-m3	0.37	610.08	225
Leveling Concrete-wreck	Bulldozer 15t L=50m	m3	36.8	1.03	37
Subtotal					447
2.Esrthwork					
Ordinary Soil Excavation	Backhoe 0.2m3 With Lording	m3	735	0.54	396
Soft Rock Excavation	Backhoe 0.2m3 With Breaker	m3	116	0.43	49
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	3.92	108.97	427
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	3.92	25.42	99
Surplus Soil Portage	Dumptruck 6m3 The First 1km	c-m3	1.47	108.97	160
Surplus Soil Portage	Dumptruck 6m3 The Rest 24km	c-m3	1.47	610.08	896
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	147	1.03	151
Backfilling 1	Throwing and Compacting by Human Pow	m3	107	9.14	977
Soft-rock Crushed(SRC)		m3	107	1.16	124
Compacting	Water Binding	m3	107	2.28	243
Backfillingsoil Lording	Backhoe 0.2m3	m3	392	0.53	207
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	3.92	108.97	427
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	3.92	25.42	99
Backfilling 3	Product Backhoe 0.2m3 Throw Down	m3	276	0.53	146
Backfilling 3	SRC Backhoe 0.2m3 Throw Down	m3	312	0.60	187
SRC		m3	196	1.16	227
Tamping Soil	Tamper 60～100kg	m3	588	4.20	2,469
Subtotal					7,284
3.Foundation Work					
SRC		m3	86	1.16	99
Throwing Down SRC	Backhoe 0.2m3 Throw Down	m3	86	2.99	257
Compacting SRC	Human Power	m3	86	7.43	638
Compacting SRC	Water Binding	m3	86	2.28	196
Subtotal					1,190
4.Temporary Work					
Unwatering	Below 2m3/min	m3	725	0.38	275
Sheathing	Wood Sheet Pile、Wale、Beam	m2	616	18.64	11,482
Subtotal					11,757
5.Laying Work of Pipe					
High-density Polyethylene Pi	φ500-427 L=12m	m	98.0	24.92	2,442
Laying Pipe		m	98.0	1.87	183
Pipe Joint		pcs	7	11.28	78
Rubber Ring		pcs	14	5.16	72
Subtotal					2,775
6.Restoration Work of Pavement					
Restoration Work of Pavement		c-m2	2.45	2,626	6,433
Subtotal					6,433
7.Setting Manhole Work (1.7Place per 100m)					
Setting Manhole		pcs	1.7	868	1,475
Subtotal					1,475
1.～7.Total					31,361
8.Setting Work of House Inlet and Latelal (5% of Uper Construction Cost)		lot	1		1,568
1.～8.Total					32,929
9.Other Works (10% of Uper Construction Cost:		lot	1		3,292
Reset of Underground Installation and Side Ditch,Others)					
10.Pure Construction Cost	Direct CC+				36,221
	Common Temporary Work Cost				

Table A12.26 (Continued)

Items	Specifications	Unit	Amount	Unit Price	Price
11.Managing Cost at Site	25% of Pure CC	lot	1		9,055
12.The Cost of Works					45,276
13.General Construction Cost	15% of The Cost of Work	lot	1		6,791
Total Construction Cost					52,067

Table A12.27 Itemized account of Setting Manhole Work (Per 100 Place)

Items	Specifications	Unit	Amount	Unit Price	Price
Casting Leveling Concrete		m3	0.96	8.36	8
Leveling Concrete	175kg/cm2	m3	0.96	84.45	81
Leveling Concrete Form		m2	2.45	12.16	29
Reinforced Concrete	250kg/cm2	m3	2.51	95.07	238
Casting Base Concrete	100～300kg/cm2	m3	2.51	8.36	20
Plain Concrete	200kg/cm2	m3	1.97	88.51	174
Casting Invert Concrete	100～300kg/cm2	m3	1.97	8.36	16
Processing Steel Bar (Straight	SD30φ16 With bar	t	0.351	520.49	182
Placing Steel bar (Base)	Below φ16	t	0.351	128.90	45
Placing Form		m2	6.88	1.46	10
Mortaring fase on invert	Thickness 30mm	m2	14.23	15.18	216
Vertical Pipe	ID=1,200,H=1,220	pcs	20	122.72	2,454
Vertical Pipe	ID=1,200,H=390	pcs	10	61.21	612
Placing Vertical Pipe	ID=1,200,H=1,220	pcs	20	122.28	2,445
Placing Vertical Pipe	ID=1,200,H=390	pcs	10	39.09	390
Concrete Lid with Iron Lid		pcs	10	89.51	895
Placing Concrete Lid		pcs	10	86.96	869
Total per 10 Place					8,684
Total per 1 Place					868

Table A12.28 Restoration Work of Pavement (Per 100m2)

Items	Specifications	Unit	Amount	Unit Price	Price
Asphalt on Surface	1LT/m2	th-m2	0.10	210.00	21
Adhesive Asphalt	0.6LT/m2	th-m2	0.10	152.65	15
Midle Density Asphalt Concret	t=3.5cm	m2	100	5.44	544
High Density Asphalt Concret	t=1.5cm	m2	100	2.36	236
Concrete Paving		m3	15.0	7.33	109
Concrete	200kg/ccm2	m3	15.0	88.51	1,327
Rolling-fill on Subbed	Unscreened Crushed Stone t=0.20m	c-m2	1.00	374.14	374
Total					2,626

Table A12.29 Open Cut Method Piping Construction Cost (Out D 630mm, Inner D 535mm, Per 100m) Excavation Width 2.45m, Excavation Depth 4.4m

Items	Specifications	Unit	Amount	Unit Price	Price
1.Cutting Pavement					
Cutting Concrete-pavement	Hammer t=200	m3	36.8	3.45	126
Concrete-wreck Lording	Backhoe 0.2m3	m3	36.8	0.53	19
Concrete-wreck Portage	Dumptruck 6m3 The First 1km	c-m3	0.37	108.97	40
Concrete-wreck Portage	Dumptruck 6m3 The Rest 24km	c-m3	0.37	610.08	225
Leveling Concrete-wreck	Bulldozer 15t L=50m	m3	36.8	1.03	37
Subtotal					447
2.Esrthwork					
Ordinary Soil Excavation	Backhoe 0.2m3 With Lording	m3	735	0.54	396
Soft Rock Excavation	Backhoe 0.2m3 With Breaker	m3	203	0.43	87
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	4.64	108.97	505
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	4.64	25.42	117
Surplus Soil Portage	Dumptruck 6m3 The First 1km	c-m3	0.98	108.97	106
Surplus Soil Portage	Dumptruck 6m3 The Rest 24km	c-m3	0.98	610.08	597
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	98	1.03	100
Backfilling 1	Throwing and Compacting by Human Po	m3	92	9.14	840
Soft-rock Crushed(SRC)		m3	92	1.16	106
Compacting	Water Binding	m3	92	2.28	209
Backfillingsoil Lording	Backhoe 0.2m3	m3	464	0.53	245
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	4.64	108.97	505
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	4.64	25.42	117
Backfilling 2	Product Backhoe 0.2m3 Throw Down	m3	39	0.53	20
Tamping Soil	Tamper 60～100kg	m3	39	4.20	163
Backfilling 3	Product Backhoe 0.2m3 Throw Down	m3	261	0.53	138
Backfilling 3	SRC Backhoe 0.2m3 Throw Down	m3	376	0.60	225
Tamping Soil	Tamper 60～100kg	m3	637	4.20	2,675
Subtotal					7,151
3.Foundation Work					
SRC		m3	71	1.16	82
Throwing Down SRC	Backhoe 0.2m3 Throw Down	m3	71	2.99	212
Compacting SRC	Human Power	m3	71	7.43	527
Compacting SRC	Water Binding	m3	71	2.28	161
Subtotal					982
4.Temporary Work					
Unwatering	Below 2m3/min	m3	725	0.38	275
Sheathing	Wood Sheet Pile、Wale、Beam	m2	624	18.64	11,631
Subtotal					11,906
5.Laying Work of Pipe					
High-density Polyethylene Pipe	φ630-535 L=12m	m	97.5	42.57	4,150
Laying Pipe		m	97.5	4.74	462
Pipe Joint		pcs	7	18.58	130
Rubber Ring		pcs	14	8.33	116
Subtotal					4,858
6.Restoration Work of Pavement					
Restoration Work of Pavement		c-m2	2.45	2,626	6,433
Subtotal					6,433
7.Setting Manhole Work (1.7Place per 100m)					
Setting Manhole		pcs	1.7	1,841	3,129
Subtotal					3,129
1.～7.Total					34,906
8.Setting Work of House Inlet and Latelal (5% of Uper Construction Cost)		lot	1		1,745
1.～8.Total					36,651
9.Other Works (10% of Uper Construction Cost:		lot	1		3,665
Reset of Underground Installation and Side Ditch,Others)					
10.Pure Construction Cost	Direct CC+				40,316
	Common Temporary Work Cost				

Table A12.29 (Continued)

Items	Specifications	Unit	Amount	Unit Price	Price
11.Managing Cost at Site	25% of Pure CC	lot	1		10,079
12.The Cost of Works					50,395
13.General Construction Cost	15% of The Cost of Work	lot	1		7,559
Total Construction Cost					57,954

Table A12.30 Itemized account of Setting Manhole Work (Per 100 Place)

Items	Specifications	Unit	Amount	Unit Price	Price
Casting Leveling Concrete		m3	2.21	8.36	18
Leveling Concrete	175kg/cm2	m3	2.21	84.45	186
Leveling Concrete Form		m2	4.20	12.16	51
Reinforced Concrete	250kg/cm2	m3	27.68	95.07	2,631
Casting Base Concrete	100～300kg/cm2	m3	5.42	8.36	45
Casting Wall Concrete	100～300kg/cm2,backet	m3	22.26	5.94	132
Plain Concrete	200kg/cm2	m3	5.21	88.51	461
Casting Invert Concrete	100～300kg/cm2	m3	5.21	8.36	43
Processing Steel Bar (Straight Ba	SD30φ12 With bar	t	0.576	526.87	303
Processing Steel Bar (Straight Ba	SD30φ16 With bar	t	1.907	520.49	992
Processing Steel Bar (bending Ba	SD30φ12 With bar	t	0.576	561.25	323
Processing Steel Bar (bending Ba	SD30φ16 With bar	t	0.784	534.00	418
Placing Steel bar (Base)	Below φ16	t	1.123	128.90	144
Placing Steel bar (Wall)	Below φ16	t	2.720	140.44	381
Placing Form(Base)	Wood	m2	11.40	1.46	16
Placing Form(Wall)	Wood	m2	253.86	13.88	3,523
Mortaring fase on invert	Thickness 30mm	m2	28.82	15.18	437
Concrete Board	1,900＊1,900	pcs	10	108.98	1,089
PlacingConcrete Board	1,900＊1,900	pcs	10	100.54	1,005
Vertical Pipe	ID=1,200,H=1,220+780	pcs	20	122.72	2,454
Placing Vertical Pipe	ID=1,200,H=1,220	pcs	10	122.28	1,222
Placing Vertical Pipe	ID=1,200,H=780	pcs	10	78.18	781
Concrete Lid with Iron Lid		pcs	10	89.51	895
Placing Concrete Lid		pcs	10	86.96	869
Total per 10 Place					18,419
Total per 1 Place					1,841

Table A12.31 Restoration Work of Pavement(Per 100m2)

Items	Specifications	Unit	Amount	Unit Price	Price
Asphalt on Surface	1LT/m2	th-m2	0.10	210.00	21
Adhesive Asphalt	0.6LT/m2	th-m2	0.10	152.65	15
Midle Density Asphalt Concrete	t=3.5cm	m2	100	5.44	544
High Density Asphalt Concrete	t=1.5cm	m2	100	2.36	236
Concrete Paving		m3	15.0	7.33	109
Concrete	200kg/ccm2	m3	15.0	88.51	1,327
Rolling-fill on Subbed	Unscreened Crushed Stone t＝0.20m	c-m2	1.00	374.14	374
Total					2,626

Table A12.32 Open Cut Method Piping Construction Cost (Out D 800mm, Inner D 678mm, Per 100m) Excavation Width 2.50m, Excavation Depth 5.0m

Items	Specifications	Unit	Amount	Unit Price	Price
1.Cutting Pavement					
Cutting Concrete-pavement	Hammer t=200	m3	37.5	3.45	129
Concrete-wreck Lording	Backhoe 0.2m3	m3	37.5	0.53	19
Concrete-wreck Portage	Dumptruck 6m3 The First 1km	c-m3	0.38	108.97	41
Concrete-wreck Portage	Dumptruck 6m3 The Rest 24km	c-m3	0.38	610.08	231
Leveling Concrete-wreck	Bulldozer 15t L=50m	m3	37.5	1.03	38
Subtotal					458
2.Esrthwork					
Ordinary Soil Excavation	Backhoe 0.2m3 With Lording	m3	750	0.54	405
Soft Rock Excavation	Backhoe 0.2m3 With Breaker	m3	300	0.43	129
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	5.38	108.97	586
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	5.38	25.42	136
Surplus Soil Portage	Dumptruck 6m3 The First 1km	c-m3	1.00	108.97	108
Surplus Soil Portage	Dumptruck 6m3 The Rest 24km	c-m3	1	610.08	610
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	100	1.03	103
Backfilling 1(SRC)	Throwing and Compacting by Human Po	m3	101	9.14	923
Soft-rock Crushed(SRC)		m3	101	1.16	117
Compacting	Water Binding	m3	101	2.28	230
Backfillingsoil Lording	Backhoe 0.2m3	m3	538	0.53	285
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	5.38	108.97	586
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	5.38	25.42	136
Backfilling 2	Product Backhoe 0.2m3 Throw Down	m3	105	0.53	55
Tamping Soil	Tamper 60～100kg	m3	105	4.20	441
Backfilling 3	Product Backhoe 0.2m3 Throw Down	m3	180	0.53	95
Backfilling 3	SRC Backhoe 0.2m3 Throw Down	m3	574	0.60	344
Tamping Soil	Tamper 60～100kg	m3	754	4.20	3,166
Subtotal					8,455
3.Foundation Work					
SRC		m3	75	1.16	87
Throwing Down SRC	Backhoe 0.2m3 Throw Down	m3	75	2.99	224
Compacting SRC	Human Power	m3	75	7.43	557
Compacting SRC	Water Binding	m3	75	2.28	171
Subtotal					1,039
4.Temporary Work					
Unwatering	Below 2m3/min	m3	750	0.38	285
Sheathing	Wood Sheet Pile、Wale、Beam	m2	630	18.64	11,743
Subtotal					12,028
5.Laying Work of Pipe					
High-density Polyethylene Pipe	φ800-678 L=12m	m	97.8	59.86	5,854
Laying Pipe		m	97.8	5.19	507
Pipe Joint		pcs	8	85.48	683
Rubber Ring		pcs	16	11.40	182
Subtotal					7,226
6.Restoration Work of Pavement					
Restoration Work of Pavement		c-m2	2.5	2,626	6,565
Subtotal					6,565
7.Setting Manhole Work (1.3Place per 100m)					
Setting Manhole		pcs	1.3	2,122	2,758
Subtotal					2,758
1.～7.Total					38,529
8.Setting Work of House Inlet and Latelal (5% of Uper Construction Cost)		pcs	1		1,926
1.～8.Total					40,455
9.Other Works (10% of Uper Construction Cost:		lot	1		4,045
Reset of Underground Installation and Side Ditch,Others)					
10.Pure Construction Cost	Direct CC+				44,500
	Common Temporary Work Cost				

Table A12.32 (Continued)

Items	Specifications	Unit	Amount	Unit Price	Price
11.Managing Cost at Site	25% of Pure CC	lot	1		11,125
12.The Cost of Works					55,625
13.General Construction Cost	15% of The Cost of Work	lot	1		8,343
Total Construction Cost					63,968

Table A12.33 Itemized account of Setting Manhole Work (Per 100 Place)

Items	Specifications	Unit	Amount	Unit Price	Price
Casting Leveling Concrete		m3	2.65	8.36	22
Leveling Concrete	175kg/cm2	m3	2.65	84.45	223
Leveling Concrete Form		m2	4.60	12.16	55
Reinforced Concrete	250kg/cm2	m3	33.17	95.07	3,153
Casting Base Concrete	100～300kg/cm2	m3	6.62	8.36	55
Casting Wall Concrete	100～300kg/cm2,backet	m3	26.55	5.94	157
Plain Concrete	200kg/cm2	m3	8.17	88.51	723
Casting Invert Concrete	100～300kg/cm2	m3	8.17	8.36	68
Processing Steel Bar (Straight Ba	SD30φ12 With bar	t	0.648	526.87	341
Processing Steel Bar (Straight Ba	SD30φ16 With bar	t	2.514	520.49	1,308
Processing Steel Bar (bending Ba	SD30φ12 With bar	t	0.648	561.25	363
Processing Steel Bar (bending Ba	SD30φ16 With bar	t	0.933	534.00	498
Placing Steel bar (Base)	Below φ16	t	1.373	128.90	176
Placing Steel bar (Wall)	Below φ16	t	3.162	140.44	444
Placing Form(Base)	Wood	m2	12.60	1.46	18
Placing Form(Wall)	Wood	m2	309.33	13.88	4,293
Mortaring fase on invert	Thickness 30mm	m2	37.81	15.18	573
Concrete Board	1,900＊1,900	pcs	10	108.98	1,089
PlacingConcrete Board	1,900＊1,900	pcs	10	100.54	1,005
Vertical Pipe	ID=1,200,H=1,220	pcs	20	122.72	2,454
Placing Vertical Pipe	ID=1,200,H=1,220	pcs	20	122.28	2,445
Concrete Lid with Iron Lid		pcs	10	89.51	895
Placing Concrete Lid		pcs	10	86.96	869
Total per 10 Place					21,227
Total per 1 Place					2,122

Table A12.34 Restoration Work of Pavement(Per 100m2)

Items	Specifications	Unit	Amount	Unit Price	Price
Asphalt on Surface	1LT/m2	th-m2	0.10	210.00	21
Adhesive Asphalt	0.6LT/m2	th-m2	0.10	152.65	15
Midle Density Asphalt Concrete	t=3.5cm	m2	100	5.44	544
High Density Asphalt Concrete	t=1.5cm	m2	100	2.36	236
Concrete Paving		m3	15.0	7.33	109
Concrete	200kg/ccm2	m3	15.0	88.51	1,327
Rolling-fill on Subbed	Unscreened Crushed Stone t＝0.20m	c-m2	1.00	374.14	374
Total					2,626

Table A12.35 Open Cut Method Piping Construction Cost (Out D 1,000mm, Inner D 831mm, Per 100m) Excavation Width 2.70m, Excavation Depth 5.6m

Items	Specifications	Unit	Amount	Unit Price	Price
1.Cutting Pavement					
Cutting Concrete-pavement	Hammer t=200	m3	40.5	3.45	139
Concrete-wreck Lording	Backhoe 0.2m3	m3	40.5	0.53	21
Concrete-wreck Portage	Dumptruck 6m3 The First 1km	c-m3	0.41	108.97	44
Concrete-wreck Portage	Dumptruck 6m3 The Rest 24km	c-m3	0.41	610.08	250
Leveling Concrete-wreck	Bulldozer 15t L=50m	m3	40.5	1.03	41
Subtotal					495
2.Esrthwork					
Ordinary Soil Excavation	Backhoe 0.2m3 With Lording	m3	810	0.54	437
Soft Rock Excavation	Backhoe 0.2m3 With Breaker	m3	442	0.43	190
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	6.55	108.97	713
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	6.55	25.42	166
Surplus Soil Portage	Dumptruck 6m3 The First 1km	c-m3	1.08	108.97	117
Surplus Soil Portage	Dumptruck 6m3 The Rest 24km	c-m3	1.08	610.08	658
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	108	1.03	111
Backfilling 1(SRC)	Throwing and Compacting by Human Powe	m3	124	9.14	1,133
Soft-rock Crushed(SRC)		m3	124	1.16	143
Compacting	Water Binding	m3	124	2.28	282
Backfillingsoil Lording	Backhoe 0.2m3	m3	655	0.53	347
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	6.55	108.97	713
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	6.55	25.42	166
Backfilling 2	Product Backhoe 0.2m3 Throw Down	m3	187	0.53	99
Tamping Soil	Tamper 60～100kg	m3	187	4.20	785
Backfilling 3	Product Backhoe 0.2m3 Throw Down	m3	213	0.53	112
Backfilling 3	SRC Backhoe 0.2m3 Throw Down	m3	489	0.60	293
Tamping Soil	Tamper 60～100kg	m3	702	4.20	2,948
Subtotal					9,413
3.Foundation Work					
SRC		m3	87	1.16	100
Throwing Down SRC	Backhoe 0.2m3 Throw Down	m3	87	2.99	260
Compacting SRC	Human Power	m3	87	7.43	646
Compacting SRC	Water Binding	m3	87	2.28	198
Subtotal					1,204
4.Temporary Work					
Unwatering	Below 2m3/min	m3	850	0.38	323
Sheathing	Wood Sheet Pile、Wale、Beam	m2	636	18.64	11,855
Subtotal					12,178
5.Laying Work of Pipe					
High-density Polyethylene Pi	φ1,000-831 L=12m	m	97.8	97.72	9,557
Laying Pipe		m	97.8	6.01	587
Pipe Joint		pcs	9	100.80	907
Rubber Ring		pcs	18	33.00	594
Subtotal					11,645
6.Restoration Work of Pavement					
Restoration Work of Pavement		c-m2	2.7	2,626	7,090
Subtotal					7,090
7.Setting Manhole Work (1.3Place per 100m)					
Setting Manhole		pcs	1.2	1,809	2,170
Subtotal					2,170
1.～7.Total					44,195
8.Setting Work of House Inlet and Latelal (5% of Uper Construction Cost)		lot	1		2,209
1.～8.Total					46,404
9.Other Works (10% of Uper Construction Cost:		lot	1		4,640
Reset of Underground Installation and Side Ditch,Others)					
10.Pure Construction Cost	Direct CC+				51,044
	Common Temporary Work Cost				

Table A12.35 (Continued)

Items	Specifications	Unit	Amount	Unit Price	Price
11.Managing Cost at Site	25% of Pure CC	lot	1		12,761
12.The Cost of Works					63,805
13.General Construction Cost	15% of The Cost of Work	lot	1		9,570
Total Construction Cost					73,375

Table A12.36 Itemized account of Setting Manhole Work (Per 100 Place)

Items	Specifications	Unit	Amount	Unit Price	Price
Casting Leveling Concrete		m3	3.00	8.36	25
Leveling Concrete	175kg/cm2	m3	3.00	84.45	253
Leveling Concrete Form		m2	4.90	12.16	59
Reinforced Concrete	250kg/cm2	m3	37.34	95.07	3,549
Casting Base Concrete	100～300kg/cm2	m3	7.59	8.36	63
Casting Wall Concrete	100～300kg/cm2,backet	m3	29.75	5.94	176
Plain Concrete	200kg/cm2	m3	11.60	88.51	1,026
Casting Invert Concrete	100～300kg/cm2	m3	11.60	8.36	96
Processing Steel Bar (Straight	SD30φ12 With bar	t	0.780	526.87	410
Processing Steel Bar (Straight	SD30φ16 With bar	t	2.695	520.49	1,402
Processing Steel Bar (bending	SD30φ12 With bar	t	0.780	561.25	437
Processing Steel Bar (bending	SD30φ16 With bar	t	1.085	534.00	579
Placing Steel bar (Base)	Below φ16	t	1.610	128.90	207
Placing Steel bar (Wall)	Below φ16	t	3.730	140.44	523
Placing Form(Base)	Wood	m2	13.50	1.46	19
Placing Form(Wall)	Wood	m2	358.71	13.88	4,978
Mortaring fase on invert	Thickness 30mm	m2	45.91	15.18	696
Vertical Pipe	ID=1,200,H=1,030	pcs	10	61.21	612
Placing Vertical Pipe	ID=1,200,H=1,030	pcs	10	122.28	1,222
Concrete Lid with Iron Lid		pcs	10	89.51	895
Placing Concrete Lid		pcs	10	86.96	869
Total per 10 Place					18,096
Total per 1 Place					1,809

Table A12.37 Restoration Work of Pavement (Per 100m2)

Items	Specifications	Unit	Amount	Unit Price	Price
Asphalt on Surface	1LT/m2	th-m2	0.10	210.00	21
Adhesive Asphalt	0.6LT/m2	th-m2	0.10	152.65	15
Midle Density Asphalt Concre	t=3.5cm	m2	100	5.44	544
High Density Asphalt Concret	t=1.5cm	m2	100	2.36	236
Concrete Paving		m3	15.0	7.33	109
Concrete	200kg/ccm2	m3	15.0	88.51	1,327
Rolling-fill on Subbed	Unscreened Crushed Stone t＝0.20m	c-m2	1.00	374.14	374
Total					2,626

Table A12.38 Open Cut Method Piping Construction Cost (Out D 1,200mm, Inner D 1,030mm, Per 100m) Excavation Width 2.90m, Excavation Depth 6.2m

Items	Specifications	Unit	Amount	Unit Price	Price
1.Cutting Pavement					
Cutting Concrete-pavement	Hammer t=200	m3	43.5	3.45	150
Concrete-wreck Lording	Backhoe 0.2m3	m3	43.5	0.53	23
Concrete-wreck Portage	Dumptruck 6m3 The First 1km	c-m3	0.44	108.97	47
Concrete-wreck Portage	Dumptruck 6m3 The Rest 24km	c-m3	0.44	610.08	268
Leveling Concrete-wreck	Bulldozer 15t L=50m	m3	43.5	1.03	44
Subtotal					532
2.Esrthwork					
Ordinary Soil Excavation	Backhoe 0.2m3 With Lording	m3	870	0.54	469
Soft Rock Excavation	Backhoe 0.2m3 With Breaker	m3	608	0.43	261
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	7.78	108.97	847
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	7.78	25.42	197
Surplus Soil Portage	Dumptruck 6m3 The First 1km	c-m3	1.16	108.97	126
Surplus Soil Portage	Dumptruck 6m3 The Rest 24km	c-m3	1.16	610.08	707
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	116	1.03	119
Backfilling 1(SRC)	Throwing and Compacting by Human Po	m3	148	9.14	1,352
Soft-rock Crushed(SRC)		m3	148	1.16	171
Compacting	Water Binding	m3	148	2.28	337
Backfillingsoil Lording	Backhoe 0.2m3	m3	778	0.53	412
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	7.78	108.97	847
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	7.78	610.08	4,746
Backfilling 2	Product Backhoe 0.2m3 Throw Down	m3	285	0.53	151
Tamping Soil	Tamper 60～100kg	m3	285	4.20	1,197
Backfilling 3	Product Backhoe 0.2m3 Throw Down	m3	213	0.53	112
Backfilling 3	SRC Backhoe 0.2m3 Throw Down	m3	489	0.60	293
Tamping Soil	Tamper 60～100kg	m3	702	4.20	2,948
Subtotal					15,292
3.Foundation Work					
SRC		m3	100	1.16	116
Throwing Down SRC	Backhoe 0.2m3 Throw Down	m3	100	2.99	299
Compacting SRC	Human Power	m3	100	7.43	743
Compacting SRC	Water Binding	m3	100	2.28	228
Subtotal					1,386
4.Temporary Work					
Unwatering	Below 2m3/min	m3	950	0.38	361
Sheathing	Wood Sheet Pile、Wale、Beam	m2	642	18.64	11,966
Subtotal					12,327
5.Laying Work of Pipe					
High-density Polyethylene Pipe	φ1,200-1,030 L=12m	m	97.8	137.43	13,440
Laying Pipe		m	97.8	6.01	587
Pipe Joint		pcs	9	158.86	1,429
Rubber Ring		pcs	18	45.46	818
Subtotal					16,274
6.Restoration Work of Pavement					
Restoration Work of Pavement		c-m2	2.9	2,626	7,615
Subtotal					7,615
7.Setting Manhole Work (1.2Place per 100m)					
Setting Manhole		pcs	1.2	1,918	2,301
Subtotal					2,301
1.～7.Total					55,727
8.Setting Work of House Inlet and Latelal (5% of Uper Construction Cost)		lot	1		2,786
1.～8.Total					58,513
9.Other Works (10% of Uper Construction Cost:		lot	1		5,851
Reset of Underground Installation and Side Ditch,Others)					
10.Pure Construction Cost	Direct CC+				64,364
	Common Temporary Work Cost				

Table A12.38 (Continued)

Items	Specifications	Unit	Amount	Unit Price	Price
11.Managing Cost at Site	25% of Pure CC	lot	1		16,091
12.The Cost of Works					80,455
13.General Construction Cost	15% of The Cost of Work	lot	1		12,068
Total Construction Cost					92,523

Table A12.39 Itemized account of Setting Manhole Work (Per 100 Place)

Items	Specifications	Unit	Amount	Unit Price	Price
Casting Leveling Concrete		m3	3.00	8.36	25
Leveling Concrete	175kg/cm2	m3	3.00	84.45	253
Leveling Concrete Form		m2	4.90	12.16	59
Reinforced Concrete	250kg/cm2	m3	38.84	95.07	3,692
Casting Base Concrete	100～300kg/cm2	m3	7.59	8.36	63
Casting Wall Concrete	100～300kg/cm2,backet	m3	31.86	5.94	189
Plain Concrete	200kg/cm2	m3	12.19	88.51	1,078
Casting Invert Concrete	100～300kg/cm2	m3	12.19	8.36	101
Processing Steel Bar (Straight Ba	SD30φ12 With bar	t	0.936	526.87	493
Processing Steel Bar (Straight Ba	SD30φ16 With bar	t	2.791	520.49	1,452
Processing Steel Bar (bending Ba	SD30φ12 With bar	t	0.936	561.25	525
Processing Steel Bar (bending Ba	SD30φ16 With bar	t	1.181	534.00	630
Placing Steel bar (Base)	Below φ16	t	1.610	128.90	207
Placing Steel bar (Wall)	Below φ16	t	4.234	140.44	594
Placing Form(Base)	Wood	m2	13.50	1.46	19
Placing Form(Wall)	Wood	m2	394.84	13.88	5,480
Mortaring fase on invert	Thickness 30mm	m2	48.05	15.18	729
Vertical Pipe	ID=1,200,H=1,030	pcs	10	61.21	612
Placing Vertical Pipe	ID=1,200,H=1,030	pcs	10	122.28	1,222
Concrete Lid with Iron Lid		pcs	10	89.51	895
Placing Concrete Lid		pcs	10	86.96	869
Total every 10 Place					19,187
Total every 1 Place					1,918

Table A12.40 Restoration Work of Pavement (Per 100m2)

Items	Specifications	Unit	Amount	Unit Price	Price
Asphalt on Surface	1LT/m2	th-m2	0.10	210.00	21
Adhesive Asphalt	0.6LT/m2	th-m2	0.10	152.65	15
Midle Density Asphalt Concrete	t=3.5cm	m2	100	5.44	544
High Density Asphalt Concrete	t=1.5cm	m2	100	2.36	236
Concrete Paving		m3	15.0	7.33	109
Concrete	200kg/ccm2	m3	15.0	88.51	1,327
Rolling-fill on Subbed	Unscreened Crushed Stone t＝0.20m	c-m2	1.00	374.14	374
Total					2,626

Table A12.41 Construction Cost of Tunnel Construction Method for the Complete Inner Diameter of 1,500 mm

1.Shield Construction Method (1,500mm)	$1.06 * 10^{-5} * X^2 - 16.09 * 10^{-3} * X + 101.88$ $= 1.06 * 22.5 - 16.09 * 1.5 + 101.88$ = 1,015.95 thousand yen/m X: diameter (mm)
2. Tunnel Construction Method (1,500mm)	1,015.95 ∗ 0.70 = 711.17 h-yen/m = 5.926 th -USD/m
3. Adjusted to Cuban price based on the ratio between Japanese and Cuban personnel costs.	5.926 ∗ 0.775 = 4.593 th-USD/m ≒ 4.6 th-USD/m

Note: The construction cost of Tunnel Construction Method is estimated based on the Japanese cost function of shield construction method. The construction cost of Tunnel Construction Method is assumed to be 70% of Shield Construction Method which is applied to the same diameter. This ratio would be set at 60% for large diameter.

Table A12.42 Construction Cost for Inserting Pipe in Tunnel (Out D 250mm, Inner D 216mm, Per 100m)

Items	Specifications	Unit	Amount	Unit Price	Price
1.Foundation Work					
Carrying Soft-rock Crushed(SRC) in		m3	38	1.73	65
SRC		m3	38	1.16	44
Compacting	Human Power	m3	38	7.43	282
Compacting	Water Binding	m3	38	2.28	86
Protective Concrete	200kg/cm2	m3	5.96	88.51	527
Casting Concrete		m3	5.96	11.57	68
Subtotal					1,072
2.Laying Work of Pipe					
High-density Polyethylene Pipe	φ250-216 L=12m	m	100	5.66	566
Laying Pipe		m	100	1.87	187
Pipe Joint		u	8.3	2.89	23
Rubber Ring		u	16.7	0.76	12
Subtotal					788
1～2. Total					1,860
3.Other Works (10% of Uper Construction Cost:		set	1		186
Reset of Underground Installation and Others)					
4.Pure Construction Cost	Direct CC+				2,046
	Common Temporary Work Cost				
5.Managing Cost at Site	25% of Pure CC	set	1		511
6.The Cost of Works					2,557
7.General Construction Cost	15% of The Cost of Work	set	1		383
Total Construction Cost					2,940

Table A12.43 Construction Cost for Inserting Pipe in Tunnel (Out D 315mm, Inner D 271mm, Per 100m)

Items	Specifications	Unit	Amount	Unit Price	Price
1.Foundation Work					
Carrying Soft-rock Crushed(SRC) in		m3	44	1.73	76
SRC		m3	44	1.16	51
Compacting	Human Power	m3	44	7.43	326
Compacting	Water Binding	m3	44	2.28	100
Protective Concrete	200kg/cm2	m3	6.27	88.51	554
Casting Concrete		m3	6.27	11.57	72
Subtotal					1,179
2.Laying Work of Pipe					
High-density Polyethylene Pipe	φ315-271 L=12m	m	100	8.52	852
Laying Pipe		m	100	1.87	187
Pipe Joint		u	8.3	4.83	40
Rubber Ring		u	16.7	1.54	25
Subtotal					1,104
1～2. Total					2,283
3.Other Works (10% of Uper Construction Cost:		set	1		228
Reset of Underground Installation and Others)					
4.Pure Construction Cost	Direct CC+				2,511
	Common Temporary Work Cost				
5.Managing Cost at Site	25% of Pure CC	set	1		627
6.The Cost of Works					3,138
7.General Construction Cost	15% of The Cost of Work	set	1		470
Total Construction Cost					3,608

Table A12.44 Construction Cost for Inserting Pipe in Tunnel (Out D 400mm, Inner D 343mm, Per 100m)

Items	Specifications	Unit	Amount	Unit Price	Price
1.Foundation Work					
Carrying Soft-rock Crushed(SRC) in		m3	51	1.73	88
SRC		m3	51	1.16	59
Compacting	Human Power	m3	51	7.43	378
Compacting	Water Binding	m3	51	2.28	116
Protective Concrete	200kg/cm2	m3	6.48	88.51	573
Casting Concrete		m3	6.48	11.57	74
Subtotal					1,288
2.Laying Work of Pipe					
High-density Polyethylene Pipe	φ400-343 L=12m	m	100	13.67	1,367
Laying Pipe		m	100	2.60	260
Pipe Joint		u	8.3	6.85	56
Rubber Ring		u	16.7	2.40	40
Subtotal					1,723
1～2. Total					3,011
3.Other Works (10% of Uper Construction Cost:		set	1		301
Reset of Underground Installation and Others)					
4.Pure Construction Cost	Direct CC+				3,312
	Common Temporary Work Cost				
5.Managing Cost at Site	25% of Pure CC	set	1		828
6.The Cost of Works					4,140
7.General Construction Cost	15% of The Cost of Work	set	1		621
Total Construction Cost					4,761

Table A12.45 Construction Cost for Inserting Pipe in Tunnel (Out D 500mm, Inner D 427mm, Per 100m)

Items	Specifications	Unit	Amount	Unit Price	Price
1.Foundation Work					
Carrying Soft-rock Crushed(SRC) in		m3	58	1.73	100
SRC		m3	58	1.16	67
Compacting	Human Power	m3	58	7.43	430
Compacting	Water Binding	m3	58	2.28	132
Protective Concrete	200kg/cm2	m3	6.55	88.51	579
Casting Concrete		m3	6.55	11.57	75
Subtotal					1,383
2.Laying Work of Pipe					
High-density Polyethylene Pipe	φ500-427 L=12m	m	100	24.92	2,492
Laying Pipe		m	100	1.87	187
Pipe Joint		u	8.3	11.28	93
Rubber Ring		u	16.7	5.16	86
Subtotal					2,858
1～2. Total					4,241
3.Other Works (10% of Uper Construction Cost:		set	1		424
Reset of Underground Installation and Others)					
4.Pure Construction Cost	Direct CC+				4,665
	Common Temporary Work Cost				
5.Managing Cost at Site	25% of Pure CC	set	1		1,166
6.The Cost of Works					5,831
7.General Construction Cost	15% of The Cost of Work	set	1		874
Total Construction Cost					6,705

Table A12.46 Construction Cost for Inserting Pipe in Tunnel (Out D630mm, Inner D 535mm, Per 100m

Items	Specifications	Unit	Amount	Unit Price	Price
1.Foundation Work					
Carrying Soft-rock Crushed(SRC) in		m3	67	1.73	115
SRC		m3	67	1.16	77
Compacting	Human Power	m3	67	7.43	497
Compacting	Water Binding	m3	67	2.28	152
Protective Concrete	200kg/cm2	m3	6.39	88.51	565
Casting Concrete		m3	6.39	11.57	73
Subtotal					1,479
2.Laying Work of Pipe					
High-density Polyethylene Pipe	φ630-535 L=12m	m	100	42.57	4,257
Laying Pipe		m	100	4.74	474
Pipe Joint		u	8.3	18.58	154
Rubber Ring		u	16.7	8.33	139
Subtotal					5,024
1～2. Total					6,503
3.Other Works (10% of Uper Construction Cost:		set	1		650
Reset of Underground Installation and Others)					
4.Pure Construction Cost	Direct CC+				7,153
	Common Temporary Work Cost				
5.Managing Cost at Site	25% of Pure CC	set	1		1,788
6.The Cost of Works					8,941
7.General Construction Cost	15% of The Cost of Work	set	1		1,341
Total Construction Cost					10,282

Table A12.47 Construction Cost for Inserting Pipe in Tunnel (Out D 800mm,Inner D 678mm, Per 100m)

Items	Specifications	Unit	Amount	Unit Price	Price
1.Foundation Work					
Carrying Soft-rock Crushed(SRC) in		m3	77	1.73	133
SRC		m3	77	1.16	89
Compacting	Human Power	m3	77	7.43	572
Compacting	Water Binding	m3	77	2.28	175
Protective Concrete	200kg/cm2	m3	5.88	88.51	520
Casting Concrete		m3	5.88	11.57	68
Subtotal					1,557
2.Laying Work of Pipe					
High-density Polyethylene Pipe	φ800-678 L=12m	m	100	59.86	5,986
Laying Pipe		m	100	4.74	474
Pipe Joint		u	8.3	85.48	709
Rubber Ring		u	16.7	11.40	190
Subtotal					7,359
1～2. Total					8,916
3.Other Works (10% of Uper Construction Cost:		set	1		891
Reset of Underground Installation and Others)					
4.Pure Construction Cost	Direct CC+				9,807
	Common Temporary Work Cost				
5.Managing Cost at Site	25% of Pure CC	set	1		2,451
6.The Cost of Works					12,258
7.General Construction Cost	15% of The Cost of Work	set	1		1,838
Total Construction Cost					14,096

Table A12.48 Construction Cost for Inserting Pipe in Tunnel (Out D 1,000mm, Inner D 851mm, Per 100m)

Items	Specifications	Unit	Amount	Unit Price	Price
1.Foundation Work					
Carrying Soft-rock Crushed(SRC) in		m3	87	1.73	150
SRC		m3	87	1.16	100
Compacting	Human Power	m3	87	7.43	646
Compacting	Water Binding	m3	87	2.28	198
Protective Concrete	200kg/cm2	m3	4.89	88.51	432
Casting Concrete		m3	4.89	11.57	56
Subtotal					1,582
2.Laying Work of Pipe					
High-density Polyethylene Pipe	φ1,000-851 L=12m	m	100	97.72	9,772
Laying Pipe		m	100	6.01	601
Pipe Joint		u	8.3	100.80	836
Rubber Ring		u	16.7	33.00	551
Subtotal					11,760
1～2. Total					13,342
3.Other Works (10% of Uper Construction Cost:		set	1		1,334
Reset of Underground Installation and Others)					
4.Pure Construction Cost	Direct CC＋				14,676
	Common Temporary Work Cost				
5.Managing Cost at Site	25% of Pure CC	set	1		3,669
6.The Cost of Works					18,345
7.General Construction Cost	15% of The Cost of Work	set	1		2,751
Total Construction Cost					21,096

Table A12.49 Construction Cost for Inserting Pipe in Tunnel (Out D 1,200mm,Inner D 1,030mm, Per 100m)

Items	Specifications	Unit	Amount	Unit Price	Price
1.Foundation Work					
Carrying Soft-rock Crushed(SRC) in		m3	94	1.73	162
SRC		m3	94	1.16	109
Compacting	Human Power	m3	94	7.43	698
Compacting	Water Binding	m3	94	2.28	214
Protective Concrete	200kg/cm2	m3	3.55	88.51	314
Casting Concrete		m3	3.55	11.57	41
Subtotal					1,538
2.Laying Work of Pipe					
High-density Polyethylene Pipe	φ1,200-1,030 L=12m	m	100	137.43	13,743
Laying Pipe		m	100	6.01	601
Pipe Joint		u	8.3	158.86	1,318
Rubber Ring		u	16.7	45.46	759
Subtotal					16,421
1～2. Total					17,959
3.Other Works (10% of Uper Construction Cost:		set	1		1,795
Reset of Underground Installation and Others)					
4.Pure Construction Cost	Direct CC＋				19,754
	Common Temporary Work Cost				
5.Managing Cost at Site	25% of Pure CC	set	1		4,938
6.The Cost of Works					24,692
7.General Construction Cost	15% of The Cost of Work	set	1		3,703
Total Construction Cost					28,395

Table A12.50 Construction Cost for Piping of Pressure Pipe (Cast Iron Pipe φ1,350mm, Per 100m, Excavation Width 2.70m, Excavation Depth 4.3m)

Items	Specifications	Unit	Amount	Unit Price	Price
1.Cutting Pavement					
Cutting Concrete-pavement	Hammer t=200	m3	40.5	3.45	139
Concrete-wreck Lording	Backhoe 0.2m3	m3	40.5	0.53	21
Concrete-wreck Portage	Dumptruck 6m3 The First 1km	c-m3	0.41	108.97	44
Concrete-wreck Portage	Dumptruck 6m3 The Rest 24km	c-m3	0.41	610.08	247
Leveling Concrete-wreck	Bulldozer 15t L=50m	m3	40.5	1.03	41
Subtotal					492
2.Esrthwork					
Ordinary Soft Rock Excavation	Backhoe 0.2m3 With Lording	m3	1,031	0.43	443
Excavated Soft Rock Lording	Backhoe 0.2m3	m3	1,031	0.53	546
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	5.40	108.97	588
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	5.40	25.42	137
Surplus Soil Portage	Dumptruck 6m3 The First 1km	c-m3	4.91	108.97	535
Surplus Soil Portage	Dumptruck 6m3 The Rest 24km	c-m3	4.91	610.08	2,995
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	491	1.03	505
Backfilling 1	Throwing and Compacting by Human Pow	m3	113	9.14	1,032
Soft-rock Crushed(SRC)		m3	113	1.16	131
Compacting	Water Binding	m3	113	2.28	257
Backfillingsoil Lording	Backhoe 0.2m3	m3	540	0.53	286
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	5.40	108.97	588
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	5.40	25.42	137
Backfilling 3(Product)	Backhoe 0.2m3 Throw Down	m3	540	0.53	286
Tamping Soil	Tamper 60～100kg	m3	540	4.20	2,268
Subtotal					10,734
3.Foundation Work					
SRC		m3	97	1.16	112
Throwing Down SRC	Backhoe 0.2m3 Throw Down	m3	97	2.99	290
Compacting SRC	Human Power	m3	97	10.66	1,034
Compacting SRC	Water Binding	m3	97	2.28	221
Subtotal					1,657
4.Temporary Work					
Unwatering	Below 2m3/min	m3	850	0.38	323
Subtotal					323
5.Laying Work of Pipe					
Cast Iron Pipe	φ1,350 K-Tipe3 L=6.0m	m	100.0	800.00	80,000
Other Parts of Pipe	3.5% of Direct Cost of Pipe	lot	1		2,800
Laying Pipe		m	100.0	25.41	2,541
Subtotal					85,341
6.Restoration Work of Pavement					
Restoration Work of Pavement		c-m2	2.7	2,626	7,090
Subtotal					7,090
1.～6.Total					105,637
7.Other Works (5% of Uper Construction Cost:		lot	1		5,281
Reset of Underground Installation and Side Ditch,Others)					
8.Pure Construction Cost	Direct CC+				110,918
	Common Temporary Work Cost				
9.Managing Cost at Site	25% of Pure CC	lot	1		27,729
10.The Cost of Works					138,647
11.General Construction Cost	15% of The Cost of Work	lot	1		20,797
Total Construction Cost					159,400

Table A12.51 Restoration Work of Pavement (Per 100m2)

Items	Specifications	Unit	Amount	Unit Price	Price
Asphalt on Surface	1LT/m2	th-m2	0.10	210.00	21
Adhesive Asphalt	0.6LT/m2	th-m2	0.10	152.65	15
Midle Density Asphalt Concrete	t=3.5cm	m2	100	5.44	544
High Density Asphalt Concrete	t=1.5cm	m2	100	2.36	236
Concrete Paving		m3	15.0	7.33	109
Concrete	200kg/ccm2	m3	15.0	88.51	1,327
Rolling-fill on Subbed	Unscreened Crushed Stone t＝0.20m	c-m2	1.00	374.14	374
Total					2,626

Table A12.52 Construction Cost for Piping (Centrifugal Reinforced Concrete Pipe φ 1,500mm, Per 100m, Excavation Width 2.50m, Excavation Depth 5.8m)

Items	Specifications	Unit	Amount	Unit Price	Price
1.Cutting Pavement					
Cutting Concrete-pavement	Hammer t=200	m3	45.0	3.45	155
Concrete-wreck Lording	Backhoe 0.2m3	m3	45.0	0.53	23
Concrete-wreck Portage	Dumptruck 6m3 The First 1km	c-m3	0.45	108.97	49
Concrete-wreck Portage	Dumptruck 6m3 The Rest 24km	c-m3	0.45	610.08	274
Leveling Concrete-wreck	Bulldozer 15t L=50m	m3	45.0	1.03	46
Subtotal					547
2.Esrthwork					
Soft Rock Excavation	Backhoe 0.2m3 With Breaker	m3	1,460	0.43	627
Exacavated Soft Rock Lording	Backhoe 0.2m3	m3	1,460	0.53	773
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	8.95	108.97	975
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	8.95	25.42	227
Surplus Soil Portage	Dumptruck 6m3 The First 1km	c-m3	5.65	108.97	615
Surplus Soil Portage	Dumptruck 6m3 The Rest 24km	c-m3	5.65	610.08	3,446
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	565	1.03	581
Backfilling 1(SRC)	Throwing and Compacting by Human Po	m3	141	9.14	1,288
Soft-rock Crushed(SRC)		m3	141	1.16	163
Compacting	Water Binding	m3	141	2.28	321
Backfillingsoil Lording	Backhoe 0.2m3	m3	895	0.53	474
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	8.95	108.97	975
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	8.95	25.42	227
Backfilling 2	Product Backhoe 0.2m3 Throw Down	m3	115	0.53	60
Backfilling 3	Product Backhoe 0.2m3 Throw Down	m3	780	0.60	468
Tamping Soil	Tamper 60～100kg	m3	895	4.20	3,759
Subtotal					14,979
3.Foundation Work					
SRC		m3	117	1.16	135
Throwing Down SRC	Backhoe 0.2m3 Throw Down	m3	117	2.99	349
Compacting SRC	Human Power	m3	117	7.43	869
Compacting SRC	Water Binding	m3	117	2.28	266
Subtotal					1,619
4.Temporary Work					
Unwatering	Below 2m3/min	m3	1,000	0.38	380
Subtotal					380
5.Laying Work of Pipe					
Centrifugal Reinforced Concrete Pipe	φ1,500 L=2.36m	m	98.2	285.00	27,987
Laying Pipe		m	98.2	22.75	2,234
Subtotal					30,221
6.Restoration Work of Pavement					
Restoration Work of Pavement		c-m2	3.0	2,626	7,878
Subtotal					7,878
7.Setting Manhole Work (1.0Place per 100m)					
Setting Manhole		place	1.0	2,131	2,131
Subtotal					2,131
1.～7.Total					57,755
8.Other Works (10% of Uper Construction Cost:		lot	1		5,775
Reset of Underground Installation and Side Ditch,Others)					
9.Pure Construction Cost	Direct CC+				63,530
	Common Temporary Work Cost				

Table A12.52 (Continued)

Items	Specifications	Unit	Amount	Unit Price	Price
10.Managing Cost at Site	25% of Pure CC	lot	1		15,882
11.The Cost of Works					79,412
12.General Construction Cost	15% of The Cost of Work	lot	1		11,888
Total Construction Cost					91,300

Table A12.53 Itemized account of Setting Manhole Work (Each 100place)

Items	Specifications	Unit	Amount	Unit Price	Price
Casting Leveling Concrete		m3	3.00	8.36	25
Leveling Concrete	175kg/cm2	m3	3.00	84.45	253
Leveling Concrete Form		m2	4.90	12.16	59
Reinforced Concrete	250kg/cm2	m3	29.61	95.07	2,815
Casting Base Concrete	100～300kg/cm2	m3	7.59	8.36	63
Casting Wall Concrete	100～300kg/cm2,backet	m3	22.02	5.94	130
Plain Concrete	200kg/cm2	m3	13.16	88.51	1,164
Casting Invert Concrete	100～300kg/cm2	m3	13.16	8.36	110
Processing Steel Bar (Straight Ba	SD30φ12 With bar	t	1.014	526.87	534
Processing Steel Bar (Straight Ba	SD30φ16 With bar	t	2.647	520.49	1,377
Processing Steel Bar (bending Ba	SD30φ12 With bar	t	1.014	561.25	569
Processing Steel Bar (bending Ba	SD30φ16 With bar	t	1.037	534.00	553
Placing Steel bar (Base)	Below φ16	t	1.610	128.90	207
Placing Steel bar (Wall)	Below φ16	t	4.102	140.44	576
Placing Form(Base)	Wood	m2	13.50	1.46	19
Placing Form(Wall)	Wood	m2	348.27	13.88	4,833
Mortaring fase on invert	Thickness 30mm	m2	50.06	15.18	759
Vertical Pipe	ID=1,200,H=1,030	pcs	30	61.21	1,836
Placing Vertical Pipe	ID=1,200,H=1,030	pcs	30	122.28	3,668
Concrete Lid with Iron Lid		pcs	10	89.51	895
Placing Concrete Lid		pcs	10	86.96	869
Total every 10 Place					21,314
Total every 1 Place					2,131

Table A12.54 Restoration Work of pavement (Each 100m2)

Items	Specifications	Unit	Amount	Unit Price	Price
Asphalt on Surface	1LT/m2	th-m2	0.10	210.00	21
Adhesive Asphalt	0.6LT/m2	th-m2	0.10	152.65	15
Midle Density Asphalt Concrete	t=3.5cm	m2	100	5.44	544
High Density Asphalt Concrete	t=1.5cm	m2	100	2.36	236
Concrete Paving		m3	15.0	7.33	109
Concrete	200kg/ccm2	m3	15.0	88.51	1,327
Rolling-fill on Subbed	Unscreened Crushed Stone t＝0.20m	c-m2	1.00	374.14	374
Total					2,626

Table A12.55 Construction Cost for Piping Instead of Renewal (Centrifugal Reinforced Concrete Pipe φ1,800mm、Per 100m Excavation Width 3.30m, Excavation Depth 7.0m)

Items	Specifications	Unit	Amount	Unit Price	Price
1.Cutting Pavement					
Cutting Concrete-pavement	Hammer t=200	m3	49.5	3.45	170
Concrete-wreck Lording	Backhoe 0.2m3	m3	49.5	0.53	26
Concrete-wreck Portage	Dumptruck 6m3 The First 1km	c-m3	0.50	108.97	53
Concrete-wreck Portage	Dumptruck 6m3 The Rest 24km	c-m3	0.50	610.08	301
Leveling Concrete-wreck	Bulldozer 15t L=50m	m3	49.5	1.03	50
Subtotal					600
2.Esrthwork					
Soft-rock Excavation	Backhoe 0.2m3 With Lording	m3	1,910	0.43	821
Excavated Soft-rock lording	Backhoe 0.2m3	m3	1,910	0.53	1,012
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	19.1	108.97	2,081
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	19.1	25.42	485
Surplus Soil Portage	Dumptruck 6m3 The First 1km	c-m3	7.19	108.97	783
Surplus Soil Portage	Dumptruck 6m3 The Rest 24km	c-m3	7.19	610.08	4,386
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	719	1.03	740
Backfilling 1	Throwing and Compacting by Human Pow	m3	187	9.14	1,709
Soft-rock Crushed(SRC)		m3	187	1.16	216
Compacting	Water Binding	m3	187	2.28	426
Backfillingsoil Lording	Backhoe 0.2m3	m3	1,191	0.53	631
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	11.91	108.97	1,297
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	11.91	25.42	302
Trowing Down Backfilling 2,3	Backhoe 0.2m3 (Product)	m3	1,191	0.53	631
Tamping Soil	Tamper 60～100kg	m3	1,191	4.20	5,002
Subtotal					20,522
3.Foundation Work					
SRC		m3	135	1.16	156
Throwing Down SRC	Backhoe 0.2m3 Throw Down	m3	135	2.99	403
Compacting SRC	Human Power	m3	135	10.66	1,439
Compacting SRC	Water Binding	m3	135	2.28	307
Subtotal					2,305
4.Temporary Work					
Unwatering	Below 2m3/min	m3	1,150	0.38	437
Subtotal					437
5.Laying Work of Pipe					
Centrifugal reinforced Concrete Pipe	φ1,800 L=2.36m	m	98.2	380.00	37,316
Laying Pipe		m	98.2	29.74	2,920
Subtotal					40,236
6.Restoration Work of Pavement					
Restoration Work of Pavement		c-m2	3.3	2,626	8,665
Subtotal					8,665
7.Setting Manhole Work (1.0Place Every 100m)					
Setting Manhole		place	1.0	2,396	2,396
Subtotal					2,396
1.～7.Total					75,161
8.Other Works (10% of Uper Construction Cost:		lot	1		7,516
Reset of Underground Installation and Side Ditch,Others)					
9.Pure Construction Cost	Direct CC+				82,677
	Common Temporary Work Cost				
10.Managing Cost at Site	25% of Pure CC	lot	1		20,669
11.The Cost of Works					103,346
12.General Construction Cost	15% of The Cost of Work	lot	1		15,454
Total Construction Cost					118,800

Construction Cost of Renewal Pipe	106,900

Table A12.56 Itemized account of Setting Manhole Work (Per 100 Place)

Items	Specifications	Unit	Amount	Unit Price	Price
Casting Leveling Concrete		m3	3.00	8.36	25
Leveling Concrete	175kg/cm2	m3	3.00	84.45	253
Leveling Concrete Form		m2	4.90	12.16	59
Reinforced Concrete	250kg/cm2	m3	25.49	95.07	2,423
Casting Base Concrete	100～300kg/cm2	m3	7.59	8.36	63
Casting Wall Concrete	100～300kg/cm2,Bucket	m3	17.90	5.94	106
Plain Concrete	200kg/cm2	m3	11.62	88.51	1,028
Casting Invert Concrete	100～300kg/cm2	m3	11.62	8.36	97
Processing Steel Bar (Straight B	SD30φ12 With Steel Bar	t	1.092	526.87	575
Processing Steel Bar (Straight B	SD30φ16 With Steel Bar	t	2.935	520.49	1,527
Processing Steel Bar (Bending B	SD30φ12 With Steel Bar	t	1.092	561.25	612
Processing Steel Bar (Bending B	SD30φ16 With Steel Bar	t	1.325	534.00	707
Placing Steel bar (Base)	Belowφ16	t	1.610	128.90	207
Placing Steel bar (Base)	Belowφ16以下	t	4.834	140.44	678
Placing Form	Wood	m2	13.50	1.46	19
Placing Form	Wood	m2	352.42	13.88	4,891
Mortaring fase on invert	Thickness 30mm	m2	53.23	15.18	808
Vertical Pipe	ID 1,200,H=1,220	pcs	30	122.72	3,681
Vertical Pipe	ID 1,200,H=160	pcs	10	61.21	612
Placing Vertical Pipe	ID 1,200,H=1,220	pcs	30	122.28	3,668
Placing Vertical Pipe	ID 1,200,H=160	pcs	10	16.04	160
Concrete Lid with Iron Lid		pcs	10	89.51	895
Placing Concrete Lid		pcs	10	86.96	869
Total every 10 Place					23,963
Total every 1 Place					2,396

Table A12.57 Restoration Work of Pavement (Per100m2)

Items	Specifications	Unit	Amount	Unit Price	Price
Asphalt on Surface	1LT/m2	th-m2	0.10	210.00	21
Adhesive Asphalt	0.6LT/m2	th-m2	0.10	152.65	15
Midle Density Asphalt Concrete	t=3.5cm	m2	100	5.44	544
High Density Asphalt Concrete	t=1.5cm	m2	100	2.36	236
Concrete Paving		m3	15.0	7.33	109
Concrete	200kg/ccm2	m3	15.0	88.51	1,327
Rolling-fill on Subbed	Rord-roller	c-m2	1.00	374.14	374
Total					2,626

Table A12.58 Construction Cost for Piping Instead of Renewal
(Centrifugal Reinforced Concrete Pipe φ2,000mm, Per 100m , Excavation Width 3.50m, Excavation Depth 7.0m)

Items	Specifications	Unit	Amount	Unit Price	Price
1.Cutting Pavement					
Cutting Concrete-pavement	Hammer t=200	m3	52.5	3.45	181
Concrete-wreck Lording	Backhoe 0.2m3	m3	52.5	0.53	27
Concrete-wreck Portage	Dumptruck 6m3 The First 1km	c-m3	0.53	108.97	57
Concrete-wreck Portage	Dumptruck 6m3 The Rest 24km	c-m3	0.53	610.08	320
Leveling Concrete-wreck	Bulldozer 15t L=50m	m3	52.5	1.03	54
Subtotal					639
2.Esrthwork					
Soft-rock Excavation	Backhoe 0.2m3 With Lording	m3	2,050	0.43	881
Excavated Soft-rock lording	Backhoe 0.2m3	m3	2,050	0.53	1,086
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	12.13	108.97	1,321
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	12.13	25.42	308
Surplus Soil Portage	Dumptruck 6m3 The First 1km	c-m3	8.37	108.97	912
Surplus Soil Portage	Dumptruck 6m3 The Rest 24km	c-m3	8.37	610.08	5,106
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	837	1.03	862
Backfilling 1	Throwing and Compacting by Human Powe	m3	208	9.14	1,901
Soft-rock Crushed(SRC)		m3	208	1.16	241
Compacting	Water Binding	m3	208	2.28	474
Backfillingsoil Lording	Backhoe 0.2m3	m3	1,213	0.53	642
Backfillingsoil Portage	Dumptruck 6m3 The First 1km	c-m3	12.13	108.97	1,321
Backfillingsoil Portage	Dumptruck 6m3 The Next 1km	c-m3	12.13	25.42	308
Trowing Down Backfilling 2,3	Backhoe 0.2m3 (Product)	m3	1,213	0.53	642
Tamping Soil	Tamper 60～100kg	m3	1,213	4.20	5,094
Subtotal					21,099
3.Foundation Work					
SRC		m3	152	1.16	176
Throwing Down SRC	Backhoe 0.2m3 Throw Down	m3	152	2.99	454
Compacting SRC	Human Power	m3	152	10.66	1,620
Compacting SRC	Water Binding	m3	152	2.28	346
Subtotal					2,596
4.Temporary Work					
Unwatering	Below 2m3/min	m3	1,250	0.38	475
Subtotal					475
5.Laying Work of Pipe					
Centrifugal reinforced Concrete Pipe	φ2,000 L=2.36m	m	98.2	485.00	47,627
Laying Pipe		m	98.2	35.69	3,504
Subtotal					51,131
6.Restoration Work of Pavement					
Restoration Work of Pavement		c-m2	3.5	2,626	9,191
Subtotal					9,191
7.Setting Manhole Work (1.0Place Every 100m)					
Setting Manhole		place	1.0	2,524	2,524
Subtotal					2,524
1.～7.Total					87,655
8.Other Works (10% of Uper Construction Cost:		lot	1		8,765
Reset of Underground Installation and Side Ditch,Others)					
9.Pure Construction Cost	Direct CC+				96,420
	Common Temporary Work Cost				
10.Managing Cost at Site	25% of Pure CC	lot	1		24,105
11.The Cost of Works					120,525
12.General Construction Cost	15% of The Cost of Work	lot	1		18,075
Total Construction Cost					138,600

Construction Cost of Renewal Pipe	124,700

Table A12.59 Itemized account of Setting Manhole Work (Per 100 Place)

Items	Specifications	Unit	Amount	Unit Price	Price
Casting Leveling Concrete		m3	3.00	8.36	25
Leveling Concrete	175kg/cm2	m3	3.00	84.45	253
Leveling Concrete Form		m2	4.90	12.16	59
Reinforced Concrete	250kg/cm2	m3	31.96	95.07	3,038
Casting Base Concrete	100～300kg/cm2	m3	7.59	8.36	63
Casting Wall Concrete	100～300kg/cm2,Bucket	m3	24.37	5.94	144
Plain Concrete	200kg/cm2	m3	10.14	88.51	897
Casting Invert Concrete	100～300kg/cm2	m3	10.14	8.36	84
Processing Steel Bar (Straight Bar)	SD30φ12 With Steel Bar	t	1.170	526.87	616
Processing Steel Bar (Straight Bar)	SD30φ16 With Steel Bar	t	2.935	520.49	1,527
Processing Steel Bar (Bending Bar)	SD30φ12 With Steel Bar	t	1.170	561.25	656
Processing Steel Bar (Bending Bar)	SD30φ16 With Steel Bar	t	1.325	534.00	707
Placing Steel bar (Base)	Belowφ16	t	1.610	128.90	207
Placing Steel bar (Base)	Belowφ16以下	t	4.990	140.44	700
Placing Form	Wood	m2	13.50	1.46	19
Placing Form	Wood	m2	453.78	13.88	6,298
Mortaring fase on invert	Thickness 30mm	m2	55.34	15.18	840
Vertical Pipe	ID 1,200,H=1,220	u	30	122.72	3,681
Placing Vertical Pipe	ID 1,200,H=1,220	u	30	122.28	3,668
Concrete Lid with Iron Lid		u	10	89.51	895
Placing Concrete Lid		u	10	86.96	869
Total every 10 Place					25,246
Total every 1 Place					2,524

Table A12.60 Restoration Work of Pavement (Per100m2)

Items	Specifications	Unit	Amount	Unit Price	Price
Asphalt on Surface	1LT/m2	th-m2	0.10	210.00	21
Adhesive Asphalt	0.6LT/m2	th-m2	0.10	152.65	15
Midle Density Asphalt Concrete	t=3.5cm	m2	100	5.44	544
High Density Asphalt Concrete	t=1.5cm	m2	100	2.36	236
Concrete Paving		m3	15.0	7.33	109
Concrete	200kg/ccm2	m3	15.0	88.51	1,327
Rolling-fill on Subbed	Rord-roller	c-m2	1.00	374.14	374
Total					2,626

Table A12.61 Construction Cost for Placing Tunnel Invert of Sur A
Invert Shape of Inner D 1,200mm Each 100mm

Items	Specifications	Unit	Amount	Unit Price	Price
1.Work of Concrete					
Plain Concrete	200kg/cm2	m3	24.31	88.51	2,151
Casting Invert Concrete	Concrete Pump Car	m3	24.31	11.57	281
Placing Form	Half-pipe、Floating Form	m2	188.50	8.35	1,573
Troweling Concrete Surface		m2	30.00	0.59	17
Mortaring fase on invert	1:2 Thickness 30mm	m2	188.50	7.23	1,362
Subtotal					5,384
2.Pure Construction Cost	Direct CC+				5,384
	Common Temporary Work Cost				
3.Managing Cost at Site	25% of Pure CC	set	1		1,346
4.The Cost of Works					6,730
5.General Construction Cost	15% of The Cost of Work	set	1		1,009
Total Construction Cost					7,700

Table A12. 62 Construction Cost of Matadero Pumping Station, Civil Work

Items	Specifications	Unit	Amount	Unit Price	Price
1.Esrthwork					
Excavation	Soft Rock, Backhoe 1.0m3	m3	12,765	0.43	5,488
Portage of Temporary Stack Soi	Dumptruck 10m3 The 0.2km	c-m3	70.65	108.97	7,698
Lording Temporary Stack Soil	Backhoe 1.0m3	m3	7,065	0.53	3,744
Backfillingsoil Portage	Dumptruck 10m3 The 0.2km	c-m3	70.65	108.97	7,698
Backfilling and Compacting	Bulldozer 3t L=50m	m3	7,065	0.40	2,826
Surplus Soil Portage	Dumptruck 10m3 The First 1km	c-m3	57.00	108.97	6,211
Surplus Soil Portage	Dumptruck 10m3 The Rest 24km	c-m3	57.00	610.08	34,774
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	5,700	0.40	2,280
Subtotal					70,719
2.Foundation Work					
Soft-rock Crushed(SRC)		m3	59	1.16	68
Compacting SRC	Machine	m3	59	7.43	438
Compacting SRC	Water Binding	m3	59	2.28	134
Casting Leveling Concrete		m3	15	8.36	125
Leveling Concrete	175kg/cm2	m3	15	84.45	1,266
Leveling Concrete Form		m2	5.3	12.16	64
Subtotal					2,095
3.Steel Bar Work					
Processing Steel Bar	SD40φ12 With straight bar	t	14.237	527.04	7,503
	SD40φ12 With bending bar	t	16.364	596.24	9,756
	SD40φ16 With straight bar	t	28.474	520.49	14,820
	SD40φ16 With bending bar	t	32.727	589.69	19,298
	SD40φ20 With straight bar	t	28.474	519.10	14,780
	SD40φ20 With bending bar	t	32.727	588.30	19,253
Placing Steel bar (Base)	Base below φ16	t	9.984	40.39	403
	Base over φ20	t	6.656	23.06	153
	Wall, slab below φ16	t	81.818	140.44	11,490
	Wall, slab over φ20	t	54.546	128.90	7,030
Subtotal					104,486
4.Concrete Work					
Casting Concrete	Base, crane and bucket	m3	208	8.36	1,738
Casting Concrete	Wall, concrete pump car	m3	1480	5.63	8,332
Reinforced Concrete	250kg/cm2	m3	1688	95.07	160,478
Placing Form	Base	m2	1987	11.90	23,645
Placing Form	Wall	m2	3,214	13.12	42,167
Troweling Concrete Surface		m2	327	0.59	192
Subtotal					236,552
5.Temporary Work					
Unwatering	Submerged pump φ100 H=10m	m3	10,000	0.38	3,800
Scaffolding	Pipe scaffold	m2	1,203	5.06	6,087
Timbering	Within 5m	m2	586	41.75	24,465
Subtotal					34,352
1.～5.Total					448,204
6.Annex Work					
Hardware Work	1.0% of 1.～5.total	lot	1		4,482
Placingwork of Lid	5.0% of 1.～5.total	lot	1		22,410
Work of Expansion Joint	0.5% of 1.～5.total	lot	1		2,241
Other Works	1.5% of 1.～5.total	lot	1		6,723
Subtotal					35,856
1.～6.Total					484,060
7 Pure Construction Cost	Direct CC＋				484,060
	Common Temporary Work Cost				
8 Managing Cost at Site	25% of Pure CC	lot	1		121,015
9 The Cost of Works					605,075
10 General Construction Cost	Below 10% of The Cost of Work	lot	1		59,925
11 Total Construction Cost					665,000

Table A12. 63 Construction Cost of Matadero Pumping Station, Build Work

The construction cost for the build work of Matadero Pumping Station is estimated at 200 USD /m3 with overhead expenses.

Term	Price	Unit
1.Pump Building	200×1,435 = 287,000	USD
2.Power Generation Building	200× 539 = 107,800	USD
Total	394,800 ≒395, 000	USD USD

Table A12. 64 Construction Cost of Matadero Pumping Station, Mechanical Work

1. Screen and Grit Chamber	1,494,000	USD
2. Main Pump	455,000	USD
Total	1,949,000	USD

Table A12. 65 Construction Cost of Matadero Pumping Station, Electrical Work

	JapanesePrice：Thousand Yen				Cuban Price ：USD
	Equipment	Installation, Cabling and Wiring	Overhead Expenses	Total	
High Voltage Incoming Panel	1,000	250	375	1,625	9,000
High Voltage Receiving Pane	11,000	2,750	4,125	17,875	97,000
Transformer Panel	12,000	3,000	4,500	19,500	106,000
Control Center					0
480/110v	20,000	5,000	7,500	32,500	176,000
120kw(Reactor Starter Pan	12,000	3,000	4,500	19,500	106,000
Auxiliary Control panel	12,000	3,000	4,500	19,500	106,000
Flowmeter					0
magnetic Flowmeter φ800 Recorder	10,000	2,500	3,750	16,250	88,000
Level Detector Submergedtype	2,500	625	938	4,063	22,000
Instrumentation panel	2,500	625	938	4,063	22,000
Generator				133,000	720,000
Total	83,000	20,750	31,125	267,875	1,452,000

Table A12. 66 Total Construction Cost of Matadero Pumping Station

Civil Work	665,000	USD
Build Work	395,000	USD
mechanical Work	1,949,000	USD
Electrical Work	1,452,000	USD
Total	4,461,000	USD

Table A12.67 Primary Sedimentation Tank of Luyanó WWTP
Itemized Account of the construction Cost

Items	Specifications	Unit	Amount	Unit Price	Price
1.Esrthwork					
Excavation	Ordinary Soil, Backhoe 1.0m3	m3	3,375	0.39	1,316
Portage of Temporary Stack Soil	Dumptruck 10m3 The 0.2km	c-m3	10.79	108.97	1,175
Lording Temporary Stack Soil	Backhoe 1.0m3	m3	1,079	0.53	571
Backfillingsoil Portage	Dumptruck 10m3 The 0.2km	c-m3	10.79	108.97	1,175
Backfilling and Compacting	Bulldozer 3t L=50m	m3	1,079	0.40	431
Surplus Soil Portage	Dumptruck 10m3 The First 1km	c-m3	22.96	108.97	2,501
Surplus Soil Portage	Dumptruck 10m3 The Rest 24km	c-m3	22.96	610.08	14,007
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	2,296	0.40	918
Subtotal					22,094
2.Foundation Work					
Pile Driving	C-Pile □500 L=10m	pcs	65	930.90	60,508
Forming the pile head	C-pile □500	pcs	65	56.36	3,663
Soft-rock Crushed(SRC)		m3	94	1.16	109
Compacting SRC	Machine	m3	94	7.43	698
Compacting SRC	Water Binding	m3	94	2.28	214
Casting Leveling Concrete		m3	24	8.36	200
Leveling Concrete	175kg/cm2	m3	24	84.45	2,026
Leveling Concrete Form		m2	4.3	12.16	52
Subtotal					67,470
3.Steel Bar Work					
Processing Steel Bar	SD40φ12 With straight bar	t	17.408	527.04	9,174
	SD40φ12 With bending bar	t	15.660	596.24	9,337
	SD40φ16 With straight bar	t	7.737	520.49	4,027
	SD40φ16 With bending bar	t	6.960	589.69	4,104
	SD40φ20 With straight bar	t	13.540	519.10	7,028
	SD40φ20 With bending bar	t	12.180	588.30	7,165
Placing Steel bar (Base)	Base below φ16	t	10.066	40.39	406
	Base over φ20	t	5.420	23.06	124
	Wall, slab below φ16	t	37.700	140.44	5,294
	Wall, slab over φ20	t	20.300	128.90	2,616
Subtotal					49,275
4.Concrete Work					
Casting Concrete	Base, crane and bucket	m3	225	8.36	1,881
Casting Concrete	Wall, concrete pump car	m3	666	5.63	3,749
Reinforced Concrete	250kg/cm2	m3	891	95.07	84,707
Placing Form	Base	m2	938	11.90	11,162
Placing Form	Wall	m2	1,840	13.12	24,140
Troweling Concrete Surface		m2	508	0.59	299
Subtotal					125,938
5.Temporary Work					
Unwatering	Submerged pump φ100 H=10m	m3	15,000	0.38	5,700
Scaffolding	Pipe scaffold	m2	1,104	5.06	5,586
Timbering	Within 5m	m2	111	29.24	3,245
Subtotal					14,531
1.～5.Total					279,308
6.Annex Work					
Hardware Work	1.0% of 1.～5.total	lot	1		2,793
Placingwork of Lid	5.0% of 1.～5.total	lot	1		13,965
Work of Expansion Joint	0.5% of 1.～5.total	lot	1		1,396
Other Works	1.5% of 1.～5.total	lot	1		4,189
Subtotal					22,343
1.～6.Total					301,651
7. Pure Construction Cost	Direct CC＋				301,651
	Common Temporary Work Cost				
8. Managing Cost at Site	25% of Pure CC	lot	1		75,412
9. The Cost of Works					377,063
1(General Construction Cost	Below 10% of The Cost of Work	lot	1		36,937
1 Total Construction Cost					414,000

Table A12.68 Reaction Tank of Luyanó WWTP
Itemized Account of the construction Cost

Items	Specifications	Unit	Amount	Unit Price	Price
1.Esrthwork					
Excavation	Ordinary Soil, Backhoe 1.0m3	m3	8,124	0.39	3,168
Portage of Temporary Stack Soil	Dumptruck 10m3 The 0.2km	c-m3	23.48	108.97	2,558
Lording Temporary Stack Soil	Backhoe 1.0m3	m3	2,348	0.53	1,244
Backfillingsoil Portage	Dumptruck 10m3 The 0.2km	c-m3	23.48	108.97	2,558
Backfilling and Compacting	Bulldozer 3t L=50m	m3	2,348	0.40	939
Surplus Soil Portage	Dumptruck 10m3 The First 1km	c-m3	57.76	108.97	6,294
Surplus Soil Portage	Dumptruck 10m3 The Rest 24km	c-m3	57.76	610.08	35,238
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	5,776	0.40	2,310
Subtotal					54,309
2.Foundation Work					
Pile Driving	C-Pile □500 L=10m	pcs	180	651.63	117,293
Forming the pile head	C-pile □500	pcs	180	56.36	10,144
Soft-rock Crushed(SRC)		m3	206	1.16	238
Compacting SRC	Machine	m3	206	7.43	1,530
Compacting SRC	Water Binding	m3	206	2.28	469
Casting Leveling Concrete		m3	52	8.36	434
Leveling Concrete	175kg/cm2	m3	52	84.45	4,391
Leveling Concrete Form		m2	7.0	12.16	85
Subtotal					134,584
3.Steel Bar Work					
Processing Steel Bar	SD40φ12 With straight bar	t	90.179	527.04	47,527
	SD40φ12 With bending bar	t	92.548	596.24	55,180
	SD40φ16 With straight bar	t	45.090	520.49	23,468
	SD40φ16 With bending bar	t	46.274	589.69	27,287
	SD40φ20 With straight bar	t	90.179	519.10	46,811
	SD40φ20 With bending bar	t	92.548	588.30	54,445
Placing Steel bar (Base)	Base below φ16	t	42.741	40.39	1,726
	Base over φ20	t	28.481	23.06	656
	Wall, slab below φ16	t	231.370	140.44	32,493
	Wall, slab over φ20	t	154.247	128.90	19,882
Subtotal					309,475
4.Concrete Work					
Casting Concrete	Base, crane and bucket	m3	608	8.36	5,082
Casting Concrete	Wall, concrete pump car	m3	4,294	5.63	24,175
Reinforced Concrete	250kg/cm2	m3	4,902	95.07	466,033
Placing Form	Base	m2	1,727	11.90	20,551
Placing Form	Wall	m2	7,844	13.12	102,913
Troweling Concrete Surface		m2	1,120	0.59	660
Subtotal					619,414
5.Temporary Work					
Unwatering	Submerged pump φ100 H=10m	m3	30,000	0.38	11,400
Scaffolding	Pipe scaffold	m2	3218	5.06	16,283
Timbering	Within 5m	m2	463	29.24	13,538
Subtotal					41,221
1.～5.Total					1,159,003
6.Annex Work					
Hardware Work	1.0% of 1.～5.total	lot	1		11,590
Placingwork of Lid	5.0% of 1.～5.total	lot	1		57,950
Work of Expansion Joint	0.5% of 1.～5.total	lot	1		5,795
Other Works	1.5% of 1.～5.total	lot	1		17,385
Subtotal					92,720
1.～6.Total					1,251,723
7. Pure Construction Cost	Direct CC＋				1,251,723
	Common Temporary Work Cost				
8. Managing Cost at Site	25% of Pure CC	lot	1		312,930
9. The Cost of Works					1,564,653
10. General Construction Cost	Below 10% of The Cost of Work	lot	1		156,347
11. Total Construction Cost					1,721,000

Table A12.69 Final Sedimentation Tank of Luyanó WWTP
Itemized Account of the construction Cost

Items	Specifications	Unit	Amount	Unit Price	Price
1.Esrthwork					
Excavation	Ordinary Soil, Backhoe 1.0m3	m3	5,525	0.39	2,154
Portage of Temporary Stack Soil	Dumptruck 10m3 The 0.2km	c-m3	15.57	108.97	1,696
Lording Temporary Stack Soil	Backhoe 1.0m3	m3	1,557	0.53	825
Backfillingsoil Portage	Dumptruck 10m3 The 0.2km	c-m3	15.57	108.97	1,696
Backfilling and Compacting	Bulldozer 3t L=50m	m3	1,557	0.40	622
Surplus Soil Portage	Dumptruck 10m3 The First 1km	c-m3	39.68	108.97	4,323
Surplus Soil Portage	Dumptruck 10m3 The Rest 24km	c-m3	39.68	610.08	24,207
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	3,968	0.40	1,587
Subtotal					37,110
2.Foundation Work					
Pile Driving	C-Pile □500 L=10m	u	120	837.81	100,537
Forming the pile head	C-pile □500	u	120	56.36	6,763
Soft-rock Crushed(SRC)		m3	172	1.16	199
Compacting SRC	Machine	m3	172	7.43	1,277
Compacting SRC	Water Binding	m3	172	2.28	392
Casting Leveling Concrete		m3	43	8.36	359
Leveling Concrete	175kg/cm2	m3	43	84.45	3,631
Leveling Concrete Form		m2	6.2	12.16	75
Subtotal					113,233
3.Steel Bar Work					
Processing Steel Bar	SD40φ12 With straight bar	t	22.499	527.04	11,857
	SD40φ12 With bending bar	t	16.607	596.24	9,901
	SD40φ16 With straight bar	t	22.499	520.49	11,710
	SD40φ16 With bending bar	t	16.607	589.69	9,792
	SD40φ20 With straight bar	t	11.249	519.10	5,839
	SD40φ20 With bending bar	t	8.304	588.30	4,885
Placing Steel bar (Base)	Base below φ16	t	22.854	40.39	923
	Base over φ20	t	5.714	23.06	131
	Wall, slab below φ16	t	55.358	140.44	7,774
	Wall, slab over φ20	t	13.840	128.90	1,783
Subtotal					64,595
4.Concrete Work					
Casting Concrete	Base, crane and bucket	m3	391	8.36	3,268
Casting Concrete	Wall, concrete pump car	m3	787	5.63	4,430
Reinforced Concrete	250kg/cm2	m3	1,178	95.07	111,992
Placing Form	Base	m2	1,180	11.90	14,042
Placing Form	Wall	m2	1,927	13.12	25,282
Troweling Concrete Surface		m2	933	0.59	550
Subtotal					159,564
5.Temporary Work					
Unwatering	Submerged pump φ100 H=10m	m3	30,000	0.38	11,400
Scaffolding	Pipe scaffold	m2	1847	5.06	9,345
Timbering	Within 5m	m2	52	29.24	1,520
Subtotal					22,265
1.～5.Total					396,767
6.Annex Work					
Hardware Work	1.0% of 1.～5.total	lot	1		3,967
Placingwork of Lid	5.0% of 1.～5.total	lot	1		19,838
Work of Expansion Joint	0.5% of 1.～5.total	lot	1		1,983
Other Works	1.5% of 1.～5.total	lot	1		5,951
Subtotal					31,739
1.～6.Total					428,506
7. Pure Construction Cost	Direct CC＋				428,506
	Common Temporary Work Cost				
8. Managing Cost at Site	25% of Pure CC	lot	1		107,126
9. The Cost of Works					535,632
10. General Construction Cost	15% of The Cost of Work	lot	1		53,368
11. Total Construction Cost					589,000

Table A12.70 Thickener of Luyanó WWTP
Itemized Account of the construction Cost

Items	Specifications	Unit	Amount	Unit Price	Price
1.Esrthwork					
Excavation	Ordinary Soil, Backhoe 1.0m3	m3	464	0.39	180
Portage of Temporary Stack Soil	Dumptruck 10m3 The 0.2km	c-m3	1.25	108.97	136
Lording Temporary Stack Soil	Backhoe 1.0m3	m3	125	0.53	66
Backfillingsoil Portage	Dumptruck 10m3 The 0.2km	c-m3	1.25	108.97	136
Backfilling and Compacting	Bulldozer 3t L=50m	m3	125	0.40	50
Surplus Soil Portage	Dumptruck 10m3 The First 1km	c-m3	3.39	108.97	369
Surplus Soil Portage	Dumptruck 10m3 The Rest 24km	c-m3	3.39	610.08	2,068
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	339	0.40	135
Subtotal					3,140
2.Foundation Work					
Pile Driving	C-Pile □500 L=10m	u	15	1070.53	16,057
Forming the pile head	C-pile □500	u	15	56.36	845
Soft-rock Crushed(SRC)		m3	28	1.16	32
Compacting SRC	Machine	m3	28	7.43	208
Compacting SRC	Water Binding	m3	28	2.28	63
Casting Leveling Concrete		m3	7	8.36	58
Leveling Concrete	175kg/cm2	m3	7	84.45	591
Leveling Concrete Form		m2	43.0	12.16	522
Subtotal					18,376
3.Steel Bar Work					
Processing Steel Bar	SD40φ12 With bending bar	t	3.463	596.24	2,064
	SD40φ16 With straight bar	t	1.369	520.49	712
	SD40φ16 With bending bar	t	5.830	589.69	3,437
Placing Steel bar (Base)	Base below φ16	t	6.847	40.39	276
	Wall, slab below φ16	t	3.815	140.44	535
Subtotal					7,024
4.Concrete Work					
Casting Concrete	Base, crane and bucket	m3	86	8.36	718
Casting Concrete	Wall, concrete pump car	m3	48	5.63	270
Reinforced Concrete	250kg/cm2	m3	134	95.07	12,739
Placing Form	Base	m2	32	11.90	380
Placing Form	Wall	m2	309	13.12	4,054
Troweling Concrete Surface		m2	141	0.59	83
Subtotal					18,244
5.Temporary Work					
Unwatering	Submerged pump φ100 H=10m	m3	10,000	0.38	3,800
Scaffolding	Pipe scaffold	m2	309	5.06	1,563
Subtotal					5,363
1.～5.Total					52,147
6.Annex Work					
Hardware Work	1.0% of 1.～5.total	lot	1		521
Placingwork of Lid	5.0% of 1.～5.total	lot	1		2,607
Work of Expansion Joint	0.5% of 1.～5.total	lot	1		260
Other Works	1.5% of 1.～5.total	lot	1		782
Subtotal					4,170
1.～6.Total					56,317
7. Pure Construction Cost	Direct CC＋				56,317
	Common Temporary Work Cost				
8. Managing Cost at Site	25% of Pure CC	lot	1		14,079
9. The Cost of Works					70,396
10 General Construction Cost	15% of The Cost of Work	lot	1		6,604
11 Total Construction Cost					77,000

Table A12.71 Digestion Tank of Luyanó WWTP
Itemized Account of the construction Cost

Items	Specifications	Unit	Amount	Unit Price	Price
1.Esrthwork					
Excavation	Ordinary Soil, Backhoe 1.0m3	m3	1,300	0.39	507
Portage of Temporary Stack Soil	Dumptruck 10m3 The 0.2km	c-m3	2.94	108.97	320
Lording Temporary Stack Soil	Backhoe 1.0m3	m3	294	0.53	155
Backfillingsoil Portage	Dumptruck 10m3 The 0.2km	c-m3	2.94	108.97	320
Backfilling and Compacting	Bulldozer 3t L=50m	m3	294	0.40	117
Surplus Soil Portage	Dumptruck 10m3 The First 1km	c-m3	10.07	108.97	1,097
Surplus Soil Portage	Dumptruck 10m3 The Rest 24km	c-m3	10.07	610.08	6,143
Leveling Surplus Soil	Bulldozer 15t L=50m	m3	1,007	0.40	402
Subtotal					9,061
2.Foundation Work					
Pile Driving	C-Pile □500 L=10m	u	75	930.90	69,817
Forming the pile head	C-pile □500	u	75	56.36	4,227
Soft-rock Crushed(SRC)		m3	71	1.16	82
Compacting SRC	Machine	m3	71	7.43	527
Compacting SRC	Water Binding	m3	71	2.28	161
Casting Leveling Concrete		m3	18	8.36	150
Leveling Concrete	175kg/cm2	m3	18	84.45	1,520
Leveling Concrete Form		m2	3.3	12.16	40
Subtotal					76,524
3.Steel Bar Work					
Processing Steel Bar	SD40φ12 With straight bar	t	4.056	527.04	2,137
	SD40φ12 With bending bar	t	1.728	596.24	1,030
	SD40φ16 With straight bar	t	16.224	520.49	8,444
	SD40φ16 With bending bar	t	6.912	589.69	4,075
	SD40φ20 With straight bar	t	20.280	519.10	10,527
	SD40φ20 With bending bar	t	8.640	588.30	5,082
Placing Steel bar (Base)	Base below φ16	t	14.520	40.39	586
	Base over φ20	t	14.520	23.06	334
	Wall, slab below φ16	t	14.400	140.44	2,022
	Wall, slab over φ20	t	14.400	128.90	1,856
Subtotal					36,093
4.Concrete Work					
Casting Concrete	Base, crane and bucket	m3	242	8.36	2,023
Casting Concrete	Wall, concrete pump car	m3	288	5.63	1,621
Reinforced Concrete	250kg/cm2	m3	530	95.07	50,387
Placing Form	Base	m2	46	11.90	547
Placing Form	Wall	m2	1,271	13.12	16,675
Troweling Concrete Surface		m2	381	0.59	224
Subtotal					71,477
5.Temporary Work					
Unwatering	Submerged pump φ100 H=10m	m3	15,000	0.38	5,700
Scaffolding	Pipe scaffold	m2	1,111	5.06	5,621
Timbering	Within 5m	m2	392	58.67	22,998
Subtotal					34,319
6.Paiting Work					
Painting	Tar Epoxy Painting 3Streak	m2	1,036	15.02	15,560
Scaffolding	Pipe scaffold	m2	2,300	5.06	11,638
Subtotal					27,198
1.～6.Total					254,672
7.Annex Work					
Hardware Work	1.0% of 1.～5.total	lot	1		2,546
Placingwork of Lid	5.0% of 1.～5.total	lot	1		12,733
Work of Expansion Joint	0.5% of 1.～5.total	lot	1		1,273
Other Works	1.5% of 1.～5.total	lot	1		3,820
Subtotal					20,372
1.～7.Total					275,044

Table A12. 71 (Continued)

Items	Specifications	Unit	Amount	Unit Price	Price
8. Pure Construction Cost	Direct CC+				275,044
	Common Temporary Work Cost				
9. Managing Cost at Site	25% of Pure CC	lot	1		68,761
10. The Cost of Works					343,805
11. General Construction Cost	15% of The Cost of Work	lot	1		34,195
12. Total Construction Cost					378,000

Table A12.72 Total Construction Cost for Civil Work of Luyanó WWTP on the Master Plan

	1 Train	First Stage	Secound Stage	Third Stage
Primary Sedimentation Tank	414,000	414,000	414,000	414,000
Reaction Tank	1,721,000	1,721,000	1,721,000	1,721,000
Final Sedimentation Tank	589,000	589,000	589,000	589,000
Thickner	77,000		77,000	
Digestion Tank	378,000	378,000	378,000	378,000
Total	3,179,000	3,102,000	3,179,000	3,102,000

Table A12.73 Total Construction Cost for Civil Work of Luyanó WWTP on Feasibility Study

Primary Sedimentation Tank	414,000
Reaction Tank	1,721,000
Final Sedimentation Tank	589,000
Digestion Tank	378,000
Total	3,102,000

Table A12.74 Construction Cost of Luyanó WWTP, Build Work (JICA Part)

We estimate cuban unit price for building work 200 USD/room m3 with overhead expences.
So

Blower Building	200	＊	1,316	＝	263,200	263,000 USD
Dewatering Machine building	200	＊	4,032	＝	806,400	806,000 USD
Total						1,069,000 USD

Table A12.75 Construction Cost of Luyanó WWTP, Mechanical Work

The Cuban cost is estimated 60 % price of the Japanese cost.

Principal Facility Name	Japanese Price：Thousand Yen					Cuban Price：USD				
	Construc-tion Cost for All Train	Cost for 1 Train(Japanese Price)				Construc-tion Cost for 1Train	First Stage	Second Stage	Third Stage	Master Plan
		Cost for Machine	Placing and Piping	Overhead Expenses	Total					
Screen and Gritcollector	172,920	13,300	2,660	4,790	20,750	104,000	104,000	104,000	104,000	312,000
Gritchamber	70,620	41,100	13,220	16,300	70,620	353,000	0	88,000	0	88,000
Main Pump	64,200	10,100	7,020	5,140	22,260	111,000	111,000	111,000	111,000	333,000
Primary Sedi-mentation Tank	296,560	47,900	19,550	20,240	87,690	438,000	438,000	438,000	438,000	1,314,000
Reaction Tank	532,990	83,300	26,670	32,990	142,960	715,000	715,000	715,000	715,000	2,145,000
Final Sedimen-tation Tank	381,200	59,000	21,800	24,240	105,040	525,000	525,000	525,000	525,000	1,575,000
Thickener	84,500	50,000	15,000	19,500	84,500	423,000	0	212,000	0	212,000
Digestion Tank	430,140	6,000	16,230	6,670	28,900	145,000	145,000	145,000	145,000	435,000
Dewatering Machine	963,260	87,500	37,500	37,500	162,500	813,000	813,000	1,626,000	813,000	3,252,000
Blower	398,100	49,700	14,940	19,390	84,030	420,000	420,000	420,000	420,000	1,260,000
Total	3,394,490	447,900	174,590	186,760	809,250	4,047,000	3,271,000	4,384,000	3,271,000	10,926,000

Table A12.76 Construction Cost of Luyanó WWTP, Electrical Work (USD)

	First Stage	Second Stage	Third Stage	Master Plan
Screen	0	5,000	0	5,000
Grit Chamber	0	10,000	0	10,000
Main Pump	55,000	55,000	0	110,000
Tank	123,000	92,000	92,000	307,000
Reaction Tank	50,000	38,000	38,000	126,000
Final Sedimen tation Tank	125,000	94,000	94,000	313,000
Thickener	0	53,000	0	53,000
Digestion Tank	35,000	26,000	26,000	87,000
Dewatering Machine	77,000	46,000	31,000	154,000
Blower	92,000	46,000	46,000	184,000
Instrumentation	428,000	321,000	321,000	1,070,000
Supervisory	2,692,000	2,019,000	2,019,000	6,730,000
Total	3,677,000	2,805,000	2,667,000	9,149,000

Table A12. 77 Annual Operation and Maintenance Costs

Year	Annual Personnel Cost (x 1,000 Pesos)							Annual Power Cost (x 1,000 Pesos)						Annual Chemical Cost (x 1,000 USD)	O/M Cost Total	
	Head Quarter	Existing Sewerage Improvements				New Sewerage Development	Total	Existing Sewerage Improvements				New Luyano WWTP	Total		Posos	USD
		Matadero PS	Casablanca PS	Chivo Re-PS	Sub-total	Luyano WWTP		Madero PS	Casablanca PS	Chivo Re-PS	Sub-total			New Luyano WWTP	x 1,000	x 1,000
2011	540	73	107	0	180	145	865	53	180	0	233	44	277	17	1,142	17
2012	540	73	107	0	180	145	865	53	180	0	233	51	284	33	1,149	33
2013	540	73	107	0	180	145	865	138	180	0	318	56	374	46	1,239	46
2014	540	73	107	0	180	145	865	138	180	0	318	59	377	54	1,242	54
2015	540	73	107	0	180	145	865	138	180	0	318	63	381	62	1,246	62
2016	657	73	107	57	237	162	1,056	53	184	118	355	101	456	83	1,512	83
2017	657	73	107	57	237	162	1,056	53	184	118	355	111	466	104	1,522	104
2018	657	73	107	57	237	162	1,056	53	184	118	355	119	474	121	1,530	121
2019	657	73	107	57	237	162	1,056	53	184	118	355	124	479	133	1,535	133
2020	657	73	107	57	237	162	1,056	53	184	118	355	130	485	146	1,541	146
2021	692	73	107	57	237	162	1,091	53	187	119	359	164	523	166	1,614	166
2022	692	73	107	57	237	162	1,091	53	187	119	359	175	534	187	1,625	187
2023	692	73	107	57	237	162	1,091	53	187	119	359	184	543	204	1,634	204
2024	692	73	107	57	237	162	1,091	53	187	119	359	190	549	216	1,640	216
2025	692	73	107	57	237	162	1,091	53	187	119	359	197	556	229	1,647	229
2026	692	73	107	57	237	162	1,091	53	187	119	359	199	558	233	1,649	233
2027	692	73	107	57	237	162	1,091	53	187	119	359	201	560	237	1,651	237
2028	692	73	107	57	237	162	1,091	53	187	119	359	204	563	241	1,654	241
2029	692	73	107	57	237	162	1,091	53	187	119	359	206	565	245	1,656	245
2030	692	73	107	57	237	162	1,091	53	187	119	359	208	567	249	1,658	249
2031	692	73	107	57	237	162	1,091	53	187	119	359	208	567	249	1,658	249
2032	692	73	107	57	237	162	1,091	53	187	119	359	208	567	249	1,658	249
2033	692	73	107	57	237	162	1,091	53	187	119	359	208	567	249	1,658	249
2034	692	73	107	57	237	162	1,091	53	187	119	359	208	567	249	1,658	249
2035	692	73	107	57	237	162	1,091	53	187	119	359	208	567	249	1,658	249

Table A12. 78 Necessary Personnel in Headquarters for the Proposed New Sewer District Development, After the First Stage (after 2010)

Headquater of Executing Agency	Nessary Personnel for the First Stage Implementation of New Sewer District Development									
	Director	Head	Manager	Section Cheif	Engineer	Administ rator	Operator	Driver	Worker	Total
Director General	1									1
Deputy Director General										1
1. General Management and Services Department		1								
1.1 **General Management Division**			1	1		3				5
1 Section										
1.2 **Accounting Division**				1		3				4
1 Section										
1.3 **Billing Management (User charge collection)**			1	1		3				5
1 Section										
1.4 **Personnel Division**				1		2				3
1 Section										
1.5 **Property Affair Division**				1		1				2
1 Section										
1.6 **Information Management Division**				1		2				3
1 Section										
1.7 **Vehicle Management Division**				1				2		3
1 Section										
Total of the Department		**1**	**2**	**7**	**0**	**14**	**0**	**2**	**0**	**26**
2. Construction Department		1								
2.1 **General Management Division**				1		2		3		6
1 Section										
2.2 **Planning Division**			1	1	2					4
1 Section										
2.3 **Design Division**				2	4					6
2 Section										
2.4 **Construction Division**			1	2	4					7
2 Section										
2.5 **House Connection Engineering Division**			1	2	3	1				7
2 Section										
Total of the Department		**1**	**3**	**8**	**13**	**3**	**0**	**3**	**0**	**31**
3. Operation and Maintenance Department		1								
3.1 General Management Division				1		1		2		4
1 Section										
3.2 Sewer Maintenance Division			1	1	2					4
1 Section										
3.3 WWTP Division			1	1	2					4
1 Section										
3.4 Water Quality Monitoring Division				1	2					3
1 Section										
3.5 House Connection Service Division			1	1	2					4
1 Section										
Total of the Department		**1**	**3**	**5**	**8**	**1**	**0**	**2**	**0**	**20**
4. Sewer Maintenance Branch Office			**1**		**4**	**1**		**6**	**12**	**24**
1 Offices										
5. Total in First Stage	**1**	**3**	**9**	**20**	**25**	**19**	**0**	**13**	**12**	**102**

Table A12. 79 Necessary Personnel in Headquarters for the Proposed New Sewer District Development, After the Second Stage (after 2015)

Headquater of Executing Agency	Nessary Personnel for the Second Stage Implementation of New Sewer District Development									
	Director	Head	Manager	Section Cheif	Engineer	Administ rator	Operator	Driver	Worker	Total
Director General	1									1
Deputy Director General		1								1
1. General Management and Services Department		1								
1.1 **General Management Division**			1	1		3				5
1 Section										
1.2 **Accounting Division**				1		3				4
1 Section										
1.3 **Billing Management (User charge collection)**			1	2		6				9
2 Section										
1.4 **Personnel Division**				1		2				3
1 Section										
1.5 **Property Affair Division**				1		1				2
1 Section										
1.6 **Information Management Division**				1		2				3
1 Section										
1.7 **Vehicle Management Division**				1				3		4
1 Section										
Total of the Department		**1**	**2**	**8**	**0**	**17**	**0**	**3**	**0**	**31**
2. Construction Department		1								
2.1 **General Management Division**				1		2		3		6
1 Section										
2.2 **Planning Division**			1	1	2					4
1 Section										
2.3 **Design Division**				2	4					6
2 Section										
2.4 **Construction Division**			1	2	4					7
2 Section										
2.5 **House Connection Engineering Division**			1	2	3	1				7
2 Section										
Total of the Department		**1**	**3**	**8**	**13**	**3**	**0**	**3**	**0**	**31**
3. Operation and Maintenance Department		1								
3.1 General Management Division				1		2		3		6
1 Section										
3.2 Sewer Maintenance Division			1	1	2					4
1 Section										
3.3 WWTP Division			1	1	2					4
1 Section										
3.4 Water Quality Monitoring Division				1	2					3
1 Section										
3.5 House Connection Service Division			1	2	4					7
2 Section										
Total of the Department		**1**	**3**	**6**	**10**	**2**	**0**	**3**	**0**	**25**
4. Sewer Maintenance Branch Office			**2**		**6**	**2**		**10**	**20**	**40**
2 Offices										
5. Second Stage in Total	**1**	**4**	**10**	**22**	**29**	**24**	**0**	**19**	**20**	**129**

Table A12. 80 Necessary Personnel in Headquarters for the Proposed New Sewer District Development, After the Third Stage (after 2020)

Headquater of Executing Agency	Nessary Personnel for the Third Stage Implementation of New Sewer District Development									
	Director	Head	Manager	Section Cheif	Engineer	Administ rator	Operator	Driver	Worker	Total
Director General	1									1
Deputy Director General		1								1
1. General Management and Services Department		1								
1.1 **General Management Division**			1	1		3				5
1 Section										
1.2 **Accounting Division**				1		3				4
1 Section										
1.3 **Billing Management (User charge collection)**			1	2		6				9
2 Section										
1.4 **Personnel Division**				1		2				3
1 Section										
1.5 **Property Affair Division**				1		2				3
1 Section										
1.6 **Information Management Division**				1		2				3
1 Section										
1.7 **Vehicle Management Division**				1				3		4
1 Section										
Total of the Department		**1**	**2**	**8**	**0**	**18**	**0**	**3**	**0**	**32**
2. Construction Department		1								
2.1 **General Management Division**				1		2		3		6
1 Section										
2.2 **Planning Division**			1	1	2					4
1 Section										
2.3 **Design Division**				2	4					6
2 Section										
2.4 **Construction Division**			1	2	4					7
2 Section										
2.5 **House Connection Engineering Division**			1	2	3	1				7
2 Section										
Total of the Department		**1**	**3**	**8**	**13**	**3**	**0**	**3**	**0**	**31**
3. Operation and Maintenance Department		1								
3.1 General Management Division				1		2		3		6
1 Section										
3.2 Sewer Maintenance Division			1	1	2					4
1 Section										
3.3 WWTP Division			1	1	2					4
1 Section										
3.4 Water Quality Monitoring Division				1	2					3
1 Section										
3.5 House Connection Service Division			1	2	4					7
2 Section										
Total of the Department		**1**	**3**	**6**	**10**	**2**	**0**	**3**	**0**	**25**
4. Sewer Maintenance Branch Office			**2**		**8**	**2**		**12**	**24**	**48**
2 Offices										
5. Total in Third Stage	**1**	**4**	**10**	**22**	**31**	**25**	**0**	**21**	**24**	**138**

Table A12. 81 Personnel Cost in Headquarters for the Proposed New Sewer District Development, After the First Stage (after 2010)

Headquater of Executing Agency	Unit: Pesos/Year									
	Director	Head	Manager	Section Cheif	Engineer	Administ rator	Operator	Driver	Worker	Total
Director General	8,820	0	0	0	0	0	0	0	0	8,820
Deputy Director General		0	0	0	0	0	0	0	0	0
1. General Management and Services Department		7,800	14,400	48,300	0	48,720	0	6,960	0	126,180
2. Construction Department		7,800	21,600	55,200	81,900	10,440	0	10,440	0	187,380
3. Operation and Maintenance Department		7,800	21,600	34,500	50,400	3,480	0	6,960	0	124,740
4. Sewer Maintenance Branch Office		0	7,200	0	25,200	3,480	0	20,880	36,000	92,760
Total of First Stage	**8,820**	**23,400**	**64,800**	**138,000**	**157,500**	**66,120**	**0**	**45,240**	**36,000**	**539,880**

Table A12. 82 Personnel Cost in Headquarters for the Proposed New Sewer District Development, After the Second Stage (after 2015)

Headquater of Executing Agency	Unit: Pesos/Year									
	Director	Head	Manager	Section Cheif	Engineer	Administ rator	Operator	Driver	Worker	Total
Director General	8,820	0	0	0	0	0	0	0	0	8,820
Deputy Director General		7,800	0	0	0	0	0	0	0	7,800
1. General Management and Services Department		7,800	14,400	55,200	0	59,160	0	10,440	0	147,000
2. Construction Department		7,800	21,600	55,200	81,900	10,440	0	10,440	0	187,380
3. Operation and Maintenance Department		7,800	21,600	41,400	63,000	6,960	0	10,440	0	151,200
4. Sewer Maintenance Branch Office		0	14,400	0	37,800	6,960	0	34,800	60,000	153,960
Total of Second Stage	**8,820**	**31,200**	**72,000**	**151,800**	**182,700**	**83,520**	**0**	**66,120**	**60,000**	**656,160**

Table A12. 83 Personnel Cost in Headquarters for the Proposed New Sewer District Development, After the Third Stage (after 2020)

Headquater of Executing Agency	Unit: Pesos/Year									
	Director	Head	Manager	Section Cheif	Engineer	Administ rator	Operator	Driver	Worker	Total
Director General	8,820	0	0	0	0	0	0	0	0	8,820
Deputy Director General		7,800	0	0	0	0	0	0	0	7,800
1. General Management and Services Department		7,800	14,400	55,200	0	62,640	0	10,440	0	150,480
2. Construction Department		7,800	21,600	55,200	81,900	10,440	0	10,440	0	187,380
3. Operation and Maintenance Department		7,800	21,600	41,400	63,000	6,960	0	10,440	0	151,200
4. Sewer Maintenance Branch Office		0	14,400	0	50,400	6,960	0	41,760	72,000	185,520
Total of Third Stage	**8,820**	**31,200**	**72,000**	**151,800**	**195,300**	**87,000**	**0**	**73,080**	**72,000**	**691,200**

Table A12. 84 Necessary Personnel in Site Offices for the Proposed New Sewer District Development, After the First Stage (after 2010)

Site Office	Nessary Personnel afther the First Stage Project							
	Manager	Section Cheif	Engineer	Administrator	Operator	Driver	Worker	Total
1. Luyanó PTR (Main WWTP)								
Manager	1							1
1.1 **Management Section**				1		2		3
1.2 **Treatment Section**		1	2		2		4	9
1.3 **Operation Section**		1			12			13
1.4 **Water Quality Section**		1	3					4
Total of Main WWTP	**1**	**3**	**5**	**1**	**14**	**2**	**4**	**30**
2. CHIVO WWTP (Primary Treatment)								
Manager		1						1
2.1 **Management Section**						2		2
2.2 **Treatment Section**		1			2		4	7
2.3 **Operation Section**		1			12			13
2.4 **Water Quality Section**								0
Total of CHIVO WWTP	**0**	**3**	**0**	**0**	**14**	**2**	**4**	**23**
3. Matadero Pumping Station								
Manager		1						1
3.1 **Management Section**				1		1		2
3.2 **Operation Section**		1			8		2	11
Total of Pumping Station	**0**	**2**	**0**	**1**	**8**	**1**	**2**	**14**
4. CASABLANCA Pumping Station								
Manager		1						1
4.1 **Management Section**				1		1		2
4.2 **Operation Section**		1			12		6	19
Total of Pumping Station	**0**	**2**	**0**	**1**	**12**	**1**	**6**	**22**
5. Re Pumping Station								
Manager								0
5.1 **Management Section**				1		1		2
5.2 **Operation Section**		1			6		3	10
Total of Re Pumping Station	**0**	**1**	**0**	**1**	**6**	**1**	**3**	**12**
6. New Sewerage System	**1**	**9**	**5**	**3**	**42**	**6**	**13**	**79**
7. Existing Sewerage	**0**	**2**	**0**	**1**	**12**	**1**	**6**	**22**
8. Total	**1**	**11**	**5**	**4**	**54**	**7**	**19**	**101**

Table A12. 85 Necessary Personnel in Site Offices for the Proposed New Sewer District Development, After the Second Stage (after 2015)

Site Office	Nessary Personnel afther the First Stage Project							
	Manager	Section Cheif	Engineer	Administ rator	Operator	Driver	Worker	Total
1. Luyanó PTR (Main WWTP)								
Manager	1							1
1.1 **Management Section**				1		2		3
1.2 **Treatment Section**		1	2		2		4	9
1.3 **Operation Section**		1			9			10
1.4 **Water Quality Section**		1	3					4
Total of Main WWTP	**1**	**3**	**5**	**1**	**11**	**2**	**4**	**27**
2. CHIVO WWTP (Primary Treatment)								
Manager								0
2.1 **Management Section**								0
2.2 **Treatment Section**								0
2.3 **Operation Section**								0
2.4 **Water Quality Section**								0
Total of CHIVO WWTP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3. Matadero Pumping Station								
Manager		1						1
3.1 **Management Section**				1		1		2
3.2 **Operation Section**		1			8		2	11
Total of Pumping Station	**0**	**2**	**0**	**1**	**8**	**1**	**2**	**14**
4. CASABLANCA Pumping Station								
Manager		1						1
4.1 **Management Section**				1		1		2
4.2 **Operation Section**		1			12		6	19
Total of Pumping Station	**0**	**2**	**0**	**1**	**12**	**1**	**6**	**22**
5. Re Pumping Station								
Manager								0
5.1 **Management Section**								0
5.2 **Operation Section**								0
Total of Re Pumping Station	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
6. New Sewerage System	**1**	**5**	**5**	**2**	**19**	**3**	**6**	**41**
7. Existing Sewerage	**0**	**2**	**0**	**1**	**12**	**1**	**6**	**22**
8. Total	**1**	**7**	**5**	**3**	**31**	**4**	**12**	**63**

Table A12. 86 Necessary Personnel in Site Offices for the Proposed New Sewer District Development, After the Third Stage (after 2020)

Site Office	Nessary Personnel afther the First Stage Project							
	Manager	Section Cheif	Engineer	Administ rator	Operator	Driver	Worker	Total
1. Luyanó PTR (Main WWTP)								
Manager	1							1
1.1 **Management Section**				1		2		3
1.2 **Treatment Section**		1	2		2		4	9
1.3 **Operation Section**		1			12			13
1.4 **Water Quality Section**		1	3					4
Total of Main WWTP	**1**	**3**	**5**	**1**	**14**	**2**	**4**	**30**
2. CHIVO WWTP (Primary Treatment)								
Manager								0
2.1 **Management Section**								0
2.2 **Treatment Section**								0
2.3 **Operation Section**								0
2.4 **Water Quality Section**								0
Total of CHIVO WWTP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3. Matadero Pumping Station								
Manager		1						1
3.1 **Management Section**				1		1		2
3.2 **Operation Section**		1			8		2	11
Total of Pumping Station	**0**	**2**	**0**	**1**	**8**	**1**	**2**	**14**
4. CASABLANCA Pumping Station								
Manager		1						1
4.1 **Management Section**				1		1		2
4.2 **Operation Section**		1			12		6	19
Total of Pumping Station	**0**	**2**	**0**	**1**	**12**	**1**	**6**	**22**
5. Re Pumping Station								
Manager								0
5.1 **Management Section**				1		1		2
5.2 **Operation Section**		1			6		3	10
Total of Re Pumping Station	**0**	**1**	**0**	**1**	**6**	**1**	**3**	**12**
6. New Sewerage System	**1**	**6**	**5**	**3**	**28**	**4**	**9**	**56**
7. Existing Sewerage	**0**	**2**	**0**	**1**	**12**	**1**	**6**	**22**
8. Total	**1**	**8**	**5**	**4**	**40**	**5**	**15**	**78**

Table A12.87 Personnel Cost in Site Offices for the Proposed New Sewer District Development, After the First Stage (after 2010)

Site Office	Unit: Pesos/Year							
	Manager	Section Cheif	Engineer	Adminis trator	Operator	Driver	Worker	Total
1.1 Luyanó PTR (Main WWTP)	7,200	20,700	31,500	3,480	62,700	6,960	12,000	144,540
1.2 CHIVO WWTP (Primary Treatment)	0	0	0	0	0	0	0	0
1.3 Matadero Pumping Station	0	13,800	0	3,480	45,600	3,480	6,000	72,360
1.4 Re Pumping Station	0	0	0	0	0	0	0	0
2. CASABLANCA Pumping Station	0	13,800	0	3,480	68,400	3,480	18,000	107,160
1. New Sewerage System	7,200	34,500	31,500	6,960	108,300	10,440	18,000	216,900
2. Existing Sewerage System	0	13,800	0	3,480	68,400	3,480	18,000	107,160
3. Total	7,200	48,300	31,500	10,440	176,700	13,920	36,000	324,060

Table A12. 88 Personnel Cost in Site Offices for the Proposed

Site Office	Unit: Pesos/Year							
	Manager	Section Cheif	Engineer	Administrator	Operator	Driver	Worker	Total
1.1 Luyanó PTR (Main WWTP)	7,200	20,700	31,500	3,480	79,800	6,960	12,000	161,640
1.2 CHIVO WWTP (Primary Treatment)	0	0	0	0	0	0	0	0
1.3 Matadero Pumping Station	0	13,800	0	3,480	45,600	3,480	6,000	72,360
1.4 Re Pumping Station	0	6,900	0	3,480	34,200	3,480	9,000	57,060
2. CASABLANCA Pumping Station	0	13,800	0	3,480	68,400	3,480	18,000	107,160
1. New Sewerage System	7,200	41,400	31,500	10,440	159,600	13,920	27,000	291,060
2. Existing Sewerage System	0	13,800	0	3,480	68,400	3,480	18,000	107,160
3. Total	7,200	55,200	31,500	13,920	228,000	17,400	45,000	398,220

New Sewer District Development, After the Second Stage (after 2015)

Table A12. 89 Personnel Cost in Site Offices for the Proposed New Sewer District Development, After the Third Stage (after 2020)

Site Office	Unit: Pesos/Year							
	Manager	Section Cheif	Engineer	Administrator	Operator	Driver	Worker	Total
1.1 Luyanó PTR (Main WWTP)	7,200	20,700	31,500	3,480	79,800	6,960	12,000	161,640
1.2 CHIVO WWTP (Primary Treatment)	0	0	0	0	0	0	0	0
1.3 Matadero Pumping Station	0	13,800	0	3,480	45,600	3,480	6,000	72,360
1.4 Re Pumping Station	0	6,900	0	3,480	34,200	3,480	9,000	57,060
2. CASABLANCA Pumping Station	0	13,800	0	3,480	68,400	3,480	18,000	107,160
1. New Sewerage System	7,200	41,400	31,500	10,440	159,600	13,920	27,000	291,060
2. Existing Sewerage System	0	13,800	0	3,480	68,400	3,480	18,000	107,160
3. Total	7,200	55,200	31,500	13,920	228,000	17,400	45,000	398,220

Table A12. 90 Electrical Charge for Pumping Stations (1)

	CASA BLANCA Pump Station			Re-pumpup Pump Station		
Years	2011～2015	2016～2020	2021～2030	2011～2015	2016～2020	2021～2030
Volume m3/day	217,400	224,100	230,600		224,100	230,600
Pump Capacity m3/day		453,600			453,600	
w		660			420	
Base Charge : pesos / m		3,300			2,100	
Rate of Operation for 1hr						
Peak hours	0.700	0.700	0.710		0.700	0.710
Daytime	0.508	0.540	0.553		0.540	0.553
Nighttime	0.302	0.302	0.321		0.302	0.321
Pumping Volume for 1hr						
Peak hours m3/hr	13,230	13,230	13,419		13,230	13,419
Daytime m3/hr	9,601	10,206	10,452		10,206	10,452
Nighttime m3/hr	5,708	5,708	6,067		5,708	6,067
Pumping Volume for 1day						
Peak hours m3/day	66,150	66,150	67,095		66,150	67,095
Daytime m3/day	105,613	112,266	114,969		112,266	114,969
Nighttime m3/day	45,662	45,662	48,535		45,662	48,535
Total m3/day	217,426	224,078	230,599		224,078	230,599
E.Comsumption for 1hr						
Peak hours kwh	462	462	469		294	298
Daytime kwh	335	356	365		227	232
Nighttime kwh	199	199	212		127	135
E.Comsumption for 1day						
Peak hours kwh	2,310	2,310	2,343		1,470	1,491
Daytime kwh	3,688	3,920	4,015		2,495	2,555
Nighttime kwh	1,595	1,595	1,695		1,015	1,079
Total kwh	7,593	7,825	8,053		4,980	5,124
Electrical Charge for 1 day						
Peak hours pesos/day	192	192	194		122	124
Daytime pesos/day	155	165	169		105	107
Nighttime pesos/day	45	45	47		28	30
Total pesos/day	391	401	411		255	261
Electrical Charge for 1 m						
Peak hours pesos/m	5,752	5,752	5,834		3,660	3,713
Daytime pesos/m	4,647	4,940	5,059		3,143	3,219
Nighttime pesos/m	1,339	1,339	1,424		852	906
Total pesos/m	11,738	12,031	12,316		7,656	7,838
Total Electrical Charge for 1 month : pesos / m	15,000	15,300	15,600		9,800	9,900
Total Electrical Charge for 1 year : pesos / y	180,000	183,600	187,200		117,600	118,800

Note: Business Electrical Charge of Cuba is given below.

(Base Charge) ;5.00 pesos / kw

(Electrical Charge) Peak Hours ; 0.083 pesos / kwh
Daytime ; 0.042 pesos / kwh
Nighttime ; 0.028 pesos / kwh

(Slot) Slot isn't set on rule. But the slot is assumed as follows.
Peak Hours ; 5 hours
Daytime ; 11 hours
Nighttime ; 8 hours

Table A12. 91 Electrical Charge for Pumping Stations (2)

	During Refabilitation (2013-2015)	Normal Situation (2011-12, 2016-)
Maximum Hourly Wastewater Flow m^3	197,251	58,406
Average Daily Wastewater Flow m^3/day	127,267	29,894
Electrical Capacity :kw	500	180
Deal Electriccal Power :kw	400	150
Base Charge : pesos / m	2,000	750
E.Comsumption for 1hr		
Peak hours kwh	320	120
Daytime kwh	280	110
Nighttime kwh	240	90
E.Comsumption for 1day		
Peak hours kwh	1,600	600
Daytime kwh	3,080	1,210
Nighttime kwh	1,920	720
Total kwh	6,600	2,530
Electrical Charge for 1 day		
Peak hours pesos/day	133	50
Daytime pesos/day	129	51
Nighttime pesos/day	54	20
Total pesos/day	316	121
Electrical Charge for 1 m		
Peak hours pesos/m	3,984	1,494
Daytime pesos/m	3,881	1,525
Nighttime pesos/m	1,613	605
Total pesos/m	9,478	3,623
Total Electrical Charge for 1 month : pesos / m	11,500	4,400
Total Electrical Charge for 1 year : pesos / y	138,000	52,800

Note: Business Electrical Charge of Cuba is given below.

(Base Charge) ;5.00 pesos / kw

(Electrical Charge) Peak Hours ; 0.083 pesos / kwh
Daytime ; 0.042 pesos / kwh
Nighttime ; 0.028 pesos / kwh

(Slot) Slot isn't set on rule. But the slot is assumed as follows.
Peak Hours ; 5 hours
Daytime ; 11 hours
Nighttime ; 8 hours

Influent of New WWTP
The Influent of New WWTP is estimated to calculate power cost and chemical cost.

Influent change from the GEF/UNDP target area
90% of all the influent is collected in the 5th year, and 100 % in the 10th year.

Table A12.92 Influent change rate from GEF/UNDP target area

Years	1	2	3	4	5	6	7	8	9	10
Influent rate each year	50	15	10	10	5	3	2	2	2	1
Total rate below the year %	50	65	75	85	90	93	95	97	99	100

Table A12.93 Influent change into GEF WWTP
Q = 0.200 m3/sec = 17,300 m3/day (Maximum Daily), 14,400 m3/day(Average Daily)

Years	1	2	3	4	5	6	7	8	9	10
Influent (m3/day)	7,200	9,360	10,800	12,240	12,960	13,400	13,680	13,970	14,260	14,400

Influent change from the extended area
75 % of all the influent is supposed to be collected in the 5th year, and 100 % in the 0th year.

Table A12.94 Influent change rate from extended area

Years	1	2	3	4	5	6	7	8	9	10
Influent rate each year	20	20	15	10	10	5	5	5	5	5
Total rate below the year %	20	40	55	65	75	80	85	90	95	100

Table A12.95 Influent change into the first stage facilities of New WWTP
Q = 0.207 m3/sec = 17,900 m3/day (Maximum Daily), 15,100 m3/day (Average Daily)

Years	1	2	3	4	5	6	7	8	9	10
Influent (m3/day)	3,020	6,040	8,310	9,820	11,330	12,080	12,840	13,590	14,350	15,100

Influent change into Luyanó WWTP
The operation of GEF WWTP will be supposed to start in 2006, to start in 2011 about the first train facility of new WWTP, to start in2016 about the second train facility of them , to start In2021 about the thirdtrain facility of them.

Table A12.96 Influent change (part 1)

(m3/day)

Years	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
GEF	7,200	9,360	10,800	12,240	12,960	13,400	13,680	13,970	14,260	14,400
the first train of new facilities						3,020	6,040	8,310	9,820	11,330
the second train of new faciliies										
the third train of new facilities										
Total of new facilities	0	0	0	0	0	3,020	6,040	8,310	9,820	11,330
Total	7,200	9,360	10,800	12,240	12,960	16,420	19,720	22,280	24,080	25,730

Table A12.97 Influent change (part 2)

(m3/day)

Years	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
GEF	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400
the first train of new facilities	12,080	12,840	13,590	14,350	15,100	15,100	15,100	15,100	15,100	15,100
the second train of new faciliie	3,020	6,040	8,310	9,820	11,330	12,080	12,840	13,590	14,350	15,100
the third train of new facilities						3,020	6,040	8,310	9,820	11,330
Total of new facilities	15,100	18,880	21,900	24,170	26,430	30,200	33,980	37,000	39,270	41,530
Total	29,500	33,280	36,300	38,570	40,830	44,600	48,380	51,400	53,670	55,930

Table A12.98 Influent change (part 3)

(m3/day)

Years	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
GEF	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400	14,400
the first train of new facilities	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100
the second train of new faciliie	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100	15,100
the third train of new facilities	12,080	12,840	13,590	14,350	15,100	15,100	15,100	15,100	15,100	15,100
Total of new facilities	42,280	43,040	43,790	44,550	45,300	45,300	45,300	45,300	45,300	45,300
Total	56,680	57,440	58,190	58,950	59,700	59,700	59,700	59,700	59,700	59,700

Table A12.99 Electrical Charge change in All new Facilities (part 1)

Unit of Charge : Thousand Pesos/Year

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average Daily WW Flow (m3/d)	7,200	9,360	10,800	12,240	12,960	16,420	19,720	22,280	24,080	25,730
Base Charge in All Facirities	18	18	18	18	18	24	24	24	24	24
E. Charge in All Facirities	28	36	42	47	50	63	76	86	93	99
All E. Charge in All Facirities	46	54	60	65	68	87	100	110	117	123
All E. Charge in All New Train Facirities	0	0	0	0	0	44	51	56	59	63

Table A12.100 Electrical Charge change in All new Facilities (part 2)

Unit of Charge : Thousand Pesos/Year

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Average Daily WW Flow (m3/d)	29,500	33,280	36,300	38,570	40,830	44,600	48,380	51,400	53,670	55,930
Base Charge in All Facirities	36	36	36	36	36	45	45	45	45	45
E. Charge in All Facirities	114	128	140	149	157	172	186	198	207	215
All E. Charge in All Facirities	150	164	176	185	193	217	231	243	252	260
All E. Charge in All New Train Facirities	101	111	119	124	130	164	175	184	190	197

Table A12.101 Electrical Charge change in All new Facilities (part 3)

Unit of Charge : Thousand Pesos/Year

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Average Daily WW Flow (m3/d)	56,680	57,440	58,190	58,950	59,700	59,700	59,700	59,700	59,700	59,700
Base Charge in All Facirities	45	45	45	45	45	45	45	45	45	45
E. Charge in All Facirities	218	221	224	227	230	230	230	230	230	230
All E. Charge in All Facirities	263	266	269	272	275	275	275	275	275	275
All E. Charge in All New Train Facirities	199	201	204	206	208	208	208	208	208	208

Table A12.102 Electrical Charge for Luyanó WWTP

Stage	First Stage	Second Stage	Third Stage
(m3/d)	36,165	53,050	70,935
(m3/d)	29,538	44,562	59,585
Water Treatment Process	Conventional activated sludge process	Conventional activated sludge process	Conventional activated sludge process
Sludge Treatment Process	Digestion+ Mecanical Dewatering	Thickning+Digestion+ Mecanical Dewatering	Thickning+Digestion+ Mecanical Dewatering
Electrical Capacity :kw	500	750	930
Deal Electriccal Power :kw	400	600	750
Base Charge : pesos / m	2,000	3,000	3,750
E.Comsumption for 1hr			
Peak hours kwh	320	480	600
Daytime kwh	280	420	530
Nighttime kwh	240	360	450
E.Comsumption for 1day			
Peak hours kwh	1,600	2,400	3,000
Daytime kwh	3,080	4,620	5,830
Nighttime kwh	1,920	2,880	3,600
Total kwh	6,600	9,900	12,430
Electrical Charge for 1 day			
Peak hours pesos/day	133	199	249
Daytime pesos/day	129	194	245
Nighttime pesos/day	54	81	101
Total pesos/day	316	474	595
Electrical Charge for 1 m			
Peak hours pesos/m	3,984	5,976	7,470
Daytime pesos/m	3,881	5,821	7,346
Nighttime pesos/m	1,613	2,419	3,024
Total pesos/m	9,478	14,216	17,840
Total Electrical Charge for 1 month : pesos / m	11,500	17,200	21,600
Total Electrical Charge for 1 year : pesos / y	138,000	206,400	259,200

Note: Business Electrical Charge of Cuba is given below.

(Base Charge) ;5.00 pesos / kw

(Electrical Charge) Peak Hours ; 0.083 pesos / kwh
Daytime ; 0.042 pesos / kwh
Nighttime ; 0.028 pesos / kwh

(Slot) Slot isn't set on rule. But the slot is assumed as follows.
Peak Hours ; 5 hours
Daytime ; 11 hours
Nighttime ; 8 hours

Table A12. 103 Chemical Cost in Luyanó WWTP

New Train Treatment Facility								
Years	Treatment Flow : m3/day	Thickened sludge solid each treatment flow 1 m3 : kg/m3	Thickened sludge solid : kg/day	Dosage : %	Additive amount each day : kg/day	Additive amount each year : kg/year	Cost for Polymer : th-yen /year	Cost for Polymer : th-dollars /year
2011	3,020		547		5.47	1,995	1,995	17
2012	6,040		1,093		10.93	3,990	3,990	33
2013	8,310		1,504		15.04	5,490	5,490	46
2014	9,820		1,777		17.77	6,488	6,488	54
2015	11,330		2,051		20.51	7,485	7,485	62
2016	15,100		2,733		27.33	9,976	9,976	83
2017	18,880		3,417		34.17	12,473	12,473	104
2018	21,900		3,964		39.64	14,468	14,468	121
2019	24,170		4,375		43.75	15,968	15,968	133
2020	26,430	0.181	4,784	1.0	47.84	17,461	17,461	146
2021	30,200		5,466		54.66	19,952	19,952	166
2022	33,980		6,150		61.50	22,449	22,449	187
2023	37,000		6,697		66.97	24,444	24,444	204
2024	39,270		7,108		71.08	25,944	25,944	216
2025	41,530		7,517		75.17	27,437	27,437	229
2026	42,280		7,653		76.53	27,932	27,932	233
2027	43,040		7,790		77.90	28,434	28,434	237
2028	43,790		7,926		79.26	28,930	28,930	241
2029	44,550		8,064		80.64	29,432	29,432	245
2030	45,300		8,199		81.99	29,927	29,927	249
2031	45,300		8,199		81.99	29,927	29,927	249
2032	45,300		8,199		81.99	29,927	29,927	249
2033	45,300		8,199		81.99	29,927	29,927	249
2034	45,300		8,199		81.99	29,927	29,927	249
2035	45,300		8,199		81.99	29,927	29,927	249

Note: Chlorination will not be used in Luyano WWTP. Therefore chemical cost consists of only the polymer for mecanical sludge dev
Unit price of the polymer : 1,000Yen/kg

APPENDIX-13

ECONOMIC AND FINANCIAL CONSIDERATIONS

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APPENDIX 13
FINANCIAL AND ECONOMIC CONSIDERATIONS

13.1 FINANCIAL VALUATION OF COSTS AND BENEFIT OF THE MASTER PLAN PROJECT

The financial costs and benefits of the master plan project were identified and summarized in Table A13.1 (same as Table 13.32 of Part I, Volume II). Basic conditions and assumptions used in the valuation are described in Section 13.9.1 of Part I, Volume II. Various basic computations to reach the project cash flow are presented subsequently.

The breakdowns of financial cost of each stage are shown in:

Table A13.2 (Breakdown of Financial Cost of Master Plan Project – First Stage)

Table A13.3 (Breakdown of Financial Cost of Master Plan Project – Second Stage)

Table A13.4 (Breakdown of Financial Cost of Master Plan Project – Third Stage)

The financial costs and the investment schedules of the master plan project are also shown in:

Table A13.5 (First Stage Capital Investment Schedule and Cost at Financial Value – Master Plan)

Table A13.6 (Second Stage Capital Investment Schedule and Cost at Financial Value – Master Plan)

Table A13.7 (Third Stage Capital Investment Schedule and Cost at Financial Value – Master Plan)

The financial costs for O/M are computed as net of the without-project situation. They are shown in Table A13.8 (Operating Expenditure at Financial Value in Master Plan Project).

The financial benefits are revenues coming from four sources, which are shown in:

Table A13.9 (Revenue from Foreign Currency Earners in Master Plan Project)

Table A13.10 (Revenue from Corporations in Master Plan Project)

Table A13.11 (Revenue from Domestic Customers in Master Plan Project)

Table A13.12 (Contribution from Tourists)

13.2 ECONOMIC VALUATION OF COSTS AND BENEFIT OF THE MASTER PLAN PROJECT

The economic costs and benefits of the master plan project were identified and summarized in Table A13.13 (same as Table 13.37 of Part I, Volume II). Basic conditions and assumptions used in the valuation are described in Section 13.9.2 of Part I, Volume II. By applying the conversions factors described in that section, those financial costs are converted into their economic costs. Lands are valuated economically based on their expected agricultural production.

The breakdowns of economic cost of each stage are shown in:

Table A13.14 (Breakdown of Economic Cost of Master Plan Project – First Stage)

Table A13.15 (Breakdown of Economic Cost of Master Plan Project – Second Stage)

Table A13.16 (Breakdown of Economic Cost of Master Plan Project – Third Stage)

The economic costs and the investment schedules of the master plan project are also shown in:

Table A13.17 (First Stage Capital Investment Schedule and Cost at Economic Value – Master Plan)

Table A13.18 (Second Stage Capital Investment Schedule and Cost at Economic Value – Master Plan)

Table A13.19 (Third Stage Capital Investment Schedule and Cost at Economic Value – Master Plan)

Likewise the economic costs for O/M were computed by using conversion factors of salary (0.86), electricity (2.0), and chemical (0.9). The results are shown in Table A13.20 (Operating Expenditure at Economic Value in Master Plan Project).

The economic benefits can be identified in domestic customers (Table A13.21: Economic Benefit of Inhabitants in Master Plan Project), industries (Table A13.22: Economic Benefit of Industries in Master Plan Project) and tourists. Benefit of tourists is the same as the contribution from tourists that was computed in financial valuation (Table A13.12).

13.3 FINANCIAL VALUATION OF COSTS AND BENEFIT OF THE PRIORITY PROJECT

The financial costs and benefits of the priority project were identified and summarized in Table A13.23 (the same as Table 4.1 of Part II, Volume II). Basic conditions and assumptions used in the valuation are described in Section 4.1.2 of Part II, Volume II. Various basic computations to reach the project cash flow are presented subsequently.

The breakdown of financial costs is the same as what is shown in Table A13.2 (Breakdown of Financial Cost of Master Plan Project – First Stage).

The financial costs and the investment schedule of the priority project are also the same as those shown in Table A13.5 (First Stage Capital Investment Schedule and Cost at Financial Value – Master Plan).

The financial costs for O/M are computed as net of the without-project situation. They are shown in Table A13.24 (Operating Expenditure at Financial Value in Priority Project).

The financial benefits are revenues coming from four sources, which are shown in:

Table A13.25 (Revenue from Foreign Currency Earners in Priority Project)

Table A13.26 (Revenue from Corporations in Priority Project)

Table A13.27 (Revenue from Domestic Customers in Priority Project)

Table A13.28 (Contribution from Tourists in Priority Project)

13.4 ECONOMIC VALUATION OF COSTS AND BENEFIT OF THE PRIORITY PROJECT

The economic costs and benefits of the priority project were identified and summarized in Table A13.29 (the same as Table 4.6 of Part II, Volume II). Basic conditions and assumptions used in the valuation are described in Section 4.2.2 of Part II, Volume II. By applying the conversions factors described in that section, those financial costs are converted into their economic costs. Lands are valuated economically based on their expected agricultural production.

The breakdown of economic costs of the priority project is shown in Table A13.30 (Breakdown of Economic Cost of Priority Project).

The economic costs and the investment schedule of the priority project are also shown in Table A13.31 (Capital Investment Schedule and Cost at Economic Value – Priority Project).

Likewise the economic costs for O/M were computed by using conversion factors of salary (0.86), electricity (2.0), and chemical (0.9). The results are shown in Table A13.32 (Operating Expenditure at Economic Value in Priority Project).

The economic benefits can be identified in domestic customers (Table A13.33: Economic Benefit of Inhabitants in Priority Project), industries (Table A13.34: Economic Benefit of Industries in Priority Project) and tourists. Benefit of tourists is the same as the contribution from tourists that was computed in the financial valuation (Table A13.28).

Table A13.1 Master Plan Project Cash Flow at Financial Value

Yr. no.	Year	Cost				Benefit				Net Benefit			
		Capital expenditure ($000)	Capital expenditure (Ps000)	Operating expend. ($000)	Operating expend. (Ps000)	Foreign currency ($000)	Corpo-ration (Ps000)	Domestic user (Ps000)	Tourist contribut. ($000)	US$ ($000)	Peso (Ps000)	$ + Peso Ps1:$1 (Ps000)	$ + Peso Ps26:$1 (Ps000)
1	2004												
2	2005												
3	2006	1,553	684							-1,553	-684	-2,237	-41,070
4	2007	1,553	684							-1,553	-684	-2,237	-41,070
5	2008	14,610	9,612							-14,610	-9,612	-24,222	-389,467
6	2009	17,251	10,861							-17,251	-10,861	-28,112	-459,376
7	2010	18,680	11,992							-18,680	-11,992	-30,672	-497,661
8	2011	5,278	3,616	17	1,142	813	6,203	21,890	2,600	-1,883	23,335	21,452	-25,618
9	2012	5,277	3,616	33	1,149	845	6,466	22,420	2,600	-1,865	24,120	22,255	-24,377
10	2013	7,059	4,672	46	1,239	878	6,663	22,848	2,600	-3,628	23,599	19,971	-70,724
11	2014	14,055	7,513	54	1,242	910	6,794	23,172	2,600	-10,599	21,212	10,613	-254,351
12	2015	9,246	5,569	62	1,246	943	6,926	23,498	2,600	-5,765	23,608	17,843	-126,283
13	2016	5,752	3,938	83	1,512	975	7,172	24,002	2,600	-2,260	25,724	23,464	-33,038
14	2017	5,751	3,938	104	1,522	1,008	7,420	24,508	2,600	-2,248	26,467	24,219	-31,971
15	2018	6,519	4,193	121	1,530	1,040	7,621	24,942	2,600	-3,000	26,840	23,840	-51,162
16	2019	8,743	5,263	133	1,535	1,073	7,777	25,306	2,600	-5,204	26,285	21,081	-109,009
17	2020	8,831	5,458	146	1,541	1,105	7,934	25,670	2,600	-5,272	26,604	21,332	-110,470
18	2021			166	1,614	1,138	8,173	26,164	2,600	3,572	32,723	36,294	125,582
19	2022			187	1,625	1,170	8,413	26,657	2,600	3,583	33,446	37,029	126,604
20	2023			204	1,634	1,203	8,604	27,075	2,600	3,599	34,045	37,644	127,606
21	2024			216	1,640	1,235	8,746	27,418	2,600	3,619	34,524	38,143	128,618
22	2025			229	1,647	1,268	8,889	27,760	2,600	3,639	35,002	38,641	129,603
23	2026			233	1,649	1,300	8,938	27,956	2,600	3,667	35,245	38,912	130,587
24	2027			237	1,651	1,333	8,987	28,152	2,600	3,696	35,487	39,183	131,570
25	2028			241	1,654	1,365	9,035	28,347	2,600	3,724	35,728	39,452	132,552
26	2029			245	1,656	1,398	9,084	28,543	2,600	3,753	35,971	39,723	133,536
27	2030			249	1,658	1,430	9,131	28,739	2,600	3,781	36,212	39,993	134,518
28	2031			249	1,658	1,430	9,131	28,859	2,600	3,781	36,332	40,113	134,638
29	2032			249	1,658	1,430	9,131	28,979	2,600	3,781	36,452	40,233	134,758
30	2033			249	1,658	1,430	9,131	28,979	2,600	3,781	36,452	40,233	134,758
31	2034			249	1,658	1,430	9,131	28,979	2,600	3,781	36,452	40,233	134,758
32	2035			249	1,658	1,430	9,131	28,979	2,600	3,781	36,452	40,233	134,758
33	2036			249	1,658	1,430	9,131	28,979	2,600	3,781	36,452	40,233	134,758
34	2037			249	1,658	1,430	9,131	28,979	2,600	3,781	36,452	40,233	134,758
35	2038			249	1,658	1,430	9,131	28,979	2,600	3,781	36,452	40,233	134,758
36	2039			249	1,658	1,430	9,131	28,979	2,600	3,781	36,452	40,233	134,758
37	2040			249	1,658	1,430	9,131	28,979	2,600	3,781	36,452	40,233	134,758
38	2041			249	1,658	1,430	9,131	28,979	2,600	3,781	36,452	40,233	134,758
39	2042			249	1,658	1,430	9,131	28,979	2,600	3,781	36,452	40,233	134,758
40	2043			249	1,658	1,430	9,131	28,979	2,600	3,781	36,452	40,233	134,758
41	2044			249	1,658	1,430	9,131	28,979	2,600	3,781	36,452	40,233	134,758
42	2045			249	1,658	1,430	9,131	28,979	2,600	3,781	36,452	40,233	134,758
	Total	130,158	81,611	6,741	54,956	43,875	295,945	949,629	91,000	-2,024	1,109,007	1,106,983	1,056,383

Results:

Case I	US$ portion	FIRR: -0.1%	B/C: 0.5	NPV($): -40,511	(Discount rate: 6%)
Case II	Peso portion	FIRR: 45.1%	B/C: 4.5	NPV(P): 176,239	(Discount rate: 8%)
Case III	US$+peso (Ps1:$1)	FIRR: 21.0%	B/C: 2.1	NPV(P): 135,728	
Case IV	US$+peso (Ps26:$1)	FIRR: 1.8%	B/C: 0.6	NPV(P): -877,044	

Table A13.2 Breakdown of Financial Cost of Master Plan Project - First Stage

(Foreign currency:US$000, Local currency:Ps000)

			Direct cost																						Indirect cost				Total capital cost
			Luyano Martin Perez		Luyano left colector		Central system Sur nuevo		Central system Pumped main		Central system Interconnection		Central system Cross connect.		Luyano WWTP		New Matadero pump. station		Rehabilitation Casablanca PS		Rehabilitation Caballeria		Total direct cost		Land	Admin. expenses	Engineering services	Physical contingency	
Construction works	FC	Material & equipment	12,502	(65%)	3,075	(65%)	652	(65%)	634	(65%)	638	(55%)	2,262	(65%)	1,164	(50%)	274	(55%)	14	(55%)			21,215	(63%)					
		Labor	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)			0	(0%)					
		Transactional cost	3,847	(20%)	946	(20%)	201	(20%)	195	(20%)	348	(30%)	696	(20%)	814	(35%)	150	(30%)	8	(30%)			7,204	(22%)					
		Dealer margin	2,885	(15%)	710	(15%)	150	(15%)	146	(15%)	174	(15%)	522	(15%)	349	(15%)	75	(15%)	4	(15%)			5,015	(15%)					
		Total	19,234	(100%)	4,730	(100%)	1,003	(100%)	976	(100%)	1,160	(100%)	3,480	(100%)	2,327	(100%)	499	(100%)	25	(100%)			33,434	(100%)					
	LC	Material & equipment	1,923	(15%)	473	(15%)	100	(15%)	98	(15%)	271	(35%)	348	(15%)	233	(30%)	58	(35%)	3	(35%)			3,506	(16%)					
		Labor	6,411	(50%)	1,577	(50%)	334	(50%)	325	(50%)	232	(30%)	1,160	(50%)	233	(30%)	50	(30%)	2	(30%)			10,324	(48%)					
		Transactional cost	2,564	(20%)	631	(20%)	134	(20%)	130	(20%)	155	(20%)	464	(20%)	194	(25%)	33	(20%)	2	(20%)			4,306	(20%)					
		Dealer margin	1,923	(15%)	473	(15%)	100	(15%)	98	(15%)	116	(15%)	348	(15%)	116	(15%)	25	(15%)	1	(15%)			3,200	(15%)					
		Total	12,822	(100%)	3,154	(100%)	668	(100%)	650	(100%)	773	(100%)	2,320	(100%)	775	(100%)	166	(100%)	8	(100%)			21,336	(100%)					
Architectural works	FC	Material & equipment													34	(50%)	119	(50%)					153	(50%)					
		Labor													0	(0%)	0	(0%)					0	(0%)					
		Transactional cost													24	(35%)	83	(35%)					107	(35%)					
		Dealer margin													10	(15%)	36	(15%)					46	(15%)					
		Total													68	(100%)	237	(100%)					305	(100%)					
	LC	Material & equipment													14	(30%)	47	(30%)					61	(30%)					
		Labor													14	(30%)	47	(30%)					61	(30%)					
		Transactional cost													12	(25%)	40	(25%)					51	(25%)					
		Dealer margin													7	(15%)	24	(15%)					31	(15%)					
		Total													46	(100%)	158	(100%)					204	(100%)					
Mechanical works	FC	Material & equipment													1,489	(65%)	887	(65%)	834	(65%)	111	(65%)	3,320	(65%)					
		Labor													0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)					
		Transactional cost													458	(20%)	273	(20%)	257	(20%)	34	(20%)	1,021	(20%)					
		Dealer margin													344	(15%)	205	(15%)	192	(15%)	26	(15%)	766	(15%)					
		Total													2,290	(100%)	1,364	(100%)	1,283	(100%)	170	(100%)	5,107	(100%)					
	LC	Material & equipment													147	(15%)	88	(15%)	83	(15%)	11	(15%)	328	(15%)					
		Labor													589	(60%)	351	(60%)	330	(60%)	44	(60%)	1,313	(60%)					
		Transactional cost													98	(10%)	59	(10%)	55	(10%)	7	(10%)	219	(10%)					
		Dealer margin													147	(15%)	88	(15%)	83	(15%)	11	(15%)	328	(15%)					
		Total													981	(100%)	585	(100%)	550	(100%)	73	(100%)	2,189	(100%)					
Electrical works	FC	Material & equipment													1,434	(65%)	566	(65%)	780	(65%)	13	(65%)	2,793	(65%)					
		Labor													0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)					
		Transactional cost													441	(20%)	174	(20%)	240	(20%)	4	(20%)	859	(20%)					
		Dealer margin													331	(15%)	131	(15%)	180	(15%)	3	(15%)	645	(15%)					
		Total													2,206	(100%)	871	(100%)	1,200	(100%)	20	(100%)	4,297	(100%)					
	LC	Material & equipment													221	(15%)	87	(15%)	120	(15%)	2	(15%)	430	(15%)					
		Labor													883	(60%)	349	(60%)	480	(60%)	8	(60%)	1,720	(60%)					
		Transactional cost													147	(10%)	58	(10%)	80	(10%)	1	(10%)	287	(10%)					
		Dealer margin													221	(15%)	87	(15%)	120	(15%)	2	(15%)	430	(15%)					
		Total													1,471	(100%)	581	(100%)	800	(100%)	14	(100%)	2,866	(100%)					
Total works	FC	Material & equipment	12,502	(65%)	3,075	(65%)	652	(65%)	634	(65%)	638	(55%)	2,262	(65%)	4,120	(60%)	1,846	(62%)	1,628	(65%)	124	(65%)	27,480	(64%)					
		Labor	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)					
		Transactional cost	3,847	(20%)	946	(20%)	201	(20%)	195	(20%)	348	(30%)	696	(20%)	1,737	(25%)	680	(23%)	504	(20%)	38	(20%)	9,192	(21%)					
		Dealer margin	2,885	(15%)	710	(15%)	150	(15%)	146	(15%)	174	(15%)	522	(15%)	1,034	(15%)	446	(15%)	376	(15%)	29	(15%)	6,471	(15%)					
		Total	19,234	(100%)	4,730	(100%)	1,003	(100%)	976	(100%)	1,160	(100%)	3,480	(100%)	6,891	(100%)	2,971	(100%)	2,508	(100%)	190	(100%)	43,143	(100%)			4,438	4,314	51,895
	LC	Material & equipment	1,923	(15%)	473	(15%)	100	(15%)	98	(15%)	271	(35%)	348	(15%)	614	(19%)	280	(19%)	205	(15%)	13	(15%)	4,326	(16%)					
		Labor	6,411	(50%)	1,577	(50%)	334	(50%)	325	(50%)	232	(30%)	1,160	(50%)	1,718	(52%)	797	(53%)	812	(60%)	52	(60%)	13,418	(50%)					
		Transactional cost	2,564	(20%)	631	(20%)	134	(20%)	130	(20%)	155	(20%)	464	(20%)	450	(14%)	189	(13%)	137	(10%)	9	(10%)	4,862	(18%)					
		Dealer's margin	1,923	(15%)	473	(15%)	100	(15%)	98	(15%)	116	(15%)	348	(15%)	491	(15%)	224	(15%)	204	(15%)	13	(15%)	3,989	(15%)					
		Total	12,822	(100%)	3,154	(100%)	668	(100%)	650	(100%)	773	(100%)	2,320	(100%)	3,273	(100%)	1,490	(100%)	1,358	(100%)	87	(100%)	26,595	(100%)	0	798	2,735	2,660	32,788

Table A13.3 Breakdown of Financial Cost of Master Plan Project - Second Stage

(Foreign currency:US$000, Local currency:Ps000)

			Direct cost																						Indirect cost				Total capital cost
			Luyano Martin Perez		Luyano left colector		Central system Cross connect.		Replace. inade-quate sewers		Rehabilitation Colector Sur		New construct. Colector Sur A		Luyano WWTP		Transmission Tunnel		Re-pumping station at Chivo		Replacement Outfall sewer		Total direct cost		Land	Admin. expenses	Engineering services	Physical contingency	
Construction works	FC	Material & equipment	4,910	(65%)	4,687	(65%)	882	(65%)	534	(65%)	1,271	(65%)	2,126	(65%)	1,192	(50%)	96	(55%)	50	(50%)	1,235	(65%)	16,984	(64%)					
		Labor	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)					
		Transactional cost	1,511	(20%)	1,442	(20%)	271	(20%)	164	(20%)	391	(20%)	654	(20%)	834	(35%)	52	(30%)	35	(35%)	380	(20%)	5,736	(21%)					
		Dealer margin	1,133	(15%)	1,082	(15%)	204	(15%)	123	(15%)	293	(15%)	491	(15%)	358	(15%)	26	(15%)	15	(15%)	285	(15%)	4,009	(15%)					
		Total	7,554	(100%)	7,211	(100%)	1,357	(100%)	822	(100%)	1,956	(100%)	3,271	(100%)	2,384	(100%)	174	(100%)	100	(100%)	1,900	(100%)	26,729	(100%)					
	LC	Material & equipment	755	(15%)	721	(15%)	136	(15%)	82	(15%)	196	(15%)	327	(15%)	239	(30%)	91	(35%)	10	(30%)	71	(15%)	2,628	(16%)					
		Labor	2,518	(50%)	2,404	(50%)	452	(50%)	274	(50%)	652	(50%)	1,091	(50%)	239	(30%)	78	(30%)	10	(30%)	238	(50%)	7,954	(49%)					
		Transactional cost	1,007	(20%)	961	(20%)	181	(20%)	110	(20%)	261	(20%)	436	(20%)	199	(25%)	52	(20%)	8	(25%)	95	(20%)	3,310	(20%)					
		Dealer margin	755	(15%)	721	(15%)	136	(15%)	82	(15%)	196	(15%)	327	(15%)	119	(15%)	39	(15%)	5	(15%)	71	(15%)	2,451	(15%)					
		Total	5,036	(100%)	4,807	(100%)	904	(100%)	548	(100%)	1,304	(100%)	2,181	(100%)	795	(100%)	260	(100%)	33	(100%)	475	(100%)	16,343	(100%)					
Architectural works	FC	Material & equipment													287	(50%)			119	(50%)			405	(50%)					
		Labor													0	(0%)			0	(0%)			0	(0%)					
		Transactional cost													201	(35%)			83	(35%)			284	(35%)					
		Dealer margin													86	(15%)			36	(15%)			122	(15%)					
		Total													573	(100%)			237	(100%)			810	(100%)					
	LC	Material & equipment													115	(30%)			47	(30%)			162	(30%)					
		Labor													115	(30%)			47	(30%)			162	(30%)					
		Transactional cost													96	(25%)			40	(25%)			135	(25%)					
		Dealer margin													57	(15%)			24	(15%)			81	(15%)					
		Total													382	(100%)			158	(100%)			540	(100%)					
Mechanical works	FC	Material & equipment													1,995	(65%)			709	(65%)			2,704	(65%)					
		Labor													0	(0%)			0	(0%)			0	(0%)					
		Transactional cost													614	(20%)			218	(20%)			832	(20%)					
		Dealer margin													460	(15%)			164	(15%)			624	(15%)					
		Total													3,069	(100%)			1,091	(100%)			4,160	(100%)					
	LC	Material & equipment													197	(15%)			70	(15%)			267	(15%)					
		Labor													789	(60%)			281	(60%)			1,070	(60%)					
		Transactional cost													132	(10%)			47	(10%)			178	(10%)					
		Dealer margin													197	(15%)			70	(15%)			267	(15%)					
		Total													1,315	(100%)			468	(100%)			1,783	(100%)					
Electrical works	FC	Material & equipment													1,094	(65%)			510	(65%)			1,604	(65%)					
		Labor													0	(0%)			0	(0%)			0	(0%)					
		Transactional cost													337	(20%)			157	(20%)			493	(20%)					
		Dealer margin													252	(15%)			118	(15%)			370	(15%)					
		Total													1,683	(100%)			784	(100%)			2,467	(100%)					
	LC	Material & equipment													168	(15%)			78	(15%)			247	(15%)					
		Labor													673	(60%)			314	(60%)			987	(60%)					
		Transactional cost													112	(10%)			52	(10%)			165	(10%)					
		Dealer margin													168	(15%)			78	(15%)			247	(15%)					
		Total													1,122	(100%)			523	(100%)			1,645	(100%)					
Total works	FC	Material & equipment	4,910	(65%)	4,687	(65%)	882	(65%)	534	(65%)	1,271	(65%)	2,126	(65%)	4,567	(59%)	96	(55%)	1,387	(63%)	1,235	(65%)	21,696	(64%)					
		Labor	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)					
		Transactional cost	1,511	(20%)	1,442	(20%)	271	(20%)	164	(20%)	391	(20%)	654	(20%)	1,985	(26%)	52	(30%)	493	(22%)	380	(20%)	7,345	(21%)					
		Dealer margin	1,133	(15%)	1,082	(15%)	204	(15%)	123	(15%)	293	(15%)	491	(15%)	1,156	(15%)	26	(15%)	332	(15%)	285	(15%)	5,125	(15%)					
		Total	7,554	(100%)	7,211	(100%)	1,357	(100%)	822	(100%)	1,956	(100%)	3,271	(100%)	7,709	(100%)	174	(100%)	2,212	(100%)	1,900	(100%)	34,166	(100%)			3,503	3,417	41,086
	LC	Material & equipment	755	(15%)	721	(15%)	136	(15%)	82	(15%)	196	(15%)	327	(15%)	719	(20%)	91	(35%)	206	(17%)	71	(15%)	3,304	(16%)					
		Labor	2,518	(50%)	2,404	(50%)	452	(50%)	274	(50%)	652	(50%)	1,091	(50%)	1,815	(50%)	78	(30%)	652	(55%)	238	(50%)	10,173	(50%)					
		Transactional cost	1,007	(20%)	961	(20%)	181	(20%)	110	(20%)	261	(20%)	436	(20%)	538	(15%)	52	(20%)	147	(12%)	95	(20%)	3,788	(19%)					
		Dealer's margin	755	(15%)	721	(15%)	136	(15%)	82	(15%)	196	(15%)	327	(15%)	542	(15%)	39	(15%)	177	(15%)	71	(15%)	3,047	(15%)					
		Total	5,036	(100%)	4,807	(100%)	904	(100%)	548	(100%)	1,304	(100%)	2,181	(100%)	3,614	(100%)	260	(100%)	1,182	(100%)	475	(100%)	20,311	(100%)	0	609	2,092	2,031	25,043

Table A13.4 Breakdown of Financial Cost of Master Plan Project - Third Stage

(Foreign currency:US$000, Local currency:Ps000)

			Direct cost												Indirect cost				Total capital cost
			Luyano Martin Perez		Luyano left colector		Central system Cross connect.		Replace. inade-quate sewers		Luyano WWTP		Total direct cost		Land	Admin. expenses	Engineering services	Physical contingency	
Construction works	FC	Material & equipment	5,535	(65%)	8,298	(65%)	1,560	(65%)	667	(65%)	1,163	(50%)	17,223	(64%)					
		Labor	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)					
		Transactional cost	1,703	(20%)	2,553	(20%)	480	(20%)	205	(20%)	814	(35%)	5,756	(21%)					
		Dealer margin	1,277	(15%)	1,915	(15%)	360	(15%)	154	(15%)	349	(15%)	4,055	(15%)					
		Total	8,515	(100%)	12,766	(100%)	2,400	(100%)	1,026	(100%)	2,326	(100%)	27,033	(100%)					
	LC	Material & equipment	852	(15%)	1,277	(15%)	240	(15%)	103	(15%)	233	(30%)	2,703	(16%)					
		Labor	2,839	(50%)	4,255	(50%)	800	(50%)	342	(50%)	233	(30%)	8,468	(49%)					
		Transactional cost	1,135	(20%)	1,702	(20%)	320	(20%)	137	(20%)	194	(25%)	3,488	(20%)					
		Dealer margin	852	(15%)	1,277	(15%)	240	(15%)	103	(15%)	116	(15%)	2,587	(15%)					
		Total	5,677	(100%)	8,510	(100%)	1,600	(100%)	684	(100%)	776	(100%)	17,247	(100%)					
Architectural works	FC	Material & equipment																	
		Labor																	
		Transactional cost																	
		Dealer margin																	
		Total																	
	LC	Material & equipment																	
		Labor																	
		Transactional cost																	
		Dealer margin																	
		Total																	
Mechanical works	FC	Material & equipment									1,489	(65%)	1,489	(65%)					
		Labor									0	(0%)	0	(0%)					
		Transactional cost									458	(20%)	458	(20%)					
		Dealer margin									344	(15%)	344	(15%)					
		Total									2,290	(100%)	2,290	(100%)					
	LC	Material & equipment									147	(15%)	147	(15%)					
		Labor									589	(60%)	589	(60%)					
		Transactional cost									98	(10%)	98	(10%)					
		Dealer margin									147	(15%)	147	(15%)					
		Total									981	(100%)	981	(100%)					
Electrical works	FC	Material & equipment									1,040	(65%)	1,040	(65%)					
		Labor									0	(0%)	0	(0%)					
		Transactional cost									320	(20%)	320	(20%)					
		Dealer margin									240	(15%)	240	(15%)					
		Total									1,600	(100%)	1,600	(100%)					
	LC	Material & equipment									160	(15%)	160	(15%)					
		Labor									640	(60%)	640	(60%)					
		Transactional cost									107	(10%)	107	(10%)					
		Dealer margin									160	(15%)	160	(15%)					
		Total									1,067	(100%)	1,067	(100%)					
Total works	FC	Material & equipment	5,535	(65%)	8,298	(65%)	1,560	(65%)	667	(65%)	3,692	(59%)	19,751	(64%)					
		Labor	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)	0	(0%)					
		Transactional cost	1,703	(20%)	2,553	(20%)	480	(20%)	205	(20%)	1,592	(26%)	6,534	(21%)					
		Dealer margin	1,277	(15%)	1,915	(15%)	360	(15%)	154	(15%)	932	(15%)	4,638	(15%)					
		Total	8,515	(100%)	12,766	(100%)	2,400	(100%)	1,026	(100%)	6,216	(100%)	30,923	(100%)			3,161	3,092	37,176
	LC	Material & equipment	852	(15%)	1,277	(15%)	240	(15%)	103	(15%)	540	(19%)	3,011	(16%)					
		Labor	2,839	(50%)	4,255	(50%)	800	(50%)	342	(50%)	1,462	(52%)	9,697	(50%)					
		Transactional cost	1,135	(20%)	1,702	(20%)	320	(20%)	137	(20%)	399	(14%)	3,693	(19%)					
		Dealer's margin	852	(15%)	1,277	(15%)	240	(15%)	103	(15%)	424	(15%)	2,894	(15%)					
		Total	5,677	(100%)	8,510	(100%)	1,600	(100%)	684	(100%)	2,824	(100%)	19,295	(100%)	0	579	1,975	1,930	23,779

Table A13.5 First Stage Capital Investment Schedule and Cost at Financial Value - Master Plan

Year	Direct cost				Indirect cost							Direct + Indirect cost	
	New construction		Rehabilitation		Land	Administrative		Engineering services		Physical contingency		(US$000)	(Peso000)
	(US$000)	(Ps000)	(US$000)	(Ps000)	(Ps000)	(US$000)	(Ps000)	(US$000)	(Ps000)	(US$000)	(Ps000)		
2004													
2005													
2006								1,553	684			1,553	684
2007								1,553	684			1,553	684
2008	9,020	5,781	3,858	2,218			266	444	547	1,288	800	14,610	9,612
2009	13,323	8,011	1,160	773			266	444	410	1,448	878	16,375	10,338
2010	14,622	9,038	1,160	774			266	444	410	1,578	981	17,804	11,469
2011													
2012													
2013													
2014													
2015													
2016													
2017													
2018													
2019													
2020													
2021													
Total	36,965	22,830	6,178	3,765	0	0	798	4,438	2,735	4,314	2,659	51,895	32,787

Table A13.6 Second Stage Capital Investment Schedule and Cost at Financial Value - Master Plan

Year	Direct cost				Indirect cost							Direct + Indirect cost	
	New construction		Rehabilitation		Land	Administrative		Engineering services		Physical contingency		(US$000)	(Ps000)
	(US$000)	(Ps000)	(US$000)	(Ps000)	(Ps000)	(US$000)	(Ps000)	(US$000)	(Ps000)	(US$000)	(Ps000)		
2004													
2005													
2006													
2007													
2008													
2009								876	523			876	523
2010								876	523			876	523
2011	4,044	2,695	436	291			122	350	209	448	299	5,278	3,616
2012	4,043	2,695	436	291			122	350	209	448	299	5,277	3,616
2013	4,838	2,960	1,261	986			122	350	209	610	395	7,059	4,672
2014	10,652	5,355	1,088	725			122	350	209	1,174	608	13,264	7,019
2015	6,280	3,590	1,088	723			122	350	209	737	431	8,455	5,075
2016													
2017													
2018													
2019													
2020													
2021													
Total	29,857	17,295	4,309	3,016	0	0	610	3,503	2,092	3,417	2,032	41,086	25,045

Table A13.7 Third Stage Capital Investment Schedule and Cost at Financial Value - Master Plan

Year	Direct cost				Indirect cost							Direct + Indirect cost	
	New construction		Rehabilitation		Land	Administrative		Engineering services		Physical contingency			
	(US$000)	(Ps000)	(US$000)	(Ps000)	(Ps000)	(US$000)	(Ps000)	(US$000)	(Ps000)	(US$000)	(Ps000)	(US$000)	(Ps000)
2004													
2005													
2006													
2007													
2008													
2009													
2010													
2011													
2012													
2013													
2014								790	494			790	494
2015								790	494			790	494
2016	4,256	2,838	686	457			116	316	198	494	330	5,752	3,938
2017	4,256	2,838	685	457			116	316	198	494	330	5,751	3,938
2018	4,954	3,070	685	457			116	316	198	564	353	6,519	4,193
2019	6,976	4,043	685	457			116	316	198	766	450	8,743	5,263
2020	7,056	4,221	685	456			116	316	198	774	468	8,831	5,458
2021													
Total	27,498	17,010	3,426	2,284	0	0	579	3,161	1,975	3,092	1,931	37,177	23,779

Table A13.8 Operating Expenditure at Financial Value in Master Plan Project

Year	With-project situation (net of without-project situation)											
	Electricity (Ps000)				Chemical (US$000)	Salary (Ps000)					Total	
	Matadero PS	C. Blanca PS	Chivo Re PS	Luyano WWTP	Luyano WWTP	Head Quarter	Matadero PS	C. Blanca PS	Chivo Re PS	Luyano WWTP	(US$000)	(Ps000)
2005												
2006												
2007												
2008												
2009												
2010												
2011	53	180		44	17	540	73	107		145	17	1,142
2012	53	180		51	33	540	73	107		145	33	1,149
2013	138	180		56	46	540	73	107		145	46	1,239
2014	138	180		59	54	540	73	107		145	54	1,242
2015	138	180		63	62	540	73	107		145	62	1,246
2016	53	184	118	101	83	657	73	107	57	162	83	1,512
2017	53	184	118	111	104	657	73	107	57	162	104	1,522
2018	53	184	118	119	121	657	73	107	57	162	121	1,530
2019	53	184	118	124	133	657	73	107	57	162	133	1,535
2020	53	184	118	130	146	657	73	107	57	162	146	1,541
2021	53	187	119	164	166	692	73	107	57	162	166	1,614
2022	53	187	119	175	187	692	73	107	57	162	187	1,625
2023	53	187	119	184	204	692	73	107	57	162	204	1,634
2024	53	187	119	190	216	692	73	107	57	162	216	1,640
2025	53	187	119	197	229	692	73	107	57	162	229	1,647
2026	53	187	119	199	233	692	73	107	57	162	233	1,649
2027	53	187	119	201	237	692	73	107	57	162	237	1,651
2028	53	187	119	204	241	692	73	107	57	162	241	1,654
2029	53	187	119	206	245	692	73	107	57	162	245	1,656
2030	53	187	119	208	249	692	73	107	57	162	249	1,658
2031	53	187	119	208	249	692	73	107	57	162	249	1,658
2032	53	187	119	208	249	692	73	107	57	162	249	1,658
2033	53	187	119	208	249	692	73	107	57	162	249	1,658
2034	53	187	119	208	249	692	73	107	57	162	249	1,658
2035	53	187	119	208	249	692	73	107	57	162	249	1,658
2036	53	187	119	208	249	692	73	107	57	162	249	1,658
2037	53	187	119	208	249	692	73	107	57	162	249	1,658
2038	53	187	119	208	249	692	73	107	57	162	249	1,658
2039	53	187	119	208	249	692	73	107	57	162	249	1,658
2040	53	187	119	208	249	692	73	107	57	162	249	1,658
2041	53	187	119	208	249	692	73	107	57	162	249	1,658
2042	53	187	119	208	249	692	73	107	57	162	249	1,658
2043	53	187	119	208	249	692	73	107	57	162	249	1,658
2044	53	187	119	208	249	692	73	107	57	162	249	1,658
2045	53	187	119	208	249	692	73	107	57	162	249	1,658

Table A13.9 Revenue from Foreign Currency Earners in Master Plan Project

Year	With-project situation			Without-project situation		
	Sewer connected customers	Rate (US$/yr)	Revenue (US$000)	Sewer connected customers	Rate (US$/yr)	Revenue (US$000)
2004	4,500	270	1,215	4,500	270	1,215
2005	4,750	270	1,283	4,750	270	1,283
2006	5,000	365	1,825	5,000	365	1,825
2007	5,250	365	1,916	5,250	365	1,916
2008	5,500	365	2,008	5,500	365	2,008
2009	5,750	365	2,099	5,750	365	2,099
2010	6,000	365	2,190	6,000	365	2,190
2011	6,250	495	3,094	6,250	365	2,281
2012	6,500	495	3,218	6,500	365	2,373
2013	6,750	495	3,341	6,750	365	2,464
2014	7,000	495	3,465	7,000	365	2,555
2015	7,250	495	3,589	7,250	365	2,646
2016	7,500	495	3,713	7,500	365	2,738
2017	7,750	495	3,836	7,750	365	2,829
2018	8,000	495	3,960	8,000	365	2,920
2019	8,250	495	4,084	8,250	365	3,011
2020	8,500	495	4,208	8,500	365	3,103
2021	8,750	495	4,331	8,750	365	3,194
2022	9,000	495	4,455	9,000	365	3,285
2023	9,250	495	4,579	9,250	365	3,376
2024	9,500	495	4,703	9,500	365	3,468
2025	9,750	495	4,826	9,750	365	3,559
2026	10,000	495	4,950	10,000	365	3,650
2027	10,250	495	5,074	10,250	365	3,741
2028	10,500	495	5,198	10,500	365	3,833
2029	10,750	495	5,321	10,750	365	3,924
2030	11,000	495	5,445	11,000	365	4,015
2031	11,000	495	5,445	11,000	365	4,015
2032	11,000	495	5,445	11,000	365	4,015
2033	11,000	495	5,445	11,000	365	4,015
2034	11,000	495	5,445	11,000	365	4,015
2035	11,000	495	5,445	11,000	365	4,015
2036	11,000	495	5,445	11,000	365	4,015
2037	11,000	495	5,445	11,000	365	4,015
2038	11,000	495	5,445	11,000	365	4,015
2039	11,000	495	5,445	11,000	365	4,015
2040	11,000	495	5,445	11,000	365	4,015
2041	11,000	495	5,445	11,000	365	4,015
2042	11,000	495	5,445	11,000	365	4,015
2043	11,000	495	5,445	11,000	365	4,015
2044	11,000	495	5,445	11,000	365	4,015
2045	11,000	495	5,445	11,000	365	4,015

Table A13.10 Revenue from Corporations in Master Plan Project

Year	Existing system						New sewerage (1st area)				New sewerage (2nd area)				New sewerage (3rd area)				Total			
	With-project situation			Without-project situation			With-project		Without-project		With-project		Without-project		With-project		Without-project		With-project		Without-project	
	Sewer connected customers	Rate (Ps/yr)	Revenue (Ps000)	Sewer connected customers	Rate (Ps/yr)	Revenue (Ps000)	Sewer connected customers	Revenue (Ps000)	Sewer connected customers	Revenue (Ps000)	Sewer connected customers	Revenue (Ps000)	Sewer connected customers	Revenue (Ps000)	Sewer connected customers	Revenue (Ps000)	Sewer connected customers	Revenue (Ps000)	Sewer connected customers	Revenue (Ps000)	Sewer connected customers	Revenue (Ps000)
2004	11,000	180	1,980	11,000	180	1,980													11,000	1,980	11,000	1,980
2005	11,000	180	1,980	11,000	180	1,980													11,000	1,980	11,000	1,980
2006	11,000	360	3,960	11,000	360	3,960													11,000	3,960	11,000	3,960
2007	11,000	360	3,960	11,000	360	3,960													11,000	3,960	11,000	3,960
2008	11,000	360	3,960	11,000	360	3,960													11,000	3,960	11,000	3,960
2009	11,000	360	3,960	11,000	360	3,960													11,000	3,960	11,000	3,960
2010	11,000	360	3,960	11,000	360	3,960													11,000	3,960	11,000	3,960
2011	11,000	900	9,900	11,000	360	3,960	292	263											11,292	10,163	11,000	3,960
2012	11,000	900	9,900	11,000	360	3,960	584	526											11,584	10,426	11,000	3,960
2013	11,000	900	9,900	11,000	360	3,960	803	723											11,803	10,623	11,000	3,960
2014	11,000	900	9,900	11,000	360	3,960	949	854											11,949	10,754	11,000	3,960
2015	11,000	900	9,900	11,000	360	3,960	1,095	986											12,095	10,886	11,000	3,960
2016	11,000	900	9,900	11,000	360	3,960	1,168	1,051			201	181							12,369	11,132	11,000	3,960
2017	11,000	900	9,900	11,000	360	3,960	1,241	1,117			403	363							12,644	11,380	11,000	3,960
2018	11,000	900	9,900	11,000	360	3,960	1,314	1,183			554	499							12,868	11,581	11,000	3,960
2019	11,000	900	9,900	11,000	360	3,960	1,387	1,248			654	589							13,041	11,737	11,000	3,960
2020	11,000	900	9,900	11,000	360	3,960	1,460	1,314			755	680							13,215	11,894	11,000	3,960
2021	11,000	900	9,900	11,000	360	3,960	1,460	1,314			805	725			216	194			13,481	12,133	11,000	3,960
2022	11,000	900	9,900	11,000	360	3,960	1,460	1,314			856	770			432	389			13,748	12,373	11,000	3,960
2023	11,000	900	9,900	11,000	360	3,960	1,460	1,314			906	815			594	535			13,960	12,564	11,000	3,960
2024	11,000	900	9,900	11,000	360	3,960	1,460	1,314			956	860			702	632			14,118	12,706	11,000	3,960
2025	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			810	729			14,277	12,849	11,000	3,960
2026	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			864	778			14,331	12,898	11,000	3,960
2027	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			918	826			14,385	12,947	11,000	3,960
2028	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			972	875			14,439	12,995	11,000	3,960
2029	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,026	923			14,493	13,044	11,000	3,960
2030	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960
2031	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960
2032	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960
2033	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960
2034	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960
2035	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960
2036	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960
2037	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960
2038	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960
2039	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960
2040	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960
2041	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960
2042	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960
2043	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960
2044	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960
2045	11,000	900	9,900	11,000	360	3,960	1,460	1,314			1,007	906			1,079	971			14,546	13,091	11,000	3,960

Table A13.11 Revenue from Domestic Customers in Master Plan Project

Year	Existing system						New sewerage (1st area)				New sewerage (2nd area)				New sewerage (3rd area)				Total			
	With-project situation			Without-project situation			With-project		Without-project		With-project		Without-project		With-project		Without-project		With-project		Without-project	
	Served Population	Rate (Ps/yr)	Revenue (Ps000)	Served Population	Rate (Ps/yr)	Revenue (Ps000)	Served Population	Revenue (Ps000)	Served Population	Revenue (Ps000)	Served Population	Revenue (Ps000)	Served Population	Revenue (Ps000)	Served Population	Revenue (Ps000)	Served Population	Revenue (Ps000)	Served Population	Revenue (Ps000)	Served Population	Revenue (Ps000)
2004	860,000	6	5,160	860,000	6	5,160													860,000	5,160	860,000	5,160
2005	865,000	6	5,190	865,000	6	5,190													865,000	5,190	865,000	5,190
2006	870,000	12	10,440	870,000	12	10,440													870,000	10,440	870,000	10,440
2007	875,000	12	10,500	875,000	12	10,500													875,000	10,500	875,000	10,500
2008	880,000	12	10,560	880,000	12	10,560													880,000	10,560	880,000	10,560
2009	885,000	12	10,620	885,000	12	10,620													885,000	10,620	885,000	10,620
2010	890,000	12	10,680	890,000	12	10,680													890,000	10,680	890,000	10,680
2011	895,000	36	32,220	895,000	12	10,740	11,390	410											906,390	32,630	895,000	10,740
2012	900,000	36	32,400	900,000	12	10,800	22,780	820											922,780	33,220	900,000	10,800
2013	905,000	36	32,580	905,000	12	10,860	31,320	1,128											936,320	33,708	905,000	10,860
2014	910,000	36	32,760	910,000	12	10,920	37,010	1,332											947,010	34,092	910,000	10,920
2015	915,000	36	32,940	915,000	12	10,980	42,710	1,538											957,710	34,478	915,000	10,980
2016	920,000	36	33,120	920,000	12	11,040	45,550	1,640			7,850	283							973,400	35,042	920,000	11,040
2017	925,000	36	33,300	925,000	12	11,100	48,400	1,742			15,700	565							989,100	35,608	925,000	11,100
2018	930,000	36	33,480	930,000	12	11,160	51,250	1,845			21,590	777							1,002,840	36,102	930,000	11,160
2019	935,000	36	33,660	935,000	12	11,220	54,090	1,947			25,520	919							1,014,610	36,526	935,000	11,220
2020	940,000	36	33,840	940,000	12	11,280	56,940	2,050			29,450	1,060							1,026,390	36,950	940,000	11,280
2021	945,000	36	34,020	945,000	12	11,340	56,940	2,050			31,410	1,131			8,420	303			1,041,770	37,504	945,000	11,340
2022	950,000	36	34,200	950,000	12	11,400	56,940	2,050			33,370	1,201			16,840	606			1,057,150	38,057	950,000	11,400
2023	955,000	36	34,380	955,000	12	11,460	56,940	2,050			35,330	1,272			23,160	834			1,070,430	38,535	955,000	11,460
2024	960,000	36	34,560	960,000	12	11,520	56,940	2,050			37,300	1,343			27,370	985			1,081,610	38,938	960,000	11,520
2025	965,000	36	34,740	965,000	12	11,580	56,940	2,050			39,260	1,413			31,580	1,137			1,092,780	39,340	965,000	11,580
2026	970,000	36	34,920	970,000	12	11,640	56,940	2,050			39,260	1,413			33,680	1,212			1,099,880	39,596	970,000	11,640
2027	975,000	36	35,100	975,000	12	11,700	56,940	2,050			39,260	1,413			35,790	1,288			1,106,990	39,852	975,000	11,700
2028	980,000	36	35,280	980,000	12	11,760	56,940	2,050			39,260	1,413			37,890	1,364			1,114,090	40,107	980,000	11,760
2029	985,000	36	35,460	985,000	12	11,820	56,940	2,050			39,260	1,413			40,000	1,440			1,121,200	40,363	985,000	11,820
2030	990,000	36	35,640	990,000	12	11,880	56,940	2,050			39,260	1,413			42,100	1,516			1,128,300	40,619	990,000	11,880
2031	995,000	36	35,820	995,000	12	11,940	56,940	2,050			39,260	1,413			42,100	1,516			1,133,300	40,799	995,000	11,940
2032	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			39,260	1,413			42,100	1,516			1,138,300	40,979	1,000,000	12,000
2033	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			39,260	1,413			42,100	1,516			1,138,300	40,979	1,000,000	12,000
2034	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			39,260	1,413			42,100	1,516			1,138,300	40,979	1,000,000	12,000
2035	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			39,260	1,413			42,100	1,516			1,138,300	40,979	1,000,000	12,000
2036	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			39,260	1,413			42,100	1,516			1,138,300	40,979	1,000,000	12,000
2037	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			39,260	1,413			42,100	1,516			1,138,300	40,979	1,000,000	12,000
2038	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			39,260	1,413			42,100	1,516			1,138,300	40,979	1,000,000	12,000
2039	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			39,260	1,413			42,100	1,516			1,138,300	40,979	1,000,000	12,000
2040	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			39,260	1,413			42,100	1,516			1,138,300	40,979	1,000,000	12,000
2041	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			39,260	1,413			42,100	1,516			1,138,300	40,979	1,000,000	12,000
2042	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			39,260	1,413			42,100	1,516			1,138,300	40,979	1,000,000	12,000
2043	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			39,260	1,413			42,100	1,516			1,138,300	40,979	1,000,000	12,000
2044	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			39,260	1,413			42,100	1,516			1,138,300	40,979	1,000,000	12,000
2045	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			39,260	1,413			42,100	1,516			1,138,300	40,979	1,000,000	12,000

Table A13.12 Contribution from Tourists in Master Plan Project

Year	Number of tourists to Havana	With-project situation		Without-project situat.	
		Rate ($/tourist)	Contribution (US$000)	Rate ($/tourist)	Contribution (US$000)
2004					
2005					
2006					
2007					
2008					
2009					
2010					
2011	1,300,000	2	2,600	0	0
2012	1,300,000	2	2,600	0	0
2013	1,300,000	2	2,600	0	0
2014	1,300,000	2	2,600	0	0
2015	1,300,000	2	2,600	0	0
2016	1,300,000	2	2,600	0	0
2017	1,300,000	2	2,600	0	0
2018	1,300,000	2	2,600	0	0
2019	1,300,000	2	2,600	0	0
2020	1,300,000	2	2,600	0	0
2021	1,300,000	2	2,600	0	0
2022	1,300,000	2	2,600	0	0
2023	1,300,000	2	2,600	0	0
2024	1,300,000	2	2,600	0	0
2025	1,300,000	2	2,600	0	0
2026	1,300,000	2	2,600	0	0
2027	1,300,000	2	2,600	0	0
2028	1,300,000	2	2,600	0	0
2029	1,300,000	2	2,600	0	0
2030	1,300,000	2	2,600	0	0
2031	1,300,000	2	2,600	0	0
2032	1,300,000	2	2,600	0	0
2033	1,300,000	2	2,600	0	0
2034	1,300,000	2	2,600	0	0
2035	1,300,000	2	2,600	0	0
2036	1,300,000	2	2,600	0	0
2037	1,300,000	2	2,600	0	0
2038	1,300,000	2	2,600	0	0
2039	1,300,000	2	2,600	0	0
2040	1,300,000	2	2,600	0	0
2041	1,300,000	2	2,600	0	0
2042	1,300,000	2	2,600	0	0
2043	1,300,000	2	2,600	0	0
2044	1,300,000	2	2,600	0	0
2045	1,300,000	2	2,600	0	0

Table A13.13 Master Plan Project Cash Flow at Economic Value

Yr. no.	Year	Cost				Benefit				Net Benefit			
		Capital expenditure ($000)	(Ps000)	Operating expend. ($000)	(Ps000)	Foreign currency ($000)	Corpo-ration (Ps000)	Domestic user (Ps000)	Tourist contribut. ($000)	US$ ($000)	Peso (Ps000)	$ + Peso Ps1:$1 (Ps000)	$ + Peso Ps26:$1 (Ps000)
1	2004												
2	2005												
3	2006	1,264	559							-1,264	-559	-1,823	-33,417
4	2007	1,264	559							-1,264	-559	-1,823	-33,417
5	2008	11,886	8,336							-11,886	-8,336	-20,222	-317,385
6	2009	13,981	8,845							-13,981	-8,845	-22,826	-372,348
7	2010	15,143	9,771							-15,143	-9,771	-24,914	-403,502
8	2011	3,968	2,671	15	1,298	1,600	3,200	70,897	2,600	217	70,128	70,345	75,760
9	2012	3,967	2,671	30	1,312	1,632	3,264	70,793	2,600	235	70,074	70,309	76,182
10	2013	5,307	3,451	41	1,492	1,665	3,329	70,688	2,600	-1,084	69,075	67,991	40,896
11	2014	10,566	5,549	49	1,498	1,698	3,396	70,584	2,600	-6,317	66,933	60,616	-97,299
12	2015	6,951	4,113	56	1,506	1,732	3,464	70,480	2,600	-2,675	68,324	65,650	-1,214
13	2016	4,324	2,909	75	1,820	1,767	3,533	70,311	2,600	-32	69,115	69,083	68,271
14	2017	4,324	2,909	94	1,840	1,802	3,604	70,143	2,600	-15	68,998	68,982	68,600
15	2018	4,901	3,097	109	1,856	1,838	3,676	69,975	2,600	-572	68,697	68,125	53,827
16	2019	6,573	3,888	120	1,866	1,875	3,749	69,807	2,600	-2,218	67,802	65,584	10,136
17	2020	6,639	4,032	131	1,878	1,912	3,824	69,638	2,600	-2,258	67,553	65,295	8,837
18	2021			149	1,984	1,950	3,901	69,638	2,600	4,401	71,555	75,956	185,982
19	2022			168	2,006	1,989	3,979	69,638	2,600	4,421	71,611	76,032	186,560
20	2023			184	2,024	2,029	4,058	69,638	2,600	4,446	71,673	76,118	187,259
21	2024			194	2,036	2,070	4,140	69,638	2,600	4,475	71,742	76,217	188,102
22	2025			206	2,050	2,111	4,222	69,638	2,600	4,505	71,811	76,316	188,943
23	2026			210	2,054	2,153	4,307	69,638	2,600	4,544	71,891	76,435	190,028
24	2027			213	2,058	2,196	4,393	69,638	2,600	4,583	71,973	76,556	191,136
25	2028			217	2,064	2,240	4,481	69,638	2,600	4,624	72,055	76,679	192,267
26	2029			221	2,068	2,285	4,570	69,638	2,600	4,665	72,141	76,805	193,424
27	2030			224	2,072	2,331	4,662	69,638	2,600	4,707	72,228	76,935	194,606
28	2031			224	2,072	2,378	4,755	69,638	2,600	4,753	72,321	77,075	195,911
29	2032			224	2,072	2,425	4,850	69,638	2,600	4,801	72,416	77,217	197,243
30	2033			224	2,072	2,474	4,947	69,638	2,600	4,850	72,513	77,363	198,601
31	2034			224	2,072	2,523	5,046	69,638	2,600	4,899	72,612	77,511	199,986
32	2035			224	2,072	2,574	5,147	69,638	2,600	4,949	72,713	77,663	201,399
33	2036			224	2,072	2,625	5,250	69,638	2,600	5,001	72,816	77,817	202,840
34	2037			224	2,072	2,678	5,355	69,638	2,600	5,053	72,921	77,975	204,310
35	2038			224	2,072	2,731	5,462	69,638	2,600	5,107	73,028	78,135	205,809
36	2039			224	2,072	2,786	5,571	69,638	2,600	5,162	73,138	78,299	207,339
37	2040			224	2,072	2,841	5,683	69,638	2,600	5,217	73,249	78,466	208,899
38	2041			224	2,072	2,898	5,796	69,638	2,600	5,274	73,363	78,637	210,490
39	2042			224	2,072	2,956	5,912	69,638	2,600	5,332	73,479	78,811	212,113
40	2043			224	2,072	3,015	6,031	69,638	2,600	5,391	73,597	78,988	213,768
41	2044			224	2,072	3,076	6,151	69,638	2,600	5,452	73,717	79,169	215,457
42	2045			224	2,072	3,137	6,274	69,638	2,600	5,513	73,840	79,353	217,179
	Total	101,058	63,362	6,067	67,869	79,992	159,985	2,444,278	91,000	63,867	2,473,032	2,536,899	4,133,577

Results:

Case I	US$ portion	EIRR: 3.4%	B/C: 0.5	NPV($): -20,821	(Discount rate: 10%)
Case II	Peso portion	EIRR: 96.7%	B/C: 10.3	NPV(P): 330,635	(Discount rate: 10%)
Case III	US$+peso (Ps1:$1)	EIRR: 54.6%	B/C: 4.9	NPV(P): 309,814	
Case IV	US$+peso (Ps26:$1)	EIRR: 7.6%	B/C: 0.8	NPV(P): -210,707	

Table A13.14 Breakdown of Economic Cost of Master Plan Project - First Stage

(Foreign currency:US$000, Local currency:Ps000)

			Direct cost											Indirect cost				Total
			Luyano Martin Perez	Luyano left colector	Central system Sur nuevo	Central system Pumped main	Central system Interconnection	Central system Cross connect.	Luyano WWTP	New Matadero pump. station	Rehabilitation Casablanca PS	Rehabilitation Caballeria	Total direct cost	Land	Admin. expenses	Engineering services	Physical contingency	capital cost
Financial Value	FC	Material & equipment	12,502	3,075	652	634	638	2,262	4,120	1,846	1,628	124	27,480					
		Labor																
		Transactional cost	3,847	946	201	195	348	696	1,737	680	504	38	9,192					
		Dealer margin	2,885	710	150	146	174	522	1,034	446	376	29	6,471					
		Total	19,234	4,730	1,003	976	1,160	3,480	6,891	2,971	2,508	190	43,143			4,438	4,314	51,895
	LC	Material & equipment	1,923	473	100	98	271	348	614	280	205	13	4,326					
		Labor	6,411	1,577	334	325	232	1,160	1,718	797	812	52	13,418					
		Transactional cost	2,564	631	134	130	155	464	450	189	137	9	4,862					
		Dealer's margin	1,923	473	100	98	116	348	491	224	204	13	3,989					
		Total	12,822	3,154	668	650	773	2,320	3,273	1,490	1,358	87	26,595	0	798	2,735	2,660	32,788
Conversion Factor	*FC*	*Material & equipment*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*						
		Labor	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*						
		Transactional cost	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*						
		Dealer margin	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*				*1*	*0.98*	
	LC	*Material & equipment*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*						
		Labor	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*						
		Transactional cost	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*						
		Dealer's margin	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*		*n.a.*	*1.02*	*1*	*1.02*	
Economic Value	FC	Material & equipment	11,252	2,767	587	571	574	2,036	3,708	1,661	1,465	111	24,732					
		Labor	0	0	0	0	0	0	0	0	0	0	0					
		Transactional cost	3,693	908	193	187	334	668	1,668	652	484	36	8,824					
		Dealer margin	0	0	0	0	0	0	0	0	0	0	0					
		Total	14,945	3,675	779	758	908	2,704	5,376	2,314	1,949	148	33,556		0	4,438	4,228	42,222
	LC	Material & equipment	2,000	492	104	101	281	362	639	292	214	14	4,499					
		Labor	5,129	1,262	267	260	186	928	1,374	637	650	42	10,734					
		Transactional cost	2,564	631	134	130	155	464	450	189	137	9	4,862					
		Dealer's margin	0	0	0	0	0	0	0	0	0	0	0					
		Total	9,693	2,384	505	491	621	1,754	2,463	1,118	1,000	64	20,095	471	814	2,735	2,713	26,828

Note: Combined conversion factor for FC of first stage is computed at 0.814

Combined conversion factor for LC of first stage is computed at 0.818

Table A13.15 Breakdown of Eonomic Cost of Master Plan Project - Second Stage

(Foreign currency:US$000, Local currency:Ps000)

			Direct cost											Indirect cost				Total
			Luyano Martin Perez	Luyano left colector	Central system Cross connect.	Replace. inade-quate sewers	Rehabilitation Colector Sur	New construct. Colector Sur A	Luyano WWTP	Transmission Tunnel	Re-pumping station at Chivo	Replacement Outfall sewer	Total direct cost	Land	Admin. expenses	Engineering services	Physical contingency	capital cost
Financial Value	FC	Material & equipment	4,910	4,687	882	534	1,271	2,126	4,567	96	1,387	1,235	21,696					
		Labor																
		Transactional cost	1,511	1,442	271	164	391	654	1,985	52	493	380	7,345					
		Dealer margin	1,133	1,082	204	123	293	491	1,156	26	332	285	5,125					
		Total	7,554	7,211	1,357	822	1,956	3,271	7,709	174	2,212	1,900	34,166			3,503	3,417	41,086
	LC	Material & equipment	755	721	136	82	196	327	719	91	206	71	3,304					
		Labor	2,518	2,404	452	274	652	1,091	1,815	78	652	238	10,173					
		Transactional cost	1,007	961	181	110	261	436	538	52	147	95	3,788					
		Dealer's margin	755	721	136	82	196	327	542	39	177	71	3,047					
		Total	5,036	4,807	904	548	1,304	2,181	3,614	260	1,182	475	20,311	0	609	2,092	2,031	25,043
Conversion Factor	*FC*	*Material & equipment*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*						
		Labor	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*						
		Transactional cost	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*						
		Dealer margin	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*				*1*	*0.98*	
	LC	*Material & equipment*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*						
		Labor	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*						
		Transactional cost	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*						
		Dealer's margin	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*		*n.a.*	*1.02*	*1*	*1.02*	
Economic Value	FC	Material & equipment	4,419	4,218	794	481	1,144	1,914	4,111	86	1,249	1,112	17,613					
		Labor	0	0	0	0	0	0	0	0	0	0	0					
		Transactional cost	1,450	1,385	261	158	376	628	1,906	50	473	365	6,423					
		Dealer margin	0	0	0	0	0	0	0	0	0	0	0					
		Total	5,869	5,603	1,054	639	1,520	2,542	6,017	136	1,722	1,476	24,036		0	3,503	3,349	30,888
	LC	Material & equipment	786	750	141	85	203	340	747	95	214	74	3,096					
		Labor	2,014	1,923	362	219	522	872	1,452	62	522	190	7,266					
		Transactional cost	1,007	961	181	110	261	436	538	52	147	95	3,352					
		Dealer's margin	0	0	0	0	0	0	0	0	0	0	0					
		Total	3,807	3,634	683	414	986	1,649	2,738	209	883	359	13,713	0	621	2,092	2,072	18,498

Note: Combined conversion factor for FC of second stage is computed at 0.752

Combined conversion factor for LC of second stage is computed at 0.739

Table A13.16 Breakdown of Economic Cost of Master Plan Project - Third Stage

(Foreign currency:US$000, Local currency:Ps000)

			Direct cost						Indirect cost				Total capital cost
			Luyano Martin Perez	Luyano left colector	Central system Cross connect.	Replace. inade-quate sewers	Luyano WWTP	Total direct cost	Land	Admin. expenses	Engineerin services	Physical contingenc	
Financial Value	FC	Material & equipment	5,535	8,298	1,560	667	3,692	19,751					
		Labor											
		Transactional cost	1,703	2,553	480	205	1,592	6,534					
		Dealer margin	1,277	1,915	360	154	932	4,638					
		Total	8,515	12,766	2,400	1,026	6,216	30,923			3,161	3,092	37,176
	LC	Material & equipment	852	1,277	240	103	540	3,011					
		Labor	2,839	4,255	800	342	1,462	9,697					
		Transactional cost	1,135	1,702	320	137	399	3,693					
		Dealer's margin	852	1,277	240	103	424	2,894					
		Total	5,677	8,510	1,600	684	2,824	19,295	0	579	1,975	1,930	23,779
Conversion Factor	*FC*	*Material &equipmen*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*						
		Labor	*0*	*0*	*0*	*0*	*0*						
		Transactional cost	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*						
		Dealer margin	*0*	*0*	*0*	*0*	*0*				*1*	*0.98*	
	LC	*Material &equipmen*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*						
		Labor	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*						
		Transactional cost	*1*	*1*	*1*	*1*	*1*						
		Dealer's margin	*0*	*0*	*0*	*0*	*0*		*n.a.*	*1.02*	*1*	*1.02*	
Economic Value	FC	Material & equipment	4,981	7,468	1,404	600	3,322	17,776					
		Labor	0	0	0	0	0	0					
		Transactional cost	1,635	2,451	461	197	1,528	6,272					
		Dealer margin	0	0	0	0	0	0					
		Total	6,616	9,919	1,865	797	4,851	24,048		0	3,161	3,030	30,239
	LC	Material & equipment	886	1,328	250	107	562	3,131					
		Labor	2,271	3,404	640	274	1,169	7,758					
		Transactional cost	1,135	1,702	320	137	399	3,693					
		Dealer's margin	0	0	0	0	0	0					
		Total	4,292	6,434	1,210	517	2,130	14,582	0	591	1,975	1,969	19,116

Note: Combined conversion factor for FC of second stage is computed at 0.813
Combined conversion factor for LC of second stage is computed at 0.804

Table A13.17 First Stage Capital Investment Schedule and Cost at Economic Value - Master Plan

Year	Direct cost				Indirect cost							Direct + Indirect cost	
	New construction		Rehabilitation		Land	Administrative		Engineering services		Physical contingency		(US$000)	(Peso000)
	(US$000)	(Ps000)	(US$000)	(Ps000)	(Ps000)	(US$000)	(Ps000)	(US$000)	(Ps000)	(US$000)	(Ps000)		
2004													
2005													
2006								1,264	559			1,264	559
2007								1,264	559			1,264	559
2008	7,339	4,730	3,139	1,815	471		218	361	448	1,048	655	11,886	8,336
2009	10,840	6,555	944	632			218	361	336	1,178	718	13,322	8,459
2010	11,896	7,395	944	633			218	361	336	1,284	803	14,485	9,385
2011													
2012													
2013													
2014													
2015													
2016													
2017													
2018													
2019													
2020													
2021													
Total	30,075	18,680	5,026	3,081	471	0	653	3,611	2,238	3,510	2,176	42,222	27,299

Note: Combined conversion factor for foreign costs of first stage is 0.814
Combined conversion factor for local costs of first stage is 0.818

Table A13.18 Second Stage Capital Investment Schedule and Cost at Economic Value - Master Plan

Year	Direct cost				Indirect cost							Direct + Indirect cost	
	New construction		Rehabilitation		Land	Administrative		Engineering services		Physical contingency		(US$000)	(Ps000)
	(US$000)	(Ps000)	(US$000)	(Ps000)	(Ps000)	(US$000)	(Ps000)	(US$000)	(Ps000)	(US$000)	(Ps000)		
2004													
2005													
2006													
2007													
2008													
2009								658	386			658	386
2010								658	386			658	386
2011	3,040	1,991	328	215			90	263	155	337	221	3,968	2,671
2012	3,039	1,991	328	215			90	263	155	337	221	3,967	2,671
2013	3,637	2,186	948	728			90	263	155	459	292	5,307	3,451
2014	8,008	3,955	818	536			90	263	155	883	449	9,972	5,185
2015	4,721	2,652	818	534			90	263	155	554	318	6,357	3,749
2016													
2017													
2018													
2019													
2020													
2021													
Total	22,446	12,775	3,239	2,228	0	0	451	2,633	1,545	2,569	1,501	30,888	18,499

Note: Combined conversion factor for foreign costs of second stage is 0.752
Combined conversion factor for local costs of second stage is 0.739

Table A13.19 Third Stage Capital Investment Schedule and Cost at Economic Value - Master Plan

Year	Direct cost				Indirect cost								Direct + Indirect cost	
	New construction		Rehabilitation		Land	Administrative		Engineering services		Physical contingency				
	(US$000)	(Ps000)	(US$000)	(Ps000)	(Ps000)	(US$000)	(Ps000)	(US$000)	(Ps000)	(US$000)	(Ps000)		(US$000)	(Ps000)
2004														
2005														
2006														
2007														
2008														
2009														
2010														
2011														
2012														
2013														
2014								594	365				594	365
2015								594	365				594	365
2016	3,200	2,096	516	338			86	238	146	371	244		4,324	2,909
2017	3,200	2,096	515	338			86	238	146	371	244		4,324	2,909
2018	3,724	2,268	515	338			86	238	146	424	261		4,901	3,097
2019	5,244	2,986	515	338			86	238	146	576	332		6,573	3,888
2020	5,305	3,118	515	337			86	238	146	582	346		6,639	4,032
2021														
Total	9,349	5,066	2,472	1,648	0	0	201	1,232	705	1,182	671		27,949	17,564

Note: Combined conversion factor for foreign costs of third stage is 0.813
Combined conversion factor for local costs of third stage is 0.804

Table A13.20 Operating Expenditure at Economic Value in Master Plan Project

Year	With-project situation (net of without-project situation)											
	Electricity (Ps000)				Chemical	Salary (Ps000)					Total	
	Matadero PS	C. Blanca PS	Chivo Re PS	Luyano WWTP	(US$000) Luyano WWTP	Head Quarter	Matadero PS	C. Blanca PS	Chivo Re PS	Luyano WWTP	(US$000)	(Ps000)
2005												
2006												
2007												
2008												
2009												
2010												
2011	106	360		88	15	464	63	92		125	15	1,298
2012	106	360		102	30	464	63	92		125	30	1,312
2013	276	360		112	41	464	63	92		125	41	1,492
2014	276	360		118	49	464	63	92		125	49	1,498
2015	276	360		126	56	464	63	92		125	56	1,506
2016	106	368	236	202	75	565	63	92	49	139	75	1,820
2017	106	368	236	222	94	565	63	92	49	139	94	1,840
2018	106	368	236	238	109	565	63	92	49	139	109	1,856
2019	106	368	236	248	120	565	63	92	49	139	120	1,866
2020	106	368	236	260	131	565	63	92	49	139	131	1,878
2021	106	374	238	328	149	595	63	92	49	139	149	1,984
2022	106	374	238	350	168	595	63	92	49	139	168	2,006
2023	106	374	238	368	184	595	63	92	49	139	184	2,024
2024	106	374	238	380	194	595	63	92	49	139	194	2,036
2025	106	374	238	394	206	595	63	92	49	139	206	2,050
2026	106	374	238	398	210	595	63	92	49	139	210	2,054
2027	106	374	238	402	213	595	63	92	49	139	213	2,058
2028	106	374	238	408	217	595	63	92	49	139	217	2,064
2029	106	374	238	412	221	595	63	92	49	139	221	2,068
2030	106	374	238	416	224	595	63	92	49	139	224	2,072
2031	106	374	238	416	224	595	63	92	49	139	224	2,072
2032	106	374	238	416	224	595	63	92	49	139	224	2,072
2033	106	374	238	416	224	595	63	92	49	139	224	2,072
2034	106	374	238	416	224	595	63	92	49	139	224	2,072
2035	106	374	238	416	224	595	63	92	49	139	224	2,072
2036	106	374	238	416	224	595	63	92	49	139	224	2,072
2037	106	374	238	416	224	595	63	92	49	139	224	2,072
2038	106	374	238	416	224	595	63	92	49	139	224	2,072
2039	106	374	238	416	224	595	63	92	49	139	224	2,072
2040	106	374	238	416	224	595	63	92	49	139	224	2,072
2041	106	374	238	416	224	595	63	92	49	139	224	2,072
2042	106	374	238	416	224	595	63	92	49	139	224	2,072
2043	106	374	238	416	224	595	63	92	49	139	224	2,072
2044	106	374	238	416	224	595	63	92	49	139	224	2,072
2045	106	374	238	416	224	595	63	92	49	139	224	2,072

Note: Conversion factor of salary is 0.86
Conversion factor of electricity is 2.00
Conversion factor of chemical is 0.90

Table A13.21 Economic Benefit of Inhabitants in Master Plan Project

Year	With-project situation			Without-project situation		
	Population	Rate (HH/month)	Revenue (Ps000)	Served Population	Rate (HH/month)	Revenue (Ps000)
2004						
2005						
2006						
2007						
2008						
2009						
2010	2,151,562					
2011	2,148,399	11	70,897	0		0
2012	2,145,236	11	70,793	0		0
2013	2,142,073	11	70,688	0		0
2014	2,138,910	11	70,584	0		0
2015	2,135,747	11	70,480	0		0
2016	2,130,649	11	70,311	0		0
2017	2,125,551	11	70,143	0		0
2018	2,120,452	11	69,975	0		0
2019	2,115,354	11	69,807	0		0
2020	2,110,256	11	69,638	0		0
2021	2,110,256	11	69,638	0		0
2022	2,110,256	11	69,638	0		0
2023	2,110,256	11	69,638	0		0
2024	2,110,256	11	69,638	0		0
2025	2,110,256	11	69,638	0		0
2026	2,110,256	11	69,638	0		0
2027	2,110,256	11	69,638	0		0
2028	2,110,256	11	69,638	0		0
2029	2,110,256	11	69,638	0		0
2030	2,110,256	11	69,638	0		0
2031	2,110,256	11	69,638	0		0
2032	2,110,256	11	69,638	0		0
2033	2,110,256	11	69,638	0		0
2034	2,110,256	11	69,638	0		0
2035	2,110,256	11	69,638	0		0
2036	2,110,256	11	69,638	0		0
2037	2,110,256	11	69,638	0		0
2038	2,110,256	11	69,638	0		0
2039	2,110,256	11	69,638	0		0
2040	2,110,256	11	69,638	0		0
2041	2,110,256	11	69,638	0		0
2042	2,110,256	11	69,638	0		0
2043	2,110,256	11	69,638	0		0
2044	2,110,256	11	69,638	0		0
2045	2,110,256	11	69,638	0		0

Table A13.22 Economic Benefit of Industries in Master Plan Project

Year	City of Havana Production (Ps Million)	With-project situation				Without-project situation	
		US$ rate	Aggregate benefit (US$000)	Peso rate	Aggregate benefit (Ps000)	(US$000)	(Ps000)
2004	6,056						
2005	6,177						
2006	6,301						
2007	6,427						
2008	6,555						
2009	6,686						
2010	6,820						
2011	6,957	0.023%	1,600	0.046%	3,200	0	0
2012	7,096	0.023%	1,632	0.046%	3,264	0	0
2013	7,238	0.023%	1,665	0.046%	3,329	0	0
2014	7,382	0.023%	1,698	0.046%	3,396	0	0
2015	7,530	0.023%	1,732	0.046%	3,464	0	0
2016	7,681	0.023%	1,767	0.046%	3,533	0	0
2017	7,834	0.023%	1,802	0.046%	3,604	0	0
2018	7,991	0.023%	1,838	0.046%	3,676	0	0
2019	8,151	0.023%	1,875	0.046%	3,749	0	0
2020	8,314	0.023%	1,912	0.046%	3,824	0	0
2021	8,480	0.023%	1,950	0.046%	3,901	0	0
2022	8,650	0.023%	1,989	0.046%	3,979	0	0
2023	8,823	0.023%	2,029	0.046%	4,058	0	0
2024	8,999	0.023%	2,070	0.046%	4,140	0	0
2025	9,179	0.023%	2,111	0.046%	4,222	0	0
2026	9,363	0.023%	2,153	0.046%	4,307	0	0
2027	9,550	0.023%	2,196	0.046%	4,393	0	0
2028	9,741	0.023%	2,240	0.046%	4,481	0	0
2029	9,936	0.023%	2,285	0.046%	4,570	0	0
2030	10,135	0.023%	2,331	0.046%	4,662	0	0
2031	10,337	0.023%	2,378	0.046%	4,755	0	0
2032	10,544	0.023%	2,425	0.046%	4,850	0	0
2033	10,755	0.023%	2,474	0.046%	4,947	0	0
2034	10,970	0.023%	2,523	0.046%	5,046	0	0
2035	11,189	0.023%	2,574	0.046%	5,147	0	0
2036	11,413	0.023%	2,625	0.046%	5,250	0	0
2037	11,641	0.023%	2,678	0.046%	5,355	0	0
2038	11,874	0.023%	2,731	0.046%	5,462	0	0
2039	12,112	0.023%	2,786	0.046%	5,571	0	0
2040	12,354	0.023%	2,841	0.046%	5,683	0	0
2041	12,601	0.023%	2,898	0.046%	5,796	0	0
2042	12,853	0.023%	2,956	0.046%	5,912	0	0
2043	13,110	0.023%	3,015	0.046%	6,031	0	0
2044	13,372	0.023%	3,076	0.046%	6,151	0	0
2045	13,640	0.023%	3,137	0.046%	6,274	0	0

Note: Production of the year 2002 was Ps5821 million. An annual growth of 2% is assumed.

Table A13.23 Priority Project Cash Flow at Financial Value

Yr. no.	Year	Cost				Benefit				Net Benefit			
		Capital expenditure ($000)	(Ps000)	Operating expend. ($000)	(Ps000)	Foreign currency ($000)	Corpo-ration (Ps000)	Domestic user (Ps000)	Tourist contribut. ($000)	US$ ($000)	Peso (Ps000)	$ + Peso Ps1:$1 (Ps000)	$ + Peso Ps26:$1 (Ps000)
1	2004												
2	2005												
3	2006	1,553	684							-1,553	-684	-2,237	-41,070
4	2007	1,553	684							-1,553	-684	-2,237	-41,070
5	2008	14,610	9,612							-14,610	-9,612	-24,222	-389,467
6	2009	16,375	10,338							-16,375	-10,338	-26,713	-436,083
7	2010	17,804	11,469							-17,804	-11,469	-29,273	-474,368
8	2011			17	1,142	813	6,203	21,890	2,600	3,396	26,951	30,346	115,234
9	2012			33	1,149	845	6,466	22,420	2,600	3,412	27,737	31,149	116,449
10	2013			46	1,154	878	6,663	22,848	2,600	3,432	28,356	31,788	117,575
11	2014			54	1,157	910	6,794	23,172	2,600	3,456	28,809	32,265	118,665
12	2015			62	1,161	943	6,926	23,498	2,600	3,481	29,262	32,743	119,755
13	2016			67	1,304	975	6,991	23,720	2,600	3,508	29,407	32,915	120,615
14	2017			71	1,306	1,008	7,057	23,942	2,600	3,537	29,693	33,230	121,642
15	2018			75	1,308	1,040	7,123	24,165	2,600	3,565	29,980	33,545	122,670
16	2019			79	1,310	1,073	7,188	24,387	2,600	3,594	30,266	33,859	123,697
17	2020			83	1,312	1,105	7,254	24,610	2,600	3,622	30,552	34,174	124,724
18	2021			83	1,361	1,138	7,254	24,730	2,600	3,655	30,623	34,277	125,640
19	2022			83	1,361	1,170	7,254	24,850	2,600	3,687	30,743	34,430	126,605
20	2023			83	1,361	1,203	7,254	24,970	2,600	3,720	30,863	34,582	127,570
21	2024			83	1,361	1,235	7,254	25,090	2,600	3,752	30,983	34,735	128,535
22	2025			83	1,361	1,268	7,254	25,210	2,600	3,785	31,103	34,887	129,500
23	2026			83	1,361	1,300	7,254	25,330	2,600	3,817	31,223	35,040	130,465
24	2027			83	1,361	1,333	7,254	25,450	2,600	3,850	31,343	35,192	131,430
25	2028			83	1,361	1,365	7,254	25,570	2,600	3,882	31,463	35,345	132,395
26	2029			83	1,361	1,398	7,254	25,690	2,600	3,915	31,583	35,497	133,360
27	2030			83	1,361	1,430	7,254	25,810	2,600	3,947	31,703	35,650	134,325
28	2031			83	1,361	1,430	7,254	25,930	2,600	3,947	31,823	35,770	134,445
29	2032			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
30	2033			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
31	2034			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
32	2035			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
33	2036			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
34	2037			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
35	2038			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
36	2039			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
37	2040			83	1,361	1,430	7,254	26,050	2,600	3,947	31,943	35,890	134,565
	Total	51,895	32,787	2,247	39,523	36,725	213,744	747,729	78,000	60,583	889,162	949,745	2,464,320

Results:

Case I	US$ portion	FIRR: 5.2%	B/C: 0.9	NPV($): -3,393	(Discount rate: 6%)
Case II	Peso portion	FIRR: 51.0%	B/C: 7.0	NPV(P): 175,413	(Discount rate: 8%)
Case III	US$+peso (Ps1:$1)	FIRR: 28.1%	B/C: 3.6	NPV(P): 172,020	
Case IV	US$+peso (Ps26:$1)	FIRR: 7.3%	B/C: 1.1	NPV(P): 87,185	

Table A13.24 Operating Expenditure at Financial Value in Priority Project

Year	With-project situation (net of without-project situation)											
	Electricity (Ps000)				Chemical	Salary (Ps000)					Total	
	Matadero PS	C. Blanca PS	Chivo Re PS	Luyano WWTP	(US$000) Luyano WWTP	Head Quarter	Matadero PS	C. Blanca PS	Chivo Re PS	Luyano WWTP	(US$000)	(Ps000)
2005												
2006												
2007												
2008												
2009												
2010												
2011	53	180		44	17	540	73	107		145	17	1,142
2012	53	180		51	33	540	73	107		145	33	1,149
2013	53	180		56	46	540	73	107		145	46	1,154
2014	53	180		59	54	540	73	107		145	54	1,157
2015	53	180		63	62	540	73	107		145	62	1,161
2016	53	184		85	67	657	73	107		145	67	1,304
2017	53	184		87	71	657	73	107		145	71	1,306
2018	53	184		89	75	657	73	107		145	75	1,308
2019	53	184		91	79	657	73	107		145	79	1,310
2020	53	184		93	83	657	73	107		145	83	1,312
2021	53	187		104	83	692	73	107		145	83	1,361
2022	53	187		104	83	692	73	107		145	83	1,361
2023	53	187		104	83	692	73	107		145	83	1,361
2024	53	187		104	83	692	73	107		145	83	1,361
2025	53	187		104	83	692	73	107		145	83	1,361
2026	53	187		104	83	692	73	107		145	83	1,361
2027	53	187		104	83	692	73	107		145	83	1,361
2028	53	187		104	83	692	73	107		145	83	1,361
2029	53	187		104	83	692	73	107		145	83	1,361
2030	53	187		104	83	692	73	107		145	83	1,361
2031	53	187		104	83	692	73	107		145	83	1,361
2032	53	187		104	83	692	73	107		145	83	1,361
2033	53	187		104	83	692	73	107		145	83	1,361
2034	53	187		104	83	692	73	107		145	83	1,361
2035	53	187		104	83	692	73	107		145	83	1,361
2036	53	187		104	83	692	73	107		145	83	1,361
2037	53	187		104	83	692	73	107		145	83	1,361
2038	53	187		104	83	692	73	107		145	83	1,361
2039	53	187		104	83	692	73	107		145	83	1,361
2040	53	187		104	83	692	73	107		145	83	1,361

Table A13.25 Revenue from Foreign Currency Earners in Priority Project

Year	With-project situation			Without-project situation		
	Sewer connected customers	Rate (US$/yr)	Revenue (US$000)	Sewer connected customers	Rate (US$/yr)	Revenue (US$000)
2004	4,500	270	1,215	4,500	270	1,215
2005	4,750	270	1,283	4,750	270	1,283
2006	5,000	365	1,825	5,000	365	1,825
2007	5,250	365	1,916	5,250	365	1,916
2008	5,500	365	2,008	5,500	365	2,008
2009	5,750	365	2,099	5,750	365	2,099
2010	6,000	365	2,190	6,000	365	2,190
2011	6,250	495	3,094	6,250	365	2,281
2012	6,500	495	3,218	6,500	365	2,373
2013	6,750	495	3,341	6,750	365	2,464
2014	7,000	495	3,465	7,000	365	2,555
2015	7,250	495	3,589	7,250	365	2,646
2016	7,500	495	3,713	7,500	365	2,738
2017	7,750	495	3,836	7,750	365	2,829
2018	8,000	495	3,960	8,000	365	2,920
2019	8,250	495	4,084	8,250	365	3,011
2020	8,500	495	4,208	8,500	365	3,103
2021	8,750	495	4,331	8,750	365	3,194
2022	9,000	495	4,455	9,000	365	3,285
2023	9,250	495	4,579	9,250	365	3,376
2024	9,500	495	4,703	9,500	365	3,468
2025	9,750	495	4,826	9,750	365	3,559
2026	10,000	495	4,950	10,000	365	3,650
2027	10,250	495	5,074	10,250	365	3,741
2028	10,500	495	5,198	10,500	365	3,833
2029	10,750	495	5,321	10,750	365	3,924
2030	11,000	495	5,445	11,000	365	4,015
2031	11,000	495	5,445	11,000	365	4,015
2032	11,000	495	5,445	11,000	365	4,015
2033	11,000	495	5,445	11,000	365	4,015
2034	11,000	495	5,445	11,000	365	4,015
2035	11,000	495	5,445	11,000	365	4,015
2036	11,000	495	5,445	11,000	365	4,015
2037	11,000	495	5,445	11,000	365	4,015
2038	11,000	495	5,445	11,000	365	4,015
2039	11,000	495	5,445	11,000	365	4,015
2040	11,000	495	5,445	11,000	365	4,015

Table A13.26 Revenue from Corporations in Priority Project

Year	Existing system						New sewerage (1st area)				Total			
	With-project situation			Without-project situation			With-project		Without-project		With-project		Without-project	
	Sewer connected customers	Rate (Ps/yr)	Revenue (Ps000)	Sewer connected customers	Rate (Ps/yr)	Revenue (Ps000)	Sewer connected customers	Revenue (Ps000)	Sewer connected customers	Revenue (Ps000)	Sewer connected customers	Revenue (Ps000)	Sewer connected customers	Revenue (Ps000)
2004	11,000	180	1,980	11,000	180	1,980					11,000	1,980	11,000	1,980
2005	11,000	180	1,980	11,000	180	1,980					11,000	1,980	11,000	1,980
2006	11,000	360	3,960	11,000	360	3,960					11,000	3,960	11,000	3,960
2007	11,000	360	3,960	11,000	360	3,960					11,000	3,960	11,000	3,960
2008	11,000	360	3,960	11,000	360	3,960					11,000	3,960	11,000	3,960
2009	11,000	360	3,960	11,000	360	3,960					11,000	3,960	11,000	3,960
2010	11,000	360	3,960	11,000	360	3,960					11,000	3,960	11,000	3,960
2011	11,000	900	9,900	11,000	360	3,960	292	263			11,292	10,163	11,000	3,960
2012	11,000	900	9,900	11,000	360	3,960	584	526			11,584	10,426	11,000	3,960
2013	11,000	900	9,900	11,000	360	3,960	803	723			11,803	10,623	11,000	3,960
2014	11,000	900	9,900	11,000	360	3,960	949	854			11,949	10,754	11,000	3,960
2015	11,000	900	9,900	11,000	360	3,960	1,095	986			12,095	10,886	11,000	3,960
2016	11,000	900	9,900	11,000	360	3,960	1,168	1,051			12,168	10,951	11,000	3,960
2017	11,000	900	9,900	11,000	360	3,960	1,241	1,117			12,241	11,017	11,000	3,960
2018	11,000	900	9,900	11,000	360	3,960	1,314	1,183			12,314	11,083	11,000	3,960
2019	11,000	900	9,900	11,000	360	3,960	1,387	1,248			12,387	11,148	11,000	3,960
2020	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2021	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2022	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2023	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2024	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2025	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2026	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2027	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2028	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2029	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2030	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2031	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2032	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2033	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2034	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2035	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2036	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2037	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2038	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2039	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960
2040	11,000	900	9,900	11,000	360	3,960	1,460	1,314			12,460	11,214	11,000	3,960

Table A13.27 Revenue from Domestic Customers in Priority Project

Year	Existing system						New sewerage (1st area)				Total			
	With-project situation			Without-project situation			With-project		Without-project		With-project		Without-project	
	Served Population	Rate (Ps/yr)	Revenue (Ps000)	Served Population	Rate (Ps/yr)	Revenue (Ps000)	Served Population	Revenue (Ps000)	Served Population	Revenue (Ps000)	Served Population	Revenue (Ps000)	Served Population	Revenue (Ps000)
2004	860,000	6	5,160	860,000	6	5,160					860,000	5,160	860,000	5,160
2005	865,000	6	5,190	865,000	6	5,190					865,000	5,190	865,000	5,190
2006	870,000	12	10,440	870,000	12	10,440					870,000	10,440	870,000	10,440
2007	875,000	12	10,500	875,000	12	10,500					875,000	10,500	875,000	10,500
2008	880,000	12	10,560	880,000	12	10,560					880,000	10,560	880,000	10,560
2009	885,000	12	10,620	885,000	12	10,620					885,000	10,620	885,000	10,620
2010	890,000	12	10,680	890,000	12	10,680					890,000	10,680	890,000	10,680
2011	895,000	36	32,220	895,000	12	10,740	11,390	410			906,390	32,630	895,000	10,740
2012	900,000	36	32,400	900,000	12	10,800	22,780	820			922,780	33,220	900,000	10,800
2013	905,000	36	32,580	905,000	12	10,860	31,320	1,128			936,320	33,708	905,000	10,860
2014	910,000	36	32,760	910,000	12	10,920	37,010	1,332			947,010	34,092	910,000	10,920
2015	915,000	36	32,940	915,000	12	10,980	42,710	1,538			957,710	34,478	915,000	10,980
2016	920,000	36	33,120	920,000	12	11,040	45,550	1,640			965,550	34,760	920,000	11,040
2017	925,000	36	33,300	925,000	12	11,100	48,400	1,742			973,400	35,042	925,000	11,100
2018	930,000	36	33,480	930,000	12	11,160	51,250	1,845			981,250	35,325	930,000	11,160
2019	935,000	36	33,660	935,000	12	11,220	54,090	1,947			989,090	35,607	935,000	11,220
2020	940,000	36	33,840	940,000	12	11,280	56,940	2,050			996,940	35,890	940,000	11,280
2021	945,000	36	34,020	945,000	12	11,340	56,940	2,050			1,001,940	36,070	945,000	11,340
2022	950,000	36	34,200	950,000	12	11,400	56,940	2,050			1,006,940	36,250	950,000	11,400
2023	955,000	36	34,380	955,000	12	11,460	56,940	2,050			1,011,940	36,430	955,000	11,460
2024	960,000	36	34,560	960,000	12	11,520	56,940	2,050			1,016,940	36,610	960,000	11,520
2025	965,000	36	34,740	965,000	12	11,580	56,940	2,050			1,021,940	36,790	965,000	11,580
2026	970,000	36	34,920	970,000	12	11,640	56,940	2,050			1,026,940	36,970	970,000	11,640
2027	975,000	36	35,100	975,000	12	11,700	56,940	2,050			1,031,940	37,150	975,000	11,700
2028	980,000	36	35,280	980,000	12	11,760	56,940	2,050			1,036,940	37,330	980,000	11,760
2029	985,000	36	35,460	985,000	12	11,820	56,940	2,050			1,041,940	37,510	985,000	11,820
2030	990,000	36	35,640	990,000	12	11,880	56,940	2,050			1,046,940	37,690	990,000	11,880
2031	995,000	36	35,820	995,000	12	11,940	56,940	2,050			1,051,940	37,870	995,000	11,940
2032	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			1,056,940	38,050	1,000,000	12,000
2033	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			1,056,940	38,050	1,000,000	12,000
2034	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			1,056,940	38,050	1,000,000	12,000
2035	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			1,056,940	38,050	1,000,000	12,000
2036	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			1,056,940	38,050	1,000,000	12,000
2037	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			1,056,940	38,050	1,000,000	12,000
2038	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			1,056,940	38,050	1,000,000	12,000
2039	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			1,056,940	38,050	1,000,000	12,000
2040	1,000,000	36	36,000	1,000,000	12	12,000	56,940	2,050			1,056,940	38,050	1,000,000	12,000

Table A13.28 Contribution from Tourists in Priority Project

Year	Number of tourists to Havana	With-project situation		Without-project situat.	
		Rate ($/tourist)	Contribution (US$000)	Rate ($/tourist)	Contribution (US$000)
2004					
2005					
2006					
2007					
2008					
2009					
2010					
2011	1,300,000	2	2,600	0	0
2012	1,300,000	2	2,600	0	0
2013	1,300,000	2	2,600	0	0
2014	1,300,000	2	2,600	0	0
2015	1,300,000	2	2,600	0	0
2016	1,300,000	2	2,600	0	0
2017	1,300,000	2	2,600	0	0
2018	1,300,000	2	2,600	0	0
2019	1,300,000	2	2,600	0	0
2020	1,300,000	2	2,600	0	0
2021	1,300,000	2	2,600	0	0
2022	1,300,000	2	2,600	0	0
2023	1,300,000	2	2,600	0	0
2024	1,300,000	2	2,600	0	0
2025	1,300,000	2	2,600	0	0
2026	1,300,000	2	2,600	0	0
2027	1,300,000	2	2,600	0	0
2028	1,300,000	2	2,600	0	0
2029	1,300,000	2	2,600	0	0
2030	1,300,000	2	2,600	0	0
2031	1,300,000	2	2,600	0	0
2032	1,300,000	2	2,600	0	0
2033	1,300,000	2	2,600	0	0
2034	1,300,000	2	2,600	0	0
2035	1,300,000	2	2,600	0	0
2036	1,300,000	2	2,600	0	0
2037	1,300,000	2	2,600	0	0
2038	1,300,000	2	2,600	0	0
2039	1,300,000	2	2,600	0	0
2040	1,300,000	2	2,600	0	0

Table A13.29 Priority Project Cash Flow at Economic Value

Yr. no.	Year	Cost				Benefit				Net Benefit			
		Capital expenditure ($000)	(Ps000)	Operating expend. ($000)	(Ps000)	Foreign currency ($000)	Corpo-ration (Ps000)	Domestic user (Ps000)	Tourist contribut. ($000)	US$ ($000)	Peso (Ps000)	$ + Peso Ps1:$1 (Ps000)	$ + Peso Ps26:$1 (Ps000)
1	2004												
2	2005												
3	2006	1,264	559							-1,264	-559	-1,823	-33,417
4	2007	1,264	559							-1,264	-559	-1,823	-33,417
5	2008	11,886	8,326							-11,886	-8,326	-20,212	-317,375
6	2009	13,322	8,457							-13,322	-8,457	-21,779	-354,841
7	2010	14,485	9,382							-14,485	-9,382	-23,867	-385,995
8	2011			15	1,298	1,600	3,200	62,518	2,600	4,185	64,421	68,605	173,223
9	2012			30	1,312	1,632	3,264	62,426	2,600	4,202	64,379	68,581	173,639
10	2013			41	1,322	1,665	3,329	62,334	2,600	4,223	64,342	68,565	174,147
11	2014			49	1,328	1,698	3,396	62,242	2,600	4,249	64,310	68,560	174,794
12	2015			56	1,336	1,732	3,464	62,150	2,600	4,276	64,278	68,554	175,457
13	2016			60	1,489	1,767	3,533	62,002	2,600	4,306	64,046	68,353	176,009
14	2017			64	1,493	1,802	3,604	61,854	2,600	4,338	63,965	68,303	176,752
15	2018			68	1,497	1,838	3,676	61,705	2,600	4,370	63,884	68,255	177,516
16	2019			71	1,501	1,875	3,749	61,557	2,600	4,404	63,806	68,209	178,299
17	2020			75	1,505	1,912	3,824	61,408	2,600	4,437	63,728	68,166	179,103
18	2021			75	1,563	1,950	3,901	61,408	2,600	4,476	63,747	68,222	180,115
19	2022			75	1,563	1,989	3,979	61,408	2,600	4,515	63,825	68,339	181,208
20	2023			75	1,563	2,029	4,058	61,408	2,600	4,555	63,904	68,459	182,322
21	2024			75	1,563	2,070	4,140	61,408	2,600	4,595	63,985	68,581	183,458
22	2025			75	1,563	2,111	4,222	61,408	2,600	4,637	64,068	68,705	184,617
23	2026			75	1,563	2,153	4,307	61,408	2,600	4,679	64,153	68,831	185,800
24	2027			75	1,563	2,196	4,393	61,408	2,600	4,722	64,239	68,961	187,005
25	2028			75	1,563	2,240	4,481	61,408	2,600	4,766	64,327	69,092	188,235
26	2029			75	1,563	2,285	4,570	61,408	2,600	4,811	64,416	69,227	189,490
27	2030			75	1,563	2,331	4,662	61,408	2,600	4,856	64,508	69,364	190,770
28	2031			75	1,563	2,378	4,755	61,408	2,600	4,903	64,601	69,504	192,075
29	2032			75	1,563	2,425	4,850	61,408	2,600	4,950	64,696	69,646	193,407
30	2033			75	1,563	2,474	4,947	61,408	2,600	4,999	64,793	69,792	194,765
31	2034			75	1,563	2,523	5,046	61,408	2,600	5,048	64,892	69,940	196,150
32	2035			75	1,563	2,574	5,147	61,408	2,600	5,099	64,993	70,092	197,563
33	2036			75	1,563	2,625	5,250	61,408	2,600	5,150	65,096	70,246	199,004
34	2037			75	1,563	2,678	5,355	61,408	2,600	5,203	65,201	70,404	200,474
35	2038			75	1,563	2,731	5,462	61,408	2,600	5,256	65,308	70,564	201,973
36	2039			75	1,563	2,786	5,571	61,408	2,600	5,311	65,417	70,728	203,503
37	2040			75	1,563	2,841	5,683	61,408	2,600	5,367	65,529	70,895	205,063
	Total	42,222	27,283	2,022	45,331	64,910	129,820	1,848,366	78,000	98,666	1,905,573	2,004,239	4,470,890

Results:

Case I	US$ portion	EIRR: 8.9%	B/C: 0.9	NPV($): -2,648	(Discount rate: 10%)
Case II	Peso portion	EIRR: 93.5%	B/C: 14.1	NPV(P): 295,126	(Discount rate: 10%)
Case III	US$+peso (Ps1:$1)	EIRR: 55.3%	B/C: 7.2	NPV(P): 292,477	
Case IV	US$+peso (Ps26:$1)	EIRR: 13.4%	B/C: 1.3	NPV(P): 226,272	

Table A13.30 Breakdown of Economic Cost of Priority Project

(Foreign currency:US$000, Local currency:Ps000)

			Direct cost											Indirect cost				Total capital cost
			Luyano Martin Perez	Luyano left colector	Central system Sur nuevo	Central system Pumped main	Central system Interconnection	Central system Cross connect.	Luyano WWTP	New Matadero pump. station	Rehabilitation Casablanca PS	Rehabilitation Caballeria	Total direct cost	Land	Admin. expenses	Engineering services	Physical contingency	
Financial Value	FC	Material & equipment	12,502	3,075	652	634	638	2,262	4,120	1,846	1,628	124	27,480					
		Labor																
		Transactional cost	3,847	946	201	195	348	696	1,737	680	504	38	9,192					
		Dealer margin	2,885	710	150	146	174	522	1,034	446	376	29	6,471					
		Total	19,234	4,730	1,003	976	1,160	3,480	6,891	2,971	2,508	190	43,143			4,438	4,314	51,895
	LC	Material & equipment	1,923	473	100	98	271	348	614	280	205	13	4,326					
		Labor	6,411	1,577	334	325	232	1,160	1,718	797	812	52	13,418					
		Transactional cost	2,564	631	134	130	155	464	450	189	137	9	4,862					
		Dealer's margin	1,923	473	100	98	116	348	491	224	204	13	3,989					
		Total	12,822	3,154	668	650	773	2,320	3,273	1,490	1,358	87	26,595	0	798	2,735	2,660	32,788
Conversion Factor	*FC*	*Material & equipment*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*	*0.9*						
		Labor	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*						
		Transactional cost	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*	*0.96*						
		Dealer margin	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*				*1*	*0.98*	
	LC	*Material & equipment*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*	*1.04*						
		Labor	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*	*0.8*						
		Transactional cost	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*						
		Dealer's margin	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*		*n.a.*	*1.02*	*1*	*1.02*	
Economic Value	FC	Material & equipment	11,252	2,767	587	571	574	2,036	3,708	1,661	1,465	111	24,732					
		Labor	0	0	0	0	0	0	0	0	0	0	0					
		Transactional cost	3,693	908	193	187	334	668	1,668	652	484	36	8,824					
		Dealer margin	0	0	0	0	0	0	0	0	0	0	0					
		Total	14,945	3,675	779	758	908	2,704	5,376	2,314	1,949	148	33,556		0	4,438	4,228	42,222
	LC	Material & equipment	2,000	492	104	101	281	362	639	292	214	14	4,499					
		Labor	5,129	1,262	267	260	186	928	1,374	637	650	42	10,734					
		Transactional cost	2,564	631	134	130	155	464	450	189	137	9	4,862					
		Dealer's margin	0	0	0	0	0	0	0	0	0	0	0					
		Total	9,693	2,384	505	491	621	1,754	2,463	1,118	1,000	64	20,095	463	814	2,735	2,713	26,821

Note: Combined conversion factor for FC of priority project is computed at 0.814

Combined conversion factor for LC of priority project is computed at 0.818

Table A13.31 Capital Investment Schedule and Cost at Economic Value - Priority Project

Year	Direct cost				Indirect cost							Direct + Indirect cost	
	New construction		Rehabilitation		Land	Administrative		Engineering services		Physical contingency		(US$000)	(Peso000)
	(US$000)	(Ps000)	(US$000)	(Ps000)	(Ps000)	(US$000)	(Ps000)	(US$000)	(Ps000)	(US$000)	(Ps000)		
2004													
2005													
2006								1,264	559			1,264	559
2007								1,264	559			1,264	559
2008	7,339	4,729	3,139	1,814	463		218	361	447	1,048	654	11,886	8,326
2009	10,840	6,553	944	632			218	361	336	1,178	718	13,322	8,457
2010	11,896	7,393	944	633			218	361	336	1,284	802	14,485	9,382
2011													
2012													
2013													
2014													
2015													
2016													
2017													
2018													
2019													
2020													
2021													
Total	30,075	18,675	5,026	3,080	463	0	653	3,611	2,237	3,510	2,175	42,222	27,283

Note: Combined conversion factor for foreign costs of priority project i 0.814
Combined conversion factor for local costs of priority project is 0.818

Table A13.32 Operating Expenditure at Economic Value in Priority Project

Year	With-project situation (net of without-project situation)											
	Electricity (Ps000)				Chemical	Salary (Ps000)					Total	
	Matadero PS	C. Blanca PS	Chivo Re PS	Luyano WWTP	(US$000) Luyano WWTP	Head Quarter	Matadero PS	C. Blanca PS	Chivo Re PS	Luyano WWTP	(US$000)	(Ps000)
2005												
2006												
2007												
2008												
2009												
2010												
2011	106	360		88	15	464	63	92		125	15	1,298
2012	106	360		102	30	464	63	92		125	30	1,312
2013	106	360		112	41	464	63	92		125	41	1,322
2014	106	360		118	49	464	63	92		125	49	1,328
2015	106	360		126	56	464	63	92		125	56	1,336
2016	106	368		170	60	565	63	92		125	60	1,489
2017	106	368		174	64	565	63	92		125	64	1,493
2018	106	368		178	68	565	63	92		125	68	1,497
2019	106	368		182	71	565	63	92		125	71	1,501
2020	106	368		186	75	565	63	92		125	75	1,505
2021	106	374		208	75	595	63	92		125	75	1,563
2022	106	374		208	75	595	63	92		125	75	1,563
2023	106	374		208	75	595	63	92		125	75	1,563
2024	106	374		208	75	595	63	92		125	75	1,563
2025	106	374		208	75	595	63	92		125	75	1,563
2026	106	374		208	75	595	63	92		125	75	1,563
2027	106	374		208	75	595	63	92		125	75	1,563
2028	106	374		208	75	595	63	92		125	75	1,563
2029	106	374		208	75	595	63	92		125	75	1,563
2030	106	374		208	75	595	63	92		125	75	1,563
2031	106	374		208	75	595	63	92		125	75	1,563
2032	106	374		208	75	595	63	92		125	75	1,563
2033	106	374		208	75	595	63	92		125	75	1,563
2034	106	374		208	75	595	63	92		125	75	1,563
2035	106	374		208	75	595	63	92		125	75	1,563
2036	106	374		208	75	595	63	92		125	75	1,563
2037	106	374		208	75	595	63	92		125	75	1,563
2038	106	374		208	75	595	63	92		125	75	1,563
2039	106	374		208	75	595	63	92		125	75	1,563
2040	106	374		208	75	595	63	92		125	75	1,563

Note: Conversion factor of salary is 0.86
Conversion factor of electricity is 2.00
Conversion factor of chemical is 0.90

Table A13.33 Economic Benefit of Inhabitants in Priority Project

Year	With-project situation			Without-project situation		
	Population	Rate (HH/month)	Revenue (Ps000)	Served Population	Rate (HH/month)	Revenue (Ps000)
2004						
2005						
2006						
2007						
2008						
2009						
2010	2,151,562					
2011	2,148,399	9.7	62,518	0		0
2012	2,145,236	9.7	62,426	0		0
2013	2,142,073	9.7	62,334	0		0
2014	2,138,910	9.7	62,242	0		0
2015	2,135,747	9.7	62,150	0		0
2016	2,130,649	9.7	62,002	0		0
2017	2,125,551	9.7	61,854	0		0
2018	2,120,452	9.7	61,705	0		0
2019	2,115,354	9.7	61,557	0		0
2020	2,110,256	9.7	61,408	0		0
2021	2,110,256	9.7	61,408	0		0
2022	2,110,256	9.7	61,408	0		0
2023	2,110,256	9.7	61,408	0		0
2024	2,110,256	9.7	61,408	0		0
2025	2,110,256	9.7	61,408	0		0
2026	2,110,256	9.7	61,408	0		0
2027	2,110,256	9.7	61,408	0		0
2028	2,110,256	9.7	61,408	0		0
2029	2,110,256	9.7	61,408	0		0
2030	2,110,256	9.7	61,408	0		0
2031	2,110,256	9.7	61,408	0		0
2032	2,110,256	9.7	61,408	0		0
2033	2,110,256	9.7	61,408	0		0
2034	2,110,256	9.7	61,408	0		0
2035	2,110,256	9.7	61,408	0		0
2036	2,110,256	9.7	61,408	0		0
2037	2,110,256	9.7	61,408	0		0
2038	2,110,256	9.7	61,408	0		0
2039	2,110,256	9.7	61,408	0		0
2040	2,110,256	9.7	61,408	0		0

Table A13.34 Economic Benefit of Industries in Priority Project

Year	City of Havana Production (Ps Million)	With-project situation				Without-project situation	
		US$ rate	Aggregate benefit (US$000)	Peso rate	Aggregate benefit (Ps000)	(US$000)	(Ps000)
2004	6,056						
2005	6,177						
2006	6,301						
2007	6,427						
2008	6,555						
2009	6,686						
2010	6,820						
2011	6,957	0.023%	1,600	0.046%	3,200	0	0
2012	7,096	0.023%	1,632	0.046%	3,264	0	0
2013	7,238	0.023%	1,665	0.046%	3,329	0	0
2014	7,382	0.023%	1,698	0.046%	3,396	0	0
2015	7,530	0.023%	1,732	0.046%	3,464	0	0
2016	7,681	0.023%	1,767	0.046%	3,533	0	0
2017	7,834	0.023%	1,802	0.046%	3,604	0	0
2018	7,991	0.023%	1,838	0.046%	3,676	0	0
2019	8,151	0.023%	1,875	0.046%	3,749	0	0
2020	8,314	0.023%	1,912	0.046%	3,824	0	0
2021	8,480	0.023%	1,950	0.046%	3,901	0	0
2022	8,650	0.023%	1,989	0.046%	3,979	0	0
2023	8,823	0.023%	2,029	0.046%	4,058	0	0
2024	8,999	0.023%	2,070	0.046%	4,140	0	0
2025	9,179	0.023%	2,111	0.046%	4,222	0	0
2026	9,363	0.023%	2,153	0.046%	4,307	0	0
2027	9,550	0.023%	2,196	0.046%	4,393	0	0
2028	9,741	0.023%	2,240	0.046%	4,481	0	0
2029	9,936	0.023%	2,285	0.046%	4,570	0	0
2030	10,135	0.023%	2,331	0.046%	4,662	0	0
2031	10,337	0.023%	2,378	0.046%	4,755	0	0
2032	10,544	0.023%	2,425	0.046%	4,850	0	0
2033	10,755	0.023%	2,474	0.046%	4,947	0	0
2034	10,970	0.023%	2,523	0.046%	5,046	0	0
2035	11,189	0.023%	2,574	0.046%	5,147	0	0
2036	11,413	0.023%	2,625	0.046%	5,250	0	0
2037	11,641	0.023%	2,678	0.046%	5,355	0	0
2038	11,874	0.023%	2,731	0.046%	5,462	0	0
2039	12,112	0.023%	2,786	0.046%	5,571	0	0
2040	12,354	0.023%	2,841	0.046%	5,683	0	0

Note: Production of the year 2002 was Ps5821 million. An annual growth of 2% is assumed.