Park Zone

The top is to have an area of about 19,000m^2. The area will be used as a multi-purpose space, where it is possible to have a football pitch, a baseball field, tennis courts, etc.

Green Zone

Open forest will be developed in the upper slope, where people can have a stroll along nature trail.

Buffer Zone

Vegetated buffer zone will be established in the lower slope, which harmonizes with the surrounding green area.

K.2.2 Pre-feasibility Study on Transfer and Transport System

a. Consideration of Necessity of Transfer and Transport System

a.1 Background

The District has experienced an expansion toward the North and the East. The Corregimientos to the North, Chilibre and Las Cumbres, experienced a population growth of 49% and 64% from 1990 to 2000 respectively. On the other hand, the Eastern Corregimientos, San Martin, Pacora and Tocumen, experienced a growth of 44%, 132%, and 77% from 1990 until 2000 respectively.

The collection system in the Eastern part is done mostly with compactors of 12.2 m^3 (16 yd^3); and the eventual use of compactors of 15.3 m^3 (20 yd^3), especially for areas where highly concentrated and residential sectors are found such as Mall Los Pueblos, San Joaquín, and Jardín Olímpico routes. DIMAUD´s data suggests that the current collection amount is about 70 tons/day.

On the other hand, the collection system in the Northern part was initially done with compactors of 12.2 m^3; however, with the recent acquisition of additional 15.3 m^3 compactors, collection is done with 15.3 m^3 compactors for the most distant part to the North, such as Chilibre Centro and Quebrada Ancha routes; and a small dump-truck of 3.1 m^3 (4 yd^3) for areas where the 15.3 m^3 compactor can not access. According to data from DIMAUD´s collection service, from those two routes an average of 7.6 tons are collected on a daily basis.

Although the current waste amount collected in the East is not so large and the one in the North is small, there is a growing need to evaluate transfer stations due to the rapid

population growth in the areas. Consequently, a pre-feasibility study has been conducted for a transfer and transport system.

a.2 Compliance with Norms, Regulations and other Plans

a.2.1 City Planning

East

Decree 205 has approved the "Urban Development Plan for the Metropolitan Areas in the Pacific and the Atlantic" defined provisions for infrastructure systems for "...Drinking Water, Drainage, Waste Water, Electricity, Telecommunications, and Solid Wastes..." The Plan, in fact, considers a Tocumen Transfer Station located to only 1.5 km to the West from the Airport, which would serve Pacora, San Martin, and Tocumen. The population to be serviced would be 148,442 persons by 2020. However, provisions should also be taken into consideration because that same Decree 205 (December 28th, 2000) establishes "Tocumen Airport and its surroundings" as a Functional Special Area which is defined as a "zone which requires more detailed studies to ensure that the character and function of its future development are compatible with the rest of the urban area." A Transfer and Transport system might not be compatible with the functions of an International Airport operation and its expansion.

North

A Transfer and Transport System for the North will have special considerations due to the following:

a) Many of the most important population centers to the North, such as, Alcalde Díaz, Villa Esperanza, Don Bosco, and Chilibre, are located within the Panama Canal Basin and along the Trans-Isthmian Corridor.

b) The Trans-Isthmian Corridor is defined by Decree 205[1] (December 28, 2000) as "a special area of critical concern where every consideration related to the Corridor´s management should have as a primary goal to rehabilitate and to protect the natural environment, specifically the water resource which serves to operate the Panama Canal and supplies of drinking water to the metropolitan population".

c) There is an explicit policy to "direct the urban growth along the coast shores and outside the Panama Canal Basin...." (Law No. 21[2], Categories for Territorial Planning, Urban Areas, July 2, 1997). Currently, the Authority of the Panama Canal (ACP) is promoting a regulation of Law No. 21 and a draft of this regulation is expected to be ready by the end of the year 2002.

[1] Decree which approved the Urban Development Plan in the Metropolitan Areas of the Pacific and the Atlantic which is ascribed to the General Direction of Urban Development of MIVI

[2] Law by which it is approved the Regional Plan for the Development of the Inter-oceanic Region and the General Plan to Use, to Conserve, and to Develop the canal area

d) MIVI and other related institutions are reviewing a document titled "Normative for the Urban Development of Localities in the Chilibre and Las Cumbres Corregimientos" which will regulate the population settlement for those two Corregimientos inside the Panama Canal Basin. The Normative will regulate urban expansion mostly by defining areas for specific purposes and with defined minimum areas for residential constructions for example. The Normative is expected to be enacted during the year 2002.

Consequently, the urban growth and the projected amount of waste generated by its population should be carefully evaluated.

On the other hand, the concept of Transfer Stations to provide service to the Eastern and Northern part of the city is also included in the Report for the "Plan of Urban Development of the Metropolitan Areas in the Pacific and the Atlantic."[3] In fact, Decree 205 establishes considerations for this type of facilities because it defines provisions for infrastructure systems for "...Drinking Water, Drainage, Waste Water, Electricity, Telecommunications, and Solid Wastes..."

The report by Dames & Moore proposed a T/S denominated Las Cumbres which would service José Domingo Espinar, Belisario Porras, and Integrated zone No. 4 (Las Cumbres and Chilibre). The total population to be serviced would be 495,595 persons by 2020. It should be noted that Jose Domingo Espinar and Belisario Porras belong now to San Miguelito District, which is currently serviced by a private collection company.

a.2.2 Transport

Panama does not have specific environmental regulations related to Transfer Stations and Transport. However, there are other regulations related to these facilities, for example, Law 10 (enacted on January 27th, 1989) which deals with the Weight and Dimensions of Heavy duty vehicles that transit through public roads. The entity in charge to enforce Law 10 is the Authority for Terrestrial Transit and Transport (ATTT).

Transfer and transport systems often employ tractor-trailer for transportation to carry a large amount of waste at once. A typical tractor-trailer corresponds to a truck-tractor of three axles and a semi-trailer of two axles. This type of combination is denominated T3-S2 according to the ATTT. The Authority restricts the total maximum weight for this type of vehicle to 38.3 Tons. If a vehicle exceeds the defined weight, Law 10 requires the user to obtain a special permit from the Ministry of Public Works. The recommended transport system, i.e., tractor-trailer (payload 20 ton), would exceed the limit depending on specifications. Nonetheless, the client can also request the manufacturer to construct a trailer that suits the

[3] Prepared by Dames & Moore

needs and restrictions at hand, i.e., meet the required payload (20 tons) and the maximum weight regulation (38.3 tons).

a.3 Future Waste Amount

Corregimientos covered with the transfer stations were defined, based on trials of break-even analysis that is described in the later part, where the transfer and transport system would be more beneficial than the conventional collection system. Those corregimientos are as follows.

- East: Tocumen, Pacora and San Martin
- North: Chilibre

It is supposed that the transfer station in the East would deal with household waste, commercial waste, institutional waste, industrial waste (non-hazardous), market waste and street sweeping waste, meanwhile, one in the North would receive only household waste and industrial waste taking into account the current situation and the policies to restrict development in the Panama Canal Basin. With this assumption, Waste Amount in the future in the areas is forecast as shown in Table K-39 and Table K-40. It should be noted that the population forecast is based on the trend of population growth in the recent years, but does not take into account the policies on the Panama Canal Basin as there are many uncertainties to consider such policies in the population forecast.

Table K-39: Forecast of Waste Collection Amount in the East

Year		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Population	Pacora	79,175	86,108	93,648	101,848	110,766	120,465	131,014	142,486	154,963	168,532	183,290	199,339	216,795
	San Martín	3,990	4,139	4,293	4,453	4,619	4,792	4,970	5,156	5,348	5,547	5,754	5,969	6,191
	Tocumen	98,708	104,501	110,633	117,126	123,999	131,276	138,980	147,136	155,770	164,911	174,589	184,834	195,681
	Total	181,873	194,748	208,574	223,427	239,384	256,533	274,964	294,778	316,081	338,990	363,633	390,142	418,667
Waste Amount (ton/day)		205.2	221.8	240.3	261.0	280.6	299.4	319.5	340.5	362.9	386.8	411.6	438.1	466.0

Table K-40: Forecast of Waste Collection Amount in the North

Year		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Population	Chilibre	45,634	47,495	49,433	51,449	53,548	55,733	58,007	60,373	62,836	65,400	68,068	70,845	73,735
Waste amount (ton/day)		27.1	28.8	30.5	32.4	33.7	35.1	36.5	38	39.5	41.1	42.7	44.4	46.2

a.4 Break-even Analysis

a.4.1 Key Data

Key data for break-even analysis of the transfer and transport system vs. the conventional transport system which is done by collection vehicles are set as shown in Table K-41.

Table K-41: Key Data for Break-even Analysis

i. Basic Parameters

Item	Unit	Value
Basic parameter		
Daily working hour	hr	16
Operating time	hr	14
Maintenance time	hr	2
Nos. of shift	nos.	2
Working days	day	300

ii. Conventional Transport System

Item	Unit	Value
Compactor truck (12.2 m^3)		
Payload	ton/truck	5
Trip time of collection	hr/trip	5.0
Nos. of trip	nos./day	2.4
Waste amount collected	ton/truck/day	12
Economic life	years	4
Distance per trip	km	50[a] – 60[b]
Annual mileage	km	36,000[a]-43,200[b]
Fuel consumption	km/liter	2.2
Driver	person	1
Worker	person	3

Item	Unit	Value
Compactor truck (15.3 m^3)		
Payload	ton/truck	7.7
Trip time of collection	hr/trip	4.5
Nos. of trip	nos./day	2.7
Waste amount collected	ton/truck/day	21
Economic life	years	4
Distance per trip	km	50[a] – 60[b]
Annual mileage	km	40,500[a]-48,600[b]
Fuel consumption	km/liter	2
Driver	person	1
Worker	person	3

[a] For the Transport and Transfer system to the East
[b] For the Transport and Transfer system to the North

iii. Transfer and Transport System for the East

Item	Unit	Value
Tractor and trailer (65 m^3)		
Payload	ton/trailer	20
Trip time of transport	hr/trip	4
Nos. of trip	nos./day	3
Waste amount transported	ton/trailer/day	60
Economic life	years	7
Distance per trip	km	50
Annual mileage	km	45,000
Fuel consumption	km/liter	1.8
Driver	person	1
Worker	person	0

Item	Unit	Value
Transfer Station		
Capacity	ton/day	570
Service Life	years	15
Total Cost	USD	10,449,000

iv. Transfer and Transport System for the North

Item	Unit	Value
Roll on/off & container of 22.9 m^3		
Payload	ton/truck	6.5
Trip time of Collection	Hr/trip	4
Nos. of trip	nos./day	3
Waste amount collected	ton/truck/day	20
Economic life	years	5
Distance per trip	km	60
Annual mileage	km	54,000
Fuel Consumption	km/liter	2
Driver	person	1
Worker	person	3
Capacity to be handled	ton/day	60
No. of Containers of 22.9 m^3 to be used from 2003 to 2015	Units	67

a.4.2 Analysis on the East

The break-even analysis is conducted based on the waste collection amount forecast in the M/P's target year 2015.

a.4.2.1 Transfer and Transport System

Required capacity of the transfer and transport system in the East is calculated as shown in Table K-42 by taking into account that there are 300 working days per year. In year 2015, the required capacity of the system would be 570 ton/day, which is enough large to apply combination of a transfer station and a large scale of transport equipment. Therefore, the transfer and transport system for the analysis is set as shown in Table K-43.

Table K-42: Required Capacity of Transfer Station in the East

Unit: ton/day

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Required capacity	250	270	300	320	350	370	390	420	450	480	510	540	570

Table K-43: Transfer and Transport System in the East

Item	Specification
Transfer station	570 ton/day of direct dump station
Transport equipment	Tractor and trailer, 65 m^3 (payload 20 ton)

a.4.2.2 Results of Analysis

The break-even analysis was carried out based on the following unit costs which were derived from the key data mentioned previously.

Table K-44: Cost Estimates for Transfer and Transport System for the East

Item	Unit	Value
Conventional Transport		
Compactor Truck (15.3 m^3)	USD/ton-min	0.044
Compactor Truck (12.2 m^3)	USD/ton-min	0.058
Transfer Station Proposed		
Capacity	ton/day	570
Unit Cost Estimate	USD/ton	3.06
Transport Proposed		
Tractor-trailer (65 m^3)	USD/ton-min	0.0103

The cost estimates were graphed and the intersection point between the conventional transport and the proposed systems represents the break-even point (See Figure K-35).

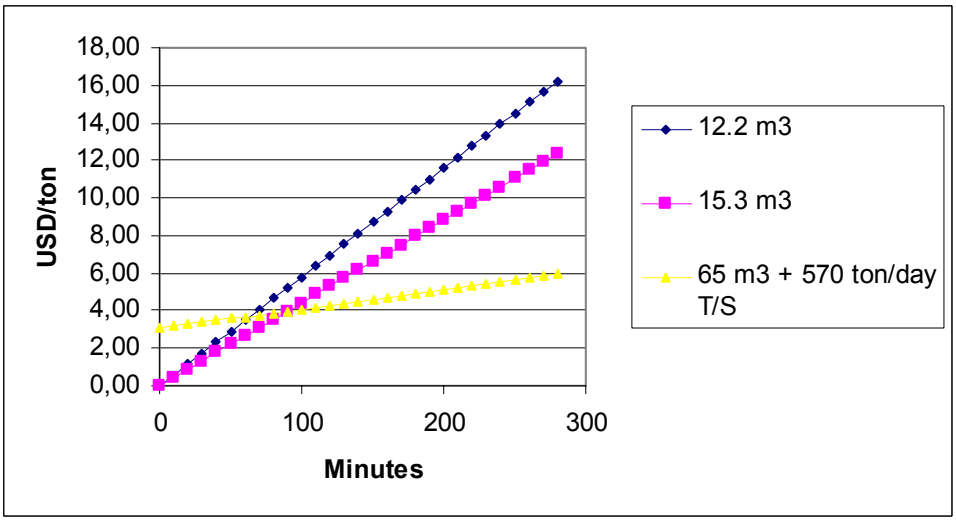

Figure K-35: Break-even Analysis in the East

These results can be included in a table in the following manner:

	Break-even Time (min.) 65 m^3 + 570 tons/day T/S	Break-even Distance (km)[a] 65 m^3 + 570 tons/day T/S	Distance from Tocumen to Patacón Round-trip (km)[b]
12.2 m^3	64	32	48
15.3 m^3	90	45	48

[a] The break-even distance was calculated based on an average velocity of 30 km/hr
[b] The distance was measured by the Study Team from Tocumen Airport until Patacon

The results show that a transfer station of 570 tons/day with a transport done by a 65 m^3 tractor-trailer is feasible compared to the transportation done by the 12.2 m^3 compactor for the area located further than 32 km from Cerro Patacon landfill (round trip), and compared to the transportation done by the 15.3 m^3 compactor for the area further than 45 km from the landfill (round trip). Tocumen Airport (Central part of Tocumen Corregimiento) is located to 24 km from Patacon landfill site (48 km round trip). Pacora and San Martin are found to the east of Tocumen Airport. Consequently, it can be concluded that a transfer and transport system will be feasible financially in Tocumen, Pacora, and San Martin.

a.4.3 Analysis on the North

a.4.3.1 Transfer and Transport System

Required capacity of the transfer and transport system in the North is calculated as shown in Table K-45 by taking into account that there are 300 working days per year. In year 2015, the required capacity of transfer station would be 60 ton/day. As the scale of the system is too small to apply the same system as one for the East, combination of Roll-on/Roll-off truck and 22.9 m^3 (30 yd^3) of container is applied as the transfer and transport system for the North.

Table K-45: Required Capacity of Transfer Station in the North

Unit: ton/day

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Required capacity	40	40	40	40	50	50	50	50	50	60	60	60	60

Table K-46: Transfer and Transport System in the North

Item	Specification
Transfer station	22.9 m^3 (30 yd^3) container and site for placement of container
Transport equipment	Roll-on/Roll-off truck

a.4.3.2 Results of Analysis

The break-even analysis was based on the following unit costs which were derived from the key data mentioned previously.

Table K-47: Cost Estimates for Transfer and Transport System for the North

Item	Unit	Value
Conventional Transport		
Compactor Truck (15.3 m^3)	USD/ton-min	0.045
Compactor Truck (12.2 m^3)	USD/ton-min	0.059
Transfer System Proposed		
Capacity	ton/day	60
Number of Containers of 22.9 m^3	Units/year	6
Unit Cost Estimate	USD/ton	3.35
Transport Proposed		
Roll-on/Roll-off (22.9 m^3)	USD/ton-min	0.031

The cost estimates were graphed and the intersection point between the conventional transport and the proposed systems represents the break-even point (See Figure K-36).

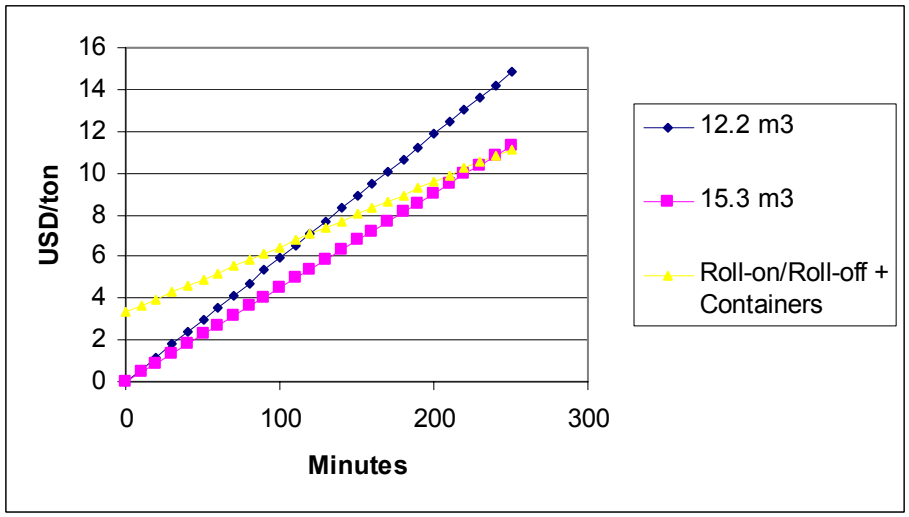

Figure K-36: Break-even Analysis in the North

These results can be included in a table in the following manner:

	Break-even Time (min.) Roll-on/Roll-off	Break-even Distance (km) Roll-on/Roll-off[a]	Distance from Chilibre Centro to Patacon Round-trip (km)[b]
12.2 m^3	119	60	58
15.3 m^3	240	120	58

[a] The break-even distance was calculated based on an average velocity of 30 km/hr
[b] The distance was measured by the Study Team from Chilibre Centro to Patacon

These results show that the Roll-on/Roll-off system of transport is feasible compared to the compactor (conventional transport system) only when the round-trip distances are farther than 60 km for the 12.2 m^3 compactor or farther than 120 km for the 15.3 m^3 compactor. Chilibre Centro is located to 29 km (58 km round-trip) from the landfill site. The population of Chilibre is concentrated along the Trans-isthmian road which center can be located precisely in Chilibre Centro where the proposed Roll-on/Roll-off system might be feasible only for the 12.2 m^3, but not for the case of the 15.3 m^3 compactor which is precisely the type of vehicle that is currently providing service to Quebrada Ancha and Chilibre Centro.

a.5 Conclusion

East

- The population growth toward the East is projected to continue high as the two previous censuses, which were conducted in 1990 and 2000, showed. This trend might be even promoted by explicit policies, e.g. Law 21, which discourage additional settlements to the North, but it promotes them toward the East.
- The break-even analysis showed that the transfer and transport system (composed by a Transfer Station of 570 tons/day and tractor-trailers of 65 m^3 capacities) is financially feasible compared to the conventional transport system executed by 12.2 m^3 or 15.3 m^3 compactor trucks.
- Consequently, the Transfer and Transport system composed by a Transfer Station of 570 tons/day and tractor-trailers of 65 m^3 capacities is recommended to be implemented for the Eastern Sector formed by Tocumen, Pacora, and San Martin.

North

- The previous censuses conducted in 2000 showed that this sector has experienced high population growth. However, there are explicit policies to discourage additional settlements in the area, e.g., Law 21 and Decree 205. If these policies are implemented stringently, then the population growth can be expected to be lower than the projected growth derived from the previous censuses.
- The break-even analysis showed that the proposed Transfer and Transport system which is composed of Roll-off/Roll-on trucks and 22.9 m^3 containers is not feasible if it is compared to compactor trucks of 12.2 m^3 and compactor trucks of 15.3 m^3 which are currently used in Quebrada Ancha and Chilibre Centro. Moreover, the current collection amount in the routes mentioned previously is only 7 tons/day.
- Consequently, it is not recommendable at this moment to introduce a Transfer and Transport system to service the North. However, an evaluation of the variables that lead to the former conclusion (population growth, enforcement of urban development regulations, etc.) should be done in the future in order to determine if there has been any change in this regard and to define the necessity of introducing a Transfer and Transport system.

b. Outline of the Project of Transfer and Transport System in the East

b.1 Target Areas

The project of Transfer and Transport System in the East covers the following corregimientos.

- Tocumen
- Pacora
- San Martin

b.2 Examination of Design Conditions

Conditions that are important on planning and designing of the transfer and transport system are population forecast and city planning in the target area. These issues were fully discussed in the previous section, a. Consideration of Necessity of Transfer and Transport System.

It should be noted that there is large difference between estimated required capacity of the transfer and transport system and actual waste collection amount. Based on the population forecast in year 2002, the estimated one is 240 ton/day, but the actual one is about 70 ton/day. In order to bridge the difference, it is supposed that the actual waste collection amount would meet with the estimated one in year 2007 where the amount is 350 ton/day. Consequently,

waste collection amount for designing the transfer and transport system is set as shown in Table K-48.

Table K-48: Waste Collection Amount for Design of Transfer and Transport System in the East

Unit: ton/day

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Estimated required capacity	240	250	270	300	320	350	370	390	420	450	480	510	540	570
Amount for Design	70	100	140	190	260	350	370	390	420	450	480	510	540	570

b.3 Recommended Location and Scale of Transfer Station

b.3.1 Location

The ideal location of transfer station is a gravity center of waste collection amount generated from a target area. The gravity center at present is regarded as the area around the Tocumen Airport where is densely populated. It will be difficult to construct a large scale of transfer station in the area, which has been developed and is close to the international airport. Meanwhile, the area along the Pan American Highway (Carretera Panamericana) in the Pacora corregimiento is rapidly developing in recent years and further development is expected in the future. Then, it can be predicted that the gravity center moves to the area. Consequently, it is recommended to place the transfer station in the area along the Pan American Highway in Pacora corregimiento.

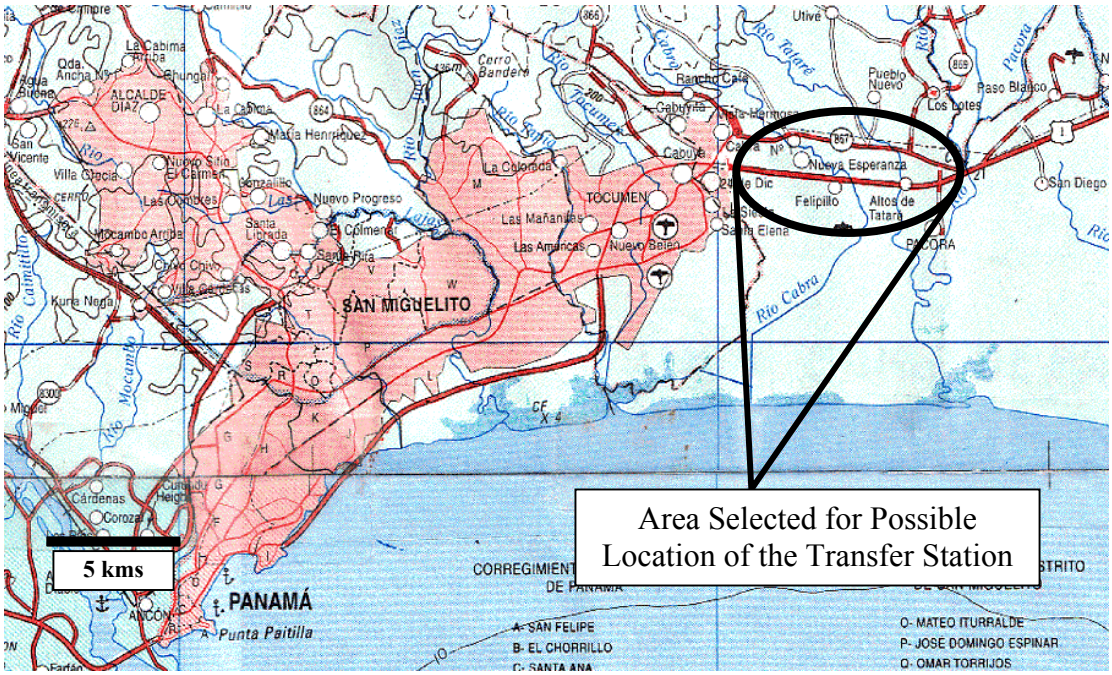

Figure K-37: Recommended Location of Transfer Station in the East

b.3.2 Scale

Required capacity of the transfer station for the area is 570 ton/day in 2015. Being on the safe side, 600 ton/day of facility capacity is recommendable. Meanwhile, it can be said that to construct such a large scale of facility at once is highly risky, as the current waste collection amount in the area is about 70 ton/day as well as the population forecast in more than 10 years contains large uncertainties. Consequently, it is recommendable to divide facility construction in two phases, i.e., 300 ton/day each, in order to reduce the risk.

b.4 Examination of Technical Alternatives

There are several types of transfer stations to be considered for the transfer and transport system in the East. Those are:

- Direct dump station,
- Pit or platform non-compaction station,
- Hopper compaction station, and
- Push pit compaction station.

Table K-49 discusses advantages and disadvantages of each type of transfer station.

As introduction of the transfer station is the first case in Panama District and it is expected to expand the facility, the system should be simple to operate and the facility be flexible to expand. Consequently, the "direct dump station" is recommendable as it suits to the needs.

Table K-49: Advantage and Disadvantage of Transfer Station Type

Type	Outline	Advantage	Disadvantage
Direct dump station	Waste is dumped directly from collection vehicle into waiting transfer trailers.	• Little hydraulic equipment is used, a shutdown is unlikely. • Minimizes handling of waste • Relatively inexpensive construction cost • Drive-through arrangement of transfer vehicle can be easily provided	• Requires lager trailer than compaction station • Dropping bulky item directly into trailers can damage trailers • Minimizes opportunity to recover materials • Number and availability of stalls may not be adequate to allow direct dumping peak period
Pit or platform non-compaction station	Waste is dumped into a pit or onto a platform and then loaded into trailers using waste handling equipment	• Convenient and efficient waste storage area is provided • Un-compacted waste can be by bulldozer in pit or platform • Top-loading trailers are less expensive than compaction trailers • Peak loads can be handled easily • Drive-through arrangement of transfer vehicles can be easily provided • Simplicity of operation and equipment minimizes potential for station shutdown • Can allow recovery of materials	• Higher capital cost, compared to other alternatives, for structure and equipment • Increased floor area to maintain • Requires larger trailers than compaction station
Hopper compaction station	Waste is unloaded from the collection truck, through a hopper, and loaded into an enclosed trailer through a compactor	• Use smaller trailers than non-compaction station • Some compactors can be installed in manner that eliminates the need for a separate, lower level for trailers	• If compactor fails, there is no way to load waste on trailer • Weight of ejection system and reinforce trailer reduces legal payload • Capital costs are higher for compaction trailers • Compactor capacity may not be adequate for peak inflow • Cost to operation and maintain compactors may be high
Push compaction station	Waste is unloaded from the collection truck into a push pit, and then loaded into an enclosed trailer through a compactor	• Pit provides waste storage during peak period • Increased opportunity for recovery of materials • All advantage of hopper compaction station	• Capital costs for pit equipment are significant • All other disadvantage of hopper compaction stations

sources : Decision-Makers' Guide To Solid Waste Management, Volume II, 1995, US EPA

b.5 Conceptual Design

b.5.1 Outline of the Project

The project is outlined in Table K-50.

Table K-50: Outline of the Project

Item	Specification
Transfer station	Type: Direct dump station Capacity: 600 ton/day in total First phase; 300 ton/day Second phase; 300 ton/day
Transport equipment	Tractor: 300-350 Hp Trailer: payload 20 ton, 65 m^3 (85 yd^3) with hydraulic ejector blade
Collection equipment	Compactor:12.2 m^3 (16 yd^3) compactor truck

b.5.2 Design Parameters

Parameters for designing the transfer and transport system are set as shown in Table K-51.

Table K-51: Design Parameters for Transport and Transport System

Item	Unit	Value
Basic parameter		
Daily working hour	hr	16
Operating time	hr	14
Maintenance time	hr	2
Nos. of shift	nos.	2
Working days	day	300

Item	Unit	Value
Tractor and trailer		
Payload	ton/trailer	20
Trip time of transport	hr/trip	4
Nos. of trip	nos./day	3.5
Waste amount transported	ton/trailer/day	70
Economic life	years	7
Distance per trip	km	60
Annual mileage	km	63,000
Fuel consumption	km/liter	1.8
Driver	person	1
Worker	person	0

Item	Unit	Value
Compactor truck (12.2 m3)		
Payload	ton/truck	5
Trip time of collection	hr/trip	3.5
Nos. of trip	nos./day	4.0
waste amount collected	ton/truck/day	20
Economic life	years	5
Distance per trip	km	20
Annual mileage	km	24,000
Fuel consumption	km/liter	2.2
Driver	person	1
Worker	person	3

b.5.3 Conceptual Design of Transfer Station

Conceptual design of the transfer station is outlined in Table K-52. Figure K-38 and Figure K-39 show a plan of the transfer station in Phase I, 300 ton/day of capacity, and one in Phase II, 600 ton/day of capacity in total respectively. It should be noted that a site for the transfer station was not presented by the Panamanian side, as this pre-feasibility study aimed at examining necessity of transfer and transport system in the area. Therefore, the facilities of the transfer station were not designed based on actual information such as geological and environmental data. Then, construction of the facilities will require redesign based on such information of site in the future.

Table K-52: Outline of Conceptual Design of Transfer Station

Item	Details	unit	Phase I	Phase II	Total
			Quantify	Quantify	Quantify
Land acquisition		m2	49,450	0	49,450
Transfer station construction					
Platform	R/C	m2	1,250	1,250	2,500
Roof on the platform	Slate covered	m2	1,250	1,250	2,500
Office		m2	270	-	270
Workshop (Garage)		m2	450	-	450
Scale house		m2	60	-	60
Road pavement (access to platform)	Concrete pavement	m2	1,200	525	1,725
Road pavement (road and reception)	Asphalt pavement	m2	7,070	2,480	9,550
Road pavement (parking)	Asphalt pavement	m2	3,180	1,240	4,420
Green area	Turf	m2	6,080	6,340	12,420
Banking (access to platform)		m3	6,728	4,532	11,260
Retaining wall		m2	1,096	1,040	2,136
Fence	h=2.0m	m	600	110	710
Gate	W=10.0m	unit	1	-	1
					0
Equipment					0
Weighbridge	60ton	unit	1	1	2
Hopper	Steel, 12m x 5m	unit	2	2	4
Hopper – Ventilation facilities		unit	2	2	4
Generator	230kW	unit	1	1	2
Car Washer	20 liter/hour	unit	1	1	2
Electric facilities (Platform)		unit	1	1	2
Electric facilities (Fan)		unit	1	1	2
Electric facilities (Light)		unit	1	1	2
Electric facilities (Others)		unit	1	1	2
Wheel loader	100kW	unit	1	-	1
Drainage facilities		unit	1	1	2
Garage goods		unit	1	-	1

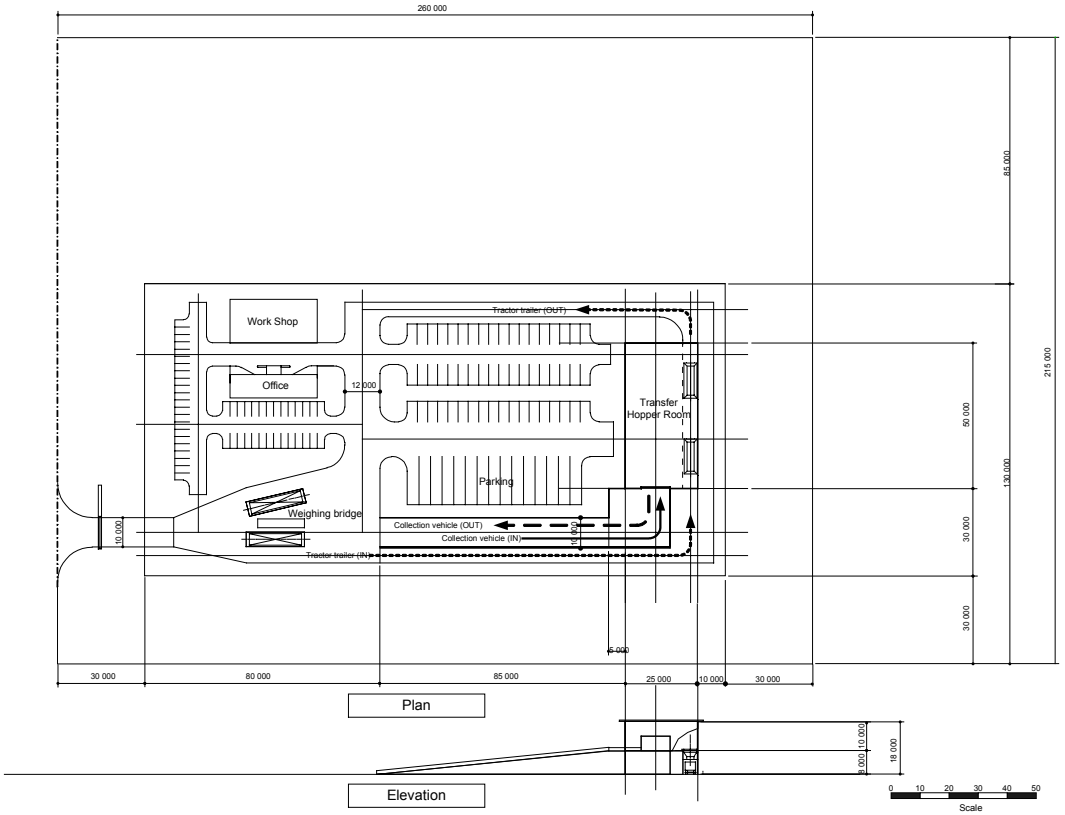

Figure K-38: Plan of Transfer Station (Phase I, 300 ton/day)

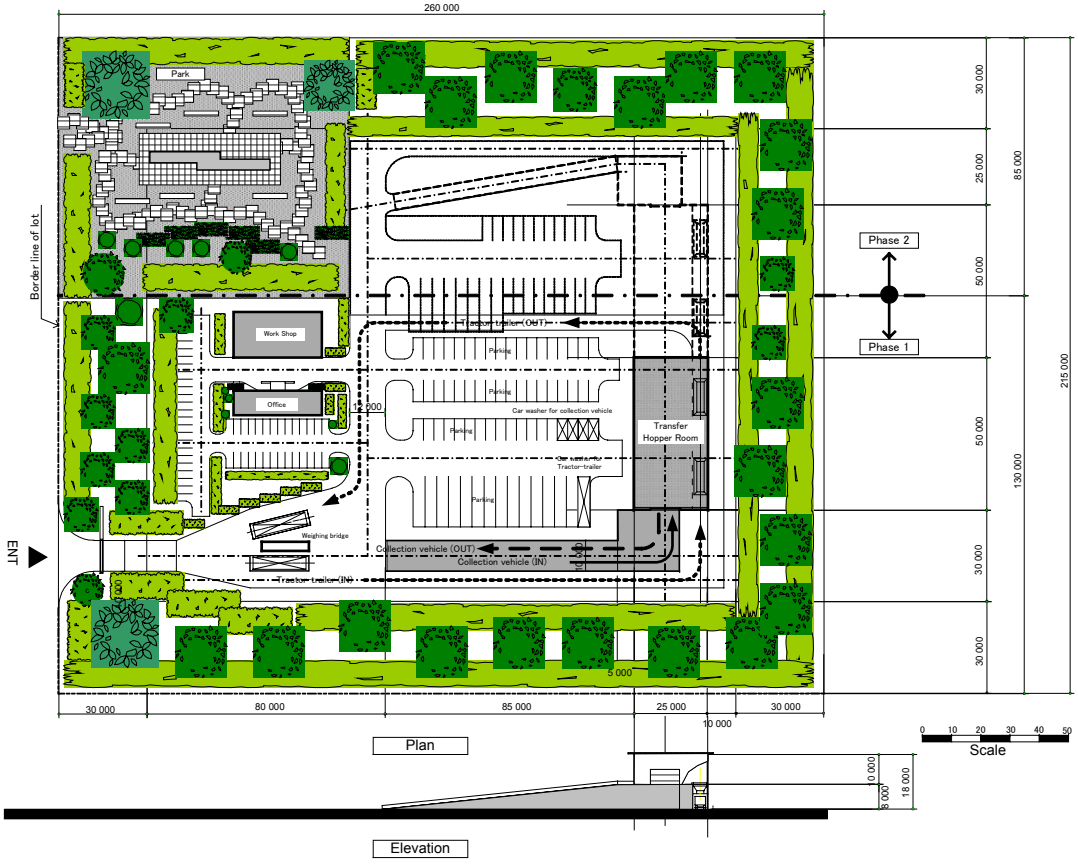

Figure K-39: Plan of Transfer Station (Phase II, 600 ton/day)

b.5.4 Required Number of Transport Equipment

Required number of transport equipment shown in Table K-53 is calculated based on the waste collection amount presented in Table K-48.

Table K-53: Required Number of Transport Equipment

Item	Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Tractor (300-350hp)													
Required	nos.	3	4	5	6	6	6	7	7	8	8	9	-
Spare (10% of required)	nos.	1	1	1	1	1	1	1	1	1	1	1	-
Total	nos.	4	5	6	7	7	7	8	8	9	9	10	-
Purchase schedule	nos.	4	1	1	1	0	0	1	4	2	1	2	17
Trailer (85 yd3, 20 ton)													
Required	nos.	3	4	5	6	6	6	7	7	8	8	9	-
For loading	nos.	2	2	2	4	4	4	4	4	4	4	4	-
Spare (10% of required)	nos.	1	1	1	1	1	1	1	1	1	1	1	-
Total	nos.	6	7	8	11	11	11	12	12	13	13	14	-
Purchase schedule	nos.	6	1	1	3	0	0	1	6	2	1	4	25

b.5.5 Required Number of Collection Equipment

Required number of collection equipment shown in Table K-54 is calculated based on the waste collection amount presented in Table K-48.

Table K-54: Required Number of Collection Equipment

Item	Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Required	nos.	10	16	18	19	20	21	23	24	26	27	29	-
Spare (10% of required)	nos.	1	2	2	2	2	3	3	3	3	3	3	-
Total	nos.	11	18	20	21	22	24	26	27	29	30	32	-
Purchase schedule	nos.	11	7	2	1	1	13	9	3	3	2	15	67

b.6 Execution Scheme

Through consultation with the counterpart, construction of the first part of the transfer station is set in year 2004. Then, operation is planed to begin in year 2005. As for the remaining part, it is supposed that construction would be carried out in year 2007 and operation would start in year 2008. The schedule is schematized in Table K-55.

Table K-55: Execution Scheme

Item		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Design and supervision		⟷	⟷			⟷								
Phase I	Construction		⟷											
	Operation			→	→	→	→	→	→	→	→	→	→	→
Phase II	Construction					⟷								
	Operation						→	→	→	→	→	→	→	→

b.7 Operation and Maintenance Scheme

b.7.1 Staff Assignment

Positions and numbers of staffs necessary to operate the transfer station are presented in Table K-56. As for vehicles, one tractor needs one driver, and one collection vehicle is supposed to require one driver and three workers as shown in Table K-51.

Table K-56: Staff Assignment for Transfer Station

Item	Phase I	Phase II
manager	1	1
engineer	1	1
supervisor	2	2
mechanic	1	1
mechanic assistant	2	2
worker	8	12
secretary (office & weighbridge)	5	5
Total	20	24

b.7.2 Inspection and Maintenance

The direct dump station does not require high-tech inspection and maintenance, which is the principal advantage of this type of transfer station. Facilities that require periodical inspection and maintenance are mechanical equipment such as weighbridge, tractor, trailer and compactor truck. Inspection and maintenance shall follow instructions of suppliers.

Table K-57: Inspection and Maintenance of Facilities

Facility	Items to be inspected/maintained
Platform	Surface of the platform
Road/parking	Surface of road and parking
Weighbridge	Adjustment according to supplier's recommendations
Vehicles	Inspection and maintenance according to supplier's recommendations
Others	According to supplier's recommendation

b.8 Cost Estimation

This section presents estimated cost of the project.

b.8.1 Transfer Station

Table K-58 shows cost for land acquisition. Table K-59 presents required capital cost of the transfer station. Table K-60 explains cost for design and supervision of construction. Table K-61 and Table K-62 demonstrate annual costs of operation and maintenance (O&M) and personnel respectively.

Table K-58: Cost Estimation of Transfer Station (Land Acquisition)

Item	Details	unit	Unit Cost US$	Phase I		Phase II		Total	
				Quantify	US$	Quantify	US$	Quantify	US$
Land acquisition									
Land		m2	7	49,450	346,150	0	0	49,450	346,150

Table K-59: Cost Estimation of Transfer Station (Capital Cost)

Item	Details	unit	Unit Cost US$	Phase I		Phase II		Total	
				Qty	Cost US$	Qty	Cost US$	Qty	Cost US$
Transfer station construction									
Platform	R/C	m2	350	1,250	437,500	1,250	437,500	2,500	875,000
Roof on the platform	Slate covered	m2	14	1,250	17,500	1,250	17,500	2,500	35,000
Office		m2	300	270	81,000		0	270	81,000
Workshop (Garage)		m2	300	450	135,000		0	450	135,000
Scale house		m2	300	60	18,000		0	60	18,000
Pavement (access to platform)	Concrete	m2	14	1,200	16,800	525	7,350	1,725	24,150
Pavement (road and reception)	Asphalt	m2	12	7,070	84,840	2,480	29,760	9,550	114,600
Pavement (parking)	Asphalt	m2	12	3,180	38,160	1,240	14,880	4,420	53,040
Green area		m2	2	6,080	12,160	6,340	12,680	12,420	24,840
banking (access to platform)		m3	8	6,728	53,824	4,532	36,256	11,260	90,080
Retaining wall		m2	160	1,096	175,360	1,040	166,400	2,136	341,760
Fence	h=2.0m	m	30	600	18,000	110	3,300	710	21,300
Gate	W=10.0m	unit	3,000	1	3,000		0	1	3,000
Structure Total					1,070,144		722,326		1,792,470
Equipment									
Weighbridge	60ton	unit	71,000	1	71,000	1	71,000	2	142,000
Hopper	Steel, 12m x 5m	unit	35,000	2	70,000	2	70,000	4	140,000
Hopper - Ventilation facilities		unit	20,000	2	40,000	2	40,000	4	80,000
Generator	230 kW	unit	96,000	1	96,000	1	96,000	2	192,000
Car Washer	120 liter/hour	unit	15,000	1	15,000	1	15,000	2	30,000
Electric facilities		unit	41,000	1	41,000	1	41,000	2	82,000
Wheel loader	100kw	unit	135,000	1	135,000		0	1	135,000
Drainage facilities		unit	15,000	1	15,000	1	15,000	2	30,000
Garage goods		unit	30,000	1	30,000		0	1	30,000
Utilities total					513,000		348,000		861,000
Sub-total					1,583,144		1,070,326		2,653,470
Miscellaneous	20%				316,629		214,065		530,694
Direct cost					1,899,773		1,284,391		3,184,164
General expenses/overhead	35%				664,921		449,537		1,114,458
Total construction cost					2,564,694		1,733,928		4,298,622
ITBM	5%				128,235		86,696		214,931
Total Cost					2,692,929		1,820,624		4,513,553

Table K-60: Cost Estimation of Transfer Station (Design and Supervision)

Item	Details	Phase I		Phase II		Total
		Quantify	US$	Quantify	US$	US$
Design and supervision	% of con.Cost	5%	128,235	3%	52,018	180,253
ITBM	5%		6,412		2,601	9,013
Total Cost			134,647		54,619	189,266

Table K-61: Cost Estimation of Transfer Station (Operation and Maintenance)

Item		Details	Phase I	Phase II
			US$/year	US$/year
	electricity, water, etc. (1% of con. cost)	1%	25,647	42,986
	maintenance (1% of con. cost)	1%	25,647	42,986
Sub-total			51,294	85,972
ITBM		5%	2,565	4,299
Total			53,859	90,271

Table K-62: Cost Estimation of Transfer Station (Personnel Cost)

Item		Details	unit	Unit Cost US$	Phase I		Phase II	
					Quantify	US$/year	Quantify	US$/year
	manager		pers.	21,000	1	21,000	1	21,000
	engineer		pers.	15,600	1	15,600	1	15,600
	supervisor		pers.	5,280	2	10,560	2	10,560
	mechanic		pers.	4,956	1	4,956	1	4,956
	mechanic assistant		pers.	4,560	2	9,120	2	9,120
	worker		pers.	4,320	8	34,560	12	51,840
	secretary (office & weighbridge)		pers.	5,040	5	25,200	5	25,200
Sub-total						120,996		138,276
Insurance and others		30%				36,299		41,483
Total						157,295		179,759

b.8.2 Transport

Table K-63 shows capital, O&M and personnel costs per unit of tractor and trailer respectively. It should be noted that costs of O&M and personnel are annual costs.

Table K-63: Unit Cost of Transport Equipment

Item	Detail	US$	Remarks
1. Unit cost of tractor			
1) Capital			
Tractor (300-350hp)		77,000	a
Spare parts and miscellaneous	10 % of tractor	7,700	b
Tax	5% of a+b	4,235	c
Total	a+b+c	88,935	
2) O&M			
Fuel		12,600	a
Oil	10% of a	1,260	b
Maintenance	15% of capital/economic life	1,815	c
Tax	5% of a+b+c	784	d
Total	a+b+c+d	16,459	per year
3) Personnel			
Driver	2 persons	10,800	a
Insurance and others	30% of a	3,240	b
Total	a+b	14,040	per year
2. Unit cost of trailer			
1) Capital			
Trailer (85 yd3, 20 ton)		47,000	a
Spare parts and miscellaneous	10 % of tractor	4,700	b
Tax	5% of a+b	2,585	c
Total	a+b+c	54,285	
2) O&M			
Maintenance	15% of capital/economic life	1,108	a
Total		1,108	per year

b.8.3 Collection

Table K-64 shows costs of capital, O&M and personnel per unit of collection vehicle. It should be noted that the costs of O&M and personnel are annual costs.

Table K-64: Unit Cost of Collection Equipment

Item		Detail	US$	Remarks
1)	Capital			
	Compactor truck (16 yd3)		77,000	a
	Spare parts and miscellaneous	10 % of tractor	7,700	b
	Tax	5% of a+b+c	4,235	d
	Total	a+b+c+d	88,935	
2)	O&M			
	Fuel		3,927	a
	Oil	10% of a	393	b
	Maintenance	15% of capital/economic life	2,541	c
	Tax	5% of a+b+c+d	343	e
	Total		7,204	per year
3)	Personnel			
	Driver	2 persons	10,800	a
	Worker	6 persons	25,920	b
	Insurance and others	30% of a+b	11,016	c
	Total		47,736	per year

b.8.4 Overall Costs

Table K-65 shows overall costs required for the transport ant transport system. Table K-66 presents required costs per ton of waste collected, where the costs are divided by waste amount between 2005 and 2015. It should be noted that in year 2015 both the transfer station and vehicles will still have remaining economic life. If the remaining economic life period is taken into account, the cost per ton would be lower than the ones presented in Table K-66.

Table K-65: Overall Cost of the Transfer and Transport System in the East

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
1. Transfer station														
Design and supervision	67	67	0	0	55	0	0	0	0	0	0	0	0	189
Capital	0	3,039	0	0	1,821	0	0	0	0	0	0	0	0	4,860
O&M	0	0	211	211	211	270	270	270	270	270	270	270	270	2,793
Total	67	3,106	211	211	2,087	270	270	270	270	270	270	270	270	7,842
2. Transport														
Capital			682	143	143	252	0	0	143	682	287	143	395	2,870
O&M			129	160	192	225	225	225	257	257	288	288	321	2,567
Total			811	303	335	477	225	225	400	939	575	431	716	5,437
3.3 Collection														
Capital			978	623	178	89	89	1,156	800	267	267	178	1,334	5,959
O&M			604	989	1,099	1,153	1,208	1,319	1,428	1,484	1,593	1,648	1,759	14,284
Total			1,582	1,612	1,277	1,242	1,297	2,475	2,228	1,751	1,860	1,826	3,093	20,243
3.4 Total Cost	67	3,106	2,604	2,126	3,699	1,989	1,792	2,970	2,898	2,960	2,705	2,527	4,079	33,522

Table K-66: Unit Cost of the Transfer and Transport System in the East

Item	Cost (US$1,000)	Waste amount	Unit cost (US$/ton)
Transfer station	7,842	1,359,000 ton (Waste collected between 2005 and 2015)	5.77
Transport	5,437		4.00
Collection	20,243		14.90
Total	33,522		24.67

K.3 Institutional Plan

The results of the financial evaluation of the M/P tell that it is appropriate to consign the project subject to the Feasibility Study and Pre-feasibility Study to the private sector under concession contract. Therefore, this institutional plan will examine conditions of the concession contract and provide a guideline to prepare a Terms of Reference (TOR).

K.3.1 Final Disposal Project

This section provides a guideline for preparing a TOR of Concession Contract of the Final Disposal Project.

Process for Concession of Public Work (the Final Disposal Project)

1. Background

Cerro Patacon sanitary landfill began operating in 1985; currently, CP landfill site is receiving the solid wastes from Panama Metropolitan area which include Panama and San Miguelito Districts and, eventually, wastes originated in Arraijan District.

In 1999, the Ministry of Economy and Finances contracted the partnership Jobefra – Saniplan for the Study called "Diagnostic, Master Plan, Characterization of assets, and evaluation of Alternatives for the Participation of the Private Sector (PPS) in the Solid Waste Management for the Metropolitan area of Panama, Colon, Reverted areas and West Panama". In this study, several alternatives are proposed for the PPS which include the solid waste final disposal from Panama and San Miguelito Districts to Cerro Patacon Sanitary landfill.

During the year 2000, the Panama municipality requested the assistance of the Japanese government to undertake a study related to SWM in the district. JICA chose Kokusai Kogyo Ltd., Co. as the consultant in order to undertake "The Study on Solid Waste Management Plan for Municipality of Panama in the Republic of Panama."

The final disposal of wastes from the Panama and San Miguelito districts to the CP sanitary landfill was studied as part of a Feasibility Study of the JICA Study.

The feasibility study includes the final disposal needs between the years 2004-2015. The F/S also evaluates the area which is needed, capacity, access, control of the facility, leachate management, gases from, the landfill site, rainfall, operation, aesthetic closure, operation for closure and post-closure.

The following was analyzed: laws and regulations, geological conditions, groundwater table, leachate management plan, permeability, meteorology, urban development, rainfall drainage, closure plan and cost estimation of investment, operation and maintenance.

The study provides a digitalized map of the sanitary landfill site and adjacent areas.

Regarding the technical regulations which can be applied, it is important to note that the Health Ministry is close to sanction norms for the design and operation of the sanitary landfill. Additionally, the Panama Municipality is analyzing a project to regulate cleansing which includes the technical requirements for the operation of Cerro Patacon sanitary landfill.

2. Legal Attributions

The legal foundation is originated by Law No. 41 of the 27 of August, which states that: "the Panama municipality will have the responsibility to manage Cerro Patacon which will also be use jointly by the San Miguelito Municipality."

Additionally, Article 8th establishes that "a Mayor who would manage a sanitary landfill could arrange contracts through a tender for private companies which are specialized in environmental sanitation; these companies should be accredited by a competent Panamanian authority. The company(ies) should satisfy the national environmental normative in the areas defined for these purposes..."

3. Terms of Reference (TOR)

Taking into account the PPS which is being proposed, the TOR should be precise and meticulous as much as possible. Bidders should have access to database available in the Panama Municipality on the issue at hand.

JICA study is providing a feasibility study which contains valuable information that should serve as base for the execution of an engineering project which should be developed by the contractor in advance to the initiation of operations.

The list of charges should contain the following minimal conditions:

a) Detail exposition of the service to be provided by the private operator

b) Details of the privileges, advantages, exclusivities or special conditions which will be given to the private operator to which has been awarded the contract; the time periods should also be defined.

c) Description of investment requirements and parameters of the fee policy which the private operator should abide to.

d) Description of the methodology and proceedings to calculate fee and prices.

e) Establishment of coverage goals and service levels

f) Establishment of special conditions related to ownership of goods which are subject to be incorporated in the active private participation

g) Manner and procedure to transfer the final disposal service of Cerro Patacon Sanitary landfill.

h) Regime and conditions to transfer the assets which are employed to provide the service after the contract has expired.

4. Manner of Participation of the Private Sector (PPS)

There are different manners of the PPS and its selection varies in accordance to the type of market, the particular characteristics of the system and objectives of Panama municipality.

The PPS in other areas, e.g., water supply, sewerage and treatment, etc. varies in accordance to concepts, scope, and applicability from the PPS in the area of solid wastes management.

It is important to analyze and review the models that have been implemented in both developing and developed countries and experiences should be learned from this implementation. The selection of the optimal model for the PPS should be defined by several factors such as:

- Size and type of market
- Objectives by the owner, such as equity vs. efficiency
- Long term objectives
- Activity level of rent-seeking of the system
- Existing levels of human resources
- Capacity of the entity to regulate
- Special conditions and characteristics of the property

In advance to the selection of the model that best suits the characteristics of Panama municipality, it is necessary to define the institutional structure, level of activities of opportunistic type (free-riding), monitoring system, legal sanctions system, information and control systems, level of personnel who has been trained for the regulation, public perception toward the private operation, among others.

The most common types of PPS in solid waste management are: contracts, concessions, franchises and open competition. (Urban Management Vol. 13, UNCHS, PNUD, World Bank, GTZ)

Contracts. The government grants a contract for a set term to a private company for the provision of the solid waste collection service, street cleansing service, collection of recyclable materials, operation of the transfer station, operation of the final disposal site, or maintenance of the fleet. The Contract is granted after a tender competition process. The

government pays to the private company for the provision of the service in accordance with the terms of the contract.

Comment: The contract that the Panama Municipality currently has with operator of Cerro Patacon sanitary landfill.

Concessions. The government grants a concession to a private company in order to construct a facility which uses the resources which belong to the government – i.e – solid wastes. This concession allows the private company to recycle certain materials (paper, plastic, metal, glass, etc.); it also allows the private company to recover resources (compost, heat, electricity) from the solid wastes; it also allows the transfer and disposal of these solid wastes.

The concession is done under in the form of a long term contract according to which the private company construct a facility. In some cases, the private company can maintain indefinitely the property and operation of the facilities. In other cases, the private company can transfer the domain over the facility to the government, after a specific period when the company was the owner and private operator of this facility.

Comment: This is the PPS system which could be applied for the concession of Cerro Patacon sanitary landfill and the Transfer Station

Franchise. The government grants a monopoly for a set term over an area (franchise) to a private company which should provide the service for solid waste collection. The franchise becomes effective after a competitive qualifying process. The private company deposits a performance warranty to the government and pays a license right which should cover the monitoring costs of the government. The private company recovers the costs and obtains profits through a direct fee which is charged to households and establishments that receive the service. The government controls the fee charge through: a) development of an adequate competition and controlling any plot to unify prices or b) direct regulation of such prices.

Comment: This alternative cannot be applied under the current circumstances of the Panama District. In advance, it is required a specific regulation framework and an analysis of market sharing in order to promote competition.

Open competition. The government allows the private companies to compete freely for solid wastes´ collection services, recycling or disposal. In open competition, households and establishments agree on private contracts with one of the companies in order to collect and recycle these wastes. No company has a monopoly over an area and there are not limitations on the number of companies which can compete to provide the service in the same area.

Similarly to open competition, the government grants a license to defined companies which are qualified to provide the disposal services. A city can have several disposal sites to its disposal which can compete among themselves in order to lure the business of local governments in the specific area, private operators, and government businesses and operators of localities in remote areas. The government role in an open competition is to issue licenses, to monitor and, whenever it is necessary, to sanction the private companies. In open competition, the costs are directly billed from the private companies to the clients.

Comment: Currently, it is taking place an open competition which is not regulated between the companies which provide the private collection service in Panama District. These activities would be regulated with the approval of the Cleansing regulation.

A general summary is shown subsequently which present the most common manners of PPS in solid waste management.

Table K-67: Options for the PPS in Solid Waste Management

Types of PPS	Asset ownership	Investment	Operation / Management	Commercial Risk	Establishment of the price	Service quality
Service Contract	Private	Private	Private	Public	Auction	Regulated
Operation Contract	-------					
Competitive prices (lump sum o unit prices)	Public	Public	Private	Public	Auction	Regulated
Cost-Plus	Public	Public	Private	Public	Verified	Regulated
Administration Contract	--------					
Fixed payment (lump sum)	Public	Public	Private	Public	Auction	Self-regulated
Fixed payment plus incentives	Public	Public	Private	Public	Auction	Self-regulated
Franchise	--------					
To competitive prices	Private	Private	Private	Private	Auction	Regulated
To regulated prices	Private	Private	Private	Private	Regulated	Regulated
Concession	---------					
To competitive prices	Private	Private	Private	Private	Auction	Regulated
To regulated prices	Private	Private	Private	Private	Regulated	Regulated
Non-regulated franchise or license (exclusive or non-exclusive)	Private	Private	Private	Private	Free price	Regulated or non-regulated (as it is desired)
Open competition regulated (license is not paid)	Private	Private	Private	Private	Regulated	Regulated
Non-regulated open competition or informal market	Private	Private	Private	Private	Free price	Non- regulated
BOT BOOT BOO	Private or Public	Private or Public	Private or Public	Private or Public	Auction	Regulated

Source: Madrid-Aris (1999)
Notes: BOT: Build-Operate-Transfer BOOT: Build-Operate-Own and Transfer BOO: Build-Operate and Own

In economic theory of regulation, the manner of PPS regulation through auction is considered as the "optimum regulation." The auction corresponds a competitive tender of closed envelope type. This type of regulation is optimal because if the auction process is competitive (there is not collusion and the participants´ number is high), then efficient prices are obtained easily and without great burden nor regulation cost.

Developing countries should tend to follow this type of regulation because there area important restrictions (lack of human resource, high level of rent-seeking activities, lack of resources to monitor and control prices, unstable regulation framework, deficient control and information systems, etc.) to regulate efficiently.

Normally, people tend to analyze based on the previous table and to correlate the property manner of assets and investment with the levels of risk for the different types of PPS. It should be noted that the privatization and/or regulation processes not only depend on the type

of PPS (assets ownership, investment and operation), but also to the fact that the PPS should be directly linked to the "regulation and fee conceptual framework."

For example, if a concession is conducted under a fee framework which can allow an extraordinary revision of prices or fees previous to the regular revision period, i.e., the price regulation period is reduced which leads to what is defined as "regulatory lag", then the risk might not only bear by the concessionary as a totality because the risk could be transfer to the public sector; i.e., by the customers.

On the other side, a tariff regime normally has an indexing system or automatic readjustment of tariffs which can generally be of unique or polynomial type. It is common that if a polynomial index is used, it should contain endogenous variables related to the efficient cost of production. Consequently, the existence of exogenous variables as part of this index could transfer part of the risk to the consumers through a tariff readjustment.

In other occasions, the private part requests a warranty from the state for the investment, as a result, part of the risk (investment) is transferred to the public sector. Taking into account the foregoing, it can be shown that regarding the risk in the PPS, the regulation problem is very complex and can not only be confined to the previous table as many suppose it should be done.

4.1 Recommendation on the type of PPS

The most important aspect to consider is related to the amount of investment which should be done because of this the time duration should be enough so that investment depreciate sufficiently and capital investors obtain reasonable profits.

Consequently, it is required that the private sector which finances the investments should have domain on the facilities for the time foreseen in the Master Plan, i.e., the years between 2004-2015.

The resulting fee derived from the calculations of investment, and operation and maintenance costs is defined as reasonable; even if it is also considered the remediation costs of Etapa I and the works of closure and post-closure; moreover, there is an strict observance of the environmental law for a change.

If it is considered that the land will continue to be state property (Municipal or Executive), then the option that better suits the reality is that the private sector should bear the investments, construction the facilities, acquire temporarily the facilities and when the contract expires, the private company should transfer the assets to the state. This type of system would correspond to BOT of PPS.

The system of contracts type BOT and variations are applied mainly to the construction of sanitary landfills and transfer stations.

Under a BOT regime and its variations, the private sector has the responsibility to elaborate the engineering design, construction, maintenance, management and initial investment and expansion of the services. Under this regime, it could also assume or decline the billing and charge for the services, as a result, in this case the private company is acquiring the commercial risk. The BOT projects area assigned through a competitive tender of closed envelope type (auction).

A BOT can be implemented under a regulatory system of return rate; although it can also be implemented under a system of pure top price (price – cap) or under a model of top prices in a model company.

BOT agreement requires defining meticulously specifications. The most important is that the agreements describe the requirement for a regular maintenance which should be provided by the private sector to the facilities; additionally, it should establish the final condition that the facilities should have when they are transferred back. Without these specifications, it can easily be foreseen that the facility would have a planned obsolescence which would be adjusted to a transfer plan.

Additionally, the following is recommended:

- convocation for tender should be published internationally;
- a reference price should be attached in the tender document;
- a minimum of three economic offers should be presented during the opening of bids if the tender is to be considered competitive;
- if the price is higher than 25% of the referral price, the proposal would be considered invalid.

4.2 Limitations to the PPS in Cerro Patacon sanitary landfill

Previous to the preparation of the tender document, it is advisable to consider the following limitations which currently take place in Cerro Patacon:

a) Regarding the property and expansion of the zone which has been assigned as solid waste final disposal in the Panama District.

According to Law No. 41 of August, 1999, Panama Municipality has the responsibility to manage the sanitary landfill in Cerro Patacon.

In this regard, it is convenient to arrange with the competent authority (ARI) the cession of land which was assigned to the former DIMA for the disposal of solid wastes in the Metropolitan Area, taking into account that Panama municipality will take care of the

required investments which are foreseen in the Master Plan or it will have to respond for these investments in the case of a contract with the private sector.

In parallel, the negotiations with ARI should be finished to obtain the property of the land to expand the operations and provide cover soil for the landfill site.

b) Regarding the discharge of solid wastes in San Miguelito District

San Miguelito Municipality subscribed a contract with the private sector where it is established that this Municipality guarantees to the company the right to use Cerro Patacon without any cost for such company.

Likewise, with respect to Cerro Patacon sanitary landfill, San Miguelito Municipality will have the responsibility to obtain from Panama Municipality the corresponding authorizations to exempt form any payment to this company. For the purpose of this clause (ClauseN°4) the wastes which are transported by the company will be considered as a service without cost in favor of San Miguelito Municipality in accordance to what is established in the third paragraph (3) of the fifth article of Law N°41 de 1999.

On the other hand: the right of San Miguelito Municipality to negotiate with the Panama Municipality 50 hectares located in Cerro Patacon site. In this property, the company will have the right to operate a Sanitary Landfill and a Treatment Plant and Recycling of wastes.

Under the assumption that Panama Municipality undertakes to contract the private sector; the contractor would be expected to bear the investments foreseen in the Master Plan and the operations costs and the clients of the system would be compelled to pay for the services provided to them and the investments done by the contractor. A valid question would be: Who would bear the costs of solid waste final disposal by San Miguelito Municipality?

The Panama Municipality should consider a final solution to this situation, taking into account that San Miguelito discharge currently, and does not pay for it, an average of 216.7 tons per day (daily average between August 2001 and July 2002) (this figure represents 17.9% of the total which is discharged daily in Cerro Patacon sanitary landfill).

c) Regarding the extraction of recyclable materials and others

There is a reasonable doubt about the possibility that the private sector bears the foreseen investment and reach the efficiency of the operations, if it is considered the presence of persons who extract materials which can be represented as a reduction of performance (30%) in machinery due to the potentiality of accidents which might occur.

Panama Municipality should conduct every effort and undertake any required negotiation to prohibit the extraction of materials which are circulating in the waste stream in order to eliminate the current extraction practices as part of the social considerations to be formulated.

d) Regarding the registration of specialized private companies

In the article 8th of Law 41 of August 27, 1999, which was quoted previously, it is established that private companies which take part in the tender process should be specialized in environmental sanitation and they should be credited by the competent authority.

The law acknowledges the jurisdiction of the Health Ministry on this matter and, consequently, the Panama Municipality should request to this ministry the opening of an accreditation register. It is important that the municipality warns the ministry about the minimum requirements that the companies should satisfy regarding their technical and financial capacity, taking into account the size of the investment and the volume of solid wastes to be disposed.

5. Bidding and Hiring Process

The participation of the private sector will be materialized through the free participation which would include the following main stages:

a) Production of a pre-qualification document

b) Convocation to the pre-qualification process

c) Pre-qualification of firms and consortium of firms which are interested

d) Production of lists of charges and tender documents

e) Approval of list of charges and tender documents

f) Invitation of pre-qualified firms or consortiums which should present their offers based on the documents provided.

g) Presentation of technical and financial offers.

h) Technical and financial-economical evaluation of the offers presented

i) Awarding the winning offer

j) Subscription of the contract

k) Endorsement by the General Controllership of the Republic

l) Provision of the Order to Proceed

m) Production and approval of the engineering design

With the purpose to conduct the whole process, an Evaluating Commission will be formed which is in charge to pre-qualify to those participating and to evaluate the proposals which are presented in public bid. This evaluating commission would be integrated by at least three (3) of five (5) members who are appointed by the Mayor with the approval of the Municipal Council.

6. Provision of the final disposal service and supervision of the works executed

The firm or consortium (Concessionaire) would begin immediately the elaboration of the engineering design after the Order to Proceed has been received, for this purpose a reasonable term should be considered.

Within this term, the Concessionaire should have a period of mobilization previous to initiate operations in the final disposal site. During this stage, the concessionaire would construct offices, warehouses, garages, dressing room and dining room, first aid, water supply services will be installed, sewerage. The land surveying works would also initiate by using the digital map provided by JICA.

Once the mobilization period has finished, the Concessionaire would begin works for final disposal by taking charge of the whole operation and receiving the income established by the fee. All the foregoing would be done while the final engineering design are finished and the construction of structures is finalized.

DIMAUD should create an administrative unit to supervise the operations, oversee the strict satisfaction of the terms of reference and the corresponding technical specifications.

The supervision unit would be composed by a professional engineer with a experience of at least 5 years in sanitary landfills which receive more that 500 ton/day; a surveyor; and a civil engineer assistant with at least three years of professional experience.

K.3.2 Transfer and Transport Project

This section provides a guideline for preparing a TOR of Concession Contract of the Transfer and Transport Project.

Process for Concession of Public Work (the Transfer and Transport Project)

1. Background

Panama Metropolitan Area is the subject of an urban development plan conducted by Dames & Moore Consultant Company; this plan led to enactment of Decree 205 on the 28 of December of 2000. Through this decree, it was approved the Urban Development Plan for the Metropolitan areas of the Pacific and Atlantic.

The urban development plan promotes the urban growth in the Eastern direction and disincentive the development toward the North with the purpose to protect and maintain the hydrographical basin of the Panama Canal.

It is advisable to establish a transfer station in the eastern area which will service the solid waste management needs of Tocumen, Pacora and San Martin Corregimiento.

The population in these three corregimientos is estimated in 181,873 persons in the year 2003 that could generate about 205 Tons/day. The population could reach, by the year 2015, around 418,667 persons which would generate about 466 Tons/day.

With the purpose to service the projected transfer demand to Cerro Patacon sanitary landfill, a pre-feasibility study has been prepared to establish a transfer station in the area.

In the pre-feasibility study, the documents related to population growth by the Head Office of Statistics and Census of the General Controller and the Head Office of Urban Development of the Ministry of Housing were analyzed. It was also conducted the break-even analysis by comparing the performance between the conventional transport (by using a compactor truck between 12.2 m3 y 15.3 m3) and a transfer system with trailers of 65 m3. The discharge is direct (without compaction).

The required capacity of the transfer station has been estimated in 570 Tons/day and the working days have been estimated in 300 working days per year.

Regarding, the possibility to establish a transfer station in the North, the pre-feasibility study has provided a negative verdict; as a result, it is not recommended such facility in the near future. In any event, it is suggested that DIMAUD convokes government entities which are related to the preservation of the Panama canal basin in order to prepare an action plan which

would be directed to improve the solid and liquid wastes management in the Panama District area.

2. Legal Attributions

Law No. 106 enacted on October 8th, 1973: this is the law for local governments and its article 138 states that "the concession of a public service should be decreed by the Council through an agreement which would be adopted as the result of a favorable vote by an absolute majority of its members. The contract should abide to the following norms (among others):

- The service is not possible to be provided or the financial burden unbearable on the Municipality side."

Law No. 41 enacted on August 1999 authorizes the Municipality to pursue every type of contracts and participation of the private sector to satisfy the provision of the solid waste management services.

Law No. 56 enacted on December 1995 regulates public contracts; it regulates everything related to contracts between the State and the private sector.

3. Terms of Reference (TOR)

It is advisable to continue with the preparation process of the feasibility study with the purpose to obtain sufficient and necessary information which can allow having a better understanding of the required investments and operation costs.

With this information the TOR can be prepared to ensure better advantages for the entity in a PPS process.

4. Manner of Participation of the Private Sector (PPS)

Refer to the different participation manners of the private sector in a PPS document for Cerro Patacon sanitary landfill.

4.1 Recommendation of PPS Manners

Sufficient time period should be considered to allow enough depreciation of the investments. At least, a time period similar to the time covered by the Master Plan (2003-2015) should be considered.

The conceptual design of the transfer station considers a capital investment of US$4,86 millions for the construction (including the cost of the land) and US$2,87 millions for the transport equipment. The total investment amount would reach US$7,73 millions.

Due to the characteristics of the project, where the most relevant issues are the capital assets, the Panama municipality would be interested to transfer this investment to the private sector.

The private sector would bear the investment: construction, equipment, transport vehicles, operation and maintenance. Additionally, at the end of the concession period, the totality of the capital assets would be transferred to the Panama Municipality. The investment for the purchase of the land would correspond to the Municipality.

This manner corresponds to the concession type BOT (Built-Operate-Transfer)

The Panama Municipality would establish a reasonable base to define the fees.

4.2 Limitations of the PPS for the Transfer Station in the East

The following limitations of the project can be considered and it should be paid attention to them:

a) Feasibility Study

Panama Municipality should consider upgrading the pre-feasibility study to a feasibility study.

b) Selection of the location of the site

Panama municipality should select the location of the site (approximately 5 hectares) by negotiating an option to buy. Initially, an engineering project should be prepared; additionally, negotiations with the competent authorities should be conducted and corresponding permits and authorizations should be obtained. Subsequently, the purchase of the land can be formalized. It is important to consider the existing limitations due to the operation of Tocumen airport.

If Panama Municipality considers convenient, the PPS could be defined for the collection service in Tocumen, Pacora and San Martin corregimientos as possible additional component of the transfer station. In the pre-feasibility study, the size of the collection fleet is defined, its investment, operation and maintenance cost and its total cost.

5. Bidding and Hiring Process

The stages suggested for the bidding and hiring are similar to those which are reflected in the PPS document prepared for Cerro Patacon sanitary landfill.

6. Provision of the Transfer Service and the Supervision of Operations

The concessionaire will have the responsibility to develop the final engineering design. After the signing of the contract and the reception of the order to proceed, the elaboration of the aforementioned document (final engineering design) will take place; additionally, the final negotiations for approval of permits from the competent authorities will also take place.

DIMAUD should create a unit to supervise and monitor the strict execution of the terms of reference and the respective technical specifications.

K.4 Financial Analysis

Financial analysis was conducted for the Sanitary Landfill, the subject of feasibility study, and for the Transfer & Transport, the subject of pre-feasibility study. The purpose of this analysis was to assess the financial viability of the said activities from the standpoint of a possible concessionaire. Accordingly, income from the concessionaire standpoint was assumed to be equivalent to the concession cost for DIMAUD. The cost under consideration included investment plus operation & maintenance costs.

1. Sanitary Landfill

Under conditions explained above, the resulting financial internal rate of return (FIRR) would be 5.2%. The sensitivity analysis showed that a 10% income reduction would lower FIRR to –1.0%, while a 10% cost increase would lower FIRR to –0.4%. A simultaneous 5% income drop and a 5% cost increase would change FIRR to –0.7%.

2. Transfer & Transport

Under conditions explained above, the resulting financial internal rate of return (FIRR) would be 3.5%. The sensitivity analysis showed that a 10% income reduction would make FIRR negative lowering it to -1.1%, while a 10% cost increase would lower FIRR to –0.6%. A simultaneous 5% income drop and a 5% cost increase would change FIRR to –0.8%.

3. Sanitary Landfill plus Transfer & Transport

When sanitary landfill plus transfer & transport were considered under joint concession, the resulting financial internal rate of return (FIRR) would be 4.9%. The sensitivity analysis showed that a 10% income reduction would lower FIRR to –1.0%, while a 10% cost increase would lower FIRR to –0.5%. A simultaneous 5% income drop and a 5% cost increase would change FIRR to –0.7%.

Table K-68: Financial Analysis of Feasibility Study

Cases	FIRR Sanitary Landfill (%)	FIRR Transfer & Transport (%)	FIRR LF, T&T (%)
Base	5.2	3.5	4.9
Income reduction: -10%	-1.0	-1.1	-1.0
Cost increase: +10%	-0.4	-0.6	-0.5
Income: -5% & Cost: +5%	-0.7	-0.8	-0.7

K.5 Environmental Impact Assessment

This section describes results of Environmental Impact Assessment (EIA) of the priority projects, i.e., Final Disposal System and Transfer and Transport System.

K.5.1 Scope of EIA Work

Contents of EIA

Process of the EIA employed in the Study consists of Initial Environmental Examination (IEE) and detailed EIA. As for the Final Disposal System, both the IEE and the detailed EIA were conducted. Meanwhile, only the IEE was carried out for the Transport and Transfer System, as any specific site has not been proposed.

Contents	Final Disposal System (Feasibility Study)	Transfer and Transport System (Pre-feasibility Study)
IEE	○	○
Detailed EIA	○	-

Scope of the detailed EIA Work

A whole EIA process usually includes public participation in decision-making. Consultation with the public is responsibility to a project proposer, and also this is out of the scope of the Study. The Study will prepare technical information that is required for the EIA process. Then, it is sought that the Panamanian side will conduct a whole process of the EIA with the information, if such EIA is required to carry out the project.

K.5.2 Initial Environmental Examination

a. IEE Outline and Objective

IEE is a process aiming to determine (i) whether detailed EIA (Environmental Impact Assessment) is required and (ii) if so, what types of impacts should be further studied. The former is often called “screening” and the latter “scoping”. Generally, screening is done by a competent authority according to relevant laws and regulations of the country. According to the EIA system of the country shown in the section of “Screening” below, projects dealing with solid waste would be subject to EIA. Therefore, supposing the priority projects to be required EIA, this IEE concentrates on “Scoping” in order to allot available resources to selected problematic issues and to make the Study as efficiently as possible.

b. IEE Process

IEE in the Study will be carried out as follows.

Step 1: Potential environmental impact will be checked as far as possible within information available.

Step 2 (Screening): Whether father EIA study should be carried out is considered.

Step 3 (Scoping): Environmental items, which are considered to might have serious impact, were picked up as subjects for further study in the second study work in Panama.

c. Screening

The country has a system of environmental impact assessment, which has been established in 2000 (Executive Decree 59). Projects that have a potential to generate an environmental risk needs to conduct an environmental impact study, EIS. Such projects are listed in the Executive Decree. Degree of EIS depends on a type of project. That is, the more serious environmental risks are expected, the more studies are required. In the system, projects will be categorized according to seriousness of environmental risk as follows.

Category I: Projects in the list that do not generate significant environmental impacts and do not pose environmental risks.

Category II: Projects in the list that can generate negative impacts that can be easily mitigated to comply with standards. These projects imply partial effects on the environment, with no indirect, cumulative or synergistic impacts.

Category III: Projects that require a more thorough analysis because of the potential negative impacts.

The list of projects and activities that might be subject to EIS includes those dealing with solid waste. Thus, environmental impact studies would be required for the Priority Projects below.

- Final Disposal System (for feasibility study)
- Transfer Transport System (for pre-feasibility study)

What important herewith is which category those priority projects fall into. The Study Team is not an agency to decide such matter. This will be subject to discussion among organizations concerned in the Panamanian side.

d. Scoping

It was carried out to pick up serious problems that might be caused by the implementation of the priority projects.

- As for the priority project of the Final Disposal System, concrete evaluation of environmental items was made, as the site has been clearly defined, i.e., Cerro Patacon Final Disposal Site. Therefore, Environmental Impact Assessment in the phase II of the study was carried out based on the results of this scoping.

- As for the priority project of the Transfer and Transport System, less concrete evaluation has been done compared with the Final Disposal System, as a site for the project has not been decided. Therefore, it is recommended to carry out EIA out of this study with taking into account the results of this scoping, once the site is defined.

Results of the scoping were shown in Table K-69. It was carried out based on JICA Guideline, where words used in the table has the following meanings.

- Activities 'During Construction' include land acquisition, land occupation, use of construction equipment and traffic of construction tracks.
- Activities 'During Operation' include traffic of waste trailers and operations of the facility.
- Evaluation of possible environmental impact is expressed by ranks from A to D.
  - Rank A; Serious impacts might be caused.
  - Rank B; Some impacts might be caused.
  - Rank C; Extent of impact is unknown because information is lacking and/or it depends on project location.
  - Rank D; There is little or no impact.

Table K-69: Results of Scoping

Evaluation Items	Possible Cause and Effect		Landfill Expansion (Cerro Patacon Final Disposal Site)		Transfer Stations (unknown)	
	During Construction	During Operation	Rank	Reasons	Rank	Reasons
Social Environment						
Resettlement	Resettlement of people living in the proposed site or on the access route		D	There are no permanent dwellings in the site.	D	Sites have not been identified but required areas are small.
Economic Activities	Disturbance of economic activities		D	Area is already used for solid waste disposal. Further disturbance of economic activity is not expected.	D	Location of sites is flexible so economic impacts can be minimized.
Transport	Increase in traffic and accidents	Increase in traffic and accidents	D	Area is already used for landfill operations	B	Near the locations there will be a change in traffic pattern.
Public Facilities	Impacts on schools, hospitals, etc. by traffic and noise	Impacts on schools, hospitals, etc. by traffic and noise	D	Area is already used for landfill operations.	C	Although potential sites have not been identified, impacts may not be serious, as required areas are small.
Division of Community	Geographical separation of community or interruption of communication		D	Area is already used for landfill operations.	D	Required areas are relatively small.
Historical Heritage/ Cultural properties	Loss and/or devaluation of heritage or cultural properties-- archeological remains, or historical assets	Devaluation of such properties by disposal trucks passing nearby	C	There is a potential that archeological remains would be found, because such discovery is common in the region.	D	Required areas are relatively small and increase in traffic should not be as significant
Water Rights/ Access Rights	Obstruction of water or common access rights		D	Area is already used for landfill operation	D	Required areas are relatively small and should not cause obstructions.
Public Health		Degradation of public health due to wastes fallen from trucks, existence of wastes in an area or proliferation of vermin	B	Although soil cover has been applied to avoid waste littering, the landfill operation is still associated with some littering.	B	Waste removal and cleansing of area should be done according to a strict schedule to avoid impacts.
Waste (from the project)	Generation of construction waste and debris		D	Minimal waste to be generated and disposed of on site	D	Wastes should be transported to landfill
Accident/Risks		Landfill gas explosion, refuse fires, landslides, lateral pressure on land, traffic accident	B	Hazardous wastes need to be controlled to avoid chemical reactions. Landfill design and practice, such as waste covering, should	B	Traffic of collection vehicles need to be controlled to avoid traffic accidents both in and out of the site.

Evaluation Items	Possible Cause and Effect		Landfill Expansion (Cerro Patacon Final Disposal Site)		Transfer Stations (unknown)	
	During Construction	During Operation	Rank	Reasons	Rank	Reasons
				minimize risks. A due distance from physical structures should be kept.		
Natural Environment						
Topography and Geology	Change in valuable topography and geology due to excavation	Change in valuable topography due to operations	C	Excavation works are required to obtain soil for covering waste.	D	Required areas are relatively small and modifications to topography would not be significant
Soil Erosion	Increase in soil erosion due to land preparation and/or deforestation	Increase in soil erosion during operation	B	Torrential rains can cause erosion of exposed soil	C	Torrential rains can cause erosion of exposed soil, but required areas are relatively small.
Groundwater		Change in quality and level of groundwater due to leachate	B	Groundwater hydrology should be understood and a monitoring program should be conducted. It should be noted that the former landfill area may cause groundwater pollution, because there is only a clay liner which might not prevent leachate from leaking into the ground..	B	Control of liquids from wastes and washing areas need to be strictly followed.
Hydrological Conditions	Changes in river discharge and riverbed condition	Changes in river discharge and riverbed condition due to inflow from the site	B	Effluents might reach bigger water bodies, even if creeks are diverted. A monitoring program should be established.	B	Control of liquids from wastes and washing areas need to be strictly followed.
Coastal Zone	Impacts on Coastal Environment	Impacts on Coastal Environment	D	Area is far from Coastal zone	D	Required areas are small and will probably be far from coastal zone.
Fauna and Flora	Obstruction of natural species and extinction of them due to loss of habitat		B	A national park is near the landfill and will animals sometimes cross the area	D	Required areas are too small to cause a major impact on flora or fauna
Meteorology	Changes in temperature or winds	Changes in temperature or winds	D	The scale of the project is not large enough to cause any change in meteorology.	D	The scale of the project is not large enough to cause any change in meteorology.
Landscape/ Aesthetics	Change in landscape	Decrease in aesthetic value due to landfill	B/A	Landfill work will result in a change in landscape	C	Even though required areas are small, they could impact aesthetics
Pollution						
Air Pollution	Deterioration of air quality due to the increased traffic	Deterioration of air quality due to the increased traffic and dust from wastes delivered by trucks, landfill	B	Landfill should be properly operated to avoid fires, explosions, and control of gases needs to be considered	B	Traffic in areas selected can be expected to increase.

Evaluation Items	Possible Cause and Effect		Landfill Expansion (Cerro Patacon Final Disposal Site)		Transfer Stations (unknown)	
	During Construction	During Operation	Rank	Reasons	Rank	Reasons
		gases, and smoke from operation				
Water Pollution	Deterioration of water quality of surface or ground water due to silt or debris from land preparation	Deterioration of water quality of surface or ground water due to silt and leachate from the site	B	Soil and leachate control measures as well as monitoring need to be established.	B	Control of liquids from wastes and washing area need to be strictly followed.
Soil Contamination		Contamination of soil due to leakage of leachate	B	Leachate control measures need to be established and followed.	B	Control of liquids from wastes and washing areas need to be strictly followed.
Noise and Vibration	Noise and vibration caused by the construction operation	Noise and vibration caused by the operation	D	Sites are distant from major population areas.	B	Traffic and noises will increase near areas selected.
Land Subsidence	Land subsidence due to the land deformation.		D	Subsidence would be limited to selected areas, as the ground of the site is firm.	D	Required areas are too small to cause major subsidence problems.
Offensive Odor		Odor caused by wastes during operation	B	Wastes should be covered by soil.	B	Odors could become disturbing if removal is not conducted on schedule.